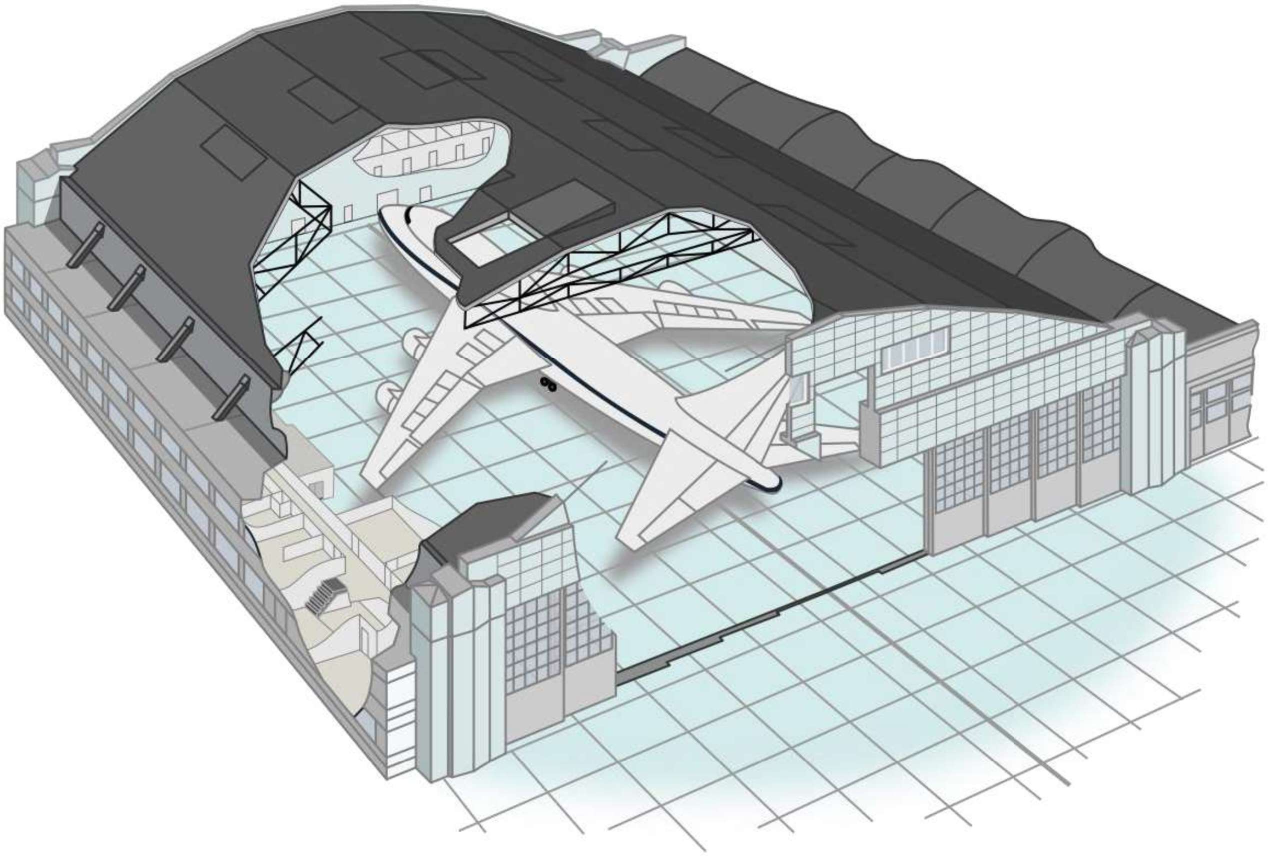
เอกสารอ้างอิงประกอบการทำงาน
ของคณะทำงาน



การประชุมขับเคลื่อนการพัฒนาช่างอากาศยาน
ตามคำสั่งกรอบคุณวุฒิแห่งชาติ

คำนำ

เอกสารชุดนี้จัดทำขึ้นเพื่อรวบรวมประกาศของทางราชการและเอกสารสำคัญที่ใช้ในการอ้างอิงสำหรับการพัฒนาสถานศึกษาให้ได้การรับรองการเป็น Approved Training Organisation ที่คณะทำงานใช้ประกอบการพิจารณาเพื่อการพัฒนาหลักสูตร การจัดทำรายการครุภัณฑ์และการพัฒนาครูช่างอากาศยาน อันได้แก่ ประกาศกรมการขนส่งทางอากาศ เรื่องการรับรองสถานฝึกอบรมนายช่างภาคพื้นดิน และการรับรองการฝึกอบรมนายช่างภาคพื้นดิน พ.ศ.2551 และคู่มือการปฏิบัติงานของสถานศึกษาด้านช่างอากาศยานของสำนักงานการบินพลเรือนแห่งประเทศไทย

สำหรับเอกสารของต่างประเทศประกอบด้วยคู่มือการฝึกอบรมของ ICAO (Doc 7192 – Training manual , Part D-1) ที่ใช้ในการกำหนดหลักสูตรการฝึกอบรมช่างอากาศยาน (Aircraft maintenance – Technical / Engineer : AME) , เกณฑ์มาตรฐานของการออกใบอนุญาตช่างอากาศยาน (Minimum Standard for Personal Licensing) ของ ICAO, เกณฑ์การพิจารณา ATO ของ ICAO ในส่วนของการเรียนการสอนหลักสูตรช่างอากาศยาน (Model Civil and Regulations Part 3 - Approved Training Organisation version 2.8), คุณสมบัติของช่างอากาศยานในการพิจารณาการออกใบอนุญาตช่างอากาศยานของ ICAO (Part 147 – Aviation maintenance – Technician School – chapter 4 : Annex 1) รวมทั้งคู่มือการและดำเนินการของสถานฝึก อบรมช่างอากาศยานของ ICAO (Doc 9401-AN/921) และตัวอย่างรายละเอียดของการพัฒนาสถานฝึกอบรม เพื่อให้ได้รับการรับรองเป็น ATO ของหน่วยงานของรัฐในประเทศอื่น

คณะทำงานด้านครุภัณฑ์
คณะทำงานด้านการพัฒนาครูช่าง
คณะทำงานด้านหลักสูตรและการจัดการเรียนการสอน

สารบัญ

ประกาศกรมการขนส่งทางอากาศ
เรื่อง การรับรองสถาบันฝึกอบรมนายช่างภาคพื้นดิน
และการรับรองหลักสูตรการฝึกอบรมนายช่างภาคพื้นดิน

อาศัยอำนาจตามความในข้อ ๖ แห่งข้อบังคับของคณะกรรมการการบินพลเรือน ฉบับที่ ๗๗ ว่าด้วยคุณสมบัติและสิทธิทำการของผู้ขออนุญาตเป็นนายช่างภาคพื้นดิน อธิบดีกรมการขนส่งทางอากาศจึงออกประกาศ เรื่อง การรับรองสถาบันฝึกอบรมนายช่างภาคพื้นดิน และการรับรองหลักสูตรการฝึกอบรมนายช่างภาคพื้นดินไว้ ดังต่อไปนี้

ข้อ ๑ ให้ยกเลิกประกาศกรมการบินพาณิชย์ เรื่องการรับรองหลักสูตรนายช่างภาคพื้นดิน ประกาศ ณ วันที่ ๘ กันยายน พ.ศ. ๒๕๔๓

ข้อ ๒ ในประกาศนี้

"สถาบัน" หมายความว่า สถาบันฝึกอบรมนายช่างภาคพื้นดิน

"หลักสูตรการฝึกอบรม" หมายความว่า หลักสูตรการฝึกอบรมนายช่างภาคพื้นดิน

"ผู้แทนสถาบัน" หมายความว่า เจ้าหน้าที่ของผู้ได้รับใบรับรองสถาบันฝึกอบรมนายช่างภาคพื้นดิน ซึ่งรับผิดชอบในการประสานงานกับกรมการขนส่งทางอากาศ เพื่อให้มั่นใจว่าสถาบันฝึกอบรมสามารถจัดหาทุนและดำเนินการตามมาตรฐานที่กรมการขนส่งทางอากาศกำหนด

"อธิบดี" หมายความว่า อธิบดีกรมการขนส่งทางอากาศ

ข้อ ๓ ผู้ขอให้รับรองสถาบันฝึกอบรมนายช่างภาคพื้นดินต้องมีคุณสมบัติและลักษณะดังต่อไปนี้

(๑) เป็นนิติบุคคลตามกฎหมายไทย

(ก) มีทุนหรือหุ้นไม่น้อยกว่าร้อยละห้าสิบเอ็ดเป็นของผู้มีสัญชาติไทย และ

(ข) กรรมการ ผู้จัดการ หรือผู้มีอำนาจจัดการนิติบุคคลส่วนใหญ่ต้องมีสัญชาติไทย

(๒) มีกรรมสิทธิ์ สิทธิครอบครอง หรือสิทธิใช้ประโยชน์ในพื้นที่ที่จะใช้จัดตั้งสถาบัน

(๓) มีฐานะทางการเงินที่มั่นคงและมีศักยภาพเพียงพอที่จะดำเนินการสถาบัน

(๔) ไม่อยู่ระหว่างถูกพักใช้ใบรับรองสถาบัน หรือถูกเพิกถอนใบรับรองสถาบันมายังไม่ครบสองปี

ข้อ ๔ ผู้ที่ประสงค์จะขอรับการรับรองสถาบัน ให้ยื่นคำขอเป็นหนังสือต่อสำนักมาตรฐานความปลอดภัยในการเดินอากาศก่อนวันที่คาดว่าจะดำเนินการไม่น้อยกว่าหนึ่งร้อยยี่สิบวัน พร้อมด้วยเอกสารดังต่อไปนี้

(๑) หนังสือการรับรองการจดทะเบียนนิติบุคคล หรือเอกสารแสดงความเป็นนิติบุคคลของผู้ขอ และผู้มีอำนาจลงนามผูกพันนิติบุคคล

(๒) สำเนาบัญชีรายชื่อผู้ถือหุ้นที่นายทะเบียนรับรอง

(๓) สำเนาเอกสารแสดงกรรมสิทธิ์ สิทธิครอบครอง หรือสิทธิใช้ประโยชน์ในพื้นที่ที่จะใช้จัดตั้งสถาบัน

(๔) เอกสารแสดงฐานะทางการเงิน เช่น รายงานทางการเงินที่เสนอต่อผู้ถือหุ้น หรือหลักฐานอื่น ๆ ที่แสดงแหล่งที่มาและใช้ไปของเงินทุน หรือการลงทุนในกิจการอื่น หรือเอกสารรับรองสถานะทางการเงินของสถาบันการเงิน

(๕) เอกสารเกี่ยวกับการดำเนินงานสถาบัน ได้แก่

(ก) โครงสร้างขององค์กร และหน้าที่ความรับผิดชอบของบุคลากรแต่ละตำแหน่ง

(ข) ชื่อและคุณสมบัติของผู้ที่จะเสนอให้เป็นผู้แทนสถาบัน

(ค) คุณสมบัติของเจ้าหน้าที่ระดับบริหารและบุคลากรที่ทำการฝึกอบรม

(ง) คู่มือการดำเนินงานและการฝึกอบรม (Training and Procedure Manual)

ข้อ ๕ คู่มือการดำเนินงานและการฝึกอมรมของสถาบัน สำหรับให้ผู้เกี่ยวข้องปฏิบัติตาม ให้จัดทำเป็นส่วน ๆ ซึ่งอย่างน้อยต้องประกอบด้วยข้อมูลดังต่อไปนี้

(๑) ส่วนที่ ๑ บททั่วไป ซึ่งแสดงรายละเอียดของขอบเขตการฝึกอบรมที่ได้รับอนุญาตตามเงื่อนไขการรับรองสถาบัน ประกอบด้วย

(ก) คำนำ

(ข) สารบัญ

(ค) ขอบเขตการฝึกอบรมที่ได้รับอนุญาตพร้อมทั้งเงื่อนไขการอนุญาต

(ง) วิธีการแก้ไขปรับปรุงคู่มือการดำเนินงานและการฝึกอบรม และวิธีการลงบันทึกการเปลี่ยนแปลงเอกสาร

(จ) การแจกจ่ายคู่มือการดำเนินงานและการฝึกอบรมให้หน่วยงานและบุคลากรที่เกี่ยวข้อง

(ฉ) นโยบายและโครงสร้างการบริหารสถาบัน (Organization Chart) และ

(ช) แผนผังอาคารสถานที่

(๒) ส่วนที่ ๒ ชื่อและรายละเอียดเกี่ยวกับบุคลากรที่รับผิดชอบเพื่อปฏิบัติหน้าที่ในตำแหน่งผู้แทนสถาบัน

(ก) คุณสมบัติของผู้แทนสถาบัน

(ข) อำนาจหน้าที่ของของผู้แทนสถาบัน

(๓) ส่วนที่ ๓ รายชื่อและรายละเอียดเกี่ยวกับคุณสมบัติของบุคลากรที่แต่งตั้งในตำแหน่งที่รับผิดชอบในการวางแผน กจรปฏิบัติการและการควบคุมการฝึกอบรม รวมทั้งสัดส่วนของบุคลากรดังกล่าว

(๔) ส่วนที่ ๔ รายละเอียดเกี่ยวกับวิธีดำเนินการในการคงไว้ซึ่งความรู้และความสามารถของบุคลากรที่ทำการฝึกอบรม

(๕) ส่วนที่ ๕ เนื้อหาของแผนการฝึกอบรมภาคความรู้ (Knowledge) และภาคความสามารถ (Skill) ประกอบด้วย

(ก) วิธีการรับนักศึกษา และจำนวนนักศึกษาที่คาดว่าจะรับในแต่ละปีการศึกษา

(ข) วิธีการเทียบโอนผลการศึกษา (ถ้ามี)

(ค) วิธีการกำหนดสัดส่วนระหว่างครูกับนักศึกษา

(ง) รายละเอียดของหลักสูตรที่จะทำการฝึกอบรมตามข้อ ๙ (๑) – (๖)

(จ) วิธีการวัดผลการศึกษา และการออกใบรับรองผลการศึกษา

(๖) ส่วนที่ ๖ รายละเอียดเกี่ยวกับระบบประกันคุณภาพ (Quality Assurance) ของสถาบัน

(๗) ส่วนที่ ๗ รายละเอียดเกี่ยวกับสถานที่และสิ่งอำนวยความสะดวกของสถาบัน ได้แก่ข้อมูล เอกสาร ห้องเรียน ห้องฝึกงาน สื่อการสอน และอุปกรณ์ที่ใช้ในการฝึกอบรม ซึ่งต้องเหมาะสมกับหลักสูตรที่จะดำเนินการ และเพียงพอต่อจำนวนนักศึกษา

ข้อ ๖ เมื่อสำนักมาตรฐานความปลอดภัยในการเดินอากาศได้รับคำขอแล้ว ให้ตรวจสอบคุณสมบัติและลักษณะของผู้ขอตามข้อ ๓ เอกสารหลักฐานตามข้อ ๔ และคู่มือการดำเนินงานและการฝึกอบรมตามข้อ ๕ หากปรากฏว่าผู้ขอมีคุณสมบัติครบถ้วน และมีบุคลากร วิธีดำเนินการ แผนการฝึกอบรม หลักสูตรการฝึกอบรม ระบบรับรองคุณภาพ และสถานที่และสิ่งอำนวยความสะดวก ที่สามารถดำเนินการฝึกอบรมได้ตามคู่มือการดำเนินงานและการฝึกอบรมที่ยื่นไว้ ให้เสนออธิบดีเพื่อออกใบรับรองสถาบันให้กับผู้ขอ

ข้อ ๗ ใบรับรองสถาบันให้มีอายุห้าปีนับแต่วันที่ออกใบรับรองสถาบัน และเป็นไปตามแบบแนบท้ายประกาศนี้ โดยต้องมีรายละเอียดอย่างน้อยดังต่อไปนี้

(๑) หมายเลขใบรับรองสถาบัน

(๒) ชื่อสถาบัน

(๓) ที่อยู่สถาบัน

(๔) ชื่อหลักสูตรที่ได้รับการรับรอง

(๔) วันที่ออกและวันที่หมดอายุของใบรับรองสถาบัน

(๕) ลายมือชื่ออธิบดี

ข้อ ๘ สถาบันที่ได้รับใบรับรองสถาบัน หากประสงค์จะแก้ไขเพิ่มเติม คู่มือการดำเนินงานและการฝึกอมรม ให้ยื่นคำขอต่อสำนักมาตรฐานความปลอดภัยในการเดินอากาศพร้อมด้วยรายละเอียดที่จะขอแก้ไข และจะดำเนินงานตามคู่มือการดำเนินงานและการฝึกอมรมที่ขอแก้ไขได้เมื่ออธิบดีให้ความเห็นชอบการแก้ไขเพิ่มเติมนั้นแล้ว

ข้อ ๙ ผู้ได้รับใบรับรองสถาบันที่ประสงค์จะขอแก้ไขเพิ่มเติม เพิ่ม หรือลดหลักสูตรการฝึกอบรมที่ได้รับการรับรอง ให้ยื่นคำขอเป็นหนังสือต่อสำนักมาตรฐานความปลอดภัยในการเดินอากาศ พร้อมด้วยเอกสารแสดงรายละเอียด ในเรื่องดังต่อไปนี้

(๑) วัตถุประสงค์ของหลักสูตร ที่ขอรับรอง

(๒) คุณสมบัติของผู้เข้ารับการฝึกอบรมในหลักสูตรที่ขอรับรอง

(๓) รูปแบบการฝึกอบรมทั้งภาคความรู้ และภาคความสามารถ

(๔) เนื้อหาวิชาในหลักสูตร ซึ่งต้องเป็นไปตาม Doc 7192 Training Manual ที่องค์การการบินพลเรือนระหว่างประเทศกำหนดฉบับล่าสุด

(๕) รายละเอียดของห้องเรียน ห้องฝึกงาน สื่อการสอน และอุปกรณ์ที่ใช้ในการฝึกอบรม ในหลักสูตรที่ขอรับรอง

(๖) วิธีการวัดผลการศึกษา

ให้สำนักมาตรฐานความปลอดภัยในการเดินอากาศตรวจสอบเอกสารตามวรรคหนึ่ง หากเห็นว่าเนื้อหาวิชาในหลักสูตรที่ขอแก้ไขเพิ่มเติมเป็นไปตาม Doc 7192 Training Manual ที่องค์การการบินพลเรือนระหว่างประเทศกำหนด ฉบับล่าสุด และผู้ขอมีความสามารถดำเนินการฝึกอบรมตามหลักสูตรที่ขอรับรองได้อย่างมีประสิทธิภาพสอดคล้องกับคู่มือการดำเนินงานและการฝึกอบรมของสถาบัน ให้เสนออธิบดีเพื่อรับรองหลักสูตรการฝึกอบรมให้กับผู้ขอ โดยระบุหลักสูตรที่ได้รับการรับรองลงในข้อกำหนดรายละเอียดหลักสูตรการฝึกอบรมนายช่างภาคพื้นดินแนบท้ายใบรับรองสถาบัน

ข้อ ๑๐ สถาบันต้องจัดให้มีผู้แทนสถาบันคนหนึ่งเป็นผู้มีหน้าที่รับผิดชอบในการประสานงานกับกรมการขนส่งทางอากาศ เพื่อให้มั่นใจว่าสถาบันสามารถจัดหาทุนและดำเนินการตามมาตรฐานที่กรมการขนส่งทางอากาศกำหนด และมีหน้าที่ตามที่กำหนดไว้ในข้อ ๑๑ (๓) ถึง (๑๐) และข้อ ๑๓

ข้อ ๑๑ สถาบันที่ได้รับใบรับรองสถาบันมีหน้าที่ดังต่อไปนี้

(๑) จัดให้มีผู้แทนสถาบันตลอดเวลาที่ได้รับการรับรอง หากเปลี่ยนแปลงตัวผู้แทนสถาบันต้องเสนอชื่อให้อธิบดีให้ความเห็นชอบภายในสิบสี่วันนับแต่วันที่มีการเปลี่ยนแปลง

(๒) ปฏิบัติตามคู่มือการดำเนินงานและการฝึกอบรม

(๓) รายงานการเปลี่ยนแปลงข้อเท็จจริงตาม ข้อ ๔ (๕) ให้อธิบดีทราบภายในสิบสี่วันนับแต่วันที่มีการเปลี่ยนแปลง

(๔) เสนอขอแก้ไขปรับปรุงคู่มือการดำเนินงานและการฝึกอบรมให้ถูกต้องกับการเปลี่ยนแปลงการดำเนินงานและให้ทันสมัยอยู่เสมอ และต้องได้รับความเห็นชอบจากอธิบดี

(๕) แก้ไขปรับปรุงคู่มือการดำเนินงานและการฝึกอบรมตามรายการและภายในระยะเวลาที่อธิบดีกำหนด

(๖) จัดให้มีสำเนาคู่มือการดำเนินงานและการฝึกอบรมที่เป็นปัจจุบันให้แก่เจ้าหน้าที่และบุคลากรที่มีส่วนเกี่ยวข้อง

(๗) จัดทำทะเบียนประวัติของผู้เข้ารับการฝึกอบรม (Trainee) และเก็บรักษาไว้ไม่น้อยกว่าสองปีนับแต่วันที่การฝึกอบรมเสร็จสมบูรณ์

(๘) จัดทำทะเบียนประวัติของบุคลากรที่ทำการฝึกอบรม (Instructor) และเจ้าหน้าที่ที่ทดสอบสถาบัน (Examining Staff) และเก็บรักษาไว้ไม่น้อยกว่าสองปีนับแต่วันที่บุคลากรหรือเจ้าหน้าที่ดังกล่าวสิ้นสุดการปฏิบัติหน้าที่

(๙) ยินยอมและอำนวยความสะดวกให้แก่เจ้าหน้าที่ของกรมการขนส่งทางอากาศเข้าไปในสถานที่ตั้งสถาบันในระหว่างเวลาทำการเพื่อตรวจสอบการปฏิบัติให้เป็นไปตามคู่มือการดำเนินงานและการฝึกอบรม หรือตามที่อธิบดีมอบหมาย

(๑๐) แก้ไขข้อบกพร่องจากการตรวจสอบโดยเจ้าหน้าที่ของกรมการขนส่งทางอากาศให้เป็นไปตามคู่มือการดำเนินงานและการฝึกอบรม

ข้อ ๑๒ ทะเบียนประวัติของผู้เข้ารับการฝึกอบรม ตามข้อ ๑๑ (๗) ให้มีรายละเอียดอย่างน้อยดังต่อไปนี้

(๑) ชื่อและนามสกุลของผู้เข้ารับการฝึกอบรม

(๒) สำเนาใบแสดงผลการศึกษา

(๓) คุณสมบัติก่อนเข้ารับการฝึกอบรม

(๔) ช่วงระยะเวลาการฝึกอบรม

(๕) ชื่อหลักสูตรที่ผ่านการฝึกอบรม

(๖) วันที่สำเร็จหลักสูตร หรือวันที่พ้นจากสภาพการเป็นผู้เข้ารับการฝึกอบรม หรือวันที่ย้ายไปฝึกอบรมในสถาบันอื่น

(๗) ผลที่ได้รับในแต่ละขั้นตอนการฝึกอบรมและชื่อบุคลากรที่ทำการฝึกอบรม

(๘) ความคืบหน้าในการฝึกอบรมในแต่ละขั้นตอน

(๙) วันแสดงผลการทดสอบความรู้และความสามารถ รวมทั้งชื่อบุคลากรที่ทำการทดสอบ

(๑๐) จำนวนชั่วโมงการฝึกอบรมเพิ่มเติม ในกรณีไม่ผ่านการทดสอบ

ข้อ ๑๓ เมื่อผู้เข้ารับการฝึกอบรมผ่านหลักสูตรการฝึกอบรมแล้ว สถาบันต้องออกใบรับรองจบการศึกษา (Graduated Certificate) และใบแสดงผลการศึกษา (Transcripts) ซึ่งต้องมีรายละเอียดอย่างน้อย ดังต่อไปนี้

(๑) ใบรับรองจบการศึกษาต้องมีรายละเอียดอย่างน้อย ดังต่อไปนี้
(ก) ชื่อสถาบันและหมายเลขใบรับรองสถาบัน
(ข) ชื่อและนามสกุลของผู้จบการศึกษา
(ค) ชื่อหลักสูตรการฝึกอบรม
(ง) วันที่จบการฝึกอบรม
(จ) ชื่อผู้มีอำนาจลงนามรับรองของสถาบัน

(๒) ใบแสดงผลการศึกษาต้องมีรายละเอียดอย่างน้อย ดังต่อไปนี้
(ก) ชื่อสถาบันและหมายเลขในใบรับรองสถาบัน
(ข) ชื่อและนามสกุลของผู้จบการศึกษา
(ค) รายละเอียดของหลักสูตรการฝึกอบรม
(ง) ผลการฝึกในแต่ละขั้นตอนในหลักสูตรการฝึกอบรม
(จ) ชื่อผู้มีอำนาจลงนามรับรองของสถาบัน

ข้อ ๑๔ ในกรณีที่สถาบันไม่ปฏิบัติตาม ข้อ ๑๑ และข้อ ๑๓ และอธิบดีได้มีหนังสือเตือนให้ดำเนินการแก้ไขปรับปรุงให้แล้วเสร็จภายในเวลาที่กำหนด แต่สถาบันไม่ปฏิบัติตาม หรือไม่สามารถปฏิบัติได้ อธิบดีจะพักใช้ใบรับรองสถาบันเป็นเวลาอย่างน้อยเก้าสิบวัน

ข้อ ๑๕ ในกรณีที่อธิบดีสั่งพักใช้ใบรับรองสถาบัน และครบกำหนดเวลาพักใช้แล้ว แต่สถาบันไม่อาจแก้ไขปรับปรุงตามที่อธิบดีกำหนด ให้อธิบดีเพิกถอนใบรับรองสถาบันนั้น

ข้อ ๑๖ เมื่ออธิบดีพักใช้หรือเพิกถอนใบรับรองสถาบัน ให้ผู้แทนสถาบันส่งคืนใบรับรองสถาบันแก่กรมการขนส่งทางอากาศภายในห้าวันทำการ

ข้อ ๑๗ ให้ใบรับรองสถาบันเป็นอันใช้ไม่ได้ เมื่อสถาบันไม่เริ่มดำเนินการฝึกอบรมภายในระยะเวลาหกสิบวันนับแต่วันที่ออกใบรับรองสถาบัน

ข้อ ๑๘ ผู้ได้รับใบรับรองสถาบันผู้ใดประสงค์จะขอต่ออายุใบรับรองสถาบัน ให้ยื่นคำขอต่อสำนักมาตรฐานความปลอดภัยในการเดินอากาศ ก่อนวันที่ใบรับรองสถาบันดังกล่าวสิ้นอายุไม่น้อยกว่าหกสิบวัน และเมื่อได้ยื่นคำขอต่ออายุใบรับรองสถาบันแล้ว ให้ดำเนินการต่อไปได้จนกว่าจะได้รับแจ้งการไม่รับรอง

ให้นำความใน ข้อ ๖ มาใช้บังคับกับการพิจารณาการต่ออายุใบรับรองสถาบันโดยอนุโลม

การต่ออายุใบรับรองสถาบันจะต่อให้คราวละห้าปีนับแต่วันที่ใบรับรองสถาบันเดิมสิ้นอายุ

ข้อ ๑๙ ในกรณีที่ใบรับรองสถาบัน สูญหาย ถูกทำลาย หรือชำรุดในสาระสำคัญ ให้ผู้ได้รับใบรับรองสถาบัน ยื่นคำร้องขอรับใบแทนใบรับรองสถาบัน เมื่ออธิบดีพิจารณาอนุญาตแล้ว ให้ออกใบแทนใบรับรองสถาบันให้แก่ผู้ยื่นคำขอ

ในการออกใบแทนใบรับรองสถาบัน ให้ใช้แบบใบรับรองสถาบัน และเขียนหรือประทับตราความว่า "ใบแทน" ด้วยอักษรสีแดงไว้ด้านบนของใบรับรองนั้น

ข้อ ๒๐ บรรดาสถาบันฝึกอบรมนายช่างภาคพื้นดินที่เปิดดำเนินงานและได้รับการรับรองหลักสูตรการฝึกอบรมอยู่ก่อนวันที่ประกาศนี้ใช้บังคับ ให้เจ้าของหรือผู้ดำเนินการสถาบันยื่นคำขอใบรับรองสถาบันและใบรับรองหลักสูตรการฝึกอบรม ภายในสามสิบวันนับแต่วันที่ประกาศนี้ใช้บังคับ

เมื่อได้ยื่นคำขอแล้ว ให้เจ้าของหรือผู้ดำเนินการสถาบันดำเนินการต่อไปได้ จนกว่าอธิบดีจะแจ้งว่าสถาบันไม่อยู่ในเกณฑ์ที่จะออกใบรับรองสถาบันให้

ทั้งนี้ ตั้งแต่บัดนี้เป็นต้นไป

ประกาศ ณ วันที่ ๑๔ พฤษภาคม พ.ศ. ๒๕๕๑

(นายชัยศักดิ์ อังค์สุวรรณ)
อธิบดีกรมการขนส่งทางอากาศ

วิทยาลัยเทคนิค

Technical College

SCHOOL OPERATIONS MANUAL

วิทยาลัยเทคนิค

Technical College

School OPERATIONS MANUAL

Certificate Number
0S0TS00K

Chapter: 0
Section: 1
Date issued October 1st, 2016
Revision: 0

Record of Revisions

REVISION	DATE	INSERT BY:
0	October 1, 2016	

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Chapter: 1
Section: 2
Date issued October 1st, 2016
Revision: 0

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Chapter Three – Instructional aids

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Revision Procedure

1. It is the responsibility of the Superintendent/President, or his/her delegate, to initiate and write all revisions to this manual. The Superintendent/President, or delegate, will submit all revisions to the CAAT (Civil Aviation Authority of Thailand) for review and acceptance prior to publishing and distributing changes.

2. All revisions will be marked with section, chapter, date issued and revision number on each page.

3. The List of Effective Pages, Chapter 1, Section 2, will be updated to show which page or pages were revised.

4. The updated manual will be posted to the TC (Technical College) website. (www.utc.ac.th) This will be the only official location of the current approved operations manual.

5. A Notice of Revision with a list of changes will be sent to each registered manual holder when new revisions are posted. This notice will be sent by email with a read receipt required or Thailand Postal Office with return receipt to confirm manual holders receive the notification.

Manual Control

1. The Superintendent/President, or his/her delegate, will have the revisions he/she finds necessary produced in a final form for coordination with the CAAT (Civil Aviation Authority of Thailand).

2. Upon acceptance by CAAT, the new manual will be posted to the UTC (Ubonratchathani Technical College) website. (www.utc.ac.th).

3. A Notice of Revision with a list of each change will be sent to each registered manual user when new revisions are posted. This notice will be sent by email with a read receipt required or Thailand Postal Office with return receipt to confirm manual holders receive the notification.

4. A list of effective pages will be issued with each revision so any printed versions of manual used by registered manual holders can be checked and kept current.

Introduction

1. This operations manual has been prepared in accordance with the current Federal Aviation Regulation (FAR's), AC-147-3B, and Doc. 9841 the laws and regulations governing by Office of Vocational Education Commission, Ministry of Education of Thailand, the policies and practices of TC (Technical College of Thailand).

2. This manual will explain the procedures for controlling and certifying student enrollment, instruction time, attendance, records, transcripts and, student certificates of completion.

3. This operation manual will also describe and explain the school's curriculum, facilities, technical reference data, instructional aides and materials, shop equipment, and specialized/ precision tools.

4. The TC (Technical College) curriculum will consist of three separate segments: General, Airframe and Powerplant. The instructional period for each course can vary from: five hours a day, five days a week with a ten minute break after each two and one half hours of instruction, six hours a day, five days a week with a ten minute break after each two hours of instruction or eight hours a day, five days a week with a ten minute break after each two hours of instructions.

   4.1. The General segment is 512.0 hours of scheduled instruction including 50 hours of embedded make-up time. This segment consists of two courses each of which includes 256 hours of instruction (48 hours of lecture and 208 hours of practical lab).

   4.1.1. General Aviation I consists of instruction which follows CAAT (FAR) Part 147 core curriculum standards for Mathematics, Basic Electricity, Fluid Lines and Fittings, Materials and Processes and Basic Physics.

   4.1.2. General Aviation II consists of instruction which follows CAAT (FAR) Part 147 core curriculum standards for Ground Operations and Servicing, Cleansing and Corrosion Control, Maintenance Publications, Mechanic Privileges and Limitations, Weight and Balance, Aircraft Drawings.

4.2. The Airframe segment is 778.0 hours of student training including 28 hours of embedded make-up time. This segment consists of three courses each of which includes 256 hours of instruction (48 hours of lecture and 208 hours of practical lab).

4.2.1. Airframe I consists of instruction following CAAT (FAR) Part 147 core curriculum standards for Wood Structures, Aircraft Covering, Aircraft Finishes, Sheet Metal and Non-Metallic Structures and Airframe Inspection

.

4.2.2. Airframe II consists of instruction following CAAT (FAR) Part 147 core curriculum standards for Aircraft Landing Gear Systems, Hydraulic and Pneumatic Power Systems, Cabin Atmosphere Control Systems, Aircraft Instrument Systems, Communication and Navigation Systems and Aircraft Fuel Systems.

4.2.3. Airframe III consists of instruction following CAAT (FAR) Part 147 core curriculum standards for Aircraft Electrical Systems, Position and Warning Systems, Ice and Rain Control Systems and Fire Protection Systems.

4.3. The Powerplant segment is 778.0 hours of student training including 28 hours of embedded make-up time. This segment consists of three courses each of which includes 256 hours of instruction (48 hours of lecture and 208 hours of practical lab).

4.3.1. Powerplant I consists of instruction following CAAT (FAR) Part 147 core curriculum standards for Reciprocating Engines, Turbine Engines and Engine Inspection.

4.3.2. Powerplant II consists of instruction following CAAT (FAR) Part 147 core curriculum standards for Induction and Engine Autoflow Systems, Engine Cooling Systems, Engine Exhaust and Reverser Systems, Propellers, Unducted Fans and Auxiliary Power Units.

4.3.3. Powerplant III consists of instruction following CAAT (FAR) Part 147 core curriculum standards for Engine Instrument Systems, Engine Fire Protection Systems, Engine Electrical Systems, Lubrication, Ignition and Starting Systems, Fuel Metering Systems and Engine Fuel Systems.

4.4. Curriculum revisions will be submitted to the CAAT (FAA) Civil Aviation Authority of Thailand. CAAT (FAA) approval is required prior to course implementation.

5. Each course is developed and designed to meet CAAT (FAA) curriculum requirements of Appendix B, C or D of FAR 147.

6. Official class time off for the TC (Technical College) will follow the approved academic calendar for TC (Technical College) which at a minimum includes:

   6.1. Two weeks off for the Summer Break.
   6.2. Two weeks off for the Winter Break.
   6.3. All Government Holidays.

7. School advertising requirements.

   7.1. Anytime an “Advertising Brochure” is designed and distributed it must have the following information included on the front page of the advertisement:

      7.1.1. Complete School Name: TC (Technical College).

      7.1.2. The CAAT Certificate Number, 0S0TS00K and the licensed and authorized course(s) the CAAT has approved for the school to teach and certify: Airframes and Powerplant.

Chapter: 1
Section: 6
Date issued October 1st, 2016
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ORGANIZATIONAL CHART

A copy of the school personnel roster will be maintained and made available for CAAT inspection in the school's TC (Technical College) Administration office.

SUPERINTENDENT/PRESIDENT (TC Director)

VICE PRESIDENT OF INSTRUCTION & STUDENT SERVICES

DEAN OF INDUSTRIAL TECHNOLOGY

DEPARTMENT CHAIR/DISCIPLINE FACILITATOR

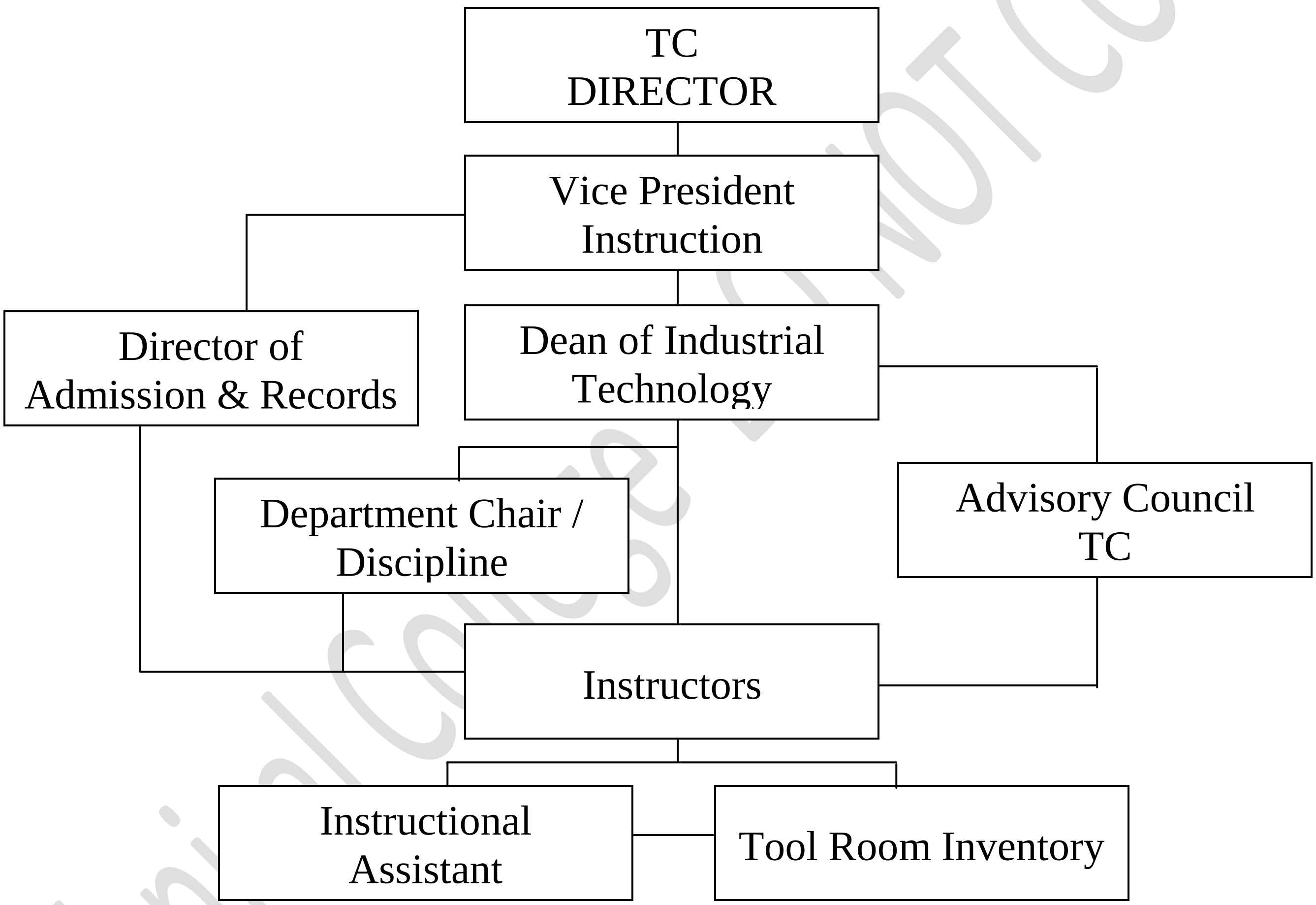
INSTRUCTORS

INSTRUCTIONAL ASSISTANTS

Chapter: 1
Section: 7
Date issued October 1st, 2016
Revision: 0

Organization Statement

The organization of the school functions is as follows:



Chapter: 1
Section: 8
Date issued October 1st, 2016
Revision: 0

DUTIES AND RESPONSIBILITIES

TC Director

The TC Director has the sole responsibility for the overall operation of Technical College which operates the TC (Technical College).

The TC Director has the authority to delegate duties and assignments as required. In the absence of the TC Director the Vice President of Instruction will assume the responsibilities and can then delegate authority to staff personnel as required.

VICE PRESIDENT INSTRUCTION

The Vice President Instruction is responsible to the President of TC (Technical College) and will assume responsibility for overall operations of the college in the absence of the Superintendent/President. The Vice President coordinates all instructional programs at TC (Technical College).

DEAN OF INDUSTRIAL TECHNOLOGY

The Dean of Industrial Technology is responsible to the Superintendent/President of TC (Technical College). The Dean of Industrial Technology is responsible for of managing the day to day operations of the TC (Technical College). The Dean of Industrial Technology is responsible to ensure the TC (Technical College) meets CAAT standards including instruction, record-keeping and certification.

Chapter: 1
Section: 8
Date issued October 1st, 2016
Revision: 0

Director of Admissions and Records

The Director of Admissions and Records is responsible for enrolling students into TC (Technical College).

The Director of Admissions and Records is responsible for maintaining academic records for students including grades and college credits earned.

Instructors

Instructor's primary responsibilities are the day to day instructing of students.

It is the responsibilities of all instructors and instructional assistants to fulfill the duties assigned, such as:

1. Teaching
2. Keeping daily roster forms
3. Managing all classroom administration requirements
4. Managing and issue lab projects and ensuring that the safety procedures are all met.
5. Maintaining student grades

Instructor Qualifications and Listing

Qualifications:

CAAT (Refer to – FAA Part 147)

Instructors teaching within the TC (Technical College) School of Aviation Technology will meet minimum CAAT (Civil Aviation Authority of Thailand) standards of teaching within and CAAT Certificated School which include:

1. Be CAAT-Certificated with a CAAT mechanic certificate having the ratings appropriate to those subjects to be taught.

    1.1. An individual with a Mechanic's Certificate authorized for Airframe and Powerplant may be qualified to teach all General, Airframe and Powerplant classes.

    1.2. An individual with a Mechanic's Certificated authorized for Airframe may be qualified to teach all General and Airframe classes.

    1.3. An individual with a Mechanic's Certificated authorized for Powerplant may be qualified to teach all General and Powerplant classes.

2. Have at least three years experience working in the aviation industry, either in general aviation, commercial aviation, military aviation or a combination of the above.

3. The Instructor who teaching at URTC must meet minimum standards.

4. Aeronautics

(Airframe and Powerplant, aircraft mechanics, aeronautical engineering technician, avionics)
The minimum qualifications for disciplines on this list are any bachelor's degree and two years of experience, or any associate degree and six years of experience.

5. Work experience (equivalency)

A minimum of fifteen (15) years of work experience in the field is required. The candidate is responsible for submitting evidence, proving mastery of the skills in the vocation, through enough for the specific assignment and broad enough to serve as a basis for teaching the other courses in the discipline. Extensive and diverse knowledge of the working environment is required. Applicant will be required to provide specific and conclusive evidence of equivalency such as certifications, license, employer certificatory letter and experience.

Other Desirable Qualifications

Additional qualifications that will add to the qualifications of an instructor and are desirable will be:

1. Teaching Certificated for CAAT 147 AMT School.
2. Retired personnel from CAAT who has experience teaching rerated courses.
3. Previous experience teaching aviation rerated courses.

Instructor List:

A list of all qualified certificated instructors will be made to include the instructor's name, FAA certificate number, CAAT certificate number, EASA certificate number and qualifications and the list of classes qualified to teach. This list will be kept in the school's UTC Administration Office and an official copy sent to CAAT for their records. These lists will be verified true and correct and signed by the Superintendent / President.

A list of any non-certificated instructors will also be kept in the school's UTC Administration Office and an official copy sent to the CAAT for their records, signed by the Superintendent / President. The list will contain the name of any non-certificated instructors with their CAAT approval date and a list of all subjects that they are qualified to teach.

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Section: 10
Date issued October 1st, 2016
Revision: 0

Personnel Listing

The UTC Director, through the Dean of Industrial Technology, will keep current list of all Instructors and Instructional Assistants and the courses they are certified to teach. In addition to this the personnel listing will include the name and contact information for the Dean of Industrial Technology and any other positions working for the school. These listings will be maintained current and be available for CAAT review at any time.

Chapter: 1
Section: 11
Date issued October 1st, 2016
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General, Airframe and Powerplant Curriculum

General Curriculum	Course Code	Class Hrs	Lab Hrs	Total Hrs
G - Basic Electricity & Electronics	3126-1003, 1004	30	20	50
G - Aircraft Drawings	3126-1005	20	10	30
G - Weight and Balance	3126-2108	20	10	30
G - Fluid Lines and Fittings	3126-9006	20	25	45
G - Materials and Processes	3126-1001, 1002	15	10	25
G - Ground Operation and Servicing	3126-2109	15	10	25
G - Mathematics	3000-1410	30	20	50
G - Maintenance Forms and Records	3000-1507*1	20	10	30
G - Basic Physics	3000-1318	30	20	50
G - Laws & Regulations, Maintenance Publications	3000-1507*1	26	10	36
G - Mechanic Privileges and Limitations	3000-1507*1	20	10	30
G - Precision Tools	3126-9005	0	3	3
G - Tools & Special Tools	3126-9004	0	3	3
G - Human Factors & SMS	3000-1611, 3001-1001	6	0	6
Total Curriculum Hours		252	161	**413**
Review		9	9	18
Makeup Time		25	25	50

Airframe Curriculum	Course Code	Class Hrs	Lab Hrs	Total Hrs
A1 - Aircraft Structure 1	3126-2005*2	5	5	10
A1 - Wood Structures	3126-2005*2	5	0	5
A1 - Aircraft Structure 2	3126-2006	5	5	10
A1 - Aircraft Covering	3126-2106	5	0	5
A1 -Aircraft Finishes	3126-2107	10	10	20
A1 - Sheet Metal and Nonmetallic Structures	3126-2105	50	200	250
A1 - Welding	3126-9002	10	15	25
A1 - Assembly and Rigging	3126-9001	10	25	35
A1 - Aircraft Landing Gear Systems	3126-2007*3	20	50	70
A1 - Hydraulic and Pneumatic Power Systems	3126-2007*3	20	45	65
A2 - Basic Aerodynamic F/W & R/W	3126-2101, 2102	6	0	6
A2 - Cabin Atmosphere Control Systems	3126-9007*5	20	5	25
A2 - Aircraft Instrument Systems / EIS	3126-2003*4	20	25	45

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Airframe Curriculum	Course Code	Class Hrs	Lab Hrs	Total Hrs
A2 - Communication and Navigation Systems / EIS	3126-2003*4	20	5	25
A2 - Aircraft Systems	3126-2198	20	15	35
A1 - Aircraft Electrical & Avionic Systems	3126-2004*13	20	25	45
A2 - Position and Warning Systems	3126-2007	10	15	25
A2 - Ice and Rain Protection Systems	3126-9007*5	10	0	10
A2 - Fire Detection Systems	3126-9007*5	10	10	20
A2 - Airframe Inspection	3126-9003*12	20	25	45
Total Curriculum Hours		296	480	**776**
Review		8	8	16
Makeup Time		25	25	50

Powerplant Curriculum	Course Code	Class Hrs	Lab Hrs	Total Hrs
P2 - Reciprocating Engine Theory and Development	3126-2002*6	30	45	75
P2 - Reciprocating Eng Familiarization & Differences	3126-2002*6	10	0	10
P2 - Engine Inspection, Maintenance and Operation	3126-9003*12	10	10	20
P1 - Engine Instrument System	3126-9010*7	10	10	20
P1 - Lubrication Systems	3126-9010*7	10	10	20
P1 - Engine Cooling Systems	3126-9010*7	10	5	15
P1 - Engine Exhaust Systems	3126-9010*7	5	10	15
P1 - Ignition and Starting Systems	3126-9008*9	15	10	25
P1 - Engine Fuel & Fuel Metering Systems	3126-9009*10	10	15	25
P1 - Electronic Engine Systems	3126-2004*13	10	0	10
P1 - Induction and Airflow Systems	3126-9009*10	10	10	20
P2 - Turbine Engine Theory and Development	3126-2001*8	20	80	100
P2 - Turbine Engine Operating Principles	3126-2001*8	20	50	70
P2 - Engine Inspection, Maintenance & Troubleshooting	3126-9003*12	10	10	20
P1 - Turbine Engine Instrument Systems	3126-9010*7	10	10	20
P1 - Turbine Engine Lubricating Systems	3126-9010*7	10	10	20

Powerplant Curriculum	**Course Code**	**Class Hrs**	**Lab Hrs**	**Total Hrs**
P1 - Turbine Engine Ignition & Starting System	3126-9008*9	10	10	20
P1 - Turbine Engine Fuel & Fuel Metering System	3126-9009*10	10	10	20
P1 - Turbine Engine Electronic Engine System / EIS	3126-2003*4	10	10	20
P1 - Turbine Engine Inlets and Nacelles	3126-2001*8	10	10	20
P1 - Turbine Engine Cooling Systems	3126-9010*7	10	10	20
P1 - Turbine Engine Exhaust Systems	3126-9010*7	10	10	20
P2 - Turbine Engine Familiarization & Differences	3126-2001*8	10	10	20
P1 - Turbine Engine Fire Protection System	3126-9010*7	10	10	20
P2 - Turbine Engine Electrical Systems	3126-2001*8	10	10	20
P2 - Basic Propeller Principles	3126-2104*11	10	5	15
P2 - Types of Propellers	3126-2104*11	10	0	10
P2 - Fixed-pitch & Constant speed Propellers	3126-2104*11	10	10	20
P2 - Turboprop Propellers	3126-2104*11	10	0	10
P2 - Propeller Ice-control Systems	3126-2104*11	5	10	15
P2 - Propeller Inspection & Maintenance	3126-2104*11	10	10	20
Total Curriculum Hours		345	410	**755**
Review		16	16	32
Makeup Time		25	25	50
Total Course Hours		**893**	**1051**	**1944**
Project				**72**
Grand Total Course Hours				**2016**

Chapter: 1
Section: 12
Date issued October 1st, 2016
Revision: 0

Instruction/Student Ratio

1. TC (Technical College) will provide the number of instructors holding appropriate mechanic certificates and ratings that the Dean of Industrial Technology determines necessary to provide adequate instruction and supervision of the students, including no more than 32 students per instructor in each laboratory or shop class.

2. TC (Technical College) will maintain a list of names and qualifications of specialized instructors and when requested provide a copy to the CAAT.

3. If an instructor goes on leave/or absent another instructor will be assigned to take over the class.

   3.1. If an instructor has not arrived for the class 15 minutes prior to the assigned class starting time, the Dean of Industrial Technology will locate and assign another qualified Instructor to take over the class. If the replacement instructor is unable to appear within 15 minutes of the assigned class starting time, the class period will be rescheduled.

4. If any TC (Technical College) Instructor is terminated, resigns or requests a leave of absence (for any length of time) CAAT will be notified either prior to or as soon as possible with the name of the replacement instructor.

5. Qualifications for each instructor will be maintained in the TC (Technical College) Human Resources Office.

Chapter: 1
Section: 13
Date issued October 1st, 2016
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TEXT BOOKS & TECHNICAL REFERENCE GUIDES

1. JEPPESEN
   - 1.1. A&P TECHNICIAN General Textbook ISBN 0-88487-203-3

2. McGraw-Hill
   - 2.1. Aircraft Gas Turbine Engine Technology (Third Edition) ISBN 0-02-801828-1
   - 2.2. Aircraft Maintenance & Repair (Sixth Edition) ISBN 0-02-803459-7
   - 2.3. Aircraft Electricity & Electronics (Fifth Edition) ISBN 0-02-801859-1
   - 2.4. Aircraft Basic Science (Seventh Edition) ISBN 0-02-801814-1

3. FAA
   - 3.1. General-Hand Book: H-8083-30 ISBN 10: 1560279508 / ISBN 13: 9781560279501
   - 3.2. Airframe Handbook: H-8083-30 ISBN 10: 1560279508 / ISBN 13: 9781560279501
   - 3.3. Powerplant Handbook: H-8389-30 ISBN 10: 1560279508 / ISBN 13: 9781560279501
   - 3.4. AC 43.13-1B chg 1 - Acceptable Methods, Techniques, and Practices-Aircraft Inspection and Repair
   - 3.5. AC 43.13-2B - Acceptable Methods, Techniques, and Practices-Aircraft Alterations
   - 3.6. FAR's Parts 1 through 199
   - 3.7. FAA Airworthiness Directives
   - 3.8. FAA Type Certificate Data Sheets
   - 3.9. FAA Supplemental Type Certificates
   - 3.10. FAA Orders as required

4. Manufacture Maintenance Manuals
   - 4.1. Will be maintained for "Instructional Use" only.
   - 4.2. Manufacturer Maintenance Manuals used for "return to service" will be verified as current prior to use.

5. CAAT will be notified of any changes to assigned technical publications prior to using.

Records

1. Files will be kept on each student attending TC. The instructor will be required to keep up all daily attendance files TC 001. The records of completed courses will be kept for two years from completion the TC of Administration Office, and will be available to the CAAT for the purposes of Certification: Airman other than Flight crew.

2. Student files will be a record of the student's attendance, kept in TC's Administration Office and accessible only to the administrators and TC instructors for TC business only. A sign out sheet will be maintained by the TC Director for checking out the record by any authorized personnel.

3. Student record will track the number of hours that the student has put in and track the number of absences.

4. Student record will include the student's attendance, tests and grades received as required by Part 147.33: the instruction credited to him/she under Part 147.31 (c), if any; and the official transcripts of his/her grades from that TC.

5. The TC shall maintain a current progress record for each of its students showing the completed General Lab Projects, Airframe Lab Projects and Powerplant Lab Projects. These record will be documented on TC 003, General Lab Project grade record, TC 009, Airframe Lab Project grade record and TC 006, Powerplant Lab Project grade record.

6. The TC will use academic standard minimum passing grade of 80%.

7. Records will be secured in the TC's Administration office in a locked file cabinet.

8. Academic transcripts will contain a complete record of courses taught, student grades, and dates of completion. Transcripts will be maintained by the Director of Admissions & Records and be made available to the student regardless of whether the student graduates or not.

9. Graduation certificates or certificates of completion will be issued by the administrator or designated representative. The certificate will contain the name of the TC (Technical College), the certificate number, the approved course name, and the date of graduation, and sign by the instructor and TC (Technical College) representative.

Practical Grading Criteria

1. CAAT grade-of-method will be method "a". A percentage value for each subject will be used to attain a passing grade of 80%.

    1.1. Grading will be on a percentile system for all written tests.

    Example: The number of right answered questions divided by the total questions asked.

    1.2. No major course grade of less than 80% shall be acceptable for a certification certificate.

    1.3. Performance grades will be based on the completion of mandatory lab tasks and acceptance of any project is made a matter Of Record.

    1.4. Scoring methods will be a minimum of 80% for a passing grade.

    1.5. Completed practical projects are the only way to satisfy a project requirement

    1.6. Missed written/low score tests or Incomplete/Missed Practical Projects must be made-up during the makeup period listed on the project sheet.

    1.7. A student who fails a written test will be able to retake a make-up written test during the make-up period.

Chapter: 1
Section: 16
Date issued October 1st, 2016
Revision: 0

Credit for Prior Instruction or Experience

1. TC (Technical College) will not graduate a student with a certificate or degree in Aviation Technology unless they complete all curriculum requirements. However, TC (Technical College) will credit a student with instruction in conformance with TC (Technical College). The process for requesting credit is published in the TC (Technical College) catalog.

   Generally this will be as follows:

1.1. TC (Technical College) may credit a student with instruction satisfactorily completed at:

   1.1.1. An CAAT certified aviation maintenance technical school.

1.2. TC (Technical College) will determine the amount of credit to be allowed:

   1.2.1. By a challenge examination equal to the one given to the student who completes a comparable required curriculum subject at the crediting school.
   1.2.2. By an evaluation of an authenticated transcript from the student's school.
   1.2.3. In the case or an applicant from a military school, on the basis of a Directorate of Aeronautical Engineering (RTAF) Subject Standardized Test scores and challenge examination, if required.

1.3. TC (Technical College) may credit a student with previous aviation maintenance experience comparable to required curriculum subjects. To do so, the college must determine the amount of credit to be allowed by documents verifying that experience, and by giving the student a challenge exam equal to the one given to students who complete the comparable required curriculum subject at the school.

1.4. TC (Technical College) may credit a student seeking an additional rating with previous satisfactory completion of the General Aviation portion of an Aviation Maintenance Technical School (AMTS) Curriculum.

GLOSSARY

This glossary of terms clarifies some of the terms used. When used with in the context of part 147, these terms apply to TC AMTS 147 Aviation School.

1. **Accreditation**. This term refers exclusively to school credited within the TC (Technical College).

2. **Certified Instructors**. Those instructors who hold CAAT, FAA and EASA mechanic certificates and the ratings appropriate for the subjects to be taught.

3. **Certification**. This term refers to AMTSs certified by the CAAT.

4. **Check**. Means to verify proper operation. A check is performed to verify a proper operation without the item necessarily qualifying for return to service condition. At an AMTS, the item checked does not have to be the item overhauled.

5. **Common Handtools**. Small, ordinary tools such as ratchets and sockets.

6. **Civil Aviation Authority of Thailand (CAAT).** The CAAT office controlling a particular part 147 AMTS.

7. **Instruction Hour**. The educational unit hour, as used by an AMTS, that consists of a time period of 50 to 60 minutes. This instructional time period conforms to the existing practices at many education institutions.

8. **Instruction Aids**. Equipment used to provide instruction. Examples include diagrams, visual aids, computers, interactive software, aircraft, and mock-ups of aircraft, engines, and components, as well as actual components, such as magnetos and fuels controls, an instructional aid is not required to meet return-to-service standards.

9. **Laboratory.** Facilities for providing instruction in general principles that may require student demonstrations or participation. Determination of what laboratory equipment is required depends on the subjects taught and the teaching level at which it is taught.

10. **OVERHAUL.** To disassemble, inspect, and repair as necessary, and check in accordance with FAA-acceptable instructions; that is, manufacturers' maintenance manuals, FAA directives, and service bulletins. For an AMTS, the overhaul requirement in a teaching scenario does not require the overhauled component to meet return-to-service mechanical tolerances. For example, a run out turbine powerplant may be adequate to teach students overhaul techniques, but could present a danger if operated.

11. **Practical Project.** A hands-on assignment that requires the use of manipulative skills taught at a teaching level of 2 or 3. A practical project generally does not include non-manipulative activities such as book reports. However, for certain required subjects such as maintenance publications, the use of FAA directives or manufacturers' data constitutes a practical project.

12. **Principal Maintenance Inspector (PMI).** The representative of the CAAT with principal responsibility for the certification and audit of a part 147 AMTS.

13. **Ratings.** An AMTS may be certificated for the following ratings: airframe, powerplant, or combined A&P. The general portion of the required curriculum is not a rating, but it is a required part of all the ratings.

14. **Return to Service.** With respect to skills developed to make a part or component airworthy or to be airworthy condition.

15. **Shop.** Facilities for providing instruction on projects taught at teaching level 2 or 3. The shop environment should resemble a typical aviation repair facility.

16. **Shop Equipment**. Machinery, such as fabricating devices, sheet metal equipment, and battery chargers.

17. **Special Tools.** Highly specialized tools, such as tensionometers, micrometers, and torque wrenches.

18. **Specialized Instructors.** Non-CAAT, FAA and EASA-certificated instructors who have been approved by the CAAT, FAA and EASA to teach pertinent subjects at a particular AMTS must submit to the CAAT a list of instructors and substitute instructors. The list must specify which subjects each instructor will teach. Then the CAAT approves or disapproves each instructor individually. An instructor who does not hold a CAAT, FAA and EASA mechanic certificate cannot be approved to teach subjects other than certain general curriculum subjects, such as mathematics, physics, and mechanical drawing. The list of approve instructors must be maintained by the AMTS.

19. **Teaching Levels.**
   a. Level 1. Level 1 requires knowledge of general principles and instruction by lecture, demonstration, and discussion, but no practical application or development of manipulative skill. Teaching aids or instructional equipment may include charts, books, diagrams, or other visual teaching aids. If an AMTS chooses to teach level 1 course incorporating actual components, the components do not have to be operational.
   b. Level 2. Level 2 requires knowledge of general principles, limited practical application, and development of sufficient manipulative skill to perform basic operations, as well as instruction by lecture, demonstration, discussion, and limited practical application. This teaching level requires some hands-on manipulative skills and their accompanying actual or stimulated components/equipment, but still may be taught primarily in the classroom, environment.
   c. Level 3. Level 3 requires knowledge of general principles, performance of a high degree of practical application, development of sufficient manipulative skills to simulate return to service, and instruction by lecture, demonstration, and discussion. This teaching level requires hands –on manipulative skill, as well as sufficient and appropriate instructional aides to train the student to develop manipulative skills sufficient to simulate return to service. At this level the teaching aids must be similar to, or the actual items of, equipment on which the student is expected to develop required skill levels. A level 3 subject cannot be taught solely by lecture in the classroom; the appropriate training aids and hands-on experience must be used.

20. **Troubleshoot**. To analyze and identify malfunctions, and to identify the source of trouble in and airframe, powerplant, or aircraft component. For the purposes of AMTSs, the item of equipment or simulator training aids must be in operating condition. For example, a turbine powerplant must be operational for the student to trouble shoot.

Quality of Instruction

1. TC (Technical College) will be required to meet or exceed the National Passing Norms for student first time passing of the CAAT A&P Written Test.

2. The school will provide instruction quality such that during any 24 Calendar-Period, a prescribed percentage of its graduates will be able to pass the appropriate CAAT written test on the first attempt.

3. The following FAA Forms will be reviewed and if the percentage falls below those specified in FAR 147.38(a) corrective action will be initiated.
   3.1. AC Form 8080-08
   3.2. AC Form 8080-10
   3.3. AC Form 8080-13

4. The Dean of Industrial Technology is responsible for performing this review and presenting it to the Vice President of Instruction for further action.

5. The Vice President of Instruction will:

   5.1. Review the appropriate forms to determine which curriculum items are being missed.

   5.2. Review the specific curriculum with the Instructors and set up a corrective action plan to increase the first time passing rate to the National average.

   5.3. Keep the corrective action plan in place until the next National Passing Norms for students has met the required percentage.

6. The School Instructors will implement the corrective action plan and ensure that this plan is passed down to the students in the normal instruction process.

Chapter: 2
Section: 1
Date issued October 1st, 2016
Revision: 0

FACILITIES

1. The TC (Technical College Name) is located at ….(Province)…, Thailand (near by Airport name); The school will use the hangar building at the Airport for all instructional training in the future (approximately 6,000 square feet minimum (560 square meters) of useable instructional area).

2. TC (Technical College) is located at Soi ………….. Road ………., Province …………… and contains:

   2.1. Computer Lab with twelve computer stations, master computer and printer.

   2.2. Two classrooms with capacity to seat thirty two students, computer hook-ups and overhead projector.

   2.3. Two shop / laboratory rooms with pneumatic and electrical power available to accommodate aircraft propeller, component, reciprocating and turbine engine complete disassembly and reassembly.

   2.4. Tool crib with special tools for shop and lab projects.

   2.5. Adjacent grounds for engine run-up and testing.

3. Aircraft Hanger located at TC (Technical College) nearby Airport, has approximately 6,000 Square feet of open floor area and instructional space that contains:

   3.1. Two class rooms with the capacity to seat thirty two students each.

   3.2. Twelve work stations with pneumatic and electrical power available.

   3.3. Paint spray booth.

   3.4. Welding booth.

   3.5. Tool crib with special precision tools and storage area.

   3.6. Fenced yard area for engine run-ups and maintenance checks

   3.7. Working floor space can accommodate two general aviation type aircraft.

4. Floor plans for each facility are provided.

Chapter: 2
Section: 2
Date issued October 1st, 2016
Revision: 0

STUDENT HAND TOOLS

1. The following list of hand tools is required for each student to have when they start the class. The tools required for a specific project must be accounted for prior to the beginning of a project.

2. All personal tools will be etched with student initials or student identification number. (Etcher is available in tool room upon request) Student hand tool list is subject to change to meet department requirements.

3. The tools should be kept in a single non-rolling hand held type tool box. Storage for student tool boxes is limited.

4. All tools will be inventoried prior to and upon completion of use.

5. All lost or missing tools will be reported immediately to the instructor or aide.

6. TC (Technical College) will provide an area for students to lock up personal tool boxes when not in use in lab area.

7. Students will be required to provide the following tools:

    1. LOCKABLE TOOL BOX
    2. TOOL BAG
    3. ¼ INCH DRIVE 12 POINT SOCKET SET W/RATCHET AND EXT (SHALLOW)
    4. 3/8 INCH DRIVE 12 POINT SOCKET SET W/RATCHET AND EXT (SHALLOW)
    5. ¼ INCH DRIVE 12 POINT DEEP SOCKET SET
    6. 3/8 INCH DRIVE 12 POINT DEEP SOCKET SET
    7. ½ INCH 12 POINT DEEP SOCKET SET W/ RATCHET
    8. FLASHLIGHTS (ONE REGULAR AND ONE MINI-MAG)
    9. 6 INCH STEEL RULER
    10. 8 FOOT STEEL TAPE MEASURE
    11. 4 INCH COMMON SCREWDRIVER
    12. 8 INCH COMMON SCREWDRIVER
    13. 1 ½ INCH STUBBY COMMON SCREWDRIVER
    14. 6 INCH PHILLIPS SCREWDRIVERS (BOTH #2 & #3 TIPS)
    15. 1 ½ INCH STUBBY PHILLIPS SCREWDRIVER (#2 TIP)
    16. COMPLETE SET OF COMBINATION WRENCHES (1/4 TO 1 INCH)
    17. COMPLETE SET OF SMALL COMBINATION WRENCHES
    18. 6 INCH DUCKBILL PLIERS

19. 6 INCH COMBINATION PLIERS (CHANNEL LOCK 6 INCH LONG NOSE)
20. 6 INCH LONG NOSE PLIERS (NEEDLE)
21. 6 INCH DIAGONAL CUTTER
22. COMPLETE SET OF FILES (SMALL TO 1 INCH)
23. 3/16 INCH CENTER PUNCH
24. DRIFT PIN SET 3/32, 1/8, 5/32, 3/16.
25. SOFT FACED MALLET (RAWHIDE-MINIMUM 2 INCH DIAMETER)
26. 18 INCH HACKSAW WITH BLADES
27. 8 OUNCE BALLPEEN HAMMER
28. 12 OUNCE BALLPEEN HAMMER
29. 1INCH OR 2 INCH INSPECTION MIRROR
30. POCKET SCRIBE WITH MAGNET
31. 6 INCH DIVIDER
32. MECHANICAL FINGERS (MINIMUM 12 INCH LONG)
33. POCKET KNIFE WITH LOCKING BLADE
34. ½ INCH COLD CHISEL
35. FEELER GAUGE SET
36. SAFETY GLASSES OR GOGGLES
37. WORK GLOVES

Chapter: 2
Section: 3
Date issued October 1st, 2016
Revision: 0

TOOLS

1. A current inventory list of all TC (Technical College) tools is kept in the Administrator's Office and will be available for review by the CAAT as required.

2. All special tools are included in the inventory list and will be issued to the students by the Instructor as required for Lab Projects.

3. Normal hand tools purchased by the students are not supplied by the school and must be supplied by the student.

Chapter: 2
Section: 4
Date issued October 1st, 2016
Revision: 0

Precision Tools

1. All precision tools will be maintained by the Instructors.

2. When required, precision tools that require calibration will be sent out to a proper calibration center for calibration. Upon return of precision tool, it will then be returned to the Tool Room with the appropriate Calibration Sticker applied.

Calibration of Tools

3. One tool from each type will be identified and marked that it has been calibrated.

4. The remaining tools of each type will be for student training and marked as NOT CALIBRATED.

5. When critical calibration requirements are required the Instructor and Student will use the calibrated tool.

Chapter: 2
Section: 5
Date issued October 1st, 2016
Revision: 0

Maintenance of Equipment and Training Aids

1. All Lab/Shop equipment and Training Aids will be maintained in a safe operating condition by the Instructors or Tool Room Assistant.

2. Each piece of equipment will be maintained as per the:

    2.1. User/Owner Manuals

    2.2. Maintenance Operations Manuals

    2.3. Manufacturer Maintenance Handbook

3. All maintenance will be recorded in an Equipment Log Book and maintained in the Tool/Stock Room so the Instructor or Aide can monitor the status of all equipment.

4. An Inspection will be made prior to use of any piece of equipment by the Instructor or Aide.

5. Routine maintenance/inspection of equipment will be performed as required by Maintenance/Operation Manuals and logged in the Equipment Log Book.

6. If a piece of equipment is found to be Unsafe or Unserviceable it will be removed from service until it has been repaired or replaced and logged into the Equipment Log Book.

7. If a special tool listed in the inventory is removed permanently a letter identifying the special tool removed from inventory to the CAAT with the reason for removal will be sent to the PMI.

LAB/SHOP EQUIPMENT

1. The following equipment is located in the school shop-labs and is maintained in good working order. Special tools located in the tool room. To check out a tool the student will leave a special chip with his number on it. (Each student will receive 10 chips and will be responsible for returning the tool or be charged the cost of replacing it).

2. Teaching Aids

   2.1 In the General, Airframe and Powerplant LABs, the following Aids are available to the students: Hydraulic fluid line and fittings, fire HRD (Hydrant) Aids and lines, Landing gear systems, Gear emergency extension systems, Gear throttle warning systems, Hydraulic test bench, Continental engines for tear down and reassembly, Lycoming Engines for tear down and reassembly, Allison 250 Test Cell and teardown engines, Fuel System Trainer, IFR Instrument Panel Trainer, Avionics Cockpit Panel Trainer, Fire Detection Trainer, and 28 volt DC training system trainer.

   2.2 A Cessna 150 is available for engine removal and installation and run up when completed, also for trouble shooting for faults put in by the instructor, a Thorpe aircraft for run up and trouble shooting for faults put in by the instructor. The aircraft will also be used for flight control cable labs using swaging tools and cables. Magnetos, Compression testers, Generators, for testing and overhauling engines and engine systems. The student will learn and observe safety requirements when working around an aircraft.

3 Propellers

   3.1 Hartzell, Sensenich Propellers, fix pitch, constant speed propellers, perform allowed repairs on metal blades, blending, inspection and meeting manufacturers specifications for blending.

4. Electrical

   4.1 The students will perform electrical LAB projects, using electrical test boards for parallel and series circuits. Perform wiring and soldering, and identifying resistors, capacitors, etc. using millimeters, such as Fluke, Simpson meters. Identifying wire sizes and fuses protection required. How to trouble shoot circuits common to aircraft systems.

5. VIDEO AIDS

5.1 Video training Aids, to be used by the instructors in showing the relations of hands on lab training and classroom training, to get the information to an aircraft airframe and powerplant mechanic student to be able to analyze and be able to trouble shoot a problem on the powerplant and aircraft.

6. Shop Tools

6.1 Drill presses, band saws, Shears, bending breaks, paint booth, cleaning tanks, hand tools, safety requirements, wearing goggles, protective head sets, gloves, protective clothing, how to use all the equipment safely, eye wash sink, overhead shower, the use of fire extinguishers for ABC Fires etc. All students will be trained in shop safety.

Chapter: 2
Section: 7
Date issued October 1st, 2016
Revision: 0

Physical Move of the School Facility

1. TC (Technical College) may not make any change in the school's location unless the change is approved by the CAAT in advance. TC (Technical College) is required to notify the CAAT in writing at least 30 days before the date change is contemplated. During the change in location, no disruption may be made to student instruction or normal classroom attendance. Equipment, facilities, and instructors must be at least at the same level as the standards approved for the vacated facilities.

Chapter: 3
Section: 1
Date issued October 1st, 2016
Revision: 0

Instructional Materials

1. All handout materials will be provided by the school. Handout material will be given out when needed by the Instructor to complete a project.

2. Class Instructor will maintain and monitor all handouts.

3. All materials will be located in the Administration Office file cabinet and updated as required by the Instructor.

4. All consumables items that are required to perform or complete a Lab/Shop Project will be provided by the school. Project Materials will be given out by the Instructor when needed to complete a Project.

5. Class Instructor will maintain and monitor all consumable items.

6. These consumable items will be located in the Tool Room/Stock Room and the Tool Room Attendant will order all consumables when the low level is reached on the Consumable Inventory List.

PRACTICAL PROJECTS GUIDE

1. Each practical guide will contain a minimum of the following: (AC 147-3B APP 7, PAGE 5-6).

    1.1. **PURPOSE:** this is to acquaint the student with what is associated with this practical task.

    1.2. **STANDARD:** this will be to develop a level of knowledge of understanding for each practical task.

    1.3. **TOOLS AND EQUIPMENT:** this area will explain what tools and **equipment** are required to accomplish this task.

    1.4. **INSTRUCTION:** this area will provide the step by step instructions for doing the task.

Chapter: 3
Section: 3
Date issued October 1st, 2016
Revision: 0

Instructional aids

1. An inventory list will be maintained and updated as required by assigned instructors and a current listing will be kept in the administrator's office.

Instructional aid equipment

2. Safety wire box, Allison 250 Turbo, runnable, Allison 250 teardown, turbine fuels system trainer, hydraulic system trainer, hydraulic system.

Available Aircraft for hand on:

3. Cessna 172 aircraft and Bell 206B II Jet Ranger helicopter.

Shop Equipment

4. Radial arm saw, band saw, grinders, dill press, growler, parts cleaner, special use tools and equipment as mentioned under Instructional Aids.

Lab Project Teaching Level

1. The Curriculum identifies the Teaching Level requirements per FAR Part 147. All Lab requirements for the General, Airframe and Powerplant Curriculum will be taught to a requirement of Level 2 and Level 3 Teaching Levels.

2. Since Level 1 Teaching Level requires lecture teaching only, no Lab Projects will be developed for Level 1 Teaching Level.

Lab Project Grading

3. All Project/Lab Assignments will be graded for knowledge, performance standards, and ability to follow instructions.

    3.1. The student will be required to complete all items in each Lab Project and answer or perform 80% of the requirements correctly.

4. These abilities will be turned into a percentage grade as assigned by the Teaching Level and Instructor.

Lab Project Completion Times

5. All Lab Assignments will have a time limit listed on each project and correspond to the hours listed in Chapter 1 Section 11 giving the total Lab Project hours assigned for each curriculum item.

Chapter: 3
Section: 5
Date issued October 1st, 2016
Revision: 0

Practical Grading Criteria

1. CAAT Grade-of-Method will be Method "A". A percentage value for each subject will be used to obtain a passing grade of 80%.

2. Grading will be on a percentile system for all written tests, for example, the number of correct answered questions divided by the total number of questions asked.

3. No major course grade of less than 80% shall be acceptable for a Certification Certificate.

4. Performance grades will be based on the completion of mandatory Lab tasks and acceptance of any project is made a matter of record.

5. Scoring methods will be a minimum of 80% for a passing grade.

6. Completed Practical Projects is the only way to satisfy a Project requirement.

7. Missed written or low score tests or incomplete/missed Practical Projects must be made-up during the Make Up period at the end of each Curriculum.

8. A student who fails a written test will be able to retake a make-up written test during the make-up period of each Curriculum.

STUDENT CONDUCT

1. Industries that employ maintenance technicians require a high level of professionalism. TC (Technical College) expects students to conduct themselves in the same professional manner in class and on field trips.

2. **Safety**

    2.1. Horseplay will not be tolerated at any time.

    2.2. Students are responsible for following safety rules.

        2.2.1. Safety glasses must be worn when operating machinery or engaged in any operation that may be dangerous to the eyes.

        2.2.2. Power tools may be used only if the student has received proper instruction and under the supervision of the instructor/aide.

        2.2.3. Material safety data sheets (MSDS) must be reviewed prior to using any hazardous materials.

3. Fighting

    3.1. Fighting will not be tolerated and is grounds for immediate suspension

4. Dress

    4.1. Open toe shoes/sandals or shorts are not allowed in labs.

5. Clean up

    5.1. When it is time to clean up, all students are expected to stop work immediately turn any tools and equipment and clean up classroom/lab.

6. **Cheating**

    6.1. The submission of work which is not a product of the student is dishonest and is subject to severe disciplinary action up to and including expulsion from the school.

7. **Harassment**

7.1. The TC (Technical College) is committed to providing an academic and work environment that respects the dignity of individuals and groups. In addition to freedom from discrimination, the school is committed to provide an educational environment free from harassment, intimidation or exploitation.

8. **Guest/Children**

8.1. Adult guest are permitted in classroom/lab areas as long as they are escorted.

8.2. Children are not permitted at any time.

9. **Courtesy**

9.1. Cell phones or any device that needs ear phones are not allowed in classroom/lab area.

9.2. Cell phones will be turned off or on vibrate during class.

9.2.1. Cell phones maybe answered, but just to let the caller know individual will call back at break or lunch.

9.2.2. Sitting, lying on desks, tables, or workbenches is strictly prohibited.

9.2.3. No food is allowed in classroom or lab.

9.2.4. Personal incoming calls on school phones will not be accepted unless there is an emergency.

10. Disabilities

10.1. Student who has a disability should advise the administrator and instructor so reasonable accommodations can be made.

Chapter: 4
Section: 2
Date issued October 1st, 2016
Revision: 0

ATTENDANCE & REPORTING

Attendance and reporting will be governed by the TC (Technical College) and the policies of TC (Technical College) as published in the college catalog. Any requirement of the CAAT will be added to these minimum standards to ensure compliance with all applicable agencies.

1. **ATTENDANCE**

1.1 Hourly attendance requirements for the course are programmed to meet the following procedures.

1.1.1 Seven consecutive 60 minute periods, five days a week for a total of 35 hours per week.

1.1.2 Each student must meet the minimum attendance hours.

1.1.3 There is no vacation or sick time allowed for each course.

1.1.4 At the end of each course there will be a make-up session for any time missed.

2. **DROPPING CLASS**

2.1 Students who stop attending class or stop completing assigned work, for any reason, are responsible for dropping or withdrawing from the course in the admissions office.

2.2 Students who do not officially drop from the course will receive a grade for the course which reflects their failure to participate in the full course.

2.3 Instructors may recommend a student to drop a class for lack of academic progress.

2.4 Students may be asked to drop the class due to repeated tardiness or absences.

2.5 When a student is dropped from a class they will be removed from the instructor's roster by the Director of Admissions & Records.

3. **REPORTING**

3.1. Attendance will be taken at the start of each class.

3.2. Any absence of one (1) hour will be a matter of record and will be annotated in the student record.

3.3. Any tardiness or early departures will be a matter of record and will be annotated in the student record.

3.4. Any subject the student missed will also be annotated for student make-up time.

3.5. The instructor/aide will complete a registrar of time that will be used to complete (on computer) total hours for that week.

3.6. Only time spent in classroom or lab will be counted toward time recorded.

3.7. Total hours for each subject will be recorded on a computer spreadsheet.

4. RECORDING HOURS

4.1. Recording time for the student.

4.1.1. Instructor roll call and sign-in sheet at the beginning of each class session.

4.1.2. Instructor will monitor students and annotate class roster when a student is either late or leaves early.

5. FIELD TRIPS

5.1. Field trips are occasionally scheduled to augment the instructional program. Field trips required by the curriculum are mandatory and will be explained by the instructor.

Chapter: 4
Section: 3
Date issued October 1st, 2016
Revision: 0

STUDENT TRANSCRIPT

Access to student records is governed by the Office of Vocational Education Commission, Ministry of Education, Thailand which protects the privacy of student records. Student records include those found in the Admissions & Records Office (admission application, transcripts, petitions, etc.) Students may have access to their records with appropriate notice and may provide permission in writing for the college to release information to other interested parties.

1. A student transcript will be issued when a formal request has been received from the student himself/herself request or from any other interested party to whom the student has given permission in writing for the college to release such information.

2. A student transcript will be issued to the CAAT upon a formal request from the school's PMI, provided the student has provided permission in writing for such release.

3. A student's transcript will include the following information:

    3.1. Student's name.

    3.2. Student's registration number.

    3.3. Identification of the courses fully completed the completion date and final grade. The fully completed courses can be either or all of the following:

        3.3.1. General Aviation I
        3.3.2. General Aviation II
        3.3.3. Powerplant I
        3.3.4. Powerplant II
        3.3.5. Powerplant III
        3.3.6. Airframe I
        3.3.7. Airframe II
        3.3.8. Airframe III

4. If a student has not completed any or all of the above courses of study than a transcript will be issued as follows:

    4.1. "I" Incomplete

4.2. "IP" In Progress (the course continued beyond the regular academic term)

4.3. "NP" Non-Pass

4.4. "W" Withdrawal

4.5. "FW" Unofficial Withdrawal

4.6. "MW" Military Withdrawal

5. Each official transcript completed by TC (Technical College) will be reviewed by the Director of Admissions & Records, or his/her delegate, and be delivered in a sealed envelope marked "official if sealed."

6. Student files will reflect the specific elements of any course that are completed or not completed:

6.1. Each curriculum item completed with the following information:

6.1.1. Date completed

6.1.2. Hours of classroom instruction

6.1.3. Hours of laboratory instruction

6.1.4. Grade at the stated date

6.2. Each curriculum item partially completed with the following information:

6.2.1. Date of last class

6.2.2. Hours of classroom instruction completed

6.2.3. Hours of laboratory instruction completed

6.2.4. Grade at the last class date.

STUDENT DAILY ATTENDANCE RECORD (Form TC 001)

1. The STUDENT DAILY ATTENDANCE RECORD (Form TC 001) is the official school form that will be used to record the students' attendance and hours for each class. This form will be used to record the total number of hours that each student attended each class session.

2. It is the instructor's responsibility to fill this form each day for each student in the class.

3. The form will be filled out according to the below instructions:

3.1. Item number 1 on Form TC 001 will contain the Course Title, for example General Course 09.001.

3.1.1. The 09 are the last two digits of the year the course was started.

3.1.2. The .001 indicates the first General class for the year and will add one number for each additional class.

3.2. Item number 2 on Form TC 001 will contain the Instructor's name

3.3. Item number 3 on Form TC 001 will contain the beginning date and ending date of the course.

3.4. Item number 4 on Form TC 001 will be the names of each student assigned to this class. Each student's name will be on one line. This will be the official record of the student's attendance and hours spent in each class.

3.5. Item number 5 on Form TC 001 will be the calendar month/day of the week. This section is divided in five-day sections. The first block in each section will be used for Monday and the last block will be for Friday.

3.5.1. Normally each class will start on a Monday so all five days will be filled in.

3.5.1.1. For example, if the first day of the class is Monday, January 12 the first block will be filled in with: 1/12.

3.5.1.2. If there is a legal holiday that is observed by the school the date will still be listed in the number 5 area. The Instructor will write in the first line of the number 6 area the letter "H" in red and draw a line, in red ink, through all the student records.

3.5.1.3. This will indicate that no hours were recorded for this day.

3.6. Item number 6 on Form TC 001 will be used to record the official time that each student was in class for each day of scheduled instruction.

3.6.1. Each class day is scheduled to be five (5) hours of instruction/lab work.

3.6.1.1. The Instructor will record when each student reported for class using the 10th (.1) of an hour system.

3.6.1.2. If the student reports to class on time and attends the entire class for that day the Instructor will put a "5" in the corresponding day/date section of the TC 001.

3.6.1.3. If the student was more than six and no more than twelve minutes late for that class day then the Instructor will put "4.8" in the corresponding day/date section of the TC 001. This will mean that the student attended 4.8 hours of a 5 hour class.

3.6.1.4. If the student arrives on time to the class but leaves before the scheduled five hours than the Instructor will be required to correct the specific students' attendance time for that day.

4. The Instructor will be required to add up all missed time for each student during the last scheduled week of the course period. The Instructor will notify each student, on Form TC 008, who has missed some class time how many hours the student is short of the scheduled class hours for this course.

    4.1. It will be the students' responsibility to work with the instructor to schedule the makeup hours required for this course period.

    4.2. The Instructor will hold the students course grade until all minimum hours are completed for that course.

Chapter: 5
Section: 1
Date issued October 1st, 2016
Revision: 0

TC 001
STUDENT DAILY ATTENDANCE RECORD

COURSE: 1 INSTRUCTOR: 2 CLASS DATES: 3

Student Name	5																			
	C	L	C	L	C	L	C	L	C	L	C	L	C	L	C	L	C	L	C	L
4	6					7														

C = Classroom
L = Lab (Work Shop)

Form TC 001
Page **1** of **1**

Chapter: 5
Section: 2
Date issued October 1st, 2016
Revision: 0

STUDENT REGISTRATION RECORD (Form TC 002)

1. The STUDENT REGISTRATION RECORD (Form TC 002) is the official school student registration record. This form is used to record all the pertinent personal information for each student.

2. The STUDENT REGISTRATION RECORD will be completed as follows:

    2.1. Enter the student's name.

    2.2. Enter the student's local address

    2.3. Enter the student's cell and/or home phone number.

    2.4. Enter the student's Emergency Contact Information:

        2.4.1. Contact name.

        2.4.2. Contact relationship

        2.4.3. Contact phone number

        2.4.4. Students health insurance

    2.5. Under the Course Information section add the date(s) the student starts the course and the completion date.

        2.5.1. After the course is completed add the final grade that the student received.

TC 002
STUDENT REGISTRATION RECORD

STUDENT INFORMATION:

NAME: ____

ADDRESS: ____
____
____

PHONE NUMBER: HOME __________________ CELL ________________

EMERGENCY CONTACT INFORMATION:

In case of Emergency contact: Name: ________________________________

Relationship: ___________________________

Contact Number: __________________________

Health Insurance: ________________________

COURSE INFORMATION:

COURSE	START DATE	COMPLETION DATE	FINAL GRADE
GENERAL			
POWERPLANTS			
AIRFRAMES			

Form TC 002
Page **1** of **1**

Chapter: 5
Section: 3
Date issued October 1st, 2016
Revision: 0

GENERAL LAB PROJECT GRADE RECORD (Form TC 003)

1. The GENERAL LAB PROJECT GRADE RECORD (Form TC 003) is the official school student record of the completion date and grade for each required General Curriculum Lab Project. The passing requirement for each Lab Project will be 80%. Anything less than an 80% will be considered a failing grade and will be required to be made up by the student in order to receive a final course grade.

2. The GENERAL LAB PROJECT GRADE RECORD will be filled out as follows:

    2.1. Enter the Students' name, Instructors' name and class dates.

    2.2. In the Date Completed column the Instructor will enter the date that the completed project was turned into the Instructor.

    2.3. In the Project Grade column the instructor will enter the final grade for the project.

    2.4. If a project in the Project Title column is not required than the Instructor will enter a "N/A" in the Date Completed column and sign his name in the Project Grade column.

    2.5. If a new temporary project is added to the current class requirement by the Instructor the title of this project will be written in by the Instructor in the appropriate empty line on the Project Title column.

        2.5.1. A new permanent requirement for this project will have to be initiated by a change to this form and submission to the CAAT for approval.

    2.6. Any final Project Grade that is below the required 80% passing grade will be transferred to the STUDENT REQUIRED MAKE-UP TIME, Form TC 008. This form will track the completion of the open/incomplete requirement.

Chapter: 5
Section: 3
Date issued October 1st, 2016
Revision: 0

TC 003
GENERAL LAB PROJECTS GRADE RECORD

Student Name: ________________ Instructor: __________________ Class Date: _____________

GENERAL LAB PROJECTS

Curriculum Section	Project Title	Date Completed	Project Grade
Aviation Physics			
	Boyles, Charles & Pascal's Law		
	Specific Gravity		
	First-Class Lever		
	Thermal Expansion		
Aerodynamics			
	Bernoulli's Principle		
	Controlling Factors or Aerodynamics		
Tools And Techniques			
	Micrometers & Calipers		
Hardware And Materials			
	Turnbuckles/Safety Wire		
	Torque Wrench and Adapters		
	AN Hardware		
	Cable Tensiometer		
	Swaging Tool/Nicopress Sleeves		
	Heli-Coil Kit		
Fluid Lines And Fittings			
	Flaring Tool Kit		
	Tube Cutter & Sleeve Coupling		
	Types of Coupling		
	"MS" Flareless Fittings		
	2024-T Aluminum Tube Fabrication		

Form TC 003
Page **1** of **3**

Chapter: 5
Section: 3
Date issued October 1st, 2016
Revision: 0

TC 003
GENERAL LAB PROJECTS GRADE RECORD

Student Name: _________________ Instructor: ___________________ Class Date: ______________

GENERAL LAB PROJECTS

Curriculum Section	Project Title	Date Completed	Project Grade
	Tubing Repair		
	Fabrication of Aeroquip 303 Hose		
	Fabrication of Aeroquip 601 Hose		
Basic Electricity	Resistor Color Codes		
	Lead Acid Battery		
	24 Volt Lead Acid Battery		
	Nickel-Cadmium Battery		
	Troubleshoot Electric Circuits		
	A/C Gen. Disassemble & Reassemble		
	A/C Gen. Parts & Components Ident.		
	A/C Reg. Disassembly & Reassembly		
	A/C Reg. Parts & Component Ident.		
	Electrical Circuits: Read & Interpret		
	Ele. Cir. Troubleshoot @ Wiring Diagram		
Blueprints And Drawings			
	Types of Lines & Symbols		
	Identify & Locate Parts & Components		
	Types of Charts & Graphs		
	Draw a Proper Sketch of a Repair		
Weight And Balance			
	Calculate the “CG” of an Aircraft		
	Weight & Balance Documentation		

Form TC 003
Page **2** of **3**

Chapter: 5
Section: 3
Date issued October 1st, 2016
Revision: 0

TC 003
GENERAL LAB PROJECTS GRADE RECORD

Student Name: __________________ Instructor: ____________________ Class Date: ______________

GENERAL LAB PROJECTS

Curriculum Section	Project Title	Date Completed	Project Grade
Maint. Documentation			
	Type Certificate Data Sheet		
	Airworthiness Directives		
	Manufacturers' Maintenance Manual		
	Federal Aviation Regulation Part 43		
Privileges & Responsibilities			
	FAR Parts 43-65		
Aircraft Inspections			
	Nondestructive Testing Methods		
	Aircraft Parts Inspection Process		
	Inspection Reports		
	Perform Precision Measurement		
	Precision Measurement Equipment		

I CERTIFY THAT ALL THE FINAL GRADES LISTED ON THIS GENERAL LAB PROJECTS GRADE RECORD ARE TRUE AND CORRECT.

INSTRUCTOR: ________________________________ DATE: ___________________

Form TC 003
Page **3** of **3**

GENERAL QUIZ/EXAM GRADE RECORD (Form TC 004)

1. The GENERAL QUIZ/EXAM GRADE RECORD (Form TC 004) is the official school student record of the completion date and grade for each required General Curriculum Quiz or Exam. The passing requirement for each Quiz/Exam will be 80%. Anything less than an 80% will be considered a failing grade and will be required to be made up by the student in order to receive a final course grade.

2. The GENERAL QUIZ/EXAM GRADE RECORD will be filled out as follows:

   2.1. Enter the Students' name, Instructors' name and class dates.

   2.2. In the QUIZ/EXAM ISSUE DATE column the Instructor will insert the date the Quiz or Exam was given and identify whether it was a Quiz or Exam.

   2.3. In the Date Completed column the Instructor will enter the date that the completed Quiz/Exam was turned into the Instructor.

   2.4. In the Grade column the instructor will enter the final grade for the Quiz/Exam.

   2.5. Any final Quiz/Exam Grade that is below the required 80% passing grade will be transferred to the STUDENT REQUIRED MAKE-UP TIME, Form TC 008. This form will track the completion of the open/incomplete requirement.

Chapter: 5
Section: 4
Date issued October 1st, 2016
Revision: 0

TC 004
GENERAL QUIZ/EXAM GRADE RECORD

Student Name: __________________ Instructor: ____________________ Class Date: ______________

GENERAL QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
Aviation Physics			
Aerodynamics			
Tools And Techniques			
Hardware And Materials			
Fluids Lines And Fittings			
Basic Electricity			
Blueprints And Drawings			
Weight And Balance			

Form TC 004
Page **1** of **2**

Chapter: 5
Section: 4
Date issued October 1st, 2016
Revision: 0

TC 004
GENERAL QUIZ/EXAM GRADE RECORD

Student Name: __________________ Instructor: ____________________ Class Date: _______________

GENERAL QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
Maint. Documentation			
Privileges & Responsibilities			
Aircraft Inspections			
Ground Support Equipment			
General Final Exam			

I CERTIFY THAT ALL THE FINAL GRADES LISTED ON THIS GENERAL QUIZ/EXAM GRADE RECORD ARE TRUE AND CORRECT.

INSTRUCTOR: ______________________________________ DATE: __________________

Form TC 004
Page **2** of **2**

Chapter: 5
Section: 5
Date issued October 1st, 2016
Revision: 0

POWERPLANT QUIZ/EXAM GRADE RECORD (Form TC 005)

1. The POWERPLANT QUIZ/EXAM GRADE RECORD (Form TC 005) is the official school student record of the completion date and grade for each required General Curriculum Quiz or Exam. The passing requirement for each Quiz/Exam will be 80%. Anything less than an 80% will be considered a failing grade and will be required to be made up by the student in order to receive a final course grade.

2. The POWERPLANT` QUIZ/EXAM GRADE RECORD will be filled out as follows:

2.1. Enter the Students' name, Instructors' name and class dates.

2.2. In the QUIZ/EXAM ISSUE DATE column the Instructor will insert the date the Quiz or Exam was given and identify whether it was a Quiz or Exam.

2.3. In the Date Completed column the Instructor will enter the date that the completed Quiz/Exam was turned into the Instructor.

2.4. In the Grade column the instructor will enter the final grade for the Quiz/Exam.

2.5. Any final Quiz/Exam Grade that is below the required 80% passing grade will be transferred to the STUDENT REQUIRED MAKE-UP TIME, Form TC 008. This form will track the completion of the open/incomplete requirement.

Chapter: 5
Section: 5
Date issued October 1st, 2016
Revision: 0

TC 005
STUDENT QUIZ/EXAM RECORD

Student Name: _________________ Instructor: ___________________ Class Date: ______________

POWERPLANT QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
1-1 Reciprocation Engine Theory			
1-2 Design And Construction			
1-3 Insp, Maintenance And Operation			
2-1 Engine Instrument Systems			
2-2 Lubrication Systems			
2-3 Ignition And Starting Systems			
2-4 Eng Fuel & Fuel Metering System			

Form TC 005
Page **1** of **6**

TC 005
STUDENT QUIZ/EXAM RECORD

Student Name: ________________ Instructor: __________________ Class Date: _____________

POWERPLANT QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
2-5 Electronic Engine Systems			
2-6 Induction & Airflow Systems			
2-7 Engine Cooling Systems			
2-8 Engine Exhaust Systems			
2-9 Recip. Engine Familiarization			
3-1 Turbine Engine Theory			
3-2 Turbine Engine Operation Principles			

Form TC 005
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Chapter: 5
Section: 5
Date issued October 1st, 2016
Revision: 0

TC 005
STUDENT QUIZ/EXAM RECORD

Student Name: __________________ Instructor: ____________________ Class Date: _______________

POWERPLANT QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
3-3 Turbine Eng Design & Construction			
3-4 Turbine Eng Nomenclature			
3-5 Insp, Maintenance & T/S			
4-1 Engine Instrument System			
4-2 Engine Lubrication System			
4-3 Ignition & Starting System			
4-4 Engine fuel & Fuel Metering SYS.			

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Chapter: 5
Section: 5
Date issued October 1st, 2016
Revision: 0

TC 005
STUDENT QUIZ/EXAM RECORD

Student Name: __________________ Instructor: ____________________ Class Date: _______________

POWERPLANT QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
4-5 Electronic Engine System			
4-6 Inlets And Nacelles			
4-7 Turbine Cooling System			
4-8 Turbine Eng. Exhaust System			
4-9 Turbine Engine FAM			
4-10 Engine Fire Protection			
4-11 Engine Electrical System			

Form TC 005
Page **4** of **6**

TC 005
STUDENT QUIZ/EXAM RECORD

Student Name: __________________ Instructor: ____________________ Class Date: _______________

POWERPLANT QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
5-1 Basic Propellers			
5-2 Types of Propellers			
5-3 Fixed Pitch Propellers			
5-4 Constant Speed Propellers			
5-5 Turboprop Propellers			
5-6 Propeller Ice Control			
5-7 Propeller Inspection			

Form TC 005
Page **5** of **6**

TC 005
STUDENT QUIZ/EXAM RECORD

Student Name: ___________________ Instructor: _____________________ Class Date: _______________

POWERPLANT QUIZ/EXAM GRADE RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
Powerplant Final Exam			

I CERTIFY THAT ALL THE FINAL GRADES LISTED ON THIS POWERPLANT QUIZ/EXAM GRADE RECORD ARE TRUE AND CORRECT.

INSTRUCTOR: ___________________________________ DATE: _________________

Form TC 005
Page **6** of **6**

Chapter: 5
Section: 6
Date issued October 1st, 2016
Revision: 0

POWERPLANT LAB PROJECT GRADE RECORD (Form TC 006)

1. The POWERPLANT LAB PROJECT GRADE RECORD (Form TC 006) is the official school student record of the completion date and grade for each required Powerplant Curriculum Lab Project. The passing requirement for each Lab Project will be 80%. Anything less than an 80% will be considered a failing grade and will be required to be made up by the student in order to receive a final course grade.

2. The POWERPLANT LAB PROJECT GRADE RECORD will be filled out as follows:

    2.1. Enter the Students' name, Instructors' name and class dates.

    2.2. In the Date Completed column the Instructor will enter the date that the completed project was turned into the Instructor.

    2.3. In the Project Grade column the instructor will enter the final grade for the project.

    2.4. If a project in the Project Title column is not required than the Instructor will enter a "N/A" in the Date Completed column and sign his name in the Project Grade column.

    2.5. If a new temporary project is added to the current class requirement by the Instructor the title of this project will be written in by the Instructor in the appropriate empty line on the Project Title column.

        2.5.1. A new permanent requirement for this project will have to be initiated by a change to this form and submission to the CAAT for approval.

    2.6. Any final Project Grade that is below the required 80% passing grade will be transferred to the STUDENT REQUIRED MAKE-UP TIME, Form TC 008. This form will track the completion of the open/incomplete requirement.

Chapter: 5
Section: 6
Date issued October 1st, 2016
Revision: 0

TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: __________________ Instructor: ____________________ Class Date: ______________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
1-1 Reciprocating Engine Theory	1-1-1	Maintenance Publications		
	1-1-2	FAA Publications		
1-2 Design and Construction				
	1-2-1	O-470-G Disassembly		
	1-2-2	IO-470-G Disassembly		
	1-2-3	O-470-G Engine Cleaning & Component Inspection		
	1-2-4	IO-470-G Engine Cleaning & Component Inspection		
	1-2-5	O-470-G Assembly Major Subassemblies		
	1-2-6	IO-470-G Assembly Major Subassemblies		
	1-2-7	O-470-G Final Assembly		
	1-2-8	IO-470-G Final Assembly		
	1-2-9	Cylinder Differential Pressure Check		
	1-2-10	Engine Removal Cessna 150		
	1-2-11	Engine Installation Cessna 150		
	1-2A-1	O-320H Disassembly		
	1-2A-2	O-320H Engine Cleaning & Component Inspection		
	1-2A-3	O-320H Assembly Major Subassemblies		
	1-2A4	O-320H Final Assembly		

Form TC 006
Page **1** of **7**

Chapter: 5
Section: 6
Date issued October 1st, 2016
Revision: 0

TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: ________________ Instructor: __________________ Class Date: _____________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
1-3 Inspection, Maintenance and Operation				
	1-3-1	Powerplant Conformity and Airworthiness Inspection		
2-1 Engine Instrument System				
	2-1-1	Cessna 150 Fuel Flow Indicator		
	2-1-2	Cessna 150 Fuel Quantity Indicator		
	2-1-3	Cessna 150 Carburetor Air Temperature Gage		
	2-1-4	Cessna 150 Cylinder Head Temperature Gage		
2-2 Lubrication Systems				
	2-2-1	Identify and select proper lubricant		
	2-2-2	Oil Filter Inspection		
2-3 Ignition and Starting Systems				
	2-3-1	Inspect Ignition Harness		
	2-3-2	Inspect Magneto		
2-4 Engine Fuel and Fuel Metering Systems				
	2-4-1	Inspect Engine Fuel and Fuel Metering Systems		

Form TC 006
Page **2** of **7**

TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: __________________ Instructor: ____________________ Class Date: ______________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
2-5 Electronic Engine Systems				
		N/A		
2-6 Induction and Airflow Systems				
	2-6-1	Inspect Engine Induction and Airflow Systems		
2-7 Engine Cooling Systems				
	2-7-1	Cylinder Head Cooling Fin Repair		
2-8 Engine Exhaust Systems				
	2-8-1	Inspect Engine Exhaust System		
	2-8-2	Inspect Carburetor Heat Box and Cabin Heater		
2-9 Reciprocating Engine Familiarization and Differences				
		N/A		
3-1 Turbine Engine Theory and Development				
		N/A		
3-2 Turbine Engine Operating Principles				
	3-2-1	Allison 250 Turbine Engine Disassembly		

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TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: ________________ Instructor: __________________ Class Date: _____________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
	3-2-2	Allison 250 Turbine Engine Inspection Disassembly		
	3-2-3	Allison 250 Turbine Engine Assembly		
3-3 Turbine Engine Design and Construction				
		Continuation of Section 3-2 Labs		
3-4 Turbine Engine Nomenclature				
		Continuation of Section 3-2 Labs		
3-5 Inspection, Maintenance and Troubleshooting				
	3-5-1	Allison 250 Conformity Inspection using the current TCDS		
	3-5-2	Perform Test Cell Run of the Allison 250 Turbine Engine		
4-1 Engine Instrument Systems				
	4-1-1	Turbine Engine Instrument Fuel Flow System		
	4-1-2	Turbine Engine Instrument Thermocouple System		

Form TC 006
Page **4** of **7**

Chapter: 5
Section: 6
Date issued October 1st, 2016
Revision: 0

TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: ________________ Instructor: __________________ Class Date: _____________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
4-2 Turbine Engine Lubricating Systems				
	4-2-1	Inspect Allison 250 Lubrication System		
4-3 Turbine Engine Ignition and starting systems				
	4-3-1	Inspect Turbine Engine Ignition		
4-4 Turbine Engine Fuel and Fuel Metering Systems				
	4-4-1	Turbine Engine Fuel and Fuel Metering System		
4-5 Turbine Engine Electronic Engine System				
		N/A		
4-6 Turbine Engine Inlets and Nacelles				
	4-6-1	Inspect Allison 250 for Compressor Inlet Blockage		
4-7 Turbine Engine Cooling Systems				
		N/A		

Form TC 006
Page **5** of **7**

TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: __________________ Instructor: ____________________ Class Date: ______________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
4-8 Turbine Engine Exhaust Systems				
	4-8-1	Inspect Allison 250 Exhaust System		
4-9 Turbine Engine Familiarization and Differences				
	4-9-1	Perform Conformity Inspection on Allison 250 Turbine Engine using the current TCDS		
4-10 Turbine Engine Fire Protection Systems				
	4-10-1	Perform Fire Detection Demonstration with Training Aid AS-60		
	4-10-2	Perform Fire Extinguishing Demonstration with Training Aid AS-60		
4-11 Turbine Engine Electrical Systems				
	4-11-1	Inspect Allison 250 Turbine Engine Electrical Wire System		
5-1 Basic Propeller Principles				
		N/A		
5-2 Types of Propellers				
		N/A		

Form TC 006
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Chapter: 5
Section: 6
Date issued October 1st, 2016
Revision: 0

TC 006
POWERPLANTS LAB PROJECTS GRADE RECORD

Student Name: _________________ Instructor: ___________________ Class Date: ______________

POWERPLANTS LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
5-3 Fixed-pitch Propellers				
	5-3-1	Repair Fixed-pitch Propeller Blades		
5-4 Constant-speed Propellers for Light Aircraft				
	5-4-1	Inspect Installation and Function of Constant-speed Propeller		
5-5 Turboprop Propellers				
		N/A		
5-6 Propeller Ice-control Systems				
		N/A		
5-7 Propeller Inspection and Maintenance				
	5-7-1	Identify Proper Propellers to be Installed on a Cessna 150 using TCDS		

I CERTIFY THAT ALL THE FINAL GRADES LISTED ON THIS GENERAL LAB PROJECTS GRADE RECORD ARE TRUE AND CORRECT.

INSTRUCTOR: _______________________________ DATE: _____________

Form TC 006
Page **7** of **7**

TC 007
STUDENT REQUIRED MAKE-UP TIME RECORD (Form TC 007)

1. The STUDENT REQUIRED MAKE-UP TIME RECORD will be the official record indicating if the student has completed sufficient minimum CAAT (FAA) required classroom hours for each curriculum section of the Airframes and Powerplants Course.

2. The STUDENT REQUIRED MAKE-UP TIME RECORD will be filled out as follows:

   2.1. Fill in the student Name and ID number.

   2.2. For the General Curriculum, fill in the actual classroom hours calculated from the completed STUDENT DAILY ATTENDANCE RECORD, Form TC 001.

   2.3. Subtract the CAAT (FAA) minimum hours required of 400 classroom hours from the total classroom the student had recorded.

   2.4. Put the difference between the required 400 classroom hours and the student total classroom hours in the next section.

   2.5. If the number is a positive number mark out the "IS" in the bottom statement. If the number is a negative number mark out the "IS NOT" which will mean the student has not completed the "Minimum FAA Required Classroom Hours.
      2.5.1. When the student does not have sufficient classroom hours the Instructor will calculate the required subjects and hours from the completed STUDENT DAILY ATTENDANCE RECORD, Form TC 001, and transfer this information to the STUDENT MAKE-UP TIME RECORD for the curriculum section that is missing required hours.

   2.6. The Instructor's signature in Section 1 or 2 of this form indicates that all the information listed on the form is correct and accurate.

   2.7. In Section 3 of this form, the Instructor will sign this statement when all the appropriate CAAT (FAA) Required Classroom Hours have been completed. The Instructor will also attach the appropriate completed STUDENT MAKE-UP TIME RECORD, Form TC 008.

Chapter: 5
Section: 8
Date issued October 1st, 2016
Revision: 0

TC 007
STUDENT REQUIRED MAKE-UP TIME RECORD

STUDENT NAME: __________________________ STUDENT ID: ____________

1. GENERAL CURICULUM REQUIREMENTS:

ACTUAL CLASSROOM HOURS COMPLETED: ________________

CAAT (FAA) MINIMUM HOURS REQUIRED: ________400______

HOURS NOT MEETING MINIMUM CAAT (FAA) HOURS: _________________
STUDENT IS / IS NOT REQUIRED TO MAKE-UP ANY GENERAL CURICULUM HOUR REQUIREMENTS.

INSTRUCTOR SIGNITURE: _________________ DATE: _________

STUDENT COMPLETED REQUIRED MAKE-UP HOURS: ___________
(SEE ATTACHED UT FORM 008 – STUDENT MAKE-UP TIME RECORD)

INSTRUCTOR SIGNITURE: ________________________

2. POWERPLANT CURICULUM REQUIREMENTS:

ACTUAL CLASSROOM HOURS COMPLETED: ________________

CAAT (FAA) MINIMUM HOURS REQUIRED: _______750_______

HOURS NOT MEETING MINIMUM CAAT (FAA) HOURS: _________________
STUDENT IS / IS NOT REQUIRED TO MAKE-UP ANY GENERAL CURICULUM HOUR REQUIREMENTS.

INSTRUCTOR SIGNITURE: ___________________ DATE: _________

STUDENT COMPLETED REQUIRED MAKE-UP HOURS: ____________
(SEE ATTACHED UT FORM 008 – STUDENT MAKE-UP TIME RECORD)

INSTRUCTOR SIGNITURE: ___________________ DATE: _______

Form TC 007
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TC 007
STUDENT REQUIRED MAKE-UP TIME RECORD

3. AIRFRAME CURICULUM REQUIREMENTS:

ACTUAL CLASSROOM HOURS COMPLETED: _________________

CAAT (FAA) MINIMUM HOURS REQUIRED: _______750_______

HOURS NOT MEETING MINIMUM CAAT (FAA) HOURS: __________________
STUDENT IS / IS NOT REQUIRED TO MAKE-UP ANY GENERAL CURICULUM HOUR REQUIREMENTS.

INSTRUCTOR SIGNITURE: _________________ DATE: __________

STUDENT COMPLETED REQUIRED MAKE-UP HOURS: _____________
(SEE ATTACHED UT FORM 008 – STUDENT MAKE-UP TIME RECORD)

INSTRUCTOR SIGNITURE: __________________ DATE: __________

4. UPON COMPLETION OF ALL MAKE-UP HOURS THE STUDENT HAS SUCCESFULLY COMPLETED ALL CAAT (FAA) REQUIREMENTS AND WILL BE AWARDED THE APPROPRIATE CERTIFICATION OF COMPLETION.

INSTRUCTOR: _______________________ DATE: ____________

Form TC 007
Page **2** of **2**

Chapter: 5
Section: 9
Date issued October 1st, 2016
Revision: 0

TC 008
STUDENT MAKE-UP TIME RECORD (Form TC 008)

1. The Student Make-Up Time Record / Form TC 008 (as revised) will be the official record indicating the specific Subject and hours of each subject that the student has not completed. In addition to the above this form will also be used as the time keeping record to record the make-up hours performed by each student.

2. The Student Make-Up Time Record will be filled out as follows:

   2.1. Fill in the student Name and ID number.
   2.2. Fill in the Instructor's Name.
   2.3. In the two column table the Instructor will fill in the Subjects and Required Hours to be completed for each.
   2.4. In the Completion Record the Instructor will keep a daily record of the hours that the Student successfully completed.
      2.4.1. In the subject column the Instructor lists the Subject that was taught on each day.
      2.4.2. In the Date column the Instructor lists the date that the make-up time was taught.
      2.4.3. In the Hours Completed column the Instructor lists the hours of instruction for the specific date.
      2.4.4. The Instructor's signature in the Instructor column indicates that the listed subject and make-up hours was completed on that specific date.
   2.5. The General Curriculum and Powerplant Curriculum sections will be filled out the same as above.
   2.6. When all the required hours of make-up time have been completed the Instructor will sign and date the form and attached it to the Student Required Make-Up Time Record, Form TC 007.

3. See Attached Form TC 008.

Chapter: 5
Section: 9
Date issued October 1st, 2016
Revision: 0

TC 008
STUDENT MAKE-UP TIME RECORD

STUDENT NAME: _________________________ STUDENT ID: ____________

INSTRUCTOR: _______________________

General Curriculum Required Make-Up Time

Subject	Required Hours

Completed Record

Subject	Date	Hours Completed	Instructor

I CERTIFY THAT THE ABOVE LISTED STUDENT HAS COMPLETED ALL THE REQUIRED MAKE-UP TIME.

INSTRUCTOR: _________________________________ DATE: ______________

Form TC 008
Page **1** of **3**

Chapter: 5
Section: 9
Date issued October 1st, 2016
Revision: 0

TC 008
STUDENT MAKE-UP TIME RECORD

STUDENT NAME: ________________________ STUDENT ID: ____________

INSTRUCTOR: _______________________

Powerplant Curriculum Required Make-Up Time

Subject	Required Hours

Completed Record

Subject	Date	Hours Completed	Instructor

I CERTIFY THAT THE ABOVE LISTED STUDENT HAS COMPLETED ALL THE REQUIRED MAKE-UP TIME.

INSTRUCTOR: ________________________________ DATE: ______________

Form TC 008
Page **2** of **3**

TC 008
STUDENT MAKE-UP TIME RECORD

STUDENT NAME: _________________________ STUDENT ID: ____________

INSTRUCTOR: _______________________

Airframe Curriculum Required Make-Up Time

Subject	Required Hours

Completed Record

Subject	Date	Hours Completed	Instructor

I CERTIFY THAT THE ABOVE LISTED STUDENT HAS COMPLETED ALL THE REQUIRED MAKE-UP TIME.

INSTRUCTOR: __________________________________ DATE: ______________

Form TC 008
Page **3** of **3**

Chapter: 5
Section: 10
Date issued October 1st, 2016
Revision: 0

TC 009
AIRFRAME LAB PROJECTS GRADE RECORD (Form TC 009)

1. The AIRFRAME LAB PROJECTS GRADE RECORD (Form TC 009) is the official school student record of the completion date and grade for each required Airframe Curriculum Lab Project. The passing requirement for each Lab Project will be 80%. Anything less than an 80% will be considered a failing grade and will be required to be made up by the student in order to receive a final course grade.

2. The AIRFRAME LAB PROJECTS GRADE RECORD will be filled out as follows:

   2.1. Enter the Students' name, Instructors' name and class dates.

   2.2. In the Date Completed column the Instructor will enter the date that the completed project was turned into the Instructor.

   2.3. In the Project Grade column the instructor will enter the final grade for the project.

   2.4. If a project in the Project Title column is not required than the Instructor will enter a "N/A" in the Date Completed column and sign his name in the Project Grade column.

   2.5. If a new temporary project is added to the current class requirement by the Instructor the title of this project will be written in by the Instructor in the appropriate empty line on the Project Title column.

      2.5.1. A new permanent requirement for this project will have to be initiated by a change to this form and submission to the CAAT (FAA) for approval.

   2.6. Any final Project Grade that is below the required 80% passing grade will be transferred to the STUDENT REQUIRED MAKE-UP TIME, Form TC 008. This form will track the completion of the open/incomplete requirement.

Chapter: 5
Section: 10
Date issued October 1st, 2016
Revision: 0

TC 009
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: _________________ INSTRUCTOR: ________________ CLASS DATES: ____________

AIRFRAME LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
CH 1 – Wood Structures				
CH 2 – Fabric Covering				
CH 3 – Aircraft Finishes				
	3-1-1	Identify Paint Finish Defects		
	3-2-1	Prepare and Apply Finishing Materials		
	3-2-2	Prepare and Apply Numbers and Letters		
CH 4 – Sheet Metal and Nonmetallic Structures				
	4-3-1	Rivet pattern layout, raised head rivets		
	4-3-2	Rivet pattern layout, countersink rivets		
	4-4-1	Programmed Instruction – Aircraft Rivets		
	4-4-2	Programmed Instruction – Special Structural Fasteners		
	4-5-1	Aluminum form design and fabrication		
	4-5-2	Programmed Instruction – Bend allowance		
	4-5-3	Bend allowance and parts fabrication		

Form TC 009
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Chapter: 5
Section: 10
Date issued October 1st, 2016
Revision: 0

TC 009
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: __________________ INSTRUCTOR: _________________ CLASS DATES: _____________

AIRFRAME LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
	4-5-4	Fabricate an a/c rib with lightening holes		
	4-5-5	Fabricate an a/c spar section		
	4-5-6	Shrinking and stretching aluminum angles		
	4-5-7	Forming convex and concave flanges		
	4-5-8	Manufacture joggle tool and joggle material		
	4-5-9	Manufacture a rivet gauge		
	4-5-10	Joggle a piece of material		
	4-5-11	Flush patch on fuselage		
	4-5-12	Patch repair of circular hole on fuselage		
	4-5-13	Channel flange repair		
	4-5-14	Programmed Instruction – Heat treatment of aluminum alloys		
	4-5-15	Web repair of aircraft spar assembly		
	4-5-16	Manufacture a honeycomb fiberglass panel		
	4-5-17	Identify damage, develop repair and repair fiberglass panel		
CH 5 - Welding				
	5-1-1	Programmed Instruction – Soldering methods		

Form TC 009
Page **2** of **6**

TC 009
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: __________________ INSTRUCTOR: _________________ CLASS DATES: ____________

AIRFRAME LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
CH 6 – Assembly and Rigging				
	6A-1-1	Rigging and Assembly Data		
	6A-2-1	Control Surface Balance, Installation and Rigging		
	6A-3-1	Control Surface Travel Measurement		
	6A-4-1	Aircraft Jacking – Cessna 310		
	6B-1-1	Rotary Wing Rigging Requirements		
CH 7 – Aircraft Landing Gear Systems				
	7-1-1	Hydraulic Landing Gear System Operation		
	7-1-2	Cessna 310 Main Landing Gear Strut Removal/Installation and Overhaul		
	7-1-3	Cessna 310 Nose Landing Gear Strut Removal/Installation and Overhaul		
	7-1-4	Cessna 310 MLG Brake Assembly Removal/Installation and Overhaul		
	7-1-5	Cessna 310 Nose Gear Shimmy Dampener Removal/Installation and Overhaul		

Form TC 009
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Chapter: 5
Section: 10
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TC 009
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: _________________ INSTRUCTOR: ________________ CLASS DATES: ____________

AIRFRAME LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
CH 8 – Hydraulic and Pneumatic Power Systems				
	8-1-1	Fabricate and install a Fluid Line in an Operational Hydraulic System		
	8-1-2	Select and Install Seals in an Operational Hydraulic System Component		
	8-1-3	Selection of Hydraulic Fluids		
	8-1-4	Remove, Clean, Inspect and Reinstall the Hydraulic Filter		
	8-1-5	Check the Pneumatic Charge and Service the Accumulator		
CH 9 – Cabin Atmosphere Control Systems				
	9-6-1	Check the Components of an Oxygen System for Serviceability		
CH 10 – Aircraft Instrument Systems				
	10-1-1	Remove, Install & Troubleshoot Aircraft Pressure and Electrical Instruments		
	10-1-2	Testing Static Pressure System		
	10-1-3	Testing Pitot Pressure Lines		

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Chapter: 5
Section: 10
Date issued October 1st, 2016
Revision: 0

TC 009
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: _________________ INSTRUCTOR: ________________ CLASS DATES: ____________

AIRFRAME LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
CH 11 – Communication and Navigation Systems				
	11-1-1	Install BNC Connector on Antenna Coaxial Cable		
	11-2-1	Inspect, Check and Troubleshoot a Basic IFR Aircraft Package		
CH 12 – Aircraft Fuel Systems				
	12-1-1	Turbine Fuel System Operation		
	12-1-2	Turbine Fuel System Fault Troubleshooting		
CH 13 – Aircraft Electrical Systems				
	13-1-2	Use of an Aircraft Electrical Shop Manual		
	13-1-3	Set up and Operate the Multimeter		
	13-1-4	Troubleshoot 28 Volt Electrical System		
CH 14 – Position and Warning Systems				
	14-1-1	Identify and Check the Functions of the Landing Gear Position Indication System		
	14-1-2	Identify and Troubleshoot Landing Gear Position Indication Systems		

Form TC 009
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Chapter: 5
Section: 10
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TC 009
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: _________________ INSTRUCTOR: ________________ CLASS DATES: ____________

AIRFRAME LAB PROJECTS

Curriculum Section	Ident	Project Title	Date Completed	Project Grade
CH 15 – Ice and Rain Control Systems				
CH 16 – Fire Protection Systems				
	16-1-1	Engine Fire Protection System Inspection and Maintenance		
CH 17 – Airframe Inspection	17-1-1	B727 Conformity Inspection		

I CERTIFY THAT ALL THE FINAL GRADES LISTED ON THIS AIRFRAME LAB PROJECTS GRADE RECORD ARE TRUE AND CORRECT.

INSTRUCTOR: _________________________________ DATE: ___________

Form TC 009
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Chapter: 5
Section: 11
Date issued October 1st, 2016
Revision: 0

AIRFRAME QUIZ/EXAM GRADE RECORD (Form TC 010)

1. The AIRFRAME QUIZ/EXAM GRADE RECORD (Form TC 010) is the official school student record of the completion date and grade for each required Airframe Curriculum Quiz or Exam. The passing requirement for each Quiz/Exam will be 80%. Anything less than an 80% will be considered a failing grade and will be required to be made up by the student in order to receive a final course grade.

2. The AIRFRAME QUIZ/EXAM GRADE RECORD will be filled out as follows:

   2.1. Enter the Students' name, Instructors' name and class dates.

   2.2. In the QUIZ/EXAM ISSUE DATE column the Instructor will insert the date the Quiz or Exam was given and identify whether it was a Quiz or Exam.

   2.3. In the Date Completed column the Instructor will enter the date that the completed Quiz/Exam was turned into the Instructor.

   2.4. In the Grade column the instructor will enter the final grade for the Quiz/Exam.

   2.5. Any final Quiz/Exam Grade that is below the required 80% passing grade will be transferred to the STUDENT REQUIRED MAKE-UP TIME, Form TC 008. This form will track the completion of the open/incomplete requirement.

Chapter: 5
Section: 11
Date issued October 1st, 2016
Revision: 0

TC 010
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: __________________ INSTRUCTOR: _________________ CLASS DATES: _____________

AIRFRAME QUIZ/EXAM PROGRESS RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
CH 1 – WOOD STRUCTURES			
	Airframe Wood Structures Test		
CH 2 – FABRIC COVERING			
	Aircraft Covering		
CH 3 – AIRCRAFT FINISHES			
	Aircraft Finishes		
CH 4 – SHEET METAL AND NONMETALLIC STRUCTURES			
	Sheet Metal & Nonmetallic		
	Structures - 1		
	Sheet Metal & Nonmetallic		
	Structures - 2		
	Sheet Metal & Nonmetallic		
	Structures - 3		
	Sheet Metal & Nonmetallic		
	Structures - 4		
	Sheet Metal & Nonmetallic		
	Structures - 5		
CH 5 – WELDING			
	Welding – 1		
	Welding - 2		
CH 6 – ASSEMBLY AND RIGGING			
	Assembly and Rigging - 1		
	Assembly and Rigging - 2		

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TC 010
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: __________________ INSTRUCTOR: _________________ CLASS DATES: _____________

AIRFRAME QUIZ/EXAM PROGRESS RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
CH 7 – Aircraft Landing Gear Systems			
	Aircraft L/G Systems – 1		
	Aircraft L/G Systems – 2		
	Aircraft L/G Systems - 3		
CH 8 – Hydraulic And Pneumatic Power Systems			
	Hydraulic and Pneumatic Power Systems - 1		
	Hydraulic and Pneumatic Power Systems – 2		
	Hydraulic and Pneumatic Power Systems – 3		
	Hydraulic and Pneumatic Power Systems - 4		
CH 9 – Cabin Atmosphere Control Systems	Cabin Atmosphere Control Systems - 1		
	Cabin Atmosphere Control Systems – 2		
	Cabin Atmosphere Control Systems - 3		

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TC 010
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: _________________ INSTRUCTOR: ________________ CLASS DATES: ____________

AIRFRAME QUIZ/EXAM PROGRESS RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
CH 7 – Aircraft Landing Gear Systems			
	Aircraft L/G Systems – 1		
	Aircraft L/G Systems – 2		
	Aircraft L/G Systems - 3		
CH 8 – Hydraulic And Pneumatic Power Systems			
	Hydraulic and Pneumatic Power Systems - 1		
	Hydraulic and Pneumatic Power Systems – 2		
	Hydraulic and Pneumatic Power Systems – 3		
	Hydraulic and Pneumatic Power Systems - 4		
CH 9 – Cabin Atmosphere Control Systems	Cabin Atmosphere Control Systems - 1		
	Cabin Atmosphere Control Systems – 2		
	Cabin Atmosphere Control Systems - 3		

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AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: __________________ INSTRUCTOR: _________________ CLASS DATES: _____________

AIRFRAME QUIZ/EXAM PROGRESS RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
CH 10 – Aircraft Instrument Systems			
	Aircraft Instrument Sys - 1		
	Aircraft Instrument Sys – 2		
	Aircraft Instrument Sys - 3		
CH 11 – Communication And Navigation Systems			
	Communication and Navigation Systems - 1		
	Communication and Navigation Systems - 2		
CH 12 – Aircraft Fuel Systems			
	Aircraft Fuel Systems - 1		
	Aircraft Fuel Systems – 2		
	Aircraft Fuel Systems – 3		
	Aircraft Fuel Systems - 4		
CH 13 – Aircraft Electrical Systems			
	Aircraft Electrical Sys - 1		
	Aircraft Electrical Sys – 2		
	Aircraft Electrical Sys – 3		
	Aircraft Electrical Sys - 4		

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TC 010
AIRFRAME LAB PROJECTS GRADE RECORD

STUDENT NAME: ________________ INSTRUCTOR: _______________ CLASS DATES: ___________

AIRFRAME QUIZ/EXAM PROGRESS RECORD

Curriculum Section	Quiz/Exam Issue Date	Date Completed	Grade
CH 14 – Position And Warning Systems			
	Position and Warning Sys – 1		
	Position and Warning Sys - 3		
CH 15 – Ice And Rain Control Systems			
	Ice and Rain Control Sys - 1		
	Ice and Rain Control Sys - 2		
CH 16 – Fire Protection Systems			
	Fire Protection Systems – 1		
	Fire Protection Systems - 2		
CH 17 – Airframe Inspection			
	Airframe Inspection		
Airframe Final Exam			
	Airframe Final Test - 1		
	Airframe Final Test – 2		
	Airframe Final Test – 3		
	Airframe Final Test - 4		

I CERTIFY THAT ALL THE FINAL GRADES LISTED ON THIS AIRFRAME QUIZ/EXAM GRADE RECORD ARE TRUE AND CORRECT.

INSTRUCTOR: ________________________________ DATE: __________

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Doc 7192
AN/857

Training Manual

Part D-1
Aircraft Maintenance
(Technician/Engineer/Mechanic)

Approved by the Secretary General and published under his authority

Second Edition — 2003

International Civil Aviation Organization

Doc 7192
AN/857

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Second Edition — 2003

International Civil Aviation Organization

AMENDMENTS

The issue of amendments is announced regularly in the *ICAO Journal* and in the monthly *Supplement to the Catalogue of ICAO Publications and Audio-visual Training Aids*, which holders of this publication should consult. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS			
No.	Date applicable	Date entered	Entered by

CORRIGENDA			
No.	Date of issue	Date entered	Entered by

FOREWORD

Aircraft maintenance personnel can have varying degrees of educational background; they can range from the self-taught individual to the holder of a university engineering degree. However, irrespective of educational background, all aircraft maintenance personnel must undergo a very comprehensive technical training that provides the necessary knowledge, skills and attitudes for assuming responsibility over the maintenance of aircraft.

This manual has been prepared by the Personnel Licensing and Training Section of ICAO and replaces Doc 7192 — *Training Manual,* Part D-1 — *Aircraft Maintenance Technician* (First Edition, 1976). ICAO would like to acknowledge the contribution received from the Aircraft Maintenance Engineers Licensing Study Group and individual experts who have provided support, advice and input.

Toward this end, Doc 7192 — *Training Manual,* Part D-1 — *Aircraft Maintenance (Technician/Engineer/Mechanic)* (Second Edition, 2003) details the training requirements which, however, are not all-inclusive and are provided as a guideline for the minimum requirements used in the training of Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) or personnel. The training course for maintenance personnel assigned to duties in line with the requirements of Annex 1 — *Personnel Licensing* and Annex 6 — *Operation of Aircraft* must include but should not be limited to the syllabi suggested in this manual.

This second edition differs considerably from the first edition of Doc 7192, Part D-1. It contains training syllabi for AMEs that cover both knowledge and skill requirements outlined in Annex 1. New subject matter has been included for the first time on topics such as airships, composite materials and Human Factors. Material that addressed the management and staffing of a training school has however been removed as this aspect is now contained in the *Manual on Establishment and Operation of Aviation Training Centres* (Doc 9401).

The format of the manual reflects the concept of competency-based training and is now consistent with other manuals in the Doc 7192 series. Subject matter that must be addressed during the three phases of training is indicated in 1.5 — Training reference guide and the associated Appendix 1 to Chapter 1, which outlines the approximate duration of the course and the level of expertise required in each subject.

Throughout this manual, the use of the male gender should be understood to include male and female persons. References to Annex 1 take into account all amendments up to and including Amendment 162.

Furthermore, with respect to the phrase "Aircraft Maintenance (Technician/Engineer/Mechanic)," the terms in brackets are given as acceptable additions to the title of the Licence. Each Contracting State is expected to use in its own regulations the one it prefers. For the purpose of this manual and as a matter of convenience, the acronym AME will be used to refer to Aircraft Maintenance (Technician/Engineer/Mechanic).

Comments on this manual, particularly with respect to its application, usefulness and scope of coverage, would be appreciated from States and ICAO Technical Co-operation Field Missions. These will be taken into consideration in the preparation of subsequent editions. Comments concerning this manual should be addressed to:

The Secretary General
International Civil Aviation Organization
999 University Street
Montréal, Quebec H3C 5H7
Canada

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INTRODUCTION

The responsibilities of an Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) range from line maintenance, day-to-day care and defect rectification to base maintenance (which can include major modification and repair of the aircraft structure or systems). In many approved maintenance organizations (AMOs), the AME supervises the work of teams of less experienced personnel.

For this reason, the syllabi of instruction for the training of AMEs should be developed based on the specifications outlined in Chapters 2 to 14 of this manual. The standard of training recommended in this manual is intended to be sufficient for an individual to qualify for a Licence which complies with Annex 1 — *Personnel Licensing,* and for an individual, if given additional specialized training, to undertake responsibilities in relation to more specialized aircraft systems or equipment.

The duties envisaged for the AME require supervisory and communication skills, diagnostic prowess and a high degree of technical knowledge. The training courses should therefore be structured in such a way as to provide the trainees with sufficient ability to think logically and to apply their knowledge objectively. The courses should also help them develop physical skills that would enable them to carry out each task in a professional manner by using good engineering and maintenance practices. At the same time, it is also important for the trainees to develop a high degree of confidence, competence, initiative, team spirit and self-reliance so that they can perform well under varying and sometimes trying circumstances.

Many AMEs are licensed personnel holding licences conforming to the specifications contained in Chapter 4 of Annex 1 to the Convention on International Civil Aviation — *Personnel Licensing*. The privileges of a Licence issued in accordance with Annex 1 by a Contracting State are to certify the aircraft or parts of the aircraft as airworthy after an authorized repair, modification or installation of a powerplant, accessory, instrument and/or item of equipment, and to sign a maintenance release. Part 1 of Chapter 6 of Annex 6 — *Operation of Aircraft* requires the same Annex 1 training standards for signatories of maintenance release in an AMO or equivalent system.

The privileges, responsibilities and terminology relating to aircraft maintenance personnel vary between the States. In some cases licences are limited to certain technology groups such as aircraft engines or radios. In other cases the limitation may be on the kind of tasks performed such as minor servicing or base maintenance.

The target audience of this manual are State aviation regulatory bodies which, in turn, may recommend the manual to their aviation training centres for the development of detailed training syllabi. It may also be used by the State as the basis for the approval of aviation training centres and/or their courses.

ACRONYMS AND ABBREVIATIONS

ACARS	ARINC Communication and Reporting System
AD	Airworthiness Directives
ADF	Automatic direction finder
ADG	Air driven generator
ADI	Altitude direction indicator
AED	Aeronautical Engineering Directorate
AF	Audio frequency
AFC	Automatic frequency control
AFCS	Automatic flight control system
AH	Artificial horizon
AID	Aeronautical Inspection Directorate
AIP	Aeronautical information publication
ALU	Arithmetic logic unit
AM	Amplitude modulation
AME	Aircraft Maintenance (Technician/Engineer/Mechanic)
AMM	Aircraft Maintenance Manual
AMO	Approved maintenance organization
APU	Auxiliary power unit
ASI	Air speed indicator
ATA	Air Transport Association (of America)
ATC	Air traffic control
AWOPS	All Weather Operations
BCD	Binary coded decimal
BDC	Bottom dead centre
BITE	Built-in Test Equipment
BMEP	Brake mean effective pressure
BSFC	Brake specific fuel consumption
CADC	Central air-data computer
CAT	*Computer Applications in Training*
CDFMCW	Constant difference frequency modulated carrier wave
CDI	Course deviation indicator
CDU	Control display unit
CG	Centre of gravity
CofA	Certificate of Airworthiness
CofR	Certificate of Registration
CRM	Crew resource management
CRO	Cathode ray oscilloscope
CRT	Cathode ray tube
CSD	Constant speed drives
CVR	Cockpit voice recording system
DC	Direct current
DDM	Difference in depth of modulation
DG	Directional gyros
DME	Distance measuring equipment
EADI	Electronic attitude direction indicator
ECAM	Electronic centralized aircraft monitoring system
EFIS	Electronic flight instrument system
EHIS	Electronic horizontal situation indicator
EICAS	Engine indicating and crew alerting system
ELT	Emergency locator transmitter
EMF	Electromotive force
ESD	Electrostatic sensitive devices
ESI	Engine speed indication
ETOPS	Extended range operations by aeroplanes with two turbine power-units
FADEC	Full authority digital engine control
FBW	Fly-by-wire system
FDR	Flight data recording system
FET	Field effect transistors
FM	Frequency modulation
FMCW	Frequency modulated carrier wave
FMEP	Friction mean effective pressure
FMS	Flight management system
GCU	Generator control unit
GNSS	Global navigation satellite system
GPS	Global positioning system
GPU	Ground power units
GPWS	Ground proximity warning system
G/S	Glideslope systems
GS	Ground speed
HEIU	High energy ignition units
HF	High frequency
HSI	Horizontal situation indicator
IAS	Indicated air speed
IATA	International Air Transport Association

IC	Inductive capacitive; Integrated circuits
IDG	Integrated drive generator
IF	Intermediate frequency
IFR	Instrument flight rules
IGFET	Insulated gate FET
ILS	Instrument landing system
IMEP	Indicated mean effective pressure
INS	Inertial navigation system
I/R	Insulation and resistance
IR	Inductive resistive
IRS	Inertial reference system
JFET	Junction FET
KSA	Knowledge, skills and attitude
KVAR	Reactive component
LCD	Liquid crystal display
LED	Light emitting diode
LF	Low frequency
LOC	Localizer
LOFT	Line-oriented flight training
LOP	Lines of position
LSI	Large scale integration
LWTR	Licence without type rating (an aircraft maintenance licence)
MAC	Mean aerodynamic chord
MAP	Manifold absolute power
MAT	Mass/altitude/temperature
MEL	Minimum equipment list
MIG	Metal inert gas arc welding
MKR	Marker system
MLS	Microwave landing system
MMEL	Master minimum equipment list
MMF	Magnomotive force
MMO	Maximum operating mach number
MNPS	Minimum navigation performance specification
MOSFET	Metal oxide silicon FET
MRH	Main rotor head
MRM	Maintenance resource management
MSI	Medium scale integration
NDB	Non-directional radio beacon
NGT	Negative going transition
NOTAM	Notices to airmen
OAT	Outside air temperature
OBI	Omni-bearing indicator
OEU	Operational equipment unit
ONS	Omega navigation system
OPAMP	Operational Amplifiers
PCU	Power control unit
PLL	Phrase locked loop
PRF	Pulse repetition frequency
PSU	Passenger service unit
RA	Resolution advisory
RAT	Ram air turbine
RBI	Relative bearing indicator
RC	Resistive capacitive
RCU	Receiver computer unit
RF	Radio frequency
RMI	Radio magnetic indicator
RNAV	Area navigation
RNP	Required Navigation Performance
RPM	Revolutions per minute
RVSM	Reduced Vertical Separation Minima
SAE	Society of Automotive Engineers
SAS	Stability augmentation system
SCR	Silicon controlled rectifier
SRM	Structural repair manual
SSB	Single sideband
STC	Sensitivity time control
TAS	True air speed
TC	Type certification
TCAS	Traffic Alert and Collision Avoidance System
TDC	Top dead centre
TDG	*TRAINAIR Training Development Guideline*
TIG	Tungsten inert gas arc welding
TMG	*TRAINAIR Training Management Guidelines*
TOW	Take-off weight (mass)
TR	Type rating (on an aircraft maintenance licence)
TRSB	Time referenced scanning beam system
TRU	Transformer rectifier unit
TWT	Travelling wave tube
ULB	Underwater locator beacon
VCO	Voltage controlled oscillator
VHF	Very high frequency
VLF	Very low frequency
VLSI	Very large scale integration
VMO	Maximum operating speed/velocity
VOR	VHF omnidirectional radio range
VSI	Vertical speed indicators
VSWR	Voltage standing wave meter

Chapter 1

TRAINING PRINCIPLES

1.1 REGULATORY REQUIREMENTS

1.1.1 The successful application of regulations concerning the safety and regularity of aircraft operation and the achievement of regulatory objectives depend greatly on the appreciation by all individuals concerned of the risks involved and on a full understanding of the regulations. This can only be achieved by well-planned and well-maintained initial and recurrent training programmes for all persons involved in aircraft operations. Aircraft maintenance personnel play a significant role in the safe operation of an aircraft, and the Annexes to the Convention on International Civil Aviation require that they be appropriately trained.

1.1.2 Paragraph 8.1.2 of Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* and paragraph 6.1.2 of Annex 6, Part III — *International Operations — Helicopters,* Section 2 require that an operator may only operate aeroplanes which have been maintained and released to service by an approved maintenance organization (AMO) or under an equivalent system acceptable to the State of Registry.

1.1.3 Paragraph 8.1.3 of Annex 6, Part I requires that when the State of Registry of the aircraft accepts an equivalent system, the person signing the maintenance release shall be licensed in accordance with Annex 1 — *Personnel Licensing*.

1.1.4 Paragraph 8.7.5.3 of Annex 6, Part I requires that within an AMO, the competence of maintenance personnel shall be established in accordance with a procedure and to a level acceptable to the State granting the approval. In addition, this paragraph requires that the person signing the maintenance release shall be qualified in accordance with Annex 1. There are however no Annex 1 requirements for personnel who perform the actual maintenance or repair work on the aircraft or its components.

1.1.5 Paragraphs 8.1 and 8.2 of Annex 6, Part II — *International General Aviation — Aeroplanes* require that for general aviation, the person signing the maintenance release shall be qualified in accordance with Annex 1.

1.1.6 The requirements in respect of age, knowledge, experience, training and skills for the licensing of the Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) when employed in conjunction with a method accepted as an equivalent system by the State of Registry for the purpose of signing a maintenance release in accordance with Annex 6, Part I, 8.1.2, are detailed in Annex 1 — *Personnel Licensing*. States use Annex 1 and Annex 6 specifications as a basis for their national regulations that are related to the licensing of aircraft maintenance personnel (technician/engineer/mechanic) and to the approval of operators' maintenance control arrangements in the context of the issue and extension of an Air Operator's Certificate.

1.1.7 Before 1998, Annex 1 categorized licences as Type 1 or Type 2, making a clear distinction between overhaul and release to service. Today Annex 1 no longer specifies these two levels of licence and so States are now able to define the scope of licences in a way that best suits their local needs. The historical background detailing the changes to Annex 1 is shown in Appendix 3 to this chapter.

1.2 TRAINING REQUIREMENTS

1.2.1 States and maintenance organizations may use the training specifications in this manual as part of their training requirements to establish the competence of maintenance personnel, both licensed or unlicensed.

1.2.2 The responsibilities of the AME as specified in Annex 6, Part I are:

a) signing a maintenance release to certify that the maintenance work performed has been completed satisfactorily and in accordance with the procedures described in the maintenance organization's procedure manual; and

b) ensuring that the maintenance release contains a certification which includes the details of the work, the date and identity of the organization and the signatory.

1.2.3 In order to sign the maintenance release or certify an aircraft as airworthy, the AMEs must supervise or perform inspections, repairs, replacements, modifications, overhauls and maintenance in such a way that they are able to take responsibility for the work and also issue a maintenance release on completion.

1.2.4 Licensed or unlicensed, AMEs usually specialize in a particular category or categories (e.g. airframes; engines; propellers; aircraft; airships; electrical; instruments or radio systems). The method of performing specific duties may vary according to the type and make of aircraft; the duties and detailed tasks described in this paragraph represent typical examples of those performed by AMEs specializing in the airframe category. It must be understood that the work of other categories may vary quite considerably from that of an airframe category technician. The following paragraphs are a general description of the types of tasks which are performed under the supervision of a licensed AME:

a) Responds to defects found and recorded by flight crew. Inspects and checks condition of aircraft parts (e.g. engines, wings, tail, fuselage and landing gear) for serviceability by visually inspecting the skin and noting condition of landing gear parts, leaking connections, correct fitting of parts and of operating controls. Attends to all other factors which can affect the safe operation of an aircraft. Determines whether adjustment, repair or replacement is necessary; and if necessary, makes adjustments to manufacturer's/company's maintenance schedule and to the instructions on use of appropriate equipment.

b) When required to rectify a defect or to meet the Approved Maintenance Programme, ensures the removal and replacement of parts as well as the opening of inspection panels in structure in order to inspect or disconnect control cables, fuel lines and electrical wiring. Determines when and how to support the aircraft on jacks in order to remove and replace major assemblies such as landing gear or powerplants from the aircraft.

c) Ensures that adjustments and repairs are carried out as required; e.g. the replacement of cracked material in metal skin surfaces by cutting a new metal patch in accordance with the structural repair manuals from the Type Certificate holder. Reads engineering drawings in order to ensure that structural members are repaired to an approved standard in accordance with manufacturer's instructions.

d) Supervises the performance of servicing activities such as oleo and tyre inflation, fuel/oil replenishment and lubrication; cleaning of structure and mechanical components; and replacement of light filaments. In accordance with the Type Certificate holder's instructions, a wide variety of test equipment, hand and other tools are used for these tasks.

e) Writes reports and work details for the maintenance release as required by the operator, the AMO, and Parts I, II and III of Annex 6.

1.2.5 The working environment for maintenance personnel may be noisy due to the operation of power tools, running of engines or manoeuvring of aircraft. The work is sometimes performed in narrow spaces within the aircraft or from ladders or platforms while working on flight surfaces such as wings or fuselages. Sometimes lighting and weather may be poor so good judgement is needed to ensure that the work is not adversely affected. Maintenance personnel may work alone, or more often with a team of aircraft maintenance technicians (both licensed and unlicensed) inside a hangar or workshop or outside on the apron or ramp.

1.3 TYPES OF TRAINING

1.3.1 The training of AMEs requires the imparting of manual and intellectual skills, sound knowledge of basic theory, and a comprehensive understanding of the aircraft or system upon which they will have to work. They should also develop an appreciation for the high value of, and therefore treat accordingly, the aircraft, test equipment and tools that they will use in their work. Trainees should be instructed and encouraged to develop safe and neat working routines as well as a sense of responsibility, technical honesty and integrity. These are essential features since, notwithstanding the inspections carried out during maintenance, it is these routines and the integrity of the technicians which in many instances will determine the airworthiness of an aircraft.

1.3.2 Practical training is necessarily dependent on the trainees' familiarity with certain background subjects, such as mathematics, physics and technical drawing. The trainees also need to know not only the importance of using the maintenance manuals but also to understand the language and structure of the documents. These manuals have elaborate amendment arrangements, which must also be understood.

1.3.3 The training specifications recommended in this manual are drawn up for practical and on-the-job training phases in classrooms and workshops. The specifications and phase recommendations in this manual assume that the trainee selection, training school management, organization, staffing and facilities generally follow the recommendations of the *Manual on Establishment and Operation of Aviation Training Centres* (Doc 9401).

1.3.4 The training specifications in this manual are presented in such a way that the diverse training needs of AMEs, both in terms of technology and levels of work, can be covered. The recent amendments to Annex 1 now enable the State to issue Aircraft Maintenance Licences in which the scope is limited or categorized in various different ways.

1.3.5 The *Manual of Procedures for Establishment and Management of a State's Personnel Licensing System* (Doc 9379) suggests that the AME privileges outlined in Annex 1 can be categorized technically as follows:

– aircraft in its entirety, specifically or under broad categories

– airframe or powerplant aircraft in its entirety, specifically or under broad categories

– aircraft systems or components, specifically or under broad categories

– avionics systems or components, specifically or under broad categories

Following the practices of many States, Doc 9379 also suggests that the AME privileges can be categorized by scope or kind of work into the following:

– Line Maintenance

– Base Maintenance

Some States are also known to issue AME Licences with or without aircraft release to service privileges. Doc 9379 identifies this as a viable practice (provided appropriate type training for authorization purposes is approved by the State) and suggests the following categorization:

– Type-rated licence (TR) with release to service privileges; and

– Non-type rated licence (LWTR) without release to service privileges.

1.3.6 Table A1-1 in Appendix 1 to Chapter 1 shows how the State may combine or separate the various technical groupings, types of work or licence categories, while ensuring that the licence meets the requirements of Annex 1.

1.3.7 In order to facilitate the States in their selection of the categories and modules that are consistent with the definition of the scope and privileges of their licences, the training specifications in this manual are set out under the same headings contained in Annex 1, 4.2.

1.3.8 Annex 1 does not address the question of different entry qualifications or capabilities. For the training specifications in this manual, it is assumed that the trainees are intelligent, well-motivated, capable of sustained hard work and have a minimum educational attainment equivalent to a good secondary or high school standard, preferably with concentration in the sciences and mathematics. In some States, holders of higher academic qualifications (such as a university degree) in relevant subjects are granted partial exemptions from parts of the syllabus. Aviation training by the military should also be given favourable consideration for appropriate exemptions. It is thus suggested that the State may agree to changes in the syllabus in order to take into account the trainees' entry standards which are significantly different from those described here.

1.3.9 To cover the requirements of Annex 1 and to minimize the cost of rectifying mistakes on airworthy aircraft or components, it is recommended that the training course be divided into the following three phases:

Phase One — Knowledge
Consists of basic training, its completion ensures that a trainee has the necessary background in terms of knowledge to proceed to Phase Two of the training. The training specifications defined in Chapters 3 to 9 are basic principles corresponding to the knowledge common to all the tasks of an AME job.

*Phase Two — Skill*s
Consists of general maintenance practices, practical skills and attitude training in order to master essential skills before proceeding to work on airworthy aircraft or components. A training specification for this phase is detailed in Chapters 10, 11 and 12.

Phase Three — Experience
Consists of applied practical on-the-job training (simulated or actual tasks under supervision) and job-oriented maintenance experience. This phase may be arranged on the job or in the training centre. A training specification for this phase is detailed in Chapter 13.

1.3.10 In practice it will be advantageous to combine Phase One and Phase Two so that the practical aspects can be linked directly to the theory and performed as such, perhaps on the same day or the same week so that the trainees can have a better understanding of the topic. Conversely, there are disadvantages in combining Phase Two and Phase Three. For example, it can be costly to rectify errors of skill on a real airworthy aircraft or its components as compared to the relatively low raw material cost associated with an error made on a bench exercise.

1.3.11 Appendix 2 to Chapter 1 provides an approximate duration for each phase of the training. The duration does not take into account the different entry level capabilities of the trainees. These capabilities are likely to be different in various States and judgements will have to be made in order to avoid trainees repeating same topics. For similar reasons, the duration does not take into account the trainees' level of competency in the language of instruction.

1.3.12 In some cases trainees may have military experience or perhaps an Annex 1 compliant licence from another State. In order to avoid duplication of training and examinations, some States operate a system of credits. Each case is likely to be different and some guidance can be found in Doc 9379.

1.3.13 In using the training specifications recommended in the following chapters, local considerations may dictate the advisability of changing the sequence of the subjects. However, the relative importance accorded to each subject should, as much as possible, remain unchanged. The multiplicity in the types of aircraft, avionic systems and maintenance practices throughout the world makes it undesirable for this manual to define too rigidly many of the headings for the training. Some flexibility must therefore be left to either the State or the training management. The training centres must however ensure that all subjects in their training syllabi are adequately covered and any requirements relevant to individual regulatory authorities should be treated as additional subjects and not as substitutions for the subjects recommended in this manual. In cases where the training centre and its aviation courses are approved by the State, all subjects required in the State's licensing examination must be adequately covered. Inclusion of any additional topics will have to be made through specific requests by operators and maintenance organizations, depending on the aircraft used in the State.

1.3.14 Visits to aircraft maintenance hangars, workshops and manufacturers' plants are important in order to demonstrate practical application of theory and practice. The interdependence of AMEs with pilots and other technical crew members should be explained by citing examples and bringing them frequently to the attention of trainees.

1.3.15 Physical (motor) skills are a vital feature in the training of AMEs. Training in workshop practice should begin with the use of hand tools to make simple shapes from metal to specified dimensions, followed by more and more complicated and precise tasks. Instructors should ensure that students develop the habit of handling basic tools in the correct manner, and action should be taken to correct any bad or potentially dangerous practices before they become habitual. At all times, and particularly during the early stages of training, the importance of producing accurate and careful work must be stressed. It is better if classroom and workshop activities (Phase One and Phase Two of the training specifications) are integrated so as to demonstrate the practical application of theory.

1.3.16 Attitudes and responsibility are important and emphasis should always be placed on the following:

a) the responsibility for the safety of co-workers and of the general public;

b) the individual responsibility of the AME for the quality of work performed;

c) the importance of good judgement based on positive knowledge and careful analysis of facts;

d) the importance of asking for help when in doubt;

e) the importance of continuous study to improve knowledge and keep abreast of both technology and techniques;

f) the need to adhere to standard procedures and to establish the prevailing procedures;

g) the need for integrity in all technical matters;

h) the importance of good teamwork and communication; and

i) attention to detail and ability to understand written and oral maintenance procedures.

1.3.17 The training course for AMEs should be designed to equip the students with the following essential capabilities that will enable them to pass the State AME licence examinations:

a) theoretical and practical skills, technical knowledge and attitudes;

b) familiarization with the design, construction and operation of the types of aircraft and associated equipment (including test equipment) that are in general use in the country where the trainees will work after completion of training; and

c) inspection ability, i.e. the necessary judgement and sense of responsibility required to assess the airworthiness of aircraft and airborne equipment.

1.4 STANDARD OF ACCOMPLISHMENT

1.4.1 The training of AMEs should be directed towards achieving a standard of competence in which the AMEs are capable of performing their duties safely and with minimum supervision. Recognition of this achievement should be in the form of an official document, perhaps accredited at a national level. Aviation training centres should therefore consider introducing their own diplomas and awards, or make provision for graduating students to obtain the recognized qualifications or licences for their profession.

1.4.2 Training of AMEs in line with the standards of Annex 1 is aimed at ensuring that the required level of professional skills and competence is maintained across international boundaries at a consistently high standard.

1.4.3 Each chapter of this manual describes the training objectives with reference to the required *conditions*, *performance* and a *standard of accomplishment*.

a) The *conditions* describe the scenario under which trainee performance will be developed and tested, while also indicating whether or not actual equipment, mock-ups, simulators, etc. are to be used.

b) The *standard of accomplishment* establishes the level of trainee performance that must be attained.

c) There are two kinds of *standards of accomplishment*, both of which should be tested. The "process" standard indicates the behaviour of the trainee when executing the required performance. Attitude is part of the process standard. Meanwhile, the "product" standard indicates what the product of the required performance looks like.

1.4.4 In measuring the standard of accomplishment, it is recommended that only two grades, PASS and FAIL, be used. For the many training establishments that prefer to use a numerical grading/scoring system, it is possible to assign a numeric grade/score preferred by the establishment (e.g. 70 per cent) to PASS based on the standard (minimum) indicated in the training objective. This way, the numeric grade/score indicates not only a PASS but also shows that the trainee has worked towards a score better than a PASS. A score less than the assigned numeric grade/score of PASS is therefore a FAIL.

1.4.5 The level of accomplishment that must be attained upon the completion of each training unit or module should be determined by the Aviation training centre based on the assessment of a test. The test must be administered according to the standard of accomplishment stated in each chapter of the training specifications in this manual.

1.4.6 This manual also includes some elements of supervisory/management training as this will form an important aspect of the AME job in an AMO or operator. Both Annex 1 and Annex 6 include a requirement for training in Human Factors; this requirement is also included as part of the recommended training specifications.

1.5 TRAINING REFERENCE GUIDE

1.5.1 Appendix 2 to Chapter 1 presents a list of the various subjects and the recommended duration (in hours) that have to be covered during Phase One (Knowledge) and also during Phase Two and Phase Three (Skills and Experience) of training. In appreciation of the fact that differences in State or operator requirements may necessitate changes in the recommended syllabus in order to allow for completion of the course within the period allotted for training, the total number of hours required for the completion of a subject is given.

1.5.2 The training centre should ensure, perhaps by progress tests, that all trainees have achieved the required level in all sections of the syllabus before they are assigned to Phase Three training.

1.5.3 It will be advantageous for the development of the students that Phase One and Phase Two are combined so that the practical aspects can be linked directly to the theoretical aspects. There are also potential economic and equipment utilization benefits for the training centre to combine these two phases.

1.5.4 The various subjects in the training specifications have been assigned codes of 1 to 3 to indicate the increasing level of capability. This classification is included in the manual in order to explain the level required for mastering the knowledge, skills and attitudes of the subject.

Code	*Level of capability/requirements*
1	denotes a basic understanding of a subject. Trainees should have a basic understanding of the subject but are not expected to be able to apply it in practice.
2	denotes understanding of the subject and the ability, where applicable, to apply it in practice with the help of reference materials and instructions.
3	denotes a thorough understanding of the subject and the ability to apply it with speed, accuracy and judgement appropriate to the circumstances.

1.5.5 Practical workshop training should begin with the use of hand tools to make simple shapes from metal to specified dimensions, followed by more and more complicated and precise tasks in line with the considerations stated in 1.3.15.

1.6 TRAINING OBJECTIVES

1.6.1 Annex 1 and Annex 6 have two requirements affecting aircraft maintenance personnel and which can be met by means of training. These are:

– Annex 1, Chapter 4, which concerns the issue of an aircraft maintenance licence compliant with Annex 1.

– Annex 6, Part I, 8.7.5.3, which requires that within an AMO, "the competence of maintenance personnel (should) be established with a procedure and to a level acceptable to the State granting the approval."

1.6.2 When designing courses and associated syllabi in order to enable individuals and AMOs to meet the training requirements of Annex 1, an aviation training centre should have the following goals in mind:

– to train an individual to enable him or her to meet the standard required for the issue of an AME licence by the State or its aviation regulatory body;

– to train AMO maintenance personnel to meet the standard of competence required by Annex 1 for signatories of maintenance release; and

– to train AMO maintenance personnel to meet the standard of competence required by that AMO and is approved by the State or its aviation regulatory body.

1.6.3 Many aviation training centres use different standards in training maintenance personnel for all operators or AMOs. While their training courses are not the subject of this manual, it is hoped that the use of training specifications outlined in this manual will enable individuals to gradually achieve the goals cited in 1.6.2.

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Appendix 1 to Chapter 1

RECOMMENDED LICENCE CATEGORIZATION AND LIMITATIONS

Table A1-1 illustrates how a State may utilize the various topics in the training specifications of this manual in order to determine the qualifications on basic (rather than aircraft type) topics that should be included in the aircraft maintenance licence categories or subcategories. The table assumes that the State licence scope is divided into either line or base maintenance as recommended by Doc 9379 — *Manual of Procedures for Establishment and Management of a State's Personnel Licensing System.*

Applicable subjects are indicated by an "L" or a "B" for Line or Base maintenance, respectively.

Table A1-1. Classification of basic topics

	Line (L) or Base (B) Maintenance				
	Aeroplane/Airship		*Rotary wing*		
Chapter and paragraph	*Turbine engine(s)*	*Piston engine(s)*	*Turbine engine(s)*	*Piston engine(s)*	*Avionics*
Chapter 3, all paragraphs	L and B	L and B	L and B	L and B	L and B
Chapter 4, 4.3 to 4.6	L and B	L and B	L and B	L and B	L and B
Chapter 4, 4.7	L and B	L and B			
Chapter 4, 4.8			L and B	L and B	
Chapter 5, 5.3	L and B	L and B	L and B	L and B	
Chapter 5, 5.4	L and B	L and B			
Chapter 5, 5.5			L and B	L and B	
Chapter 5, 5.6	L and B	L and B			L and B
Chapter 6, 6.3		L and B		L and B	
Chapter 6, 6.4	L and B	L and B			
Chapter 6, 6.5	L and B		L and B		
Chapter 6, 6.6	L and B	L and B	L and B	L and B	
Chapter 7, all paragraphs					L and B
Chapter 8, 8.3					L and B

Chapter 8, 8.4					L and B
Chapter 8, 8.5					L and B
Chapter 8, 8.6					L and B
Chapter 9, all paragraphs	L and B	L and B	L and B	L and B	L and B
Chapter 10, all paragraphs	L and B	L and B	L and B	L and B	
Chapter 11, all paragraphs	L and B	L and B	L and B	L and B	
Chapter 12, all paragraphs					L and B
Chapter 13, 13.3 Airframe	L	L	L	L	
Chapter 13, 13.3 Engine	L	L	L	L	
Chapter 13, 13.3 Avionics					L
Chapter 13, 13.4 Airframe	B	B	B	B	
Chapter 13, 13.4 Engine	B	B	B	B	
Chapter 13, 13.4 Avionics					B

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Appendix 2 to Chapter 1

TRAINING SPECIFICATIONS

Table A2-1. Recommended duration and level of capability for Phase One — Knowledge training

Note 1.— This table assumes that the State licence scope is divided into either line or base maintenance as recommended by Doc 9379 — Manual of Procedures for Establishment and Management of a State's Personnel Licensing System. *If the State licence combines both line and base maintenance privileges, then the target level of capability should be the higher of the two shown here.*

Note 2.— The definition of levels of capability is shown in 1.5.3.

Subject matter	*Recommended duration (hours)*	*Level of capability*	
		Line	*Base*
Chapter 3 Civil aviation requirements, laws and regulations			
3.3.1 International and State aviation law	10	3	2
3.3.2 Airworthiness requirements	10	3	2
3.3.3 Civil aviation operating regulations	10	3	2
3.3.4 Air transport operations	10	3	2
3.3.5 Organization and management of the operator	10	3	2
3.3.6 Operator economics related to maintenance	10	3	2
3.3.7 Approved maintenance organizations (AMOs)	30	3	3
3.3.8 Aircraft maintenance licence requirements	20	3	3
3.3.9 The role of the State aviation regulatory body	10	3	2
3.3.10 Aircraft certification, documents and maintenance	10	3	2
Chapter 4 Natural science and general principles of aircraft			
4.3 Mathematics	75	1	1
4.4 Physics	70	1	1
4.5 Technical drawing	70	1	1
4.6 Chemistry	30	1	1
4.7 Fixed wing aerodynamics and flight control	100	2	2

Subject matter	Recommended duration (hours)	Level of capability	
		Line	Base
4.8 Rotary wing aerodynamics and flight control	100	2	2
Chapter 5 Aircraft engineering and maintenance: Airframe			
5.3 Maintenance practices and materials: Airframe/Powerplant	200	3	3
5.4 Aircraft systems and structures: Fixed wing	250	3	3
5.5 Aircraft systems and structures: Rotary wing	250	3	3
5.6 Airship systems and structures	100	3	3
Chapter 6 Aircraft engineering and maintenance: Engines/Powerplants			
6.3 Piston engines	250	3	3
6.4 Propellers	100	3	3
6.5 Gas turbine engines	300	3	3
6.6 Fuel systems	100	3	3
Chapter 7 Aircraft engineering and maintenance: Avionics — Electrical and instrument			
7.3 Maintenance practices and materials	200	3	3
7.4 Electrical and electronic fundamentals	450	2	2
7.5 Digital techniques, computers and associated devices	200	2	2
7.6 Aircraft electrical systems	250	3	2
7.7 Aircraft instrument systems	250	3	2
Chapter 8 Aircraft engineering and maintenance: Avionics — AFCS/Navigation/Radio			
8.3 Automatic flight control systems (AFCS): Fixed wing	200	3	2
8.4 Automatic flight control systems (AFCS): Rotary wing	75	3	2
8.5 Aircraft inertial navigation systems (INS)	60	3	2
8.6 Aircraft radio and radio navigation systems	450	3	2
Chapter 9 Human performance and limitations			
9.7 Required knowledge, skills and attitudes			
A. General programme overview	3	3	3
B. Human Factors knowledge	3	3	3
C. Communication skills	3	3	3
D. Teamwork skills	3	3	3
E. Performance management	3	3	3
F. Situation awareness	3	3	3

Subject matter	*Recommended duration (hours)*	*Level of capability*	
		Line	*Base*
G. Human error	3	3	3
H. Reporting and investigating errors	3	3	3
I. Monitoring and auditing	3	3	3
J. Document design	3	3	3

Table A2-2. Recommended duration and level of capability for Phase Two — Skills training

Note 1.— This table assumes that the State licence scope is divided into either line or base maintenance as recommended by Doc 9379 — Manual of Procedures for Establishment and Management of a State's Personnel Licensing System. *If the State licence combines both line and base maintenance privileges, then the target level of capability should be the higher of the two shown here.*

Note 2.— The definition of levels of capability is shown in 1.5.3.

Subject matter		*Recommended duration (hours)*	*Level of capability*	
			Line	*Base*
Chapter 10	**Practical maintenance skills: Airframe**			
10.3	Basic workshop and maintenance practices: Airframe	725	3	3
10.4	Basic workshop and maintenance practices: Repair, maintenance and function testing of aircraft systems/component	1 000	3	2
10.5	Job/task documentation and control practices	100	3	2
Chapter 11	**Practical maintenance skills: Engine and propeller**			
11.3	Basic workshop and maintenance practices: Engine and Propeller	450	3	3
11.4	Basic workshop and maintenance practices: Engine/Propeller Systems/ Component and Function Testing	450	3	2
11.5	Job/task documentation and control practices	100	3	2
Chapter 12	**Practical maintenance skills: Avionics — Electrical, instruments, autoflight and radio**			
12.3	Basic workshop and maintenance practices: Avionics — Electrical	775	2	3
12.4	Basic workshop and maintenance practices: Avionics — Instrument	1 000	2	3
12.5	Basic workshop and maintenance practices: Avionics — Autoflight	225	2	3
12.6	Basic workshop and maintenance practices: Avionics — Radio	875	2	3
12.7	Repair, maintenance and function testing of aircraft systems/component: Avionics	100	2	3
12.8	Job/task documentation and control practices	100	3	2

Table A2-3. Recommended duration and level of capability for Phase Three — Experience training

Note 1.— This table assumes that the State licence scope is divided into either line or base maintenance as recommended by Doc 9379 — Manual of Procedures for Establishment and Management of a State's Personnel Licensing System. *If the State licence combines both line and base maintenance privileges, then the target level of capability should be the higher of the two shown here.*

Note 2.— The recommended duration shown in this table is the period required by Annex 1, 4.2 and assumes that the person has completed a training course approved by the State.

Note 3.— The definition of levels of capability is shown in 1.5.3.

Subject matter	*Recommended duration (hours)*	*Level of capability*	
		Line	*Base*
Chapter 13 Applied practical training: Experience			
13.3 Applied practical line maintenance operations: Airframe	2 years	3	
13.3 Applied practical line maintenance operations: Engine	2 years	3	
13.3 Applied practical line maintenance operations: Avionics	2 years	3	
13.4 Applied practical base maintenance operations: Airframe	2 years		2
13.4 Applied practical base maintenance operations: Engine	2 years		2
13.4 Applied practical base maintenance operations: Avionics	2 years		2

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Appendix 3 To Chapter 1

BACKGROUND TO THE DEVELOPMENT OF ANNEX 1 — *PERSONNEL LICENSING*

1.1 Historically Aircraft Maintenance Licence and its privileges have often been deliberated at various meetings of ICAO staff and study groups on Personnel Licensing, which included representatives from Contracting States. As a result numerous changes have been made to Annex 1 since its inception in 1948. A key issue has been the separation of standards and privileges. For many years, licences were classified into Type I (essentially an airworthiness certification of parts after overhaul) and Type II (which held release to service privileges for the complete aircraft). The development of this licensing issue and others is described in various reports of related meetings on file in ICAO.

1.2 In 1952 it was agreed that airlines needed to have Type II licensed Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs) who are authorized to issue a maintenance release (Certificate of Safety for Flight). It was also agreed that Type II AMEs in the field should be able to release an aircraft for flight after inspection for possible damage affecting the airworthiness of the aircraft.

1.3 Type I licence privileges were restricted to the certification of parts of the aircraft that were affected by the work performed in overhaul bases and in manufacturing plants. The issue of a maintenance release (Certificate of Safety for Flight) remained a privilege of the Type II licence. Meanwhile, it was agreed that as an alternative, it should be possible for Contracting States to grant the privileges of a licence holder to an approved maintenance organization (AMO).

1.4 As a result, the following definitions were inserted in Annex 1:

a) To issue a maintenance release (Certificate of Safety for Flight) means to certify that the inspection and maintenance work has been completed satisfactorily in accordance with the methods prescribed in the Aircraft Maintenance Manual.

b) To certify as airworthy means to certify that an aircraft or parts thereof comply with current airworthiness requirements after being overhauled, repaired, modified or installed.

1.5 In 1970, the question of Type I and Type II privileges again came under review. As a result, amendments were made to Annex 1 requiring States to indicate separately the privileges attached to licences rated for the aircraft in its entirety and to licences rated for specific components.

1.6 It was further agreed that as Type I licences were being issued to cater to the needs of small operators and owners of General Aviation aircraft and that most States had introduced a system of approved organizations for air carrier aircraft, powerplants and their equipment including avionics, the privileges were amended suitably to incorporate the concept agreed upon for the granting of Type II licences, namely: "to authorize the holder of a restricted licence to certify as airworthy after overhaul, authorized repair or authorized modification of such parts as are entered in his licence and to indicate separately the privileges attached to licences rated for specific components." In recognition of the practice of successive specialized technician releases, the expression "issuing a maintenance release" was replaced by the defined expression "signing a maintenance release." This was still the case in 2002.

1.7 These changes to requirements resulted in more diversified training of AMEs. Training courses for Type I or Type II AMEs were common, as were courses for AMEs who did not seek a licence but were being trained to become part of the team of skilled people (often specialists in one or another aircraft part only) who in turn formed the technical staff of AMOs.

1.8 In 1989 it was recognized that AME licensing practices in many Contracting States had rendered the concept of the Type I licence obsolete as maintenance on large aircraft was generally carried out in AMOs. There was therefore an agreement that a single level of licence broadly based on the Type II licence would be appropriate. However, it was recognized that some States would continue to require Type I licences. It was thus agreed that provisions should be worded in such a way that it would be possible for a State to continue to grant Type I privileges.

1.9 In 1993 the Council at the 16th Meeting of its 138th Session (138/16) adopted Amendment 160 to Annex 1 which related to personnel other than flight crew. This amendment did not cover the licensing provisions for AMEs because during its 128th Session, the Air Navigation Commission decided to develop Standards and Recommended Practices (SARPs) in Annex 6 — *Operation of Aircraft* for an AMO. In view of the close association between the AME licence and the AMO, the Air Navigation Commission felt that a system approach was necessary to ensure consistency between the provisions for AME and AMO. It therefore agreed to postpone its review of the AME licence to provide the time necessary to develop SARPs for AMO.

1.10 In 1997 the Air Navigation Commission noted that the high level of specialization involved in the overhaul of modern complex aircraft and components had rendered a generic qualification (such as that provided by the Type I licence) to be impractical in most cases. In addition, the distinction between major and minor repairs or modifications was an intricate issue. Practices differed from State to State. Actually very few States were known to grant licences with privileges for the entire aircraft at the level of either Type I or Type II licence. Instead, almost all States granted separate licences or licence ratings for airframes and engines, even though the common practice was for individuals to hold both. Accordingly, Amendment 161 to Annex 1, which introduced a single-level licence for the AME, was adopted in 1998.

1.11 Since their initial adoption in the Second Edition of Annex 1 (1948), Annex 1 Standards for the AME Licence have been intended for persons who sign a maintenance release after routine maintenance or who certify an aircraft or an aircraft component airworthy after repair, overhaul or modification. There are no Annex 1 requirements for the personnel who perform the actual maintenance or repair work to be licensed. The review of the Annex 1 AME licensing provisions confirmed that this approach is still valid, and Amendment 161 continues to provide only for inspection and certification privileges.

1.12 During the adoption process for Amendment 161 to Annex 1, it was noted that the change would not prevent States from having broad-based “generalist” (i.e. Type I) licences if they chose to do so. This amendment provides States with the flexibility to issue an AME licence with various levels and scopes of privileges. However, in order to ensure that the privileges granted are clearly defined, a new Standard (Annex 1, 4.2.2.3) requires that the scope of privileges of the licence holder shall be prescribed and recommends that details of the certification privileges shall be documented either by inclusion or reference in each licence.

Chapter 2

GENERAL RECOMMENDATIONS

2.1 ACCOMMODATION AND EQUIPMENT FOR CLASSROOM-BASED TRAINING (CBT)

2.1.1 General

The *TRAINAIR Training Management Guidelines* (TMG), developed by the TRAINAIR Programme, provides detailed information on training support functions, training delivery, administrative support functions, planning and design of training facilities, etc. Another manual, the *TRAINAIR Training Development Guideline* (TDG), details the development methodologies used in the training courses for aviation personnel and also provides guidelines on the training techniques; validation, revision and implementation of courseware; design of tests; post-training evaluation etc. The training specification in this manual is produced based on job/task analysis, so the majority of the material included in the TMG and TDG may not be applied directly to the training of Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs). However the aim of both the TMG and TDG is to provide aviation training managers with the tools they need to effectively manage their training organizations. At the same time, the providers of AME training may be able to benefit by utilizing these tools. Both the TMG and TDG contain detailed information on the issues discussed in this chapter.

2.1.2 Classrooms and equipment

2.1.2.1 Opinions differ on the amount of classroom space required for each trainee. The amount of "ideal" space for each adult in a classroom ranges from a low of 1.4 m^2 to a high of 6.7 m^2. The reason for the wide range in the "ideal" dimensions is that classroom designers either envision different classroom environments or account for certain spaces within the classroom (such as aisles and front setback) differently.

2.1.2.2 The sizes of classrooms are affected by:

- number of trainees in a class;
- size of trainee workstation;
- class configuration;
- size of aisles; and
- use of media (in particular, projected media and hands-on projects).

Note.— ICAO recommends that the ratio of trainees per instructor be taken into account when planning the classroom size. In order to provide for sufficient supervision and control, a ratio of 1 instructor for every 6 trainees or 2 instructors for every 15 trainees is recommended. In the case of groups of more than 15, separate parallel courses are recommended.

2.1.2.3 The use of media, hands-on experiments and practical workshop practice is an important factor in determining the amount of common space required in a classroom and the associated practical workshop training area. The most commonly used visual media are slides, chalk/marker boards, overhead projectors, video tapes and easels. The use of projection media (slides, overheads, television, etc.) has considerable impact on room size and it is recommended that the distance between the farthest student and the screen should not exceed 6 times the width of the screen.

2.1.2.4 In planning the space requirements for the training of AMEs, training managers must take into consideration the trainee workstations, the area required for practical hands-on workshop training, faculty workstations, and storage area.

2.1.2.5 Trainee workstation space includes the trainee's work surface, any additional equipment (terminal, audio/visual, etc.), a chair and the space for manoeuvring the chair. The concept of workstation space is important when measuring rooms for classes containing different numbers of trainees. The total area allowed in a classroom for each trainee varies with the size of the class. An adequate work surface within the workspace is very important. The large amount of reference material used in the training of AMEs requires considerably larger work surfaces than would be provided by the attached writing surface of an auditorium chair.

2.1.2.6 Personal computers can be useful training aids for AMEs. They can communicate verbal and graphic information and can accept verbal as well as manual or tactile responses. Computers may be used for drills, computer-managed instruction, testing and simulations. For detailed information about the use of computers as a training tool, training managers are advised to refer to the TRAINAIR document — *Computer Applications in Training* (CAT).

2.1.3 The learning environment

2.1.3.1 The key to a good learning environment is the elimination of discomforts and other undesirable characteristics. Ten primary factors have been identified:

– The climate must be comfortable.

– Lighting must be of adequate level for work or viewing.

– Distracting sound must be kept to a minimum.

– Work areas must be aesthetically pleasing.

– Workstations must be comfortable.

– Workspaces must be adequate.

– Work areas must be reasonably clean.

– Training equipment must be adequate.

– Visual media must be visible.

– Audio media must be satisfactorily audible.

2.1.3.2 If any of these factors is unsatisfactory, the result can be distraction from the task at hand, and fatigue can result from the effort required of the trainee to adapt to a poor environment. One of the most widely cited factors contributing to a positive learning environment is the comfort level of workstations, which includes the comfort level of the chair.

2.2 PERFORMANCE EVALUATION TESTS

2.2.1 Performance evaluation tests are an integral part of the training process. Tests should always be prepared with the sole purpose of measuring whether or not the trainees have achieved the training objective. Trainees must always be informed on how they are going to be evaluated so they can orient their efforts. The information must include the conditions that will exist during the test, the performance that is expected from the trainees, the standards of accomplishment that have to be met, and the consequences of an inadequate performance. Trainees must also be informed of the result of their evaluation. It is recommended that both instructors and trainees review the errors on all tests together in order to obtain feedback that may lead to perfect or improved score on the tests.

2.2.2 Time and resource constraints may limit the amount of testing that can be given to attain each objective. However, the criticality of the subject and the performance difficulties that may be encountered should help determine when, how and what performance evaluation should be required. Generally speaking, performance measurement is undertaken to evaluate whether or not courses taught have been understood by the trainees at the desired level:

– Knowledge is best tested by oral or written tests.

– Skills are best tested by performance tests in which the trainee performs the task described in the objective under real or simulated conditions.

– Attitudes are tested by observations of performance or by means of questionnaires.

2.2.3 The validity of a test is the extent to which a test measures what it intended to measure. Validity can be established by ensuring that the conditions, behaviour and standards of the test correspond to those described in the objective.

2.2.4 The reliability of a test is the ability of a test to consistently reproduce the same results when administered to the same groups of students under the same conditions with different instructors/assessors. To ensure that the test is reliable, the score key providing model answers and specific instructions on how the test should be administered is critical. A model answer should give the instructor enough information to establish how closely the trainee has mastered the tested behaviour. These three elements (score key, model answer, and the conditions under which the test has to be administered) provide the basis for determining a PASS or FAIL grade in a consistent manner.

PHASE ONE — KNOWLEDGE

Chapter 3

CIVIL AVIATION REQUIREMENTS, LAWS AND REGULATIONS

3.1 INTRODUCTION

3.1.1 International aircraft operations is governed by the rule of law; since the first flight by a heavier-than-air machine, a number of conventions, regulations, legislation, orders, agreements, etc. have been promulgated among and within States to ensure that flights are operated in a safe and orderly manner. Achievement of safety and regularity in air transportation operations requires that all States accept and implement a common standard of aircraft operations with regards to training, licensing, certification, etc. for international operations. The standardization of operational practices for international services is of fundamental importance in order to prevent costly errors which may be caused by misunderstanding or inexperience. Although this manual and other ICAO manuals address international aircraft operations, the need for standardization is equally applicable to all other aircraft operations.

3.1.2 International and national regulations and air laws are promulgated to ensure safety, regularity and efficiency of international aircraft operations. On the international scene, ICAO, pursuant to the provisions of Article 37 of the Convention on International Civil Aviation, develops and adopts Standards and Recommended Practices or SARPs (Annexes to the Convention) as the minimum requirement for aircraft operations. National regulations are developed on the basis of the SARPs, with some variations to suit the specific requirements of individual States. States may enact legislation that may differ significantly from those enacted in other States. However, international aircraft operations share many regulations, laws and statutes. The syllabus contained in this chapter gives an overview of air law as adopted by ICAO and practised in international aircraft operations.

3.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided with a broad outline of the regulatory requirements that must be met by an operator engaged in commercial air transport and an outline of regulatory documents that are significant to the Aircraft Maintenance (Engineer/Technician/Mechanic) (AME) (including those on maintenance), and maintenance control concepts that illustrate the application of regulatory requirements as they relate to the responsibilities and work of the AME.

Performance: The trainees will be able to identify the role of international and national aviation regulatory bodies, identify the importance of applicable regulations to aircraft maintenance activities, and describe the application of regulations relating to aircraft maintenance in those areas which fall under the duties and responsibilities of the AME.

Standard of accomplishment: The regulations and legislation applicable to the described case will be accurately identified. Provisions, practical applications and implementation will also be described to demonstrate understanding of the relevant issues.

3.3 REQUIRED KNOWLEDGE, SKILLS, AND ATTITUDES

3.3.1 International and State aviation laws

– International Civil Aviation Organization (ICAO): formation, structure, functions, obligations and responsibilities

– Review of ICAO Annexes, particularly Annex 1 — *Personnel Licensing*, Annex 6 — *Operation of Aircraft* and Annex 8 — *Airworthiness of Aircraft*

– ICAO specifications applicable to the particular course of study

– National civil aviation regulations

– Government, ministerial and departmental responsibilities for civil aviation within the State

– State competency and licensing regulations for AMEs

– Formalities prescribed by the State: Certificates of Airworthiness (CoA), logbooks, Certificates of Maintenance, maintenance schedules, and Certificates of Approval

– Format of documents, required signatures, conditions for issue of or compliance, and period of validity

3.3.2 Airworthiness requirements

– Design requirements: performance, structural strength, handling, aerodynamics, reliability, system or component performance and reliability, engine types and tests

– Construction requirements: material quality, construction methods, approved manufacturing organizations (AMOs), systems of traceability to source of origin, and quality control/assurance

– Test requirements: structural test programmes, including "safe life", "fail safe" and "damage tolerant" testing

– Component testing and systems testing

– Flight test schedules and engine test schedules

– Test programmes for special cases (aircraft, systems and components)

– Procedures for the maintenance of continuing airworthiness

– Airworthiness directives (AD): indigenous, foreign, issue dissemination, and action

– Operational requirements: performance scheduling, flight and operations manuals

– Maintenance requirements: use of aircraft maintenance manuals, maintenance schedules, overhaul periods/ lives, "on-condition" maintenance programmes and "condition monitoring" programmes

– Responsibilities of licensed aircraft maintenance personnel working in an operator or an AMO

3.3.3 Civil aviation operating regulations

– Regulations concerning aircraft, aircraft operations, safety, and airworthiness requirements

– Personnel licensing, maintenance of competency, approved organizations, and training requirements

– Aircraft and aircraft maintenance documentation

3.3.4 Air transport operations

– Brief historical review of commercial aviation

– Outline of major factors in airline organization and economics

– Description of route network of State concerned

3.3.5 Organization and management of the operator

– Understanding of the air operator's responsibilities for maintenance and the relationship between the operator's Maintenance Control Manual and the maintenance organization's Procedures Manual

– General structure of an airline; functions and organization of various departments; organization of the maintenance department and AMOs; and detailed functions of departments such as Technical, Engineering, Production Engineering, Quality Control/ Assurance and Inspection

– Documentation of maintenance: use of aircraft manuals, manufacturer's bulletins and ADs, preparation and approval of maintenance schedules, job/task cards, worksheets, aircraft/engine logbooks and operator's technical logbooks

– Operation of inspection and/or quality departments

– Stores organization and procedures

– Planned maintenance work: inspection periods and component lifing, check cycles, rotation of components, and overhaul requirements

– Hangar layout and equipment, and maintenance docks

– Workshop safety, fire prevention and first aid

– Responsibilities of departmental managers

– Management methods: methods study, time and motion study, statistical methods, budgeting and analysis

3.3.6 Operator economics related to maintenance

– Maintenance costs: percentage of operating costs, capital equipment costs, labour, consumable stores, stores inventory, effect of elapsed time on airline costs, man-hours required to complete typical work, and maintenance time overrun penalties

– Relative costs of overhaul by manufacturer or airline

– Component/powerplant leasing

– Planning: analysis of different cyclic systems (progressive and equalized checks, etc.), long-term planning for mixed fleet, balancing work loading, effects of seasonal peaks on work loading, etc.

– Preparation of worksheets and job cards, task time analysis, and task sequencing for optimum down time

– Development engineering: liaison with manufacturers; study of new aircraft types; performance analysis; modifications policy; defect analysis; engineering contributions to improved utilization; reliability programmes; engine trend monitoring and reliability centred maintenance studies

– Labour policy: skills required, training and recruitment, grading and qualifications; salary structures; agreements with trade unions etc.

– State regulations, incentives and discipline, and welfare

– Quality control/assurance: inspection procedures, documents, records, and sampling techniques; psychological aspects of inspection, and duplicate inspections according to international, national and airline standards

– Safety: national requirements for industrial safety, insurance requirements, hazards from hazardous fluids and gases (such as fuel, hydraulic fluid, vapours), mechanical dangers, and protective measures in work areas

3.3.7 Approved maintenance organizations (AMOs)

– Concept of a corporate body, its legal responsibilities and organizational structure

– Group of persons nominated as being responsible for ensuring compliance with approval requirements

– Establishment of the competence of personnel and training of persons signing maintenance release

– Issue of terms of approval by the State

– AMO procedures and procedure manual

– AMO quality assurance or inspection system

– AMO facilities, tools, equipment and working environment

– AMO storage facilities and procedures

– Access to necessary technical data

– Record-keeping and records procedures, and issue of a maintenance release

3.3.8 Aircraft maintenance licence requirements

– Eligibility, age, limits of location, language and fees

– Categories of licence as defined in State requirements

– Knowledge and experience requirements

– Training requirements

– Examination requirements and content and issue of licence document

– Privileges of the licence

– Revocation and suspension procedures by the State

3.3.9 The role of the State aviation regulatory body

– Protection of public interests by establishing the need for and feasibility of air service and ensuring the safety of flight operations conducted within the State

– Regulation of the degree of competition between operators and exercise of control over commercial air operators

– Definition of the requirements for State-owned or State-operated facilities and services

– State authority is normally exercised through the incorporation of civil aviation acts, laws and statutes into the State's legal system. It is also asserted through the establishment of a State Civil Aviation Authority (CAA) which has the power to apply principles set forth in aviation law, develop civil aviation regulations and orders, and establish requirements for the issue of licences, certificates and other instruments of authority deemed necessary for commercial air transport. The State must also inspect all aspects of commercial air transport operations to ensure continuing compliance with State requirements, recommend corrective action to air operators and revoke air operators' licences.

3.3.10 Aircraft certification, documents and maintenance

3.3.10.1 *Aircraft, propeller and engine Type Certification*

- Certification rules (e.g. FAR/JAR 23, 25, 27 and 29)
- Type Certification (TC), TC issue, and associated TC Data Sheet
- Supplemental Type Certification or major modification

3.3.10.2 *Individual aircraft certification*

- Approval of design or production organizations
- Issue of Certificate of Airworthiness (CofA) and Certificate of Registration (CofR)
- Documents to be carried on-board the aircraft: CofA, Cof R, Noise Certificate, Weight and Balance Reports, and Radio Station Licence and Approval

3.3.10.3 *Requirements for continuing airworthiness*

- Understanding of the concept that continuing airworthiness is the process of ensuring that at any time in its operating life, the aircraft should comply with airworthiness requirements and should be in a condition for safe operation
- Renewal or continued validity of the CofA
- State approval or acceptance of maintenance programmes, minimum equipment lists, ADs, manufacturer's service information (SBs, SLs, etc.), aircraft maintenance manual, operator maintenance control manual, and AMO Maintenance Procedures Manual
- Understanding of the importance of defect reporting to the State of Registry and to the organization responsible for the type design
- Analysis of defect accident or other maintenance or operational information by the organization responsible for the type design
- Importance of structural integrity with particular reference to supplemental structural inspection programmes and any other requirements related to ageing aircraft
- Special operational approvals (e.g. Extended Range Operations by Aeroplanes by Twin-engined Aeroplanes (ETOPS), All Weather Operations, Reduced Vertical Separation Minima (RVSM), Required Navigation Performance (RNP), and Minimum Navigation Performance Specifications (MNPS))

Chapter 4

NATURAL SCIENCE AND GENERAL PRINCIPLES OF AIRCRAFT

4.1 INTRODUCTION

4.1.1 In addition to the subjects which are of direct day-to-day concern to the responsibilities of the Aircraft Maintenance (Technician/Engineer/Mechanic) (AME), the AME training should include a sound understanding of the academic aspects of aircraft and aviation operations. This background will provide the trainees with a more complete understanding of not only their working environment but also the wider scientific principles employed in aviation.

4.1.2 The academic level of background subjects such as mathematics and physics should be specified as a prerequisite to course entry. However, if this is not practical or possible, then mathematics and physics may be taught to the required level before the start of the aviation training course. Where the knowledge of mathematics and physics is only just below the required entry level, or it is felt that a refresher course in mathematics and physics would be advantageous to the students, then these subjects could be taught in parallel with the aviation subjects.

4.1.3 The selection of topics for the mathematics and physics syllabi as well as the type of course instruction must reflect the depth and breadth of knowledge required to fully complement the level required by the aviation subjects.

4.1.4 Even though it is covered in the Maintenance Practices and Materials sections of both the mechanical and avionics curricula, technical drawing has been incorporated into the area of natural science and general principles of aircraft for the benefit of those students who will be involved in major modification and/or repair work.

4.1.5 Understanding the subjects of mathematics, physics, technical drawing. etc. constitutes an important part of the AMEs training base. It will permit a more comprehensive operational understanding, develop general in-depth awareness of air transport operations, and improve communication with both flight crew members and other maintenance personnel, thereby improving the overall safety of the aircraft operation.

4.2 TRAINING OBJECTIVES

Conditions: The trainees will receive instructions on pertinent information on aviation-relevant situations or characteristics.

Performance: The trainees will be able to identify and explain how the conditions relate to the scientific principles by using correct aviation nomenclature and mathematics.

Standard of accomplishment:
The trainees will display a good understanding of the principles, and make required calculations quickly and accurately, while also displaying some understanding of the context of practical applications.

4.3 MATHEMATICS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

4.3.1 Arithmetic

– Arithmetical terms and signs; methods of multiplication and division; fractions and decimals; factors and multiples; weights, measures and conversion factors; ratio and proportion; averages and percentages; areas and volumes; squares, cubes, square and cube roots

4.3.2 Algebra

- Evaluation of simple algebraic expressions; addition, subtraction, multiplication and division; use of brackets; simple algebraic fractions, linear equations and their solutions; and introduction to simultaneous equations

- Polynomials and binomial theorem, solution of second degree equations with one unknown, solution of simultaneous linear equations, and use of complex numbers

4.3.3 Geometry

- Simple geometrical constructions

- Graphical representation: nature and uses of graphs, rectangular and polar coordinates; graphs of equations

- Simple trigonometry: trigonometrical relationships and use of tables

4.3.4 Trigonometry

- Solution of plane triangles; solution of spherical triangles; application of some hyperbolic functions

4.3.5 Logarithms

- Indices and powers: negative and fractional indices; square root; reciprocal and exponential tables

- Logarithms: use of log tables, and logarithms of produces, quotients, powers and root

4.3.6 Calculators

- Use of electronic calculators for logarithmic and trigonometric applications

4.3.7 Differential and integral calculus

- Derivatives and differentials; maxima and minima; expansion in series; indeterminate forms; curvatures; table of indefinite integrals, definite integrals; differential equations encountered in physics

4.3.8 Graphical representation of functions

- Equations involving two variables; equations for empirical curves; use of logarithmic paper; equations involving three variables; alignment charts

4.4 PHYSICS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

4.4.1 Mechanics

- Forces as vectors: scalars, vectors, resultants, triangle of vectors, polygon of vectors, and resolution of a vector

- Forces and moments, composition and resolution

- Centre of gravity

- Uniform motion in a straight line; acceleration; motion under gravity; Newton's Laws; momentum; force; mass and weight; work, energy, rate of doing work, potential energy, relative velocity, angular velocity, physical units of mass, force, speed, work and power

- Friction: nature and effects, and coefficient of friction

- Specific gravity and density

- Viscosity, fluid resistance and rolling resistance

- Pressure and buoyancy in liquids (barometers)

- Elements of fluid dynamics: streamlines, Bernouilli's Theorem, venturi, Pitot tube and speed of sound

- Elements of vibration theory: harmonic motion, pendulum, damped harmonic motion, forced harmonic motion, and resonance

- Velocity ratio, mechanical advantage and efficiency

- Elements of theory on stress, strain and elasticity; tension, compression, shear and torsion stress; Hooke's Law and Young's Modulus

- Dynamics: kinematics of pure rotation, work, power, torque, kinetic energy, moment of inertia, radius of gyration, rotational equilibrium, centre of mass, couples, momentum and impulse, conservation of momentum, elastic and inelastic collisions, two-dimensional motion, and rolling bodies

- Elasticity: internal forces in solids, stress, strain, Hooke's Law, Poisson's ratio, shear, torsion, and bulk modulus

- Periodic motion: motion in a circle at constant speed, energy relations in simple harmonic motion, angular harmonic motion, and equilibrium of a dynamical system

4.4.2 Heat

- Temperature: thermometers and temperature scales (Celsius/Centigrade, Fahrenheit, Rankine and Kelvin); conversion from one scale to another
- Expansion: linear expansion, surface and volume expansion
- Quantity of heat: units of heat (calories, BTU, CHU), heat capacity and specific heat
- Heat transfer: convection, radiation and conduction
- Mechanical equivalent of heat, first and second laws of thermodynamics
- Properties of fluids: solid, liquid and gaseous states, melting, boiling, evaporation and reverse processes, vapour pressure, absolute and relative humidity
- Gases: ideal gas; Charles' and Boyle's Laws; internal energy of a gas; specific heat of a gas; relationship between internal energy and heat
- Latent heats of fusion and evaporation, thermal energy, and heat of combustion
- Gases: specific heat at constant volume and constant pressure; work done by expanding gas; kinetic theory of gases
- Avogadro's number
- Thermodynamics: isothermal expansion and compression; adiabatic expansion and compression; the Carnot cycle; engine cycles; constant volume and constant pressure; refrigerators and heat pumps

4.4.3 Light

- Introduction to nature of light; speed of light
- Laws of reflection and refraction: reflection at plane surfaces; reflection by spherical mirrors, refraction, lenses, cameras and projectors, microscopes and telescopes
- Propagation of light, illumination, and photometry
- Wave optics: interference, interferometers, Huygens' model, diffraction, diffraction gradings, and polarization
- Spectra: dispersion by refraction, spectrometers, emission and absorption spectra, and quanta

4.4.4 Electricity and magnetism

- Fundamentals: atoms and electrons, conductors and insulators, electric currents, electromotive force, difference of potential, electrical units, power, work and energy, Ohm's Law, specific resistance, series, parallel and combined DC circuits, Kirchoff's Laws and the Wheatstone Bridge
- Batteries and thermal EMF: theory of electrolysis, primary cells, secondary cells; lead-acid and alkaline accumulators; and thermocouples
- Magnetism: permanent magnets, laws of magnetism, the earth's magnetism, magnetic fields, electromagnetism, polarity rules, field strength and flux density, permeability, hysteresis, and reluctance
- Electrostatics: positive and negative charges, charges developed by friction, electrostatic induction, surface charges, electrostatic fields, static charges on aircraft and methods of dispersing them
- Electromagnetic induction: Faraday's Laws, Lenz's Law, magnitude and direction of induced EMF, generators, and induction coils
- Inductance and capacitance: mutual inductance; self-inductance; unit of capacitance; specific inductive capacity; dielectric strength; losses and efficiency
- Outline of AC theory: generation, principles, single-phase and three-phase generation, measurement of current and voltage, RMS, audio and radio frequencies
- Resistance, inductance and capacitance in AC circuits: inductive reactance, resistance and inductance in series, impedance, power factor and true power, capacitive reactance, resistance and capacitance in series, resonance, Q factor, and voltage developed at resonance
- Resistance, inductance, capacity and parallel combinations
- Methods of coupling: mutual inductive coupling, resistive coupling, auto-inductive coupling, capacitive coupling, equivalent resistance, equivalent reactance, coupling factor, and resonance curves
- Transformers: primary and secondary EMF; load-on secondary, resistive, inductive and capacitive loads; transformer losses; tests of transformers; X-rays and natural radioactivity; photoelectric and inverse photoelectric effect; generation of X-rays; radioactive substances; radiography with X-rays and gamma-rays

4.4.5 Wave motion and sound

- Wave motion: mechanical waves, sinusoidal wave motion, interference phenomena, and standing waves
- Sound: speed of sound, production of sound, intensity, pitch and quality, and Doppler effect

4.5 TECHNICAL DRAWING: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

4.5.1 Introduction

- Purpose of technical drawing
- Care and use of drawing instruments
- Standard paper sizes, blocks, conventions for lines, and dimensions

4.5.2 Practice with drawing instruments

- Lettering
- Simple geometric constructions
- Layout of patterns with metric or inch dimensions

4.5.3 Simple orthographic projections

- Orthographic conventions
- Practice in first angle projections
- Practice in third angle projections

4.5.4 Simple isometric projections

- Isometric conventions
- Practice in making workshop sketches

4.5.5 Geometric construction

- Constructions involving lines and angles, circles and conic sections
- Geometric projections

4.5.6 Practice in sketching

- Proportioning
- Orthographic sketching
- Pictorial sketching

4.5.7 Orthographic projection

- Rules, determination of number of views, notation and representations, layout of three-view drawings, computation of weights
- Sectional views, standard symbols for sections and materials
- Dimensioning
- Representation of machine elements, threads, bolts, nuts, rivets, etc.
- Exercises incorporating standard conventions

4.5.8 Shop terms and processes

- Relationship between drawing and manufacturing processes
- Drawings for castings, forgings, machined parts, sheet metal parts, and welded constructions
- Practices as appropriate to particular course

4.5.9 Assembly drawings

- Layout drawing
- Assemblies, erection and installation drawings, interchangeability, tolerances, fits and clearances, datum surfaces, tolerancing of form and position
- Surface finish, finish marks and specifications
- Checking drawings

4.5.10 Auxiliary projections

- Notation and relationship of auxiliary planes
- Layout of drawing with one auxiliary view
- Layout of drawing with two auxiliary views

4.5.11 Axonometric projection

- Isometric projections, dimetric and trimetric projections
- Theory of axonometric projections

4.5.12 Oblique projection

- Theory
- Cavalier projection
- Cabinet projection

4.5.13 Circuit layout

- Convention for electrical and radio components
- Standard symbols for theoretical circuits and wiring diagrams

4.5.14 Exercises in blueprint reading

- Interpretation of blueprint data
- Check for consistency

4.5.15 Exercises in engineering design

- To be selected by the instructor in accordance with the nature of the particular course and the type of work that the student will undertake in the future

4.6 CHEMISTRY: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

- Nature of matter: the chemical elements; structure of atoms, molecules, crystals, colloids, solutions and solvents; hardness and ductility

4.7 FIXED WING AERODYNAMICS AND FLIGHT CONTROL: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

4.7.1 Aerodynamic physics

- Application of International Standard Atmosphere (ISA) to aerodynamics
- Newton's Laws of Motion
- Boyle's Law
- Charles' Law
- General Gas Laws
- Archimedes Principle
- Bernoulli's Theorem
- Dalton's Law

4.7.2 Airflow

- Airflow in relation to a body at rest and in motion
- Boundary layer: laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices and stagnation
- Effect of ice on an aircraft

4.7.3 Aerofoils

- Understanding of the following terms:
  - camber
  - chord
  - mean aerodynamic chord
  - parasitic drag
  - induced drag
  - centre of pressure
  - angle of attack
  - angle of incidence
  - wash in and wash out
  - fineness ratio
  - wing shape
  - aspect ratio
- Relationship between lift, weight, thrust and drag

4.7.4 Conditions of flight

- Understanding of the following terms:
  - wing loading
  - centrifugal force
  - centripetal force
  - gravitational force
  - sideslip
  - skidding
  - stall
  - centre of gravity

– Effects on wing loading and stalling speed due to changes in wing area, angle of bank, angle of attack, and mass

– Relationship between ground speed (GS), true air speed (TAS) and indicated air speed (IAS)

4.7.5 Flight stability

– Understanding of the following terms:
  - dihedral
  - longitudinal dihedral
  - anhedral
  - sweepback
  - taper
  - torque effect
  - slipstream
  - gyroscopic effect
  - asymmetric power/thrust
  - longitudinal stability
  - lateral stability
  - directional stability
  - flutter
  - Dutch roll
  - pitch up

4.7.6 Flight controls

– Operation and effect of roll control: ailerons and spoilers pitch control; elevators, stabilators, variable incidence stabilizers and canards yaw control; rudders including rudder throw limiters

– Control about two axes, elevons, and ruddervators

– High lift devices, slots, slats, and flaps (including leading edge flaps)

– Drag inducing devices, spoilers, lift dumpers, and speed brakes

– Boundary layer control using wing fences, saw-tooth leading edges, vortex generators, stall wedges or leading edge spoilers

– Operation and effect of trim tabs, balance (lagging) and anti-balance (leading) tabs, servo tabs, spring tabs, bob weights, control surface bias, and aerodynamic balance panels

– Understanding of aerodynamic balance

– Power-boosted and power-operated controls: purpose, layouts, power supplies, artificial feel devices, installation, adjustments and testing

– Fly-by-wire systems (FBW) (both digital and analogue), full FBW system and FBW with manual reversion

4.7.7 High speed flight

– Understanding of the following terms and of the factors which affect them:
  - speed of sound
  - subsonic flight
  - transonic flight
  - supersonic flight
  - mach number
  - critical mach number
  - mach cone
  - compressibility
  - shock wave (oblique and normal)
  - expansion waves
  - shock-induced stall
  - shock-induced drag
  - aerodynamic heating
  - area rule

– Factors affecting airflow in engine intakes of high-speed aircraft

– Effects of sweepback and fineness ratio on critical mach number

– Control problems encountered and methods to overcome them in transonic and supersonic flight

4.8 ROTARY WINGS AERODYNAMICS AND FLIGHT CONTROL: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

4.8.1 Introduction

– Classification of helicopter types

– Guide to operating environment peculiar to helicopters

– Names of airframe components of helicopter and function of main components

– Strength and weight of components

4.8.2 Rotary wing theory of flight

– Understanding of the following terms:
  - air density

- centrifugal force
- tip path plane
- coning angle
- lift thrust vector resultant
- pitch angle
- angle of attack
- collective pitch
- cyclic pitch
- disc loading
- blade loading
- node
- relative airflow
- feathering
- axis of rotation or shaft axis

– Vortex ring state, power settling, overpitching and their relationship

– Understanding of the relationship between: lift, thrust, weight, drag and centre of gravity

– Torque reaction and its effect on directional control of helicopter

– Gyroscopic precession and the use of this effect in providing control of the main rotor disc for forward, sideways and rearward flight

– Dissymmetry of lift and its control

– Understanding of Corriolis effect and features (lead/lag hinges, underslung rotor) used to relieve stresses which it creates

– Ground effect and translational lift and their relationship

– Translation of tendency and its correction by mast offset and cyclic rigging

– Understanding of the reason for built-in twist in rotor blades

– Understanding of the reasons for blade tip stall and why it results in nose pitch up of the helicopter

4.8.3 Rotary wing stability

– Understanding of static and dynamic stability and why most helicopters are considered to be statically stable and dynamically unstable

– Understanding of how inherent dynamic instability is overcome by the use of the following design methods: stabilizer bar, offset flapping hinges and delta three hinges

– Ground resonance, its causes and remedial maintenance action to be taken should it occur

Chapter 5

AIRCRAFT ENGINEERING AND MAINTENANCE: AIRFRAMES

5.1 INTRODUCTION

5.1.1 In order to be able to satisfactorily assimilate training on individual aircraft types, the Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) must have a good fundamental understanding of the principles and functions of construction generally used in aircraft of all types.

5.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the aircraft or its components, the AME must have a very complete knowledge of all the associated maintenance practices that are likely to be used.

5.2 TRAINING OBJECTIVES

Conditions: The trainees will receive training on aircraft engineering principles related to the aircraft structure, materials, components, construction, specifications and functional systems.

Performance: The trainees will describe the characteristics and applications of the materials used in aircraft construction, including the principles of construction and functions of aircraft structures; fastening techniques; powerplants and their associated systems; mechanical, fluid, and electrical power sources; basic aircraft instrument and display systems; aircraft flight control systems; basic airborne navigation and communication systems.

Standard of accomplishment:
The trainees will describe the characteristics and applications of the materials, construction, system operating principles and maintenance practices in accordance with actual practice on existing aircraft.

5.3 MAINTENANCE PRACTICES AND MATERIALS: AIRFRAME/POWERPLANT

5.3.1 Aircraft, hangar and workshop safety precautions

– A guide to the various aspects of safe working practices, including the precautions to be taken when working with electricity, gases, oils and chemicals

– Instruction in the remedial action to be taken in the event of an accident with one or more of the hazards

5.3.2 Principles of workshop practice

– Care of tools

– Use of workshop materials

– Dimensions and standards of workmanship

5.3.3 General purpose tools

– Review of types of tools: hammers and mallets, screwdrivers, wrenches (spanners), torque wrenches, punches, pliers, clamps/vices/presses, hacksaws, snips/nibblers, chisels, files, taps and dies, reamers, drill bits, thread gauges and crimping tools, grease guns, oil cans and lubrication methods

5.3.4 General purpose power tools

– Electric and pneumatic powered saws, drills, grinders, sanders, routers, nibblers, rivet guns and heat guns

5.3.5 Precision measuring tools

– Micrometers: metric/inch, vernier gauge, vernier calipers, surface table and accessories, marking out, dial test indicators, go/no-go gauges, combination sets, bore and depth gauges, steel rule, inside and outside calipers, slip gauges and feeler gauges

5.3.6 Screw threads

– Screw nomenclature

– Thread forms, dimensions and tolerances for standard threads used in aircraft

– Measuring screw threads

5.3.7 Bolts, studs, screws and fasteners

– Bolt types: specification, identification and marking of aircraft bolts, Society of Automotive Engineers (SAE) and metric

– Nuts: self-locking, anchor, and standard types

– Machine screws: aircraft specifications

– Studs: types and uses, insertion and removal

– Woodscrews, cotter pins, dowels, self-tapping screws and nuts

– Locking devices: tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick release fasteners, keys and circlips

5.3.8 Fits and clearances

– Allowances and tolerances, drill sizes for bolt holes, and classes of fits

– Common system of fits and clearances

– Schedule of fits and clearances for aircraft and engines

– Limits for bow, twist and wear

– Standard methods for checking shafts, bearings and other parts

5.3.9 Maintenance data, engineering drawings and diagrams

– Understanding of the following drawing types and diagrams, their symbols, dimensions and tolerances:
  • orthographic
  • isometric
  • oblique
  • perspective
  • electrical
  • block
  • schematic
  • sectional
  • blueprint
  • logic flow chart

– Identification of the following information within the title block:
  • drawing and revision number
  • reference number
  • scale
  • weight

– Understanding of the use of maintenance data to Specifications 100 and 2100 of the Air Transport Association (ATA) of America

5.3.10 Electrical cables and connectors (as applicable to a mechanical AME)

– Electrical connector: identification, codes, shape, locking pins, removal, insertion, crimping and soldering

– Electric cables: types, sizes, gauges, insulation, properties application, temperature ranges, numbering and identification

– Coaxial cables, high and low tension cables and precautions when attaching them

– Crimping, terminal ends, splices, wire grip, insulation grip, diamond grip, tools, colour codes, crimp insulation dimple codes tool testing, millivolt drop test, and go/no-go gauges

5.3.11 Aircraft fasteners

– Types of riveted joints, rivet spacing, and pitch

– Types of solid rivets: specifications and identification

– Types of hollow rivets: cherry, pop, chobert, avdel and semi-pierced

– Tools used for riveting and dimpling

– Inspection of rivets

5.3.12 Pipes and unions

- Identification of types of rigid and flexible pipes and their connectors that are used in aircraft
- Bending and belling/flaring aircraft pipes
- Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air system pipes
- Inspection and testing of aircraft pipes and hoses

5.3.13 Springs

- Types of springs, materials, applications, limitations, inspection and testing

5.3.14 Bearings

- Purpose of bearings, loads, material, construction and application
- Types of bearing: plain, ball, roller, needle, self-aligning and air bearing
- Testing, cleaning and inspection of bearings
- Lubrication requirements of bearings
- Defects in bearings and their causes: brinelling, burnishing, galling, spalling, abrasion, burning, burring, chafing, chipping, corrosion, fretting, gouging, grooving, cutting, inclusions; nicks, peening, pitting and scoring

5.3.15 Gears

- Gear types: spur, helical, bevel, hypoid, worm, planetary, differential, sector, rack and pinion
- Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, and mesh patterns
- Inspection of gears, backlash and lubrication

5.3.16 Transmission systems

- Belts and pulleys, Bowden cables, and chains and sprockets
- Aircraft flexible control systems
- Screw jacks, lever devices, and push-pull rod systems

5.3.17 Cables and wires used in aircraft

- Standard wire gauges: British, American and metric
- Types of wire used on aircraft and specification for aircraft wire ropes
- Splicing and swaging of end fittings and types of end fittings
- Turnbuckles and standard tensioning devices, pulleys and cable system components
- Inspection and testing of flying control cables

5.3.18 Sheet metal work

- Marking out of sheet metal
- Calculation of bending allowance
- Folding, bending, forming, stretching, shrinking, shearing and riveting of sheet metal

5.3.19 Machine tool operation

- General understanding of operation of lathes, grinders, milling machines, shapers, scrapers, drills and saws (band)

5.3.20 Forging, welding, brazing, soldering and bonding

- Forging: hand forging of simple items, hardening and tempering of carbon steel using forge
- Welding: gas welding and brazing
- Electric arc welding: metallic arc welding, tungsten inert gas arc welding (TIG), atomic hydrogen arc welding, carbon arc welding, and metal inert gas arc welding (MIG)
- Resistance welding and spot welding
- Identification of welding defects, bad depth and width, penetration, undercut and spatter
- Soldering: soft soldering, hard soldering, silver soldering, flux, tinning, lead/tin content, melting points, and cold/dry joints
- Use of heat sinks

- Soldering iron types, temperature controlled and bits
- Bonding: resin bonding and adhesives

5.3.21 Aircraft materials: Ferrous

- Iron and steel production, strength, and melting points
- Characteristics of low, medium and high carbon steels
- Identification of common steels used in aircraft by SAE number
- Characteristics of various alloy steels
- Heat treatment, properties and application of carbon/alloy steels
- Testing of ferrous materials for hardness, tensile strength, fatigue strength and impact resistance
- Electrical/magnetic properties of the material

5.3.22 Aircraft materials: Non-ferrous

- Aluminum, magnesium, brass, bronze, copper, lead, tin, zinc and titanium: production, weight, strength, melting points, heat treatment, anodic treatment, plating, applications and limitations
- Common alloying elements for magnesium and aluminum and the effect on the base metal
- Identification of heat treatment of aluminum alloys by code number
- Testing of non-ferrous metal for hardness, tensile strength, fatigue strength and impact resistance
- Electrical/magnetic properties of the material

5.3.23 Aircraft materials: Composite/Non-metallic

- Wood: types, specifications, plywoods, damage/failure mode, environmental contamination, disease, joining, cutting, grain, protection, sealing, application and uses
- Identification of composite materials commonly used in non-structural aircraft applications: glass, carbon, and kevlar fibres
- Standard weaves used in fibre mats and properties of fibre elements
- Resin matrixes and their properties
- Core material used in sandwich-type construction
- Defects in non-structural composite material; its detection and rectification
- Repair of laminates and fibre reinforced plastics, tools, testing, and vacuum processes
- Plastics, transparent materials, acrylics, glass and wood
- Sealants, bonding agents, rubbers, synthetic rubbers, characteristics, handling precautions, vulcanizing and inspection
- Electrical properties of the material
- Fabric covering, dopes, thinners, paints, cements, stitching, nails, tapes, patches, zips, and inspection panels

5.3.24 Corrosion

- Formation by galvanic action process, microbial and stress
- Types of corrosion: surface, intergranular, pitting, filiform and exfoliation
- Causes of corrosion: dissimilar metals, heat treatment, welding, fretting and stress
- Material types susceptibility to corrosion
- Identification of corrosion types, forms and effect

5.3.25 Aircraft corrosion control

- Methods of corrosion removal from common aircraft metals
- Corrosion protection treatment methods: chemical, sacrificial and mechanical
- Mercury contamination of aircraft structure, removal, protection and precautions

5.3.26 Non-destructive testing (NDT)/Non-destructive inspection (NDI)

- Dye/chemical penetrant method: water washable, post-emulsifiable and solvent removable

- Magnetic particle, eddy current, conductivity and ultrasonic
- Radiographic X-ray/gamma ray
- Use of ultraviolet light with fluorescent dyes
- Methods for testing, castings, forgings, extrusions, welds aircraft and engine components
- Visual probes and eyeglass equipment

5.3.27 Basic electricity

- Use of electricity in aircraft
- Elementary electrical physics: types of electricity
- Units: amps, ohms, volts, watts, and Ohm's Law
- Mechanical and chemical methods of producing electricity

5.3.28 Aircraft handling

- Aircraft towing: safety precautions, towing arms, weak links, locking devices, weight limits, turning angle limits, control of aircraft brakes, lookouts, tugs and tractors
- Aircraft jacking: principles of aircraft jacking, safety precautions, weight and balance limits, jack types, jacking points and jacking techniques

5.4 AIRCRAFT SYSTEMS AND STRUCTURES: FIXED WING

5.4.1 Mechanical control components: Construction and function

- Function and adjustment (where applicable) of bell cranks, quadrants, levers, torque arms, torque tubes, push-pull rods and their end fittings, universal joints, fire and vapour seals for control systems
- Function, inspection, maintenance and identification of cables, cable end fittings, pulleys, cable guards, and cable tensioning devices
- Chains and sprockets: types, construction, distortion, wear, elongation, and prevention against jamming

5.4.2 Hydraulic system

- Principles of hydraulics: its relation to Pascal's Law, understanding of the relationship between pressure, force and area relating to differential areas, pressures and mechanical advantage
- Hydraulic fluids: types, identification, military specifications, colour, properties, user precautions, and applications
- Hydraulic seals: types, seal/fluid correct compatibility, identification, applications, tools, storage life, and maintenance practices
- Fittings and flexible pipes: identification of pipes, inspection and maintenance of pipes, and hydraulic accumulators
- Pumps: manual and power operated; reservoirs; filters; regulating valves; hydraulic fuses; priority systems
- Pressure/contents/temperature indication
- Interface with electrical and emergency systems
- Typical hydraulic systems in aircraft

5.4.3 Pneumatic and air systems

- High-pressure air systems and components
- Bleed air pneumatic systems
- Safety precautions when working with high-pressure gas systems
- Pneumatic control systems features, components and function
- Inspection and maintenance of air/pneumatic systems
- Ducting, mass flow, pressure control/indication, leak detection, valves, alternate supply, Auxiliary Power Unit (APU), and ground cart supply
- Indications and system protection devices

5.4.4 Airframe structures: General concepts

- Airworthiness requirements for structural strength
- Understanding of the following terms:
  - stress

- strain
- bending
- compression
- shear
- torsion
- tension
- hoop stress

– Understanding of the principles of “fail safe” design, fatigue life, strength and rigidity

– Construction methods: monococque, semi-monococque and truss (Pratt truss and Warren truss)

– Non-stressed skin fuselage construction and stressed skin fuselage construction

– Formers, stringers, longerons, bulkheads, frames, struts, ties, beams, floor structures, reinforcement methods of skinning, anti-corrosive protection skin, wing and empennage attachments, doors, windows, nacelles, engine mounts, pylons, vibration damping methods, and firewalls

5.4.5 Wings, primary and auxiliary control surfaces

– Wing construction methods: monospar, multispar, and box beam

– Wood, metal and composite spars

– Constructional features: ribs, struts, wires, tie rods, braces, stringers, stressed skin, and biplanes

– Leading and trailing edges, and wing tips

– Fuel tanks: integral and detachable, internal and external, sealing of fuel tanks and inspection of tanks

– Load distribution on cantilever spar beams

– Special construction methods: spot welding, adhesive bonding, honeycomb structures, integral milling, and contour etching

– Constructional and general features of primary and auxiliary control surfaces

– Static and aerodynamic balancing of control surfaces

– Calculations for the balance of controls following repair or repainting

– Trim and balance tabs, and mass balance

5.4.6 Inspection of structures

– Understanding of the following terms:
  - fuselage station
  - wing station
  - water lines
  - butt lines or buttock lines

– ATA-100 zoning system used to identify aircraft component locations and access points

– Inspection of structures for wear, damage and deterioration

– Identification of visual indications of flight or ground overloads, structural failure of adjacent members and corrosion

– Classification of damage, repair or maintenance implications attributed to structures

5.4.7 Airframe symmetry

– Methods of alignment and symmetry checks: wings and horizontal stabilizers for dihedral and incidence; vertical stabilizers for alignment; fuselage for twist and bending, and complete airframe for symmetry

– Understanding of the following terms as they are applied to airframe symmetry requirements:
  - rigging position
  - incidence angle
  - wash in
  - wash out
  - anhedral
  - dihedral
  - longitudinal dihedral
  - stagger
  - decolage
  - cabane struts
  - interplane struts

5.4.8 Fastener installation

– Identification of solid and blind rivets by head markings, physical characteristics and identification number

– Requirements for edge distance, pitch and gauge for rivet installation

– Identification of incorrectly installed rivets and rivet failure

– Understanding of the following terms in relation to rivet design, installation or layout:
  - pitch
  - gauge
  - clearance
  - dimpling
  - shaving
  - countersinking

5.4.9 Sheet metal repair in aircraft

– Understanding of the following processes used in the fabrication/repair of sheet metal parts: folding, bumping, dimpling, crimping, stretching, shrinking, joggling, coining operation and use of the hand and power tools such as shears, presses, brakes/folding machines, roll formers, cutters and guillotine

– Calculation of bend allowance and setback

– Calculation of geometric shapes: circumference of circles, length and angles of the sides of triangles, etc.

– Calculation of weight of completed repair and determination of its effect on surrounding structure

5.4.10 Tubular structure repair

– Design characteristics: angles and dimensions of tubular weld repairs patching, inner and outer sleeves, and splicing

– Typical non-welded repairs of tubular structural members

5.4.11 Window and windshield repairs

– Hot and cold methods of forming acrylic sheet

– Considerations and precautions to be taken when cutting acrylic sheet

– Cementing and curing of acrylic sheet

– Finishing methods for acrylic sheet, buffing, polishing and cleaning

– Glass windshields: construction, lamination, fitting, removal, handling, storage, inspection, heating, sealing, cleaning, and minor damage repair techniques

5.4.12 Pressurized structures

– Understanding of aircraft design related to load transfer, load path continuity and reduction of stress raisers in pressurized fuselages

– Methods by which doors and other large cutouts are restrained from opening under pressurization loads

– Methods used to seal structure and components to the structure of airframe pressure cells

– Methods used to ensure structural protection from rapid decompression

– Sealing methods at pressure bulkheads for control and electrical cables

– Sealing methods used in doors and cutouts in pressure cells

– Maintenance precautions in maintenance of blowout panels, airflow louvres, and decompression doors

– Methods used to achieve minimum drag and aerodynamically clean structures

5.4.13 Surface protection and paint systems

– Methods for the removal of existing corrosion protection and surface corrosion

– Methods of preparation, cleaning and degreasing prior to surface treatment

– Methods of pre-treatment prior to application of finishes

– Various types of primers; advantages, disadvantages and uses

– Various types of topcoat finishes; advantages, disadvantages and uses

– Physical conditions necessary for correct application of particular finishes: temperature, humidity, dust free, etc.

– Application process and equipment including cleaning equipment after use, techniques of spraying, etc.

– Identification and understanding of possible causes of defects in applied coatings or finishes

5.4.14 Landing gear and associated systems

– Fixed landing gear: tail wheel assemblies, nose wheel types, shock struts, shock or bungee cords, bracing, spring steel struts, air-oil oleo struts, spring-oleo struts, floats and skids

– Retractable landing gear: geometry, construction, actuation, locking, position indication, torque links, drag braces and bogey beams

– Limit vertical inertia load factor and energy dissipation rate

– Tail wheel and nose wheel types, track-type gear, tandem and multi-contact gears, crosswind landing gear, anti-shimmy mechanisms, gear doors and mechanisms, and emergency extension

– Nose wheel steering: principles, control, actuation, maintenance and inspection

– Wheels and tyres: treads, size, construction, speed limits, identification/markings, pressures, valves, safety devices, inflation, inspection and maintenance

– Brakes: braking factors, actuation, heat dissipation, anti-skid devices, disc brakes, drum brakes and expanding tube brakes

– Auto-brakes, single and dual servo brakes, and master cylinders

5.4.15 Ice and rain protection

– Ice formation on aircraft, engines and propellers, its effects and classification

– Anti-icing systems: electric, thermal and chemical

– De-icing systems: electric, pneumatic and chemical sensors, and indicators for quantity or temperature cyclic systems

– Chemical rain repellant systems

– Pneumatic rain removal

– Ice detection systems

– Water and toilet drain heaters

– Windshield wipers: electric and hydraulic

– Demisting

– Ground removal of frost, ice and snow: temperatures, time limits, materials and application techniques

5.4.16 Cabin systems and installation

– Water systems and pressure control

– Safety installations: emergency exits, life jackets and dinghies, escape slides, harnesses and safety belts, seats and seat belts, freight stowage, and catering trolleys, and crash, rescue and first aid equipment

– Operation of safety devices and control of service power supply (such as refrigeration, galleys, heaters and other cabin equipment including lift mechanisms)

– Toilet and sanitary equipment including health precautions

– Waste collection and drainage

– Safety precautions related to emergency exits and escape slides

– Cabin entertainment (films, video, television and audio) and public address

– Furnishings, soundproofing, and role change equipment

– Operation of internal and external, normal and emergency lighting systems

5.4.17 Environmental, air conditioning and oxygen systems

– Gas composition of the atmosphere and the physical properties of oxygen

– Understanding of hypoxia, anoxia, hyperventilation and carbon monoxide poisoning, including related symptoms for each

– Elements and principles of cabin air conditioning: power, air supply, cabin structure, pressure control, pneumatic and electronic control devices and sensors, safety and warning devices

– Cooling and heating: air cycle machines, refrigeration equipment, vapour cycle systems and controls, electrical, exhaust and combustion heaters, temperature control equipment, and circulation systems

- Humidity control: humidification, water separation, and humidity control devices
- Oxygen systems: oxygen storage, distribution and production
- System components: regulators (continuous flow, demand, diluter-demand and pressure-demand types), oxygen bottles, identification of oxygen equipment, demand valves, charging valves, quantity and pressure indication, pipes and connectors, masks, safety and pressure relief devices, liquid oxygen systems, gaseous oxygen systems, chemical oxygen systems, on-board oxygen generation systems, and purging method for oxygen systems
- Safety precautions related to the handling and replenishment of oxygen systems
- Testing of oxygen systems, pressure cabins and test equipment
- Bleed air, turbo-charged bleed air, mass flow control, temperature control, differential pressure and maximum pressure

5.4.18 Fire warning, protection and control systems

- Aircraft and engine fire warning principles and control
- Principles of fire and smoke warning and detection systems
- Principles of fire extinguishers: extinguishing agents, types of extinguishers and their operation
- Installation layout of typical fire warning and detection systems in aircraft and their operation
- Awareness of life limitations of fire extinguisher components
- Testing of fire warning/detection/extinguisher systems
- Precautions to be taken during servicing and maintenance
- Centralized warning systems, principles of inputs-outputs and priority philosophy

5.4.19 Fuel supply systems

- Layout of fuel supply system for piston- and turbine-powered aircraft
- Contents indication, instrument and electrical interface
- Identification and location of fuel system components
- Fuel-specific gravity, densitometer, and fuel properties
- Boost/scavenge systems
- Non-return valves: refuelling/de-fuelling/fuel dump
- Venting, tank sealing, and sealants
- Water drains and testing for water contamination of fuel
- Usable/unusable fuel
- Use of fuel for aircraft trim control

5.4.20 Aircraft electrical systems

- Lead acid batteries: plate material, electrolyte, specific gravity, capacity and capacity testing, determination of state of charge, charging constant voltage/constant current, gassing, sulphation, temperature, hydrometer, and insulation and resistance (I/R) checks
- Safety precautions when dealing with lead acid batteries
- Neutralization of acid spills, cleaning and maintenance
- Storage and shipping requirements
- Environmental hazards associated with lead acid batteries
- Separation of lead acid and nickel-cadmium battery: charging facilities, location, storage, components, chemicals and service equipment
- Nickel-cadmium batteries: plate material, electrolyte, capacity and capacity testing, determination of state of charge, gassing, charging constant current, cell imbalance/balance, cell voltage reversal, I/R checks deep cycle recovery, cell removal/replacement, and cell leak tests
- Thermal runaway: cause and prevention, temperature indication/warning and control
- Neutralization of electrolyte spills, cleaning and maintenance
- Storage and shipping requirements

- DC power supplies: generators construction, function and maintenance, and generator balancing
- Voltage regulators: carbon pile, mechanical, electronic, cut-outs, reverse current relays, and circuit protection
- Typical DC circuits, DC motors and actuators
- AC power supplies: alternators (single phase and three phase), inverters (static and rotary), transformers, rectifiers, transformer rectifier units, and protection devices
- Alternator drives, constant speed devices, integrated drive generator systems, and data bus systems
- Aircraft electrical wiring: cable specifications, looms, identification, fuses, circuit breakers, current limiters, bonding and discharge of static
- Logic gates, electrostatic devices handling and protection
- Engine starter motors

5.4.21 Aircraft instrument systems

- Pitot static system: function, layout, testing, airspeed indicators, pressure altimeters, and vertical speed indicators
- Gyroscopic components: principles, turn and slip indicators, directional gyros, artificial horizons, and turn coordinators
- Precautions when handling gyroscopic instruments
- Engine instruments: manifold pressure gauge, oil pressure gauge, electrical and mechanical tachometers
- Electrical resistance thermometers, thermocouples, radiometer and torque meters
- Flow measuring instruments: pressure/volume, fuel and mass airflow, sensing type, fuel quantity indicator capacitive and float types
- Compasses: principles and function of magnetic compasses, standby and remote reading
- Effect of faults in components of the aircraft/engine instrument system

5.4.22 Float planes, amphibians and flying boats

- Floats: design, construction, material, corrosion protection, draining and plugs
- Hull: shape, step, planing and strakes
- Water rudders: design, construction, and control
- Mooring, fittings and mooring points, tie down points, anchors and life jackets
- Taxiing, manoeuvre and control of aircraft on water
- Docking and slipping

5.5 AIRCRAFT SYSTEMS AND STRUCTURES: ROTARY WING

5.5.1 Main rotor heads (MRH)

- Main rotor head: various designs and features to accommodate flapping, feathering, leading and lagging actions of main rotor blades
- Operation of swash plate and its effect on tip path plane
- Construction and operation of rotor blade dampers
- Mounting, inspection and maintenance of main rotor heads

5.5.2 Tail rotors and anti-torque control

- Methods of achieving directional/anti-torque control through tail rotor, bleed air or aerodynamics
- Principles, construction, mounting and maintenance requirements of typical tail rotor drive systems (including shafts, bearings, couplings, universal joints, gearboxes and pitch change mechanisms)

5.5.3 Clutches, freewheel units and rotor brakes

- Operation, function, construction, and component location

5.5.4 Cyclic control system

- Operation and function of system

– Layout and location of components (cyclic stick to pitch-change rod inclusive)

5.5.5 Collective control system

– Operation and function of system

– Layout and location of components (collective lever to pitch-change rod inclusive)

– Pilot control for power and non-power assisted flying controls

– Methods of rotor revolutions per minute (RPM) compensation applicable to collective control

5.5.6 Main rotor gearbox and main rotor mast

– Operation, function and mounting methods of gearboxes and masts

– Lubrication and loads

– Inspection and maintenance of gearboxes and masts

5.5.7 Main/Tail rotor blades

– Construction methods and materials used in wood, metal and composite main and tail rotor blades

– Blade attachment systems

– Inspection and maintenance of main and tail rotor blades

5.5.8 Blade tracking and helicopter vibration analysis

– Precautions to observe when moving and positioning helicopters (e.g. turning rotor blades)

– Methods of and requirements for tracking main and tail rotor blades

– Balancing, static and dynamics of main and tail rotor blades

– Hub and main rotor alignment; checks and adjustment on semi-rigid rotor heads

– Types of vibration experienced in helicopters: causes and effects

– Methods used to reduce vibration and dampers

– Auto-rotation: calculation of correct rotor speed and effects of too high or too low rotor RPM

5.5.9 Fuselage, doors, engine mounts and landing: (Gear attachments)

– Construction methods: truss (Pratt truss and Warren truss), monocoque and semi-monocoque (including the identification of load-carrying members)

– Construction of doors, nacelles and firewalls

– Engine mountings, pylons, and vibration damping

– Landing gear and skid mounting attachment points

– Winches, cables, supports, lifting hooks, and hard points

– Flotation devices: explosive and mechanical activation

5.6 AIRSHIP SYSTEMS AND STRUCTURES

5.6.1 Principles of lift

– Bodies immersed in fluids

– Gases: expansion, constant volume, constant pressure and constant temperature

– Mixture of gases in a containing vessel

– Centre of gravity, centre of buoyancy, static heaviness, static lightness and static trim

– Ballonet ceiling and pressure height

– Super pressure and superheat

– Porosity

– Equilibrium and ballast-shot/water

5.6.2 Theory of flight and control

– Aerodynamic lift and aerodynamic balance

– Stability and control

- Free ballooning, fins, rudders and elevators
- Tabs: balance, servo, trim and spring
- Powered-flying controls

5.6.3 Envelope

- Materials: fabrics and Kevlar
- Ultraviolet light effects
- Gas-tight membranes
- Ballonets, gases load curtains, shear curtains, support cables, gas valves, air valves, entry ports, inspection domes, charge adaptors, load patches, handling lines, and nose cone
- Charging, purging, and porosity checks
- Lightning protection
- Air systems: ram air scoops, ballonet fans, dampers, and transfer fans

5.6.4 Gondola

- Materials: Kevlar laminate, Fibrelam sandwich panels, etc.
- Moulding/bonding techniques
- Support cables, support cable attachments, bulkheads, and equipment attachment
- Furnishings
- Doors, windows and hatches
- Fire protection and skinning
- Lightning protection

5.6.5 Airship flight control

- Fins, rudder and elevators
- Operating systems and surfaces: manual- and power-operated
- Trim operating systems: manual and electric

5.6.6 Ice and rain protection

- Windscreen wipers
- Surface de-icing systems

5.6.7 Heating and ventilation

- Exhaust heat exchangers
- Ventilation systems

5.6.8 Vacuum and pressure

- Supply and associated systems

5.6.9 Toilets and water systems

- Toilets
- Potable water systems
- Potable water: health considerations

5.6.10 Landing gear

- Geometric arrangements
- Structural arrangements
- Castoring, pivoting and locking
- Shock absorbers
- Weight sensing/measurement

5.6.11 Airship ducted propellers

- Principles of operation
- Propeller forces: aerodynamic and centrifugal
- Pitch variation/control
- Positive/negative vectoring
- Power conversion
- Control systems: electronic control and emergency forward course selection

- Balance
- Clutches
- Materials of construction
- Protective finishes, contour control, and visibility
- Duct pivoting system: drive and control, motors, limit control, gearboxes, interconnection, and emergency manual

5.6.12 Ground handling

- Attachment to/release from mast
- Ground power
- Fuelling
- Ballasting
- Helium: charging, purifying, and leak testing
- Pressure watch techniques
- Mooring: mobile/portable
- Engine running
- Hangaring
- Adverse weather considerations

Chapter 6

AIRCRAFT ENGINEERING AND MAINTENANCE: ENGINES/POWERPLANTS

6.1 INTRODUCTION

6.1.1 In order to be able to satisfactorily assimilate training on individual engine types, the Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) must have a good fundamental understanding of the principles and functions of construction generally used in engines of all types.

6.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the engine or its components, the AME must have a very complete knowledge of all the associated maintenance practices likely to be used.

6.2 TRAINING OBJECTIVES

Conditions: The trainees will receive training in engineering principles related to the engine, propeller and powerplant structure, materials, components, construction, specifications and functional systems.

Performance: The trainees will describe the characteristics and applications of the materials used in engine and propeller construction, including the principles of their construction and function: fastening techniques; associated powerplant systems (mechanical, fluid, electrical and electronic); associated flight deck instruments and display systems; engine and propeller control systems; and ground running and maintenance adjustments.

Standard of accomplishment: The trainees will describe the characteristics and applications of the materials, construction and system operating principles and maintenance practices in accordance with actual practice on existing engines, propellers and powerplants.

6.3 PISTON ENGINES: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

6.3.1 Principles of operation and terminology

– Understanding of the following terms:
  - bore
  - stroke
  - top dead centre (TDC)
  - bottom dead centre (BDC)
  - swept volume
  - clearance volume

– Calculation of mechanical and thermal efficiency

– Four-stroke operating cycle: efficiency, volumetric efficiency, piston displacement and compression ratio

– Two-stroke operating cycle: piston displacement and compression ratio

– Valve operating cycle: valve lead, valve lag and valve overlap

– Layout and typical firing order of in-line, horizontally opposed, vee and radial piston engines

6.3.2 Engine construction: Top end

– Constructional features, function, classification and material composition of: cylinders, pistons, piston rings, piston or gudgeon pins, connecting rods, inlet and exhaust manifolds

6.3.3 Engine construction: Valves and valve operating mechanisms

- Constructional features, function, classification and material composition of: rocker assemblies, push rods, cam followers, tappets, inlet and exhaust valves/seats/guides/springs

- Valve types: poppet, sleeve, rotary, disc and reed

6.3.4 Engine construction: Bottom end

- Constructional features, function, classification and material composition of: crankshafts, cam shafts, cam rings, engine casings, sumps, and accessory/reduction gearboxes

- Typical ball, roller and plain bearings

6.3.5 Engine power

- Calculation of mechanical efficiency, thermal efficiency, volumetric efficiency, piston displacement and compression ratio from given information

- Effect of incorrect valve timing on the above parameters

- Measurement of piston displacement, compression ratio and manifold pressure

6.3.6 Engine power measurement

- Determination/calculation of horsepower (HP) and/or kilowatt (KW); indicated horsepower (IHP); friction horsepower (FHP); brake horsepower (BHP); indicated mean effective pressure (IMEP); brake mean effective pressure (BMEP); friction mean effective pressure (FMEP)

- Plot of fuel consumption and engine power charts from given information

6.3.7 Factors affecting engine power

- Rich and lean mixture burn rates and effect upon engine

- Symptoms and causes of: pre-ignition, detonation, after firing and backfiring

- Calculation of brake-specific fuel consumption (BSFC) from given engine data

- Definition of the following terms:
  - stoichiometric mixture
  - rich best power mixture
  - lean best power mixture
  - cruise power mixture

6.3.8 Classification of engine lubricants and fuels

- Properties and specific uses of mineral, ashless dispersant, detergent and hypoid oils

- Terms in relation to engine oil ratings: viscosity and viscosity index, flashpoint, pour point and cloud point

- Classification methods of piston engine fuels (aviation gasolines)

- Terms in relation to piston engine fuels: octane rating, anti-knock additive (tetraethyl lead), performance number, volatility, specific gravity, and Reid vapour pressure test values

- Grease: types, characteristics and uses

6.3.9 Magneto ignition system principles

- Magneto principles

- Terms: “E” gap, flux eddies, flux reversal, etc.

- Function of contact breaker and condenser/capacitor distributor

- Primary and secondary systems

6.3.10 Ignition systems

- Construction of polar inductor and rotating magnet magneto types

- Effect on timing of magneto points gapping

- Advanced and retarded ignition timing

- Magneto switches, harnesses, screening and bonding

- Construction and function of magneto compensating cam

- Battery ignition systems
- Auxiliary ignition systems, booster coil, induction vibrator and impulse coupling
- Low and high tension systems
- Safety precautions associated with ignition systems

6.3.11 Spark plugs and ignition leads

- Constructional features and materials, temperature classification, reach, gapping and effect on spark plug performance
- Diagnosis of engine condition by spark plug appearance
- Ignition lead/harness construction, features and screening

6.3.12 Float chamber carburettors

- Principles, features and construction
- Configurations, updraught and downdraught
- Operation of: throttle valves, main and idle jets, power enrichment systems, float chambers, discharge nozzles, accelerator pumps, mixture control systems, and altitude control
- Causes and effects of impact, throttle and fuel ice
- Carburettors heat

6.3.13 Pressure injection carburettors

- Principles, features and construction
- Operation of air/fuel metering forces, mixture control system, idle system, acceleration system and power enrichment system (manual/airflow)

6.3.14 Fuel injection systems

- Principles, features and construction
- Operation and function of air/fuel metering forces, impact tubes, venturis, flow dividers, throttle valves, altitude mixture controls, fuel injection nozzles, fuel injection pumps, fuel control units, and electronic control

6.3.15 Lubrication systems

- Principles, features, operation and construction of wet and dry sump lubrication systems
- Operation, features and construction of pressure pumps, scavenge pumps, oil coolers, oil cooler regulators, oil tank/hoppers, relief valves, check valves, oil filters, and oil dilution systems
- Oil pressure regulation and indication

6.3.16 Induction, exhaust and cooling systems

- Construction and operation of typical engine induction/intake and alternate air systems
- Construction, features, material and operation of typical engine exhaust systems
- Engine cooling: air and liquid, and cooling efficiency
- Radiators, liquid jackets, pipes and connections
- Coolant fluids: types, characteristics and hazards
- Heat exchangers, fins, baffles, cowls, cowl flaps, gills, panels, and air seals

6.3.17 Supercharging/Turbocharging

- Principles and purpose of supercharging and its effects on charge density and temperature; brake horsepower (BHP); manifold absolute pressure (MAP); detonation; revolutions per minute (RPM); fuel consumption
- Construction and operation of typical geared supercharger
- Construction and function of impeller; diffuser; engine gear drives; turbine; intercooler
- Understanding of the following terms:
  - rated altitude
  - critical altitude
  - overshoot
  - boot strapping
  - upper deck pressure
  - manifold pressure
- System configurations: internal (supercharger), external (turbo supercharger), multi-stage and multi-speed
- Differences between ground and altitude boosted engines

- Function and construction of system control components: absolute pressure controller; variable absolute pressure controller; ratio controller; manifold pressure relief valve; waste gate assembly
- Operation and function of system with ground adjusted waste gate valve and manifold pressure relief valve
- Function, requirements and operation of lubrication system
- Identification of supercharging faults involving low power, surging, low deck pressure, high deck pressure, low critical altitude, and low oil pressure
- Lubrication system and protective devices
- Control system adjustments

6.3.18 Rotary (Wankel) engine theory

- Analysis of Wankel (rotary) cycle
- Rotor design and shape: rotor tip seals
- Combustion chamber shape and sealing
- Rotor shaft and epitrochoidal gear drive to output shaft
- Unit construction, weight, power, and fuel consumption
- Lubrication system
- Carburation and control system adjustments

6.3.19 Piston engine installation

- Safety precautions associated with the installation and removal of engines
- Storage, preservation and inhibiting techniques required for piston engines
- Engine bearers, anti-vibration mounts, and bearer mounting points
- Hoses, pipes, feeders and connections from systems to engine
- Control lines and cable lifting points
- Inspection of engine bearers for serviceability and condition
- Cowls, drains, electrical wiring, exhaust and inlets associated with engine installations

6.3.20 Piston engine operation, maintenance and ground running

- Precautions and pre-start checks prior to ground running a piston engine
- General precautions for starting, running and stopping a piston engine
- Use of power charts and graphs to determine engine performance
- Determination of piston engine defects from data obtained during an engine run
- Maintenance procedures: removal, replacement and inspection of valve operating assemblies, cylinders, pistons, bearings and associated components
- Top-end overhauls
- Understanding of the use of maintenance data in Specification 100 or 2100 of the Air Transport Association (of America) (ATA)

6.4 PROPELLERS: REQUIRED KNOWLEDGE, SKILLS, AND ATTITUDES

6.4.1 Propeller theory

- Blade element theory
- Effects on propeller thrust by high/low blade angle and reverse angle, angle of attack, pitch, and rotational speed
- Understanding of propeller slip
- Forces affecting rotating propeller blade: aerodynamic force, centrifugal force, torque and thrust
- Effects in changes in the direction of relative airflow on blade angle of attack

6.4.2 Propeller configuration and type

- Propeller types: fixed pitch, ground adjustable, controllable pitch, and constant speeding

6.4.3 Propeller construction, assembly and installation

- Construction methods and specific materials used in composite, metal and wooden propellers

– Typical mounting requirements for tapered and splined propeller installations

– Understanding of the following terms:
  - blade station
  - blade face
  - blade shank
  - blade back
  - blade shank
  - hub assembly

6.4.4 Pitch change mechanisms

– Operation and function of the following pitch change mechanisms: mechanical, hydraulic, aerodynamic, aerodynamic and hydraulic combination, and electrical

– Function and operation of propeller feathering and synchronizer systems

6.4.5 Governors: Principles of operation and construction

– Operation of typical governors

– Effects of variation in spring pressure and engine RPM on governor operation

– Single and double acting governors

– Operation and function of speeder springs, pitch change stops, pilot valves, and fly weights

– Understanding of the following conditions on speed:
  - under speed
  - over speed
  - alpha
  - beta
  - feathering
  - unfeathering
  - reverse pitch

6.4.6 Damage and repair criteria

– Assessment of propeller blade damage

– Erosion, corrosion, impact damage and delamination

– Treatment/repair schemes for metal, wooden and composite blades

6.5 GAS TURBINE ENGINES: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

6.5.1 Fundamental principles

– Relationship between force, work, power, energy, velocity, and acceleration and their respective relationship to gas turbine operation

– Definition and application to gas turbine operation of the following:
  - potential energy
  - kinetic energy
  - Newton's Laws of Motion
  - Brayton Cycle
  - Bernoulli's Theorem
  - thermodynamic laws

– Constant pressure gas turbine cycle, open cycle and closed cycle gas turbines

– Basic constructional arrangement and the relative merits of the following engine types: turbojet, turbofan, turboshaft, turboprop, prop fan and ducted fan

6.5.2 Principles of propulsion

– Understanding of the following conditions, their relationship to each other and their application to engine operation:
  - gross thrust
  - net thrust
  - chocked nozzle thrust
  - thrust distribution
  - resultant thrust
  - thrust horsepower
  - equivalent shaft horsepower
  - specific fuel consumption

– Adiabatic, thermal and propulsive engine efficiencies and ways to derive them

– Bypass ratio and engine pressure ratio

– Pressure, temperature and velocity of the gas flow as it passes through each section of the engine

6.5.3 Inlet ducts

– Principles of operation and construction of the following compressor inlet ducts: subsonic, supersonic and bell-mouth

– Effects on pressure, velocity and temperature of airflow through convergent, divergent and convergent-divergent ducts

– Effects of ram recovery and the causes of inlet duct losses

6.5.4 Centrifugal compressors

– Constructional features, materials, operating principles and applications of single stage and multi-stage centrifugal compressors

– Purpose and function of impellers, diffusers, and inlet guide vanes

– Pressure ratios, inspection and balancing

6.5.5 Axial compressors

– Constructional features, materials, operating principles and applications of the following axial flow compressors: single spool, dual/twin spool and triple spool

– Purpose and function of rotor blades, stator blades, fixed inlet guide vanes and variable inlet guide vanes

6.5.6 Compressor operation

– Purpose, constructional features, materials, operating principles, advantages and disadvantages of a combined axial and centrifugal compressor assembly

– Causes, effects and control of compressor stall and surge

– Principal methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes and rotating stator blades

– Compressor ratio and ways to derive it

6.5.7 Combustion section

– Constructional features, materials and principles of operation of the following combustion chambers and their respective advantages and disadvantages: can type, can-annular type, annular type and reverse flow annular type

– Understanding of the following terms:
  - primary zone/airflow
  - secondary zone/airflow (dilution and cooling)
  - combustion fuel/air ratio
  - overall fuel/air ratio
  - flame temperatures
  - flame stabilization

– Construction, purpose and principles of simplex (single orifice) atomizing fuel nozzles, duplex (dual orifices) atomizing fuel nozzles, spill type atomizing fuel nozzles, and vapourizing type nozzles

– Construction, purpose and operation of swirl chambers, air shrouds and discharge orifices

6.5.8 Turbine section

– Principles of operation and characteristics of the following turbine blading: impulse, reaction and impulse-reaction

– Purpose and function of nozzle guide vanes and driving force for impulse and impulse reaction turbines

– Differences between turbine power extraction requirements for turbojet, turbofan and turboprop engines

– Various methods of turbine blade to disc attachment

– Causes and effects of turbine blade stress

– Factors which determine blade creep

– Constructional properties of typical materials used in the fabrication of turbine components

6.5.9 Exhaust section

– Constructional features, purpose, operating principles and materials of exhaust system: cone, tailpipe, propelling nozzle, cooling shroud, and gas flow straighteners

– Purposes of convergent, divergent and variable area nozzles

– Pressure, velocity and temperature changes that occur in various types of exhaust systems

– Principles of operation, constructional features and purpose of thrust reversers

– Effect of thrust reversers on engine efficiency, re-ingestion of exhaust gases, and magnitude of reverse thrust produced

- Constructional features, materials and principles of operation of engine noise suppressors

- Methods of reducing engine noise level

- Relationship between turbulence and energy in the exhaust gas stream to engine noise levels, typical noise patterns and methods of reducing noise levels

6.5.10 Bearings and seals

- Types, constructional features and principles of operation of bearings used in gas turbine engines

- Primary loads and causes acting on the engine main bearings

- Purpose, construction and principles of operation of typical gas turbine engine bearing seals

6.5.11 Classification and properties of lubricants and fuels

- Basic requirements of a gas turbine lubricant: viscosity and viscosity index

- Desirable characteristics of synthetic-based lubricants: low volatility, anti-foaming quality, low lacquers and coke deposit, high flashpoint, and low pour point

- Properties of gas turbine fuels: specific gravity, calorific value, vapour pressure, flashpoint, fire hazard, fuel icing, and corrosion characteristics

- Fuel additives: anti-icing and anti-microbiological

- Ground handling requirements and safety precautions to be observed in relation to gas turbine engine fuels, oils and additives

- Effects of the following on safety, handling and inspection procedures: exposure to skin or eyes, flammability, misting, evaporation rate, gum formation, corrosion, contamination (water and dirt), and sampling

6.5.12 Lubrication systems

- Arrangement, requirements and principles of operation of gas turbine engine lubrication system

- Function, relationship and typical location of oil tank; oil pumps (pressure/scavenge); oil filters/screens; oil jets; oil cooler; scavenge sub-system; vent sub-system (air/oil separators); valves (bypass/check/relief)

6.5.13 Fuel control and metering systems

- Requirements, arrangement and principles of operation of gas turbine fuel control and metering system including: starting control, acceleration scheduling, over-speed governing, power limiting, temperature limiting, air density/altitude/outside air temperature (OAT)/airspeed compensation, and shutdown control

- Operation and function of fuel system components: main fuel pumps, fuel filters (HP and LP), fuel heater, fuel control unit (hydro-pneumatic, hydro mechanical and electromechanical), governors and limiting devices, engine sensing variables, and valves (throttle/dump/shut off)

6.5.14 Engine air systems

- Requirements, arrangements and principles of operation of gas turbine engine air distribution and anti-ice control systems (including internal cooling, sealing and external air services)

- Relationship, location and operation of engine internal cooling/sealing system components, air distribution/external services components, and air starting system components

- Effects of faults in components on internal cooling/sealing, anti-icing, anti-surge, bleed and air distribution systems

6.5.15 Starting and ignition systems

- Requirements, arrangements and principles of operation of gas turbine engine starter systems and their components: electric starters, starter generators, air turbine starters, turbo starter systems (cartridge and monofuel), and pressure regulating and shut-off valves

- Requirements, arrangements and principles of operation of the following engine ignition systems and their components: low voltage D.C. input, high voltage AC input, igniter and glow plug types, and harnesses

- Safety precautions during servicing and maintenance of engine ignition systems

- Effect of faults in components of engine ignition and starting systems

6.5.16 Power augmentation systems

– Principles of operation, requirements and typical location of components in water injection and water/methanol injection systems

– Interrelationship between the augmentation system components and the fuel control system

– Principles of operation and typical location of components in a reheat/afterburner system: burner ring, variable propulsion nozzle/two-position propulsion nozzle, burner ignition (spark, hotshot and catalytic), jet pipe, cooling/airflow, and heat shield

– Effects of faults in engine power augmentation systems

6.5.17 Engine controls

– Principles of operation, requirements and typical location of components of the following engine controls: linkages and controls to and from propeller coordinator/interconnector and fuel control unit; units and components interconnected for emergency shut-down; mechanical control inputs and outputs for electrical fuel control systems; throttle/power/condition levers, cables and linkages

– Effects and rectification of faults in engine controls

– Electronic engine control (digital and analogue) including Full Authority Digital Engine Control (FADEC)

6.5.18 Engine operation, maintenance, and ground running

– Precautions and pre-start checks prior to ground running a gas turbine engine

– General procedures for starting, ground run-up and stopping a gas turbine engine

– Determination of engine and system malfunctions by using given typical manufacturers' data

– Interpretation of engine power output and parameters from limitation/performance charts

– Principles of trend monitoring pertaining to engine condition

– Determination of engine condition/defects from obtained data

– Inspection of engine and components according to criteria, tolerances and data specified by engine manufacturer

– Hot section inspections and manufacturer designated module split inspections

– Compressor washing/soft blasting

6.5.19 Engine installation, storage and preservation

– Function, construction and configuration of typical gas turbine engine firewalls; cowlings; acoustic panels; engine mountings; anti-vibration mounts; hoses; pipes; feeders; connectors; wiring looms; control cables and rods; lifting points and drains

– Blade containment areas/rings

– Basic requirements for the preservation and de-preservation of gas turbine engines, accessories and systems (both installed (on the wing) and during storage)

6.5.20 Turboprop engines

– Gas-coupled and gear-coupled turbines

– Reduction gears: construction, function and layout

– Over-speed safety devices

– Propellers for turboprops: design factor, starting requirements, constant speeding, feathering and braking control systems

6.6 FUEL SYSTEMS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

6.6.1 Operation, control, construction and indication

– Fuel boost pumps, engine high-pressure pumps and fuel heaters

– Refuel/de-fuel, feed, jettison and cross-feed systems

– Fuel valve operation and control

Chapter 7

AIRCRAFT ENGINEERING AND MAINTENANCE: AVIONICS — ELECTRICAL/INSTRUMENTS

7.1 INTRODUCTION

7.1.1 In order to be able to satisfactorily assimilate training on individual aircraft avionics systems, the Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) must have a good fundamental understanding of the principles and functions of the operation generally used in all types of aircraft avionics systems.

7.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the aircraft avionics systems or its components, the AME must have a very complete knowledge of all the associated maintenance practices that are likely to be used.

7.2 TRAINING OBJECTIVES

Conditions: The trainees will receive training in aircraft, electrical and electronic engineering principles related to the electrical, avionics and instrument components, materials, installations, specifications and functional systems of the aircraft.

Performance: The trainees will describe the characteristics, applications, and materials of aircraft electrical, avionics and instrument systems, including the principles of installation and operation, connection techniques, interface with associated aircraft and powerplant systems, flight deck instruments and displays.

Standards of accomplishment:
The trainees will describe the characteristics and applications of the materials, installation, construction, system operational principles and maintenance practices in accordance with actual practice on existing aircraft and systems.

7.3 MAINTENANCE PRACTICES AND MATERIALS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

7.3.1 Aircraft and workshop safety precautions

– A guide to the various aspects of safe working practices, including precautions to be taken when working with electricity, gases, oils and chemicals

– Instruction in the remedial action to be taken in the event of an accident with one or more of the hazards

7.3.2 Principles of workshop practices

– Care of tools

– Use of workshop materials

– Dimensions and standards of workmanship

7.3.3 General purpose tools

– Review of types of tools: hammers, mallets, screwdrivers, wrenches (spanners), torque wrenches, punches, hacksaws, clamps, vices and presses, snips and nibblers, chisels, files, reamers, taps and dies, drill bits, thread gauges, strippers, crimping tools, grease guns, oil cans, and lubricating syringes

7.3.4 General purpose power tools

– Electric and pneumatic-powered saws, drills, grinders, sanders, routers, nibblers, riveting guns and heat guns

7.3.5 Precision measuring tools

– Micrometers: metric and inch, vernier gauge, vernier calipers, surface table and accessories, marking out, dial test indicators, go/no-go gauges, combination sets, bore and depth gauges, steel rule, inside and outside calipers, slip gauge and feeler gauge

7.3.6 Screw threads

– Screw nomenclature

– Thread forms, dimensions and tolerances for standard threads used in aircraft

– Measuring screw threads

7.3.7 Bolts, studs, screws and fasteners

– Bolt types: specification, identification and marking of aircraft bolts, Society of Automotive Engineers (SAE), and metric

– Nuts: self-locking, anchor and standard types

– Machine screws: aircraft specifications

– Studs: types and uses, insertion and removal

– Woodscrews, cotter pins, self-tapping screws and nuts, and dowels

– Locking devices: tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick release fasteners, keys, circlips and turnbuckles

7.3.8 Fits and clearances

– Allowances and tolerances, drill sizes for bolt holes, and classes of fits

– Common system of fits and clearances

– Schedule of fits for avionics systems installation

– Limits for bow, twist and wear

7.3.9 Engineering drawings and diagrams

– Understanding of the following drawing types and diagrams, their symbols, dimensions and tolerances:
  - orthographic
  - isometric
  - oblique
  - perspective
  - electrical
  - block
  - schematic
  - sectional
  - blueprint
  - logic flow chart

– Identification of the following information from the title block:
  - drawing and revision number
  - reference number
  - scale
  - weight

– Understanding of the use of maintenance data in Specification 100 and 2100 of the Air Transport Association (ATA) of America

7.3.10 Electrical cables and connectors

– Wire types: insulation, strand metal composition, strand number and diameter, wire gauge rating, voltage and current-carrying capacity and rating, temperature characteristics, uses, identification of wire codes, and braiding

– High-tension cables: precautions, identification, and routing

– Coaxial cables: identification, uses, methods of attaching connectors, testing, and installation precautions

– Crimping: types of crimp ends, in-line, lug, bayonet, wrist joint, blind end, and terminal

– Identification of crimps: colour code, identification marks, insulation grip, wire grip, and crimp form

– Testing of crimp joints: millivolt drop test, crimp pull test, etc.

– Crimp tools: types, colour codes, ratchet devices, jaws and chucks, testing and go/no-go gauges

– Connector types, pins, pin removal and insertion, insertion and removal tools, plugs, sockets, insulators, current and voltage rating, coupling, and identification codes

7.3.11 Soldering

- Soldering irons: types, sizes and uses
- Solder: tin/lead content, melting point, and chemical combinations
- Flux: types, uses and purpose of flux, core flux, flux removal, flux corrosion and flux temperatures
- Special solder for non-ferrous metals
- Soldering techniques
- Anti-static considerations when soldering
- Heat shunts and de-soldering
- Dry joints and soldering defects

7.3.12 General test equipment for avionics

- Operation, construction, functions and uses of the following: AC and DC voltmeters, ammeters, ohm-meters, multimeters, bonding testers, Meggers, decade boxes, attenuators, frequency meters, watt/meters, Wheatstone bridge, volt amps reactive (VAR) meter, logic probe, cathode ray oscilloscope (CRO), dummy loads, audio frequency (AF) and radio frequency (RF) output power meters, voltage standing wave meter (VSWR), spectrum analyser, and AF/RF signal generators

7.3.13 Aerodynamics

- Atmosphere, pressure, temperature, humidity and density
- Newton's Laws of Motion, general gas laws, and Bernoulli's Theorem
- Airflow in relation to a body, steady or moving
- Aerofoils, shape and aspect ratio, and pressure distribution
- Lift, weight, thrust and drag
- Conditions of flight, centre of gravity, loads and forces
- Flight stability: longitudinal, lateral and directional
- Slip and skid
- Control surfaces: elevators, ailerons, rudders, elevons, ruddervators, stabilators and canards
- Boundary layer control: aerodynamic balancing
- Considerations and factors affecting high speed and supersonic flight

7.3.14 Aircraft handling

- Aircraft towing: safety precautions, towing arm types, weak links, locking devices, weight and balance limits, turn angle limits, aircraft brake control, lookouts, tugs and tractors
- Aircraft jacking: principles of aircraft jacking, safety precautions, weight and balance limits, jack types, jacking points and jacking techniques

7.4 ELECTRICAL AND ELECTRONIC FUNDAMENTALS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

7.4.1 Electron theory

- Structure and distribution of electrical charges within atoms, molecules, ions and compounds
- Molecular structure of conductors, semiconductors and insulators

7.4.2 Static electricity and conduction

- Static electricity and distribution of electrostatic charges
- Electrostatic laws of attraction and repulsion
- Units of charge
- Coulomb's Law
- Conduction of electricity in solids, liquids, gases and in a vacuum

7.4.3 Electrical terminology

- Definition of the following terms, their units and the factors affecting them:
  - potential difference
  - electromotive force

- voltage
- current
- resistance
- conductance
- charge
- conventional current flow
- electron flow

– Definition of the following units and conversion from one unit into another unit: giga-, mega-, kilo-, milli-, micro-, nano-, pico-, and degrees (Fahrenheit, Celsius/Centigrade and Kelvin)

7.4.4 Generation of electricity and heat

– Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism and motion

– British Thermal Unit: calorie, specific heat and latent heat

– Heat transfer, convection, conduction and radiation

– Thermal expansion

– Coefficient of linear expansion

– Bimetallic strips

7.4.5 DC sources of electricity

– Construction and basic chemical action of the following: primary cells, secondary cells, lead acid cells, nickel cadmium cells and other alkaline cells

– Cells connected in series and in parallel

– Internal resistance and its effect on a battery

– Construction, materials and operation of thermocouples

7.4.6 DC circuits

– Ohm's Law

– Kirchoff's Voltage and Current Laws

– Calculations to find resistance, voltage and current by using Ohm's Law, Kirchoff's Voltage and Current Laws, etc.

– Significance of the internal resistance of a supply

7.4.7 Resistors and resistance

– Resistance and affecting factors

– Specific resistance

– Positive and negative temperature coefficient conductance

– Fixed resistors including their stability, tolerance and limitations: carbon composition, carbon film, wire wound, and metallic film

– Variable resistors: wire wound, carbon film, thermistors, voltage dependent resistors and varistors

– Resistor colour code, values and tolerances, preferred values, and wattage ratings

– Resistors in series and in parallel

– Calculation of total resistance by using series, parallel and series-parallel combinations

7.4.8 Power

– Dissipation of power by a resistor

– Power, work and energy (kinetic and potential)

– Conversion of horsepower to watts and vice versa

– Power formula

– Maximum power transfer theorem

– Calculations involving power, work and energy

7.4.9 Rheostats and potential dividers

– Construction, operation and use of potentiometers and rheostats, and the effect of varying the load on the output voltage

– Construction and operation of Wheatstone bridge

– Polarities of potential differences in resistive circuits

7.4.10 Capacitors and capacitance

– Principles of the operation and function of a capacitor

– Factors affecting the capacitance area of plates, distance between plates, number of plates, dielectric and dielectric constant

- Units of capacitance and their interrelationships
- Working voltage, voltage rating, and relationship between capacitance and working voltage
- Construction and function of the following capacitors: paper, mica, ceramic, electrolytic and tantalum
- Capacitor colour coding and preferred values
- Variable capacitors: air and solid dielectric
- Calculations of capacitance and voltage in series and parallel circuits
- Exponential charge and discharge of a capacitor, and time constants
- Testing of capacitors using an ohmmeter for short circuit, open circuit, and leaky capacitor

7.4.11 Magnetism

- Properties of a magnet
- Theory of magnetism, molecular and domain
- Laws of attraction and repulsion
- Action of a magnet suspended in the earth's magnetic field
- Magnetization and demagnetization
- Artificially-made magnets
- Magnetic shielding
- Various types of magnetic material
- Electromagnets: construction and principles of operation
- Hand-clasp rules to determine magnetic field around current-carrying conductor: north and south poles; the direction of current flow through a coil
- Factors affecting field strength in electromagnets
- Magnomotive force (MMF): field strength (H), magnetic flux density (B), permeability, B/H curves, hysteresis loop, retentivity, coercive force, reluctance, saturation point, and eddy currents
- Precautions for care and storage of magnets

7.4.12 Inductors and inductance

- Faraday's Law
- Action of inducing a voltage in a conductor moving in a magnetic field
- Effects of the following on the magnitude of an induced voltage:
  - magnetic field strength
  - rate of change of flux
  - the number of conductor turns
- Mutual induction
- Effect of the rate of change in primary current and of mutual inductance on induced voltage
- Factors affecting mutual inductance:
  - number of turns in coil
  - physical size of coil
  - permeability of coil
  - position of coils with respect to each other
- Unit of inductance
- Lenz's Law and the rules determining polarity
- Back electromotive force (EMF) and self induction
- Calculation of total inductance in series, parallel and series-parallel circuits
- Inductive resistive circuit: functions and time constants
- Saturation point
- Principal uses of inductors
- Construction and functions of fixed inductors: laminated iron core, iron dust core, air core and ferrite core
- Methods of varying inductor value: tapped coil, slider contact on coil, adjustable slug, and variometer
- Testing inductors for faults, open circuit coil, and shorted turns

7.4.13 DC motor/generator theory

- Construction and purpose of components in DC generator
- Operation of and factors affecting output and direction of current flow in DC generators

- Operation of and factors affecting output power, torque, speed and direction of rotation of DC motors
- Series wound, shunt wound and compound motors

7.4.14 AC theory

- Analysis and terms related to sinusoidal waveform: radian, angular velocity, phase, period, frequency and cycle
- Harmonic: effects of even and odd harmonics on fundamental waveform
- Current and power calculations of the following values in relation to voltage: instantaneous, average, root mean square, peak and peak-to-peak

7.4.15 Resistive (R), capacitive (C) and inductive (L) circuits

- Phase relationship of voltage and current in L, C and R circuits: parallel, series and series-parallel
- Power dissipation in L, C and R circuits
- Factors affecting inductive and capacitive reactance
- Calculations of inductive and capacitive reactance
- Impedance, phase angle, power factor and current calculations
- Calculations of true power, apparent power and reactive power

7.4.16 Series and parallel resonance

- Definition of resonance
- Changes in circuit properties at resonance of parallel- and series-tuned circuits
- Effects of circuit prior to and after resonance
- Effects on impedance, current and phase angle when frequency of a series or parallel resonant circuit is varied
- Frequency response curves for series and parallel resonant circuits
- Voltage magnification factor (Q) of a circuit
- Effects of resistance on circuit “Q” and resonance curves
- Calculation of circuit resonant frequency
- Calculation of bandwidth
- Operation and use of tank circuit

7.4.17 Transformers

- Operation of transformer
- Transformer: losses and methods for overcoming them
- Transformer action under load and no-load conditions
- Power transfer, efficiency, and polarity markings
- Calculation of primary and secondary current, primary and secondary voltage, turns ratio, power, and efficiency
- Auto transformers and variacs

7.4.18 Filters

- Operation, application and uses of the following filters: low pass, high pass, band pass and band stop
- Interpretation of filter response curves
- Function of and differences between active filters and passive filters

7.4.19 AC generators

- Rotation of loop in a magnetic field and the waveform produced
- Principles, operation and construction of revolving armature and revolving field type AC generators
- Single-phase, two-phase and three-phase alternators
- Three-phase star and delta connections: advantages and uses
- Calculation of line and phase voltages and currents
- Calculation of power in three-phase system

7.4.20 AC motors

- Construction, principles of operation and characteristics of AC synchronous motors and induction motors (both single and polyphase)

- Methods of speed control and direction of rotation

- Methods of producing a rotating field: capacitor, inductor, shaded or split pole

7.4.21 Signal processing devices

- Principles, operation and uses of the following signal processing devices: summing networks or points, integrators, limiters, modulators, demodulators, adders and subtracters

7.4.22 Servo-mechanisms

- Understanding of the following terms:
  - open and closed loop
  - follow-up
  - servo-mechanism
  - analogue
  - transducer
  - null
  - damping
  - feedback
  - dead band
  - hunting

- Construction, operation and uses of the following synchro-system components:
  - resolvers
  - differential
  - control
  - torque
  - E and I transformers
  - inductance transmitters
  - capacitance transmitters

- Control and displacement: rate/rate, rate/displacement, displacement/rate, and displacement/displacement

- Servo-mechanism defects, reversal of synchro leads, and hunting

7.4.23 Semiconductors (diodes)

- Materials (silicon and germanium): electron configuration, crystalline structure, and electrical properties

- P and N type materials: effects of impurities on conduction, doping process to produce P and N type materials, majority and minority characters

- PN junction in a semiconductor

- Development of a potential across a PN junction in unbiased, forward biased and reverse biased conditions

- Diodes: symbols

- Characteristics of diodes: ideal, silicon, germanium and Zener

- Parameters of diodes: peak inverse voltage, maximum forward current, temperature, frequency, leakage current, and power dissipation

- Diodes in series and in parallel

- Zener effect

- Operation and function of diodes in the following circuits: clippers, clampers, full- and half-wave rectifiers, bridge rectifiers, voltage doublers and triplers (multipliers)

- Testing of diodes with an ohmmeter

- Operation and characteristics of the following devices: tunnel diode, silicon controlled rectifier (SCR), light emitting diode (LED), Shockly diode, photo conductive diode, varactor diode, varistor, Shottky barrier diode, diacs and triacs

7.4.24 Semiconductors (bipolar junction transistors)

- Construction and operation of PNP and NPN transistors

- Base, collector and emitter junctions

- Transistor parameters: IB, IC, IE, beta, alpha, Vbe, power gain, distortion and saturation, input and output impedance, and frequency response

- Diagrammatical symbols for PNP and NPN transistors

- Amplification, current voltage and power

- Temperature effects on transistors

- Biassing required to operate a transistor as a switch, class A amplifier, class B amplifier and class C amplifier

– Characteristics of the following amplifiers: class A, class B and class C

– Methods of bias stabilization: negative feedback, temperature stabilization resistor, thermistor, diode and transistor

– Transistor configurations, operation and characteristics of the following: common base, common collector and common emitter

– Transistor data sheets: interpretation of specification

– Identification of standard transistor package forms

– Testing transistors by using an ohmmeter

7.4.25 Types of transistor

– Characteristics, operation and application of the following devices:
  - injunction transistor
  - programmable injunction transistor
  - opto isolator
  - power transistor
  - photo transistor
  - small signal transistor
  - hall effect devices

7.4.26 Field effect transistors (FET)

– Operation, characteristics and basic circuit configuration of the following FET:
  - junction (JFET)
  - metal oxide silicon (MOSFET)
  - insulated gate (IGFET)

7.4.27 Operational amplifiers (OPAMP)

– Operation and function of an operational amplifier used as:
  - an integrator
  - a differentiator
  - a voltage follower
  - a comparator

– Parameters of OPAMP:
  - open loop gain
  - bandwidth
  - slew rate
  - input and output impedance
  - drift
  - input offset voltage and current

– Operation and function of the following amplifiers:
  - inverting amplifier
  - non-inverting amplifier
  - summing amplifier
  - differential amplifier

– Operation and connecting methods of amplifier stages:
  - resistive capacitive (RC)
  - inductive (transformer)
  - inductive resistive (IR)

– Advantages and disadvantages of positive and negative feedback

7.4.28 Transistor circuits

– Operation and characteristics of the following circuits:
  - push-pull amplifiers
  - darlington pairs
  - complementary symmetry configuration

7.4.29 Multi-vibrators and oscillators

– Characteristics and operation of the following multi-vibrators:
  - astable or free running
  - bistable or flip-flop
  - monostable or one shot

– Operation and function of the following transistor and FET oscillators:
  - Hartley
  - colpitts
  - resistive capacitive (RC)
  - inductive capacitive (IC)
  - crystal

7.5 DIGITAL TECHNIQUES, COMPUTERS AND ASSOCIATED DEVICES: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

7.5.1 Decimal to binary conversion

– Comparison of decimal and binary numbering systems

– Conversion of decimal into binary, and vice versa

– Addition and subtraction of binary numbers

7.5.2 Octal and hexadecimal conversion

– Conversion of decimal into octal and hexadecimal, and vice versa

7.5.3 Signed numbers

– Conversion of positive and negative numbers into their 1's and 2's compliment

– Addition of numbers in the 2's compliment

7.5.4 Digital calculation

– Addition and subtraction in binary coded decimal (BCD) and hexadecimal forms

– Conversion of hexadecimal numbers into 2's compliment form

7.5.5 Logic circuits

– Expression of logic diagrams in terms of Boolean algebra

– Conversion of Boolean algebraic expressions

– Identification of logic circuits

– Identification of the following logic gates symbols, their truth tables and equivalent circuits:
  - AND
  - NAND
  - OR
  - NOR
  - EXCLUSIVE OR
  - INVERTER

7.5.6 Flip-flop terminology and operation

– Understanding of the following flip-flop terms:
  - set up and hold times
  - asynchronous input
  - synchronous input
  - transition (positive and negative)
  - propagation delay
  - maximum clock frequency

– Symbols used to indicate clocked inputs and negative going transition (NGT)

– Operation and identification of symbols and truth tables for the following types of flip-flop: SC or RS, JK, and D type

– Operation and application of digital counters, shift registers, and data storage devices

– Operation, advantages and disadvantages of serial and parallel data transfer

7.5.7 Data conversion

– Operation and application of analogue to digital, and digital to analogue converters, inputs and outputs, and limitations of various types

7.5.8 Computer-related terminology

– Understanding of the following computer-related terminology:
  - bit
  - byte
  - address
  - nibble
  - operand
  - op code
  - label
  - software
  - mnemonic
  - hardware
  - firmware
  - instruction
  - instruction word
  - language
  - machine language
  - CPU (central processing unit)
  - accumulator

7.5.9 Basic microcomputers

– Operation, layout and interface of the major components in a microcomputer, including their associated bus systems

– Information contained in single and multi-address instruction words

7.5.10 Memory devices

– Understanding of the following memory-associated terms:
  - memory cell
  - memory word
  - capacity
  - read option
  - write option
  - access time
  - cycle time

– Operation of typical memory devices during READ and WRITE modes

– Operation, advantages and disadvantages of the following data storage systems: magnetic disk, magnetic bubble, magnetic core and magnetic tape

7.5.11 Integrated circuits (IC)

– Operation and use of encoders and decoders

– Function of the following encoder types:
  - binary coded decimal (BCD) to decimal or (4 ~o10)
  - binary to octal or (1 to 8)
  - octal to binary or (8 to 3)
  - priority encoders

– Understanding of the uses of:
  - medium scale integration (MSI)
  - large scale integration (LSI)
  - very large scale integration (VLSI)

7.5.12 Displays

– Function and operation of the following types of display:
  - liquid crystal display (LCD)
  - LED
  - Nixie tube
  - gas discharge

7.5.13 Multiplexers, de-multiplexers and tristate devices

– Operation, application and identification in logic diagrams of multiplexers, de-multiplexers and tristate devices

7.5.14 Microprocessors

– Understanding of the overall operation and functions performed by a microprocessor

– Basic operation of each of the following micro-processor elements:
  - control and CPU
  - clock
  - register
  - arithmetic logic unit (ALU)

7.5.15 Encoding and decoding

– Understanding of binary coded decimal (BCD), excess 3, and grey codes and their uses in converting binary and decimal numbers

– Understanding of the structure and uses of the ASCII code

– Understanding of the use of the parity method of error detection

– Information transmission via data buses, including various bus languages used by interconnecting systems

7.5.16 Cathode ray tubes (CRT)

– Principles of electrostatic and magnetic deflection as applied to cathode ray tubes

– Construction and basic operation of monochromatic and colour tubes

– Understanding of the following terms:
  - raster scanning
  - stroke pulse scanning
  - rho-theta and X-Y screen formats
  - interface scanning

7.5.17 Electrostatic sensitive devices (ESD)

– Sources of electrostatic sensitive devices (ESD) and the type of damage that static electricity can cause

– Special handling, identification, packaging, and protection requirements for ESD

– Personal anti-static protection devices

– Awareness of dangerous situations where there is a possibility of static charge build-up

7.5.18 Fibre optics

– Advantages and disadvantages of fibre optic data transmission over electrical wire propagation

– Fibre optic data bus

– Understanding of the following terms and effects relating to fibre optics:
  - absorption
  - attenuation
  - active medium
  - black body
  - coherent light
  - coherent bundle
  - dark current
  - diffraction
  - dopant
  - dispersion
  - flux rise time

- LED
- multimode fibres
- optical attenuators
- signal-to-noise ratio
- fibre data bus
- bit rate
- two-state modulation

– Topology: passive star, active star and transmissive star

– Terminations: cleaving, stripping, splicing, and termination losses

– Couplers, control terminals and remote terminals

– Application of fibre optics in aircraft and systems

7.5.19 Software management control

– Awareness of the necessary restrictions, airworthiness requirements and possible catastrophic effects of unapproved modifications or alterations to manufacturers' software programmes

7.6 AIRCRAFT ELECTRICAL SYSTEMS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

7.6.1 Power supplies: Lead acid batteries

– Plate materials, insulators, electrolyte, casing, terminals, specific gravity, capacity and capacity testing, determination of state of charge, constant current charging and constant voltage charging, gassing, sulphation, temperature, hydrometer, insulation and resistance (I/R) checks, and venting

– Safety precautions to be taken when dealing with lead acid batteries

– Neutralization of acid spills, action to take in the event of an acid spill and battery boil in an aircraft, cleaning, maintenance, storage and shipping requirements

– Environmental hazards associated with lead acid batteries

– Battery maintenance facilities, separation of location from nickel cadmium battery servicing area, ventilation, storage of acid and distilled water, mixing and dilution of sulphuric acid, protective clothing, battery service life and records of maintenance

7.6.2 Power supplies: Nickel cadmium batteries

– Plate materials, insulators, electrolyte, casing, terminals, capacity and capacity testing, determination of state of charge, gassing, venting, constant current charging and constant voltage charging, cell imbalance, cell voltage reversal, cell removal and replacement, cell leak testing, thermal runaway causes and prevention, temperature monitoring and warning, deep cycle recovery, and insulation and resistance (I/R) testing

– Neutralization of electrolyte spills, cleaning, maintenance, storage and shipping requirements

– Environmental hazards associated with nickel cadmium batteries

– Battery maintenance facilities, separation of location from lead acid servicing area, ventilation, storage of potassium hydroxide, protective clothing, battery service life and records of maintenance

7.6.3 DC generation

– Operation and characteristics of separately excited, shunt, series, compound wound and permanent magnet generators

– Generator construction: yoke, interpole and compensation windings, auxiliary interpoles, armature assembly, end frame assembly, brushes and gear assembly, terminal blocks, spark suppression, and installation

– Residual magnetism and effects of "flashing the field"

– Voltage regulation: carbon pile, vibrator type, cut-out, transistor type, solid state, and reverse current relays

– Multi-generator distribution: load sharing/paralleling, system layouts, and interlock circuits

– Starter generator systems, control, switching, and generator control units (GCU)

7.6.4 AC generation

– Cycle and frequency, instantaneous and amplitude values, root mean square values, phasing and phase relationships, and interconnection of phases

– Generator power ratings, power factor, effective power, apparent power, and reactive component (KVAR)

– Frequency wild generation systems: operation and application

- Generator construction: rotor, stator, brushes and gear assembly, slip rings, cooling fan, casing and end frame
- Constant frequency generation systems: operation and application (including brushless units)
- Generator construction: rotor, stator, exciter shunt field and stabilizing windings permanent magnet, exciter main poles, cooling system, and temperature compensation
- Constant speed drives (CSD): operation and construction, CSD and generator disconnect mechanisms
- Integrated drive generators (IDG): construction and operation
- Air driven generators (ADG) and ram air turbines (RAT): operation, function, and deployment
- Multi-generator distribution
- Load sharing and paralleling, real load sharing and reactive load sharing

7.6.5 Auxiliary power units (APU)

- Operation, control and protection of auxiliary power units
- Function of power generation
- Fire protection and warning

7.6.6 Power conversion equipment

- Rectifiers (conversion of AC into DC): selenium rectifiers, silicon rectifiers, operating limitations of rectifiers, silicon controlled rectifiers (SCR), rectifier circuit connections, and three-phase rectifiers
- Transformers: auto transformers, current transformers, potential/parallel transformers, control transformers, winding configuration star/delta, transformer ratings, and transformer rectifier units (TRU)
- Rotary conversion equipment: rotary converters, motor generators, rotary inverters and static inverters
- Frequency, voltage and current control

7.6.7 Power distribution systems

- Classification of power service requirements into vital, essential and non-essential
- Operation and layout of split and parallel bus systems, load shedding systems, priority bus systems, emergency bus, battery bus and ground power bus
- Defect analysis and fault finding
- Wire and cable types: identification, uses, characteristics, screening, protection, pressure and moisture sealing, looms, conduit and ducting, and clamping
- Bonding, earth/ground points, and DC/ACIRF earths
- Plugs and connectors and associated insertion and removal tooling
- Auxiliary power unit (APU) and ground power unit (GPU) interlocks and interface

7.6.8 Circuit protection devices

- Fuses, fuse holders, current limiters, limiting resistors, circuit breakers, reverse current cut-out relay, reverse current circuit breaker, over voltage protection, under voltage protection, over frequency protection, under frequency protection, Merz-Price protection system, and power contactors

7.6.9 Circuit controlling devices

- Switches, single and multi-pole/throw varieties
- Toggle and tumbler switches, push switches, rocker-button switches, roller switches, microswitches, time switches, rheostats, pressure switches, mercury switches, thermal switches, relays, proximity switches, attracted-core heavy duty relay, attracted-armature light duty relay, polarized armature relay, slugged relay, and magnetic amplifiers

7.6.10 DC motors and actuators

- Operation and construction of DC motors and actuators
- Characteristics and uses of shunt, series and compound motors (normal compound, stabilized shunt and shunt limited), and split field motors
- Speed direction and travel control, regulation and position feedback
- Clutches and brakes

7.6.11 AC motors and actuators

– Operation and construction of AC motors and actuators

– Methods of speed and rotational control: single-phase, two-phase and three-phase

– Clutches and brakes

7.6.12 Flight controls

– Principles, operation and maintenance of power control units (PCU), flap motors protection and control, and trim motors

– Position indication

– Fly-by-wire flight control systems (both digital and analogue), full authority systems and manual reversion systems

7.6.13 Fuel systems

– Fuel booster pump operation, control, construction and indication

– Function and operation of electrically controlled fuel valves

7.6.14 Hydraulic systems

– Function, operation, location and construction of electric pumps (indication and control)

– Function and operation of electrically controlled hydraulic valves

7.6.15 Pneumatic systems

– Operation of control indication and protection devices

– Function and operation of electrically controlled air valves

7.6.16 Landing gear systems

– Operation and function of electrical landing gear control and position indication

– Air/ground sensor systems

– Function and control of automatic braking systems

– Function, testing and operation of electric anti-skid system (covering each situation: no skid, skid and landing)

7.6.17 Propeller and engine control systems

– Function, operation, testing and maintenance of electrical propeller synchronizer and synchro-phaser systems

– Function, operation and testing of electric propeller feathering systems

– Function, operation and control of electronic engine control systems (both digital and analogue) including Full Authority Digital Engine Control (FADEC)

– Function and operation of electrical engine temperature and speed limiting systems

7.6.18 Ignition systems (piston engines)

– Safety precautions associated with aircraft ignition systems

– Function, operation and testing of magneto ignition (high and low tension systems), magneto and distribution speeds, "E" gap significance and adjustment, auxiliary starting devices, impulse couplings, compensating cams, ignition switches, dual ignition, and ignition leads

7.6.19 Ignition systems (turbine engines)

– Safety precautions associated with aircraft ignition systems

– Operation and layout of high energy ignition units (HEIU) (both AC- and DC-powered)

– High-energy igniter plugs: types, construction and maintenance

7.6.20 Fire detection and extinguishing systems

– Construction, operation, layout, testing and trouble-shooting of the following fire detection systems:
  - thermal switch
  - continuous loop (fire wire)
  - continuous element or pressure type sensor responder

– Operation, construction, layout, testing and trouble-shooting of the electrical aspects of aircraft fire extinguisher systems

– Safety precautions to be observed when dealing with aircraft fire extinguisher systems (including handling of explosive cartridges)

– Construction and operation of the following smoke detection systems: carbon monoxide, photoelectric and visual

– Typical fire and smoke cockpit warning indications, lights, bells, annunciator panels, and audio warnings

7.6.21 Aircraft lighting

– Operation, control layout and testing of typical aircraft lighting systems (both internal and external)

– External lighting: navigation lights, anti-collision lights (rotating and flashing), strobe lights, landing and taxi lamps, ice inspection lights, area inspection lights and logo lights

– Safety precautions when handling high-energy strobe light components

– Internal lighting: cockpit area lighting, instrument panel lights, instrument integral lighting, flood lighting, electroluminescent lighting, passenger cabin lighting, passenger instructional lighting (no smoking and fasten seat belts), strip lighting and passenger service unit (PSU) lighting

– Emergency lighting including crash inertia switches, floor proximity emergency escape path lighting and emergency exit lighting

7.6.22 Ice and rain protection systems

– Function of system control and overheat components

– Windscreen heating: control, indication and failure

– Windscreen wiper, washer and rain repellant systems

– Engine, propeller and airframe anti-ice protection: thermal, pneumatic and electrical

– Sensor ice protection: pitot head, static port, angle of airflow, and temperature probes

– Waste water and toilet drain heaters

– Antenna heaters

– Overheat indications and protection

– Ice warning and sensing devices indications

7.6.23 Air conditioning and heating systems

– Principles and operation of air conditioning

– Understanding of the following terms:
  - sensible heat
  - latent heat
  - conduction
  - convection
  - radiation

– Principles, operation, construction and maintenance of typical vapour cycle air conditioning systems

– Refrigerant types and uses, and physical and environ-mental hazards associated with each type

– Principles, operation, construction and maintenance of typical air cycle machines

– Control, monitoring, protection, maintenance and airflow of typical air conditioning systems

– Operation, construction and maintenance of typical combustion heater

– Heater warning and protection devices

7.6.24 Centralized warning and indication systems

– Operation of central warning and indication systems including inputs, output warnings and priority philosophy

7.6.25 Galley and toilet service systems

– Operation, safety devices and control of service power: supplies, water heaters, ovens, toilets and associated systems and equipment

7.6.26 Ground electrical power supplies

– Understanding of the operation and control of typical ground supply equipment including:
  - DC battery carts
  - DC GPU
  - AC/DC GPU
  - rectifiers and inverters

– Ground power supply plugs: types/patterns

– Ground power and aircraft interface, interlocks and safety devices

7.7 AIRCRAFT INSTRUMENT SYSTEMS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

7.7.1 Introduction

– Information required by pilot and crew

– Mandatory instruments

– Classification of aircraft instruments by type

– Classification of aircraft instruments by principles

– Classification of aircraft instruments by function

– Information presentation and dial design

– Instrument panel configurations

7.7.2 Atmospheric physics

– Understanding of the atmosphere, its layers and pressure, temperature and density variance with altitude

– Methods for measuring atmospheric pressure

– ICAO Standard atmosphere

– Operation of aneroid and mercury barometers for measuring atmospheric pressure

7.7.3 Terminology and conversion

– Understanding of the following instrument terminology:
  - hysteresis error
  - parallax error
  - absolute, differential and gauge pressure

– Methods of compensation of instrument mechanisms for temperature variations

– Reasons for hermetically sealing instruments

– Conversion from and to:
  - millimetres (mm) of mercury to inches of mercury, to millibars, to hecto pascals, to pounds per square inch
  - knots to miles per hour
  - US gallons to imperial gallons to litres to pounds

7.7.4 Pressure measuring devices

– Operation, function and construction of capsules (absolute and differential), diaphragms, bellows (absolute and differential) and bourdon

7.7.5 Pitot static systems

– Operation and construction of pitot static probes and static vents (primary and alternate)

– Layout of typical pitot static systems

– Pressure (position) error and its effect on pitot static instruments

– Pitot static system maintenance and leak testing

7.7.6 Altimeters

– Operation and construction of counter pointer altimeters including the effects that variation in temperature and atmospheric pressure have on their indications

– Understanding of the “Q” code terms: QFE, QNE and QNH

– Effect of QFE, QNE and QNH settings on the reading of an altimeter

– Effects and conditions associated with altimeters:
  - after effect
  - scale error and barometric scale error
  - friction

– Altimeter testing procedures

7.7.7 Vertical speed indicators (VSI)

– Operation and construction of vertical speed indicators, including instantaneous vertical speed indicators

7.7.8 Air speed indicators (ASI)

– Understanding of the following ASI-related terms:
  - indicated, calibrated and true air speed
  - speed of sound (subsonic, sonic, transonic and supersonic)
  - mach number and critical mach number
  - maximum operating speed/velocity (VMO)
  - maximum operating mach number (MMO)

– Operation, function and construction of: ASI and switches, Machmeter, mach/ASI, maximum allowable indicators

– ASI testing procedures

7.7.9 Miscellaneous altitude systems

– Operation, function and construction of typical altitude alerting and reporting systems, including encoding altimeters

7.7.10 Servo altimeters and air data computers

– Operation, function and construction of servo altimeters

– Principles of operation and layout of a typical air data computer system, including inputs and outputs

– Signal processors: mechanical, electrical and electronic

7.7.11 Instrument pneumatic systems and direct reading gauges

– Operation, function, construction and layout of a typical aircraft instrument pneumatic system

– Operation and construction of direct reading pressure, capillary type pressure and temperature gauges

7.7.12 Temperature indicating systems

– Wheatstone bridge application to instrument indication

– Operation and construction of various types of thermocouple

– Measurement of static air temperature indicating systems and total air temperature

– Cold junction compensation, material and construction of thermocouple leads and probes

– Operation and construction of radiation pyrometer type temperature indicating system

– Operation, construction and advantages of radiometer type indicators

7.7.13 Fuel flow and fuel quantity indicating systems

– Principles, operation, function and layout of typical float, capacitance and electronics type fuel quantity indicating systems

– Effects of temperature on fuel indicating system

– System compensation, adjustment and power supplies

– Principles, operation, function and location of typical fuel indicating system, including indicator, transmitter and power supplies

7.7.14 DC synchronous systems and engine speed indicating system

– Operation and construction of DC desyn and selsyn systems

– Operation, construction and maintenance of mechanical and electrical engine speed indicating systems and associated components

7.7.15 Engine indicating systems

– Operation, construction and maintenance of the following engine instruments:
  - manifold pressure gauges
  - torque meters
  - exhaust gas temperature gauges
  - engine pressure ratio gauges
  - turbine inlet temperature gauges
  - engine vibration systems
  - AC inductor
  - ratiometer oil pressure system

– Understanding of terminology associated with engine indicating/data systems

7.7.16 Gyroscopic principles

– Understanding of gyroscopic principles and terminology, including axis and plane of spin, degree of freedom, input and output axis, displacement gyro, topple and precession

- Relationship of Newton's First Law of Motion to Gyroscopes
- Gyroscopic precession and determination of the direction of precession resetting from applied forces
- Apparent precession and calculation of earth rate
- Rigidity and its affecting factors
- Gimbal lock, gimbal layout for two and three gimbal gyroscopes
- Drift (real and apparent) and affecting factors
- Gyro types: free, rate, tied and earth
- Precautions associated with the use and handling of gyroscopic instruments

7.7.17 Artificial horizons (AH)

- Operation, function and construction of air- and electrically-driven AH
- Understanding of the information displayed on AH
- Errors, acceleration, turn and erection, and methods for overcoming them
- Operation of the following erection systems: pendulous vane, ball type, torque motor and levelling switch
- Operation and precautions associated with fast erect systems

7.7.18 Turn and bank and turn coordinators

- Operation, function and construction of air- and electrically-driven turn coordinators, and turn and bank indicators
- Understanding of the information presented on turn coordinators, and turn and bank indicators

7.7.19 Directional gyros (DG)

- Operation, function and construction of directional gyros
- Operation and use of manual caging knobs
- Effects of gimbal re-balancing and gimbal errors on instrument operation

7.7.20 Compass systems

- Understanding of the following in relation to terrestrial magnetism:
  - true magnetic and geographic poles
  - magnetic meridian
  - variation or declination
  - isogonal lines
  - agonic lines
  - magnetic equator
  - angle of dip or magnetic inclination
  - isoclinal lines
  - aclinic lines or magnetic equator
  - deviation
  - isodynamic lines
- Effects on compass readings of soft and hard iron magnetism
- Methods used to overcome inherent errors and deficiencies in compass systems
- Problems associated with navigation over polar regions
- Understanding of the terms related to remote reading compasses: nutation, null, synchronized, slaved and free
- Operation, function and layout of remote compass system, including remote sensors, flux detectors, power supplies and heading reference outputs
- Modes of operation: slaved, free and directional gyros (DG)
- System synchronization methods
- Compass swinging: calculation of (from information obtained) and removal of errors in coefficients A, B and C
- Calculation and completion of compass calibration card

7.7.21 Ground proximity warning systems (GPWS)

- Requirements for GPWS
- Visual and aural indications for modes 1 to 5 (including sub-modes)
- Inputs required for operation of a typical GPWS and aircraft system interface
- Operation and function of typical GPWS
- Interpretation of mode and sub-mode envelope graphs
- Override and inhibit functions

7.7.22 Flight data and cockpit voice recording systems (FDR/CVR)

– System requirements, operation, protection and installation of FDR/CVR, including the following primary parameters: time, pressure altitude, vertical acceleration, magnetic heading, and press-to-transmit (radio transceiver)/event marker

– Methods of recording information: trace recording and electromagnetic

– Function of system components including signal conditioning units, entry and encoding panels

– Interface with aircraft systems

– Data recovery, analysis and verification

7.7.23 Electronic instrument and information display system

– Display types: CRT, LED and LCD

– Symbol generation and symbol generators

– System operation, system layout and interpretation of information presented on the following:
  - electronic centralized aircraft monitoring system (ECAM)
  - engine indicating and crew alerting system (EICAS)
  - flight management system (FMS)
  - electronic horizontal situation indicator (EHSI)
  - electronic attitude direction indicator (EADI)

– Head-up displays and presentation

– Moving map and flight tracking systems

7.7.24 Vibration measurement

– Sensing devices
– signal conditioning and process
– display and indication
– alarm levels and warnings

Chapter 8

AIRCRAFT ENGINEERING AND MAINTENANCE: AVIONICS — AFCS/NAVIGATION/RADIO

8.1 INTRODUCTION

8.1.1 In order to be able to satisfactorily assimilate training on individual aircraft avionics systems, the Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs) must have a good fundamental understanding of the principles and functions of operation generally used in aircraft avionics systems of all types.

8.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the aircraft avionics systems or its components, the AME must have a very complete knowledge of all the associated maintenance practices that are likely to be used.

8.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided instructions about the aircraft, avionics automatic flight control, navigation and radio electronic engineering principles related to the avionics components, materials, installations, specifications and functional systems of the aircraft.

Performance: The trainees will describe the characteristics and applications of the aircraft avionics, automatic flight control, navigation and radio systems, including the principles of installation and function, connection techniques, interface with associated aircraft and powerplant systems, and flight deck instruments and displays.

Standard of accomplishment: The trainees will describe the characteristics and applications of the materials, installation, construction system, operational principles and maintenance practices in accordance with the actual application on existing aircraft and systems.

8.3 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS): FIXED WING: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

8.3.1 Fundamentals of AFCS

– Understanding of the following terms:
  - authority
  - single axis autopilot
  - wing leveller and auto-stabilizer
  - couple
  - engaged
  - capture
  - crosswind effect
  - gain
  - washout
  - cone of confusion
  - versine generation and application

– Operation and typical layout of a single axis (roll) AFCS

– Operation of moving vane and E and I bar sensors

– Understanding of inner loop stabilization and outer loop control

– Purpose, advantages and disadvantages of control signal limiting and gain adjustment

– Methods by which roll and roll/yaw error signals are sensed in rate, displacement and inclined rate gyros

- Operation and construction of duplex, electro-pneumatic, electro-mechanical and electro-hydraulic servo-motors
- Differences between series and parallel connected servo-motors
- Operation and methods of torque limiting
- Methods of achieving and factors affecting artificial feel
- Understanding of the basic operation of a fly-by-wire system of controlling an aircraft's control system
- Understanding of power-assisted and power-operated flight controls

8.3.2 Command signal processing/turbulence penetration

- Methods by which attitude changes are detected in roll, pitch and yaw
- Methods and purposes of achieving the following signal processes within an autopilot system:
  - synchronization
  - limiting
  - gain and adaptive control
- Operation and layout of control wheel steering
- Operation and function of trim indicators
- Methods of reducing or eliminating the effects of turbulence on the operation of a flight control system

8.3.3 Modes of operation: Roll channel

- Selection and the operation of the following modes:
  - basic stabilization
  - turn command
  - heading hold
  - VHF omnidirectional radio range (VOR)/localizer (LOC)

8.3.4 Modes of operation: Pitch channel

- Selection and the operation of the following modes:
  - basic stabilization
  - pitch command
  - altitude hold
  - vertical speed
  - mach hold
- Operation and purpose of a mach trim system

8.3.5 Yaw dampers

- Operation and function of yaw damping systems
- Interaction of a yaw damper with an autopilot (including autopilot interlocks)
- Understanding of Dutch Roll phenomenon
- Aileron and rudder control interaction during turns

8.3.6 Automatic trim control

- Operation of automatic pitch trim systems
- Operation and function of flap compensation systems
- Operation and function of mach trim
- Operation and function of alpha trim
- Operation and function of centre of gravity (CG) trimmers

8.3.7 Autopilot navigation aids interface

- Operation and function of the following navigation system inputs and their effects and interface with an autopilot:
  - VOR
  - LOC
  - glideslope systems (G/S)
  - Doppler
  - compass systems
  - inertial navigation
- Operation of crosswind compensation

8.3.8 Flight director systems

- Operation, function and construction of an altitude direction indicator (ADI) and a horizontal situation indicator (HSI)
- Operation and layout of typical flight director systems operating in both coupled and uncoupled modes
- Information display, both analogue (mechanical instruments) and electronic flight instrument system (EFIS)

8.3.9 Maintenance data

- Understanding of the use of maintenance data to Specifications 100 or 2100 of the Air Transport Association (ATA) of America

8.4 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS): ROTARY WING: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

8.4.1 Fundamentals of AFCS

– Understanding of the following terms and their interaction with each other:
  - air density
  - centrifugal force
  - tip path plane
  - coning angle
  - lift thrust vector resultant
  - pitch angle
  - angle of attack
  - collective pitch
  - cyclic pitch
  - blade loading
  - relative airflow
  - thrust or virtual axis
  - axis of rotation or shaft axis
  - feathering

– Understanding of the relationship between: lift, thrust, weight, drag, and CG range

– Understanding of the terms and the relationship between: vortex ring state, power settling, and over pitching

– Torque reaction and its effect on directional control of helicopter

– Gyroscopic precession and the use of this effect in providing control of the main rotor disc for forward, sideways and rearward flight

– Dissymmetry of lift and its control

– Understanding of corriolis effect and features (lead/lag hinges and underslung rotor) used to relieve stresses it creates

– Ground effect and translational lift and their relationship

– Translating tendency and its correction by mast offset and cyclic rigging

– Understanding of the reason for blade tip stall and why it results in nose pitch up of the helicopter

8.4.2 Rotary wing stability

– Understanding of static and dynamic stability and why most helicopters are considered to be statically stable and dynamically unstable

– Understanding of how the inherent dynamic instability is overcome by the use of the following design methods: stabilizer bar, offset flapping hinges and delta three hinges

– Ground resonance and its causes, and remedial maintenance action to be taken should it occur

8.4.3 Roll and pitch control

– Operation, function and layout of basic helicopter flight control system, particularly the operation of pitch and roll channels

8.4.4 Helicopter yaw control and trim

– Operation, purpose and layout of the yaw channel

– Function of yaw and gravity trim systems

8.4.5 System operation

– Operation of helicopter automatic flight control system when operating collective or power axis mode, coupled or instrument flight rules (IFR), and stability augmentation system (SAS)

8.4.6 Autopilot and navigation aids interface

– Operation and function of the following navigation system inputs, their effects and interface with the autopilot system: VOR, LOC, glideslope and marker and instrument landing system (ILS)

8.4.7 Flight director systems

– Operation, function and control of altitude direction indicator (ADI) and HSI

– Operation and location of typical helicopter flight director system operating in both coupled and uncoupled modes

– Information display, both analogue mechanical instruments and EFIS

8.4.8 Maintenance data

– Understanding of the use of maintenance data to Specification 100 or 2100 of the Air Transport Association (ATA) of America

8.5 AIRCRAFT INERTIAL NAVIGATION SYSTEM (INS): REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

8.5.1 Terminology

– Understanding of the following terms:
  - bearing
  - course
  - latitude
  - longitude
  - drift
  - rhumb line
  - align
  - cross couple
  - great circle
  - gyrocompass
  - local vertical
  - orthogonal
  - grid
  - heading
  - dead reckoning
  - cross track
  - azimuth
  - pendulum
  - elevation
  - coordinate system
  - waypoint
  - track angle error

8.5.2 Fundamentals and components of inertial navigation system (INS)

– Relationship of Newton's Second Law of Motion to Inertial Navigation

– Understanding of inertia, velocity, acceleration and displacement, variation of velocity and displacement with time

– Construction, operation and function of mechanical gyroscopes and accelerometer used in a typical system

– Construction and layout of a typical platform

– Understanding of gimbal lock, random drift and cross couple error and how they may be eliminated

8.5.3 Reference system stabilization

– Operation of the following items in maintaining the stable element level:
  - gyroscopes
  - accelerometers
  - gimbal system
  - azimuth resolver

– Methods by which aircraft heading and altitude are measured

– Operation of a wander azimuth inertial system and its advantage over a typical north pointing system

8.5.4 Operational platforms

– Effects of earth rate and transport rate on the orientation of the stable element including methods of compensation for the overall operation of the system

– Factors affecting the Schuler pendulum

– Effect of the Schuler pendulum on the INS and how a platform is Schuler tuned

8.5.5 Accelerometer corrections

– Effect of centripetal and corriolis errors on the output of an accelerometer

– Factors affecting centripetal and corriolis errors and methods by which these errors are overcome in a typical system

8.5.6 Platform alignment

– Operation of an INS during the following modes of self-alignment: rough alignment (caging), fine alignment (levelling) and gyro-compassing

– Differences in the alignment between a typical north pointing system and wander azimuth inertial system

8.5.7 System integration

– Purpose and layout of the components in a typical INS

– Inputs to and outputs available from a typical INS

– Procedures for aligning an INS before flight and indications provided during flight

8.5.8 Strap-down systems

– Operation and construction of a strap-down INS and the differences with the conventional gimbal system

– Differences between INS and inertial reference system (IRS)

8.5.9 Laser gyros

– Operation, function and construction of a typical laser gyro

– Limitations and methods of improving limitations of laser gyros

8.5.10 Inertial reference system (IRS)

– Operation, function and construction of a typical IRS

– Information transfer between system components and capacity for system redundancy (various data buses)

– Conversion of true heading into magnetic heading

– Inputs required for system operation and outputs available

– Indications presented by the system during various modes of operation

– Built-in test equipment (BITE), its operation and limitations

– Provisions and procedures for obtaining maintenance data

8.6 AIRCRAFT RADIO AND RADIO NAVIGATION SYSTEMS: REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

8.6.1 Radio wave propagation

– Radio frequency spectrum, bands, uses and propagation characteristics

– Causes and effects of absorption, scatter, reflection, refraction, fading, cyclic and irregular variations, critical frequency, maximum usable frequency, temperature inversion, and ducting

– Relationship between velocity of propagation, frequency and wavelength

– Understanding of the following terms:
  - ground wave
  - sky wave
  - surface wave
  - radiation angle
  - skip distance
  - diffraction
  - field strength
  - Doppler effect

– Effect that water and various land surfaces have on radio wave propagation

8.6.2 Fundamentals of antenna

– Operation, construction and radiation field patterns of the following antenna types:
  - dipole (half wavelength and folded)
  - Marconi
  - long wire
  - Yagi antenna
  - parabolic
  - loop

– Voltage and current distribution along antennae of various lengths

– Alteration of the electrical length of antennae

– Ground planes and their characteristics

– Understanding of the following terms:
  - antenna impedance
  - radiation resistance
  - radiation power
  - polarization
  - effective height
  - reciprocity
  - gain
  - directivity
  - bandwidth
  - beamwidth
  - lobes
  - isotropic radiator

8.6.3 Circuit analysis

– Analysis of capacitance, capacitive reactance, inductance, and L, C and R circuits

– Resonant circuits: series and parallel

– Diodes, triodes, pentodes, gas tube, bipolar transistor, field effect transistors (FET), uni-junction transistor, variac diode, darlington pair, biassing, electronic voltage regulators, resistance coupled amplifiers, impedance and transformer coupled amplifiers, phase splitters, audio power amplifiers, the Hartley oscillator, colpitts oscillator, crystal oscillator, voltage controlled oscillator (VCO) and phrase locked loop (PLL)

– Operational amplifiers (inverting/non-inverting), comparators, voltage followers, adders and subtracters

8.6.4 Transmission lines

– Characteristics and construction of the following types of transmission lines:
  - parallel wire
  - coaxial cable
  - waveguide
  - skin effect

– Understanding of the following terms:
  - characteristic impedance
  - reflected power
  - forward power
  - standing wave ratio balanced line
  - unbalanced line
  - velocity factor

– Effect upon a transmission line when it is terminated in: a short circuit, an open circuit, and an impedance equal to its characteristic impedance

8.6.5 Principles of receiver

– Amplitude modulation (AM) and frequency modulation (FM)

– Stages and characteristics of superheterodyne (AM) receiver:
  - radio frequency (RF) amplifier
  - local oscillator
  - mixer
  - intermediate frequency (IF) amplifier
  - detector
  - audio frequency (AF) amplifier

– Stages and characteristics of FM receiver:
  - RF amplifier
  - local oscillator
  - mixer
  - wide filter
  - IF amplifier
  - limiter
  - frequency discriminator
  - AF amplifier

– Noise: sources, precautions to prevent random and non-random noise, and others

– Understanding of the following terms:
  - sensitivity
  - selectivity
  - stage gain
  - bandwidth
  - resonance
  - image rejection
  - adjacent channel rejection
  - noise factor
  - distortion

– Operation, construction and characteristics of headphones, speakers and microphones

– Methods used for tuning, including:
  - ferrite materials
  - variable capacitors
  - voltage variable capacitors
  - frequency synthesis
  - voltage controlled oscillators
  - phrased locked loops

– Understanding in both time and frequency domains of the following signals and methods used to demodulate them:
  - amplitude modulation (AM)
  - frequency modulation (FM)
  - single sideband (SSB)
  - continuous wave

– Operation of simple and automatic gain control

– Operation and function of noise limiters, limiters, clarifiers, squelch control and automatic frequency control (AFC)

8.6.6 Principles of transmitter

– Characteristics and principles of the stages which comprise both FM and AM transmitters

– Function and characteristics of the modulators used to generate the following types of signal:
  - AM
  - FM
  - SSB

– Understanding of the following terms:
  - bandwidth
  - modulation index
  - clipping
  - harmonics
  - high-level modulation
  - low-level modulation
  - frequency stability
  - output power
  - parasitic oscillation
  - neutralization

– Operation and function of variable frequency oscillators, crystal oscillators, and multipliers

– Principles of time and frequency division

– Muting of receivers during transmission

– Classes of operation of transmitter power output stages

– Operation and limitations of regulated power supplies and switched mode power supplies (DC to DC converter)

8.6.7 Principles of communication

– Frequency bands allocated to high frequency (HF) and very high frequency (VHF) airborne communications systems

– Methods of signal propagation and expected ranges (both day and night)

– Calculation of approximate ranges of communication (line of sight)

– Characteristics and performance levels of typical HF and VHF communications systems including frequency range, power output, sensitivity, stability, and channel spacing

– Characteristics, advantages and disadvantages of the following HF/VHF antennae:
  - wire
  - notch
  - probe
  - whip
  - blade

8.6.8 High Frequency (HF) communication systems

– Principles and operation of a typical HF transceiver (including the functions at each stage)

– Principles of operation and characteristics of typical antenna tuning units, both preset and automatic and their respective advantages and disadvantages

– System controls, their operation and limitations

– Interference: types and sources associated with HF systems and methods of eliminating interference

– System installation including location of equipment, antenna position, power supplies and audio system interface

– Functional testing of system and communication with other stations

8.6.9 Very High Frequency (VHF) communication systems

– Principles and operation of a typical VHF transceiver (including the functions at each stage)

– System controls, their operation and limitations

– Interference: types and sources associated with VHF systems and methods of eliminating interference

– System installation including location of equipment, antenna position, power supplies and audio system interface

– Functional testing of system and communication with other stations

8.6.10 Emergency Locator Transmitter (ELT)

– Purpose and function of an emergency locator transmitter

– Frequency/frequencies of operation

– Methods for activating system

– Methods for testing system

– Installation: location, antenna and switching

– Safety precautions to be observed particularly with regard to spurious/unintentional transmissions

8.6.11 Audio systems

– Characteristics of sound, upper and lower limits of hearing

– Microphones types: carbon, dynamic and piezoelectric

– Output levels, frequency response, and directional properties

– Operation of noise-cancelling microphones

– Matching transformers: uses in system, calculation of impedance and turns ratio

– Understanding of the uses and characteristics of the following:
  - isolation amplifiers
  - attenuators
  - distribution networks
  - side tone
  - muting
  - insertion losses

– Principle, operation and functions of an audio integration system

– Typical performance levels and specifications expected from an aircraft audio system

– Noise and other undesirable influences associated with audio systems and their elimination

– Installation interface with other aircraft systems

– Battery power supplies: condition, life and others

8.6.12 Cockpit voice recorder system (CVR)

– Purpose and requirements of a CVR

– Performance levels expected and specifications of typical CVR

– Theory of operation of a typical CVR

– Cockpit microphones including locations and concept of "hot" and "area" microphones

– Understanding of the following terms:
  - crosstalk
  - wow and flutter
  - record head
  - erase head
  - bias oscillator
  - bulk erase
  - track
  - frequency response
  - monitor head

– Installation of CVR, interface with audio system, power supplies, and favourable location

– System testing in aircraft (both audio and visual), downloading of recordings, etc.

– Underwater locator beacon (ULB): purpose, function, testing, battery type and life

– CVR protection against shock, fire, immersion in fluids, and erasure of recordings

8.6.13 Automatic direction finder (ADF) systems

– Principles of aircraft navigation using an ADF system

– Understanding of the following terms:
  - relative bearing
  - magnetic bearing
  - drift angle
  - homing
  - position fixing
  - aural bearing

– Antenna field patterns for or radiated by: non-directional radio beacon (NDB) — ADF ground station, loop antenna, sense antenna, and combined loop/sense antennae

– Composite field pattern created by loop and sense antenna (cardioid), phase relationship between loop and sense antenna output signals, antenna feeder lengths, sense antenna quality factor and sense antenna critical capacitance

– ADF frequency range, accuracy, sensitivity and hunting

– Principles of operation of a typical ADF receiver including: channel selection, loop antenna and goniometer, frequency synthesis, balanced modulator, beat frequency oscillators, and gain control ADF to radio magnetic indicator (RMI) adaptors

– Information presentation: relative bearing indicator (RBI) and RMI

– System installation (including location and mounting), power supplies, interface with audio system and navigation system

– Kinds of interference and errors affecting ADF systems, and their elimination or reduction of quadrantal error, loop alignment error, night effect, coastal refraction, vertical effect, mountain effect, static interference and station interference

– Calibration — loop swinging both air and ground functional testing of ADF systems

8.6.14 Very High Frequency omnidirectional radio range (VOR) systems

– Principles of aircraft navigation using VOR systems, homing directly to a VOR station, intercepting an inbound track and intercepting an outbound track

– Understanding of the following terms: radial, heading, automatic VOR, manual VOR, selected course, track, and cone of confusion

– Field pattern and signals radiated by VOR ground stations

- Operation and characteristics of a typical VOR receiver, including frequency range, channel spacing, signal polarization, variable phase circuitry, resolver, reference phase amplifier, VOR warning and TO/FROM circuitry, and omni-bearing selection

- Information presentation: RMI and omni bearing indicator (OBI)

- VOR system outputs/interface with other systems: distance measuring equipment (DME) channelling, audio output, autopilot output, RMI/OBI, TO/FROM, warning, and deviation from selected radial

- Compensating load resistors in place of indicators

- VOR system errors: course error, reciprocal error and VOR site error

- VOR antennae: types, dual systems run from single antenna, receiver duplexer, diplexers, and critical cable lengths

- System installation (including location and mounting) and antenna location

- Testing of VOR systems by using appropriate bearing simulation test set

8.6.15 Instrument landing system (ILS)

- Operation of an ILS, including ground station position with respect to runway, signal format, range, and information displayed to pilot

- Difference in depth of modulation (DDM)

- Systems comprising an ILS: localizer, glideslope and marker

- Localizer (LOC) systems: frequency range, channel spacing, modulation, signal polarization, pairing of localizer and glideslope channels, and joint VOR/LOC antennae

- Glideslope systems (G/S): frequency range, channel spacing, modulation, signal polarization, and antenna

- Marker system (MKR): operating frequency, modulation and antenna

- Localizer back course switching and operation, and precautions to take when using back course particularly concerning glideslope

- Load compensating resistors in place of indicators

- Principle and operation of a localizer receiver including: receiver element, filters, oscillators, metre circuits, flag circuits, and power supplies

- Principle and operation of a glideslope receiver including: receiver element, filters, oscillators, metre circuits, flag circuits, and power supplies

- Principle and operation of a marker receiver including: receiver element, sensitivity circuitry, filters, lamp circuits, and power supplies

- ILS information presentation on the following indicators: course deviation indicator (CDI), HSI, ADI, and marker lights and tones

- System outputs: audio, autopilot, warning, and LOC/G/S

- System installation including mounting, location and antenna location

- Interface of ILS/MKR system with audio and navigation systems

- Testing of system by using an appropriate ILS/MKR signal simulator test set

8.6.16 Microwave landing system (MLS)

- Principles of time referenced scanning beam system (TRSB)

- Operation of a MLS (including ground station position with respect to the runway, beam patterns, signal format, antennae P-DME): transmission data and structure, flair guidance, curved approach and terminal waypoints

- Range and information displayed to pilot

- Interface of MLS with other aircraft systems

- Testing of MLS by using appropriate test set

8.6.17 Very Low Frequency (VLF) and hyperbolic navigation systems

- Characteristics and factors affecting the propagation of VLF and low frequency (LF) electromagnetic waves

– Understanding of the following terms:
  • great circle
  • circular lines of position (LOP)
  • hyperbolic LOP
  • lane
  • lane slip
  • lane ambiguity

– Principles of position fixing by the following means:
  • pulsed hyperbolic
  • continuous wave hyperbolic
  • CW rho rho
  • CW rho rho rho

– Signals radiated by Omega navigation system (ONS), including: transmission format, transmitted frequencies, phase locking of signals, useful range, and rate aiding

– Characteristics of a typical ONS

– Construction, function and characteristics of ONS antennae and its couplers

– Function of operating controls and presentation of information of a typical ONS

– Principles and operation of a typical ONS control display unit (CDU), receiver computer unit (RCU), operational equipment unit (OEU) and power supplies

– Interface of ONS with other aircraft systems

– ONS testing using built-in test equipment (BITE)

– Principles and operation of Loran-C navigation system including: signal transmission format, transmitter frequency, station synchronization, and useful range

– Operation of a typical Loran-C navigation receiver, including:
  • receiver element
  • phase decoder
  • master and slave phrased locked loops
  • gate pulse formers
  • time difference measurement

– Presentation of information from a typical Loran-C system

– Installation of Loran-C system, including mounting, location and antenna position and power supplies

8.6.18 Distance measuring equipment (DME)

– Principles of operation of DME systems (including ground station responses)

– Characteristics of interrogation and reply pulse trains

– Location of ground beacons including co-located VOR/DME (or VORTAC, VOR and TACAN beacons)

– Understanding of the following terms:
  • jitter
  • automatic standby
  • squitter
  • search
  • track
  • memory
  • percentage reply echo protection
  • suppression

– Characteristics of DME system: transmitted frequency, received frequency, transmitter power, useful range, number of channels, and outputs

– Principles of operation of a typical DME transmitter receiver, including interrogation function, reply and decoding circuitry, indicator, power supplies, and antenna

– Interference with and from other avionics systems

– Installation of DME (including mounting, location and antenna position)

– Testing of DME systems by using an appropriate DME test set

8.6.19 Area navigation (RNAV)

– Principles of area navigation using VOR and DME systems

– Understanding of waypoint offset computation

– Control of system including data entry, output information presentation and interpretation

– Installation of RNAV system and its interface with DME and VOR systems and other aircraft systems

– Switching and annunciation of mode of operation of RNAV system

– Testing of RNAV system by using appropriate VOR and DME test sets

8.6.20 Air traffic control (ATC) transponder systems

– Differences between primary and secondary surveillance radar systems

– Presentation of data on ATC radar display

– Principles of operation of ATC transponder systems, including transmitter, receiver, reply, code, mode, and side lobe suppression

– Transponder transmitter frequency, receiver frequency, typical power output, antenna polarization, suppression and system range

– Functions of modes "A" and "C", and attitude reporting function

– Mode "S" interface with Traffic Alert and Collision Avoidance System (TCAS)

– Characteristics of ground transmitted interrogations and transponder reply pulse trains

– Interface of transponder with other aircraft systems

– Testing of transponder systems by using appropriate test set

8.6.21 Radio altimeter systems

– Aircraft altitude measurement using the following radio/radar techniques: pulsed, frequency modulated carrier wave (FMCW) and constant difference frequency modulated carrier wave (CDFMCW)

– Understanding of the terms with respect to FMCW radio altimeters:
  - frequency modulation
  - frequency deviation
  - modulation index
  - system errors

– Operating frequencies, accuracy, typical output power, modulation frequency, maximum and minimum height

– Antenna types, microwave and transmission line feeds

– Interface with other aircraft systems

– Testing of radio altimeter systems

8.6.22 Doppler navigation system

– Principles of Doppler navigation system

– Understanding of the following terms:
  - drift angle
  - track
  - heading
  - ground speed
  - vertical velocity
  - across heading velocity
  - along heading velocity

– Radiation patterns of antenna, and antenna stabilizations

– Interface of Doppler navigation system with other aircraft systems

– Testing of Doppler navigation system

8.6.23 Satellite navigation systems

– Principles of global positioning system (GPS)

– Differential GPS

– Characteristics of GPS

– Receiver autonomous integrity monitoring

– Antennae and transmission lines

– Installation and operation of GPS

– Testing and maintenance of GPS

8.6.24 Weather avoidance systems

– Principles of weather radar operation including:
  - pulse repetition frequency (PRF)
  - pulse width
  - radar mile
  - frequency of transmission
  - received signal strength
  - beam width
  - automatic frequency control (AFC)
  - sensitivity time control (STC)

– Antenna types, stabilization, tilt, scan, waveguides (flexible and rigid), rotary joints, choke joints, non resonant lines, resonant lines, resonant cavities, and T/R switches

– Microwave devices: magnetrons, klystrons, travelling wave tube (TWT), Gunn diodes, circulators, and Impatt diodes

– CRT displays, information presentation, ranges, weather and mapping

– Interface with other aircraft systems

- Precautions to be observed when operating radar systems
- Principles of operation of Stormscope weather detection system: range, area coverage, antenna and limitations
- Interface with weather radar and other systems
- Testing of weather avoidance systems

8.6.25 Traffic alert and collision avoidance system (TCAS)

- Principles of operation of a TCAS
- Range, altitude and resolution of operating area including warning indications (both visual and aural) of potential and immediate threats
- Resolution advisory (RA): corrective and preventive
- Interface of TCAS with other aircraft systems
- Testing of TCAS

8.6.26 ARINC communication and reporting system (ACARS)

- Principle, operation and function of ACARS
- Information/data processed by ACARS: parameters and limitations
- ACARS ground stations
- Typical aircraft ACARS installation, including interface with other systems
- Testing of ACARS

8.6.27 Passenger entertainment systems

- Principles and operation of passenger video and audio entertainment systems, including interface with other aircraft systems
- In-flight telephone (air/ground) systems

Chapter 9

HUMAN PERFORMANCE

9.1 INTRODUCTION

9.1.1 Lapses in human performance are cited as causal factors in the majority of accidents. If the accident rate is to be decreased, there must be better understanding of Human Factors and broader application of Human Factors knowledge. Increasing awareness of the importance of Human Factors in aviation presents the international aviation community with a significant opportunity to make aviation both safer and more efficient. The purpose of this chapter is thus to introduce the fundamental Human Factors concepts in aviation to Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs).

9.1.2 "Human Factors" as a term has to be clearly defined because these words, when used in the vernacular, are often applied to any factor related to humans. The human element is the most flexible, adaptable and valuable part of the aviation system, but it is also the most vulnerable to influences that can adversely affect its performance. Throughout the years, some three out of four accidents have resulted from less than optimum human performance.

9.1.3 Human Factors is a technology that deals with people. It is about people in their working and living environments, and it is about their relationship with machines, equipment and procedures. Just as importantly, it is also about their relationship with each other as individuals and in groups. It involves the overall performance of human beings within the aviation system. Human Factors seeks to optimize the performance of people by the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.

9.1.4 Human Factors has become concerned with the diverse elements in the aviation system. These include the following:

- human behaviour
- decision-making and other cognitive processes
- the design of controls and displays
- flight deck and cabin layouts
- air traffic control display systems, aircraft maintenance activities, and documentation
- training

9.1.5 Cultural differences have been recognized as issues of concern to Human Factors. The subject has been studied by many Human Factors specialists. In the context of the AME's training, cultural differences should be addressed in the light of the misunderstanding that may occur among AMEs ground and flight crew members of differing cultural backgrounds and the resulting possible break in communication and coordination. When addressing this issue, instructors must exercise caution as discussion on cultural differences is prone to misunderstanding and can result in unnecessary friction. During this phase of the training, emphasis should be placed on the development of an organizational culture that encourages a teamwork approach to the aircraft maintenance activity.

9.1.6 In spite of the reliance on the academic sources of information, Human Factors in aviation is primarily oriented toward solving practical problems in the real world. There is a growing number of integrated Human Factors techniques or methods; these varied and developing techniques can be applied to problems as diverse as accident investigation and the optimization of personnel training.

9.1.7 It is most important that everyone concerned with the operation and administration of the aviation system recognizes the inevitability of human error. No person, whether designer, engineer, manager, controller, flight dispatcher or crew member, can perform perfectly at all times. In addition, what could be considered a perfect performance in one set of circumstances might well be unacceptable in another. Thus, people need to be seen as what they really are; to wish that they be intrinsically "better" or "different" is futile, unless such a wish is backed by a recommendation for remedial action. Such a recommendation can be further supplemented by providing the means to achieve better design, training, education, experience, motivation, etc., with the objective of positively influencing the relevant aspects of human performance.

9.1.8 An understanding of the predictable human capabilities and limitations and the applications of this understanding are the primary concerns of Human Factors. Human Factors have been progressively developed, refined and institutionalized since the end of the last century and is now backed by a vast store of knowledge which can be used by those involved in enhancing the safety of today's complex commercial air transport system.

9.2 MAINTENANCE RESOURCE MANAGEMENT (MRM) AND HUMAN FACTORS

9.2.1 The importance of teamwork in the aviation maintenance activity is widely recognized. One result has been the emergence of Human Factors training and Maintenance Resource Management (MRM) programmes. In summary, the following principles are fundamental:

– Improved communication (both verbal and written)

– Establishment of a "Safety Culture", i.e. a pervasive, positive attitude towards safety

– Improvement of the inter-team and intra-team coordination and communication

– Linking and integration of the Human Factors training with improved equipment design, environmental standards and workload

9.2.2 MRM training is but one practical application of Human Factors. Although MRM can be approached in many different ways, there are some essential features. Training should focus on the functions of the AME as part of a larger team (which may include managers and occasionally flight crew members) and not simply a collection of technically-competent individuals. The Human Factors programme should teach AMEs how to use their interpersonal and leadership styles in ways that foster flight safety. The programme should also teach AMEs that their behaviour during normal, routine circumstances can have a powerful impact on how well or safely the flight is conducted. Similar situations experienced in training increase the probability that AMEs will handle actual stressful situations more competently.

9.2.3 Research studies from the behavioural sciences strongly suggest that behaviour change in any environment cannot be accomplished in a short period of time, even if the training is very well designed. Trainees need time, awareness, practice and feedback, and continual reinforcement to learn lessons that will endure. The Human Factors training should address the challenge of optimizing the person/machine interface and related interpersonal issues. These issues include effective team building and maintenance of teams, information transfer, problem solving, decision-making, maintenance of situational awareness and dealing with automated systems.

9.2.4 Accordingly, Human Factors training should include at least three distinct phases:

a) the *awareness phase* where Human Factors issues are defined and discussed;

b) the *practice and feedback phase* where trainees gain experience on Human Factors techniques; and

c) the *continual reinforcement phase* where Human Factors principles are addressed on a long-term basis.

9.3 PHASE I — HUMAN FACTORS AWARENESS PHASE

9.3.1 Awareness is the essential first phase and usually comprises instructional presentations focusing on the roles of interpersonal and group factors. It is important because it provides a common terminology and a conceptual frame work for AMEs to begin thinking about maintenance, communication and coordination problems and how such factors may have contributed to accidents and incidents. A useful way to begin the awareness phase might be to introduce Human Factors skills as they pertain to communication, situation awareness, problem solving, etc. Actual situations in which a maintenance error had a direct impact on the outcome of the event should be examined and the positive and negative interactions reviewed.

9.3.2 It is important to recognize that awareness is only a first step. Classroom instruction alone will probably not significantly alter the attitudes and behaviour of AMEs in the long term.

9.4 PHASE II — HUMAN FACTORS PRACTICE AND FEEDBACK PHASE

9.4.1 As part of the practice and feedback training, some programmes use role-playing techniques to provide group skills practice. Attitude-measuring questionnaires are also used as a means of providing feedback to individuals on their own interpersonal styles, some aspects of which they probably have not previously evaluated. Attitude insights allow individuals to recognize some of their strengths and weaknesses. On their own, however, they may not provide guidance on how those attitudes will positively or negatively affect each situation. Role-playing or group exercises can provide useful practice in the areas of dispatcher decision-making and other skills discussed in the awareness phase of the Human Factors curriculum. They can also demonstrate the critical responsibility of AMEs and the effect of various factors on their ability to perform their tasks under actual situations.

9.4.2 Videotape feedback is particularly effective because the third-person perspective creates a level of awareness not possible with other techniques. This perspective provides insight and provokes "self-critique" which appears to be a strong stimulus for attitude and behaviour change. It is easy to identify less-than-optimum managerial or interpersonal styles if one sees it for oneself. Moreover, these video feedback exercises will provide opportunities for peer critiques. There is ample evidence of the effectiveness of the video feedback technique, which should be used whenever possible. If video feedback is not possible, each exercise must be followed by a carefully guided debriefing session. Participants should be able to identify the objectives of each exercise and be encouraged to provide constructive feedback on performance ("peer review" should be highly encouraged), identify areas of concern, propose alternatives and relate all exercises to practical experience.

9.5 PHASE III — HUMAN FACTORS CONTINUAL REINFORCEMENT PHASE

No matter how effective the Human Factors classroom curriculum, interpersonal drills and feedback techniques are, a single exposure will be insufficient. Undesirable attitudes and norms which contribute to ineffective AME performance are ubiquitous and may have developed over a lifetime. It is unrealistic to expect a short training programme to counteract a lifetime of development. For maximum effect, MRM must be embedded in the total training programme, be continually reinforced, and become an integral part of the organizational culture. This last factor is often overlooked; it is clear however that effective Human Factors training requires the support of the highest levels of management.

9.6 TRAINING OBJECTIVES

Conditions: The trainees will use guidance already developed for flight crew members and other groups with respect to training in resource management. They will also use role playing to simulate conditions that require the application of Human Factors concepts.

Performance: The trainees will be able to apply concepts learned in Human Factors training in the performance of their role-playing duties and responsibilities. They will be able to develop awareness of "good" versus "poor" performance, accept the need for supportive and cooperative interrelationships between AMEs and crew members, and cope with difficult situations.

Standard of accomplishment:
During training, the recorded role-playing performance of the trainees can be compared with models provided as references.

9.7 REQUIRED KNOWLEDGE, SKILLS AND ATTITUDES

The following is a recommended outline of topics for Human Factors training:

A. General programme overview

- Purpose: Training goals and objectives
- Content: Training content
- Concepts: Human Factors concepts and definitions which form part of the course
- Cost of maintenance errors

B. Human Factors knowledge

- Understanding maintenance operations as a system: seeing the "big picture"
- Understanding basic Human Factors issues and human limitations: vision, hearing, information processing, attention and perception, memory, and the associated ergonomic issues related to workplace and task design
- Recognizing the contributory causes to human errors: interactions with organizational procedures, groups and individual factors; reason model and the "Dirty Dozen"

C. Communication skills

- Understanding the consequences of poor communication
- Communication methods (written, verbal, etc.)
- Communication content: relevance, correctness, conciseness and completeness
- Communication purpose and target audience
- Communication behaviour/style: assertiveness, aggression and feedback
- Active listening, feedback, body language and facial expression
- Effective writing
- Recognizing approved or unapproved data
- Overcoming barriers to the use of approved data
- Shifting turnover/handover process

D. Teamwork skills

- Team definition and discrimination from group
- Team dynamics (positive/neutral)
- Team leadership: telling or selling, involving or delegating
- Team building
- Inter- and intra-team communication
- Coordination and decision-making
- Understanding the characteristics of an effective team
- Understanding norms, their definition and identification
- Effective meetings and different roles: chair, shaper, worker and finisher

E. Performance management

- Stress: identifying stressors e.g. communication, role conflict, others
- Pressure: be organized, get help and facts, and delegate
- Shift work: fatigue, working hours, sleep, stress, and environmental factors
- Complacency: identification and management

F. Situation awareness

- Error chain recognition and control
- Workload management: learning to say no
- Supervision and leadership

G. Human error

- Error models (latent and active)
- Error classification and prevention
- Task analysis: be proactive; "plan — do — check"; others
- Defences: documentation; don't assume — check and ask; others
- Changing conditions rather than changing people

H. Reporting and investigating errors

- Company and state regulatory requirements
- Immunity statements and disciplinary issues
- Confidential reporting systems
- Investigation responsibilities and procedures
- Maintenance error data analysis and reporting of results
- Feedback
- Management decision-making

I. Monitoring and auditing

– Team or individual: composition

– Purpose: quality, ergonomic or others

– Process and procedure

– Audit findings, reporting and data analysis

– Feedback and corrective action

J. Document design

– Information content and readability

– Writing well: be clear, concise and accurate

– User involvement and field testing

Note 1.— Items B to G are generally representative of modules recommended for Maintenance Resource Management (MRM) training.

Note 2.— Items H to J can be suitably added, as appropriate, to the basic Human Factors Course (items A to G) as specialist modules for staff such as managers, planners, auditors, quality engineers and incident investigators.

PHASE TWO — SKILLS

Chapter 10

PRACTICAL MAINTENANCE SKILLS: AIRFRAME

10.1 INTRODUCTION

10.1.1 In order to be able to satisfactorily assimilate the training on individual aircraft and systems, the Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs) must have good fundamental practical skills and understand the maintenance processes and principles generally used in aircraft hangars and workshops.

10.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the aircraft, the aircraft engines and systems, the AME must have a very complete knowledge of all the tools and associated maintenance processes that are likely to be used in hangars and workshops.

10.1.3 For future aircraft hangar and workshop technicians, their basic workshop training should commence with Phase Two — Skills and should be completed before the students begin working on airworthy aircraft, engines or equipment in Phase Three — Experience. For this purpose, the Performance parameters required to meet the Training Objectives outlined in 10.2 of this chapter are divided into two sections: Section a) requires basic manual skills and Section b) refers to the application of these skills to non-airworthy aircraft, components or specially-designed practice rigs. The level of manual skills to be developed also varies according to the category of technicians being trained. For example, bench fitting is of importance to all categories of technicians, while radio technicians may require skills in soldering but they only need an introduction to welding.

10.1.4 The recommended facilities, tools and equipment are described in Appendix 1 to this chapter.

10.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided with appropriate facilities; tools (both hand and machine); materials; a selection of airframe assemblies, component or parts; specially-made repair, assembly and rigging test exercises. (See Appendix 1 to Chapter 10.)

Performance:

a) The trainees will practise repair schemes on airframe components as well as assemble and adjust test exercise pieces and/or assemblies by using simple engineering drawings and aircraft maintenance test (real or simulated).

b) The trainees will practise fault finding, dismantling, inspecting, repairing, decision-making regarding repair or replacement, reassembly and testing. They will also use engineering drawings as well as engine manufacturers' maintenance, overhaul and repair manuals.

Standard of accomplishment:

During workshop training, the standard is a function of the variety of exercises completed and the time spent in workshop training. The trainees/students should work individually on airframe exercises so that they have "ownership" of the standard. If necessary, they should practise and repeat increasingly complex exercises to develop greater manual skills within their respective areas of competence. Finally, they should carry out tests or operate the system exercise rigs.

10.3 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AIRFRAME

10.3.1 Introduction

a) Training in workshop practice should begin with exercises in the use of hand tools to make a series of simple shapes to specified dimensions from various metals. Each shape should be progressively more complicated with more precise tolerances. From the start, instructors should ensure that students develop the habit of handling basic hand or machine tools in the correct manner, and action should be taken to correct any bad or potentially dangerous practices before they become habitual. At all times, and particularly during the early stages of training, the importance of producing accurate and careful work must be stressed. These exercises can be used to develop the trainees' inspection ability, i.e. the necessary judgement and sense of responsibility required to assess the accuracy of their own work and that of others.

b) It is desirable that licensed AME students should have the opportunity to remove and replace major components. Practice in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase.

10.3.2 Bench fitting

- Cutting and filing: exercises in cutting metal with hacksaws; filing; drilling; drill grinding; thread cutting with taps and dies; and scraping
- Measurements: use of steel rule, dividers, calipers, micrometers, vernier, combination set, surface place, and dial test indicator

10.3.3 Forging, heat treatment, soldering and welding

- Forging by hand simple specimens such as chisels, punches and others
- Hardening and tempering carbon steel by using forge
- Tin soldering, tin-plating, and use of proper flux
- Silver soldering and brazing
- Welding: oxyacetylene and metallic arc welding of different materials
- Inspection of welded joints for flaws

10.3.4 Sheet metal work

- Sheet aluminium alloy: cutting, marking out, drilling, forming, bending, bending allowances, shrinking and flashing
- Forming sheet metal by pressing and rolling
- Riveting: types of rivets, riveting with hand tools, rivet spacing, countersinking and dimpling
- Use of pneumatic riveting hammer
- Blind riveting
- Inspection of rivets, removal of rivets, use of oversized rivet and rivet jackets
- Tube work: use of taper pins and tubular rivets
- Exercises in sheet metal patching and repair work
- Heat treatment of aluminium alloy and alloy rivets: use of salt baths and furnaces; annealing and solution treatment

10.3.5 Machine shop

- Drilling: using machine drills to drill close tolerance holes in various materials; reaming hol es to close tolerances; others
- Turning: exercises in turning steel, aluminium alloy and brass parts; use of lathe for thread cutting; others
- Grinding: use of grinding wheels for tool sharpening

10.3.6 Woodwork

- Cutting and smoothing of wood: marking out, sawing and planing wood, and exercises in woodwork involving tenon and scarf joints
- Selection of aircraft woods: defects of timber, timber, tests for moisture content, and straightness of grain
- Plywoods and laminated woods: bending, patching, and standard repairs to aircraft woodwork
- Gluing: approved glues (casein and synthetic resin); mixing; uses; drying times
- Varnishing and protection of aircraft woodwork
- Environmental aspects

10.3.7 Wire and cable work

- Inspection of aircraft cables for defects
- Splicing exercises

- Swagging exercise: attachment of standard end fittings to flying control cables
- Demonstration of proof test on flying control cable

10.3.8 Tube work

- Tube bending, with or without heat treatment
- Tube flaring
- Fitting of different kinds of unions used in fuel, oil and hydraulic systems
- Inspection and testing of tubes and flexible hoses

10.3.9 Airframe familiarization

- Airframe structures: detailed examination of various types of wing and fuselage construction, including primary and secondary structures
- Use of forged, extruded, cast and sheet material
- Main joints: methods of riveting, spot welding, and adhesive bonding
- Doors and cut-outs, positions of inspection panels, removal of fairings, and methods of gaining access to all parts of structure
- Landing gear: examination of control system; checking of control surface movements and cable tensions; interconnections of autopilot to control systems; examination (by visiting airline, if necessary) of power-operated control systems

10.3.10 Ground handling of aircraft

- Pre-flight inspection with aircraft on apron
- Starting and running of engines and auxiliary power unit (APU); observation of instrument readings; function check(s) of electrical components and radios; stopping of engines
- Compass swinging and automatic direction finder (ADF) loop swinging
- Use of ground equipment for moving, lifting or servicing aircraft

10.3.11 Installation and testing of equipment

- Removal, replacement, in situ inspection, and function testing
- Testing for leaks, errors and electrical faults of electrical equipment, instruments, autopilots, communication and navigation equipment as appropriate

10.3.12 Small aircraft

- Dismantling of aircraft: removal of engine, control surfaces, landing gear, wings, tail plane and fin, and seats
- Inspection: inspection of condition of fuselage alignment checks, freedom from distortion, and symmetry
- Checking of wings and other airframe components for condition, and freedom from distortion
- Reassembly of aircraft: replace wings, empennage, control surfaces, and engine; check rigging angles of wings and tail plane; adjust flying controls and check control surface movements; replace landing gear and check alignment track

10.3.13 Fabric and dope

- Exercises in covering frames with hand-sewn fabric; doping; stringing; repairing cuts in fabric; patching

10.3.14 Wheels and tyres

- Complete wheel assemblies: dismantling, inspection (including crack detection of wheels) and reassembly
- Inner tubes: puncture repairs
- Outer covers: inspection, identification of defects, and spot vulcanizing
- Brake units: inspection and salvage of brake pads and discs
- Inspection and testing of anti-skid devices

10.3.15 Control surfaces

- Overhaul and repair: repairs to typical fabric-covered and metal-skinned ailerons, and elevators
- Hinges and actuating mechanisms: inspection, and renewal of ball races

– Correction of mass balance after repair

– Adjustment of balance tabs, and servo-tabs on aircraft (to correct for hinge moments and flying faults)

10.3.16 Multi-engined aircraft

– Simulated airline check: familiarization with maintenance schedule

– Performance of sequence of major periodic inspection by the students, including signing of check sheets for each job done and recording of and, if possible, rectification of all defects

– Full functioning checks after replacement of components, including ground testing of hydraulic system with retraction of landing gear and function testing of electrical system; ground running of engines; weighing of the aircraft and calculation of centre of gravity

10.4 BASIC WORKSHOP AND MAINTENANCE PRACTICES: REPAIR, MAINTENANCE AND FUNCTION TESTING OF AIRCRAFT SYSTEMS/COMPONENT

10.4.1 Hydraulic systems

– Demonstration of hydraulic system rig

– Dismantling and reassembly of typical components such as hydraulic pumps, regulators, selectors, control valves, accumulators and actuators

– Dismantling and examination of control and actuating devices from powered flying control systems

– Dismantling, reassembly and recharging of selection of landing gear shock struts, nose-wheel steering mechanisms, anti-shimmy devices and other landing gear components

10.4.2 Pneumatic systems

– Demonstration of pneumatic system rig, examination of typical components such as compressors, regulators, selectors and actuators

– Dismantling, reassembly and testing of representative selection of pneumatic components: selectors, thrust reversal rams, and others

10.4.3 Environmental control systems

– Demonstration of pressurization system models or rigs

– Dismantling and reassembly of selected components such as cabin superchargers, mass flow controllers, cabin pressure controllers, discharge valves and safety valves

– Demonstration and partial dismantling of cabin heating, cooling and humidifying devices

– Dismantling, reassembly and testing of selected components

– Familiarization with the servicing and inspection of various types of pressure and mass flow control devices; heat exchangers, combustion heaters and electrical heaters; cold air units (air cycle machines), vapour cycle coolers, cabin temperature sensing and regulating devices; humidifying and dehumidifying equipment; crew and passenger emergency oxygen equipment

10.4.4 Fire control systems

– Inspection, weighing and recharging of fire extinguisher bottles

– Demonstration of fire detection and extinguishing system principles by using simulators, individual components, and operation

– Practice in controlling aircraft and shop fires

– Familiarization with different types of alarm systems, extinguishers and their uses

10.4.5 De-icing systems

– Demonstration of rigs and individual de-icing system components

– Dismantling, reassembly and testing of air control devices for mechanical de-icing systems; repairs to inflatable leading-edge overshoes/boots

– Hot air systems: overhaul procedures for combustion heaters, and hot air control valves

– Repair schemes for air-to-air heat exchangers, and mixing valves

– Repair schemes for electrically heated overshoes, and spray-mats

10.4.6 Miscellaneous systems

– Demonstrations and inspection of vacuum systems, water/methanol, drinking and washing water systems

– Inspection and tests, as necessary, of fuel system components: cocks, line booster pumps, filters, and refuelling valves

– Tests and repairs, as necessary, of safety equipment: inspection of dinghies, life jackets, survival kits, safety belts etc.

10.5 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

10.5.1 Aircraft heavy maintenance check

– Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; emptying and inserting fuel tanks, draining oil and other systems; selection and display of equipment; tools required

– Selected major operations: internal inspection of internal tanks; detailed examination of cabin structure followed by pressurization and leak rate test; change of main landing gear

– Adherence to aircraft maintenance manual and a typical airline major check schedule for each job

– Conclusion of Heavy Maintenance Check: replacement of components, function tests, restoration of internal and external finish, weighing and calculation of centre of gravity, preparation for flight test, and completion of documentation

10.5.2 Aircraft or helicopter repair

– Selection of repair scheme: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings or structural repair manual (SRM)

– Selection of material to be checked for compliance with specification

– Embodiment of repairs according to prepared drawings or SRM

– Testing to destruction of selected repair specimens to demonstrate strength of repair

– Experience in workshop processes as applicable to repair and reconditioning of aircraft parts (e.g. enlargement or reduction of dimensions to accept oversized or undersized parts; chemical or electro-chemical treatments for the protection of metals; metal depositing processes; special methods of heat treatment; special methods of welding; advanced metal processing techniques, surface texture measurement)

– Acceptance tests and final inspection

– Completion of documentation

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Appendix 1 to Chapter 10

PRACTICAL MAINTENANCE SKILLS: AIRFRAME — FACILITIES, TOOLS AND EQUIPMENT

1. INTRODUCTION

This appendix provides guidance for the kind of facilities, tools and equipment that are likely to be needed to meet the Training Objectives of Chapter 10.

2. METALWORK AND SHEET METAL WORK WITH HAND TOOLS

2.1 For basic skills training, the training workshop should be equipped with sturdy benches mounted with vices at approximately 2-m intervals, one vice per student. Other items required include:

a) powered grinding wheel for tool sharpening

b) powered drilling machine

c) large surface table for precision marking-off

d) compressor air supply suitable for use with pneumatic hand tools

e) powered hacksaw for cutting stock material

f) sheet metal guillotine

g) chalkboard/whiteboard for workshop instruction and work schedule

Note.— This list is identical to the one outlined in Appendix 1 to Chapter 11.

2.2 For airframe skills training, the workshop should ideally include the following:

a) A complete aircraft of all-metal construction with retractable landing gear, complete with engines in running order, or alternatively, an all-metal fuselage, wings and control surfaces of stressed skin type suitable for practising repair and inspection duties

b) Hydraulic lifting jacks, trestles, fuselage cradles, lifting slings, cables and steering bars, dihedral and incidence boards, and work and tools suitable for aircraft types provided

c) Desk for manuals and notices

d) Display board for inspection worksheets

e) Ground electrical power trolley

f) Apron-type fire extinguisher trolley

g) Hangar access equipment such as benches, trestles, ladders, chocks, etc.

h) Mobile lifting equipment, i.e. small crane or overhead gantry

i) Spray guns for aircraft paint and dope

j) Oil and fuel replenishing bowsers

k) Cable swaging machine

l) Mobile hydraulic test trolley

m) Landing gear oleo cylinders and retraction jacks, and wheel and brake units

n) Hydraulic pumps (both fixed and variable delivery)

o) Flying control surface hydraulic actuators

p) Flap/slat drive motors gearboxes and screw jacks

q) Airflow control valves and actuators

r) Air cycle machines (cold air units)

s) Flying control pulley, lever assemblies, tensioners and spring tab units

t) Seats and safety equipment

2.3 *Personal tool kit.* Students should have their own tools and a toolbox. This may be issued on a shop basis, i.e. a kit issued in the basic metalwork shop may contain only tools required for training in this shop and be retained by the shop when the students progress to the next phase, or students may be issued, and retain on a permanent basis, a personal basic kit which is their own property until completion of their training. Some schools may require students to purchase their own tools, their kits becoming more complete as their training advances. The following items are suggested for basic metalwork:

a) Measuring and marking-off tools

- 30-cm steel rule graduated in fractions of inches and millimetres
- Outside and inside calipers
- Try square
- Set of feeler gauges
- 15-cm dividers
- Scriber

b) Fitter's tools

- Round-nose and side-cutter pliers
- 15-cm long screwdriver
- Hacksaw
- Selection of files of different sections, lengths and cuts
- Hand drill and a set of small diameter drills
- Set of centre and pin punches
- Ball-peen and cross-pane hammers
- 20-cm flat chisel and a set of small chisels (including flat, cross-cut and round-nose)
- Plastic or hide-faced hammer
- Sheet metal snips
- Various sizes and types of screwdrivers
- Set of double-ended, open-ended and ring spanners of appropriate range in sizes and appropriate type (American, BSF, Unified or Metric) to suit available airframes
- Set of socket wrenches with handles and accessories to suit available airframes

3. METALWORK WITH MACHINE TOOLS

3.1 *Workshop equipment.* It is not important for Aircraft Maintenance (Technician/Engineer/Mechanic) (AMEs) to acquire a high degree of skill as machine tool craftsmen but they should understand the principles of turning, screw cutting, etc. For this reason, it is generally sufficient to have one or two centre lathes while a capstan or turret lathe is not essential. A small machine shop can be incorporated in the basic metalwork shop or can be housed separately, according to the premises available. It is suggested that the machine tools provided should generally be the simple, robust types suitable for training and might include the following:

a) Sensitive drilling machines

b) Surface grinding machine

c) Buffing machine

d) Centre lathe

e) Horizontal milling machine

f) Slotting or shaping machine

3.2 Trainees will not normally need any specific personal tool kit. Other items may be included to suit local needs.

4. AIRFRAME FAMILIARIZATION WORKSHOP

Shop equipment in the airframe workshop is determined according to the requirements of the technicians undergoing training. In general, it is desirable that licensed AME students should have the opportunity to remove and replace major components. Practise in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase. The requirements for the training of licensed AMEs are as follows:

a) Ideally, a complete aircraft of all-metal construction with retractable landing gear, complete with engines in running order

b) Alternatively, an all-metal fuselage, wings and control surfaces of stressed skin type suitable for practising repair and inspection duties

c) Hydraulic lifting jacks, trestles, fuselage cradles, lifting slings, cables and steering bars, dihedral and incidence boards, and work and tools suitable for aircraft types provided

d) Desk for manuals and notices

e) Display board for inspection worksheets

f) Ground electrical power trolley

g) Apron-type fire extinguisher trolley

h) Hangar access equipment such as benches, trestles, ladders, chocks, etc.

i) Mobile lifting equipment, i.e. small crane or overhead gantry

j) Spray guns for aircraft paint and dope

k) Oil and fuel replenishing bowsers

l) Cable swaging machine

m) Mobile hydraulic test trolley

n) Test boards designed to represent sections of typical aircraft cable, air and fluid systems. These should be complete with rigging instructions so that student errors are known upon completion of training

5. SPECIALIST ACTIVITIES: WOOD AND FABRIC, WELDING, AND COMPOSITES

5.1 Introduction

Equipment in the training areas for these specialist activities depends on the training requirements.

5.2 Woodwork and fabric workshop

5.2.1 Most wooden aircraft are covered with fabric as are the control surfaces of some current metal-framed commuter and light aircraft. There is therefore a continuing requirement to teach fabric covering and related repair and maintenance skills. The shop should be divided into two main areas: a) the woodworking area, and b) the fabric area. The fabric area should be separated from other areas and should be dust-free, with controlled humidity and well ventilated to expunge dangerous fumes from dopes and paints. Depending upon the types of dopes and paints used, breathing apparatus might also be required. Lighting should be adequate and all electric switches must be of the explosion-proof/spark-arresting type. There should be sufficient space to carry out work on aircraft and their components. Entry and exit doors to the fabric area must be big enough to accommodate the movement and transport of aircraft or their components.

5.2.2 The fabric area should have the following tools and equipment:

a) Trestles

b) Compressor

c) Air hoses

d) Spray gun

e) Water separator

f) Paint store cupboard

g) Paint brushes

h) Electric heat gun

i) Fabric condition testers (punch and pull)

j) Various types of scissors

k) Fabric sewing machine

5.2.3 The woodwork workshop should be equipped with carpenters' benches and with a carpenter's vice at each workstation. It should have the following combination of powered tools:

a) one carpenter's lathe

b) one wood planer

c) one circular saw

d) one disc sander

5.2.4 The following tools should be issued to form part of the students' personal basic tool kits or be made available to them from the woodwork workshop:

a) 50-cm panel saw

b) 25-cm dovetail saw

c) 30-cm padsaw

d) metal jack plane

e) 20-cm smoothing plane

f) one wood type spokeshave

g) two Firmer chisels (6 mm and 20 mm)

h) one 12-mm sash-mortise chisel

i) one claw hammer (600 to 700 g)

j) one 150-g pattern maker's hammer

k) one carpenter's try square

l) one adjustable bevel

m) one marking gauge

n) one 1-m long folding rule

o) one rachet brace and a selection of bits and countersinks

p) one bradawl

q) one 30-cm cabinet pattern screwdriver

r) one 20-cm rachet screwdriver

s) one mallet

t) one carpenter's toolbox with lock and key

5.3 Welding

5.3.1 The purpose of a short course on welding is to impart enough knowledge of welding techniques to enable students to assess the airworthiness of welded joints and structures. It is not intended to produce skilled welders. The welding shop must be chosen and equipped to comply with the safety regulations for oxyacetylene and other types of welding. Metal-screened working bays with metal work-benches should be built according to the number of workstations required.

5.3.2 Welding equipment might include the following:

a) Set of oxyacetylene welding equipment

b) Electric arc welder

c) Electric TIG or MIG welder

d) Eye and face shields, goggles, leather gloves and aprons

e) Electrodes, welding rods and welding fluxes

f) Electric resistance welder for spot welding (may be stored in sheet metal shop)

5.4 Fibreglass and reinforced plastics workshop

5.4.1 Many aircraft are fitted with secondary structures constructed from fibre or glass materials. (Indeed, some aircraft even have their primary structures made of fibre or glass materials.) From the training point of view, only secondary structures should be of concern. The repair of structures is a complex and specialized operation that requires expertise often available only from the aircraft manufacturer.

5.4.2 As far as space, a dust-free, humidity-controlled atmosphere, lighting and doors are concerned, the workshop should follow the general pattern of the fabric shop. Fireproof storage facilities for highly inflammable and corrosive resins and activators are also required. The correct type of extinguishers must also be available. The following tools should be provided for the fibreglass and reinforced plastics workshop:

a) Laying-up tables

b) Brushes and spatulas

c) Scissors and cutters

d) Sanders

e) Measuring cups

f) Heat lamps

g) Pots and trays

Chapter 11

PRACTICAL MAINTENANCE SKILLS: ENGINE AND PROPELLER

11.1 INTRODUCTION

11.1.1 In order to be able to satisfactorily assimilate the training on individual types of engines, propellers and systems, the Aircraft Maintenance (Technicians/Engineers/ Mechanics) (AMEs) must have good fundamental practical skills and understand the maintenance processes and principles generally used in aircraft hangars and workshops.

11.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the engines, propellers and systems, the AME must have a very complete knowledge of all the tools and associated maintenance processes that are likely to be used in hangars and workshops.

11.1.3 For future aircraft hangar or workshop technicians, their basic workshop training should commence with Phase Two — Skills and should be completed before the students begin working on airworthy aircraft, engines, propellers or equipment in Phase Three — Experience. For this purpose, the Performance parameters required to meet the Training Objectives outlined in 11.2 of this chapter are divided into two sections: Section a) requires basic manual skills and Section b) refers to the application of these skills to non-airworthy engines, propellers, components or specially designed practice rigs. The level of manual skills to be developed varies according to the category of technicians being trained. For example, bench fitting is of importance to all categories of technicians, while radio technicians may require skill in soldering but they only need an introduction to welding.

11.1.4 The recommended facilities, tools and equipment are described in Appendix 1 to this chapter.

11.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided with appropriate facilities; tools (both hand and machine); materials; a test/demonstration engine, propeller, necessary parts and raw materials; specially-made repair, assembly and rigging test exercises. (See Appendix 1 to Chapter 11.)

Performance:

a) The trainees will practise dismantling, repairing and reassembly by using non-airworthy parts and/or specially-designed test exercise pieces and/or assemblies. They will also use simple engineering drawings as well as engine manufacturers' maintenance, overhaul and repair tests (real or simulated).

b) The trainees will practise fault finding, dismantling, inspecting, repairing, decision making regarding repair or replacement, reassembly and test running of engines and propellers. They will also use engineering drawings and engine manufacturers' maintenance, overhaul and repair manuals.

Standard of accomplishment:

During workshop training, the standard is a function of the variety of exercises completed and the time spent in workshop training. The trainees/students should work individually on engine and/or propeller exercises so that they have "ownership" of the standard. If necessary, they should practise and repeat increasingly complex exercises to develop greater manual skills within their respective areas of competence. Finally, they should ground run the engine and/or propeller, either on a test bed or on an actual aircraft.

11.3 BASIC WORKSHOP AND MAINTENANCE PRACTICES: ENGINE AND PROPELLER

11.3.1 Introduction

11.3.1.1 Training in workshop practice should begin with exercises in the use of hand tools to make a series of simple shapes to specified dimensions from various metals. Each shape should be progressively more complicated with more precise tolerances. From the start, instructors should ensure that students develop the habit of handling basic hand or machine tools in the correct manner, and action should be taken to correct any bad or potentially dangerous practices before they become habitual. At all times, and particularly during the early stages of training, the importance of producing accurate and careful work must be stressed. These exercises can be used to develop the trainees' inspection ability, i.e. the necessary judgment and sense of responsibility required to assess the accuracy of their own work and that of others.

11.3.1.2 It is desirable that licensed AME students should have the opportunity to remove and replace major components. Practise in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase.

Note.— The basic practical training specified in this paragraph is very similar to that described in 10.3 of Chapter 10 for airframe trainees.

11.3.2 Bench fitting

– Cutting and filing: exercises in cutting metal with hacksaws, filing, drilling, drill grinding, thread cutting with taps and dies, and scraping

– Measurements: use of steel rule, dividers, calipers, micrometers, vernier, combination set, surface place, and dial test indicator

11.3.3 Forging, heat treatment, soldering and welding

– Forging by hand simple specimens such as chisels, punches and others

– Hardening and tempering carbon steel by using forge

– Tin soldering, tin-plating, and use of proper flux

– Silver soldering and brazing

– Welding: oxyacetylene and metallic arc welding of different materials

– Inspection of welded joints for flaws

11.3.4 Sheet metalwork

– Sheet aluminium alloy: cutting, marking out, drilling, forming, bending, bending allowances, shrinking and flashing

– Forming sheet metal by pressing and rolling

– Riveting: types of rivets, riveting with hand tools, rivet spacing, countersinking and dimpling

– Use of pneumatic riveting hammer

– Blind riveting

– Inspection of rivets, removal of rivets, use of oversized rivet and rivet jackets

– Tube work: use of taper pins and tubular rivets

– Exercises in sheet metal patching and repair work

– Heat treatment of aluminium alloy and alloy rivets: use of salt baths and furnaces; annealing and solution treatment

11.3.5 Machine shop

– Drilling: using machine drills to drill close tolerance holes in various materials; reaming holes to close tolerances; others

– Turning: exercises in turning steel, aluminium alloy and brass parts; use of lathe for thread cutting; others

– Grinding: use of grinding wheels for tool sharpening

11.3.6 Wire and cable work

– Inspection of aircraft cables for defects

– Splicing exercises

– Swagging exercise: attachment of standard end fittings to engine control cables

– Demonstration of proof test on engine control cable

11.3.7 Tube work

- Tube bending, with and without heat treatment
- Tube flaring
- Fitting of different kinds of unions used in fuel, oil and hydraulic systems
- Inspection and testing of tubes and flexible hoses

11.3.8 Familiarization

- Practical explanation of the mechanical arrangement of the engines available for work and practice (e.g. 2-stroke and 4-stroke spark ignition and compression ignition engines); air-cooled and water-cooled piston engines; piston aero engines of various types; turbojet, turboshaft, turbofan and turboprop aero engines; others

11.3.9 Initial inspection

- Examination of complete engine and propeller for identification to manufacturers' service publications
- Confirmation of external accessories and features
- Recognition of visible defects
- Ground run of engines (if possible) and recording of performance
- Ensured availability of manuals, workshop tools and equipment
- Identification of safety precautions to be observed

11.3.10 Dismantling

- Removal of accessories as appropriate (i.e. starters, generators and electrical equipment, pressure transmitters, transducers, thermocouples, magnetos, carburettors and spark plugs)
- Dismantling of core engine to a specified level according to manufacturer's service publications
- Complete dismantling of smaller engines: removal of all accessories, manifolds, cylinders, pistons, connecting rods, crankshaft and bearings; cleaning and laying out of these components for inspection
- Partial dismantling of larger engines: removal of accessories, reduction gear, cylinders, and pistons (without disturbing crankshaft or crankcase)
- Partial dismantling of gas turbines: removal of accessories, jet pipe assembly, and combustion chambers (without disturbing turbine/compressor assembly)

11.3.11 Inspection of dismantled engine

- Visual inspection in accordance to manufacturer's service publications
- Dimensional checks in accordance with procedures given in manufacturers' manuals for deterioration in accordance to manufacturer's service publications on blades, vanes, shafts, bearings, and connecting rods for wear, ovality, twist and distortion
- Checking of cylinder valves, pistons and piston rings as directed in overhaul manual: checking of fits and clearances; practise on repair schemes, as applicable
- Non-destructive crack detection: electromagnetic, dye penetrant, etc. on crankshafts and camshafts
- Checking for cracks and distortion on exhaust manifolds, jet pipes, and combustion chamber flame tubes
- Inspection of gas turbine and turbo-supercharger compressor and turbine assemblies; inspection of blades for deposits, damage and distortion

11.3.12 Repair and reconditioning of engine parts

- Repairs by machining and grinding; checks for fits and clearances; fitting of oversized or undersized parts
- Castings: checks and rectification of cracks, porosity and corrosion
- Rigid and flexible pipes and hoses: testing and reconditioning
- Inspection and repair of gears, accessory drives, and torque metre components
- Welding repairs to nickel alloy components (e.g. jet pipes)

11.3.13 Reassembly

- Rebuilding of totally or partially dismantled engines (with particular attention to be paid to cleanliness, correct torquing and safety, correctness of working clearances, and accuracy of valve and ignition timing)

11.3.14 Engine test bed running and fault finding

– Installation of engine on test bed, checking of instrumentation, control runs, and fuel supplies

– Fan testing of piston engines: calibration of test fan for test site, and engine type

– Full "after overhaul" test programme as specified in the State's airworthiness requirements and in the manufacturer's approved test schedule, using a method appropriate to the type of engine: initial test, strip inspection, reassembly and final test

– Interpretation of engine performance based on test results

– Experience in starting, running and ground testing of aero engines

– Inspection of powerplant installed in aircraft

– Fault finding and rectification

11.3.15 Aircraft installation

– Preparation of powerplant for installation in aircraft: functional checks on controls and interconnections

– Flow tests of fuel system

– Checks on pyrometry and on fire warning system

– Checks on engine bearers and alignment

– Slinging and installation of powerplant

– Ground running tests after installation

11.3.16 Storage and transit of engines

– Protection against corrosion

– Engine stands, crating, lifting and tie-down points

– Storage bags/covers and use of desiccant

– Preparation of engines for running after long-term storage

11.3.17 Propeller maintenance tasks

– Practise in removal and replacement of propellers on engine propeller shaft

– Dismantling and inspection of typical variable pitch propeller

– Checking of blades and blade root bearings for damage and permissible repairs

– Reassembly, resetting of blade angles, blade torque loadings, static balance of propeller, and inspection

11.4 BASIC WORKSHOP AND MAINTENANCE PRACTICES: ENGINE/PROPELLER SYSTEMS/COMPONENTS AND FUNCTION TESTING

11.4.1 Components: Ignition

– Dismantling, reassembly and testing of various kinds of magnetos and distributors

– Renewal of cables in an ignition harness

– Continuity and insulation tests

– Cleaning and testing of spark plugs

– Inspection and testing of igniter equipment for turbine engines

– Safety precautions associated with ignition equipment

11.4.2 Components: Fuel and control

– Float and injection carburettors: partial dismantling and inspection; reassembly and flow tests; others

– Propeller control devices, governors and feathering pumps: partial dismantling, reassembly and bench tests

– Fuel pumps, oil pumps, oil coolers, gearboxes, flow, pressure and other tests as specified in manufacturer's manuals

– Gas turbine fuel system components: pumps, pressure and flow control units, metering devices, automatic valves, and burners; partial dismantling to view and understand mechanism; reassembly testing; others

11.5 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

11.5.1 Heavy maintenance check or overhaul of engine/propeller

– Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; draining oil and other systems; selection and display of equipment; tools required

- Selected major operations (e.g. turbine blade inspection either by dismantling or by optical probe techniques)

- Adherence to the aircraft maintenance manual and to a typical airline check or overhaul schedule for each job

- Conclusion of Heavy Maintenance Check or overhaul: replacement of components, function tests, restoration of internal and external finish, preparation for engine run, and completion of documentation

11.5.2 Engine/propeller repair

- Selection of repair scheme: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings or repair manual

- Selection of material to be checked for compliance with specification

- Embodiment of repairs according to prepared drawings or repair manual

- Testing to destruction of selected repair specimens to demonstrate strength of repair

- Experience in workshop processes as applicable to repair and reconditioning of aircraft parts (e.g. enlargement or reduction of dimensions to accept oversized or undersized parts; chemical or electrochemical treatments for the protection of metals; metal depositing processes; special methods of heat treatment; special methods of welding; advanced metal processing techniques; surface texture measurement)

- Acceptance tests and final inspection engine run

- Completion of documentation

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Appendix 1 to Chapter 11

PRACTICAL MAINTENANCE SKILLS: ENGINE AND PROPELLER — FACILITIES, TOOLS AND EQUIPMENT

1. INTRODUCTION

This appendix provides guidance for the kind of facilities, tools and equipment that are likely to be needed to meet the Training Objectives of Chapter 11.

2. METALWORK AND SHEET METALWORK WITH HAND TOOLS

2.1 For basic skills training, the training workshop should be equipped with sturdy benches mounted with vices at approximately 2-m intervals, one vice per student. Other items required include:

a) powered grinding wheel for tool sharpening

b) powered drilling machine

c) large surface table for precision marking-off

d) compressor air supply suitable for use with pneumatic hand tools

e) powered hacksaw for cutting stock material

f) sheet metal guillotine

g) chalkboard/whiteboard for workshop instruction and work schedule

Note.—This list is identical to the one described in Appendix 1 to Chapter 10.

2.2 For engine skills training, the workshop should ideally include the following:

a) Sectioned engines (piston or turbine, according to the needs of the company or State), mounted and rotatable for demonstration purposes

b) Solvent washing plant for cleaning parts

c) Mobile lifting gantry for hoisting engines and heavy equipment

d) Engine slings and work stands for each type of engine in the shop

e) Manufacturer's tool kits for each type of engine (including extractors, assembly jigs, etc.) used for the complete dismantling of engines

f) Electromagnetic (magnetic particle) crack detection equipment

g) Medium-sized surface table with vee-blocks, DTI stand, etc.

h) Propeller assembly bench with tools for measuring blade torque

i) Propeller manufacturer's tool kit for each type of propeller used

j) Example of contemporary propeller controllers

k) Example of various types of magnetos

l) Example of various high-energy and other types of gas turbine igniter

m) Example of various types of carburettor and petrol injection equipment

n) Example of turbocharger

2.3 *Personal tool kit.* Students should have their own tools and a toolbox. This may be issued on a shop basis, i.e. a kit issued in the basic metalwork shop may contain only tools required for training in this shop and be retained by the shop when the students progress to the next phase, or students may be issued, and retain on a permanent basis, a personal basic kit which is their own property until completion of their training. Some schools may require students to purchase their own tools, their kits becoming more complete as their training advances. The following items are suggested for basic metalwork, airframe or engine tool kit:

a) Measuring and marking-off tools

– 30-cm long steel rule, graduated in fractions of inches and millimetres

– Outside and inside calipers

– Try square

– Set of feeler gauges

– 15-cm dividers

– Scriber

b) Fitter's tools

– Round-nose and side-cutter pliers

– 15-cm long screwdriver

– Hacksaw

– Selection of files of different sections, lengths and cuts

– Hand drill and a set of small diameter drills

– Set of centre and pin punches

– Ball-peen and cross-pane hammers

– 20-cm flat chisel and a set of small chisels (including flat, cross-cut and round-nose)

– Plastic or hide-faced hammer

– Sheet metal snips

– Various sizes and types of screwdrivers

– Set of double-ended, open-ended and ring spanners of appropriate range in sizes and appropriate type (American, BSF, Unified or Metric) to suit available airframes

– Set of socket wrenches with handles and accessories to suit available airframes

3. ENGINE FAMILIARIZATION WORKSHOP

3.1 The supply or provision of engines in the airframe workshop is determined according to the requirements of the technicians undergoing training (e.g. piston or turbine engines). In general it is desirable that licensed Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) students should have the opportunity to remove and replace major components. Practise in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase. The requirements for the training of licensed AMEs are as follows:

a) Ideally, a complete engine piston and/or turbine

b) Engine test bed or airframe on which the engine can be operated

c) Mobile lifting equipment (i.e. small crane or overhead gantry lifting slings) and tools suitable for engine types provided

d) Desk for manuals and notices

e) Display board for inspection work sheets

f) Access and storage equipment such as benches, trestles, shelves, etc.

g) Oil and fuel replenishing bowsers

h) Test boards designed to represent sections of typical aircraft/engine cable, air and fluid systems. These should be complete with rigging instructions so that student errors are detected immediately.

Chapter 12

PRACTICAL MAINTENANCE SKILLS: AVIONICS — ELECTRICAL, INSTRUMENT, AUTOFLIGHT AND RADIO

12.1 INTRODUCTION

12.1.1 In order to be able to satisfactorily assimilate training on individual types of aircraft avionics systems, the Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs) must have good fundamental practical skills and understand the maintenance processes and principles generally used in aircraft hangars and workshops.

12.1.2 In order to be able to perform or supervise "hands-on" tasks of mechanic/technician on the aircraft and avionics systems, the AME must have a very complete knowledge of all the tools and associated maintenance processes that are likely to be used in hangars and workshops.

12.1.3 For future aircraft hangar or workshop technicians, their basic workshop training should commence with Phase Two — Skills and should be completed before the students begin working on airworthy aircraft and avionics equipment in Phase Three — Experience. For this purpose, the Performance parameters required to meet the Training Objectives outlined in 12.2 of this chapter are divided into two sections: Section a) requires basic manual skills and Section b) refers to the application of these skills to non-airworthy avionics components, systems or specially-designed practice rigs. The level of manual skills to be developed varies according to the category of technician being trained. For example, bench fitting is of importance to all categories of technicians, while radio technicians may require skill in soldering but they only need an introduction to welding.

12.1.4 The recommended facilities, tools and equipment are described in Appendix 1 to this chapter.

12.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided with appropriate facilities; tools (both hand and machine); materials; test/demonstration avionics, electrical, instrument, autoflight items of equipment, necessary parts and raw materials or specially-made repair, assembly and rigging test exercises. (See Appendix 1 to Chapter 12.)

Performance:

a) The trainees will practise equipment removal, replacement, dismantling, inspection, decision-making regarding repair or replacement, reassembly and function testing using simple engineering drawings and manufacturers' maintenance, overhaul and repair tests (real or simulated).

b) The trainees will practise fault finding, dismantling, inspecting, repairing, decision-making regarding repair or replacement, reassembly and testing of avionics units. They will also use engineering drawings and engine manufacturers' maintenance, overhaul and repair manuals.

Standard of accomplishment:

During workshop training, the standard is a function of the variety of exercises completed and the time spent in workshop training. The trainees/students should work individually on the avionics exercises so that they have "ownership" of the standard. If necessary, they should practise and repeat increasingly complex exercises to develop greater manual skills within their respective areas of competence. Finally, they should function test the units or systems on a test rig.

12.3 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — ELECTRICAL

12.3.1 Lead acid batteries

- Checking of battery condition, adjustment of specific gravity of electrolyte, battery charging practise; capacity, discharge and insulation tests; others
- Overhaul procedures, including leak test of cells and cell replacement
- Safety precautions

12.3.2 Nickel cadmium batteries

- Checking of battery condition: determining state of charge, cell balancing, charging, etc.
- Checking of electrolyte level and insulation tests
- Safety precautions
- Cell replacement
- Deep cycling of nickel cadmium units

12.3.3 Wire and cable work

- Making up of wire lengths and specimen cable looms: soldering and crimping ends, identification of cables, using routing charts, and fitting plugs and sockets
- Cable tracing practise: continuity and insulation checks on cable runs
- Practice in aircraft wiring as carried out during modification or repair work: full tests of circuit

12.3.4 Bonding, continuity and insulation testing

- Bonding checks: use of bonding tester
- Continuity and insulation tests on aircraft circuit; use of Megger testers
- Millivolt drop checks at cable joints and terminal ends

12.3.5 Generators and electric motors

- Dismantling, examination and reassembly
- Demonstration of generator test

12.3.6 Voltage regulators, cut-outs and relays

- Partial dismantling, followed by examination and reassembly, of carbon pile and other types of voltage regulators
- Dismantling, examination and reassembly of accumulator cut-outs, reverse current relays, solenoids and relays from various circuits, and thermal circuit breakers

12.3.7 Generators and alternators

- Strip inspection: undercutting of commutators, checks for brush wear, brush spring loading and brush bedding
- Testing of generator elements: armature testing, continuity tests on field coils, armature shaft alignment, and wear of ball races and housings
- Reassembly and insulation test of generator
- Testing of generators and alternators on test rig
- Voltage regulators: overhaul procedure, correction of basic setting and adjustments making
- Adjustment and rig testing of cut-outs and relays
- Current balancing adjustments of DC power circuits on simulator of multi-engined aircraft electrical system
- Electromagnetic relays: inspection and polishing of contacts, setting and adjustment, and millivolt drop tests on test rig
- Constant speed drives (CSD): removal from alternator and testing
- Integrated drive generator (IDG): dismantling, inspection, and overhaul

12.3.8 Electric motors

– Starter motors for piston and turbine aero engines: dismantling, examination for condition and wear, check for brush gear and commutator, check of clutches and geared drives; reassembly and test

– Dismantling, inspection, reassembly and test of motors for fuel line pumps, hydraulics, propeller feathering, and windscreen wipers

– Linear and rotary actuators: dismantling, reassembly, and bench testing

12.3.9 Inverters and converters

– Rotary inverters and converters: dismantling and check for brushes and commutators, cleaning and testing of armature, and reassembly and adjustment

– Testing: checking of input and output voltages; adjustment of frequency control

– Static inverters and converters: inspection, adjustment and testing of output voltage and frequency

12.3.10 Equipment

– Magnetos: overhaul and test procedure for high and low tension systems

– Spark/igniter plug testing, ignition lead testing and inspection, and booster coil testing

– Engine high-energy ignition units: overhaul and test procedure

– Safety precautions

12.3.11 Electrical circuit equipment

– Examination and partial overhaul of a wide range of miscellaneous electrical components such as transducers, magnetic amplifiers, rectifiers, transformers, Wheatstone bridge and other balancing devices, and sensing elements

– Adherence of all testing in accordance with manufacturers' instructions

– Dismantling (as appropriate), examination and reassembly of electrical components, including converters, inverters, switchgear, heating units, and actuators

12.4 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — INSTRUMENT

12.4.1 Pressure indication

– Mechanically-operated gauges (e.g. Bourdon tube gauges): partial dismantling, examination, strip inspection, reassembly and calibration with dead weight tester

– Pressure transducers, electrically-operated transmitters, ratio metres, etc.: strip inspection, reassembly and calibration

– Electrically-operated gauges: strip inspection, reassembly and calibration

12.4.2 Flight instruments

– Calibration checks of flight instruments

– Pitot heads and static vents: maintenance checks

– Altimeters: dismantling, inspection, reassembly and calibration checks

– Air speed indicators (ASI): dismantling, inspection, reassembly and calibration checks

– Machmeters: dismantling, inspection, reassembly and calibration checks

– Rate-of-climb indicators: dismantling, inspection, reassembly and calibration checks

12.4.3 Gyroscopic instruments

– Air-driven gyroscopic instruments: partial dismantling, examination and reassembly

– Electrically-driven gyroscopic instruments: partial dismantling, examination and reassembly

– Artificial horizon: dismantling, inspection and reassembly

– Directional gyro: dismantling, inspection and reassembly

– Turn and bank indicator: dismantling, inspection and reassembly

– Zero reader: dismantling, inspection and reassembly

– Calibration checks on gyroscope test turntable

12.4.4 Engine speed indication (ESI)

- ESI generators (DC and AC types): partial dismantling, inspection and reassembly
- ESI gauges: partial dismantling, inspection and reassembly
- Engine speed synchronizing gear: examination and demonstration of principles
- Generators and gauges: dismantling, inspection, reassembly and calibration checks

12.4.5 Thermometers and temperature indication

- Engine temperature thermocouples: demonstration of cylinder head, jet-pipe temperature and other types
- Radiometer temperature gauges: partial dismantling, examination and reassembly of transmitter and indicator units
- Dismantling, reassembly and testing of temperature, and measuring instruments of various kinds
- Tests on various kinds of temperature sensing units (e.g. fire and overheating detectors, cabin air ductstats, and inching controls for cooler shutters)
- Use of portable test kits for checking gas turbine powerplant thermocouple installations

12.4.6 Fuel contents indication

- Float-operated desynn contents gauges: examination and demonstration of operation dismantling, inspection, reassembly and test
- Capacitance type contents gauges: examination and demonstration of operation reassembly and test
- Flowmeters: dismantling, inspection, reassembly and test

12.4.7 Compass systems

- Magnetic compasses: friction and damping tests, practice compass swing, and compensation
- Remote compass: examination and demonstration
- Tests of compass swinging site
- Swing of compass in available aircraft: compensation practice
- Remote compass: partial dismantling, inspection, reassembly and test

12.4.8 Miscellaneous instruments

- Examination and demonstration of other types of instruments (flowmeters, navigation and landing aid presentations)

12.5 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — AUTOFLIGHT

12.5.1 Autopilots

- Examination and demonstration of autopilot mock-up and components

12.5.2 Flight control systems

- Autopilots (electrical or electronic): dismantling, examination of components, reassembly, and installation in aircraft or on simulator by following manufacturer's test programme; practise with portable test kit
- Autopilots (pneumatic or hydraulic actuation): dismantling of component parts, reassembly, installation in aircraft or simulator, and function tests
- Examination and testing of elements of flight director systems, automatic flare and automatic landing systems, as required

12.6 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — RADIO

12.6.1 Radio workshop: fundamental techniques

- Safety precautions associated with radio equipment hazards: high voltages, radio frequency (RF) emissions and microwave emissions, electrostatic discharge, etc.
- Wiring and cabling: demonstration and practice in wiring and soldering radio circuits
- Multimeters, Megger and bonding testers: demonstrations and practice

- Identification and inspection of antenna: external wire aerials, blade, rod and rail aerials, D/F loops, and suppressed aerials; viewing on aircraft, and inspection for physical condition
- Aerial masts, static dischargers, etc.: inspection and servicing
- Chassis: sheet metalwork using drawings
- Simple receiver assembly kit: study of circuit, demonstration of assembly, operation and testing
- Measurements and experiments with circuit demonstration units simulating the following system elements:
  - TRF receiver
  - intermediate frequency amplifier
  - frequency converter
  - superheterodyne alignment
  - buffer-doubler amplifier
  - RF amplifier
  - modulation
  - transmission lines
  - reactance tube modulators
  - interference (filtering and shielding)
- Troubleshooting practice

12.6.2 Demonstration of test procedures on airborne equipment

- Identification: identity and location of principal types of airborne communication and navigation equipment: racking systems, power supplies, antennae and other interconnections
- Demonstrations of bench tests on sample equipment, including use of screened rooms

12.6.3 Wiring, cabling and soldering techniques

- Wiring: practice in stripping insulation; splicing; wiring to lugs; terminals and tube sockets; and dismantling, soldering and reassembly of connectors
- Cables: lacing of wires to form a cable, termination and soldering of cable ends, and serving of coaxial cables
- Soldering: practice with different sizes of soldering irons, different grades of solder, fluxes and types of connectors
- Microminiature precision soldering techniques
- Handling of electrostatic sensitive devices

12.6.4 Instrumentation

- Multimeter: practice in measuring and calculating series and parallel resistance; voltage and current measurements on various circuits; others
- Megger: continuity and insulation tests on aircraft cable assemblies structure; practice with circuit boards; others
- Simple valve voltmeter
- Frequency metres, absorption and heterodyne: practice in frequency measurement
- "Q" metres: practice in measuring L, R, C and Q
- Signal generators: demonstration of cathode ray oscilloscope; demonstration of use to examine waveforms, wave envelopes, and DC measurements

12.6.5 Antennae

- External wire aerials: splicing, tensioning and making connections
- Static dischargers: inspection, servicing and renewal procedures
- Fibreglass and resin laminate aerial masts: maintenance and repair
- External blade, rod and rail aerials: removal, maintenance and repair, and replacement
- Suppressed aerials: care and maintenance, maintenance and repair of dielectric covers
- DF loops: inspection, routine maintenance, ground calibration, and preparation of correction chart
- Reflectors and directors: care and maintenance

12.7 REPAIR, MAINTENANCE AND FUNCTION TESTING OF AIRCRAFT SYSTEMS/COMPONENT: AVIONICS

12.7.1 Airborne and test equipment practice

- Use of representative airborne radio and radar equipment and practice in servicing, installation and overhaul according to procedures laid down in the manufacturers' approved manuals

- Removal and replacement of equipment from aircraft racks, checks on power supplies, and remote controls
- Routine maintenance inspections of equipment in situ
- Operational checks
- Bench tests, measurement of performance characteristics, tuning, adjusting, fault finding, aligning and repairing
- Understanding and use of remote specialist communications, navigation and radio test equipment for both ramp and workshop
- Understanding and use of system built-in test equipment (BITE), including comprehension of output data
- Power supplies, installation and wiring, signal tracing, and use of cathode ray oscilloscope (CRO)
- Audio amplifier, installation and wiring, fault tracing and rectification

12.8 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

12.8.1 Aircraft heavy maintenance check: Avionics

- Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; selection and display of equipment; tools required
- Selected heavy maintenance operations
- Compliance to the aircraft maintenance manual and typical airline major check schedule for each job
- Conclusion of Heavy Maintenance Check: replacement of components; function tests; preparation for flight test; completion of documentation

12.8.2 Aircraft repair or modification: Avionics

- Selection of repair scheme or modification: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings
- Selection of material (to be checked for compliance with specification)
- Embodiment of repairs according to prepared drawings or manufacturers' manuals
- Testing to destruction of selected repair specimens to demonstrate strength of repair
- Experience in workshop processes as applicable to testing, repair and reconditioning of aircraft parts
- Acceptance tests and final inspection
- Completion of documentation

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Appendix 1 to Chapter 12

PRACTICAL MAINTENANCE SKILLS: AVIONICS — ELECTRICAL, INSTRUMENT, AUTOFLIGHT AND RADIO — FACILITIES, TOOLS AND EQUIPMENT

1. INTRODUCTION

This appendix provides guidance for the kind of facilities, tools and equipment that are likely to be needed to meet the Training Objectives of Chapter 12.

2. AVIONICS WORKSHOP: ELECTRICAL

2.1 *Shop equipment.* The electrical workshop should be equipped with demonstration mock-ups representing typical aircraft circuits. If made realistically, these can be of value for practising adjustments and troubleshooting as well as for demonstration. All areas of the engine shop should have adequate benches, racks, shelves and storage bins; electric power points and piped compressed air to operate powered hand tools; factory safety precautions with fire warning and extinguishing provisions. Benches should be smooth-topped and have sufficient vices and power points (for soldering irons) to suit the class size planned. The following major equipment items should also be available:

a) workshop test unit for testing electrical machines (universal types are available for testing a wide variety of generators and motors)

b) appropriate special tools and test metres (necessary because of the considerable range and variety of electrical equipment on the modern aircraft)

c) battery charging plant, preferably housed in a separate, well-ventilated charging room. For lead acid batteries, the charging plant should be of the series type suitable for charging several batteries at different rates.

Note.— For charging lead acid and nickel cadmium batteries, a separate and totally isolated charging room and equipment will be required for each type. For nickel cadmium batteries, a constant current charger and battery analyser must be specified.

2.2 *Personal tool kit.* Students should have their own tools and a toolbox. This may be issued on a shop basis, i.e. a kit issued in the electrical shop may contain only tools required for training in this shop and be retained by the shop when the students progress to the next phase, or students may be issued, and retain on a permanent basis, a personal basic kit which is their own property until the completion of their training. Some schools may require students to purchase their own tools, their kits becoming more complete as their training advances. The following items are suggested for basic electrical work:

a) one electric 5-mm point temperature-controlled soldering iron (soldering copper)

b) one wire stripper for removing insulation

c) a selection of small screwdrivers (including a Phillips)

d) one adjustable hook wrench (18 to 50 mm)

e) one set of Allen keys

2.3 The exercises with components should be designed to develop skills in dismantling, inspection, decision-making and assembly. The following types of components should be available and used as appropriate according to the potential needs of the trainees:

a) Lengths of aircraft cabling with typical plugs, sockets, bulkhead sealing bungs, grommets, etc. for practising wire work and making up looms

b) A selection of switches, fuses, thermal circuit breakers, wire connecting devices, junction boxes and other electrical system elements

c) Specimens of airborne batteries (both lead acid and nickel cadmium): sectioned, serviceable and chargeable

d) DC generators and AC alternators (constant speed drives)

e) Voltage regulators, generator control unit (GCU), and other types of current limiting devices (i.e. vibrator types and variable-resistance types)

f) Various types of DC and AC motors, including engine starters, continuously rated motors, rotary and linear actuators

g) Static and rotary inverters and specimens of other types of current conversion devices, such as transformer rectifier units (TRUs)

h) Specimens of various types of airborne electrical instruments, including instruments embodying principles of the voltmeter, ammeter, ohmmeter, Wheatstone bridge, thermocouple, ratio metre, servos and synchros, etc.

i) Specimens of aircraft electric heating devices, such as pitot heads, thermal de-icing shoes, etc.

j) Specimens of aircraft lighting appliances, such as cabin fluorescent lamps, landing lamps, navigation lights, etc.

3. AVIONICS WORKSHOP: INSTRUMENT

3.1 *Workshop equipment.* This shop should be a "clean area," i.e. it should be protected from dust, workshop fumes and industrial contaminants. Ideally, a separate building or room with filtered ventilation is desirable and in very humid climates, air conditioning is essential. Benches should be topped with smooth hardwood or covered with a Formica top. If air conditioning is not installed, it may be necessary to provide sealed cabinets with silica gel (for air drying) for storage of some of the test equipment and instrument specimens.

3.2 The instrument workshop should be equipped with demonstration mock-ups representing typical aircraft circuits. If made realistically, these can be of value for practising adjustments and troubleshooting as well as for demonstration. Benches should be smooth-topped and have sufficient vices and power points (for soldering irons) to suit the class size planned. The following major equipment items should also be available:

a) Dead weight tester for pressure gauges

b) Altimeter test chamber with substandard instrument

c) Mock-up of air speed indicator (ASI) system for leak test practice

d) Gyroscopic instrument test table

e) Mock-up for compass swinging practice (i.e. an old aircraft or a specially-made trolley which can be used on an outdoor site selected as compass base)

f) Bridge Megger for insulation testing of electrical items

3.3 The personal basic tool kits of students should be supplemented by the following items:

a) one set of watchmaker's screwdrivers

b) one set of miniature spanners

c) one set of Allen keys (appropriately sized)

d) one set of Bristol spline keys

e) one electric temperature-controlled soldering iron with fine point (similar to that issued in the electrical workshop)

3.4 The exercises with components should be designed to develop skills in dismantling, inspection, decision-making and assembly. The following types of components should be available and used as appropriate according to the potential needs of the trainees:

a) Boost or manifold pressure gauge

b) Hydraulic pressure gauge

c) Engine oil pressure gauge (Bourdon tube type)

d) Engine oil pressure gauge (electrical type)

e) ASI

f) Pitot static head

g) Altimeter (simple and sensitive types)

h) Rate-of-climb indicator

i) Turn and slip indicator (air-driven and electrical types)

j) Directional gyroscope (air-driven and electrical types)

k) Artificial horizon (air-driven and electrical types)

l) Engine speed indicator (DC and AC types)

m) Oil thermometer (physical and electrical types)

n) Cylinder head or jet-pipe thermocouple

o) Fuel content gauge (float-operated and capacitance types)

p) Magnetic compass

q) Simple type of autopilot

4. AVIONICS WORKSHOP: AUTOFLIGHT, NAVIGATION AND RADIO

4.1 *Workshop equipment.* This shop should be a "clean area," i.e. it should be protected from dust, workshop fumes and industrial contaminants. The shop could be combined with the instrument workshop. Ideally, a separate building or room with filtered ventilation is desirable and in very humid climates, air conditioning is essential. Benches should be topped with smooth hardwood or covered with a Formica top. If air conditioning is not installed, it may be necessary to provide sealed cabinets with silica gel (for air drying) for storage of some of the test equipment and instrument specimens.

4.2 The following test equipment items should also be available:

a) Variable stabilized power supply unit

b) Signal generator (high grade)

c) Signal generators for bench

d) Signal generator (UHFNHF)

e) Audio-frequency oscillators

f) Spectrum analyser

g) Cathode ray oscilloscopes

h) Frequency metres

i) Moving coil, volt-ohm-milliampere, and multimeters

j) Variac

k) Digital analyser

l) Valve and transistor characteristics tester

m) Digital voltmeter/ohmmeter/ammeter

n) Logic probe

o) R, L, C bridge

p) Voltage standing wave metres

q) Absorption and thermocouple watt meter

4.3 The workshop should be equipped with demonstration mock-ups representing typical aircraft circuits. The following equipment may be of value for practising adjustments and troubleshooting as well as for demonstration:

a) High frequency (HF) transmitter/receiver

b) Very high frequency (VHF) transmitter/receiver

c) Automatic direction finder system

d) VHF omnidirectional radio range/instrument landing system (VOR/ILS) system (including glideslope and marker receivers)

e) Distance measuring equipment system

f) Air traffic control transponder system (including altitude reporting mode)

g) Radio altimeter

h) Weather radar

i) Very Low Frequency (VLF) Omega navigation system

j) Loran-C system

k) Doppler navigation system

l) Navigation indicators capable of presenting combined navigation information, typically a radio magnetic indicator (RMI) and horizontal situation indicator (HSI) wired for both compass and various radio navigation inputs

m) Instrument systems with electronic amplifiers (e.g. capacitance type fuel contents gauges, cabin temperature controllers, and automatic pilots)

4.4 The radio section of the workshop needs a screened room or “cage” to prevent undue radiation from equipment undergoing testing and to provide an interference-free region for fine measurement. Although it is desirable to have this room adjoining the radio workshop, they should not be close to sources of interference, such as an electrical overhaul shop or spark plug testing equipment. As a further safeguard against interference, all power supplies to the radio workshop should be filtered, and outgoing interference should be suppressed by adequate screening of aerial cables and artificial aerials. Alternatively, if a screened room is unavailable, for certain types of equipment, it is possible to use a field simulator specified by the equipment manufacturer. (A metal box in which the respective antenna is placed to eliminate unwanted radiations and interference.) The following power supplies will be required:

a) AC mains supply for lighting, heating, air conditioning, mains rectifiers, test instruments, soldering irons, etc. (This will be at the standard voltage of the locality and the supply should be wired throughout in screened conduit.)

b) 30-volt DC supply, surge-free and of adequate capacity for the size of the workshop. (A ring main supply from lead acid or alkaline cells, ripple-free and filtered is suitable or a mains rectifier/regulator can be used.)

c) 15-volt DC supply, also surge-free

d) 115-volt, 400-cycle, single-phase AC supply. (This should be frequency-monitored and can be taken from a static inverter.)

e) 115-volt, 400-cycle, three-phase AC supply, frequency-monitored and wired to the working benches by screened cable

f) 26-volt, 400-cycle, single-phase AC supply, taken from the 115-volt AC supply through a transformer or from the 26-volt AC output from the static inverter

g) Compressed air and vacuum supplies

4.5 The personal basic tool kits of students should be the same as specified for the instrument workshop but may be supplemented to suit local needs.

4.6 The exercises with components and system demonstration rigs should be designed with a view to developing skills in inspection fault finding and decision-making.

PHASE THREE — EXPERIENCE

Chapter 13

APPLIED PRACTICAL TRAINING: EXPERIENCE

13.1 INTRODUCTION

13.1.1 Phase Three — Experience of the course takes the form of a series of supervised on-the-job exercises in which trainees are given the opportunity to develop decision-making abilities by applying the knowledge, skills and attitude learned in Phase One — Knowledge and Phase Two — Skills. The exercises consist of simulated (or real, if fully supervised) maintenance tasks based on actual sample maintenance programme extracts as well as on compliance with regulations, operator or approved maintenance organization (AMO) procedures and amendments. If this phase of the training can be arranged on the job at an operator or AMO, then this part of the curriculum should be omitted at the training school. Instead it can be given at the organization where the trainees can receive the required practical training under the guidance and supervision of an Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) instructor. In the latter case, however, it will expedite the trainees' training if, in addition to "real" maintenance exercises, hypothetical situations are set up as practical exercises when time allows.

13.1.2 The simulated or assumed operating conditions for each exercise must be clearly specified by the instructor. The exercises should be made as realistic as possible. Past maintenance records, etc. can be used (e.g. case studies), and answers arrived at by the trainees should be compared to what actually took place. A group discussion after each exercise will be beneficial in eliminating possible misconceptions.

13.1.3 The details described in 13.3 and 13.4 are divided into Line and Base modules. If the State licensing policy is not arranged in this way, the trainees should divide their time appropriately so as to cover both modules. The items are equally applicable to any of the technical disciplines (i.e. airframe, engine/propeller and avionics).

13.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided with appropriate hangar or workshop facilities; tools (both hand and machine); materials; an aircraft or components as applicable; aircraft maintenance manuals; AMO task or job cards and procedure documents.

Performance: The trainees will practise removal, replacement, dismantling, inspection, decision-making regarding repair or replacement, reassembly and function testing of fault-finding equipment, using both engineering drawings as well as manufacturers' maintenance, overhaul, and repair tests (real or simulated).

Standard of accomplishment:

During this experience phase of training, the standard is a function of the variety of exercises completed and the time spent in workshop training. The trainees/students may work individually or in teams on the exercises so that they have "ownership" of the standard. If necessary, they should practise and repeat increasingly complex exercises to develop greater skills within their respective areas of competence. Finally, they should function test the units or systems either on a test bed or on the aircraft itself.

13.3 APPLIED PRACTICAL LINE MAINTENANCE OPERATIONS: AIRFRAME/ENGINE/AVIONICS

13.3.1 The required materials and publications include the following:

a) Extract from an approved maintenance programme

b) Appropriate aircraft, engine or part thereof

c) Aircraft maintenance manual (AMM)

d) Operator's minimum equipment list (MEL)

e) Operator's maintenance control manual

f) AMO task or job cards

g) Operator's technical log

h) Associated special tools or test equipment

13.3.2 Operating conditions defined by the instructor should include, but not be limited to, the following:

a) Simulated aircraft departure time

b) Simulated aircraft maintenance state and age

c) Availability of spare parts

d) Availability of role play flight crew for questioning

e) Statement that if a defect is found, trainees must make a decision to repair, replace or defer

f) Recording of work in accordance with AMO and operator manuals and with State regulations

g) Simulated condition of the maintenance facility

13.3.3 Exercises should be designed to give trainees practice in the following:

a) Manual and diagnostic skills

b) Compilation of necessary additional work or job cards

c) Understanding of flight crew entries in the technical logs

d) Verbal briefing and debriefing of flight crew

e) Correct use of manuals such as the AMM or MEL

f) Making of accurate and complete entries in the technical logs, work or job cards

13.4 APPLIED PRACTICAL BASE MAINTENANCE OPERATIONS: AIRFRAME/ENGINE/AVIONICS

13.4.1 Operating conditions defined by the instructor should include, but not be limited to, the following:

a) Simulated stage of aircraft check completion

b) Simulated aircraft maintenance state and age

c) Availability of spare parts and materials

d) Availability of role play maintenance personnel for questioning

e) Statement that if a defect is found, trainees must make a decision to repair, replace or defer

f) Recording of work in accordance with AMO and operator manuals and with State regulations

g) Simulated condition of the maintenance facility

13.4.2 Exercises should be designed to give trainees practice in the following:

a) Manual and inspection skills

b) Assessment of damage, corrosion, etc.

c) Determination of appropriate repair/rectification action

d) Compilation of necessary additional work or job cards

e) Verbal briefing and debriefing of other maintenance personnel

f) Correct use of manuals such as the AMM or structural repair manual (SRM)

g) Making of accurate and complete entries in the work or job cards

— END —

11/03, E/P1/2000

Order No. 7192D1
Printed in ICAO

ISBN 92-9194-202-2

International Standards
and Recommended Practices

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to the Convention on
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For information regarding the applicability
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Eleventh Edition
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Published in separate English, Arabic, Chinese, French, Russian
and Spanish editions by the
INTERNATIONAL CIVIL AVIATION ORGANIZATION
999 University Street, Montréal, Quebec, Canada H3C 5H7

For ordering information and for a complete listing of sales agents
and booksellers, please go to the ICAO website at www.icao.int

First edition 1948
Tenth edition 2006
Eleventh edition 2011

Annex 1, *Personnel Licensing*
Order Number: AN 1
ISBN 978-92-9231-810-9

AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS			
No.	Date applicable	Date entered	Entered by
1–170	Incorporated in this edition		

CORRIGENDA			
No.	Date of issue	Date entered	Entered by

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FOREWORD

Historical Background

Standards and Recommended Practices for Personnel Licensing were first adopted by the Council on 14 April 1948 pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as Annex 1 to the Convention. They became effective on 15 September 1948.

Table A shows the origin of subsequent amendments together with a list of the principal subjects involved and the dates on which the Annex and the amendments were adopted by the Council, when they became effective and when they became applicable.

Application of the PEL Standards

Annex 1 contains Standards and Recommended Practices adopted by the International Civil Aviation Organization as the minimum standards for personnel licensing.

The Annex is applicable to all applicants for and, on renewal, to all holders of the licences and ratings specified herein.

The Council has decided that, in principle, amendments affecting existing licensing specifications are applicable to all applicants for, and holders of, licences but, in considering their application to existing holders of licences, the assessment, if necessary, by re-examination of the knowledge, experience and proficiency of individual licence holders is left to the discretion of Contracting States.

Action by Contracting States

Notification of differences. The attention of Contracting States is drawn to the obligation imposed by Article 38 of the Convention by which Contracting States are required to notify the Organization of any differences between their national regulations and practices and the International Standards contained in this Annex and any amendments thereto. Contracting States are invited to extend such notification to any differences from the Recommended Practices contained in this Annex and any amendments, when the notification of such differences is important for the safety of air navigation. Further, Contracting States are invited to keep the Organization currently informed of any difference which may subsequently occur, or of the withdrawal of any difference previously notified. A specific request for notification of differences will be sent to Contracting States immediately after the adoption of each amendment to this Annex.

Use of the Annex text in national regulations. The Council, on 13 April 1948, adopted a resolution inviting the attention of Contracting States to the desirability of using in their own national regulations, as far as practicable, the precise language of those ICAO Standards that are of a regulatory character and also of indicating departures from the Standards, including any additional national regulations that were important for the safety or regularity of air navigation. Wherever possible, the provisions of this Annex have been written in such a way as to facilitate incorporation, without major textual changes, into national legislation.

General Information

The expression "licence" used throughout this Annex has the same meaning as the expressions "certificate of competency and license", "license or certificate" and "license" used in the Convention. Similarly the expression "flight crew member" has the same meaning as the expressions "member of the operating crew of an aircraft" and "operating personnel" used in the Convention while the expression "personnel other than flight crew members" includes the expression "mechanical personnel" used in the Convention.

Status of Annex Components

An Annex is made up of the following component parts, not all of which, however, are necessarily found in every Annex; they have the status indicated:

1.— *Material comprising the Annex proper:*

a) *Standards* and *Recommended Practices* adopted by the Council under the provisions of the Convention. They are defined as follows:

Standard: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.

Recommended Practice: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention.

b) *Appendices* comprising material grouped separately for convenience but forming part of the Standards and Recommended Practices adopted by the Council.

c) *Definitions* of terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

d) *Tables* and *Figures* which add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

It is to be noted that some Standards in this Annex incorporate, by reference, other specifications having the status of Recommended Practices. In such cases the text of the Recommended Practice becomes part of the Standard.

2.— *Material approved by the Council for publication in association with the Standards and Recommended Practices (SARPs):*

a) *Forewords* comprising historical and explanatory material based on the action of the Council and including an explanation of the obligations of States with regard to the application of the Standards and Recommended Practices ensuing from the Convention and the Resolution of Adoption.

b) *Introductions* comprising explanatory material introduced at the beginning of parts, chapters or sections of the Annex to assist in the understanding of the application of the text.

c) *Notes* included in the text, where appropriate, to give factual information or references bearing on the Standards or Recommended Practices in question, but not constituting part of the Standards or Recommended Practices.

d) *Attachments* comprising material supplementary to the Standards and Recommended Practices, or included as a guide to their application.

Selection of Language

This Annex has been adopted in six languages — English, Arabic, Chinese, French, Russian and Spanish. Each Contracting State is requested to select one of those texts for the purpose of national implementation and for other effects provided for in the Convention, either through direct use or through translation into its own language, and to notify the Organization accordingly.

Editorial Practices

The following practice has been adhered to in order to indicate at a glance the status of each statement: *Standards* have been printed in light face roman; *Recommended Practices* have been printed in light face italics, the status being indicated by the prefix **Recommendation**; *Notes* have been printed in light face italics, the status being indicated by the prefix *Note*.

It is to be noted that in the English text the following practice has been adhered to when writing the specifications: Standards employ the operative verb "shall" while Recommended Practices employ the operative verb "should".

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in Annex 5 to the Convention on International Civil Aviation. Where Annex 5 permits the use of non-SI alternative units these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document which is identified by a number includes all subdivisions of that portion.

Table A. Amendments to Annex 1

Amendment	*Source(s)*	*Subject(s)*	*Adopted Effective Applicable*
1st Edition	Second Session of the PEL Division; January 1947.	Licensing of flight crew members and of key personnel responsible for air navigation services.	14 April 1948 15 September 1948 1 May 1949
1 to 123 (2nd Edition)	Third Session of the PEL Division; March 1948.	Modifications to existing Standards.	22 March 1950 1 September 1950 1 October 1951
124 to 129	Third Session of the PEL Division; March 1948.	Modifications to existing Standards.	27 June 1950 1 November 1950 1 October 1951
130 to 151 (3rd Edition)	Third and Fourth Sessions of the PEL Division; March 1948, February 1952.	Modifications to existing Standards.	25 November 1952 1 April 1953 1 April 1955
152	Special Meeting on Hearing and Visual Requirement for Personnel Licensing; 1955.	Hearing and Visual Requirement for Personnel Licensing.	22 February 1956 1 July 1956 1 December 1956
153	Air Navigation Commission.	New requirement for electrocardiograms.	16 April 1957 1 September 1957 1 December 1957
154 (4th Edition)	Third Air Navigation Conference; 1956.	Amendment of SARPs.	13 June 1957 1 October 1957 1 December 1957
155 (5th Edition)	Recommendation from PEL/MED Meeting; May 1961.	Amendment of SARPs.	27 June 1962 1 November 1962 1 September 1963
156 (6th Edition)	Recommendations from PEL/TRG/MED Divisional Meeting; October–November 1970.	Amendment of SARPs.	11 December 1972 11 April 1973 2 January 1975 26 January 1978
157	Council.	Use of Russian language in personnel licences.	28 June 1976 28 October 1976 21 April 1977
158 (7th Edition)	Correspondence and Secretariat, 21st Assembly and Council.	Modifications to existing Standards for medical examiners. New SARPs for assessment of medical fitness. Replacement of Physical and Mental Requirements by Classes of Medical Assessment.	4 May 1982 4 September 1982 25 November 1982

Amendment	*Source(s)*	*Subject(s)*	*Adopted* *Effective* *Applicable*
159 (8th Edition)	Second, Third and Fourth Meetings of the Personnel Licensing and Training (PELT) Panel; November 1983, April 1985, May 1986. Air Navigation Commission.	Amendment of SARPs dealing with the licensing of flight crew members. Deletion of the senior commercial pilot licence — aeroplane, the controlled VFR rating, the flight radio operator licence and the flight instructor rating for gliders and free balloons. The dividing line of 5 700 kg maximum take-off mass is replaced by a dividing line based on the crew complement required by certification. All helicopter provisions have the status of Standards. The requirements for the issue of a type rating for aircraft certificated for two-pilot operation are strengthened. The provisions for the issue of each licence and rating have been updated. Flight instruction requirements are established for the private, commercial, glider and free balloon pilot licences and for the instrument and flight instructor ratings.	28 March 1988 31 July 1988 16 November 1989
160	Air Navigation Commission.	Amendment of SARPs for air traffic controllers, aeronautical station operators and flight operations officers.	24 March 1993 26 July 1993 10 November 1994
161	Air Navigation Commission.	Amendment of SARPs for aircraft maintenance technicians/engineers/mechanics and Specifications for Personnel Licences.	10 March 1997 21 July 1997 5 November 1998
162	First, Second, Third and Fourth Meetings of the Prevention of Substance Abuse in the Workplace Study Group (PSAWSG); December 1993, August 1994, January 1995, May 1995. Air Navigation Commission.	Amendment of SARPs dealing with the use of psychoactive substances by aviation personnel.	25 February 1998 20 July 1998 5 November 1998
163 (9th Edition)	Flight Safety and Human Factors Study Group (FSHFSG); May 1995. Vision and Colour Perception Study Group (VCPSG); June 1997 to May 1998. Air Navigation Commission.	Human Factors knowledge requirements; visual and colour perception requirements; the language used in personnel licences; deletion of the Attachment.	19 February 2001 16 July 2001 1 November 2001
164	32nd Session of the Assembly, MET Divisional Meeting (2002), Air Navigation Commission.	Amendment of definitions; new provisions requiring language proficiency for aeroplane and helicopter pilots, navigators using radiotelephony, air traffic controllers and aeronautical station operators; introduction of a Note on qualification and training for aeronautical meteorology personnel; amendment to the Human Factors knowledge requirements for Aircraft Maintenance Engineer.	5 March 2003 14 July 2003 27 November 2003
165	Air Navigation Commission.	Endorsement of type rating with a limitation of privileges to the cruise phase of the flight.	25 February 2004 12 July 2004 25 November 2004
166	Air Navigation Commission; Medical Provisions Study Group (MPSG); Flight Crew Licensing and Training Panel (FCLTP).	Amendment to the medical provisions; new provisions on approved training organizations.	21 February 2005 11 July 2005 24 November 2005

Amendment	*Source(s)*	*Subject(s)*	*Adopted Effective Applicable*
167 (10th Edition)	Air Navigation Commission studies; Second meeting of the Flight Crew Licensing and Training Panel.	Revised and new medical provisions on the upper age limits for flight crew members; new personnel licensing requirements for airships and powered-lifts; introduction of the multi-crew pilot licence; amendments to the details of existing flight crew licensing Standards; amendments to the provisions on the role of flight simulation training devices in acquiring or maintaining the competencies required for the various levels of licences and ratings.	10 March 2006 17 July 2006 23 November 2006
168	Air Navigation Commission study.	The amendment concerns: a) the replacement of the approach and area radar control ratings by approach and area control surveillance ratings to reflect the fact that surveillance systems are not limited to radar; b) the harmonization of the Human Factors knowledge requirements for air traffic controllers with those recently adopted as part of Amendment 167 to Annex 1 for flight crew; c) the applicability of the existing Standards on approved training for flight crew (Annex 1, 1.2.8 and Appendix 2) to the approved training required for the air traffic controller licence and ratings; and d) new provisions for student air traffic controllers receiving instruction in an operational environment.	23 February 2007 16 July 2007 22 November 2007
169-A	Secretariat with the assistance of the Medical Provisions Study Group	Amendment introducing some new concepts in the field of aviation medicine to better address current aeromedical risks to flight safety.	2 March 2009 20 July 2009 19 November 2009
169-B	Secretariat	Amendment concerning the development of harmonized provisions relating to safety management by introducing a framework for the implementation and maintenance of a State safety programme as of 18 November 2010.	2 March 2009 20 July 2009 18 November 2010
170	Secretariat with the assistance of the Next Generation of Aviation Professionals (NGAP) Task Force and the International Air Transport Association (IATA) Training and Qualifications Initiative (ITQI)	a) an enabler for an alternative means of compliance with the experience requirements for the aircraft maintenance technician licence when approved competency-based training programmes are used; b) an amendment to the definitions of approved training and approved training organization to simplify their wording and to relocate in new Standards the requirement that training for certain categories of personnel is to be conducted in an approved training organization; c) a harmonization of threat and error management (TEM) requirements for certain licensed personnel with those for flight crew licences; d) an extension of the transitional measures for licensing requirements for powered-lift aircraft; and e) various editorial amendments.	4 March 2011 18 July 2011 17 November 2011

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

CHAPTER 1. DEFINITIONS AND GENERAL RULES CONCERNING LICENCES

1.1 Definitions

When the following terms are used in the Standards and Recommended Practices for Personnel Licensing, they have the following meanings:

Accredited medical conclusion. The conclusion reached by one or more medical experts acceptable to the Licensing Authority for the purposes of the case concerned, in consultation with flight operations or other experts as necessary.

Aeroplane. A power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.

Aircraft. Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

Aircraft avionics. A term designating any electronic device — including its electrical part — for use in an aircraft, including radio, automatic flight control and instrument systems.

Aircraft — category. Classification of aircraft according to specified basic characteristics, e.g. aeroplane, helicopter, glider, free balloon.

Aircraft certificated for single-pilot operation. A type of aircraft which the State of Registry has determined, during the certification process, can be operated safely with a minimum crew of one pilot.

Aircraft required to be operated with a co-pilot. A type of aircraft that is required to be operated with a co-pilot, as specified in the flight manual or by the air operator certificate.

Aircraft — type of. All aircraft of the same basic design including all modifications thereto except those modifications which result in a change in handling or flight characteristics.

Airmanship. The consistent use of good judgement and well-developed knowledge, skills and attitudes to accomplish flight objectives.

Airship. A power-driven lighter-than-air aircraft.

Approved maintenance organization. An organization approved by a Contracting State, in accordance with the requirements of Annex 6, Part I, Chapter 8 — Aeroplane Maintenance, to perform maintenance of aircraft or parts thereof and operating under supervision approved by that State.

Note.— Nothing in this definition is intended to preclude that the organization and its supervision be approved by more than one State.

Approved training. Training conducted under special curricula and supervision approved by a Contracting State.

Approved training organization. An organization approved by and operating under the supervision of a Contracting State in accordance with the requirements of Annex 1 to perform approved training.

ATS surveillance service. A term used to indicate a service provided directly by means of an ATS surveillance system.

ATS surveillance system. A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.

Balloon. A non-power-driven lighter-than-air aircraft.

Note.— For the purposes of this Annex, this definition applies to free balloons.

Certify as airworthy (to). To certify that an aircraft or parts thereof comply with current airworthiness requirements after maintenance has been performed on the aircraft or parts thereof.

Commercial air transport operation. An aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire.

Competency. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

Competency element. An action that constitutes a task that has a triggering event and a terminating event that clearly defines its limits, and an observable outcome.

Competency unit. A discrete function consisting of a number of competency elements.

Co-pilot. A licensed pilot serving in any piloting capacity other than as pilot-in-command but excluding a pilot who is on board the aircraft for the sole purpose of receiving flight instruction.

Credit. Recognition of alternative means or prior qualifications.

Cross-country. A flight between a point of departure and a point of arrival following a pre-planned route using standard navigation procedures.

Dual instruction time. Flight time during which a person is receiving flight instruction from a properly authorized pilot on board the aircraft.

Error. An action or inaction by an operational person that leads to deviations from organizational or the operational person's intentions or expectations.

Note.— See Attachment E of Annex 13 — Aircraft Accident and Incident Investigation *for a description of operational personnel.*

Error management. The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequences of errors and mitigate the probability of further errors or undesired states.

Note.— See Attachment C to Chapter 3 of the Procedures for Air Navigation Services — Training (PANS-TRG, Doc 9868) *and Circular 314 —* Threat and Error Management (TEM) in Air Traffic Control *for a description of undesired states.*

Flight crew member. A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Flight plan. Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

Flight procedures trainer. *See* Flight simulation training device.

Flight simulation training device. Any one of the following three types of apparatus in which flight conditions are simulated on the ground:

A flight simulator, which provides an accurate representation of the flight deck of a particular aircraft type to the extent that the mechanical, electrical, electronic, etc. aircraft systems control functions, the normal environment of flight crew members, and the performance and flight characteristics of that type of aircraft are realistically simulated;

A flight procedures trainer, which provides a realistic flight deck environment, and which simulates instrument responses, simple control functions of mechanical, electrical, electronic, etc. aircraft systems, and the performance and flight characteristics of aircraft of a particular class;

A basic instrument flight trainer, which is equipped with appropriate instruments, and which simulates the flight deck environment of an aircraft in flight in instrument flight conditions.

Flight simulator. *See* Flight simulation training device.

Flight time — aeroplanes. The total time from the moment an aeroplane first moves for the purpose of taking off until the moment it finally comes to rest at the end of the flight.

Note.— Flight time as here defined is synonymous with the term "block to block" time or "chock to chock" time in general usage which is measured from the time an aeroplane first moves for the purpose of taking off until it finally stops at the end of the flight.

Flight time — helicopters. The total time from the moment a helicopter's rotor blades start turning until the moment the helicopter finally comes to rest at the end of the flight, and the rotor blades are stopped.

Glider. A non-power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.

Glider flight time. The total time occupied in flight, whether being towed or not, from the moment the glider first moves for the purpose of taking off until the moment it comes to rest at the end of the flight.

Helicopter. A heavier-than-air aircraft supported in flight chiefly by the reactions of the air on one or more power-driven rotors on substantially vertical axes.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Instrument flight time. Time during which a pilot is piloting an aircraft solely by reference to instruments and without external reference points.

Instrument ground time. Time during which a pilot is practising, on the ground, simulated instrument flight in a flight simulation training device approved by the Licensing Authority.

Instrument time. Instrument flight time or instrument ground time.

Licensing Authority. The Authority designated by a Contracting State as responsible for the licensing of personnel.

Note.— In the provisions of this Annex, the Licensing Authority is deemed to have been given the following responsibilities by the Contracting State:

a) assessment of an applicant's qualifications to hold a licence or rating;

b) issue and endorsement of licences and ratings;

c) designation and authorization of approved persons;

d) approval of training courses;

e) approval of the use of flight simulation training devices and authorization for their use in gaining the experience or in demonstrating the skill required for the issue of a licence or rating; and

f) validation of licences issued by other Contracting States.

Likely. In the context of the medical provisions in Chapter 6, ***likely*** means with a probability of occurring that is unacceptable to the medical assessor.

Maintenance. The performance of tasks required to ensure the continuing airworthiness of an aircraft, including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.

Medical Assessment. The evidence issued by a Contracting State that the licence holder meets specific requirements of medical fitness.

Medical assessor. A physician, appointed by the Licensing Authority, qualified and experienced in the practice of aviation medicine and competent in evaluating and assessing medical conditions of flight safety significance.

Note 1.— Medical assessors evaluate medical reports submitted to the Licensing Authority by medical examiners.

Note 2.— Medical assessors are expected to maintain the currency of their professional knowledge.

Medical examiner. A physician with training in aviation medicine and practical knowledge and experience of the aviation environment, who is designated by the Licensing Authority to conduct medical examinations of fitness of applicants for licences or ratings for which medical requirements are prescribed.

Night. The hours between the end of evening civil twilight and the beginning of morning civil twilight or such other period between sunset and sunrise, as may be prescribed by the appropriate authority.

Note.— Civil twilight ends in the evening when the centre of the sun's disc is 6 degrees below the horizon and begins in the morning when the centre of the sun's disc is 6 degrees below the horizon.

Performance criteria. Simple, evaluative statements on the required outcome of the competency element and a description of the criteria used to judge whether the required level of performance has been achieved.

Pilot (to). To manipulate the flight controls of an aircraft during flight time.

Pilot-in-command. The pilot designated by the operator, or in the case of general aviation, the owner, as being in command and charged with the safe conduct of a flight.

Pilot-in-command under supervision. Co-pilot performing, under the supervision of the pilot-in-command, the duties and functions of a pilot-in-command, in accordance with a method of supervision acceptable to the Licensing Authority.

Powered-lift. A heavier-than-air aircraft capable of vertical take-off, vertical landing, and low-speed flight, which depends principally on engine-driven lift devices or engine thrust for the lift during these flight regimes and on non-rotating aerofoil(s) for lift during horizontal flight.

Problematic use of substances. The use of one or more psychoactive substances by aviation personnel in a way that:

a) constitutes a direct hazard to the user or endangers the lives, health or welfare of others; and/or

b) causes or worsens an occupational, social, mental or physical problem or disorder.

Psychoactive substances. Alcohol, opioids, cannabinoids, sedatives and hypnotics, cocaine, other psychostimulants, hallucinogens, and volatile solvents, whereas coffee and tobacco are excluded.

Quality system. Documented organizational procedures and policies; internal audit of those policies and procedures; management review and recommendation for quality improvement.

Rated air traffic controller. An air traffic controller holding a licence and valid ratings appropriate to the privileges to be exercised.

Rating. An authorization entered on or associated with a licence and forming part thereof, stating special conditions, privileges or limitations pertaining to such licence.

Rendering (a licence) valid. The action taken by a Contracting State, as an alternative to issuing its own licence, in accepting a licence issued by any other Contracting State as the equivalent of its own licence.

Safety management system. A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

Sign a maintenance release (to). To certify that maintenance work has been completed satisfactorily in accordance with the applicable Standards of airworthiness, by issuing the maintenance release referred to in Annex 6.

Significant. In the context of the medical provisions in Chapter 6, ***significant*** means to a degree or of a nature that is likely to jeopardize flight safety.

Solo flight time. Flight time during which a student pilot is the sole occupant of an aircraft.

State safety programme. An integrated set of regulations and activities aimed at improving safety.

Threat. Events or errors that occur beyond the influence of an operational person, increase operational complexity and must be managed to maintain the margin of safety.

Note.— See Attachment E of Annex 13 — Aircraft Accident and Incident Investigation *for a description of operational personnel.*

Threat management. The process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats and mitigate the probability of errors or undesired states.

Note.— See Attachment C to Chapter 3 of the Procedures for Air Navigation Services — Training (PANS-TRG, Doc 9868) *and Circular 314 —* Threat and Error Management (TEM) in Air Traffic Control *for a description of undesired states*.

1.2 General rules concerning licences

Note 1.— Although the Convention on International Civil Aviation allocates to the State of Registry certain functions which that State is entitled to discharge, or obligated to discharge, as the case may be, the Assembly recognized, in Resolution A23-13, that the State of Registry may be unable to fulfil its responsibilities adequately in instances where aircraft are leased, chartered or interchanged — in particular without crew — by an operator of another State and that the Convention may not adequately specify the rights and obligations of the State of an operator in such instances until such time as Article 83 bis *of the Convention enters into force. Accordingly, the Council urged that if, in the above-mentioned instances, the State of Registry finds itself unable to discharge adequately the functions allocated to it by the Convention, it delegate to the State of the Operator, subject to acceptance by the latter State, those functions of the State of Registry that can more adequately be discharged by the State of the Operator. While Article 83* bis *of the Convention entered into force on 20 June 1997 in respect of Contracting States which have ratified the related Protocol (Doc 9318), the foregoing action will remain particularly relevant for those Contracting States which do not have treaty relations under Article 83* bis. *It was understood that pending entry into force of Article 83* bis *of the Convention, the foregoing action would only be a matter of practical convenience and would not affect either the provisions of the Chicago Convention prescribing the duties of the State of Registry or any third State. However, as Article 83* bis *of the Convention entered into force on 20 June 1997, such transfer agreements will have effect in respect of Contracting States which have ratified the related Protocol (Doc 9318) upon fulfilment of the conditions established in Article 83* bis.

Note 2.— International Standards and Recommended Practices are established for licensing the following personnel:

a) Flight crew

- *private pilot — aeroplane, airship, helicopter or powered-lift;*
- *commercial pilot — aeroplane, airship, helicopter or powered-lift;*
- *multi-crew pilot — aeroplane;*
- *airline transport pilot — aeroplane, helicopter or powered-lift*
- *glider pilot;*
- *free balloon pilot;*
- *flight navigator;*
- *flight engineer.*

b) Other personnel

- *aircraft maintenance (technician/engineer/ mechanic);*
- *air traffic controller;*
- *flight operations officer/flight dispatcher;*
- *aeronautical station operator.*

1.2.1 Authority to act as a flight crew member

A person shall not act as a flight crew member of an aircraft unless a valid licence is held showing compliance with the specifications of this Annex and appropriate to the duties to be performed by that person. The licence shall have been issued by the State of Registry of that aircraft or by any other Contracting State and rendered valid by the State of Registry of that aircraft.

Note.— Article 29 of the Convention on International Civil Aviation requires that the flight crew members carry their appropriate licences on board every aircraft engaged in international air navigation.

1.2.2 Method of rendering a licence valid

1.2.2.1 When a Contracting State renders valid a licence issued by another Contracting State, as an alternative to the issuance of its own licence, it shall establish validity by suitable authorization to be carried with the former licence accepting it as the equivalent of the latter. When a State limits the authorization to specific privileges, the authorization shall specify the privileges of the licence which are to be accepted as its equivalent. The validity of the authorization shall not extend beyond the period of validity of the licence. The authorization ceases to be valid if the licence upon which it was issued is revoked or suspended.

Note.— This provision is not intended to preclude the State that issued the licence from extending, by a suitable notification, the period of validity of the licence without necessarily requiring either the physical return of the licence or the appearance of the licence holder before the Authorities of that State.

1.2.2.2 When an authorization under 1.2.2.1 is issued for use in commercial air transport operations, the Licensing Authority shall confirm the validity of the other Contracting State's licence before issuing the authorization.

1.2.2.3 **Recommendation.—** *A pilot licence issued by a Contracting State should be rendered valid by other Contracting States for use in private flights.*

Note.— Contracting States which, without formality, render valid a licence issued by another Contracting State for use in private flights are encouraged to notify this facility in their Aeronautical Information Publications.

1.2.3 Privileges of the holder of a licence

A Contracting State shall not permit the holder of a licence to exercise privileges other than those granted by that licence.

1.2.4 Medical fitness

Note 1.— Guidance material is published in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— To satisfy the licensing requirements of medical fitness for the issue of various types of licences, the applicant must meet certain appropriate medical requirements which are specified as three classes of Medical Assessment. Details are given in 6.2, 6.3, 6.4 and 6.5. To provide the necessary evidence to satisfy the requirements of 1.2.4.1, the Licensing Authority issues the licence holder with the appropriate Medical Assessment, Class 1, Class 2 or Class 3. This can be done in several ways such as a suitably titled separate certificate, a statement on the licence, a national regulation stipulating that the Medical Assessment is an integral part of the licence, etc.

1.2.4.1 An applicant for a licence shall, when applicable, hold a Medical Assessment issued in accordance with the provisions of Chapter 6.

1.2.4.2 **Recommendation.—** *From 18 November 2010 States should apply, as part of their State safety programme, basic safety management principles to the medical assessment process of licence holders, that as a minimum include:*

a) routine analysis of in-flight incapacitation events and medical findings during medical assessments to identify areas of increased medical risk; and

b) continuous re-evaluation of the medical assessment process to concentrate on identified areas of increased medical risk.

Note.— A framework for the implementation and maintenance of a State safety programme is contained in Attachment C. Guidance on State safety programmes and safety management principles is contained in the Safety Management Manual (SMM) *(Doc 9859) and the* Manual of Civil Aviation Medicine *(Doc 8984).*

1.2.4.3 The period of validity of a Medical Assessment shall begin on the day the medical examination is performed. The duration of the period of validity shall be in accordance with the provisions of 1.2.5.2.

1.2.4.3.1 The period of validity of a Medical Assessment may be extended, at the discretion of the Licensing Authority, up to 45 days.

Note.— It is advisable to let the calendar day on which the Medical Assessment expires remain constant year after year by allowing the expiry date of the current Medical Assessment to be the beginning of the new validity period under the proviso that the medical examination takes place during the period of validity of the current Medical Assessment but no more than 45 days before it expires.

1.2.4.4 Except as provided in 1.2.5.2.6, flight crew members or air traffic controllers shall not exercise the privileges of their licence unless they hold a current Medical Assessment appropriate to the licence.

1.2.4.5 Contracting States shall designate medical examiners, qualified and licensed in the practice of medicine, to conduct medical examinations of fitness of applicants for the issue or renewal of the licences or ratings specified in Chapters 2 and 3, and of the appropriate licences specified in Chapter 4.

1.2.4.5.1 Medical examiners shall have received training in aviation medicine and shall receive refresher training at regular intervals. Before designation, medical examiners shall demonstrate adequate competency in aviation medicine.

1.2.4.5.2 Medical examiners shall have practical knowledge and experience of the conditions in which the holders of licences and ratings carry out their duties.

Note.— Examples of practical knowledge and experience are flight experience, simulator experience, on-site observation or any other hands-on experience deemed by the Licensing Authority to meet this requirement.

1.2.4.5.3 **Recommendation.—** *The competence of a medical examiner should be evaluated periodically by the medical assessor.*

1.2.4.6 Applicants for licences or ratings for which medical fitness is prescribed shall sign and furnish to the medical examiner a declaration stating whether they have previously undergone such an examination and, if so, the date, place and result of the last examination. They shall indicate to the examiner whether a Medical Assessment has previously been refused, revoked or suspended and, if so, the reason for such refusal, revocation or suspension.

1.2.4.6.1 Any false declaration to a medical examiner made by an applicant for a licence or rating shall be reported to the Licensing Authority of the issuing State for such action as may be considered appropriate.

1.2.4.7 Having completed the medical examination of the applicant in accordance with Chapter 6, the medical examiner shall coordinate the results of the examination and submit a signed report, or equivalent, to the Licensing Authority, in accordance with its requirements, detailing the results of the examination and evaluating the findings with regard to medical fitness.

1.2.4.7.1 If the medical report is submitted to the Licensing Authority in electronic format, adequate identification of the examiner shall be established.

1.2.4.7.2 If the medical examination is carried out by two or more medical examiners, Contracting States shall appoint one of these to be responsible for coordinating the results of the examination, evaluating the findings with regard to medical fitness, and signing the report.

1.2.4.8 Contracting States shall use the services of medical assessors to evaluate reports submitted to the Licensing Authorities by medical examiners.

1.2.4.8.1 The medical examiner shall be required to submit sufficient information to the Licensing Authority to enable that Authority to undertake Medical Assessment audits.

Note.— The purpose of such auditing is to ensure that medical examiners meet applicable standards for good medical practice and aeromedical risk assessment. Guidance on aeromedical risk assessment is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

1.2.4.9 If the medical Standards prescribed in Chapter 6 for a particular licence are not met, the appropriate Medical Assessment shall not be issued or renewed unless the following conditions are fulfilled:

a) accredited medical conclusion indicates that in special circumstances the applicant's failure to meet any requirement, whether numerical or otherwise, is such that exercise of the privileges of the licence applied for is not likely to jeopardize flight safety;

b) relevant ability, skill and experience of the applicant and operational conditions have been given due consideration; and

c) the licence is endorsed with any special limitation or limitations when the safe performance of the licence holder's duties is dependent on compliance with such limitation or limitations.

1.2.4.10 Medical confidentiality shall be respected at all times.

1.2.4.10.1 All medical reports and records shall be securely held with accessibility restricted to authorized personnel.

1.2.4.10.2 When justified by operational considerations, the medical assessor shall determine to what extent pertinent medical information is presented to relevant officials of the Licensing Authority.

1.2.5 Validity of licences

1.2.5.1 A Contracting State, having issued a licence, shall ensure that the privileges granted by that licence, or by related ratings, are not exercised unless the holder maintains competency and meets the requirements for recent experience established by that State.

1.2.5.1.1 **Recommendation.—** *A Contracting State should establish maintenance of competency and recent experience requirements for pilot licences and ratings based on a systematic approach to accident prevention and should include a risk assessment process and analysis of current operations, including accident and incident data appropriate to that State.*

1.2.5.1.2 A Contracting State, having issued a licence, shall ensure that other Contracting States are enabled to be satisfied as to the validity of the licence.

Note 1.— The maintenance of competency of flight crew members, engaged in commercial air transport operations, may be satisfactorily established by demonstration of skill during proficiency flight checks completed in accordance with Annex 6.

Note 2.— Maintenance of competency may be satisfactorily recorded in the operator's records, or in the flight crew member's personal log book or licence.

Note 3.— Flight crew members may, to the extent deemed feasible by the State of Registry, demonstrate their continuing competency in flight simulation training devices approved by that State.

Note 4.— See the Manual of Criteria for the Qualification of Flight Simulation Training Devices *(Doc 9625).*

Note 5.— See the Manual of Procedures for Establishment and Management of a State's Personnel Licensing System *(Doc 9379) for guidance material on the development of a risk assessment process.*

1.2.5.2 Except as provided in 1.2.5.2.1, 1.2.5.2.2, 1.2.5.2.3, 1.2.5.2.4, 1.2.5.2.5 and 1.2.5.2.6, a Medical Assessment issued in accordance with 1.2.4.6 and 1.2.4.7 shall be valid from the date of the medical examination for a period not greater than:

60 months for the private pilot licence — aeroplane, airship, helicopter and powered-lift;

12 months for the commercial pilot licence — aeroplane, airship, helicopter and powered-lift;

12 months for the multi-crew pilot licence — aeroplane;

12 months for the airline transport pilot licence — aeroplane, helicopter and powered-lift;

60 months for the glider pilot licence;

60 months for the free balloon pilot licence;

12 months for the flight navigator licence;

12 months for the flight engineer licence;

48 months for the air traffic controller licence.

Note 1.— The periods of validity listed above may be extended by up to 45 days in accordance with 1.2.4.3.1.

Note 2.— When calculated in accordance with 1.2.5.2 and its sub-paragraphs, the period of validity will, for the last month counted, include the day that has the same calendar number as the date of the medical examination or, if that month has no day with that number, the last day of that month.

1.2.5.2.1 The period of validity of a Medical Assessment may be reduced when clinically indicated.

1.2.5.2.2 When the holders of airline transport pilot licences — aeroplane, helicopter and powered-lift, and commercial pilot licences — aeroplane, airship, helicopter and powered-lift, who are engaged in single-crew commercial air transport operations carrying passengers, have passed their 40th birthday, the period of validity specified in 1.2.5.2 shall be reduced to six months.

1.2.5.2.3 When the holders of airline transport pilot licences — aeroplane, helicopter and powered-lift, commercial pilot licences — aeroplane, airship, helicopter and powered-lift, and multi-crew pilot licences — aeroplane, who are engaged in commercial air transport operations, have passed their 60th birthday, the period of validity specified in 1.2.5.2 shall be reduced to six months.

1.2.5.2.4 When the holders of private pilot licences — aeroplane, airship, helicopter and powered-lift, free balloon pilot licences, glider pilot licences and air traffic controller licences have passed their 40th birthday, the period of validity specified in 1.2.5.2 shall be reduced to 24 months.

1.2.5.2.5 **Recommendation.—** *When the holders of private pilot licences — aeroplane, airship, helicopter and powered-lift, free balloon pilot licences, glider pilot licences and air traffic controller licences have passed their 50th birthday, the period of validity specified in 1.2.5.2 should be further reduced to 12 months.*

Note.— The periods of validity listed above are based on the age of the applicant at the time of undergoing the medical examination.

1.2.5.2.6 *Circumstances in which a medical examination may be deferred.* The prescribed re-examination of a licence holder operating in an area distant from designated medical examination facilities may be deferred at the discretion of the Licensing Authority, provided that such deferment shall only be made as an exception and shall not exceed:

a) a single period of six months in the case of a flight crew member of an aircraft engaged in non-commercial operations;

b) two consecutive periods each of three months in the case of a flight crew member of an aircraft engaged in commercial operations provided that in each case a favourable medical report is obtained after examination by a designated medical examiner of the area concerned, or, in cases where such a designated medical examiner is not available, by a physician legally qualified to practise medicine in that area. A report of the medical examination shall be sent to the Licensing Authority where the licence was issued;

c) in the case of a private pilot, a single period not exceeding 24 months where the medical examination is carried out by an examiner designated under 1.2.4.5 by the Contracting State in which the applicant is temporarily located. A report of the medical examination shall be sent to the Licensing Authority where the licence was issued.

1.2.6 Decrease in medical fitness

1.2.6.1 Holders of licences provided for in this Annex shall not exercise the privileges of their licences and related ratings at any time when they are aware of any decrease in their medical fitness which might render them unable to safely and properly exercise these privileges.

1.2.6.1.1 **Recommendation.—** *States should ensure that licence holders are provided with clear guidelines on medical conditions that may be relevant to flight safety and when to seek clarification or guidance from a medical examiner or Licensing Authority.*

Note.— Guidance on physical and mental conditions and treatments that are relevant to flight safety about which information may need to be forwarded to the Licensing Authority is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

1.2.6.1.2 **Recommendation.—** *Each Contracting State should, as far as practicable, ensure that licence holders do not exercise the privileges of their licences and related ratings during any period in which their medical fitness has, from any cause, decreased to an extent that would have prevented the issue or renewal of their Medical Assessment.*

1.2.7 Use of psychoactive substances

1.2.7.1 Holders of licences provided for in this Annex shall not exercise the privileges of their licences and related ratings while under the influence of any psychoactive substance which might render them unable to safely and properly exercise these privileges.

1.2.7.2 Holders of licences provided for in this Annex shall not engage in any problematic use of substances.

1.2.7.3 **Recommendation.—** *Contracting States should ensure, as far as practicable, that all licence holders who engage in any kind of problematic use of substances are identified and removed from their safetycritical functions. Return to the safety-critical functions may be considered after successful treatment or, in cases where no treatment is necessary, after cessation of the problematic use of substances and upon determination that the person's continued performance of the function is unlikely to jeopardize safety.*

Note.— Guidance on suitable methods of identification (which may include biochemical testing on such occasions as pre-employment, upon reasonable suspicion, after accidents/incidents, at intervals, and at random) and on other prevention topics is contained in the Manual on Prevention of Problematic Use of Substances in the Aviation Workplace *(Doc 9654).*

1.2.8 Approved training and approved training organization

Note.— The qualifications required for the issue of personnel licences can be more readily and speedily acquired by applicants who undergo closely supervised, systematic and continuous courses of training, conforming to a planned syllabus or curriculum. Provision has accordingly been made for some reduction in the experience requirements for the issue of certain licences and ratings prescribed in these Standards and Recommended Practices, in respect of an applicant who has satisfactorily completed a course of approved training.

1.2.8.1 Approved training shall provide a level of competency at least equal to that provided by the minimum experience requirements for personnel not receiving such approved training.

1.2.8.2 The approval of a training organization by a State shall be dependent upon the applicant demonstrating compliance with the requirements of Appendix 2 and Appendix 4.

Note.— Guidance on approval of a training organization can be found in the Manual on the Approval of Training Organizations *(Doc 9841).*

1.2.8.3 Approved training for flight crew and air traffic controllers shall be conducted within an approved training organization.

Note.— The approved training considered in 1.2.8.3 relates primarily to approved training for the issuance of an Annex 1 licence or rating. It is not intended to include approved training for the maintenance of competence or for an operational qualification after the initial issuance of a licence or rating, as may be required for air traffic controllers or for flight crew, such as the approved training under Annex 6 — Operation of Aircraft, *Part I* — International Commercial Air Transport — Aeroplanes, *9.3, or Part III* — International Operations — Helicopters*, Section II, 7.3.*

1.2.8.4 Competency-based approved training for aircraft maintenance personnel shall be conducted within an approved training organization.

Note.— A comprehensive training scheme for the aircraft maintenance (technician/engineer/mechanic) licence, including the various levels of competency, is contained in the Procedures for Air Navigation Services — Training *(Doc 9868, PANS-TRG).*

1.2.9 Language proficiency

1.2.9.1 Aeroplane, airship, helicopter and powered-lift pilots and those flight navigators who are required to use the radio telephone aboard an aircraft shall demonstrate the ability to speak and understand the language used for radiotelephony communications.

Note.— Pursuant to Article 42 of the Convention on International Civil Aviation, paragraph 1.2.9.1 does not apply to personnel whose licences are originally issued prior to 5 March 2004 but, in any case, does apply to personnel whose licences remain valid after 5 March 2008.

1.2.9.2 Air traffic controllers and aeronautical station operators shall demonstrate the ability to speak and understand the language used for radiotelephony communications.

1.2.9.3 **Recommendation.—** *Flight engineers, and glider and free balloon pilots should have the ability to speak and understand the language used for radiotelephony communications.*

1.2.9.4 As of 5 March 2008, aeroplane, airship, helicopter and powered-lift pilots, air traffic controllers and aeronautical station operators shall demonstrate the ability to speak and understand the language used for radiotelephony communications to the level specified in the language proficiency requirements in Appendix 1.

1.2.9.5 **Recommendation.—** *Aeroplane, airship, helicopter and powered-lift pilots, flight navigators required to use the radiotelephone aboard an aircraft, air traffic controllers and aeronautical station operators should demonstrate the ability to speak and understand the language used for radiotelephony communications to the level specified in the language proficiency requirements in Appendix 1.*

1.2.9.6 As of 5 March 2008, the language proficiency of aeroplane, airship, helicopter and powered-lift pilots, air traffic controllers and aeronautical station operators who demonstrate proficiency below the Expert Level (Level 6) shall be formally evaluated at intervals in accordance with an individual's demonstrated proficiency level.

1.2.9.7 **Recommendation.—** *The language proficiency of aeroplane, airship, helicopter and powered-lift pilots, flight navigators required to use the radiotelephone aboard an aircraft, air traffic controllers and aeronautical station operators who demonstrate proficiency below the Expert Level (Level 6) should be formally evaluated at intervals in accordance with an individual's demonstrated proficiency level, as follows:*

a) those demonstrating language proficiency at the Operational Level (Level 4) should be evaluated at least once every three years; and

b) those demonstrating language proficiency at the Extended Level (Level 5) should be evaluated at least once every six years.

Note 1.— Formal evaluation is not required for applicants who demonstrate expert language proficiency, e.g. native and very proficient non-native speakers with a dialect or accent intelligible to the international aeronautical community.

Note 2.— The provisions of 1.2.9 refer to Annex 10, Volume II, Chapter 5, whereby the language used for radiotelephony communications may be the language normally used by the station on the ground or English. In practice, therefore, there will be situations whereby flight crew members will only need to speak the language normally used by the station on the ground.

CHAPTER 2. LICENCES AND RATINGS FOR PILOTS

2.1 General rules concerning pilot licences and ratings

2.1.1 General licensing specifications

2.1.1.1 A person shall not act either as pilot-in-command or as co-pilot of an aircraft in any of the following categories unless that person is the holder of a pilot licence issued in accordance with the provisions of this Chapter:

— aeroplane

— airship of a volume of more than 4 600 cubic metres

— free balloon

— glider

— helicopter

— powered-lift.

2.1.1.2 The category of aircraft shall be included in the title of the licence itself, or endorsed as a category rating on the licence.

2.1.1.2.1 When the holder of a pilot licence seeks a licence for an additional category of aircraft, the Licensing Authority shall either:

a) issue the licence holder with an additional pilot licence for that category of aircraft; or

b) endorse the original licence with the new category rating, subject to the conditions of 2.1.2.

Note.— The requirements for category ratings are given in terms of licensing specifications for pilots and at levels appropriate to the privileges to be granted to the licence holder.

2.1.1.3 An applicant shall, before being issued with any pilot licence or rating, meet such requirements in respect of age, knowledge, experience, flight instruction, skill and medical fitness, as are specified for that licence or rating.

2.1.1.3.1 An applicant for any pilot licence or rating shall demonstrate, in a manner determined by the Licensing Authority, such requirements for knowledge and skill as are specified for that licence or rating.

2.1.1.4 *Transitional measures related to the powered-lift category*

Until 5 March 2015, the Licensing Authority may endorse a type rating for aircraft of the powered-lift category on an aeroplane or helicopter pilot licence. The endorsement of the rating on the licence shall indicate that the aircraft is part of the powered-lift category. The training for the type rating in the powered-lift category shall be completed during a course of approved training, shall take into account the previous experience of the applicant in an aeroplane or a helicopter as appropriate and incorporate all relevant aspects of operating an aircraft of the powered-lift category.

2.1.2 Category ratings

2.1.2.1 When established, category ratings shall be for categories of aircraft listed in 2.1.1.1.

2.1.2.2 Category ratings shall not be endorsed on a licence when the category is included in the title of the licence itself.

2.1.2.3 Any additional category rating endorsed on a pilot licence shall indicate the level of licensing privileges at which the category rating is granted.

2.1.2.4 The holder of a pilot licence seeking additional category ratings shall meet the requirements of this Annex appropriate to the privileges for which the category rating is sought.

2.1.3 Class and type ratings

2.1.3.1 Class ratings shall be established for aeroplanes certificated for single-pilot operation and shall comprise:

a) single-engine, land;

b) single-engine, sea;

c) multi-engine, land;

d) multi-engine, sea.

Note.— The provisions of this paragraph do not preclude the establishment of other class ratings within this basic structure.

2.1.3.1.1 **Recommendation.—** *Contracting States should consider establishing a class rating for those helicopters and powered-lifts certificated for single-pilot operations and which have comparable handling, performance and other characteristics.*

2.1.3.2 Type ratings shall be established for:

a) aircraft certificated for operation with a minimum crew of at least two pilots;

b) helicopters and powered-lifts certificated for single-pilot operation except where a class rating has been issued under 2.1.3.1.1; and

c) any aircraft whenever considered necessary by the Licensing Authority.

Note 1.— Where a common type rating is established, it shall be only for aircraft with similar characteristics in terms of operating procedures, systems and handling.

Note 2.— Requirements for class and type ratings for gliders and free balloons have not been determined.

2.1.3.3 When an applicant demonstrates skill and knowledge for the initial issue of a pilot licence, the category and the ratings appropriate to the class or type of aircraft used in the demonstration shall be entered on the licence.

2.1.4 Circumstances in which class and type ratings are required

2.1.4.1 A Contracting State having issued a pilot licence shall not permit the holder of such licence to act either as pilot-in-command or as co-pilot of an aeroplane, an airship, a helicopter or a powered-lift unless the holder has received authorization as follows:

a) the appropriate class rating specified in 2.1.3.1; or

b) a type rating when required in accordance with the provisions of 2.1.3.2.

2.1.4.1.1 When a type rating is issued limiting the privileges to act as co-pilot, or limiting the privileges to act as pilot only during the cruise phase of the flight, such limitation shall be endorsed on the rating.

2.1.4.2 For the purpose of training, testing, or specific special purpose non-revenue, non-passenger carrying flights, special authorization may be provided in writing to the licence holder by the Licensing Authority in place of issuing the class or type rating in accordance with 2.1.4.1. This authorization shall be limited in validity to the time needed to complete the specific flight.

2.1.5 Requirements for the issue of class and type ratings

2.1.5.1 *Class rating*

The applicant shall have demonstrated a degree of skill appropriate to the licence in an aircraft of the class for which the rating is sought.

2.1.5.2 *Type rating as required by 2.1.3.2 a)*

The applicant shall have:

a) gained, under appropriate supervision, experience in the applicable type of aircraft and/or flight simulator in the following:

   — normal flight procedures and manoeuvres during all phases of flight;

   — abnormal and emergency procedures and manoeuvres in the event of failures and malfunctions of equipment, such as engine, systems and airframe;

   — where applicable, instrument procedures, including instrument approach, missed approach and landing procedures under normal, abnormal and emergency conditions, including simulated engine failure;

   — procedures for crew incapacitation and crew coordination including allocation of pilot tasks; crew cooperation and use of checklists;

   Note.— Attention is called to 2.1.8.1 on the qualifications required for pilots giving flight training.

b) demonstrated the skill and knowledge required for the safe operation of the applicable type of aircraft, relevant to the duties of a pilot-in-command or a co-pilot as applicable; and

c) demonstrated, at the airline transport pilot licence level, an extent of knowledge determined by the Licensing Authority on the basis of the requirements specified in 2.6.1.2.

Note.— See the Manual of Procedures for Establishment and Management of a State's Personnel Licensing System *(Doc 9379) for guidance of a general nature on cross-crew qualification and cross-credit.*

2.1.5.3 *Type rating as required by 2.1.3.2 b) and c)*

The applicant shall have demonstrated the skill and knowledge required for the safe operation of the applicable type of aircraft, relevant to the licensing requirements and piloting functions of the applicant.

2.1.6 Use of a flight simulation training device for acquisition of experience and demonstration of skill

The use of a flight simulation training device for acquiring the experience or performing any manoeuvre required during the demonstration of skill for the issue of a licence or rating shall be approved by the Licensing Authority, which shall ensure that the flight simulation training device used is appropriate to the task.

2.1.7 Circumstances in which an instrument rating is required

A Contracting State, having issued a pilot licence, shall not permit the holder thereof to act either as pilot-in-command or as co-pilot of an aircraft under instrument flight rules (IFR) unless such holder has received proper authorization from such Contracting State. Proper authorization shall comprise an instrument rating appropriate to the aircraft category.

Note.— The instrument rating is included in the airline transport pilot licence — aeroplane or powered-lift category, multi-crew pilot licence, and commercial pilot licence — airship category. The provisions of 2.1.7 do not preclude the issue of a licence having the instrument rating as an integral part thereof.

2.1.8 Circumstances in which authorization to conduct instruction is required

2.1.8.1 A Contracting State, having issued a pilot licence, shall not permit the holder thereof to carry out flight instruction required for the issue of a pilot licence or rating, unless such holder has received proper authorization from such Contracting State. Proper authorization shall comprise:

a) a flight instructor rating on the holder's licence; or

b) the authority to act as an agent of an approved organization authorized by the Licensing Authority to carry out flight instruction; or

c) a specific authorization granted by the Contracting State which issued the licence.

2.1.8.2 A Contracting State shall not permit a person to carry out instruction on a flight simulation training device required for the issue of a pilot licence or rating unless such person holds or has held an appropriate licence or has appropriate flight training and flight experience and has received proper authorization from such Contracting State.

2.1.9 Crediting of flight time

2.1.9.1 A student pilot or the holder of a pilot licence shall be entitled to be credited in full with all solo, dual instruction and pilot-in-command flight time towards the total flight time required for the initial issue of a pilot licence or the issue of a higher grade of pilot licence.

2.1.9.2 The holder of a pilot licence, when acting as co-pilot at a pilot station of an aircraft certificated for operation by a single pilot but required by a Contracting State to be operated with a co-pilot, shall be entitled to be credited with not more than 50 per cent of the co-pilot flight time towards the total flight time required for a higher grade of pilot licence. The Contracting State may authorize that flight time be credited in full towards the total flight time required if the aircraft is equipped to be operated by a co-pilot and the aircraft is operated in a multi-crew operation.

2.1.9.3 The holder of a pilot licence, when acting as co-pilot at a pilot station of an aircraft certificated to be operated with a co-pilot, shall be entitled to be credited in full with this flight time towards the total flight time required for a higher grade of pilot licence.

2.1.9.4 The holder of a pilot licence, when acting as pilot-in-command under supervision, shall be entitled to be credited in full with this flight time towards the total flight time required for a higher grade of pilot licence.

2.1.10 Limitation of privileges of pilots who have attained their 60th birthday and curtailment of privileges of pilots who have attained their 65th birthday

2.1.10.1 A Contracting State, having issued pilot licences, shall not permit the holders thereof to act as pilot-in-command of an aircraft engaged in international commercial air transport operations if the licence holders have attained their 60th birthday or, in the case of operations with more than one pilot where the other pilot is younger than 60 years of age, their 65th birthday.

2.1.10.2 **Recommendation.—** *A Contracting State, having issued pilot licences, should not permit the holders thereof to act as co-pilot of an aircraft engaged in international commercial air transport operations if the licence holders have attained their 65th birthday.*

Note.— Attention is drawn to 1.2.5.2.3 on the validity period of Medical Assessments for pilots over the age of 60 who are engaged in commercial air transport operations.

2.2 Student pilot

2.2.1 A student pilot shall meet requirements prescribed by the Contracting State concerned. In prescribing such requirements, Contracting States shall ensure that the privileges granted would not permit student pilots to constitute a hazard to air navigation.

2.2.2 A student pilot shall not fly solo unless under the supervision of, or with the authority of, an authorized flight instructor.

2.2.2.1 A student pilot shall not fly solo in an aircraft on an international flight unless by special or general arrangement between the Contracting States concerned.

2.2.3 Medical fitness

A Contracting State shall not permit a student pilot to fly solo unless that student pilot holds a current Class 2 Medical Assessment.

2.3 Private pilot licence

2.3.1 General requirements for the issue of the licence appropriate to the aeroplane, airship, helicopter and powered-lift categories

2.3.1.1 *Age*

The applicant shall be not less than 17 years of age.

2.3.1.2 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a private pilot licence and appropriate to the category of aircraft intended to be included in the licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a private pilot licence; rules of the air; altimeter setting procedures; appropriate air traffic services practices and procedures;

Aircraft general knowledge for aeroplanes, airships, helicopters and powered-lifts

b) principles of operation and functioning of engines, systems and instruments;

c) operating limitations of the relevant category of aircraft and engines; relevant operational information from the flight manual or other appropriate document;

d) for helicopters and powered-lifts, transmission (power trains) where applicable;

e) for airships, physical properties and practical application of gases;

Flight performance, planning and loading

f) effects of loading and mass distribution on flight characteristics; mass and balance calculations;

g) use and practical application of take-off, landing and other performance data;

h) pre-flight and en-route flight planning appropriate to private operations under VFR; preparation and filing of air traffic services flight plans; appropriate air traffic services procedures; position reporting procedures; altimeter setting procedures; operations in areas of high-density traffic;

Human performance

i) human performance including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

j) application of elementary aeronautical meteorology; use of, and procedures for obtaining, meteorological information; altimetry; hazardous weather conditions;

Navigation

k) practical aspects of air navigation and dead-reckoning techniques; use of aeronautical charts;

Operational procedures

l) application of threat and error management to operational performance;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

m) altimeter setting procedures;

n) use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations;

o) appropriate precautionary and emergency procedures, including action to be taken to avoid hazardous weather, wake turbulence and other operating hazards;

p) in the case of helicopters, and if applicable, powered-lifts, settling with power; ground resonance; retreating blade stall; dynamic rollover and other operating hazards; safety procedures, associated with flight in VMC;

Principles of flight

q) principles of flight;

Radiotelephony

r) communication procedures and phraseology as applied to VFR operations; action to be taken in case of communication failure.

2.3.1.3 *Skill*

The applicant shall have demonstrated the ability to perform as pilot-in-command of an aircraft within the appropriate category of aircraft, the procedures and manoeuvres described in 2.3.3.2 or 2.3.4.2.1 or 2.3.5.2 or 2.3.6.2 with a degree of competency appropriate to the privileges granted to the holder of a private pilot licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) operate the aircraft within its limitations;

c) complete all manoeuvres with smoothness and accuracy;

d) exercise good judgement and airmanship;

e) apply aeronautical knowledge; and

f) maintain control of the aircraft at all times in a manner such that the successful outcome of a procedure or manoeuvre is assured.

2.3.1.4 *Medical fitness*

The applicant shall hold a current Class 2 Medical Assessment.

Note.— Attention is called to 2.7.1.3 on the medical fitness requirements for private pilot licence holders seeking an instrument rating.

2.3.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

2.3.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1, 1.2.9 and 2.1, the privileges of the holder of a private pilot licence shall be to act, but not for remuneration, as pilot-in-command or co-pilot of aircraft within the appropriate aircraft category engaged in non-revenue flights.

2.3.2.2 Before exercising the privileges at night, the licence holder shall have received dual instruction in aircraft within the appropriate category of aircraft in night flying, including take-off, landing and navigation.

2.3.3 Specific requirements for the issue of the aeroplane category rating

2.3.3.1 *Experience*

2.3.3.1.1 The applicant shall have completed not less than 40 hours of flight time, or 35 hours if completed during a course of approved training, as a pilot of aeroplanes appropriate to the class rating sought. The Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 40 hours or 35 hours, as the case may be. Credit for such experience shall be limited to a maximum of 5 hours.

2.3.3.1.1.1 When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.3.3.1.1 can be reduced accordingly.

2.3.3.1.2 The applicant shall have completed in aeroplanes not less than 10 hours of solo flight time appropriate to the class rating sought, under the supervision of an authorized flight instructor, including 5 hours of solo cross-country flight time with at least one cross-country flight totalling not less than 270 km (150 NM) in the course of which full-stop landings at two different aerodromes shall be made.

2.3.3.2 *Flight instruction*

The applicant shall have received dual instruction in aeroplanes appropriate to the class rating sought, from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in at least the following areas to the level of performance required for the private pilot:

a) recognize and manage threats and errors;

   Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, aeroplane inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) control of the aeroplane by external visual reference;

e) flight at critically slow airspeeds; recognition of, and recovery from, incipient and full stalls;

f) flight at critically high airspeeds; recognition of, and recovery from, spiral dives;

g) normal and crosswind take-offs and landings;

h) maximum performance (short field and obstacle clearance) take-offs; short-field landings;

i) flight by reference solely to instruments, including the completion of a level 180° turn;

j) cross-country flying using visual reference, dead reckoning and, where available, radio navigation aids;

k) emergency operations, including simulated aeroplane equipment malfunctions;

l) operations to, from and transiting controlled aerodromes, compliance with air traffic services procedures; and

m) communication procedures and phraseology.

Note.— The instrument experience specified in 2.3.3.2 i) and the night flying dual instruction in 2.3.2.2 do not entitle the holder of a private pilot licence to pilot aeroplanes under IFR.

2.3.4 Specific requirements for the issue of the helicopter category rating

2.3.4.1 *Experience*

2.3.4.1.1 The applicant shall have completed not less than 40 hours of flight time, or 35 hours if completed during a course of approved training, as a pilot of helicopters. The Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 40 hours or 35 hours, as the case may be. Credit for such experience shall be limited to a maximum of 5 hours.

2.3.4.1.1.1 When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.3.4.1.1 can be reduced accordingly.

2.3.4.1.2 The applicant shall have completed in helicopters not less than 10 hours of solo flight time under the supervision of an authorized flight instructor, including 5 hours of solo cross-country flight time with at least one cross-country flight totalling not less than 180 km (100 NM) in the course of which landings at two different points shall be made.

2.3.4.2 *Flight instruction*

2.3.4.2.1 The applicant shall have received not less than 20 hours of dual instruction time in helicopters from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in at least the following areas to the level of performance required for the private pilot:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, helicopter inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) control of the helicopter by external visual reference;

e) recovery at the incipient stage from settling with power; recovery techniques from low-rotor rpm within the normal range of engine rpm;

f) ground manoeuvring and run-ups; hovering; take-offs and landings — normal, out of wind and sloping ground;

g) take-offs and landings with minimum necessary power; maximum performance take-off and landing techniques; restricted site operations; quick stops;

h) cross-country flying using visual reference, dead reckoning and, where available, radio navigation aids, including a flight of at least one hour;

i) emergency operations, including simulated helicopter equipment malfunctions; autorotative approach;

j) operations to, from and transiting controlled aerodromes, compliance with air traffic services procedures; and

k) communication procedures and phraseology.

2.3.4.2.1.1 **Recommendation.—** *The applicant should have received dual instrument flight instruction from an authorized flight instructor. The instructor should ensure that the applicant has operational experience in flight by reference solely to instruments, including the completion of a level 180° turn, in a suitably instrumented helicopter.*

Note.— The instrument experience specified in 2.3.4.2.1.1 and the night flying dual instruction in 2.3.2.2 do not entitle the holder of a private pilot licence to pilot helicopters under IFR.

2.3.5 Specific requirements for the issue of the powered-lift category rating

2.3.5.1 *Experience*

2.3.5.1.1 **Recommendation.—** *The applicant should have completed not less than 40 hours of flight time as a pilot of powered-lifts. The Licensing Authority should determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 40 hours.*

2.3.5.1.2 **Recommendation.—** *When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority should determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.3.5.1.1 could be reduced accordingly.*

2.3.5.1.3 **Recommendation.—** *The applicant should have completed in powered-lifts not less than 10 hours of solo flight time under the supervision of an authorized flight instructor, including 5 hours of solo cross-country flight time with at least one cross-country flight totalling not less than 270 km (150 NM) in the course of which full-stop landings at two different aerodromes shall be made.*

2.3.5.2 *Flight instruction*

Recommendation.— *The applicant should have received not less than 20 hours of dual instruction time in powered-lifts from an authorized flight instructor. The instructor should ensure that the applicant has operational experience in at least the following areas to the level of performance required for the private pilot:*

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, powered-lift inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) control of the powered-lift by external visual reference;

e) ground manoeuvring and run-ups; hover and rolling take-offs and climb-out; hover and rolling approach and landings — normal, out of wind and sloping ground;

f) take-offs and landings with minimum necessary power; maximum performance take-off and landing techniques; restricted site operations; quick stops;

g) flight by reference solely to instruments, including the completion of a level 180° turn;

h) recovery at the incipient stage from settling with power; recovery techniques from low-rotor rpm within the normal range of engine rpm;

i) cross-country flying using visual reference, dead reckoning and, where available, radio navigation aids, including a flight of at least one hour;

j) emergency operations, including simulated powered-lift equipment malfunctions; power of reconversion to autorotation and autorotative approach, where applicable; transmission and interconnect driveshaft failure, where applicable;

k) operations to from and transiting controlled aerodromes, compliance with air traffic services procedures; and

l) communication procedures and phraseology.

Note.— The instrument experience specified in 2.3.5.2 g) and the night flying dual instruction specified in 2.3.2.2 do not entitle the holder of a private pilot licence to pilot powered-lifts under IFR.

2.3.6 Specific requirements for the issue of the airship category rating

2.3.6.1 *Experience*

The applicant shall have completed not less than 25 hours of flight time as a pilot of airships, including at least:

a) 3 hours of cross-country flight training in an airship with a cross-country flight totalling not less than 45 km (25 NM);

b) 5 take-offs and 5 landings to a full stop at an aerodrome with each landing involving a flight in the traffic pattern at an aerodrome;

c) 3 hours of instrument time; and

d) 5 hours as pilot assuming the duties of the pilot-in-command under the supervision of the pilot-in-command.

2.3.6.2 *Flight instruction*

The applicant shall have received dual instruction in airships from an authorized flight instructor. The instructor shall ensure that the applicant has received instruction in at least the following areas:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, airship inspection and servicing;

c) ground reference manoeuvres;

d) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

e) techniques and procedures for the take-off, including appropriate limitations, emergency procedures and signals used;

f) control of the airship by external visual reference;

g) take-offs, landings and go-arounds;

h) maximum performance (obstacle clearance) take-offs;

i) flight by reference solely to instruments, including the completion of a level 180° turn;

j) navigation, cross-country flying using visual reference, dead reckoning and radio navigation aids;

k) emergency operations (recognition of leaks), including simulated airship equipment malfunctions; and

l) communication procedures and phraseology.

Note.— The instrument experience specified in 2.3.6.2 i) and the night flying dual instruction specified in 2.3.2.2 do not entitle the holder of a private pilot licence to pilot airships under IFR.

2.4 Commercial pilot licence

2.4.1 General requirements for the issue of the licence appropriate to the aeroplane, airship, helicopter and powered-lift categories

2.4.1.1 *Age*

The applicant shall be not less than 18 years of age.

2.4.1.2 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a commercial pilot licence and appropriate to the category of aircraft intended to be included in the licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a commercial pilot licence; rules of the air; appropriate air traffic services practices and procedures;

Aircraft general knowledge for aeroplanes, airships, helicopters and powered-lifts

b) principles of operation and functioning of engines, systems and instruments;

c) operating limitations of the relevant category of aircraft and engines; relevant operational information from the flight manual or other appropriate document;

d) use and serviceability checks of equipment and systems of appropriate aircraft;

e) maintenance procedures for airframes, systems and engines of appropriate aircraft;

f) for helicopters and powered-lifts, transmission (power trains) where applicable;

g) for airships, physical properties and practical application of gases;

Flight performance, planning and loading

h) effects of loading and mass distribution on aircraft handling, flight characteristics and performance; mass and balance calculations;

i) use and practical application of take-off, landing and other performance data;

j) pre-flight and en-route flight planning appropriate to commercial operations under VFR; preparation and filing of air traffic services flight plans; appropriate air traffic services procedures; altimeter setting procedures;

k) in the case of airships, helicopters and powered-lifts, effects of external loading on handling;

Human performance

l) human performance including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

m) interpretation and application of aeronautical meteorological reports, charts and forecasts; use of, and procedures for obtaining, meteorological information, pre-flight and in-flight; altimetry;

n) aeronautical meteorology; climatology of relevant areas in respect of the elements having an effect upon aviation; the movement of pressure systems, the structure of fronts, and the origin and characteristics of significant weather phenomena which affect take-off, en-route and landing conditions;

o) causes, recognition and effects of icing; frontal zone penetration procedures; hazardous weather avoidance;

Navigation

p) air navigation, including the use of aeronautical charts, instruments and navigation aids; an understanding of the principles and characteristics of appropriate navigation systems; operation of airborne equipment;

q) in the case of airships:

   i) use, limitation and serviceability of avionics and instruments necessary for control and navigation;

   ii) use, accuracy and reliability of navigation systems used in departure, en-route, approach and landing phases of flight, identification of radio navigation aids;

   iii) principles and characteristics of self-contained and external referenced navigation systems, operation of airborne equipment;

Operational procedures

r) application of threat and error management to operational performance;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

s) use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations;

t) altimeter setting procedures;

u) appropriate precautionary and emergency procedures;

v) operational procedures for carriage of freight; potential hazards associated with dangerous goods;

w) requirements and practices for safety briefing to passengers, including precautions to be observed when embarking and disembarking from aircraft;

x) in the case of helicopters, and if applicable, powered-lifts, settling with power; ground resonance; retreating blade stall; dynamic rollover and other operating hazards; safety procedures, associated with flight in VMC;

Principles of flight

y) principles of flight;

Radiotelephony

z) communication procedures and phraseology as applied to VFR operations; action to be taken in case of communication failure.

2.4.1.3 *Skill*

The applicant shall have demonstrated the ability to perform as pilot-in-command of an aircraft within the appropriate category of aircraft, the procedures and manoeuvres described in 2.4.3.2 or 2.4.4.2 or 2.4.5.2 or 2.4.6.2 with a degree of competency appropriate to the privileges granted to the holder of a commercial pilot licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) operate the aircraft within its limitations;

c) complete all manoeuvres with smoothness and accuracy;

d) exercise good judgement and airmanship;

e) apply aeronautical knowledge; and

f) maintain control of the aircraft at all times in a manner such that the successful outcome of a procedure or manoeuvre is assured.

2.4.1.4 *Medical fitness*

The applicant shall hold a current Class 1 Medical Assessment.

2.4.2 Privileges of the holder of the licence
and the conditions to be observed in exercising such privileges

2.4.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1, 1.2.9 and 2.1, the privileges of the holder of a commercial pilot licence shall be:

a) to exercise all the privileges of the holder of a private pilot licence in an aircraft within the appropriate aircraft category;

b) to act as pilot-in-command of an aircraft within the appropriate aircraft category engaged in operations other than commercial air transportation;

c) to act as pilot-in-command, in commercial air transportation, of an aircraft within the appropriate aircraft category and certificated for single-pilot operation;

d) to act as co-pilot of an aircraft within the appropriate aircraft category required to be operated with a co-pilot; and

e) for the airship category, to pilot an airship under IFR.

2.4.2.2 Before exercising the privileges at night, the licence holder shall have received dual instruction in aircraft within the appropriate category of aircraft in night flying, including take-off, landing and navigation.

Note.— Certain privileges of the licence are curtailed by 2.1.10 for licence holders when they attain their 60th and 65th birthdays.

2.4.3 Specific requirements for the issue of the aeroplane category rating

2.4.3.1 *Experience*

2.4.3.1.1 The applicant shall have completed not less than 200 hours of flight time, or 150 hours if completed during a course of approved training, as a pilot of aeroplanes. The Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 200 hours or 150 hours, as the case may be. Credit for such experience shall be limited to a maximum of 10 hours.

2.4.3.1.1.1 The applicant shall have completed in aeroplanes not less than:

a) 100 hours as pilot-in-command or, in the case of a course of approved training, 70 hours as pilot-in-command;

b) 20 hours of cross-country flight time as pilot-in-command including a cross-country flight totalling not less than 540 km (300 NM) in the course of which full-stop landings at two different aerodromes shall be made;

c) 10 hours of instrument instruction time of which not more than 5 hours may be instrument ground time; and

d) if the privileges of the licence are to be exercised at night, 5 hours of night flight time including 5 take-offs and 5 landings as pilot-in-command.

2.4.3.1.2 When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.4.3.1.1 can be reduced accordingly.

2.4.3.2 *Flight instruction*

The applicant shall have received dual instruction in aeroplanes appropriate to the class and/or type rating, sought from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in at least the following areas to the level of performance required for the commercial pilot:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, aeroplane inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) control of the aeroplane by external visual reference;

e) flight at critically slow airspeeds; spin avoidance; recognition of, and recovery from, incipient and full stalls;

f) flight with asymmetrical power for multi-engine class or type ratings;

g) flight at critically high airspeeds; recognition of, and recovery from, spiral dives;

h) normal and crosswind take-offs and landings;

i) maximum performance (short field and obstacle clearance) take-offs; short-field landings;

j) basic flight manoeuvres and recovery from unusual attitudes by reference solely to basic flight instruments;

k) cross-country flying using visual reference, dead reckoning and radio navigation aids; diversion procedures;

l) abnormal and emergency procedures and manoeuvres including simulated aeroplane equipment malfunctions;

m) operations to, from and transiting controlled aerodromes, compliance with air traffic services procedures; and

n) communication procedures and phraseology.

Note.— The instrument experience specified in 2.4.3.1.1.1 c) and 2.4.3.2 j) and the night flying experience and dual instruction specified in 2.4.3.1.1.1 d) and 2.4.2.2 do not entitle the holder of a commercial pilot licence to pilot aeroplanes under IFR.

2.4.4 Specific requirements for the issue of the helicopter category rating

2.4.4.1 *Experience*

2.4.4.1.1 The applicant shall have completed not less than 150 hours of flight time, or 100 hours if completed during a course of approved training, as a pilot of helicopters. The Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 150 hours or 100 hours, as the case may be. Credit for such experience shall be limited to a maximum of 10 hours.

2.4.4.1.1.1 The applicant shall have completed in helicopters not less than:

a) 35 hours as pilot-in-command;

b) 10 hours of cross-country flight time as pilot-in-command including a cross-country flight in the course of which landings at two different points shall be made;

c) 10 hours of instrument instruction time of which not more than 5 hours may be instrument ground time; and

d) if the privileges of the licence are to be exercised at night, 5 hours of night flight time including 5 take-offs and 5 landing patterns as pilot-in-command.

2.4.4.1.2 When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.4.4.1.1 can be reduced accordingly.

2.4.4.2 *Flight instruction*

The applicant shall have received dual instruction in helicopters from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in at least the following areas to the level of performance required for the commercial pilot:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, helicopter inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) control of the helicopter by external visual reference;

e) recovery at the incipient stage from settling with power; recovery techniques from low-rotor rpm within the normal range of engine rpm;

f) ground manoeuvring and run-ups; hovering; take-offs and landings — normal, out of wind and sloping ground; steep approaches;

g) take-offs and landings with minimum necessary power; maximum performance take-off and landing techniques; restricted site operations; quick stops;

h) hovering out of ground effect; operations with external load, if applicable; flight at high altitude;

i) basic flight manoeuvres and recovery from unusual attitudes by reference solely to basic flight instruments;

j) cross-country flying using visual reference, dead reckoning and radio navigation aids; diversion procedures;

k) abnormal and emergency procedures, including simulated helicopter equipment malfunctions, autorotative approach and landing;

l) operations to, from and transiting controlled aerodromes, compliance with air traffic services procedures; and

m) communication procedures and phraseology.

Note.— The instrument experience specified in 2.4.4.1.1.1 c) and 2.4.4.2 i) and the night flying experience and dual instruction specified in 2.4.4.1.1.1 d) and 2.4.2.2 do not entitle the holder of a commercial pilot licence to pilot helicopters under IFR.

2.4.5 Specific requirements for the issue of the powered-lift category rating

2.4.5.1 *Experience*

2.4.5.1.1 **Recommendation.—** *The applicant should have completed not less than 200 hours of flight time in a powered-lift, or 150 hours if completed during a course of approved training, as a pilot of aircraft. The Licensing Authority should determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 200 hours or 150 hours, as the case may be.*

2.4.5.1.2 **Recommendation.—** *The applicant should have completed in a powered-lift not less than:*

a) 50 hours as pilot-in-command;

b) 10 hours of cross-country flying as pilot-in-command including a cross-country flight totalling not less than 540 km (300 NM) in the course of which full-stop landings at two different aerodromes should be made;

c) 10 hours of instrument instruction of which not more than 5 hours may be instrument ground time; and

d) if the privileges of the licence are to be exercised at night, 5 hours of night flight time including 5 take-offs and landings as pilot-in-command.

2.4.5.1.3 **Recommendation.—** *When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority should determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.4.5.1.1 could be reduced accordingly.*

2.4.5.2 *Flight instruction*

Recommendation.— *The applicant should have received dual instruction time in a powered-lift from an authorized flight instructor. The instructor should ensure that the applicant has operational experience in at least the following areas to the level of performance required for the commercial pilot:*

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, powered-lift inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) control of the powered-lift by external visual reference;

e) recovery at the incipient stage from settling with power; recovery techniques from low-rotor rpm within the normal range of engine rpm;

f) ground manoeuvring and run-ups; hover and rolling take-offs and climb-out; hover and rolling approach and landings — normal, out of wind and sloping ground; steep approaches;

g) take-offs and landings with minimum necessary power; maximum performance take-off and landing techniques; restricted site operations; quick stops;

h) hovering out of ground effect; operations with external load, if applicable; flight at high altitude;

i) basic flight manoeuvres and recovery from unusual attitudes by reference solely to basic flight instruments;

j) cross-country flying using visual reference, dead reckoning and, where available, radio navigation aids, including a flight of at least one hour;

k) emergency operations, including simulated powered-lift equipment malfunctions; power of reconversion to autorotation and autorotative approach, where applicable; transmission and interconnect driveshaft failure, where applicable;

l) operations to, from and transiting controlled aerodromes, compliance with air traffic services procedures; and

m) communication procedures and phraseology.

Note.— The instrument experience specified in 2.4.5.1.2 c) and 2.4.5.2 i) and the night flying experience and dual instruction specified in 2.4.5.1.2 d) and 2.4.2.2 do not entitle the holder of a commercial pilot licence to pilot powered-lifts under IFR.

2.4.6 Specific requirements for the issue of the airship category rating

2.4.6.1 *Experience*

2.4.6.1.1 The applicant shall have completed not less than 200 hours of flight time as a pilot.

2.4.6.1.1.1 The applicant shall have completed not less than:

a) 50 hours as a pilot of airships;

b) 30 hours in airships as pilot-in-command or pilot-in-command under supervision, to include not less than:

— 10 hours of cross-country flight time; and

— 10 hours of night flight;

c) 40 hours of instrument time, of which 20 hours shall be in flight and 10 hours in flight in airships; and

d) 20 hours of flight training in airships in the areas of operation listed in 2.4.6.2.

2.4.6.2 *Flight instruction*

The applicant shall have received dual instruction in airships from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in at least the following areas to the level of performance required for the commercial pilot:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) pre-flight operations, including mass and balance determination, airship inspection and servicing;

c) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;

d) techniques and procedures for the take-off, including appropriate limitations, emergency procedures and signals used;

e) control of the airship by external visual reference;

f) recognition of leaks;

g) normal take-offs and landings;

h) maximum performance (short field and obstacle clearance) take-offs; short-field landings;

i) flight under IFR;

j) cross-country flying using visual reference, dead reckoning and, where available, radio navigation aids;

k) emergency operations, including simulated airship equipment malfunctions;

l) operations to, from and transiting controlled aerodromes, compliance with air traffic services procedures; and

m) communication procedures and phraseology.

2.5 Multi-crew pilot licence appropriate to the aeroplane category

2.5.1 General requirements for the issue of the licence

2.5.1.1 *Age*

The applicant shall be not less than 18 years of age.

2.5.1.2 *Knowledge*

The applicant shall have met the requirements specified in 2.6.1.2 for the airline transport pilot licence appropriate to the aeroplane category in an approved training course.

2.5.1.3 *Skill*

2.5.1.3.1 The applicant shall have demonstrated the skills required for fulfilling all the competency units specified in Appendix 3 as pilot flying and pilot not flying, to the level required to perform as a co-pilot of turbine-powered aeroplanes certificated for operation with a minimum crew of at least two pilots under VFR and IFR, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) smoothly and accurately, manually control the aeroplane within its limitations at all times, such that the successful outcome of a procedure or manoeuvre is assured;

c) operate the aeroplane in the mode of automation appropriate to the phase of flight and to maintain awareness of the active mode of automation;

d) perform, in an accurate manner, normal, abnormal and emergency procedures in all phases of flight; and

e) communicate effectively with other flight crew members and demonstrate the ability to effectively perform procedures for crew incapacitation, crew coordination, including allocation of pilot tasks, crew cooperation, adherence to standard operating procedures (SOPs) and use of checklists.

2.5.1.3.2 Progress in acquiring the skills specified in 2.5.1.3.1 shall be continuously assessed.

2.5.1.4 *Medical fitness*

The applicant shall hold a current Class 1 medical assessment.

2.5.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

2.5.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1, 1.2.9 and 2.1, the privileges of the holder of a multi-crew pilot licence shall be:

a) to exercise all the privileges of the holder of a private pilot licence in the aeroplane category provided the requirements of paragraph 2.3.3 have been met;

b) to exercise the privileges of the instrument rating in a multi-crew operation; and

c) to act as co-pilot of an aeroplane required to be operated with a co-pilot.

2.5.2.2 Before exercising the privileges of the instrument rating in a single-pilot operation in aeroplanes, the licence holder shall have demonstrated an ability to act as pilot-in-command in a single-pilot operation exercised by reference solely to instruments and shall have met the skill requirement specified in 2.7.1.2 appropriate to the aeroplane category.

2.5.2.3 Before exercising the privileges of a commercial pilot licence in a single-pilot operation in aeroplanes, the licence holder shall have:

a) completed in aeroplanes 70 hours, either as pilot-in-command, or made up of not less than 10 hours as pilot-in-command and the necessary additional flight time as pilot-in-command under supervision;

b) completed 20 hours of cross-country flight time as pilot-in-command, or made up of not less than 10 hours as pilot-in-command and 10 hours as pilot-in-command under supervision, including a cross-country flight totalling not less than 540 km (300 NM) in the course of which full-stop landings at two different aerodromes shall be made; and

c) met the requirements for the commercial pilot licence specified in 2.4.1.2, 2.4.1.3, 2.4.3.1.1 (with the exception of 2.4.3.1.1.1 a)) and 2.4.3.2 appropriate to the aeroplane category.

Note 1.— When a Contracting State grants single-pilot operation privileges to the holder of a multi-crew pilot licence, it can document the privileges through an endorsement of the multi-crew pilot licence or through the issuance of a commercial pilot licence in the aeroplane category.

Note 2.— Certain privileges of the licence are curtailed by 2.1.10 for licence holders when they attain their 65th birthday.

2.5.3 Experience

2.5.3.1 The applicant shall have completed in an approved training course not less than 240 hours as pilot flying and pilot not flying of actual and simulated flight.

2.5.3.2 Flight experience in actual flight shall include at least the experience requirements at 2.3.3.1, upset recovery training, night flying and flight by reference solely to instruments.

2.5.3.3 In addition to meeting the provisions of 2.5.3.2, the applicant shall have gained, in a turbine-powered aeroplane certificated for operation with a minimum crew of at least two pilots, or in a flight simulation training device approved for that purpose by the Licensing Authority in accordance with Appendix 3, paragraph 4, the experience necessary to achieve the advanced level of competency defined in Appendix 3.

2.5.4 Flight instruction

2.5.4.1 The applicant shall have completed a course of approved training covering the experience requirements specified in 2.5.3.

2.5.4.2 The applicant shall have received dual flight instruction in all the competency units specified in Appendix 3, to the level required for the issue of the multi-crew pilot licence, to include the competency units required to pilot under instrument flight rules.

2.6 Airline transport pilot licence

2.6.1 General requirements for the issue of the licence appropriate to the aeroplane, helicopter and powered-lift categories

2.6.1.1 *Age*

The applicant shall be not less than 21 years of age.

2.6.1.2 *Knowledge*

2.6.1.2.1 The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of an airline transport pilot licence and appropriate to the category of aircraft intended to be included in the licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of an airline transport pilot licence; rules of the air; appropriate air traffic services practices and procedures;

Aircraft general knowledge for aeroplanes, helicopters and powered-lifts

b) general characteristics and limitations of electrical, hydraulic, pressurization and other aircraft systems; flight control systems, including autopilot and stability augmentation;

c) principles of operation, handling procedures and operating limitations of aircraft engines; effects of atmospheric conditions on engine performance; relevant operational information from the flight manual or other appropriate document;

d) operating procedures and limitations of the relevant category of aircraft; effects of atmospheric conditions on aircraft performance in accordance with the relevant operational information from the flight manual;

e) use and serviceability checks of equipment and systems of appropriate aircraft;

f) flight instruments; compasses, turning and acceleration errors; gyroscopic instruments, operational limits and precession effects; practices and procedures in the event of malfunctions of various flight instruments and electronic display units;

g) maintenance procedures for airframes, systems and engines of appropriate aircraft;

h) for helicopters and powered-lifts, transmission (power trains) where applicable;

Flight performance, planning and loading

i) effects of loading and mass distribution on aircraft handling, flight characteristics and performance; mass and balance calculations;

j) use and practical application of take-off, landing and other performance data, including procedures for cruise control;

k) pre-flight and en-route operational flight planning; preparation and filing of air traffic services flight plans; appropriate air traffic services procedures; altimeter setting procedures;

l) in the case of helicopters and powered-lifts, effects of external loading on handling;

Human performance

m) human performance including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

n) interpretation and application of aeronautical meteorological reports, charts and forecasts; codes and abbreviations; use of, and procedures for obtaining, meteorological information, pre-flight and in-flight; altimetry;

o) aeronautical meteorology; climatology of relevant areas in respect of the elements having an effect upon aviation; the movement of pressure systems; the structure of fronts, and the origin and characteristics of significant weather phenomena which affect take-off, en-route and landing conditions;

p) causes, recognition and effects of icing; frontal zone penetration procedures; hazardous weather avoidance;

q) in the case of aeroplanes and powered-lifts, practical high altitude meteorology, including interpretation and use of weather reports, charts and forecasts; jetstreams;

Navigation

r) air navigation, including the use of aeronautical charts, radio navigation aids and area navigation systems; specific navigation requirements for long-range flights;

s) use, limitation and serviceability of avionics and instruments necessary for the control and navigation of aircraft;

t) use, accuracy and reliability of navigation systems used in departure, en-route, approach and landing phases of flight; identification of radio navigation aids;

u) principles and characteristics of self-contained and external-referenced navigation systems; operation of airborne equipment;

Operational procedures

v) application of threat and error management to operational performance;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

w) interpretation and use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations;

x) precautionary and emergency procedures; safety practices;

y) operational procedures for carriage of freight and dangerous goods;

z) requirements and practices for safety briefing to passengers, including precautions to be observed when embarking and disembarking from aircraft;

aa) in the case of helicopters, and if applicable, powered-lifts, settling with power; ground resonance; retreating blade stall; dynamic rollover and other operating hazards; safety procedures, associated with flight in VMC;

Principles of flight

bb) principles of flight;

Radiotelephony

cc) communication procedures and phraseology; action to be taken in case of communication failure.

2.6.1.2.2 In addition to the above subjects, the applicant for an airline transport pilot licence applicable to the aeroplane or powered-lift category shall have met the knowledge requirements for the instrument rating at 2.7.1.1.

2.6.1.3 *Skill*

2.6.1.3.1 The applicant shall have demonstrated the ability to perform, as pilot-in-command of an aircraft within the appropriate category required to be operated with a co-pilot, the following procedures and manoeuvres:

a) pre-flight procedures, including the preparation of the operational flight plan and filing of the air traffic services flight plan;

b) normal flight procedures and manoeuvres during all phases of flight;

c) abnormal and emergency procedures and manoeuvres related to failures and malfunctions of equipment, such as engine, systems and airframe;

d) procedures for crew incapacitation and crew coordination, including allocation of pilot tasks, crew cooperation and use of checklists; and

e) in the case of aeroplanes and powered-lifts, procedures and manoeuvres for instrument flight described in 2.7.4.1 a) to d), including simulated engine failure.

2.6.1.3.1.1 In the case of an aeroplane, the applicant shall have demonstrated the ability to perform the procedures and manoeuvres described in 2.6.1.3.1 as pilot-in-command of a multi-engined aeroplane.

2.6.1.3.1.2 The applicant shall have demonstrated the ability to perform the procedures and manoeuvres described in 2.6.1.3 with a degree of competency appropriate to the privileges granted to the holder of an airline transport pilot licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) smoothly and accurately, manually control the aircraft within its limitations at all times, such that the successful outcome of a procedure or manoeuvre is assured;

c) operate the aircraft in the mode of automation appropriate to the phase of flight and to maintain awareness of the active mode of automation;

d) perform, in an accurate manner, normal, abnormal and emergency procedures in all phases of flight;

e) exercise good judgement and airmanship, to include structured decision making and the maintenance of situational awareness; and

f) communicate effectively with other flight crew members and demonstrate the ability to effectively perform procedures for crew incapacitation, crew coordination, including allocation of pilot tasks, crew cooperation, adherence to standard operating procedures (SOPs) and use of checklists.

2.6.1.4 *Medical fitness*

The applicant shall hold a current Class 1 Medical Assessment.

2.6.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

2.6.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1, 1.2.9 and 2.1, the privileges of the holder of an airline transport pilot licence shall be:

a) to exercise all the privileges of the holder of a private and commercial pilot licence in an aircraft within the appropriate aircraft category and, in the case of a licence for the aeroplane and powered-lift categories, of the instrument rating; and

b) to act as pilot-in-command, in commercial air transportation, of an aircraft within the appropriate category and certificated for operation with more than one pilot.

2.6.2.2 When the holder of an airline transport pilot licence in the aeroplane category has previously held only a multi-crew pilot licence, the privileges of the licence shall be limited to multi-crew operations unless the holder has met the requirements established in 2.5.2.1 a), 2.5.2.2 and 2.5.2.3 as appropriate. Any limitation of privileges shall be endorsed on the licence.

Note.— Certain privileges of the licence are curtailed by 2.1.10 for licence holders when they attain their 60th and 65th birthdays.

2.6.3 Specific requirements for the issue of the aeroplane category rating

2.6.3.1 *Experience*

2.6.3.1.1 The applicant shall have completed not less than 1 500 hours of flight time as a pilot of aeroplanes. The Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 1 500 hours. Credit for such experience shall be limited to a maximum of 100 hours, of which not more than 25 hours shall have been acquired in a flight procedure trainer or a basic instrument flight trainer.

2.6.3.1.1.1 The applicant shall have completed in aeroplanes not less than:

a) 500 hours as pilot-in-command under supervision or 250 hours, either as pilot-in-command, or made up by not less than 70 hours as pilot-in-command and the necessary additional flight time as pilot-in-command under supervision;

b) 200 hours of cross-country flight time, of which not less than 100 hours shall be as pilot-in-command or as pilot-in-command under supervision;

c) 75 hours of instrument time, of which not more than 30 hours may be instrument ground time; and

d) 100 hours of night flight as pilot-in-command or as co-pilot.

2.6.3.1.2 When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.6.3.1.1 can be reduced accordingly.

2.6.3.2 *Flight instruction*

The applicant shall have received the dual flight instruction required at 2.4.3.2 for the issue of the commercial pilot licence and at 2.7.4 for the issue of the instrument rating or at 2.5.4 for the issue of the multi-crew pilot licence.

2.6.4 Specific requirements for the issue of the helicopter category rating

2.6.4.1 *Experience*

2.6.4.1.1 The applicant shall have completed not less than 1 000 hours of flight time as a pilot of helicopters. The Licensing Authority shall determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 1 000 hours. Credit for such experience shall be limited to a maximum of 100 hours, of which not more than 25 hours shall have been acquired in a flight procedure trainer or a basic instrument flight trainer.

2.6.4.1.1.1 The applicant shall have completed in helicopters not less than:

a) 250 hours, either as pilot-in-command, or made up of not less than 70 hours as pilot-in-command and the necessary additional flight time as pilot-in-command under supervision;

b) 200 hours of cross-country flight time, of which not less than 100 hours shall be as pilot-in-command or as pilot-in-command under supervision;

c) 30 hours of instrument time, of which not more than 10 hours may be instrument ground time; and

d) 50 hours of night flight as pilot-in-command or as co-pilot.

2.6.4.1.2 When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.6.4.1.1 can be reduced accordingly.

2.6.4.2 *Flight instruction*

The applicant shall have received the flight instruction required for the issue of the commercial pilot licence (2.4.4.2).

Note.— The instrument time specified in 2.6.4.1.1.1 c) and the night flying time specified in 2.6.4.1.1.1 d) do not entitle the holder of the airline transport pilot licence — helicopter to pilot helicopters under IFR.

2.6.5 Specific requirements for the issue of the powered-lift category rating

2.6.5.1 *Experience*

2.6.5.1.1 **Recommendation.—** *The applicant should have completed not less than 1 500 hours of flight time as a pilot of powered-lifts. The Licensing Authority should determine whether experience as a pilot under instruction in a flight simulation training device is acceptable as part of the total flight time of 1 500 hours.*

2.6.5.1.2 **Recommendation.—** *The applicant should have completed in powered-lifts not less than:*

a) 250 hours, either as pilot-in-command, or made up of not less than 70 hours as pilot-in-command and the necessary additional flight time as pilot-in-command under supervision;

b) 100 hours of cross-country flight time, of which not less than 50 hours should be as pilot-in-command or as pilot-in-command under supervision;

c) 75 hours of instrument time, of which not more than 30 hours may be instrument ground time; and

d) *25 hours of night flight as pilot-in-command or as co-pilot.*

2.6.5.1.3 **Recommendation.—** *When the applicant has flight time as a pilot of aircraft in other categories, the Licensing Authority should determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.6.5.1.1 could be reduced accordingly.*

2.6.5.2 *Flight instruction*

Recommendation.— *The applicant should have received the dual flight instruction required at 2.4.5.2 for the issue of the commercial pilot licence and at 2.7.4 for the issue of the instrument rating.*

2.7 Instrument rating

2.7.1 Requirements for the issue of the rating for aeroplane, airship, helicopter and powered-lift categories

2.7.1.1 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of an instrument rating, in at least the following subjects:

Air law

a) rules and regulations relevant to flight under IFR; related air traffic services practices and procedures;

Aircraft general knowledge for the aircraft category being sought

b) use, limitation and serviceability of avionics, electronic devices and instruments necessary for the control and navigation of aircraft under IFR and in instrument meteorological conditions; use and limitations of autopilot;

c) compasses, turning and acceleration errors; gyroscopic instruments, operational limits and precession effects; practices and procedures in the event of malfunctions of various flight instruments;

Flight performance and planning for the aircraft category being sought

d) pre-flight preparations and checks appropriate to flight under IFR;

e) operational flight planning; preparation and filing of air traffic services flight plans under IFR; altimeter setting procedures;

Human performance for the aircraft category being sought

f) human performance relevant to instrument flight in aircraft including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology for the aircraft category being sought

g) application of aeronautical meteorology; interpretation and use of reports, charts and forecasts; codes and abbreviations; use of, and procedures for obtaining, meteorological information; altimetry;

h) causes, recognition and effects of icing; frontal zone penetration procedures; hazardous weather avoidance;

i) in the case of helicopters and powered-lifts, effects of rotor icing;

Navigation for the aircraft category being sought

j) practical air navigation using radio navigation aids;

k) use, accuracy and reliability of navigation systems used in departure, en-route, approach and landing phases of flight; identification of radio navigation aids;

Operational procedures for the aircraft category being sought

l) application of threat and error management to operational performance;

m) interpretation and use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations, and instrument procedure charts for departure, en-route, descent and approach;

n) precautionary and emergency procedures; safety practices associated with flight under IFR; obstacle clearance criteria;

Note.— Information for pilots and flight operations personnel on flight procedure parameters and operational procedures is contained in the Procedures for Air Navigation Services *(PANS-OPS, Doc 8168), Volume I —* Flight Procedures. *Procedures used in certain States may differ from PANS-OPS, and knowledge of these differences is important for safety reasons.*

Radiotelephony

o) communication procedures and phraseology as applied to aircraft operations under IFR; action to be taken in case of communication failure.

2.7.1.2 *Skill*

2.7.1.2.1 The applicant shall have demonstrated in an aircraft of the category for which the instrument rating is being sought the ability to perform the procedures and manoeuvres described in 2.7.4.1 with a degree of competency appropriate to the privileges granted to the holder of an instrument rating, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) operate the aircraft for the category being sought, within its limitations;

c) complete all manoeuvres with smoothness and accuracy;

d) exercise good judgement and airmanship;

e) apply aeronautical knowledge; and

f) maintain control of the aircraft at all times in a manner such that the successful outcome of a procedure or manoeuvre is assured.

2.7.1.2.1.1 The applicant shall have demonstrated the ability to operate multi-engined aircraft within the appropriate category by reference solely to instruments with one engine inoperative, or simulated inoperative, if the privileges of the instrument rating are to be exercised on such aircraft.

Note.— Attention is called to 2.1.6 on the use of flight simulation training devices for demonstrations of skill.

2.7.1.3 *Medical fitness*

2.7.1.3.1 Applicants who hold a private pilot licence shall have established their hearing acuity on the basis of compliance with the hearing requirements for the issue of a Class 1 Medical Assessment.

2.7.1.3.2 **Recommendation.—** *Contracting States should consider requiring the holder of a private pilot licence to comply with the physical and mental, and visual requirements for the issue of a Class 1 Medical Assessment.*

2.7.2 Privileges of the holder of the rating and the conditions to be observed in exercising such privileges

2.7.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6 and 2.1, the privileges of the holder of an instrument rating with a specific aircraft category shall be to pilot that category of aircraft under IFR.

2.7.2.2 Before exercising the privileges on multi-engined aircraft, the holder of the rating shall have complied with the requirements of 2.7.1.2.1.1.

Note.— Pilots may exercise joint category privileges of the instrument rating on more than one category of aircraft if they have completed the requirements in each category.

2.7.3 Experience

2.7.3.1 The applicant shall hold a pilot licence for the aircraft category being sought.

2.7.3.2 The applicant shall have completed not less than:

a) 50 hours of cross-country flight time as pilot-in-command of aircraft in categories acceptable to the Licensing Authority, of which not less than 10 hours shall be in the aircraft category being sought; and

b) 40 hours of instrument time in aircraft of which not more than 20 hours, or 30 hours where a flight simulator is used, may be instrument ground time. The ground time shall be under the supervision of an authorized instructor.

2.7.4 Flight instruction

2.7.4.1 The applicant shall have gained not less than 10 hours of the instrument flight time required in 2.7.3.2 b) while receiving dual instrument flight instruction in the aircraft category being sought, from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in at least the following areas to the level of performance required for the holder of an instrument rating:

a) pre-flight procedures, including the use of the flight manual or equivalent document, and appropriate air traffic services documents in the preparation of an IFR flight plan;

b) pre-flight inspection, use of checklists, taxiing and pre-take-off checks;

c) procedures and manoeuvres for IFR operation under normal, abnormal and emergency conditions covering at least:

— transition to instrument flight on take-off;

— standard instrument departures and arrivals;

— en-route IFR procedures;

— holding procedures;

— instrument approaches to specified minima;

— missed approach procedures;

— landings from instrument approaches;

d) in-flight manoeuvres and particular flight characteristics.

2.7.4.2 If the privileges of the instrument rating are to be exercised on multi-engined aircraft, the applicant shall have received dual instrument flight instruction in a multi-engined aircraft within the appropriate category from an authorized flight instructor. The instructor shall ensure that the applicant has operational experience in the operation of the aircraft within the appropriate category by reference solely to instruments with one engine inoperative or simulated inoperative.

2.8 Flight instructor rating appropriate to aeroplanes, airships, helicopters and powered-lifts

2.8.1 Requirements for the issue of the rating

2.8.1.1 *Knowledge*

The applicant shall have met the knowledge requirements for the issue of a commercial pilot licence as appropriate to the category of aircraft included in the licence. In addition, the applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a flight instructor rating, in at least the following areas:

a) techniques of applied instruction;

b) assessment of student performance in those subjects in which ground instruction is given;

c) the learning process;

d) elements of effective teaching;

e) student evaluation and testing, training philosophies;

f) training programme development;

g) lesson planning;

h) classroom instructional techniques;

i) use of training aids, including flight simulation training devices as appropriate;

j) analysis and correction of student errors;

k) human performance relevant to flight instruction including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683)*.

l) hazards involved in simulating system failures and malfunctions in the aircraft.

2.8.1.2 *Skill*

The applicant shall have demonstrated, in the category and class of aircraft for which flight instructor privileges are sought, the ability to instruct in those areas in which flight instruction is to be given, including pre-flight, post-flight and ground instruction as appropriate.

2.8.1.3 *Experience*

The applicant shall have met the experience requirements for the issue of a commercial pilot licence as specified in 2.4.3.1, 2.4.4.1, 2.4.5.1 and 2.4.6.1 for each aircraft category, as appropriate.

2.8.1.4 *Flight instruction*

The applicant shall, under the supervision of a flight instructor accepted by the Licensing Authority for that purpose:

a) have received instruction in flight instructional techniques including demonstration, student practices, recognition and correction of common student errors; and

b) have practised instructional techniques in those flight manoeuvres and procedures in which it is intended to provide flight instruction.

2.8.2 Privileges of the holder of the rating and the conditions to be observed in exercising such privileges

2.8.2.1 Subject to compliance with the requirements specified in 1.2.5 and 2.1, the privileges of the holder of a flight instructor rating shall be:

a) to supervise solo flights by student pilots; and

b) to carry out flight instruction for the issue of a private pilot licence, a commercial pilot licence, an instrument rating, and a flight instructor rating

provided that the flight instructor:

1) holds at least the licence and rating for which instruction is being given, in the appropriate aircraft category;

2) holds the licence and rating necessary to act as the pilot-in-command of the aircraft on which the instruction is given; and

3) has the flight instructor privileges granted entered on the licence.

2.8.2.2 The applicant, in order to carry out instruction for the multi-crew pilot licence, shall have also met all the instructor qualification requirements.

Note.— Specific provisions for flight instructors carrying out instruction for the multi-crew pilot licence exist in Chapter 4 of the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868).*

2.9 Glider pilot licence

2.9.1 Requirements for the issue of the licence

2.9.1.1 *Age*

The applicant shall be not less than 16 years of age.

2.9.1.2 *Knowledge*

2.9.1.2.1 The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a glider pilot licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a glider pilot licence; rules of the air; appropriate air traffic services practices and procedures;

Aircraft general knowledge

b) principles of operation of glider systems and instruments;

c) operating limitations of gliders; relevant operational information from the flight manual or other appropriate document;

Flight performance, planning and loading

d) effects of loading and mass distribution on flight characteristics; mass and balance considerations;

e) use and practical application of launching, landing and other performance data;

f) pre-flight and en-route flight planning appropriate to operations under VFR; appropriate air traffic services procedures; altimeter setting procedures; operations in areas of high-density traffic;

Human performance

g) human performance relevant to the glider pilot including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

h) application of elementary aeronautical meteorology; use of, and procedures for obtaining, meteorological information; altimetry;

Navigation

i) practical aspects of air navigation and dead-reckoning techniques; use of aeronautical charts;

Operational procedures

j) use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations;

k) different launch methods and associated procedures;

l) appropriate precautionary and emergency procedures, including action to be taken to avoid hazardous weather, wake turbulence and other operating hazards;

Principles of flight

m) principles of flight relating to gliders.

2.9.1.2.2 **Recommendation.—** *The applicant should have demonstrated a level of knowledge appropriate to the privileges to be granted to the holder of a glider pilot licence, in communication procedures and phraseology as appropriate to VFR operations and on action to be taken in case of communication failure.*

2.9.1.3 *Experience*

2.9.1.3.1 The applicant shall have completed not less than six hours of flight time as a pilot of gliders including two hours of solo flight time during which not less than 20 launches and landings have been performed.

2.9.1.3.1.1 When the applicant has flight time as a pilot of aeroplanes, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 2.9.1.3.1 can be reduced accordingly.

2.9.1.3.2 The applicant shall have gained, under appropriate supervision, operational experience in gliders in at least the following areas:

a) pre-flight operations, including glider assembly and inspection;

b) techniques and procedures for the launching method used, including appropriate airspeed limitations, emergency procedures and signals used;

c) traffic pattern operations, collision avoidance precautions and procedures;

d) control of the glider by external visual reference;

e) flight throughout the flight envelope;

f) recognition of, and recovery from, incipient and full stalls and spiral dives;

g) normal and crosswind launches, approaches and landings;

h) cross-country flying using visual reference and dead reckoning;

i) emergency procedures.

2.9.1.4 *Skill*

The applicant shall have demonstrated the ability to perform as pilot-in-command of a glider, the procedures and manoeuvres described in 2.9.1.3.2 with a degree of competency appropriate to the privileges granted to the holder of a glider pilot licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) operate the glider within its limitations;

c) complete all manoeuvres with smoothness and accuracy;

d) exercise good judgement and airmanship;

e) apply aeronautical knowledge; and

f) maintain control of the glider at all times in a manner such that the successful outcome of a procedure or manoeuvre is assured.

2.9.1.5 *Medical fitness*

The applicant shall hold a current Class 2 Medical Assessment.

2.9.2 Privileges of the holder of the licence
and the conditions to be observed in exercising such privileges

2.9.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1 and 2.1, the privileges of the holder of a glider pilot licence shall be to act as pilot-in-command of any glider provided the licence holder has operational experience in the launching method used.

2.9.2.2 **Recommendation.—** *If passengers are to be carried, the licence holder should have completed not less than 10 hours of flight time as a pilot of gliders.*

2.10 Free balloon pilot licence

Note.— The provisions of the free balloon pilot licence apply to free balloons using hot air or gas.

2.10.1 Requirements for the issue of the licence

2.10.1.1 *Age*

The applicant shall be not less than 16 years of age.

2.10.1.2 *Knowledge*

2.10.1.2.1 The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a free balloon pilot licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a free balloon pilot licence; rules of the air; appropriate air traffic services practices and procedures;

Aircraft general knowledge

b) principles of operation of free balloon systems and instruments;

c) operating limitations of free balloons; relevant operational information from the flight manual or other appropriate document;

d) physical properties and practical application of gases used in free balloons;

Flight performance, planning and loading

e) effects of loading on flight characteristics; mass calculations;

f) use and practical application of launching, landing and other performance data, including the effect of temperature;

g) pre-flight and en-route flight planning appropriate to operations under VFR; appropriate air traffic services procedures; altimeter setting procedures; operations in areas of high-density traffic;

Human performance

h) human performance relevant to the free balloon pilot including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

i) application of elementary aeronautical meteorology; use of, and procedures for obtaining, meteorological information; altimetry;

Navigation

j) practical aspects of air navigation and dead-reckoning techniques; use of aeronautical charts;

Operational procedures

k) use of aeronautical documentation such as AIP, NOTAM, aeronautical codes and abbreviations;

l) appropriate precautionary and emergency procedures, including action to be taken to avoid hazardous weather, wake turbulence and other operating hazards;

Principles of flight

m) principles of flight relating to free balloons.

2.10.1.2.2 **Recommendation.—** *The applicant should have demonstrated a level of knowledge appropriate to the privileges to be granted to the holder of a free balloon pilot licence, in communication procedures and phraseology as appropriate to VFR operations and on action to be taken in case of communication failure.*

2.10.1.3 *Experience*

2.10.1.3.1 The applicant shall have completed not less than 16 hours of flight time as a pilot of free balloons including at least eight launches and ascents of which one must be solo.

2.10.1.3.2 The applicant shall have gained, under appropriate supervision, operational experience in free balloons in at least the following areas:

a) pre-flight operations, including balloon assembly, rigging, inflation, mooring and inspection;

b) techniques and procedures for the launching and ascent, including appropriate limitations, emergency procedures and signals used;

c) collision avoidance precautions;

d) control of the free balloon by external visual reference;

e) recognition of, and recovery from, rapid descents;

f) cross-country flying using visual reference and dead reckoning;

g) approaches and landings, including ground handling;

h) emergency procedures.

2.10.1.3.3 If the privileges of the licence are to be exercised at night, the applicant shall have gained, under appropriate supervision, operational experience in free balloons in night flying.

2.10.1.3.4 **Recommendation.—** *If passengers are to be carried for remuneration or hire, the licence holder should have completed not less than 35 hours of flight time including 20 hours as a pilot of a free balloon.*

2.10.1.4 *Skill*

The applicant shall have demonstrated the ability to perform as pilot-in-command of a free balloon, the procedures and manoeuvres described in 2.10.1.3.2 with a degree of competency appropriate to the privileges granted to the holder of a free balloon pilot licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) operate the free balloon within its limitations;

c) complete all manoeuvres with smoothness and accuracy;

d) exercise good judgement and airmanship;

e) apply aeronautical knowledge; and

f) maintain control of the free balloon at all times in a manner such that the successful outcome of a procedure or manoeuvre is assured.

2.10.1.5 *Medical fitness*

The applicant shall hold a current Class 2 Medical Assessment.

2.10.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

2.10.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1, 2.1 and 2.10.1.3.4, the privileges of the holder of a free balloon pilot licence shall be to act as pilot-in-command of any free balloon provided that the licence holder has operational experience in hot air or gas balloons as appropriate.

2.10.2.2 Before exercising the privileges at night, the licence holder shall have complied with the requirements specified in 2.10.1.3.3.

CHAPTER 3. LICENCES FOR FLIGHT CREW MEMBERS OTHER THAN LICENCES FOR PILOTS

3.1 General rules concerning flight navigator and flight engineer licences

3.1.1 An applicant shall, before being issued with a flight navigator licence or a flight engineer licence, meet such requirements in respect of age, knowledge, experience, skill and medical fitness as are specified for those licences.

3.1.1.1 An applicant for a flight navigator licence or a flight engineer licence shall demonstrate such requirements for knowledge and skill as are specified for those licences, in a manner determined by the Licensing Authority.

3.2 Flight navigator licence

3.2.1 Requirements for the issue of the licence

3.2.1.1 *Age*

The applicant shall be not less than 18 years of age.

3.2.1.2 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a flight navigator licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a flight navigator licence; appropriate air traffic services practices and procedures;

Flight performance, planning and loading

b) effects of loading and mass distribution on aircraft performance;

c) use of take-off, landing and other performance data including procedures for cruise control;

d) pre-flight and en-route operational flight planning; preparation and filing of air traffic services flight plans; appropriate air traffic services procedures; altimeter setting procedures;

Human performance

e) human performance relevant to the flight navigator including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

f) interpretation and practical application of aeronautical meteorological reports, charts and forecasts; codes and abbreviations; use of, and procedures for obtaining, meteorological information, pre-flight and in-flight; altimetry;

g) aeronautical meteorology; climatology of relevant areas in respect of the elements having an effect upon aviation; the movement of pressure systems; the structure of fronts, and the origin and characteristics of significant weather phenomena which affect take-off, en-route and landing conditions;

Navigation

h) dead-reckoning, pressure-pattern and celestial navigation procedures; the use of aeronautical charts, radio navigation aids and area navigation systems; specific navigation requirements for long-range flights;

i) use, limitation and serviceability of avionics and instruments necessary for the navigation of the aircraft;

j) use, accuracy and reliability of navigation systems used in departure, en-route and approach phases of flight; identification of radio navigation aids;

k) principles, characteristics and use of self-contained and external-referenced navigation systems; operation of airborne equipment;

l) the celestial sphere including the movement of heavenly bodies and their selection and identification for the purpose of observation and reduction of sights; calibration of sextants; the completion of navigation documentation;

m) definitions, units and formulae used in air navigation;

Operational procedures

n) interpretation and use of aeronautical documentation such as AIP, NOTAM, aeronautical codes, abbreviations, and instrument procedure charts for departure, en-route, descent and approach;

Principles of flight

o) principles of flight;

Radiotelephony

p) communication procedures and phraseology.

3.2.1.3 *Experience*

3.2.1.3.1 The applicant shall have completed in the performance of the duties of a flight navigator, not less than 200 hours of flight time acceptable to the Licensing Authority, in aircraft engaged in cross-country flights, including not less than 30 hours by night.

3.2.1.3.1.1 When the applicant has flight time as a pilot, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 3.2.1.3.1 can be reduced accordingly.

3.2.1.3.2 The applicant shall produce evidence of having satisfactorily determined the aircraft's position in flight, and used that information to navigate the aircraft, as follows:

a) by night — not less than 25 times by celestial observations; and

b) by day — not less than 25 times by celestial observations in conjunction with self-contained or external-referenced navigation systems.

3.2.1.4 *Skill*

The applicant shall have demonstrated the ability to perform as flight navigator of an aircraft with a degree of competency appropriate to the privileges granted to the holder of a flight navigator licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) exercise good judgement and airmanship;

c) apply aeronautical knowledge;

d) perform all duties as part of an integrated crew; and

e) communicate effectively with the other flight crew members.

3.2.1.5 *Medical fitness*

The applicant shall hold a current Class 2 Medical Assessment.

3.2.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

Subject to compliance with the requirements specified in 1.2.5, 1.2.6 and 1.2.7.1, the privileges of the holder of a flight navigator licence shall be to act as flight navigator of any aircraft. If the privileges include radiotelephony communication, the licence holder shall comply with the requirements specified in 1.2.9.2.

3.3 Flight engineer licence

3.3.1 Requirements for the issue of the licence

3.3.1.1 *Age*

The applicant shall be not less than 18 years of age.

3.3.1.2 *Knowledge*

3.3.1.2.1 The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a flight engineer licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a flight engineer licence; rules and regulations governing the operation of civil aircraft pertinent to the duties of a flight engineer;

Aircraft general knowledge

b) basic principles of engines, gas turbines and/or piston engines; characteristics of fuels, fuel systems including fuel control; lubricants and lubrication systems; afterburners and injection systems, function and operation of engine ignition and starter systems;

c) principles of operation, handling procedures and operating limitations of aircraft engines; effects of atmospheric conditions on engine performance;

d) airframes, flight controls, structures, wheel assemblies, brakes and anti-skid units, corrosion and fatigue life; identification of structural damage and defects;

e) ice and rain protection systems;

f) pressurization and air-conditioning systems, oxygen systems;

g) hydraulic and pneumatic systems;

h) basic electrical theory, electric systems (AC and DC), aircraft wiring systems, bonding and screening;

i) principles of operation of instruments, compasses, autopilots, radio communication equipment, radio and radar navigation aids, flight management systems, displays and avionics;

j) limitations of appropriate aircraft;

k) fire protection, detection, suppression and extinguishing systems;

l) use and serviceability checks of equipment and systems of appropriate aircraft;

Flight performance, planning and loading

m) effects of loading and mass distribution on aircraft handling, flight characteristics and performance; mass and balance calculations;

n) use and practical application of performance data including procedures for cruise control;

Human performance

o) human performance relevant to the flight engineer including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Operational procedures

p) principles of maintenance, procedures for the maintenance of airworthiness, defect reporting, pre-flight inspections, precautionary procedures for fuelling and use of external power; installed equipment and cabin systems;

q) normal, abnormal and emergency procedures;

r) operational procedures for carriage of freight and dangerous goods;

Principles of flight

s) fundamentals of aerodynamics;

Radiotelephony

t) communication procedures and phraseology.

3.3.1.2.2 **Recommendation.—** *The applicant should have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a flight engineer licence in at least the following subjects:*

a) fundamentals of navigation; principles and operation of self-contained systems; and

b) operational aspects of meteorology.

3.3.1.3 *Experience*

3.3.1.3.1 The applicant shall have completed, under the supervision of a person accepted by the Licensing Authority for that purpose, not less than 100 hours of flight time in the performance of the duties of a flight engineer. The Licensing Authority shall determine whether experience as a flight engineer in a flight simulator, which it has approved, is acceptable as part of the total flight time of 100 hours. Credit for such experience shall be limited to a maximum of 50 hours.

3.3.1.3.1.1 When the applicant has flight time as a pilot, the Licensing Authority shall determine whether such experience is acceptable and, if so, the extent to which the flight time requirements of 3.3.1.3.1 can be reduced accordingly.

3.3.1.3.2 The applicant shall have operational experience in the performance of the duties of a flight engineer, under the supervision of a flight engineer accepted by the Licensing Authority for that purpose, in at least the following areas:

a) *Normal procedures*

— pre-flight inspections
— fuelling procedures, fuel management
— inspection of maintenance documents
— normal flight deck procedures during all phases of flight
— crew coordination and procedures in case of crew incapacitation
— defect reporting

b) *Abnormal and alternate (standby) procedures*

— recognition of abnormal functioning of aircraft systems
— use of abnormal and alternate (standby) procedures

c) *Emergency procedures*

— recognition of emergency conditions
— use of appropriate emergency procedures.

3.3.1.4 *Skill*

3.3.1.4.1 The applicant shall have demonstrated the ability to perform as flight engineer of an aircraft, the duties and procedures described in 3.3.1.3.2 with a degree of competency appropriate to the privileges granted to the holder of a flight engineer licence, and to:

a) recognize and manage threats and errors;

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

b) use aircraft systems within the aircraft's capabilities and limitations;

c) exercise good judgement and airmanship;

d) apply aeronautical knowledge;

e) perform all the duties as part of an integrated crew with the successful outcome assured; and

f) communicate effectively with the other flight crew members.

3.3.1.4.2 The use of a flight simulation training device for performing any of the procedures required during the demonstration of skill described in 3.3.1.4.1 shall be approved by the Licensing Authority, which shall ensure that the flight simulation training device is appropriate to the task.

3.3.1.5 *Medical fitness*

The applicant shall hold a current Class 2 Medical Assessment.

3.3.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

3.3.2.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6 and 1.2.7.1, the privileges of the holder of a flight engineer licence shall be to act as flight engineer of any type of aircraft on which the holder has demonstrated a level of knowledge and skill, as determined by the Licensing Authority on the basis of those requirements specified in 3.3.1.2 and 3.3.1.4 which are applicable to the safe operation of that type of aircraft.

3.3.2.2 The types of aircraft on which the holder of a flight engineer licence is authorized to exercise the privileges of that licence, shall be either entered on the licence or recorded elsewhere in a manner acceptable to the Licensing Authority.

3.4 Flight radiotelephone operator

Note 1.— Where the knowledge and skill of an applicant have been established as satisfactory in respect of the certification requirements for the radiotelephone operator's restricted certificate specified in the general radio regulations annexed to the International Telecommunication Convention and the applicant has met the requirements that are pertinent to the operation of the radiotelephone on board an aircraft, a Contracting State may endorse a licence already held by the applicant (as provided for in 5.1.1.2 XIII) or issue a separate licence as appropriate.

Note 2.— Skill and knowledge requirements on radiotelephony procedures and phraseology have been developed as an integral part of all aeroplane, airship, helicopter and powered-lift pilot licences.

CHAPTER 4. LICENCES AND RATINGS FOR PERSONNEL OTHER THAN FLIGHT CREW MEMBERS

4.1 General rules concerning licences and ratings for personnel other than flight crew members

4.1.1 An applicant shall, before being issued with any licence or rating for personnel other than flight crew members, meet such requirements in respect of age, knowledge, experience and where appropriate, medical fitness and skill, as are specified for that licence or rating.

4.1.2 An applicant, for any licence or rating for personnel other than flight crew members, shall demonstrate, in a manner determined by the Licensing Authority, such requirements in respect of knowledge and skill as are specified for that licence or rating.

4.2 Aircraft maintenance (technician/engineer/mechanic)

Note.— The terms in brackets are given as acceptable additions to the title of the licence. Each Contracting State is expected to use in its own regulations the one it prefers.

4.2.1 Requirements for the issue of the licence

4.2.1.1 *Age*

The applicant shall be not less than 18 years of age.

4.2.1.2 *Knowledge*

The applicant shall have demonstrated a level of knowledge relevant to the privileges to be granted and appropriate to the responsibilities of an aircraft maintenance licence holder, in at least the following subjects:

Air law and airworthiness requirements

a) rules and regulations relevant to an aircraft maintenance licence holder including applicable airworthiness requirements governing certification and continuing airworthiness of aircraft and approved aircraft maintenance organization and procedures;

Natural science and aircraft general knowledge

b) basic mathematics; units of measurement; fundamental principles and theory of physics and chemistry applicable to aircraft maintenance;

Aircraft engineering

c) characteristics and applications of the materials of aircraft construction including principles of construction and functioning of aircraft structures, fastening techniques; engines and their associated systems; mechanical, fluid, electrical and electronic power sources; aircraft instrument and display systems; aircraft control systems; and airborne navigation and communication systems;

Aircraft maintenance

d) tasks required to ensure the continuing airworthiness of an aircraft including methods and procedures for the overhaul, repair, inspection, replacement, modification or defect rectification of aircraft structures, components and systems in accordance with the methods prescribed in the relevant Maintenance Manuals and the applicable Standards of airworthiness; and

Human performance

e) human performance, including principles of threat and error management, relevant to aircraft maintenance.

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

4.2.1.3 *Experience*

The applicant shall have had the following experience in the inspection, servicing and maintenance of aircraft or its components:

a) for the issue of a licence with privileges for the aircraft in its entirety, at least:

1) four years; or

2) two years if the applicant has satisfactorily completed an approved training course; and

b) for the issue of a licence with privileges restricted in accordance with 4.2.2.2 a) 2) or 3), a period of time that will enable a level of competency equivalent to that required in a) to be attained, provided that this is not less than:

1) two years; or

2) such a period as the State considers necessary to provide an equivalent level of practical experience to applicants who have satisfactorily completed an approved training course.

4.2.1.4 *Training*

Recommendation.— *The applicant should have completed a course of training appropriate to the privileges to be granted.*

Note.— The Training Manual *(Doc 7192), Part D-1, contains guidance material on a training course for applicants for an aircraft maintenance licence.*

4.2.1.5 *Skill*

The applicant shall have demonstrated the ability to perform those functions applicable to the privileges to be granted.

4.2.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

4.2.2.1 Subject to compliance with the requirements specified in 4.2.2.2 and 4.2.2.3, the privileges of the holder of an aircraft maintenance licence shall be to certify the aircraft or parts of the aircraft as airworthy after an authorized repair, modification or installation of an engine, accessory, instrument, and/or item of equipment, and to sign a maintenance release following inspection, maintenance operations and/or routine servicing.

4.2.2.2 The privileges of the holder of an aircraft maintenance licence specified in 4.2.2.1 shall be exercised only:

a) in respect of such:

   1) aircraft as are entered on the licence in their entirety either specifically or under broad categories; or

   2) airframes and engines and aircraft systems or components as are entered on the licence either specifically or under broad categories; and/or

   3) aircraft avionic systems or components as are entered on the licence either specifically or under broad categories;

b) provided that the licence holder is familiar with all the relevant information relating to the maintenance and airworthiness of the particular aircraft for which the licence holder is signing a Maintenance Release, or such airframe, engine, aircraft system or component and aircraft avionic system or component which the licence holder is certifying as being airworthy; and

c) on condition that, within the preceding 24 months, the licence holder has either had experience in the inspection, servicing or maintenance of an aircraft or components in accordance with the privileges granted by the licence held for not less than six months, or has met the provision for the issue of a licence with the appropriate privileges, to the satisfaction of the Licensing Authority.

4.2.2.3 A Contracting State shall prescribe the scope of the privileges of the licence holder in terms of the complexity of the tasks to which the certification relates.

4.2.2.3.1 **Recommendation.—** *Details of the certification privileges should be endorsed on or attached to the licence, either directly or by reference to another document issued by the Contracting State.*

4.2.2.4 When a Contracting State authorizes an approved maintenance organization to appoint non-licensed personnel to exercise the privileges of 4.2.2, the person appointed shall meet the requirements specified in 4.2.1.

4.3 Student air traffic controller

4.3.1 Contracting States shall take the appropriate measures to ensure that student air traffic controllers do not constitute a hazard to air navigation.

4.3.2 Medical fitness

A Contracting State shall not permit a student air traffic controller to receive instruction in an operational environment unless that student air traffic controller holds a current Class 3 Medical Assessment.

4.4 Air traffic controller licence

4.4.1 Requirements for the issue of the licence

Before issuing an air traffic controller licence, a Contracting State shall require the applicant to meet the requirements of 4.4.1 and the requirements of at least one of the ratings set out in 4.5. Unlicensed State employees may operate as air traffic controllers on condition that they meet the same requirements.

4.4.1.1 *Age*

The applicant shall be not less than 21 years of age.

4.4.1.2 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the holder of an air traffic controller licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the air traffic controller;

Air traffic control equipment

b) principles, use and limitations of equipment used in air traffic control;

General knowledge

c) principles of flight; principles of operation and functioning of aircraft, engines and systems; aircraft performance relevant to air traffic control operations;

Human performance

d) human performance including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

e) aeronautical meteorology; use and appreciation of meteorological documentation and information; origin and characteristics of weather phenomena affecting flight operations and safety; altimetry;

Navigation

f) principles of air navigation; principle, limitation and accuracy of navigation systems and visual aids; and

Operational procedures

g) air traffic control, communication, radiotelephony and phraseology procedures (routine, non-routine and emergency); use of the relevant aeronautical documentation; safety practices associated with flight.

4.4.1.3 *Experience*

The applicant shall have completed an approved training course and not less than three months of satisfactory service engaged in the actual control of air traffic under the supervision of an appropriately rated air traffic controller. The experience requirements specified for air traffic controller ratings in 4.5 may be credited as part of the experience specified in this paragraph.

4.4.1.4 *Medical fitness*

The applicant shall hold a current Class 3 Medical Assessment.

4.5 Air traffic controller ratings

4.5.1 Categories of air traffic controller ratings

Air traffic controller ratings shall comprise the following categories:

a) aerodrome control rating;

b) approach control procedural rating;

c) approach control surveillance rating;

d) approach precision radar control rating;

e) area control procedural rating; and

f) area control surveillance rating.

Note.— The World Meteorological Organization has specified requirements for personnel making meteorological observations which apply to air traffic controllers providing such a service.

4.5.2 Requirements for air traffic controller ratings

4.5.2.1 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted, in at least the following subjects in so far as they affect the area of responsibility:

a) *aerodrome control rating:*

   1) aerodrome layout; physical characteristics and visual aids;

   2) airspace structure;

   3) applicable rules, procedures and source of information;

   4) air navigation facilities;

5) air traffic control equipment and its use;

6) terrain and prominent landmarks;

7) characteristics of air traffic;

8) weather phenomena; and

9) emergency and search and rescue plans;

b) *approach control procedural and area control procedural ratings:*

1) airspace structure;

2) applicable rules, procedures and source of information;

3) air navigation facilities;

4) air traffic control equipment and its use;

5) terrain and prominent landmarks;

6) characteristics of air traffic and traffic flow;

7) weather phenomena; and

8) emergency and search and rescue plans; and

c) *approach control surveillance, approach precision radar control and area control surveillance ratings:* The applicant shall meet the requirements specified in b) in so far as they affect the area of responsibility, and shall have demonstrated a level of knowledge appropriate to the privileges granted, in at least the following additional subjects:

1) principles, use and limitations of applicable ATS surveillance systems and associated equipment; and

2) procedures for the provision of ATS surveillance service, as appropriate, including procedures to ensure appropriate terrain clearance.

4.5.2.2 *Experience*

4.5.2.2.1 The applicant shall have:

a) satisfactorily completed an approved training course;

b) provided, satisfactorily, under the supervision of an appropriately rated air traffic controller:

1) *aerodrome control rating:* an aerodrome control service, for a period of not less than 90 hours or one month, whichever is greater, at the unit for which the rating is sought;

2) *approach control procedural, approach control surveillance, area control procedural or area control surveillance rating:* the control service for which the rating is sought, for a period of not less than 180 hours or three months, whichever is greater, at the unit for which the rating is sought; and

3) *approach precision radar control rating:* not less than 200 precision approaches of which not more than 100 shall have been carried out on a radar simulator approved for that purpose by the Licensing Authority. Not less than 50 of those precision approaches shall have been carried out at the unit and on the equipment for which the rating is sought; and

c) if the privileges of the approach control surveillance rating include surveillance radar approach duties, the experience shall include not less than 25 plan position indicator approaches on the surveillance equipment of the type in use at the unit for which the rating is sought and under the supervision of an appropriately rated controller.

4.5.2.2.2 The experience specified in 4.5.2.2.1 b) shall have been completed within the 6-month period immediately preceding application.

4.5.2.2.3 When the applicant already holds an air traffic controller rating in another category, or the same rating for another unit, the Licensing Authority shall determine whether the experience requirement of 4.5.2.2 can be reduced, and if so, to what extent.

4.5.2.3 *Skill*

The applicant shall have demonstrated, at a level appropriate to the privileges being granted, the skill, judgement and performance required to provide a safe, orderly and expeditious control service, including the recognition and management of threats and errors.

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(Doc 9868, PANS-TRG), Chapter 3, Attachment C, in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683) and in Cir 314,* Threat and Error Management (TEM) in Air Traffic Control*.*

4.5.2.4 *Concurrent issuance of two air traffic controller ratings*

When two air traffic controller ratings are sought concurrently, the Licensing Authority shall determine the applicable requirements on the basis of the requirements for each rating. These requirements shall not be less than those of the more demanding rating.

4.5.3 Privileges of the holder of the air traffic controller rating(s) and the conditions to be observed in exercising such privileges

4.5.3.1 Subject to compliance with the requirements specified in 1.2.5, 1.2.6, 1.2.7.1 and 1.2.9, the privileges of the holder of an air traffic controller licence endorsed with one or more of the undermentioned ratings shall be:

a) *aerodrome control rating:* to provide or to supervise the provision of aerodrome control service for the aerodrome for which the licence holder is rated;

b) *approach control procedural rating:* to provide or to supervise the provision of approach control service for the aerodrome or aerodromes for which the licence holder is rated, within the airspace or portion thereof, under the jurisdiction of the unit providing approach control service;

c) *approach control surveillance rating:* to provide and/or supervise the provision of approach control service with the use of applicable ATS surveillance systems for the aerodrome or aerodromes for which the licence holder is rated, within the airspace or portion thereof, under the jurisdiction of the unit providing approach control service;

1) subject to compliance with the provisions of 4.5.2.2.1 c), the privileges shall include the provision of surveillance radar approaches;

d) *approach precision radar control rating:* to provide and/or supervise the provision of precision approach radar service at the aerodrome for which the licence holder is rated;

e) *area control procedural rating:* to provide and/or supervise the provision of area control service within the control area or portion thereof, for which the licence holder is rated; and

f) *area control surveillance rating:* to provide and/or supervise the provision of area control service with the use of an ATS surveillance system, within the control area or portion thereof, for which the licence holder is rated.

4.5.3.2 Before exercising the privileges indicated in 4.5.3.1, the licence holder shall be familiar with all pertinent and current information.

4.5.3.3 A Contracting State having issued an air traffic controller licence shall not permit the holder thereof to carry out instruction in an operational environment unless such holder has received proper authorization from such Contracting State.

4.5.3.4 *Validity of ratings*

A rating shall become invalid when an air traffic controller has ceased to exercise the privileges of the rating for a period determined by the Licensing Authority. That period shall not exceed six months. A rating shall remain invalid until the controller's ability to exercise the privileges of the rating has been re-established.

4.6 Flight operations officer/flight dispatcher licence

4.6.1 Requirements for the issue of the licence

4.6.1.1 *Age*

The applicant shall be not less than 21 years of age.

4.6.1.2 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the privileges granted to the holder of a flight operations officer licence, in at least the following subjects:

Air law

a) rules and regulations relevant to the holder of a flight operations officer licence; appropriate air traffic services practices and procedures;

Aircraft general knowledge

b) principles of operation of aeroplane engines, systems and instruments;

c) operating limitations of aeroplanes and engines;

d) minimum equipment list;

Flight performance calculation, planning procedures and loading

e) effects of loading and mass distribution on aircraft performance and flight characteristics; mass and balance calculations;

f) operational flight planning; fuel consumption and endurance calculations; alternate aerodrome selection procedures; en-route cruise control; extended range operation;

g) preparation and filing of air traffic services flight plans;

h) basic principles of computer-assisted planning systems;

Human performance

i) human performance relevant to dispatch duties, including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

Meteorology

j) aeronautical meteorology; the movement of pressure systems; the structure of fronts, and the origin and characteristics of significant weather phenomena which affect take-off, en-route and landing conditions;

k) interpretation and application of aeronautical meteorological reports, charts and forecasts; codes and abbreviations; use of, and procedures for obtaining, meteorological information;

Navigation

l) principles of air navigation with particular reference to instrument flight;

Operational procedures

m) use of aeronautical documentation;

n) operational procedures for the carriage of freight and dangerous goods;

o) procedures relating to aircraft accidents and incidents; emergency flight procedures;

p) procedures relating to unlawful interference and sabotage of aircraft;

Principles of flight

q) principles of flight relating to the appropriate category of aircraft; and

Radio communication

r) procedures for communicating with aircraft and relevant ground stations.

4.6.1.3 *Experience*

4.6.1.3.1 The applicant shall have gained the following experience:

a) a total of two years of service in any one or in any combination of the capacities specified in 1) to 3) inclusive, provided that in any combination of experience the period serviced in any capacity shall be at least one year:

1) a flight crew member in air transportation; or

2) a meteorologist in an organization dispatching aircraft in air transportation; or

3) an air traffic controller; or a technical supervisor of flight operations officers or air transportation flight operations systems;

or

b) at least one year as an assistant in the dispatching of air transport;

or

c) have satisfactorily completed a course of approved training.

4.6.1.3.2 The applicant shall have served under the supervision of a flight operations officer for at least 90 working days within the six months immediately preceding the application.

4.6.1.4 *Skill*

The applicant shall have demonstrated the ability to:

a) make an accurate and operationally acceptable weather analysis from a series of daily weather maps and weather reports; provide an operationally valid briefing on weather conditions prevailing in the general neighbourhood of a specific air route; forecast weather trends pertinent to air transportation with particular reference to destination and alternates;

b) determine the optimum flight path for a given segment, and create accurate manual and/or computer generated flight plans;

c) provide operating supervision and all other assistance to a flight in actual or simulated adverse weather conditions, as appropriate to the duties of the holder of a flight operations officer licence; and

d) recognize and manage threats and errors.

Note.— Guidance material on the application of threat and error management is found in the Procedures for Air Navigation Services — Training *(Doc 9868, PANS-TRG), Chapter 3, Attachment C, and in Part II, Chapter 2, of the* Human Factors Training Manual *(Doc 9683).*

4.6.2 Privileges of the holder of the licence and the conditions to be observed in exercising such privileges

Subject to compliance with the requirements specified in 1.2.5, the privileges of the holder of a flight operations officer licence shall be to serve in that capacity with responsibility for each area for which the applicant meets the requirements specified in Annex 6.

4.7 Aeronautical station operator licence

Note.— This licence is not intended for personnel providing Aerodrome Flight Information Service (AFIS). Guidance on the qualifications to be met by these personnel can be found in Circular 211, Aerodrome Flight Information Service (AFIS).

4.7.1 Requirements for the issue of the licence

4.7.1.1 Before issuing an aeronautical station operator licence, a Contracting State shall require the applicant to meet the requirements of 4.7.1. Unlicensed individuals may operate as aeronautical station operators on the condition that the State from which they operate ensures that they meet the same requirements.

4.7.1.2 *Age*

The applicant shall be not less than 18 years of age.

4.7.1.3 *Knowledge*

The applicant shall have demonstrated a level of knowledge appropriate to the holder of an aeronautical station operator, in at least the following subjects:

General knowledge

a) air traffic services provided within the State;

Operational procedures

b) radiotelephony procedures; phraseology; telecommunication network;

Rules and regulations

c) rules and regulations applicable to the aeronautical station operator; and

Telecommunication equipment

d) principles, use and limitations of telecommunication equipment in an aeronautical station.

4.7.1.4 *Experience*

The applicant shall have:

a) satisfactorily completed an approved training course within the 12-month period immediately preceding application, and have served satisfactorily under a qualified aeronautical station operator for not less than two months; or

b) satisfactorily served under a qualified aeronautical station operator for not less than six months during the 12-month period immediately preceding application.

4.7.1.5 *Skill*

The applicant shall demonstrate, or have demonstrated, competency in:

a) operating the telecommunication equipment in use; and

b) transmitting and receiving radiotelephony messages with efficiency and accuracy.

4.7.2 Privileges of the aeronautical station operator and the conditions to be observed in exercising such privileges

Subject to compliance with the requirements specified in 1.2.5 and 1.2.9, the privileges of the holder of an aeronautical station operator licence shall be to act as an operator in an aeronautical station. Before exercising the privileges of the licence, the holder shall be familiar with all pertinent and current information regarding the types of equipment and operating procedures used at that aeronautical station.

4.8 Aeronautical meteorological personnel

Note.— The requirements for training and qualifications for all aeronautical meteorological personnel are the responsibility of the World Meteorological Organization (WMO) in accordance with the Working Arrangements between the International Civil Aviation Organization and the World Meteorological Organization *(Doc 7475). The requirements can be found in WMO Document 258 —* Guidelines for the education and training of personnel in meteorology and operational hydrology — *Volume I:* Meteorology.

CHAPTER 5. SPECIFICATIONS FOR PERSONNEL LICENCES

5.1 Personnel licences issued by a Contracting State in accordance with the relevant provisions of this Annex shall conform to the following specifications:

5.1.1 Detail

5.1.1.1 A Contracting State having issued a licence shall ensure that other States are able to easily determine the licence privileges and validity of ratings.

Note.— Operator records or a flight crew member's personal log book, in which maintenance of competency and recent experience may be satisfactorily recorded, are not normally carried on international flights.

5.1.1.2 The following details shall appear on the licence:

I) Name of State (in bold type);

II) Title of licence (in very bold type);

III) Serial number of the licence, in Arabic numerals, given by the authority issuing the licence;

IV) Name of holder in full (in Roman alphabet also if script of national language is other than Roman);

IVa) Date of birth;

V) Address of holder if desired by the State;

VI) Nationality of holder;

VII) Signature of holder;

VIII) Authority and, where necessary, conditions under which the licence is issued;

IX) Certification concerning validity and authorization for holder to exercise privileges appropriate to licence;

X) Signature of officer issuing the licence and the date of such issue;

XI) Seal or stamp of authority issuing the licence;

XII) Ratings, e.g. category, class, type of aircraft, airframe, aerodrome control, etc.;

XIII) Remarks, i.e. special endorsements relating to limitations and endorsements for privileges, including from 5 March 2008 an endorsement of language proficiency, and other information required in pursuance to Article 39 of the Chicago Convention;

XIV) Any other details desired by the State issuing the licence.

5.1.2 Material

First quality paper or other suitable material, including plastic cards, shall be used and the items mentioned in 5.1.1.2 shown clearly thereon.

5.1.3 Language

When licences are issued in a language other than English, the licence shall include an English translation of at least items I), II), VI), IX), XII), XIII) and XIV). When provided in a language other than English, authorizations issued in accordance with 1.2.2.1 shall include an English translation of the name of the State issuing the authorization, the limit of validity of the authorization and any restriction or limitation that may be established.

5.1.4 Arrangement of items

Item headings on the licence shall be uniformly numbered in roman numerals as indicated in 5.1.1, so that on any licence the number will, under any arrangement, refer to the same item heading.

Note.— Item headings may be arranged in such order as may best suit the convenience of the Contracting State issuing the licence.

CHAPTER 6. MEDICAL PROVISIONS FOR LICENSING

Note 1.— The Standards and Recommended Practices established in this chapter cannot, on their own, be sufficiently detailed to cover all possible individual situations. Of necessity, many decisions relating to the evaluation of medical fitness must be left to the judgement of the individual medical examiner. The evaluation must, therefore, be based on a medical examination conducted throughout in accordance with the highest standards of medical practice.

Note 2.— Predisposing factors for disease, such as obesity and smoking, may be important for determining whether further evaluation or investigation is necessary in an individual case.

Note 3.— In cases where the applicant does not fully meet the medical requirements and in complicated and unusual cases, the evaluation may have to be deferred and the case submitted to the medical assessor of the Licensing Authority for final evaluation. In such cases due regard must be given to the privileges granted by the licence applied for or held by the applicant for the Medical Assessment, and the conditions under which the licence holder is going to exercise those privileges in carrying out assigned duties.

Note 4.— Attention is called to the administrative clause in 1.2.4.9 dealing with accredited medical conclusion.

Note 5.— Guidance material to assist Licensing Authorities and medical examiners is published separately in the Manual of Civil Aviation Medicine *(Doc 8984). This guidance material also contains a discussion of the terms "likely" and "significant" as used in the context of the medical provisions in Chapter 6.*

Note 6.— Basic safety management principles, when applied to the medical assessment process, can help ensure that aeromedical resources are utilized effectively.

6.1 Medical Assessments — General

6.1.1 Classes of Medical Assessment

Three classes of Medical Assessment shall be established as follows:

a) Class 1 Medical Assessment;

applies to applicants for, and holders of:

— commercial pilot licences — aeroplane, airship, helicopter and powered-lift

— multi-crew pilot licences — aeroplane

— airline transport pilot licences — aeroplane, helicopter and powered-lift

b) Class 2 Medical Assessment;

applies to applicants for, and holders of:

— flight navigator licences

— flight engineer licences

— private pilot licences — aeroplane, airship, helicopter and powered-lift

— glider pilot licences

— free balloon pilot licences

c) Class 3 Medical Assessment;

applies to applicants for, and holders of:

— air traffic controller licences.

6.1.2 The applicant for a Medical Assessment shall provide the medical examiner with a personally certified statement of medical facts concerning personal, familial and hereditary history. The applicant shall be made aware of the necessity for giving a statement that is as complete and accurate as the applicant's knowledge permits, and any false statement shall be dealt with in accordance with 1.2.4.6.1.

6.1.3 The medical examiner shall report to the Licensing Authority any individual case where, in the examiner's judgement, an applicant's failure to meet any requirement, whether numerical or otherwise, is such that exercise of the privileges of the licence being applied for, or held, is not likely to jeopardize flight safety (1.2.4.9).

6.1.4 The level of medical fitness to be met for the renewal of a Medical Assessment shall be the same as that for the initial assessment except where otherwise specifically stated.

Note.— The intervals between routine medical examinations for the purpose of renewing Medical Assessments are specified in 1.2.5.2.

6.2 Requirements for Medical Assessments

6.2.1 General

An applicant for a Medical Assessment issued in accordance with the terms of 1.2.4.1 shall undergo a medical examination based on the following requirements:

a) physical and mental;

b) visual and colour perception; and

c) hearing.

6.2.2 Physical and mental requirements

An applicant for any class of Medical Assessment shall be required to be free from:

a) any abnormality, congenital or acquired; or

b) any active, latent, acute or chronic disability; or

c) any wound, injury or sequelae from operation; or

d) any effect or side-effect of any prescribed or non-prescribed therapeutic, diagnostic or preventive medication taken;

such as would entail a degree of functional incapacity which is likely to interfere with the safe operation of an aircraft or with the safe performance of duties.

Note.— Use of herbal medication and alternative treatment modalities requires particular attention to possible side-effects.

6.2.3 Visual acuity test requirements

6.2.3.1 The methods in use for the measurement of visual acuity are likely to lead to differing evaluations. To achieve uniformity, therefore, Contracting States shall ensure that equivalence in the methods of evaluation be obtained.

6.2.3.2 **Recommendation.—** *The following should be adopted for tests of visual acuity:*

a) Visual acuity tests should be conducted in an environment with a level of illumination that corresponds to ordinary office illumination (30-60 cd/m^2).

b) Visual acuity should be measured by means of a series of Landolt rings or similar optotypes, placed at a distance from the applicant appropriate to the method of testing adopted.

6.2.4 Colour perception requirements

6.2.4.1 Contracting States shall use such methods of examination as will guarantee reliable testing of colour perception.

6.2.4.2 The applicant shall be required to demonstrate the ability to perceive readily those colours the perception of which is necessary for the safe performance of duties.

6.2.4.3 The applicant shall be tested for the ability to correctly identify a series of pseudoisochromatic plates in daylight or in artificial light of the same colour temperature such as that provided by CIE standard illuminants C or D_{65} as specified by the International Commission on Illumination (CIE).

6.2.4.4 An applicant obtaining a satisfactory result as prescribed by the Licensing Authority shall be assessed as fit. An applicant failing to obtain a satisfactory result in such a test shall be assessed as unfit unless able to readily distinguish the colours used in air navigation and correctly identify aviation coloured lights. Applicants who fail to meet these criteria shall be assessed as unfit except for Class 2 assessment with the following restriction: valid daytime only.

Note.— Guidance on suitable methods of assessing colour vision is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.2.4.4.1 **Recommendation.—** *Sunglasses worn during the exercise of the privileges of the licence or rating held should be non-polarizing and of a neutral grey tint.*

6.2.5 Hearing test requirements

6.2.5.1 Contracting States shall use such methods of examination as will guarantee reliable testing of hearing.

6.2.5.2 Applicants shall be required to demonstrate a hearing performance sufficient for the safe exercise of their licence and rating privileges.

6.2.5.3 Applicants for Class 1 Medical Assessments shall be tested by pure-tone audiometry at first issue of the Assessment, not less than once every five years up to the age of 40 years, and thereafter not less than once every two years.

6.2.5.3.1 Alternatively, other methods providing equivalent results may be used.

6.2.5.4 Applicants for Class 3 Medical Assessments shall be tested by pure-tone audiometry at first issue of the Assessment, not less than once every four years up to the age of 40 years, and thereafter not less than once every two years.

6.2.5.4.1 Alternatively, other methods providing equivalent results may be used.

6.2.5.5 **Recommendation.—** *Applicants for Class 2 Medical Assessment should be tested by pure-tone audiometry at first issue of the Assessment and, after the age of 50 years, not less than once every two years*.

6.2.5.6 At medical examinations, other than those mentioned in 6.2.5.3, 6.2.5.4 and 6.2.5.5, where audiometry is not performed, applicants shall be tested in a quiet room by whispered and spoken voice tests.

Note 1.— The reference zero for calibration of pure-tone audiometers is that of the pertinent Standards of the current edition of the Audiometric Test Methods, published by the International Organization for Standardization (ISO).

Note 2.— For the purpose of testing hearing in accordance with the requirements, a quiet room is a room in which the intensity of the background noise is less than 35 dB(A).

Note 3.— For the purpose of testing hearing in accordance with the requirements, the sound level of an average conversational voice at 1 m from the point of output (lower lip of the speaker) is c. 60 dB(A) and that of a whispered voice c. 45dB(A). At 2 m from the speaker, the sound level is 6 dB(A) lower.

Note 4.— Guidance on assessment of applicants who use hearing aids is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 5.— Attention is called to 2.7.1.3.1 on requirements for the issue of instrument rating to applicants who hold a private pilot licence.

6.3 Class 1 Medical Assessment

6.3.1 Assessment issue and renewal

6.3.1.1 An applicant for a commercial pilot licence —aeroplane, airship, helicopter or powered-lift, a multi-crew pilot licence — aeroplane, or an airline transport pilot licence — aeroplane, helicopter or powered-lift shall undergo an initial medical examination for the issue of a Class 1 Medical Assessment.

6.3.1.2 Except where otherwise stated in this section, holders of commercial pilot licences — aeroplane, airship, helicopter or powered-lift, multi-crew pilot licences — aeroplane, or airline transport pilot licences — aeroplane, helicopter or powered-lift shall have their Class 1 Medical Assessments renewed at intervals not exceeding those specified in 1.2.5.2.

6.3.1.2.1 **Recommendation.—** *In alternate years, for Class 1 applicants under 40 years of age, the Licensing Authority should, at its discretion, allow medical examiners to omit certain routine examination items related to the assessment of physical fitness, whilst increasing the emphasis on health education and prevention of ill health.*

Note.— Guidance for Licensing Authorities wishing to reduce the emphasis on detection of physical disease, whilst increasing the emphasis on health education and prevention of ill health in applicants under 40 years of age, is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.1.3 When the Licensing Authority is satisfied that the requirements of this section and the general provisions of 6.1 and 6.2 have been met, a Class 1 Medical Assessment shall be issued to the applicant.

6.3.2 Physical and mental requirements

6.3.2.1 The applicant shall not suffer from any disease or disability which could render that applicant likely to become suddenly unable either to operate an aircraft safely or to perform assigned duties safely.

6.3.2.2 The applicant shall have no established medical history or clinical diagnosis of:

a) an organic mental disorder;

b) a mental or behavioural disorder due to use of psychoactive substances; this includes dependence syndrome induced by alcohol or other psychoactive substances;

c) schizophrenia or a schizotypal or delusional disorder;

d) a mood (affective) disorder;

e) a neurotic, stress-related or somatoform disorder;

f) a behavioural syndrome associated with physiological disturbances or physical factors;

g) a disorder of adult personality or behaviour, particularly if manifested by repeated overt acts;

h) mental retardation;

i) a disorder of psychological development;

j) a behavioural or emotional disorder, with onset in childhood or adolescence; or

k) a mental disorder not otherwise specified;

such as might render the applicant unable to safely exercise the privileges of the licence applied for or held.

6.3.2.2.1 **Recommendation.—** *An applicant with depression, being treated with antidepressant medication, should be assessed as unfit unless the medical assessor, having access to the details of the case concerned, considers the applicant's condition as unlikely to interfere with the safe exercise of the applicant's licence and rating privileges.*

Note 1.— Guidance on assessment of applicants treated with antidepressant medication is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— Mental and behavioural disorders are defined in accordance with the clinical descriptions and diagnostic guidelines of the World Health Organization as given in the International Statistical Classification of Diseases and Related Health Problems, 10th Edition — Classification of Mental and Behavioural Disorders, *WHO 1992. This document contains detailed descriptions of the diagnostic requirements, which may be useful for their application to medical assessment.*

6.3.2.3 The applicant shall have no established medical history or clinical diagnosis of any of the following:

a) a progressive or non-progressive disease of the nervous system, the effects of which are likely to interfere with the safe exercise of the applicant's licence and rating privileges;

b) epilepsy; or

c) any disturbance of consciousness without satisfactory medical explanation of cause.

6.3.2.4 The applicant shall not have suffered any head injury, the effects of which are likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.3.2.5 The applicant shall not possess any abnormality of the heart, congenital or acquired, which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.3.2.5.1 An applicant who has undergone coronary bypass grafting or angioplasty (with or without stenting) or other cardiac intervention or who has a history of myocardial infarction or who suffers from any other potentially incapacitating cardiac condition shall be assessed as unfit unless the applicant's cardiac condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.3.2.5.2 An applicant with an abnormal cardiac rhythm shall be assessed as unfit unless the cardiac arrhythmia has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

Note.— Guidance on cardiovascular evaluation is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.2.6 Electrocardiography shall form part of the heart examination for the first issue of a Medical Assessment.

6.3.2.6.1 Electrocardiography shall be included in re-examinations of applicants over the age of 50 no less frequently than annually.

6.3.2.6.2 **Recommendation.—** *Electrocardiography should be included in re-examinations of applicants between the ages of 30 and 50 no less frequently than every two years.*

Note 1.— The purpose of routine electrocardiography is case finding. It does not provide sufficient evidence to justify disqualification without further thorough cardiovascular investigation.

Note 2.— Guidance on resting and exercise electro-cardiography is contained in the Manual of Civil Aviation Medicine *(Doc 8984)*.

6.3.2.7 The systolic and diastolic blood pressures shall be within normal limits.

6.3.2.7.1 The use of drugs for control of high blood pressure shall be disqualifying except for those drugs, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on the subject is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.2.8 There shall be no significant functional nor structural abnormality of the circulatory system.

6.3.2.9 There shall be no acute disability of the lungs nor any active disease of the structures of the lungs, mediastinum or pleurae likely to result in incapacitating symptoms during normal or emergency operations.

6.3.2.9.1 **Recommendation.—** *Chest radiography should form part of the initial examination.*

Note.— Periodic chest radiography is usually not necessary but may be a necessity in situations where asymptomatic pulmonary disease can be expected.

6.3.2.10 Applicants with chronic obstructive pulmonary disease shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.3.2.11 Applicants with asthma causing significant symptoms or likely to cause incapacitating symptoms during normal or emergency operations shall be assessed as unfit.

6.3.2.11.1 The use of drugs for control of asthma shall be disqualifying except for those drugs, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on hazards of medication and drugs is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.2.12 Applicants with active pulmonary tuberculosis shall be assessed as unfit.

6.3.2.12.1 Applicants with quiescent or healed lesions which are known to be tuberculous, or are presumably tuberculous in origin, may be assessed as fit.

Note 1.— Guidance on assessment of respiratory diseases is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— Guidance on hazards of medications and drugs is contained in the Manual of Civil Aviation Medicine *(Doc 8984)*.

6.3.2.13 Applicants with significant impairment of function of the gastrointestinal tract or its adnexa shall be assessed as unfit.

6.3.2.13.1 Applicants shall be completely free from those hernias that might give rise to incapacitating symptoms.

6.3.2.14 Applicants with sequelae of disease of, or surgical intervention on, any part of the digestive tract or its adnexa, likely to cause incapacitation in flight, in particular any obstruction due to stricture or compression, shall be assessed as unfit.

6.3.2.14.1 **Recommendation.—** *An applicant who has undergone a major surgical operation on the biliary passages or the digestive tract or its adnexa with a total or partial excision or a diversion of any of these organs should be assessed as unfit until such time as the medical assessor, having access to the details of the operation concerned, considers that the effects of the operation are not likely to cause incapacitation in flight.*

6.3.2.15 Applicants with metabolic, nutritional or endocrine disorders that are likely to interfere with the safe exercise of their licence and rating privileges shall be assessed as unfit.

6.3.2.16 Applicants with insulin-treated diabetes mellitus shall be assessed as unfit.

Note.— Guidance on assessment of Type 2 insulin-treated diabetic applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.2.16.1 Applicants with non-insulin-treated diabetes mellitus shall be assessed as unfit unless the condition is shown to be satisfactorily controlled by diet alone or by diet combined with oral anti-diabetic medication, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on assessment of diabetic applicants is contained in the Manual of Civil Aviation Medicine *(Doc 8984)*.

6.3.2.17 Applicants with diseases of the blood and/or the lymphatic system shall be assessed as unfit unless adequately investigated and their condition found unlikely to interfere with the safe exercise of their licence and rating privileges.

Note.— Sickle cell trait or other haemoglobinopathic traits are usually compatible with a fit assessment.

6.3.2.18 Applicants with renal or genitourinary disease shall be assessed as unfit, unless adequately investigated and their condition found unlikely to interfere with the safe exercise of their licence and rating privileges.

6.3.2.18.1 Urine examination shall form part of the medical examination and abnormalities shall be adequately investigated.

Note.— Guidance on urine examination and evaluation of abnormalities is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.2.19 Applicants with sequelae of disease of or surgical procedures on the kidneys or the genito-urinary tract, in particular obstructions due to stricture or compression, shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.3.2.19.1 Applicants who have undergone nephrectomy shall be assessed as unfit unless the condition is well compensated.

6.3.2.20 Applicants who are seropositive for human immunodeficiency virus (HIV) shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed as not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

Note 1.— Early diagnosis and active management of HIV disease with antiretroviral therapy reduces morbidity and improves prognosis and thus increases the likelihood of a fit assessment.

Note 2.— Guidance on the assessment of applicants who are seropositive for human immunodeficiency virus (HIV) is contained in the Manual of Civil Aviation Medicine *(Doc 8984)*.

6.3.2.21 Applicants who are pregnant shall be assessed as unfit unless obstetrical evaluation and continued medical supervision indicate a low-risk uncomplicated pregnancy.

6.3.2.21.1 **Recommendation.—** *For applicants with a low-risk uncomplicated pregnancy, evaluated and supervised in accordance with 6.3.2.21, the fit assessment should be limited to the period from the end of the 12th week until the end of the 26th week of gestation.*

6.3.2.22 Following confinement or termination of pregnancy, the applicant shall not be permitted to exercise the privileges of her licence until she has undergone re-evaluation in accordance with best medical practice and it has been determined that she is able to safely exercise the privileges of her licence and ratings.

6.3.2.23 The applicant shall not possess any abnormality of the bones, joints, muscles, tendons or related structures which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

Note.— Any sequelae after lesions affecting the bones, joints, muscles or tendons, and certain anatomical defects will normally require functional assessment to determine fitness.

6.3.2.24 The applicant shall not possess any abnormality or disease of the ear or related structures which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.3.2.25 There shall be:

a) no disturbance of vestibular function;

b) no significant dysfunction of the Eustachian tubes; and

c) no unhealed perforation of the tympanic membranes.

6.3.2.25.1 A single dry perforation of the tympanic membrane need not render the applicant unfit.

Note.— Guidance on testing of the vestibular function is contained in Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.2.26 There shall be:

a) no nasal obstruction; and

b) no malformation nor any disease of the buccal cavity or upper respiratory tract

which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.3.2.27 Applicants with stuttering or other speech defects sufficiently severe to cause impairment of speech communication shall be assessed as unfit.

6.3.3 Visual requirements

The medical examination shall be based on the following requirements.

6.3.3.1 The function of the eyes and their adnexa shall be normal. There shall be no active pathological condition, acute or chronic, nor any sequelae of surgery or trauma of the eyes or their adnexa likely to reduce proper visual function to an extent that would interfere with the safe exercise of the applicant's licence and rating privileges.

6.3.3.2 Distant visual acuity with or without correction shall be 6/9 or better in each eye separately, and binocular visual acuity shall be 6/6 or better. No limits apply to uncorrected visual acuity. Where this standard of visual acuity can be obtained only with correcting lenses, the applicant may be assessed as fit provided that:

a) such correcting lenses are worn during the exercise of the privileges of the licence or rating applied for or held; and

b) in addition, a pair of suitable correcting spectacles is kept readily available during the exercise of the privileges of the applicant's licence.

Note 1.— 6.3.3.2 b) is the subject of Standards in Annex 6, Part I.

Note 2.— An applicant accepted as meeting these provisions is deemed to continue to do so unless there is reason to suspect otherwise, in which case an ophthalmic report is required at the discretion of the Licensing Authority. Both uncorrected and corrected visual acuity are normally measured and recorded at each re-examination. Conditions which indicate a need to obtain an ophthalmic report include: a substantial decrease in the uncorrected visual acuity, any decrease in best corrected visual acuity, and the occurrence of eye disease, eye injury or eye surgery.

6.3.3.2.1 Applicants may use contact lenses to meet this requirement provided that:

a) the lenses are monofocal and non-tinted;

b) the lenses are well tolerated; and

c) a pair of suitable correcting spectacles is kept readily available during the exercise of the licence privileges.

Note.— Applicants who use contact lenses may not need to have their uncorrected visual acuity measured at each re-examination provided the history of their contact lens prescription is known.

6.3.3.2.2 Applicants with a large refractive error shall use contact lenses or high-index spectacle lenses.

Note.— If spectacles are used, high-index lenses are needed to minimize peripheral field distortion.

6.3.3.2.3 Applicants whose uncorrected distant visual acuity in either eye is worse than 6/60 shall be required to provide a full ophthalmic report prior to initial Medical Assessment and every five years thereafter.

Note 1.— The purpose of the required ophthalmic examination is (1) to ascertain normal visual performance, and (2) to identify any significant pathology.

Note 2.— Guidance on the assessment of monocular applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.3.3.3 Applicants who have undergone surgery affecting the refractive status of the eye shall be assessed as unfit unless they are free from those sequelae which are likely to interfere with the safe exercise of their licence and rating privileges.

6.3.3.4 The applicant shall have the ability to read, while wearing the correcting lenses, if any, required by 6.3.3.2, the N5 chart or its equivalent at a distance selected by that applicant in the range of 30 to 50 cm and the ability to read the N14 chart or its equivalent at a distance of 100 cm. If this requirement is met only by the use of near correction, the applicant may be assessed as fit provided that this near correction is added to the spectacle correction already prescribed in accordance with 6.3.3.2; if no such correction is prescribed, a pair of spectacles for near use shall be kept readily available during the exercise of the privileges of the licence. When near correction is required, the applicant shall demonstrate that one pair of spectacles is sufficient to meet both distant and near visual requirements.

Note 1.— N5 and N14 refer to the size of typeface used. For further details, see the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— An applicant who needs near correction to meet this requirement will require "look-over", bifocal or perhaps multifocal lenses in order to read the instruments and a chart or manual held in the hand, and also to make use of distant vision, through the windscreen, without removing the lenses. Single-vision near correction (full lenses of one power only, appropriate for reading) significantly reduces distant visual acuity and is therefore not acceptable.

Note 3.— Whenever there is a requirement to obtain or renew correcting lenses, an applicant is expected to advise the refractionist of reading distances for the visual flight deck tasks relevant to the types of aircraft in which the applicant is likely to function.

6.3.3.4.1 When near correction is required in accordance with this paragraph, a second pair of near-correction spectacles shall be kept available for immediate use.

6.3.3.5 The applicant shall be required to have normal fields of vision.

6.3.3.6 The applicant shall be required to have normal binocular function.

6.3.3.6.1 Reduced stereopsis, abnormal convergence not interfering with near vision, and ocular misalignment where the fusional reserves are sufficient to prevent asthenopia and diplopia need not be disqualifying.

6.3.4 Hearing requirements

6.3.4.1 The applicant, when tested on a pure-tone audiometer, shall not have a hearing loss, in either ear separately, of more than 35 dB at any of the frequencies 500, 1 000 or 2 000 Hz, or more than 50 dB at 3 000 Hz.

6.3.4.1.1 An applicant with a hearing loss greater than the above may be declared fit provided that the applicant has normal hearing performance against a background noise that reproduces or simulates the masking properties of flight deck noise upon speech and beacon signals.

Note 1.— It is important that the background noise be representative of the noise in the cockpit of the type of aircraft for which the applicant's licence and ratings are valid.

Note 2.— In the speech material for discrimination testing, both aviation-relevant phrases and phonetically balanced words are normally used.

6.3.4.1.2 Alternatively, a practical hearing test conducted in flight in the cockpit of an aircraft of the type for which the applicant's licence and ratings are valid may be used.

6.4 Class 2 Medical Assessment

6.4.1 Assessment issue and renewal

6.4.1.1 An applicant for a private pilot licence — aeroplane, airship, helicopter or powered-lift, a glider pilot licence, a free balloon pilot licence, a flight engineer licence or a flight navigator licence shall undergo an initial medical examination for the issue of a Class 2 Medical Assessment.

6.4.1.2 Except where otherwise stated in this section, holders of private pilot licences — aeroplane, airship, helicopter or powered-lift, glider pilot licences, free balloon pilot licences, flight engineer licences or flight navigator licences shall have their Class 2 Medical Assessments renewed at intervals not exceeding those specified in 1.2.5.2.

6.4.1.3 When the Licensing Authority is satisfied that the requirements of this section and the general provisions of 6.1 and 6.2 have been met, a Class 2 Medical Assessment shall be issued to the applicant.

6.4.2 Physical and mental requirements

The medical examination shall be based on the following requirements.

6.4.2.1 The applicant shall not suffer from any disease or disability which could render that applicant likely to become suddenly unable either to operate an aircraft safely or to perform assigned duties safely.

6.4.2.2 The applicant shall have no established medical history or clinical diagnosis of:

a) an organic mental disorder;

b) a mental or behavioural disorder due to psychoactive substance use; this includes dependence syndrome induced by alcohol or other psychoactive substances;

c) schizophrenia or a schizotypal or delusional disorder;

d) a mood (affective) disorder;

e) a neurotic, stress-related or somatoform disorder;

f) a behavioural syndrome associated with physiological disturbances or physical factors;

g) a disorder of adult personality or behaviour, particularly if manifested by repeated overt acts;

h) mental retardation;

i) a disorder of psychological development;

j) a behavioural or emotional disorder, with onset in childhood or adolescence; or

k) a mental disorder not otherwise specified;

such as might render the applicant unable to safely exercise the privileges of the licence applied for or held.

6.4.2.2.1 **Recommendation.—** *An applicant with depression, being treated with antidepressant medication, should be assessed as unfit unless the medical assessor, having access to the details of the case concerned, considers the applicant's condition as unlikely to interfere with the safe exercise of the applicant's licence and rating privileges.*

Note 1.— Guidance on assessment of applicants treated with antidepressant medication is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— Mental and behavioural disorders are defined in accordance with the clinical descriptions and diagnostic guidelines of the World Health Organization as given in the International Statistical Classification of Diseases and Related Health Problems, 10th Edition — Classification of Mental and Behavioural Disorders, *WHO 1992. This document contains detailed descriptions of the diagnostic requirements, which may be useful for their application to medical assessment.*

6.4.2.3 The applicant shall have no established medical history or clinical diagnosis of any of the following:

a) a progressive or non-progressive disease of the nervous system, the effects of which are likely to interfere with the safe exercise of the applicant's licence and rating privileges;

b) epilepsy;

c) any disturbance of consciousness without satisfactory medical explanation of cause.

6.4.2.4 The applicant shall not have suffered any head injury, the effects of which are likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.4.2.5 The applicant shall not possess any abnormality of the heart, congenital or acquired, which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.4.2.5.1 An applicant who has undergone coronary bypass grafting or angioplasty (with or without stenting) or other cardiac intervention or who has a history of myocardial infarction or who suffers from any other potentially incapacitating cardiac condition shall be assessed as unfit unless the applicant's cardiac condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.4.2.5.2 An applicant with an abnormal cardiac rhythm shall be assessed as unfit unless the cardiac arrhythmia has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

Note.— Guidance on cardiovascular evaluation is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.6 Electrocardiography shall form part of the heart examination for the first issue of a Medical Assessment after the age of 40.

6.4.2.6.1 Electrocardiography shall be included in re-examinations of applicants after the age of 50 no less than every two years.

6.4.2.6.2 **Recommendation.—** *Electrocardiography should form part of the heart examination for the first issue of a Medical Assessment.*

Note 1.— The purpose of routine electrocardiography is case finding. It does not provide sufficient evidence to justify disqualification without further thorough cardiovascular investigation.

Note 2.— Guidance on resting and exercise electrocardiography is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.7 The systolic and diastolic blood pressures shall be within normal limits.

6.4.2.7.1 The use of drugs for control of high blood pressure shall be disqualifying except for those drugs, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on the subject is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.8 There shall be no significant functional nor structural abnormality of the circulatory system.

6.4.2.9 There shall be no disability of the lungs nor any active disease of the structures of the lungs, mediastinum or pleura likely to result in incapacitating symptoms during normal or emergency operations.

6.4.2.9.1 **Recommendation.—** *Chest radiography should form part of the initial and periodic examinations in cases where asymptomatic pulmonary disease can be expected.*

6.4.2.10 Applicants with chronic obstructive pulmonary disease shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.4.2.11 Applicants with asthma causing significant symptoms or likely to cause incapacitating symptoms during normal or emergency operations shall be assessed as unfit.

6.4.2.11.1 The use of drugs for control of asthma shall be disqualifying except for those drugs, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on hazards of medication and drugs is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.12 Applicants with active pulmonary tuberculosis shall be assessed as unfit.

6.4.2.12.1 Applicants with quiescent or healed lesions, known to be tuberculous or presumably tuberculous in origin, may be assessed as fit.

Note 1.— Guidance on assessment of respiratory diseases is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— Guidance on hazards of medication and drugs is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.13 Applicants shall be completely free from those hernias that might give rise to incapacitating symptoms.

6.4.2.13.1 Applicants with significant impairment of the function of the gastrointestinal tract or its adnexa shall be assessed as unfit.

6.4.2.14 Applicants with sequelae of disease of or surgical intervention on any part of the digestive tract or its adnexa, likely to cause incapacitation in flight, in particular any obstruction due to stricture or compression, shall be assessed as unfit.

6.4.2.14.1 **Recommendation.—** *An applicant who has undergone a major surgical operation on the biliary passages or the digestive tract or its adnexa with a total or partial excision or a diversion of any of these organs should be assessed as unfit until such time as the medical assessor, having access to the details of the operation concerned, considers that the effects of the operation are not likely to cause incapacitation in flight.*

6.4.2.15 Applicants with metabolic, nutritional or endocrine disorders that are likely to interfere with the safe exercise of their licence and rating privileges shall be assessed as unfit.

6.4.2.16 Applicants with insulin-treated diabetes mellitus shall be assessed as unfit.

Note.— Guidance on assessment of Type 2 insulin-treated diabetic applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.16.1 Applicants with non-insulin-treated diabetes mellitus shall be assessed as unfit unless the condition is shown to be satisfactorily controlled by diet alone or by diet combined with oral anti-diabetic medication, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on assessment of diabetic applicants is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.17 Applicants with diseases of the blood and/or the lymphatic system shall be assessed as unfit unless adequately investigated and their condition found unlikely to interfere with the safe exercise of their licence and rating privileges.

Note.— Sickle cell trait and other haemoglobinopathic traits are usually compatible with fit assessment.

6.4.2.18 Applicants with renal or genitourinary disease shall be assessed as unfit unless adequately investigated and their condition found unlikely to interfere with the safe exercise of their licence and rating privileges.

6.4.2.18.1 Urine examination shall form part of the medical examination and abnormalities shall be adequately investigated.

Note.— Guidance on urine examination and evaluation of abnormalities is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.19 Applicants with sequelae of disease of, or surgical procedures on, the kidneys or the genitourinary tract, in particular obstructions due to stricture or compression, shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.4.2.19.1 Applicants who have undergone nephrectomy shall be assessed as unfit unless the condition is well compensated.

6.4.2.20 Applicants who are seropositive for human immunodeficiency virus (HIV) shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed as not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

Note 1.— Early diagnosis and active management of HIV disease with antiretroviral therapy reduces morbidity and improves prognosis and thus increases the likelihood of a fit assessment.

Note 2.— Guidance on the assessment of applicants who are seropositive for human immunodeficiency virus (HIV) is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.21 Applicants who are pregnant shall be assessed as unfit unless obstetrical evaluation and continued medical supervision indicate a low-risk uncomplicated pregnancy.

6.4.2.21.1 **Recommendation.—** *For applicants with a low-risk uncomplicated pregnancy, evaluated and supervised in accordance with 6.4.2.21, the fit assessment should be limited to the period from the end of the 12th week until the end of the 26th week of gestation.*

6.4.2.22 Following confinement or termination of pregnancy, the applicant shall not be permitted to exercise the privileges of her licence until she has undergone re-evaluation in accordance with best medical practice and it has been determined that she is able to safely exercise the privileges of her licence and ratings.

6.4.2.23 The applicant shall not possess any abnormality of the bones, joints, muscles, tendons or related structures which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

Note.— Any sequelae after lesions affecting the bones, joints, muscles or tendons, and certain anatomical defects will normally require functional assessment to determine fitness.

6.4.2.24 The applicant shall not possess any abnormality or disease of the ear or related structures which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.4.2.25 There shall be:

a) no disturbance of the vestibular function;

b) no significant dysfunction of the Eustachian tubes; and

c) no unhealed perforation of the tympanic membranes.

6.4.2.25.1 A single dry perforation of the tympanic membrane need not render the applicant unfit.

Note.—Guidance on testing of the vestibular function is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.2.26 There shall be:

a) no nasal obstruction; and

b) no malformation nor any disease of the buccal cavity or upper respiratory tract

which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.4.2.27 Applicants with stuttering and other speech defects sufficiently severe to cause impairment of speech communication shall be assessed as unfit.

6.4.3 Visual requirements

The medical examination shall be based on the following requirements.

6.4.3.1 The function of the eyes and their adnexa shall be normal. There shall be no active pathological condition, acute or chronic, nor any sequelae of surgery or trauma of the eyes or their adnexa likely to reduce proper visual function to an extent that would interfere with the safe exercise of the applicant's licence and rating privileges.

6.4.3.2 Distant visual acuity with or without correction shall be 6/12 or better in each eye separately, and binocular visual acuity shall be 6/9 or better. No limits apply to uncorrected visual acuity. Where this standard of visual acuity can be obtained only with correcting lenses, the applicant may be assessed as fit provided that:

a) such correcting lenses are worn during the exercise of the privileges of the licence or rating applied for or held; and

b) in addition, a pair of suitable correcting spectacles is kept readily available during the exercise of the privileges of the applicant's licence.

Note.— An applicant accepted as meeting these provisions is deemed to continue to do so unless there is reason to suspect otherwise, in which case an ophthalmic report is required at the discretion of the Licensing Authority. Both uncorrected and corrected visual acuity are normally measured and recorded at each re-examination. Conditions which indicate a need to obtain an ophthalmic report include: a substantial decrease in the uncorrected visual acuity, any decrease in best corrected visual acuity, and the occurrence of eye disease, eye injury or eye surgery.

6.4.3.2.1 Applicants may use contact lenses to meet this requirement provided that:

a) the lenses are monofocal and non-tinted;

b) the lenses are well tolerated; and

c) a pair of suitable correcting spectacles is kept readily available during the exercise of the licence privileges.

Note.— Applicants who use contact lenses may not need to have their uncorrected visual acuity measured at each reexamination provided the history of their contact lens prescription is known.

6.4.3.2.2 Applicants with a large refractive error shall use contact lenses or high-index spectacle lenses.

Note.— If spectacles are used, high-index lenses are needed to minimize peripheral field distortion.

6.4.3.2.3 **Recommendation.—** *Applicants whose uncorrected distant visual acuity in either eye is worse than 6/60 should be required to provide a full ophthalmic report prior to initial Medical Assessment and every five years thereafter.*

Note 1.— The purpose of the required ophthalmic examination is (1) to ascertain normal visual performance, and (2) to identify any significant pathology.

Note 2.— Guidance on the assessment of monocular applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.4.3.3 Applicants who have undergone surgery affecting the refractive status of the eye shall be assessed as unfit unless they are free from those sequelae which are likely to interfere with the safe exercise of their licence and rating privileges.

6.4.3.4 The applicant shall have the ability to read, while wearing the correcting lenses, if any, required by 6.4.3.2, the N5 chart or its equivalent at a distance selected by that applicant in the range of 30 to 50 cm. If this requirement is met only by the use of near correction, the applicant may be assessed as fit provided that this near correction is added to the spectacle correction already prescribed in accordance with 6.4.3.2; if no such correction is prescribed, a pair of spectacles for near use shall be kept readily available during the exercise of the privileges of the licence. When near correction is required, the applicant shall demonstrate that one pair of spectacles is sufficient to meet both distant and near visual requirements.

Note 1.— N5 refers to the size of typeface used. For further details, see the Manual of Civil Aviation Medicine *(Doc 8984)*.

Note 2.— An applicant who needs near correction to meet the requirement will require "look-over", bifocal or perhaps multifocal lenses in order to read the instruments and a chart or manual held in the hand, and also to make use of distant vision, through the windscreen, without removing the lenses. Single-vision near correction (full lenses of one power only, appropriate for reading) significantly reduces distant visual acuity and is therefore not acceptable.

Note 3.— Whenever there is a requirement to obtain or renew correcting lenses, an applicant is expected to advise the refractionist of the reading distances for the visual flight deck tasks relevant to the types of aircraft in which the applicant is likely to function.

6.4.3.4.1 When near correction is required in accordance with this paragraph, a second pair of near-correction spectacles shall be kept available for immediate use.

6.4.3.5 The applicant shall be required to have normal fields of vision.

6.4.3.6 The applicant shall be required to have normal binocular function.

6.4.3.6.1 Reduced stereopsis, abnormal convergence not interfering with near vision, and ocular misalignment where the fusional reserves are sufficient to prevent asthenopia and diplopia need not be disqualifying.

6.4.4 Hearing requirements

Note.— Attention is called to 2.7.1.3.1 on requirements for the issue of instrument rating to applicants who hold a private pilot licence.

6.4.4.1 Applicants who are unable to hear an average conversational voice in a quiet room, using both ears, at a distance of 2 m from the examiner and with the back turned to the examiner, shall be assessed as unfit.

6.4.4.2 When tested by pure-tone audiometry, an applicant with a hearing loss, in either ear separately, of more than 35 dB at any of the frequencies 500, 1 000 or 2 000 Hz, or more than 50 dB at 3 000 Hz, shall be assessed as unfit.

6.4.4.3 **Recommendation.—** *An applicant who does not meet the requirements in 6.4.4.1 or 6.4.4.2 should undergo further testing in accordance with 6.3.4.1.1.*

6.5 Class 3 Medical Assessment

6.5.1 Assessment issue and renewal

6.5.1.1 An applicant for an air traffic controller licence shall undergo an initial medical examination for the issue of a Class 3 Medical Assessment.

6.5.1.2 Except where otherwise stated in this section, holders of air traffic controller licences shall have their Class 3 Medical Assessments renewed at intervals not exceeding those specified in 1.2.5.2.

6.5.1.3 When the Licensing Authority is satisfied that the requirements of this section and the general provisions of 6.1 and 6.2 have been met, a Class 3 Medical Assessment shall be issued to the applicant.

6.5.2 Physical and mental requirements

6.5.2.1 The applicant shall not suffer from any disease or disability which could render that applicant likely to become suddenly unable to perform duties safely.

6.5.2.2 The applicant shall have no established medical history or clinical diagnosis of:

a) an organic mental disorder;

b) a mental or behavioural disorder due to psychoactive substance use; this includes dependence syndrome induced by alcohol or other psychoactive substances;

c) schizophrenia or a schizotypal or delusional disorder;

d) a mood (affective) disorder;

e) a neurotic, stress-related or somatoform disorder;

f) a behavioural syndrome associated with physiological disturbances or physical factors;

g) a disorder of adult personality or behaviour, particularly if manifested by repeated overt acts;

h) mental retardation;

i) a disorder of psychological development;

j) a behavioural or emotional disorder, with onset in childhood or adolescence; or

k) a mental disorder not otherwise specified;

such as might render the applicant unable to safely exercise the privileges of the licence applied for or held

6.5.2.2.1 **Recommendation.—** *An applicant with depression, being treated with antidepressant medication, should be assessed as unfit unless the medical assessor, having access to the details of the case concerned, considers the applicant's condition as unlikely to interfere with the safe exercise of the applicant's licence and rating privileges.*

Note 1.— Guidance on assessment of applicants treated with antidepressant medication is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— Mental and behavioural disorders are defined in accordance with the clinical descriptions and diagnostic guidelines of the World Health Organization as given in the International Statistical Classification of Diseases and Related Health Problems, 10th Edition — Classification of Mental and Behavioural Disorders, *WHO 1992. This document contains detailed descriptions of the diagnostic requirements which may be useful for their application to medical assessment.*

6.5.2.3 The applicant shall have no established medical history or clinical diagnosis of any of the following:

a) a progressive or non-progressive disease of the nervous system, the effects of which are likely to interfere with the safe exercise of the applicant's licence and rating privileges;

b) epilepsy; or

c) any disturbance of consciousness without satisfactory medical explanation of cause.

6.5.2.4 The applicant shall not have suffered any head injury, the effects of which are likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.5.2.5 The applicant shall not possess any abnormality of the heart, congenital or acquired, which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.5.2.5.1 An applicant who has undergone coronary bypass grafting or angioplasty (with or without stenting) or other cardiac intervention or who has a history of myocardial infarction or who suffers from any other potentially incapacitating cardiac condition shall be assessed as unfit unless the applicant's cardiac condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.5.2.5.2 An applicant with an abnormal cardiac rhythm shall be assessed as unfit unless the cardiac arrhythmia has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on cardiovascular evaluation is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.6 Electrocardiography shall form part of the heart examination for the first issue of a Medical Assessment.

6.5.2.6.1 Electrocardiography shall be included in re-examinations of applicants after the age of 50 no less frequently than every two years.

Note 1.— The purpose of routine electrocardiography is case finding. It does not provide sufficient evidence to justify disqualification without further thorough cardiovascular investigation.

Note 2.— Guidance on resting and exercise electrocardiography is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.7 The systolic and diastolic blood pressures shall be within normal limits.

6.5.2.7.1 The use of drugs for control of high blood pressure is disqualifying except for those drugs, the use of which is compatible with the safe exercise of the applicant's licence privileges.

Note.— Guidance on this subject is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.8 There shall be no significant functional nor structural abnormality of the circulatory system.

6.5.2.9 There shall be no disability of the lungs nor any active disease of the structures of the lungs, mediastinum or pleurae likely to result in incapacitating symptoms.

Note.— Chest radiography is usually not necessary but may be indicated in cases where asymptomatic pulmonary disease can be expected.

6.5.2.10 Applicants with chronic obstructive pulmonary disease shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.5.2.11 Applicants with asthma causing significant symptoms or likely to cause incapacitating symptoms shall be assessed as unfit.

6.5.2.11.1 The use of drugs for control of asthma shall be disqualifying except for those drugs, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on hazards of medications is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.12 Applicants with active pulmonary tuberculosis shall be assessed as unfit.

6.5.2.12.1 Applicants with quiescent or healed lesions, known to be tuberculous or presumably tuberculous in origin, may be assessed as fit.

Note 1.— Guidance on assessment of respiratory diseases is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— Guidance on hazards of medication and drugs is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.13 Applicants with significant impairment of the function of the gastrointestinal tract or its adnexae shall be assessed as unfit.

6.5.2.14 Applicants with sequelae of disease of or surgical intervention on any part of the digestive tract or its adnexa, likely to cause incapacitation, in particular any obstructions due to stricture or compression, shall be assessed as unfit.

6.5.2.14.1 **Recommendation.—** *An applicant who has undergone a major surgical operation on the biliary passages or the digestive tract or its adnexa, with a total or partial excision or a diversion of any of these organs should be assessed as unfit until such time as the medical assessor, having access to the details of the operation concerned, considers that the effects of the operation are not likely to cause incapacitation.*

6.5.2.15 Applicants with metabolic, nutritional or endocrine disorders that are likely to interfere with the safe exercise of their licence and rating privileges shall be assessed as unfit.

6.5.2.16 Applicants with insulin-treated diabetes mellitus shall be assessed as unfit.

Note.— Guidance on assessment of Type 2 insulin-treated diabetic applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.16.1 Applicants with non-insulin-treated diabetes shall be assessed as unfit unless the condition is shown to be satisfactorily controlled by diet alone or by diet combined with oral anti-diabetic medication, the use of which is compatible with the safe exercise of the applicant's licence and rating privileges.

Note.— Guidance on assessment of diabetic applicants is contained in the Manual of Civil Aviation Medicine *(Doc 8984)*.

6.5.2.17 Applicants with diseases of the blood and/or the lymphatic system shall be assessed as unfit, unless adequately investigated and their condition found unlikely to interfere with the safe exercise of their licence and rating privileges.

6.5.2.18 Applicants with renal or genito-urinary disease shall be assessed as unfit unless adequately investigated and their condition found unlikely to interfere with the safe exercise of their licence and rating privileges.

6.5.2.18.1 Urine examination shall form part of the medical examination and abnormalities shall be adequately investigated.

Note.— Guidance on urine examination and evaluation of abnormalities is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.19 Applicants with sequelae of disease of, or surgical procedures on the kidneys or the genito-urinary tract, in particular obstructions due to stricture or compression, shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

6.5.2.19.1 Applicants who have undergone nephrectomy shall be assessed as unfit unless the condition is well compensated.

6.5.2.20 Applicants who are seropositive for human immunodeficiency virus (HIV) shall be assessed as unfit unless the applicant's condition has been investigated and evaluated in accordance with best medical practice and is assessed as not likely to interfere with the safe exercise of the applicant's licence or rating privileges.

Note 1.— Early diagnosis and active management of HIV disease with antiretroviral therapy reduces morbidity and improves prognosis and thus increases the likelihood of a fit assessment.

Note 2.— Guidance on the assessment of applicants who are seropositive for human immunodeficiency virus (HIV) is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.2.21 Applicants who are pregnant shall be assessed as unfit unless obstetrical evaluation and continued medical supervision indicate a low-risk uncomplicated pregnancy.

6.5.2.21.1 **Recommendation.—** *During the gestational period, precautions should be taken for the timely relief of an air traffic controller in the event of early onset of labour or other complications.*

6.5.2.21.2 **Recommendation.—** *For applicants with a low-risk uncomplicated pregnancy, evaluated and supervised in accordance with 6.5.2.21, the fit assessment should be limited to the period until the end of the 34th week of gestation.*

6.5.2.22 Following confinement or termination of pregnancy the applicant shall not be permitted to exercise the privileges of her licence until she has undergone re-evaluation in accordance with best medical practice and it has been determined that she is able to safely exercise the privileges of her licence and ratings.

6.5.2.23 The applicant shall not possess any abnormality of the bones, joints, muscles, tendons or related structures which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

Note.— Any sequelae after lesions affecting the bones, joints, muscles or tendons, and certain anatomical defects will normally require functional assessment to determine fitness.

6.5.2.24 The applicant shall not possess any abnormality or disease of the ear or related structures which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.5.2.25 There shall be no malformation nor any disease of the nose, buccal cavity or upper respiratory tract which is likely to interfere with the safe exercise of the applicant's licence and rating privileges.

6.5.2.26 Applicants with stuttering or other speech defects sufficiently severe to cause impairment of speech communication shall be assessed as unfit.

6.5.3 Visual requirements

The medical examination shall be based on the following requirements.

6.5.3.1 The function of the eyes and their adnexa shall be normal. There shall be no active pathological condition, acute or chronic, nor any sequelae of surgery or trauma of the eyes or their adnexa likely to reduce proper visual function to an extent that would interfere with the safe exercise of the applicant's licence and rating privileges.

6.5.3.2 Distant visual acuity with or without correction shall be 6/9 or better in each eye separately, and binocular visual acuity shall be 6/6 or better. No limits apply to uncorrected visual acuity. Where this standard of visual acuity can be obtained only with correcting lenses, the applicant may be assessed as fit provided that:

a) such correcting lenses are worn during the exercise of the privileges of the licence or rating applied for or held; and

b) in addition, a pair of suitable correcting spectacles is kept readily available during the exercise of the privileges of the applicant's licence.

Note.— An applicant accepted as meeting these provisions is deemed to continue to do so unless there is reason to suspect otherwise, in which case an ophthalmic report is required at the discretion of the Licensing Authority. Both uncorrected and corrected visual acuity are normally measured and recorded at each re-examination. Conditions which indicate a need to obtain an ophthalmic report include: a substantial decrease in the uncorrected visual acuity, any decrease in best corrected visual acuity, and the occurrence of eye disease, eye injury or eye surgery.

6.5.3.2.1 Applicants may use contact lenses to meet this requirement provided that:

a) the lenses are monofocal and non-tinted;

b) the lenses are well tolerated; and

c) a pair of suitable correcting spectacles is kept readily available during the exercise of the licence privileges.

Note.— Applicants who use contact lenses may not need to have their uncorrected visual acuity measured at each re-examination provided the history of their contact lens prescription is known.

6.5.3.2.2 Applicants with a large refractive error shall use contact lenses or high-index spectacle lenses.

Note.— If spectacles are used, high-index lenses are needed to minimize peripheral field distortion.

6.5.3.2.3 Applicants whose uncorrected distant visual acuity in either eye is worse than 6/60 shall be required to provide a full ophthalmic report prior to initial Medical Assessment and every five years thereafter.

Note 1.— The purpose of the required ophthalmic examination is (1) to ascertain normal vision performance, and (2) to identify any significant pathology.

Note 2.— Guidance on the assessment of monocular applicants under the provisions of 1.2.4.9 is contained in the Manual of Civil Aviation Medicine *(Doc 8984).*

6.5.3.3 Applicants who have undergone surgery affecting the refractive status of the eye shall be assessed as unfit unless they are free from those sequelae which are likely to interfere with the safe exercise of their licence and rating privileges.

6.5.3.4 The applicant shall have the ability to read, while wearing the correcting lenses, if any, required by 6.5.3.2, the N5 chart or its equivalent at a distance selected by that applicant in the range of 30 to 50 cm and the ability to read the N14 chart or its equivalent at a distance of 100 cm. If this requirement is met only by the use of near correction, the applicant may be assessed as fit provided that this near correction is added to the spectacle correction already prescribed in accordance with 6.5.3.2; if no such correction is prescribed, a pair of spectacles for near use shall be kept readily available during the exercise of the privileges of the licence. When near correction is required, the applicant shall demonstrate that one pair of spectacles is sufficient to meet both distant and near visual requirements.

Note 1.— N5 and N14 refer to the size of typeface used. For further details, see the Manual of Civil Aviation Medicine *(Doc 8984).*

Note 2.— An applicant who needs near correction to meet the requirement will require "look-over", bifocal or perhaps multi-focal lenses in order to read radar screens, visual displays and written or printed material and also to make use of distant vision, through the windows, without removing the lenses. Single-vision near correction (full lenses of one power only, appropriate for reading) may be acceptable for certain air traffic control duties. However, it should be realized that single-vision near correction significantly reduces distant visual acuity.

Note 3.— Whenever there is a requirement to obtain or renew correcting lenses, an applicant is expected to advise the refractionist of reading distances for the air traffic control duties the applicant is likely to perform.

6.5.3.4.1 When near correction is required in accordance with this paragraph, a second pair of near-correction spectacles shall be kept available for immediate use.

6.5.3.5 The applicant shall be required to have normal fields of vision.

6.5.3.6 The applicant shall be required to have normal binocular function.

6.5.3.6.1 Reduced stereopsis, abnormal convergence not interfering with near vision, and ocular misalignment where the fusional reserves are sufficient to prevent asthenopia and diplopia need not be disqualifying.

6.5.4 Hearing requirements

6.5.4.1 The applicant, when tested on a pure-tone audiometer shall not have a hearing loss, in either ear separately, of more than 35 dB at any of the frequencies 500, 1 000 or 2 000 Hz, or more than 50 dB at 3 000 Hz.

6.5.4.1.1 An applicant with a hearing loss greater than the above may be declared fit provided that the applicant has normal hearing performance against a background noise that reproduces or simulates that experienced in a typical air traffic control working environment.

Note 1.— The frequency composition of the background noise is defined only to the extent that the frequency range 600 to 4 800 Hz (speech frequency range) is adequately represented.

Note 2.— In the speech material for discrimination testing, both aviation-relevant phrases and phonetically balanced words are normally used.

6.5.4.1.2 Alternatively, a practical hearing test conducted in an air traffic control environment representative of the one for which the applicant's licence and ratings are valid may be used.

APPENDIX 1. REQUIREMENTS FOR PROFICIENCY IN LANGUAGES USED FOR RADIOTELEPHONY COMMUNICATIONS

(Chapter 1, Section 1.2.9, refers)

1. General

Note.— The ICAO language proficiency requirements include the holistic descriptors at Section 2 and the ICAO Operational Level (Level 4) of the ICAO Language Proficiency Rating Scale in Attachment A. The language proficiency requirements are applicable to the use of both phraseologies and plain language.

To meet the language proficiency requirements contained in Chapter 1, Section 1.2.9, an applicant for a licence or a licence holder shall demonstrate, in a manner acceptable to the Licensing Authority, compliance with the holistic descriptors at Section 2 and with the ICAO Operational Level (Level 4) of the ICAO Language Proficiency Rating Scale in Attachment A.

2. Holistic descriptors

Proficient speakers shall:

a) communicate effectively in voice-only (telephone/radiotelephone) and in face-to-face situations;

b) communicate on common, concrete and work-related topics with accuracy and clarity;

c) use appropriate communicative strategies to exchange messages and to recognize and resolve misunderstandings (e.g. to check, confirm, or clarify information) in a general or work-related context;

d) handle successfully and with relative ease the linguistic challenges presented by a complication or unexpected turn of events that occurs within the context of a routine work situation or communicative task with which they are otherwise familiar; and

e) use a dialect or accent which is intelligible to the aeronautical community.

APPENDIX 2. APPROVED TRAINING ORGANIZATION

(Chapter 1, 1.2.8.2 refers)

1. Issue of approval

1.1 The issuance of an approval for a training organization and the continued validity of the approval shall depend upon the training organization being in compliance with the requirements of this Appendix.

1.2 The approval document shall contain at least the following:

a) organization's name and location;

b) date of issue and period of validity (where appropriate);

c) terms of approval.

2. Training and procedures manual

2.1 The training organization shall provide a training and procedures manual for the use and guidance of personnel concerned. This manual may be issued in separate parts and shall contain at least the following information:

a) a general description of the scope of training authorized under the organization's terms of approval;

b) the content of the training programmes offered including the courseware and equipment to be used;

c) a description of the organization's quality assurance system in accordance with 5;

d) a description of the organization's facilities;

e) the name, duties and qualification of the person designated as responsible for compliance with the requirements of the approval in 7.1;

f) a description of the duties and qualification of the personnel designated as responsible for planning, performing and supervising the training in 7.2;

g) a description of the procedures used to establish and maintain the competence of instructional personnel as required by 7.3;

h) a description of the method used for the completion and retention of the training records required by 8;

i) a description, when applicable, of additional training needed to comply with an operator's procedures and requirements; and

j) when a State has authorized an approved training organization to conduct the testing required for the issuance of a licence or rating in accordance with 10, a description of the selection, role and duties of the authorized personnel, as well as the applicable requirements established by the Licensing Authority.

2.2 The training organization shall ensure that the training and procedures manual is amended as necessary to keep the information contained therein up to date.

2.3 Copies of all amendments to the training and procedures manual shall be furnished promptly to all organizations or persons to whom the manual has been issued.

3. Training programmes

3.1 A Licensing Authority may approve a training programme for a private pilot licence, commercial pilot licence, an instrument rating or an aircraft maintenance (technician/engineer/mechanic) licence that allows an alternative means of compliance with the experience requirements established by Annex 1, provided that the approved training organization demonstrates to the satisfaction of the Licensing Authority that the training provides a level of competency at least equivalent to that provided by the minimum experience requirements for personnel not receiving such approved training.

Note.— A comprehensive training scheme for the aircraft maintenance (technician/engineer/mechanic) licence, including the various levels of competency, is contained in the Procedures for Air Navigation Services — Training *(Doc 9868, PANS-TRG).*

3.2 When a Licensing Authority approves a training programme for a multi-crew pilot licence, the approved training organization shall demonstrate to the satisfaction of the Licensing Authority that the training provides a level of competency in multi-crew operations at least equal to that met by holders of a commercial pilot licence, instrument rating and type rating for an aeroplane certificated for operation with a minimum crew of at least two pilots.

Note.— Guidance on the approval of training programmes can be found in the Manual on the Approval of Training Organizations *(Doc 9841)*.

4. Safety management

4.1 States shall require, as part of their State safety programme, that an approved training organization that is exposed to safety risks during the provision of its services implement a safety management system acceptable to the State that, as a minimum:

a) identifies safety hazards;

b) ensures the implementation of remedial action necessary to maintain agreed safety performance;

c) provides for continuous monitoring and regular assessment of the safety performance; and

d) aims at a continuous improvement of the overall performance of the safety management system.

Note.— Guidance on defining safety performance is contained in the Safety Management Manual (SMM) *(Doc 9859).*

4.2 A safety management system shall clearly define lines of safety accountability throughout the approved training organization, including a direct accountability for safety on the part of senior management.

Note 1.— The framework for the implementation and maintenance of a safety management system is contained in Appendix 4. Guidance on safety management systems is contained in the Safety Management Manual (SMM) *(Doc 9859).*

Note 2.— A framework for the implementation and maintenance of a State safety programme is contained in Attachment C.

5. Quality assurance system

The training organization shall establish a quality assurance system, acceptable to the Licensing Authority granting the approval, which ensures that training and instructional practices comply with all relevant requirements.

6. Facilities

6.1 The facilities and working environment shall be appropriate for the task to be performed and be acceptable to the Licensing Authority.

6.2 The training organization shall have, or have access to, the necessary information, equipment, training devices and material to conduct the courses for which it is approved.

6.3 Synthetic training devices shall be qualified according to requirements established by the State and their use shall be approved by the Licensing Authority to ensure that they are appropriate to the task.

Note.— The Manual of Criteria for the Qualification of Flight Simulation Training Devices *(Doc 9625) provides guidance on the approval of flight simulation training devices*.

7. Personnel

7.1 The training organization shall nominate a person responsible for ensuring that it is in compliance with the requirements for an approved organization.

7.2 The organization shall employ the necessary personnel to plan, perform and supervise the training to be conducted.

7.3 The competence of instructional personnel shall be in accordance with procedures and to a level acceptable to the Licensing Authority.

7.4 The training organization shall ensure that all instructional personnel receive initial and continuation training appropriate to their assigned tasks and responsibilities. The training programme established by the training organization shall include training in knowledge and skills related to human performance.

Note.— Guidance material to design training programmes to develop knowledge and skills in human performance can be found in the Human Factors Training Manual *(Doc 9683).*

8. Records

8.1 The training organization shall retain detailed student records to show that all requirements of the training course have been met as agreed by the Licensing Authority.

8.2 The training organization shall maintain a system for recording the qualifications and training of instructional and examining staff, where appropriate.

8.3 The records required by 8.1 shall be kept for a minimum period of two years after completion of the training. The records required by 8.2 shall be retained for a minimum period of two years after the instructor or examiner ceases to perform a function for the training organization.

9. Oversight

Contracting States shall maintain an effective oversight programme of the approved training organization to ensure continuing compliance with the approval requirements.

10. Evaluation and checking

When a State has authorized an approved training organization to conduct the testing required for the issuance of a licence or rating, the testing shall be conducted by personnel authorized by the Licensing Authority or designated by the training organization in accordance with criteria approved by the Licensing Authority.

APPENDIX 3. REQUIREMENTS FOR THE ISSUE OF THE MULTI-CREW PILOT LICENCE — AEROPLANE

(Chapter 2, Section 2.5, refers)

1. Training

1.1 In order to meet the requirements of the multi-crew pilot licence in the aeroplane category, the applicant shall have completed an approved training course. The training shall be competency-based and conducted in a multi-crew operational environment.

1.2 During the training, the applicant shall have acquired the knowledge, skills and attitudes required as the underpinning attributes for performing as a co-pilot of a turbine-powered air transport aeroplane certificated for operation with a minimum crew of at least two pilots.

2. Assessment level

The applicant for the multi-crew pilot licence in the aeroplane category shall have satisfactorily demonstrated performance in all the nine competency units specified in 3, at the advanced level of competency as defined in Attachment B.

Note.— The training scheme for the multi-crew pilot licence in the aeroplane category, including the various levels of competency are contained in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868).*

3. Competency units

The nine competency units that an applicant has to demonstrate in accordance with Chapter 2, 2.5.1.3, are as follows:

1) apply threat and error management (TEM) principles;

2) perform aeroplane ground operations;

3) perform take-off;

4) perform climb;

5) perform cruise;

6) perform descent;

7) perform approach;

8) perform landing; and

9) perform after-landing and aeroplane post-flight operations.

Note 1.— Competency units are broken down into their constituent elements, for which specific performance criteria have been defined. Competency elements and performance criteria are contained in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868)*.

Note 2.— The application of threat and error management principles is a specific competency unit that is to be integrated with each of the other competency units for training and testing purposes.

4. Simulated flight

Note.— The Manual of Criteria for the Qualification of Flight Simulation Training Devices *(Doc 9625),* Volume I — Aeroplanes*, provides guidance on the qualification of flight simulation training devices used in training programmes. The manual defines seven examples of flight simulation training devices based on the specific training being conducted, including four examples for the four phases of multi-crew pilot licence training defined in Attachment B of Annex 1. The numbering system used in Doc 9625 is different from the numbering used in 4.2.*

4.1 The flight simulation training devices used to gain the experience specified in Chapter 2, 2.5.3.3, shall have been approved by the Licensing Authority.

4.2 Flight simulation training devices shall be categorized as follows:

a) *Type I.* E-training and part tasking devices approved by the Licensing Authority that have the following characteristics:

— involve accessories beyond those normally associated with desktop computers, such as functional replicas of a throttle quadrant, a sidestick controller, or an FMS keypad; and

— involve psychomotor activity with appropriate application of force and timing of responses.

b) *Type II.* A flight simulation training device that represents a generic turbine-powered aeroplane.

Note.— This requirement can be met by a flight simulation training device equipped with a daylight visual system and otherwise meeting, at a minimum, the specifications equivalent to FAA FTD Level 5, or JAA FNPT II, MCC.

c) *Type III.* A flight simulation training device that represents a multi-engined turbine-powered aeroplane certificated for a crew of two pilots with enhanced daylight visual system and equipped with an autopilot.

Note.— This requirement can be met by a flight simulation training device equipped with a daylight visual system and otherwise meeting, at a minimum, the specifications equivalent to a Level B simulator as defined in JAR STD 1A, as amended; and in FAA AC 120-40B, as amended, including Alternate Means of Compliance (AMOC), as permitted in AC 120-40B. (Some previously evaluated Level A full flight simulators that have been approved for training and checking required manoeuvres may be used.)

d) *Type IV.* Fully equivalent to a Level D flight simulator or to a Level C flight simulator with an enhanced daylight visual system.

Note.— This requirement can be met by a flight simulation training device meeting, at a minimum, the specifications equivalent to a Level C and Level D simulator as defined in JAR STD 1A, as amended; and in FAA AC 120-40B, as amended, including Alternate Means of Compliance (AMOC), as permitted in AC 120-40B.

APPENDIX 4. FRAMEWORK FOR SAFETY MANAGEMENT SYSTEMS (SMS)

(Chapter 1, 1.2.8.2 refers)

This appendix specifies the framework for the implementation and maintenance of a safety management system (SMS) by an approved training organization. An SMS is a management system for the management of safety by an organization. The framework includes four components and twelve elements representing the minimum requirements for SMS implementation. The implementation of the framework shall be commensurate with the size of the organization and the complexity of the services provided. This appendix also includes a brief description of each element of the framework.

1. Safety policy and objectives

    1.1 Management commitment and responsibility
    1.2 Safety accountabilities
    1.3 Appointment of key safety personnel
    1.4 Coordination of emergency response planning
    1.5 SMS documentation

2. Safety risk management

    2.1 Hazard identification
    2.2 Safety risk assessment and mitigation

3. Safety assurance

    3.1 Safety performance monitoring and measurement
    3.2 The management of change
    3.3 Continuous improvement of the SMS

4. Safety promotion

    4.1 Training and education
    4.2 Safety communication

1. Safety policy and objectives

1.1 Management commitment and responsibility

The approved training organization shall define the organization's safety policy which shall be in accordance with international and national requirements, and which shall be signed by the accountable executive of the organization. The safety policy shall reflect organizational commitments regarding safety; shall include a clear statement about the provision of the necessary resources for the implementation of the safety policy; and shall be communicated, with visible endorsement, throughout the organization. The safety policy shall include the safety reporting procedures; shall clearly indicate which types of operational behaviours are unacceptable; and shall include the conditions under which disciplinary action would not apply. The safety policy shall be periodically reviewed to ensure it remains relevant and appropriate to the organization.

1.2 Safety accountabilities

The approved training organization shall identify the accountable executive who, irrespective of other functions, shall have ultimate responsibility and accountability, on behalf of the approved training organization, for the implementation and maintenance of the SMS. The approved training organization shall also identify the accountabilities of all members of management, irrespective of other functions, as well as of employees, with respect to the safety performance of the SMS. Safety responsibilities, accountabilities and authorities shall be documented and communicated throughout the organization, and shall include a definition of the levels of management with authority to make decisions regarding safety risk tolerability.

1.3 Appointment of key safety personnel

The approved training organization shall identify a safety manager to be the responsible individual and focal point for the implementation and maintenance of an effective SMS.

1.4 Coordination of emergency response planning

The approved training organization shall ensure that an emergency response plan that provides for the orderly and efficient transition from normal to emergency operations and the return to normal operations is properly coordinated with the emergency response plans of those organizations it must interface with during the provision of its services.

1.5 SMS documentation

The approved training organization shall develop an SMS implementation plan, endorsed by senior management of the organization, that defines the organization's approach to the management of safety in a manner that meets the organization's safety objectives. The approved training organization shall develop and maintain SMS documentation describing the safety policy and objectives, the SMS requirements, the SMS processes and procedures, the accountabilities, responsibilities and authorities for processes and procedures, and the SMS outputs. Also as part of the SMS documentation, the approved training organization shall develop and maintain a safety management systems manual (SMSM), to communicate its approach to the management of safety throughout the organization.

2. Safety risk management

2.1 Hazard identification

The approved training organization shall develop and maintain a formal process that ensures that hazards in operations are identified. Hazard identification shall be based on a combination of reactive, proactive and predictive methods of safety data collection.

2.2 Safety risk assessment and mitigation

The approved training organization shall develop and maintain a formal process that ensures analysis, assessment and control of the safety risks in training operations.

3. Safety assurance

3.1 Safety performance monitoring and measurement

The approved training organization shall develop and maintain the means to verify the safety performance of the organization and to validate the effectiveness of safety risk controls. The safety performance of the organization shall be verified in reference to the safety performance indicators and safety performance targets of the SMS.

3.2 The management of change

The approved training organization shall develop and maintain a formal process to identify changes within the organization which may affect established processes and services; to describe the arrangements to ensure safety performance before implementing changes; and to eliminate or modify safety risk controls that are no longer needed or effective due to changes in the operational environment.

3.3 Continuous improvement of the SMS

The approved training organization shall develop and maintain a formal process to identify the causes of substandard performance of the SMS, determine the implications of substandard performance of the SMS in operations, and eliminate or mitigate such causes.

4. Safety promotion

4.1 Training and education

The approved training organization shall develop and maintain a safety training programme that ensures that personnel are trained and competent to perform the SMS duties. The scope of the safety training shall be appropriate to each individual's involvement in the SMS.

4.2 Safety communication

The approved training organization shall develop and maintain formal means for safety communication that ensures that all personnel are fully aware of the SMS, conveys safety-critical information, and explains why particular safety actions are taken and why safety procedures are introduced or changed.

ATTACHMENT A
ICAO LANGUAGE PROFICIENCY RATING SCALE

1.1 Expert, extended and operational levels

LEVEL	*PRONUNCIATION Assumes a dialect and/or accent intelligible to the aeronautical community.*	*STRUCTURE Relevant grammatical structures and sentence patterns are determined by language functions appropriate to the task.*	*VOCABULARY*	*FLUENCY*	*COMPREHENSION*	*INTERACTIONS*
Expert 6	Pronunciation, stress, rhythm, and intonation, though possibly influenced by the first language or regional variation, almost never interfere with ease of understanding.	Both basic and complex grammatical structures and sentence patterns are consistently well controlled.	Vocabulary range and accuracy are sufficient to communicate effectively on a wide variety of familiar and unfamiliar topics. Vocabulary is idiomatic, nuanced, and sensitive to register.	Able to speak at length with a natural, effortless flow. Varies speech flow for stylistic effect, e.g. to emphasize a point. Uses appropriate discourse markers and connectors spontaneously.	Comprehension is consistently accurate in nearly all contexts and includes comprehension of linguistic and cultural subtleties.	Interacts with ease in nearly all situations. Is sensitive to verbal and non-verbal cues and responds to them appropriately.
Extended 5	Pronunciation, stress, rhythm, and intonation, though influenced by the first language or regional variation, rarely interfere with ease of understanding.	Basic grammatical structures and sentence patterns are consistently well controlled. Complex structures are attempted but with errors which sometimes interfere with meaning.	Vocabulary range and accuracy are sufficient to communicate effectively on common, concrete, and work-related topics. Paraphrases consistently and successfully. Vocabulary is sometimes idiomatic.	Able to speak at length with relative ease on familiar topics but may not vary speech flow as a stylistic device. Can make use of appropriate discourse markers or connectors.	Comprehension is accurate on common, concrete, and work-related topics and mostly accurate when the speaker is confronted with a linguistic or situational complication or an unexpected turn of events. Is able to comprehend a range of speech varieties (dialect and/or accent) or registers.	Responses are immediate, appropriate, and informative. Manages the speaker/listener relationship effectively.
Operational 4	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation but only sometimes interfere with ease of understanding.	Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in unusual or unexpected circumstances, but rarely interfere with meaning.	Vocabulary range and accuracy are usually sufficient to communicate effectively on common, concrete, and work-related topics. Can often paraphrase successfully when lacking vocabulary in unusual or unexpected circumstances.	Produces stretches of language at an appropriate tempo. There may be occasional loss of fluency on transition from rehearsed or formulaic speech to spontaneous interaction, but this does not prevent effective communication. Can make limited use of discourse markers or connectors. Fillers are not distracting.	Comprehension is mostly accurate on common, concrete, and work- related topics when the accent or variety used is sufficiently intelligible for an international community of users. When the speaker is confronted with a linguistic or situational complication or an unexpected turn of events, comprehension may be slower or require clarification strategies.	Responses are usually immediate, appropriate, and informative. Initiates and maintains exchanges even when dealing with an unexpected turn of events. Deals adequately with apparent misunderstandings by checking, confirming, or clarifying.
Levels 1, 2 and 3 are on subsequent page						

1.2 Pre-operational, elementary and pre-elementary levels

LEVEL	*PRONUNCIATION* *Assumes a dialect and/or accent intelligible to the aeronautical community.*	*STRUCTURE* *Relevant grammatical structures and sentence patterns are determined by language functions appropriate to the task.*	*VOCABULARY*	*FLUENCY*	*COMPREHENSION*	*INTERACTIONS*
Levels 4, 5 and 6 are on preceding page.						
Pre-operational 3	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation and frequently interfere with ease of understanding.	Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.	Vocabulary range and accuracy are often sufficient to communicate on common, concrete, or work-related topics, but range is limited and the word choice often inappropriate. Is often unable to paraphrase successfully when lacking vocabulary.	Produces stretches of language, but phrasing and pausing are often inappropriate. Hesitations or slowness in language processing may prevent effective communication. Fillers are sometimes distracting.	Comprehension is often accurate on common, concrete, and work- related topics when the accent or variety used is sufficiently intelligible for an international community of users. May fail to understand a linguistic or situational complication or an unexpected turn of events.	Responses are sometimes immediate, appropriate, and informative. Can initiate and maintain exchanges with reasonable ease on familiar topics and in predictable situations. Generally inadequate when dealing with an unexpected turn of events.
Elementary 2	Pronunciation, stress, rhythm, and intonation are heavily influenced by the first language or regional variation and usually interfere with ease of understanding.	Shows only limited control of a few simple memorized grammatical structures and sentence patterns.	Limited vocabulary range consisting only of isolated words and memorized phrases.	Can produce very short, isolated, memorized utterances with frequent pausing and a distracting use of fillers to search for expressions and to articulate less familiar words.	Comprehension is limited to isolated, memorized phrases when they are carefully and slowly articulated.	Response time is slow and often inappropriate. Interaction is limited to simple routine exchanges.
Pre-elementary 1	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.

Note.— The Operational Level (Level 4) is the minimum required proficiency level for radiotelephony communication. Levels 1 through 3 describe Pre-elementary, Elementary, and Preoperational levels of language proficiency, respectively, all of which describe a level of proficiency below the ICAO language proficiency requirement. Levels 5 and 6 describe Extended and Expert levels, at levels of proficiency more advanced than the minimum required Standard. As a whole, the scale will serve as benchmarks for training and testing, and in assisting candidates to attain the ICAO Operational Level (Level 4).

ATTACHMENT B

MULTI-CREW PILOT LICENCE — AEROPLANE LEVELS OF COMPETENCY

1. Core flying skills

The level of competency at which the applicant shall have complied with the requirements for the private pilot licence specified in Chapter 2, 2.3, including night flight requirements, and, in addition, have completed, smoothly and with accuracy, all procedures and manoeuvres related to upset training and flight with reference solely to instruments. From the outset, all training is conducted in an integrated multi-crew, competency-based and threat and error management (TEM) environment. Initial training and instructional input levels are high as core skills are being embedded in the ab initio application. Assessment at this level confirms that control of the aeroplane is maintained at all times in a manner such that the successful outcome of a procedure or a manoeuvre is assured.

2. Level 1 (Basic)

The level of competency at which assessment confirms that control of the aeroplane or situation is maintained at all times and in such a manner that if the successful outcome of a procedure or manoeuvre is in doubt, corrective action is taken. Performance in the generic cockpit environment does not yet consistently meet the Standards of knowledge, operational skills and level of achievement required in the core competencies. Continual training input is required to meet an acceptable initial operating standard. Specific performance improvement/personal development plans will be agreed and the details recorded. Applicants will be continuously assessed as to their suitability to progress to further training and assessment in successive phases.

3. Level 2 (Intermediate)

The level of competency at which assessment confirms that control of the aeroplane or situation is maintained at all times and in such a manner that the successful outcome of a procedure or manoeuvre is assured. The training received at Level 2 shall be conducted under the instrument flight rules, but need not be specific to any one type of aeroplane. On completion of Level 2, the applicant shall demonstrate levels of knowledge and operational skills that are adequate in the environment and achieves the basic standard in the core capability. Training support may be required with a specific development plan to maintain or improve aircraft handling, behavioural performance in leadership or team management. Improvement and development to attain the Standard is the key performance objective. Any core competency assessed as less than satisfactory should include supporting evidence and a remedial plan.

4. Level 3 (Advanced)

The level of competency required to operate and interact as a co-pilot in a turbine-powered aeroplane certificated for operation with a minimum crew of at least two pilots, under visual and instrument conditions. Assessment confirms that control of the aeroplane or situation is maintained at all times in such a manner that the successful outcome of a procedure or manoeuvre is assured. The applicant shall consistently demonstrate the knowledge, skills and attitudes required for the safe operation of an applicable aeroplane type as specified in the performance criteria.

Note.— Material on the development of performance criteria can be found in the Procedures for Air Navigation Services — Training *(PANS-TRG, Doc 9868).*

ATTACHMENT C. FRAMEWORK FOR THE STATE SAFETY PROGRAMME (SSP)

This attachment introduces a framework for the implementation and maintenance of a State safety programme (SSP) by a State. An SSP is a management system for the management of safety by the State. The framework contemplates four components and eleven elements, outlined hereunder. The implementation of an SSP is commensurate with the size and complexity of the State's aviation system, and may require coordination among multiple authorities responsible for individual elements of civil aviation functions in the State. The SSP framework introduced in this attachment, and the safety management system (SMS) framework specified in Appendix 4, must be viewed as complementary, yet distinct, frameworks. This attachment also includes a brief description of each element of the framework.

1. State safety policy and objectives

    1.1 State safety legislative framework
    1.2 State safety responsibilities and accountabilities
    1.3 Accident and incident investigation
    1.4 Enforcement policy

2. State safety risk management

    2.1 Safety requirements for the service provider's SMS
    2.2 Agreement on the service provider's safety performance

3. State safety assurance

    3.1 Safety oversight
    3.2 Safety data collection, analysis and exchange
    3.3 Safety-data-driven targeting of oversight of areas of greater concern or need

4. State safety promotion

    4.1 Internal training, communication and dissemination of safety information
    4.2 External training, communication and dissemination of safety information

Note.— Within the context of this attachment the term service provider" refers to any organization providing aviation services. The term includes approved training organizations that are exposed to safety risks during the provision of their services, aircraft operators, approved maintenance organizations, organizations responsible for type design and/or manufacture of aircraft, air traffic services providers and certified aerodromes, as applicable.

1. State safety policy and objectives

1.1 State safety legislative framework

The State has promulgated a national safety legislative framework and specific regulations, in compliance with international and national standards, that define how the State will conduct the management of safety in the State. This includes the participation of State aviation organizations in specific activities related to the management of safety in the State, and the establishment of the roles, responsibilities and relationships of such organizations. The safety legislative framework and specific regulations are periodically reviewed to ensure they remain relevant and appropriate to the State.

1.2 State safety responsibilities and accountabilities

The State has identified, defined and documented the requirements, responsibilities and accountabilities regarding the establishment and maintenance of the SSP. This includes the directives to plan, organize, develop, maintain, control and continuously improve the SSP in a manner that meets the State's safety objectives. It also includes a clear statement about the provision of the necessary resources for the implementation of the SSP.

1.3 Accident and incident investigation

The State has established an independent accident and incident investigation process, the sole objective of which is the prevention of accidents and incidents, and not the apportioning of blame or liability. Such investigations are in support of the management of safety in the State. In the operation of the SSP, the State maintains the independence of the accident and incident investigation organization from other State aviation organizations.

1.4 Enforcement policy

The State has promulgated an enforcement policy that establishes the conditions and circumstances under which service providers are allowed to deal with, and resolve, events involving certain safety deviations, internally, within the context of the service provider's safety management system (SMS), and to the satisfaction of the appropriate State authority. The enforcement policy also establishes the conditions and circumstances under which to deal with safety deviations through established enforcement procedures.

2. State safety risk management

2.1 Safety requirements for the service provider's SMS

The State has established the controls which govern how service providers will identify hazards and manage safety risks. These include the requirements, specific operating regulations and implementation policies for the service provider's SMS. The requirements, specific operating regulations and implementation policies are periodically reviewed to ensure they remain relevant and appropriate to the service providers.

2.2 Agreement on the service provider's safety performance

The State has agreed with individual service providers on the safety performance of their SMS. The agreed safety performance of an individual service provider's SMS is periodically reviewed to ensure it remains relevant and appropriate to the service providers.

3. State safety assurance

3.1 Safety oversight

The State has established mechanisms to ensure effective monitoring of the eight critical elements of the safety oversight function. The State has also established mechanisms to ensure that the identification of hazards and the management of safety risks by service providers follow established regulatory controls (requirements, specific operating regulations and implementation policies). These mechanisms include inspections, audits and surveys to ensure that regulatory safety risk controls are appropriately integrated into the service provider's SMS, that they are being practised as designed, and that the regulatory controls have the intended effect on safety risks.

3.2 Safety data collection, analysis and exchange

The State has established mechanisms to ensure the capture and storage of data on hazards and safety risks at both an individual and aggregate State level. The State has also established mechanisms to develop information from the stored data, and to actively exchange safety information with service providers and/or other States as appropriate.

3.3 Safety-data-driven targeting of oversight of areas of greater concern or need

The State has established procedures to prioritize inspections, audits and surveys towards those areas of greater safety concern or need, as identified by the analysis of data on hazards, their consequences in operations, and the assessed safety risks.

4. State safety promotion

4.1 Internal training, communication and dissemination of safety information

The State provides training and fosters awareness and two-way communication of safety-relevant information to support, within the State aviation organizations, the development of an organizational culture that fosters an effective and efficient SSP.

4.2 External training, communication and dissemination of safety information

The State provides education and promotes awareness of safety risks and two-way communication of safety-relevant information to support, among service providers, the development of an organizational culture that fosters an effective and efficient SMS.

— END —

ISBN 978-92-9231-810-9

ATO

MODEL CIVIL AVIATION REGULATIONS
(MCARS)

[STATE]

PART 3 — APPROVED TRAINING ORGANISATIONS

VERSION 2.8

NOVEMBER 2014

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AMENDMENTS

Location	Date	Description
Introduction	9/20/11	Deleted "flight" from training organisations as ICAO Annex 1 approved training organisations now extend to air traffic and maintenance licence training. Added ICAO reference to indicate updates had been made to ICAO Annex 1, Amendment 170
Introduction	11/2014	Updated Amendment version of ICAO Annex 1 used
Table of Contents	11/2013	Added new 3.1.1.4 and 3.2.1.21
3.1.1.1(a)	9/20/11	Deleted the word "general" from the sentence
3.1.1.2(a) (3)	9/20/11	Changed the wording of the definition to reflect ICAO Annex 1 change
3.1.1.2(a)	9/29/2011	Added definitions: Alternate Means of Compliance; alternative means of compliance; competency based training and assessment; quality management; quality system; special curricula; training programme
3.1.1.2(a)	5/25/2010	Added definition: Safety Management System
3.1.1.2(a)	5/25/2010	Added definition: State Safety Programme
3.1.1.2(a)	9/29/2011	Added definition: Special Approved Curricula
3.1.1.2	11/2014	Moved definitions to MCAR Part 1
3.1.1.3	9/27/11	Added abbreviation of QA for quality assurance, and MPL for multi-crew pilot licence
3.1.1.4	11/2013	Added new paragraph for exemption authority
3.2.1.2	5/25/2010	Added (d) (e) and reference and note
3.2.1.2	11/11	Deleted note; added new text
3.2.1.3(e)	11/2013	Added reference to SMS requirements
3.2.1.3	11/11	Added authority signature to 3.2.1.3(c)(5)
3.2.1.5(a)	11/11	Changed "on" to "in"
3.2.1.5(c)	11/11	(4) Revised requirements for information about proposed training location(s); (7) Added "quality assurance" (9) Added SMS (10) Added "statement of compliance"
3.2.1.7	9/20/11	Made the dates more specific in (a)(1) and (2) and (b).
3.2.1.9	9/27/2011	Now "Inspection"
3.2.1.10	9/27/2011	"Now " Suspension and Revocation"
3.2.1.11 through 3.2.1.20	9/27/2011	Renumbered subsequent paragraphs accordingly
3.2.1.12	11/2013	Revised text in (c) for clarification
3.2.1.20	11/2013	Revised per new ICAO Annex 19
3.2.1.21	11/2013	New paragraph added for outsourcing
3.2.1.13	9/20/11	In the note, changed flight simulator to flight simulation training devices

3.2.1.17	9/20/11	Revised to include quality assurance. Added text to indicate that the outline for an ATO quality assurance and quality system is contained in IS: 3.2.1.17
3.2.1.8	11/11	3.2.1.8(a) added a requirement for description of facilities
3.2.1.19	11/2012	Corrected typographical error
3.2.1.20	5/25/2010	Added new subsection to reflect ICAO Annex 1 requirements for an ATO safety management system
3.3.2.1 (13)	9/20/11	Changed instructor course from "synthetic flight training" to "flight simulation training"
3.3.2.2	9/20/11	Totally revised to reflect training course content and approval
3.3.2.2	11/2012	Changed applicant submission requirement from 1 copy to 2 copies
3.3.2.3	9/20/11	New to reflect approval of special curricula
3.3.2.3	11/2012	Changed wording in (a) and (b) to reflect minimum hours for a licence in MCAR Part 2
3.3.4.3	11/11	Added a new (c) for maintenance of FSTDs
3.3.4.3(b)	11/2012	Corrected typographical error
3.3.4.4	11/2012	Corrected typographical error
3.3.4.4(a)	11/11	Spelling – changed "airport" to "aerodrome"
3.3.5	9/20/11	Deleted 3.3.5.1 general as redundant and renumbered sections
3.3.5.1 (d) (e)	9/20/11	Formerly 3.3.5.2 (d)(e). In (d) inserted words "by the ATO" to denote responsibility; In (e) renumbered IS reference to reflect new renumbering
3.3.5.2	9/20/11	(a)(6) changed evaluator to examiner; (b) deleted evaluator
3.3.5.4	11/12	Editorial for clarification. In (d), inserted "MCAR"
3.3.5.6	9/20/11	Deleted (b) reference to the IS.
3.4	9/20/11	Took stand alone (a) under 3.4 and added it to a new 3.4.1 General and renumbered subsections
3.4.2.2	9/20/11	Totally revised to reflect training course content and approval
3.4.2.3 (a)	11/2012	Corrected language to reflect minimum hours for a licence in MCAR Part 2
3.4.2.3	9/20/11	New to reflect approval of special curricula
3.4.2.3	11/2012	Corrected language to reflect minimum hours for a licence in MCAR Part 2.
3.4.2.3(b)(3)	11/2012	Corrected language to reflect theoretical knowledge and practical training
3.4.5	9/20/11	Formerly 3.4.4: Deleted stand alone (a) under 3.4.4 as redundant; renumbered sections
3.4.5.1 (d) (e)	9/20/11	Formerly 3.4.4.2 (d)(e). In (d) inserted words "by the ATO" to denote responsibility; In (e) renumbered IS reference to reflect new renumbering
3.4.5.2	9/20/11	(a)(6) changed evaluator to examiner; (b) deleted evaluator
3.4.5.4	11/2012	In (d), added "MCAR" for clarification.
3.4.5.6	9/20/11	Deleted (b) reference to the IS.
IS 3.2.1.3	11/2012	Corrected typographical error
IS 3.2.1.3	11/11	Added to ATO certificate lines for printed name and title of CAA official; added language to the effective date of the certificate
IS: 3.2.1.3	11/2013	Updated ATO certificate form

IS 3.2.1.17	9/27/11	Added new paragraphs to the quality system based on updated ICAO Doc 9841
IS: 3.2.1.17	11/2012	Deleted unnecessary text from the following paragraphs: Paragraph 1.1; Paragraph 2.2; Paragraph 17.1; Paragraph 18.1(c) ; Paragraph 18.2
IS: 3.2.1.19	5/25/2010	Added new subsection
IS: 3.3.3	11/2012	Inserted "MCAR" for clarification to the following paragraphs: (h); (i); (j); (l); (m); (p); (q).
IS 3.3.5.1	9/20/11	Renumbered from IS 3.3.4.2 and replaced the entire contents to reflect new ICAO guidance
IS: 3.3.5.1	11/2012	Deleted unnecessary text and updated the following paragraphs: 1.7; 1.9(c); 2.2; 2.3.
IS 3.3.5.6	9/20/11	Deleted the inspection checklist which is including in inspector handbook guidance in the ICAO GSI course on ATO.
IS 3.4.5.1	9/20/11	Renumbered from IS 3.4.4.2 and replaced the entire contents to reflect new ICAO guidance
IS: 3.4.5.1	11/2012	Deleted unnecessary text and updated the following paragraphs: 1.9(c); 2.2.
IS 3.4.5.6	9/20/11	Deleted the inspection checklist which is included in inspector handbook guidance in the ICAO GSI course on ATO.

INTRODUCTION

Part 3 of the Model Regulations addresses the certification and administration of Approved Training Organisations (ATO). ICAO Annex 1 contains standards for approval of training organisations. Part 3 uses these standards and has also adapted them to cover other areas of airman training. Part 3 also relies heavily upon regulations presented in 14 CFR and the JAR FCL and JAR 147/EASA 147. The use of an ATO for the training and qualification of airmen is common in modern aviation, most particularly as operators upgrade their aircraft inventory and airmen transition to new aircraft. The interrelation between ATO requirements under Part 3 and the licensing and certification requirements of Part 2 is plain. Even if [STATE] does not have an ATO located in the country, the requirements for ATO operation do apply to the standards required for adequate training for qualification for a [STATE] certification. Thus, [STATE] citizens who receive training from a foreign ATO should be trained by an ATO meeting [STATE] standards. This situation will be encountered when a [STATE] holder of an Air Operator Certificate (AOC), such as a national airline, is part of a regional consortium with AOC holders from other Contracting States in the region, and the consortium has established an ATO in only one of the regional Contracting States. The regulations set forth in Part 3 allow for this situation. The regulations in Part 3 are based upon ICAO Annex 1, through Amendment 172, ICAO Doc 9841. Manual on the Approval of Training Organisations, Second Edition, 2011, and ICAO Doc 9869, Procedures for Air Navigation Services – Training (PANS-TRG), Amendment No. 2, 2013.

CONTENTS

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Part 3 — Approved Training Organisations

3.1 GENERAL

3.1.1.1 APPLICABILITY

(a) Part 3 prescribes the requirements for issuing approvals to organisations for the training of aviation personnel, and prescribes the operating rules for the holders of an Approved Training Organisation (ATO) certificate.

3.1.1.2 DEFINITIONS

(a) Definitions are contained in MCAR Part 1.

3.1.1.3 ABBREVIATIONS

(a) The following abbreviations are used in Part 3.

(1) **A** – Aeroplane

(2) **AMT** – Aviation Maintenance Technician

(3) **ATCO** – Air Traffic Controller

(4) **ATO** – Aviation Training Organisation

(5) **ATPL** – Airline Transport Pilot Licence

(6) **CFI** – Chief Flight Instructor

(7) **CGI** – Chief Ground Instructor

(8) **CPL** – Commercial Pilot Licence

(9) **CRM** – Crew Resource Management

(10) **FE** – Flight Engineer

(11) **H** – Helicopter

(12) **IFR** – Instrument Flight Rules

(13) **ICAO** – International Civil Aviation Organisation

(14) **MMEL** – Master Minimum Equipment List

(15) **MPL** – Multi-crew Pilot Licence

(16) **PIC** – Pilot-in-Command

(17) **PPL** – Private Pilot Licence

(18) **QA** – Quality Assurance

(19) **RT** – Radiotelephony

(20) **VFR** – Visual Flight Rules

3.1.1.4 EXEMPTION AUTHORITY

(a) The Authority may, upon consideration of the circumstances of a particular ATO, issue an exemption providing relief from specified sections of this Part, provided that the Authority finds that the circumstances presented warrant the exemption and that a level of safety will be maintained equal to that provided by the rule from which the exemption is sought.

(b) An exemption may be terminated or amended at any time by the Authority.

(c) A request for exemption must be made in accordance with the requirements in MCAR Part 1.

(d) Each ATO that receives an exemption must have a means of notifying the appropriate management and personnel of the exemption.

3.2 CERTIFICATION OF A TRAINING ORGANISATION AND CONTINUED VALIDITY

3.2.1.1 APPLICABILITY

(a) The section prescribes the requirements for the certification of a training organisation and continued validity of the certificate.

3.2.1.2 GENERAL

(a) The Authority may approve an ATO to provide the following:

(1) Any training activity that leads toward the issuance of a licence, rating, authorisation or approval.

(2) Provision of training services necessary for an operator to meet the requirements of MCAR Part 9.

(3) Special curricula training designed to meet:

(i) Qualification-based training requirements, including those deemed acceptable through the approval of an ‘alternate means of compliance’ mechanism, or

(ii) Competency based training and assessment requirements, or

(iii) Those training requirements deemed acceptable through the approval of an ‘alternative means of compliance’ mechanism.

(b) No person may operate as a certificated ATO without, or in violation of, an approved training organisation certificate, ratings or training specifications issued under this part.

(c) The ATO shall display the ATO certificate in a place accessible to the public in the principal place of business of the training center.

(d) The certificate and training specifications issued to an approved training organisation shall be available on the premises for inspection by the public and the Authority.

(e) The approval of a training organisation by a State shall be dependent upon the applicant demonstrating compliance with the requirements of this part and the safety management requirements of MCAR 1.

ICAO Annex 1: 1.2.8.1; 1.2.8.2
14 CFR: 141.19; 142.5(a) 142.27; 147.3
CAR 407.65

3.2.1.3 APPROVED TRAINING ORGANISATION CERTIFICATE

(a) The ATO certificate will consist of two documents—

(1) A one page certificate signed by the Authority; and

(2) A multi-page training specifications signed by the Accountable Manager and the Authority containing the terms, conditions, and authorisations.

(b) An ATO shall perform training, checking and testing, or part thereof, only for which it is rated and within the terms, conditions, and authorisations placed in its training specifications.

(c) The ATO certificate will contain the following items and be in a format as shown in IS: 3.2.1.3—

(1) The certificate number specifically assigned to the ATO;

(2) The name and location (principal place of business) of the ATO;

(3) The date of issue and period of validity;

(4) Terms of approval relating to the courses to be taught; and

(5) Authority signature.

(d) The training specifications will contain the following—

(1) The certificate number specifically assigned to the ATO;

(2) The type of training authorised, including approved courses;

(3) Authorisations for the ATO; including special approvals and limitations;

(4) The name and address of any satellite training centers, and the approved training offered at each location;

(5) The facilities and equipment required to conduct the training authorised;

(6) The staff required to perform the applicable duties under this Part;

(7) Accountable manager and Authority signatures;

(8) The date issued or revised; and

(9) Other items the Authority may require or allow.

ICAO Annex 1: Appendix 2, 1.2
14 CFR: 141.3; 142.5;147.3

3.2.1.4 ADVERTISING

(a) No training organisation may advertise as a certificated approved training organisation until an approved training organisation certificate has been issued to that facility.

(b) No certificated approved training organisation may make any statement, either in writing or orally, about itself that is false or is designed to mislead any person.

(c) Whenever the advertising of an approved training organisation indicates that it is certificated, the advertisement must clearly state the approved training organisation’s certificate number.

14 CFR: 141.23; 142.31; 147.45

3.2.1.5 APPLICATION FOR AN ATO CERTIFICATE

(a) The application for approval of a training organisation shall be made in a form and in a manner acceptable to the Authority.

(b) Each application must be made at least 120 calendar days before the beginning of any proposed training or 90 days before effecting an amendment to any approved training, unless a short filing period is approved by the Authority.

(c) Each applicant shall provide –

(1) A statement showing that the minimum qualification requirements for each management position are met or exceeded;

(2) A statement acknowledging that the applicant shall notify the Authority within 10 working days of any change made in the assignment of persons in the required management positions;

(3) The proposed training authorisations and training specifications requested by the applicant;

(4) The proposed location of each training facility and any satellite facility location, the proposed courses to be taught at each location, and the equipment at each location including FSTDs, training aircraft and any aerodromes or sites to be used;

(5) Two copies of its proposed Training and Procedures manual;

(6) Two copies of each proposed training course curriculum, including syllabi, outlines, courseware, procedures, and documentation to support the curriculum for which approval is sought;

(7) Documentation of the training organisation's quality assurance and quality system;

(8) A statement of the maximum number of students it expects to teach at any one time;

(9) Documentation of the training organisation's Safety Management System;

(10) A statement of compliance to all applicable MCARs for the proposed training, including pertinent subparts and each relevant section of the regulation, which should be identified and accompanied by a brief description.

(11) Any additional information the Authority requires the applicant to submit.

ICAO Annex 1: Appendix 2, 2.1
14 CFR: 141.13; 142.11; 147. 5

3.2.1.6 ISSUANCE OF AN ATO CERTIFICATE

(a) An applicant may be issued an ATO certificate if, after investigation, the Authority finds that the applicant—

(1) Meets the applicable regulations and standards for an ATO certificate, and

(2) Is properly and adequately equipped for the performance of the training for which it seeks approval.

Note: If, under national law, any charges are to be prescribed by the Authority for the ATO application process, that requirement should be set forth in this section.

ICAO Annex 1: Appendix 2, 1.1
14 CFR: 142.5(b); 147.5

3.2.1.7 DURATION AND RENEWAL OF ATO CERTIFICATE

(a) A certificate issued to an ATO, located either inside or outside [STATE] shall, be effective from the date of issue until—

(1) The 12th month after the date on which it was initially issued, subject to satisfactory compliance with the requirements of this Part; or

(2) The 24th month after the date on which it was renewed, subject to satisfactory compliance with the requirements of this Part; or

(3) The ATO surrenders the certificate, or

(4) The Authority suspends or revokes the certificate.

(b) The holder of a certificate that expires or is surrendered, suspended, or revoked by the Authority must return the certificate and training specifications to the Authority within 5 working days of expiration, surrender or receipt from the Authority of notice of suspension or revocation.

(c) A certificated ATO that applies for a renewal of its certificate must submit its request for renewal no later than 90 days before the current certificate expires. If a request for renewal is not made within this period, the ATO must follow the application procedures for initial issuance as prescribed by the Authority.

14 CFR: 141.17; 142.7;147.7

3.2.1.8 CONTINUED VALIDITY OF APPROVAL

(a) Unless the approval has previously been surrendered, superseded, suspended, revoked or expired by virtue of exceeding any expiration date that may be specified in the approval certificate, the continued validity of approval is dependent upon—

(1) The ATO remaining in compliance with this Part;

(2) The Authority being granted access to the organisation's facilities to determine continued compliance with this regulation; and

(3) The payment of any charges prescribed by the Authority.

ICAO Annex 1: Appendix 2, 1.1, 8
14 CFR: 141.21; 142.29; 147.43

3.2.1.9 INSPECTION

(a) The Authority may, at any time, inspect an ATO holder on the ATO holder's premises to determine the ATO's compliance with this Part.

(b) Inspections will be conducted at least annually.

(c) After an inspection is made, the certificate holder will be notified, in writing, of any deficiencies found during the inspection.

(d) Inspection will also be performed on the applicant for, or the holder of, an ATO certificate held outside the authorising [STATE]. This inspection may be delegated to the Authority of the State where the ATO is located, provided an arrangement exists.

ICAO Annex 1: Appendix 2, 8
14 CFR: 141.21, 142.29, 147.43
JAR-FCL1/2/4.055 App 1a and 2., para 9

3.2.1.10 SUSPENSION OR REVOCATION

(a) The Authority may suspend or revoke an ATO certificate if it is established that a certificate holder has not met, or no longer meets the requirements of Part 3.

ICAO Annex 1: Appendix 2, 1.1
14 CFR: 141.17; 142.7; 147.7
JAR-FCL 1/2/4.010; JAR 147.120

3.2.1.11 CHANGES TO THE ATO AND CERTIFICATE AMENDMENTS

(a) To enable the Authority to determine continued compliance with this Part, the ATO shall provide written notification to the Authority for approval at least 90 days prior to any of the following changes—

- (1) The name of the organisation;
- (2) The location of the organisation;
- (3) The facilities, equipment or staff that could affect the ATO certification or ratings;
- (4) Any ratings held by the ATO, whether granted by the Authority or held through an ATO certification issued by another contracting State;
- (5) Additional locations of the organisation;
- (6) Items in the Training and Procedures Manual, including the syllabi and curricula;
- (7) The accountable manager; or
- (8) The list of management personnel identified as described in the Training and Procedures Manual.

(b) The Authority will amend the ATO certificate if the ATO notifies the Authority of a change in—

- (1) Location or facilities or equipment;
- (2) Additional locations of the organisation;
- (3) Rating, including deletions;
- (4) Items in the Training and Procedures Manual, including the syllabi and curricula;
- (5) Name of the organisation with same ownership; or
- (6) Ownership.

(c) The Authority may amend the ATO certificate if the ATO notifies the Authority of a change in—

- (1) The accountable manager;
- (2) The list of management personnel identified as described in the Training and Procedures Manual; or.
- (3) Items in the Training and Procedures Manual, including the syllabi and curricula.

(d) When the Authority issues an amendment to an ATO certificate because of new ownership of the ATO, the Authority will assign a new certificate number to the amended ATO certificate.

(e) The Authority may—

- (1) Prescribe, in writing, the conditions under which the ATO may continue to operate during any period of implementation of the changes noted in subparagraph (a); and

(2) Hold the ATO certificate in abeyance if the Authority determines that approval of the ATO certificate should be delayed; the Authority will notify the ATO certificate holder, in writing, of the reasons for any such delay.

(f) If changes are made by the ATO to the items listed in subparagraph (a) without notification to the Authority and amendment of the ATO certificate by the Authority, the ATO certificate may be suspended, or revoked, by the Authority.

ICAO Annex 1: Appendix 2, 2.2; 2.3
14 CFR: 141.13; 142.11

3.2.1.12 LOCATION OF THE ATO

(a) Principal place of business. An applicant for, or holder of, a certificated ATO under this Part shall establish and maintain a principal place of business office that is physically located at the address shown on its certificate.

(b) Satellite ATOs. The holder of an ATO certificate may conduct training in accordance with a training programme approved by the Authority at a satellite ATO if:

(1) The facilities, equipment, personnel and course content of the satellite ATO meet the applicable requirements; and

(2) The instructors at the satellite ATO are under the direct supervision of management personnel of the principal ATO, and

(3) The Authority has issued training specifications to the ATO that reflect the name and address of the satellite ATO and the approved courses offered at the satellite ATO.

(c) Foreign locations of ATOs. An ATO or a satellite of an ATO approved by the Authority may be located in a country outside [STATE] and is subject to all the applicable requirements of this Part.

ICAO Doc 9841: Chapters 6 & 12
14 CFR: 141.25(a); 141.91; 142.17
JAR-FCL 1/2.055

3.2.1.13 FACILITIES, EQUIPMENT AND MATERIAL – GENERAL REQUIREMENTS

(a) The facilities and working environment of the ATO shall be appropriate for the task to be performed and acceptable to the Authority.

(b) The ATO shall have the necessary information, technical data, equipment, training devices and material to conduct the courses for which it is approved.

(c) Any training devices used by the ATO shall be qualified according to requirements established by the Authority and their use shall be approved by the Authority to ensure they are appropriate to the task.

(d) A certificate holder shall not make a substantial change in facilities, equipment or material that have been approved for a particular training programme, unless that change is approved in advance by the Authority.

(e) The facility that is the ATO principal place of business –

(1) Shall not be shared with, or used by, another ATO, and

(2) Shall be adequate to maintain the files and records required to operate the business of the ATO.

Note: The ICAO Doc 9625, Manual of Criteria for the Qualification of Flight Simulation Training Devices, provides guidance on the approval of flight simulation training devices.

ICAO Annex 1: Appendix 2, 6.1; 6.2; 6.3
13 CFR: 141.25(b)(c); 147.13
JAR-FCL 1.2.4.055; JAR 147.30

3.2.1.14 PERSONNEL – GENERAL REQUIREMENTS

(a) The ATO shall nominate a person responsible for ensuring that it is in compliance with the requirements for an approved organisation.

(b) The ATO shall employ the necessary personnel to plan, perform and supervise the training to be conducted.

(c) The competence of instructional personnel shall be in accordance with procedures and to a level acceptable to the Authority.

(d) The ATO shall ensure that all instructional personnel receive initial and recurrent training appropriate to their assigned tasks and responsibilities. The training programme established by the ATO shall include training in knowledge and skills related to human performance.

(1) The training programme for ATO employees shall be contained in the ATO Training and Procedures Manual.

Note: Guidance material to design training programmes to develop knowledge and skills in human performance can be found in ICAO Doc 9683, Human Factors Training Manual.

ICAO Annex 1: Appendix 2, 7.1; 7.2; 7.3, 7.4

3.2.1.15 RECORDKEEPING – GENERAL REQUIREMENTS

(a) Student records.

(1) The ATO shall retain detailed student records to show that all requirements of the training course have been met as approved by the Authority.

(2) These records shall be kept for a minimum period of two years after completion of the training.

(b) ATO staff records.

(1) The ATO shall maintain a system for recording the qualifications and training of instructional and examining staff, where appropriate.

(2) These records shall be kept for a minimum period of two years after the instructor or examiner ceases to perform a function for the ATO.

ICAO Annex 1: Appendix 2, 8.1, 8.2, 8.3

3.2.1.16 ATO APPROVED FOR TESTING

(a) The Authority may approve an ATO to conduct the testing required for the issuance of a licence or rating.

(b) The ATO personnel authorised to conduct the testing shall be approved by the Authority.

ICAO Annex1: Appendix 2, 10

3.2.1.17 QUALITY ASSURANCE AND QUALITY SYSTEM

(a) Quality assurance system. The ATO shall establish a quality assurance system, acceptable to the Authority, which ensures that training and instructional practices comply with all relevant requirements.

(b) The ATO shall establish a quality system, acceptable to the Authority, to ensure that training and instructional practices comply with all relevant requirements.

(c) The ATO quality assurance and quality system shall be established in accordance with the instruction and information contained in IS: 3.2.1.17.

ICAO Annex 1: Appendix 2: 5
ICAO Doc 9841, Appendix B

3.2.1.18 ATO TRAINING AND PROCEDURES MANUAL – GENERAL REQUIREMENTS

(a) The ATO shall provide a training and procedures manual, approved by the Authority, for the use and guidance of personnel concerned. This manual may be issued in separate parts and shall contain at least the following information:

(1) A general description of the scope of training authorised under the ATO's terms of approval;

(2) The content of the training programmes offered including the courseware and equipment to be used;

(3) A description of the organisation's quality assurance system;

(4) A description of the organisation's facilities;

(5) The name, duties and qualification of the person designated as the accountable manager;

(6) A description of the duties and qualification of the personnel responsible for planning, performing and supervising the training;

(7) A description of the procedures used to establish and maintain the competence of instructional personnel;

(8) A description of the method used for the completion and retention of the training records'

(9) A description, when applicable, of additional training needed to comply with an operator's procedures and requirements; and

(10) A description of the selection, role and duties of authorised persons approved to conduct testing for a licence or rating, when an ATO has been approved by the Authority to conduct such testing.

(b) The ATO shall ensure that the training and procedures manual is amended as necessary to keep the information contained therein up to date.

(c) The ATO shall promptly furnish copies of all amendments to the training and procedures manual to the Authority and other personnel and organisations to which the manual has been issued.

ICAO Annex 1: Appendix 2, 2.1; 2.2; 2.3

3.2.1.19 DUTY PERIOD LIMITATIONS

(a) A person who holds a flight instructor certificate shall not conduct more than 8 hours of flight training in any 24-consecutive-hour period.

(b) A flight simulation training device instructor, excluding briefing and debriefing, shall not conduct more than 8 hours of instruction in any 24-consecutive-hour period.

(c) A student in a certificated aviation maintenance technician school may not be required to attend classes of instruction more than 8 hours in any day or more than 6 days or 40 hours in any 7-day period.

14 CFR: 61.195; 142.49

3.2.1.20 ATO SAFETY MANAGEMENT SYSTEM

(a) An ATO shall implement a safety management system acceptable to the Authority as outlined in MCAR Part 1: 1.6.

ICAO Annex 1: 1.2.8.2
ICAO Annex 19: 4.1.2

3.2.1.21 OUTSOURCING TO THIRD-PARTY PROVIDERS

(a) The ATO may outsource courseware, facilities and equipment and instructional personnel to a third-party, provided that the ATO has been approved by the Authority --

(1) For the training that it to be conducted, and

(2) To contract with third-party to be used.

(b) The ATO shall be accountable for the quality of third-party providers, including suitability of courseware, facilities and equipment and instructional personnel, used to meet the ATO approved programmes.

ICAO Annex 1: Appendix 2, paragraph 2 and 7
ICAO Doc 9841, Chapter 8

3.3 ADDITIONAL REQUIREMENTS FOR INSTRUCTION FOR FLIGHT CREW LICENCES

3.3.1 GENERAL

(a) In addition to the requirements of Subpart 3.2, this subpart prescribes additional requirements for ATOs teaching flight crew curricula.

3.3.2 CURRICULUM APPROVAL

3.3.2.1 FLIGHT CREW TRAINING COURSES

(a) The Authority may approve, as provided in the training specifications, the ATO to conduct the following courses of instruction to an applicant for, or holder of an ATO certificate, provided the applicant meets the requirements of Part 2 and Part 3:

(1) Private pilot licence course;

(2) Commercial pilot licence course;

(3) Instrument rating course;

(4) Commercial pilot licence/Instrument rating-multi-engine/CRM integrated course;

(5) Multi-crew pilot licence course;

(6) Airline transport pilot licence course;

(7) Flight engineer licence course;

(8) Flight navigator licence course;

(9) Class rating course;

(10) Type rating course;

(11) Crew resource management course;

(12) Flight instructor course;

(13) Instructor course for additional type or class ratings;

(14) Instructor course for flight simulation training;

(15) Refresher courses; and

(16) Other courses as the Authority may approve.

Note 1: See ICAO Document 7192, Part B-5, Volume 1 and 2 for Integrated Commercial Pilot Course

Note 2: Course contents are not specified in detail in this Part 3 to allow courses to be tailored to specific training needs of students and to be updated promptly. For examples of course curricula, see for example, the ICAO Document 7192 Training Manual series, 14 CFR Part 141, Appendices, 14 CFR: Part 121, Appendix E.

14 CFR: 141.11

3.3.2.2 TRAINING COURSE APPROVAL – QUALIFICATION BASED AND ALTERNATE MEANS OF COMPLIANCE

(a) The applicant for, or holder of, an ATO certificate shall apply to the Authority for approval for each course to be offered or amended.

(1) The applicant or ATO shall submit two copies of the training course or amendment to the Authority as part of the application when applying for new or amended training course approval.

(2) The applicant or ATO shall submit the application to the Authority at least 30 days before any training under the course is scheduled to begin.

(b) Except as provided in 3.3.2.3 of this section, each training course for which approval is requested must meet the minimum ground and flight training time requirements specified in MCAR Part 2 for the licence, rating or authorisation sought.

(c) Each training course for which approval is requested must contain:

(1) A description of each room used for ground training, including the room size and the maximum number of students that may be trained in the room at one time;

(2) A description of each type of audiovisual aid, projector, tape recorder, mockup, chart, aircraft component, and other special training aids used for ground training;

(3) A description of each flight simulation training device used for training;

(4) A listing of the aerodromes at which training flights originate and a description of the facilities, including pilot briefing areas that are available for use by the ATO's students and personnel at each of those aerodromes;

(5) A description of the type of aircraft including any special equipment used for each phase of training;

(6) The minimum qualifications and ratings for each instructor assigned to ground or flight training; and

(7) A training syllabus that includes the following information—

(i) The prerequisites for enrolling in the ground and flight portion of the course that include the pilot certificate and rating (if required by this part), training, pilot experience, and pilot knowledge;

(ii) A detailed description of each lesson, including the lesson's objectives, standards, and planned time for completion;

(iii) A description of what the course is expected to accomplish with regard to student learning;

(iv) The expected accomplishments and the standards for each stage of training; and

(v) A description of the checks and tests to be used to measure a student's accomplishments for each stage of training.

14 CFR Part 141: 53; 141.55 (a)-(c)

3.3.2.3 TRAINING COURSE APPROVAL –ALTERNATIVE MEANS OF COMPLIANCE AND COMPETENCY BASED TRAINING AND ASSESSMENT

(a) An ATO may request and receive initial approval for a period of not more than 24 calendar months for any training course under this part that does not meet the minimum hours for a licence prescribed by MCAR Part 2, provided that:

(1) the ATO shows that the training will provide an equivalent level of competency at least equal to the minimum experience requirements for personnel not receiving such training, and

(2) the following provisions are met:

(i) The ATO holds an ATO certificate issued under this part and has held that certificate for a period of at least 24 consecutive calendar months preceding the month of the request;

(ii) In addition to the information required by 3.3.2.2(c) of this section, the training course specifies planned ground and flight training time requirements for the course;

(iii) The school does not request the training course to be approved for examining authority, nor may that school hold examining authority for that course; and

(iv) The knowledge test and/or skill test for the course is to be given by—

(A) A CAA inspector; or

(B) An examiner who is not an employee of the school.

(b) An ATO may request and receive final approval for any training course under this part that does not meet the minimum hours for a licence prescribed by MCAR Part 2, provided the following conditions are met:

(1) The ATO has held initial approval for that training course for at least 24 calendar months.

(2) The ATO has—

(i) Trained at least 10 students in that training course within the preceding 24 calendar months and recommended those students for a pilot, flight instructor, or ground instructor certificate or rating; and

(ii) At least 80 percent of those students passed the skill or knowledge test, as appropriate, on the first attempt, and that test was given by—

(A) A CAA inspector; or

(B) An examiner who is not an employee of the school.

(3) In addition to the information required by 3.3.2.2 (c) of this section, the training course specifies planned ground and flight training time requirements for the course.

(4) The ATO does not request that the training course be approved for examining authority nor may that school hold examining authority for that course.

ICAO Annex 1: 1.2.8.1; 1.2.8.2
14 CFR: 141 55(d); 141.57, 142.39
JAR-FCL1/2/4.055 App.1a, para 3, 24, App. 2 para 3, 21, App. 1 para 21

3.3.3 PERSONNEL

(a) The applicant for an ATO certificate or a current certificate holder teaching flight crew curricula shall have on the staff the following—

(1) An Accountable manager;

(2) A Quality Manager;

(3) A Head of Training;

(4) A Chief Flight Instructor, as applicable;

(5) A Chief Ground Instructor, as applicable; and

(6) An adequate number of ground and flight instructors relevant to the courses provided.

(b) Each instructor to be used for training shall have received the appropriate training and hold the appropriate licences and/or ratings as required by Part 2.

(c) The duties and qualifications of the personnel listed in this paragraph are contained in IS: 3.3.3.

ICAO Annex 1: Appendix 2, 6.1; 6.2; 6.3
14 CFR: 141.33; 142.13; 147.23
JAR-FCL 1/2/4.055

3.3.4 FACILITIES REQUIRED FOR FLIGHT CREW TRAINING

3.3.4.1 TRAINING FACILITIES

(a) An applicant for, and holder of an ATO certificate teaching flight crew curricula shall have facilities, as determined by the Authority, appropriate for the maximum number of students expected to be taught at any time, as follows:

(1) Flight operations facilities:

(i) An operations room

(ii) A flight planning room

(iii) Adequate briefing rooms;

(iv) Offices for the instructors.

(2) Knowledge instruction facilities, including—

(i) Classroom accommodation;

(ii) Suitable demonstration equipment;

(iii) An RT training and testing facility;

(iv) A library;

(v) Offices for instructors.

14 CFR: 141.43; 141.45; 142.15; 142.17
JAR-FCL 1/2/4.055

3.3.4.2 TRAINING AIRCRAFT

(a) An applicant for, or holder of, an ATO certificate must ensure that each aircraft used for flight instruction and solo flights meets the following requirements:

(1) Except for flight instruction and solo flights in a curriculum for agricultural aircraft operations, external load operations, and similar aerial work operations, the aircraft must have a [STATE] standard airworthiness certificate or a foreign equivalent of a [STATE] standard airworthiness certificate acceptable to the Authority.

(2) The aircraft must be maintained and inspected in accordance with Part 8: 8.3 and an approved maintenance programme.

(3) The aircraft must be equipped as provided in the training specifications for the approved course for which it is used.

(4) Except as provided in (5) below, each aircraft used in flight training must have at least two pilot stations with engine-power controls that can be easily reached and operated in a normal manner form both pilot stations;

(5) Airplanes with controls such as nose-wheel steering, switches, fuel selectors, and engine air flow controls that are not easily reached and operated in a conventional manner by both pilots may be used for flight instruction if the certificate holder determines that the flight instruction can be conducted in a safe manner considering the location of controls and their non-conventional operation, or both.

(6) Each aircraft used in a course involving instrument flight rule en route operations and instrument approaches must be equipped and maintained for instrument flight rule operations. For maneuvering of an aircraft by reference to instruments, the aircraft may be equipped as provided in the approved course of training.

14 CFR: 141.39; 142.57
JAR-FCL 1/2/4.055

3.3.4.3 FLIGHT SIMULATION TRAINING DEVICES

(a) An applicant for, or holder of an ATO certificate, approved to use flight simulation training devices, shall show that each flight simulation training device used for training and checking will be or is specifically qualified and approved by the Authority for:

(1) Each manoeuvre and procedures for the make, model and series of aircraft, set of aircraft, or aircraft type simulated, as applicable; and

(2) Each training programme or training course in which the flight simulation training device is used.

(b) Each qualified and approved flight simulation training devices used by an ATO must:

(1) Be maintained to ensure the reliability of the performances, functions, and all other characteristics that were required for their qualification;

(2) Be modified to confirm with any modification to the aircraft being simulated if the modification results in changes to performance, functions, or other characteristics required for qualification;

(3) Be given a functional preflight check each day before being used; and

(4) Have a discrepancy log in which the instructor or evaluator, at the end of each training session, enters each discrepancy.

14 CFR: 141.41; 142.59
JAR-FCL 1/2.055(a)(4)

3.3.4.4 AERODROMES AND SITES

(a) Each applicant for, and holder of, an ATO certificate shall show that it has continuous use of each aerodrome and site (for helicopter training) at which training flights originate, and that the aerodrome has an adequate runway and the necessary equipment.

(b) The base aerodrome, and any alternative base aerodrome, at which flying training is being conducted shall have at one runway or take-off area that allows training aircraft to make a normal take-off or landing at the maximum certificated take-off or maximum certificated landing mass, under the following conditions:

(1) Under calm wind (not more than four knots) conditions;

(2) At temperatures equal to the mean high temperature for the hottest month of the year in the operating area;

(3) If applicable, with the powerplant operation, and landing gear and flap operation recommended by the manufacturer; and

(4) In the case of a takeoff—

(i) clearing all obstacles in the take-off flight path by at least 50 feet;

(ii) with a smooth transition from lift-off to the best rate of climb speed without exceptional piloting skills or techniques;

(c) Each airport must have a wind direction indicator that is visible at ground level from the ends of each runway;

(1) Have adequate runway electrical lighting if used for night training; and

(2) Have a traffic direction indicator when:

(i) the airport does not have an operating control tower; and

(ii) traffic and wind advisories are not available.

(d) Except as specified in item (e) below, each airport used for night training flights must have permanent runway lights

(e) An airport or seaplane base used for night training flights in seaplanes may be approved by the Authority to use adequate, non-permanent lighting or shoreline lighting.

(f) Sites shall be available for:

(1) confined area operation training;

(2) simulated engine off autorotation;

(3) sloping ground operation.

14 CFR 141.38
JAR-FCL1/2.055 App.1a, para 27, resp. 27/28

3.3.5 ADDITIONAL, SPECIFIC OPERATING RULES FOR FLIGHT CREW TRAINING

3.3.5.1 TRAINING AND PROCEDURES MANUAL

(a) Each applicant for, or holder of an ATO certificate shall prepare and maintain a Training Manual and a Procedures Manual containing information and instructions to enable staff to perform their duties and to give guidance to students on how to comply with course requirements.

(b) The Training Manual and Procedures Manual may be combined.

(c) The ATO shall ensure that the Training Manual and the Procedures Manual are amended as necessary to keep the information contained therein up to date.

(d) Copies of all amendments to the Training Manual and the Procedures Manual shall be furnished promptly by the ATO to all organisations or persons to whom the manual has been issued.

(e) See IS 3.3.5.1 for detailed requirements for the Training Manual and the Procedures Manual and format for each manual.

ICAO Annex 1: Appendix 2, 2.1; 2.2; 2.3
ICAO Doc 9841, Manual on the Approval of Flight Crew Training Organisations
14 CFR: 141 Subpart C,E 142 Subpart B, D
JAR-FCL1/2/4.055 App. 1a and 2, para 31-33, App. 2 para 25-27, App. 1 para 25-27

3.3.5.2 RECORD KEEPING FOR FLIGHT CREW TRAINING

(a) Students. An ATO that is approved to conduct flight crew training shall maintain a record for each trainee that contains—

(1) The name of the trainee

(2) A copy of the trainee's airman certificate, if any, and any medical certificate;

(3) The name of the course and the make and model of flight training equipment used;

(4) The trainee's prerequisite experience and course time completed;

(5) The trainee's performance on each lesson and the name of the instructor providing instruction;

(6) The date and result of each end-of-course skill test and the name of the examiner conducting the test; and

(7) The number of hours of additional training that was accomplished after any unsatisfactory skill test.

(b) ATO staff. An ATO that is approved to conduct flight crew training shall maintain a record for each instructor approved to instruct a course approval in accordance with this subpart, that indicates the instructor has complied with all applicable instructor requirements of these regulations.

(c) Record retention. An ATO shall keep all records for a minimum period of two years

(1) For students, from the date of completion of training, testing or checking;

(2) For ATO staff, from the date of the last employment.

(d) The ATO shall make the records available to the Authority upon request and at a reasonable time and shall keep the records –

(1) For students, at the ATO or satellite ATO where the training, testing, or checking occurred, and

(2) For ATO staff, at the ATO or satellite ATO where the person is employed.

(e) The ATO shall provide to a trainee, upon request, and at a reasonable time, a copy of his or her training records.

ICAO Annex 1: Appendix 2, 7.1; 7.2; 7.3
14 CFR: 141.101; 142. 73

3.3.5.3 GRADUATION CERTIFICATE

(a) An ATO shall issue a graduation certificate to each student who completes its approved course of training.

(b) The graduation certificate must be issued to the student upon completion of the course of training and contain at least the following information;

(1) The name and certificate number of the ATO;

(2) The name of the graduate who whom it was issued;

(3) The course of training for which it was issued;

(4) The date of graduation;

(5) A statement that the student has satisfactorily completed each required stage of the approved course of training including the tests for those stages;

(6) A certification of the information contained on the graduation certificate by the chief instructor for that course of training; and a statement showing the cross-country training that the student received in the course of training.

14 CFR: 141.95

3.3.5.4 EXAMINING AUTHORITY FOR ATO'S TEACHING FLIGHT CREW CURRICULUMS

(a) An ATO shall meet the following prerequisites to receive initial approval for examining authority:

(1) The ATO must complete the application for examining authority on a form and in a manner prescribed by the Authority;

(2) The ATO must hold an ATO certificate and rating issued under this Part;

(3) The ATO must have held the rating in which examining authority is sought for at least 24 consecutive calendar months preceding the month of application for examining authority;

(4) The training course for which examining authority is requested may not be a course that is approved without meeting the minimum ground and flight training time requirements of this part; and

(5) Within 24 calendar months before the date of application for examining authority, at least 90 percent of the students in the ATO must have passed the required skill or knowledge test, or any combination thereof, for the licence or rating for which examining authority is sought, on the first attempt, and that test was given by—

(i) A CAA inspector; or

(ii) A designed examiner who is not an employee of the ATO.

(b) The examining authority of the ATO is valid for 24 months, unless suspended or revoked by the Authority, and may be renewed upon request to the Authority by the ATO.

(c) An ATO that holds examining authority may recommend a person who graduated from its course for the appropriate knowledge or skill test.

(d) The ATO that holds examining authority will administer the tests or checks as required by MCAR Parts 2 or 8, as appropriate to the licence or rating sought.

(e) A pilot school that holds examining authority must maintain—

(1) A record of all temporary airman licences or ratings it issues, which consist of the following information in chronological order:

(i) The date the temporary airman licence was issued;

(ii) The student to whom the temporary airman certificate was issued, and that student's permanent mailing address and telephone number;

(iii) The training course from which the student graduated;

(iv) The name of person who conducted the knowledge or practical test;

(v) The type of temporary airman licence or rating issued to the student; and

(vi) The date the student's airman application file was sent to the Authority for processing for a permanent airman licence.

(f) A copy of the record containing each student's graduation certificate, airman application, temporary airman licence, superseded airman licence (if applicable), and knowledge test or skill test results; and

(g) Retain these records for 2 years and make them available to the Authority upon request. These records must be surrendered to the Authority when the ATO ceases to have examining authority.

14 CFR: 141.61; 141.65; 141.67; 142.65

3.3.5.5 STUDENT TRANSFER OF CREDIT BETWEEN ATO'S TEACHING A FLIGHT CREW CURRICULUM

(a) A person who transfers from one ATO to another ATO may receive credit for that previous flight crew training, provided the following requirements are met:

(1) The maximum credited training time does not exceed one-half of the receiving ATO's curriculum requirements;

(2) The person completes a knowledge and proficiency test conducted by the receiving ATO for the purpose of determining the amount of experience and knowledge to be credited;

(3) The receiving ATO determines, based on the person's performance on the knowledge and proficiency test required by paragraph (a)(2) of this section, the amount of credit to be awarded, and records that credit in the person's training record;

(4) The person who requests credit for previous experience and knowledge obtained the experience and knowledge from another ATO approved training course; and

(5) The receiving ATO retains a copy of the person's training record from the previous ATO.

3.3.5.6 INSPECTIONS OF THE ATO TEACHING FLIGHT CREW CURRICULA

(a) Each ATO shall allow the Authority to inspect the ATO facilities, equipment and records at any reasonable time and in any reasonable place in order to determine compliance with these regulations and the ATO's certificate and training specifications.

ICAO Annex 1: Appendix 2, 8
14 CFR: 141.21; 143.29

3.4 ADDITIONAL REQUIREMENTS FOR INSTRUCTION FOR MAINTENANCE LICENCES AND TRAINING

3.4.1 GENERAL

(a) In addition to the requirements of Subpart 3.2, this subpart prescribes additional requirements for ATO's teaching maintenance curricula.

3.4.2 CURRICULUM APPROVAL

3.4.2.1 MECHANIC TRAINING COURSES

(a) The Authority may approve, as provided in the training specifications, the ATO to conduct the following courses of instruction to an applicant for, or the holder of an ATO certificate, provided the applicant meets the requirements of Part 2 and Part 3:

(1) Aircraft Mechanic Technician licence course;

(2) Airframe rating course;

(3) Powerplant rating course;

(4) Airframe and Powerplant combined ratings course;

(5) Avionics rating course; and

(6) Other courses as the Authority may approve.

14 CFR: 147.11
JAR 147.15

3.4.2.2 TRAINING COURSE APPROVAL—QUALIFICATION BASED AND ALTERNATE MEANS OF COMPLIANCE

(a) An applicant for an ATO certificate shall apply to the Authority for approval for each course to be offered or amended.

(1) The applicant or ATO shall submit a copy of the training course or amendment to the Authority as part of the application when applying for new or amended training course approval.

(2) The applicant or ATO shall submit the application to the Authority at least 30 days before any training under the course is scheduled to begin.

(b) Except as provided in 3.4.2.3 of this section, each training course for which approval is requested must meet the minimum training time requirements specified in MCAR Part 2 for the licence, rating or authorisation sought.

(c) Each training course for which approval is requested must contain:

(1) A description of each room used for training, including the room size and the maximum number of students that may be trained in the room at one time;

(2) A description of each type of audiovisual aid, projector, tape recorder, mockup, chart, aircraft component, and other special training aids used for training;

(3) A description of the minimum equipment to be used in each course;

(4) The minimum qualifications and ratings for each instructor assigned to training, including initial and continuing training; and

(5) A training syllabus that includes the following information—

(i) The prerequisites for enrolling in the course;

(ii) A detailed description of each lesson, including the lesson's objectives, standards, and planned time for completion;

(iii) The subjects and items to be covered and the level of proficiency to meet;

(iv) For each subject, the proportions of theory and other instruction to be given;

(v) A description of what the course is expected to accomplish with regard to student learning,

(vi) The expected accomplishments and the standards for each stage of training, including the required practical projects to be completed; and

(vii) A description of the checks and tests to be used to measure a student's accomplishments for each stage of training.

14 CFR Part 141: 53; 141.55 (a)-(c); 147:21

3.4.2.3 TRAINING COURSE APPROVAL—ALTERNATIVE MEANS OF COMPLIANCE AND COMPETENCY BASED TRAINING AND ASSESSMENT

(a) An ATO may request and receive initial approval for a period of not more than 24 calendar months for any training course under this part that does not meet the minimum hours for a licence prescribed by MCAR Part 2, provided that:

(1) The ATO shows that the training will provide an equivalent level of competency at least equal to the minimum experience requirements for personnel not receiving such training, and

(2) The following provisions are met:

(i) The ATO holds an ATO certificate issued under this part and has held that certificate for a period of at least 24 consecutive calendar months preceding the month of the request;

(ii) In addition to the information required by 3.4.2.2(c) of this section, the training course specifies planned training time requirements for the course;

(iii) The school does not request the training course to be approved for examining authority, nor may that school hold examining authority for that course; and

(iv) The knowledge test and/or skill test for the course is to be given by—

(A) A CAA inspector; or

(B) An examiner who is not an employee of the school.

(b) An ATO may request and receive final approval for any training course under this part that does not meet the minimum hours for a licence prescribed by MCAR Part 2 , provided the following conditions are met:

(1) The ATO has held initial approval for that training course for at least 24 calendar months.

(2) The ATO has—

(i) Trained at least 10 students in that training course within the preceding 24 calendar months and recommended those students for an AMT certificate or rating; and

(ii) At least 80 percent of those students passed the skill or knowledge test, as appropriate, on the first attempt, and that test was given by—

(A) A CAA inspector; or

(B) An examiner who is not an employee of the school.

(3) In addition to the information required by 3.4.2.2 (c) of this section, the training course specifies planned theoretical knowledge and practical training time requirements for the course.

(4) The ATO does not request that the training course be approved for examining authority nor may that school hold examining authority for that course.

ICAO Annex 1: 1.2.8.1; 1.2.8.2
14 CFR 141.55(d); 141.57, 142.39,147.21

3.4.3 PERSONNEL

(a) The applicant for an ATO certificate or current certificate holder teaching maintenance curricula shall have on the staff the following—

(1) An Accountable Manager;

(2) A Quality Manager;

(3) A Head of Training;

(b) An adequate number of instructors relevant to the courses provided.

(c) Each instructor to be used for training shall have received the appropriate training and hold the appropriate licence and/or rating as required by Part 2.

(d) The duties and qualifications of training and instruction staff as follows:

(1) Head of Training. The Head of Training shall have overall responsibility for ensuring satisfactory integration of theoretical knowledge instruction and practical training and for supervising the progress of individual students. The Head of Training shall have had extensive experience in training as an instructor for AMT licensing and possess a sound managerial capability.

(2) Instructors.

(i) Each ATO shall provide the number of instructors holding appropriate licences and ratings, issued under Part 2, that the Authority determines is necessary to provide adequate instruction and supervision of the students.

(ii) An ATO may provide specialised instructors, who are not licensed but who are approved in accordance with Part 2, to teach mathematics, physics, basic electricity, basic hydraulics, drawing, and similar subjects.

14 CFR: 147.36

3.4.4 FACILITIES REQUIRED FOR MECHANIC TRAINING

(a) An applicant for, and holder of, an ATO certificate shall have facilities, as determined by the Authority, appropriate for the maximum number of students expected to be taught at any time, as follows:

(1) An enclosed classroom.

(2) Suitable facilities arranged to assure proper separation from the working space, for parts, tools, materials and similar articles.

(3) Suitable area for application of finishing materials, including paint spraying.

(4) Suitable areas equipped with washtank and degreasing equipment with air pressure or other adequate cleaning equipment.

(5) Suitable facilities for running engines.

(6) Suitable area with adequate equipment, including benches, tables, and test equipment, to disassemble, service and inspect:

(i) Ignition systems, electrical equipment and appliances;

(ii) Carburettors and fuel systems; and

(iii) Hydraulic and vacuum systems for aircraft, aircraft engines, and their appliances.

(7) Suitable space with adequate equipment, including tables, benches, stands and jacks for disassembling, inspecting and rigging aircraft.

(8) Suitable space with adequate equipment for disassembling, inspecting, assembling, troubleshooting and timing engines.

(b) An applicant for, or holder of an ATO certificate with approved AMT courses shall have and maintain the following instructional equipment as is appropriate to the rating sought:

(1) various kinds of airframe structures, airframe systems and components, powerplants and powerplant system and components (including propellers) of a quantity and type suitable to complete the practical projects required by its approved training programme;

(2) at least one aircraft of a type acceptable to the Authority;

(c) An applicant for, or holder of an ATO certificate with an AMT rating shall have airframes, powerplants, propellers, appliances and components thereof, to be used for instruction and from which students will gain practical working experience and shall insure that the airframes, powerplants, propellers, appliances and components thereof be sufficiently diversified as to show the different methods of construction, assembly, inspection and operation when installed in an aircraft for use.

(d) An applicant for an ATO certificate with an AMT rating, or an applicant seeking an additional AMT rating, shall have at least the facilities, equipment and materials appropriate to the rating sought.

(e) An applicant for, or holder of, an ATO certificate with an AMT rating shall maintain, on the premises and under the full control of the ATO, an adequate supply of material, special tools and shop equipment used in constructing and maintaining aircraft as is appropriate to the approved training programme of the ATO, in order to assure that each student will be properly instructed.

(f) A certificate holder may not make a substantial change in facilities, equipment or material that have been approved for a particular training programme, unless that change is approved by the Authority in advance.

14 CFR: 147.13, 147.17, 147.19, 147.37
JAR 147.30, 45, 50

3.4.5 ADDITIONAL, SPECIFIC OPERATING RULES FOR MAINTENANCE TRAINING

3.4.5.1 TRAINING AND PROCEDURES MANUAL

(a) Each applicant for, or holder of an ATO certificate shall prepare and maintain a Training Manual and a Procedures Manual containing information and instructions to enable staff to perform their duties and to give guidance to students on how to comply with course requirements.

(b) The Training Manual and Procedures Manual may be combined.

(c) The ATO shall ensure that the Training Manual and the Procedures Manual is amended as necessary to keep the information contained therein up to date.

(d) Copies of all amendments to the Training Manual and the Procedures Manual shall be furnished promptly by the ATO to all organisations or persons to whom the manual has been issued.

(e) See IS: 3.4.5.1 for detailed requirements for the Training Manual and the Procedures Manual and the format for each manual.

14 CFR: 147.21
JAR 147.65

3.4.5.2 RECORDKEEPING

(a) Students. An ATO that is approved to conduct maintenance training shall maintain a record for each trainee that contains—

  (1) The name of the trainee

  (2) A copy of the trainee's airman certificate, if any;

  (3) The name of the course and the instruction credited;

  (4) The trainee's prerequisite experience and course time completed;

  (5) The trainee's performance on each lesson and the name of the instructor providing instruction;

(6) The date and result of each end-of-course test and the name of the examiner conducting the test; and

(7) The number of hours of additional training that was accomplished after any unsatisfactory test.

(8) A current progress chart or individual progress record for each student, showing the practical projects or laboratory work completed, or to be completed, in each subject.

(b) ATO staff. An ATO that is approved to conduct maintenance training shall maintain a record for each instructor approved to instruct a course approval in accordance with this subpart, that indicates the instructor has complied with all applicable instructor requirements of these regulations.

(c) Record retention. An ATO shall keep all records for a minimum period of two years

(1) For students, from the date of completion of training or testing

(2) For ATO staff, from the date of the last employment.

(d) The ATO shall make the records available to the Authority upon request and at a reasonable time and shall keep the records –

(1) For students, at the ATO or satellite ATO where the training, testing, or checking occurred, and

(2) For ATO staff, at the ATO or satellite ATO where the person is employed.

(e) The ATO shall provide to a trainee, upon request, and at a reasonable time, a copy of his or her training records.

ICAO Annex 1: Appendix 2, 7.1; 7.2; 7.3
14 CFR: 147.33
JAR 147.55

3.4.5.3 GRADUATION CERTIFICATE

(a) An ATO shall issue a graduation certificate to each student who completes its approved course of training.

(b) The graduation certificate must be issued to the student upon completion of the course of training and contain at least the following information;

(1) The name and certificate number of the ATO;

(2) The name of the graduate who whom it was issued;

(3) The course of training for which it was issued;

(4) The date of graduation;

(5) A statement that the student has satisfactorily completed each required stage of the approved course of training including the tests for those stages;

(6) A certification of the information contained on the graduation certificate by the Head of Training for that course of training.

14 CFR: 147.35

3.4.5.4 EXAMINING AUTHORITY FOR ATO'S TEACHING MAINTENANCE CURRICULA

(a) An ATO shall meet the following prerequisites to receive initial approval for examining authority:

(1) The ATO must complete the application for examining authority on a form and in a manner prescribed by the Authority;

(2) The ATO must hold an ATO certificate and rating issued under this Part;

(3) The ATO must have held the rating in which examining authority is sought for at least 24 consecutive calendar months preceding the month of application for examining authority;

(4) Within 24 calendar months before the date of application for examining authority, at least 90 percent of the students in the ATO must have passed the required skill or knowledge test, or any combination thereof, for the licence or rating for which examining authority is sought, on the first attempt, and that test was given by—

(i) A CAA inspector; or

(ii) A designed examiner who is not an employee of the ATO.

(b) The examining authority of the ATO is valid for 24 months, unless suspended or revoked by the Authority, and may be renewed upon request to the Authority by the ATO.

(c) An ATO that holds examining authority may recommend a person who graduated from its course for the appropriate knowledge or skill test.

(d) The ATO that holds examining authority will administer the tests as required by MCAR Part 2 as appropriate to the licence or rating sought.

(e) An ATO that holds examining authority may conduct knowledge and skill tests on a progressive schedule if approved by the Authority. This may be necessary due to the length and complexity of an inclusive maintenance training programme.

(f) An ATO that holds examining authority must maintain—

(1) A record of all temporary airman licences or ratings it issues, which consist of the following information in chronological order:

(i) The date the temporary airman licence was issued;

(ii) The student to whom the temporary airman certificate was issued, and that student's permanent mailing address and telephone number;

(iii) The training course from which the student graduated;

(iv) The name of person who conducted the knowledge or skill test;

(v) The type of temporary airman licence or rating issued to the student; and

(vi) The date the student's airman application file was sent to the Authority for processing for a permanent airman licence.

(2) A copy of the record containing each student's graduation certificate, airman application, temporary airman licence, superseded airman licence (if applicable), and knowledge test or skill test results; and

(3) Retain these records for 2 years and make them available to the Authority upon request. These records must be surrendered to the Authority when the ATO ceases to have examining authority.

14 CFR: 141.61; 141.65; 141.67; 142.65

3.4.5.5 STUDENT TRANSFER OF CREDIT BETWEEN ATO'S TEACHING A MAINTENANCE CURRICULUM

(a) A person who transfers from one ATO to another ATO may receive credit for that previous maintenance training, provided the following requirements are met:

(1) The maximum credited training time does not exceed one-half of the receiving ATO's curriculum requirements for the licence or rating;

(2) The person completes a knowledge and practical test conducted by the receiving ATO for the purpose of determining the amount of experience and knowledge to be credited;

(3) The receiving ATO determines, based on the person's performance on the knowledge and practical test required by paragraph (a)(2) of this section, the amount of credit to be awarded, and records that credit in the person's training record; and

(4) The receiving ATO retains a copy of the person's training record from the previous ATO.

14 CFR: 147.31

3.4.5.6 INSPECTIONS OF THE ATO TEACHING MAINTENANCE CURRICULA

(a) Each ATO shall allow the Authority to inspect the ATO facilities, equipment and records at any reasonable time and in any reasonable place in order to determine compliance with these regulations and the ATO's certificate and training specifications.

ICAO Annex 1: Appendix 2, 8
14 CFR: 147.43

MODEL CIVIL AVIATION REGULATIONS

PART 3 — IMPLEMENTING STANDARDS

[STATE]

VERSIONS 2.8

NOVEMBER 2014

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PART 3 — IMPLEMENTING STANDARDS

IS 3.2.1.3 APPROVED TRAINING ORGANISATION CERTIFICATE

[STATE]

APPROVED TRAINING ORGANISATION CERTIFICATE

Number:

This certificate is issued to:

Whose principal business address is:

Upon finding that its organisation complies in all respects with the regulations of the [Civil Aviation Regulations Part 3] relating to the establishment of an Approved Training Organisation and is empowered to operate an Approved Training Organisation in accordance with the Training Specifications issued herewith, and may conduct the following courses:

This certificate shall continue in effect, unless surrendered, superseded, suspended, revoked or expired, until (enter date 12 months after first issue, 24 months after second and further issues).

Date of Issue: dd/mm/yyyy

Signature: ____
Printed Name: _____________________________________
Title: ____

This certificate is non-transferable.

FAA Order 8700.1, Vol. 2, Chapter 149, p 149-27.

IS 3.2.1.17 QUALITY ASSURANCE AND QUALITY SYSTEM

(a) In order to show compliance with 3.2.1.17, an ATO should establish its quality assurance and quality system in accordance with the instruction and information contained in the following paragraphs.

1. 0 Quality policy and strategy

1.1 The ATO shall describe how the organisation formulates, deploys and reviews its policy and strategy and turns them into plans and actions applicable to all levels of the organisation. A formal written quality policy statement should be prepared, establishing a commitment by the accountable executive of the training organisation to achieving and maintaining the highest possible standards in quality. The quality policy should reflect the achievement and continued compliance with all applicable [STATE] regulations and any additional standards specified by the ATO.

1.2 The accountable executive of the training organisation will have the overall responsibility for the standard in quality including the frequency, format and structure of the internal management review and analysis activities and may delegate the responsibility for the tasks defined under paragraph 2 of this Appendix to a quality manager. Depending on the size and scope of the organisation and the requirements of the Licensing Authority, the accountable executive and quality manager may interact in different ways as illustrated in the organisational charts in ICAO Doc 9841, Appendix C.

2.0 Quality manager

2.1 The primary role of the quality manager is to verify, by monitoring activities in the field of training, that the standards as established by the ATO and any additional requirements of the Licensing Authority are being carried out properly.

2.2 The quality manager should be responsible for ensuring that the quality system is properly documented, implemented, maintained and continuously reviewed and improved.

2.3 The quality manager should:

(a) report directly to the head of training (see Note); and

(b) have unencumbered access to all parts of the ATO.

Note: When the head of training is not the accountable executive, reporting mechanisms should be instituted to ensure that the accountable executive is aware of all issues impacting the quality of the training services being provided by the affected ATO (see example 2 in ICAO Doc 9841, Appendix C).

2.4 The quality manager should be responsible for ensuring that personnel training related to the quality system is conducted.

3. 0 Quality assurance

3.1 The term quality assurance is frequently misunderstood to mean the testing and checking of products and services. Organisations that only do checking and testing activities are merely applying ‘quality control’ measures, which are designed to catch product and service defects, but not necessarily prevent them. For example, an ATO that administers exams at the end of the training syllabus, only to discover that a large proportion of the students have failed to meet the required standard has only identified a deficiency in expected results. The implication would be that there could be a problem with the training programme, or the instructor, or even the student selection criteria. In this instance, the ATO has no idea what the real problem is or what to do about it. Quality control, by itself, provides limited value without the suite of complementary activities that comprise QA.

3.2 QA, on the other hand, attempts to improve and stabilise the training process to identify and avoid, or at least minimise, issues that lead to problems in the first place. It continuously verifies that standards are adhered to throughout the training process by introducing various checkpoints and controls. It further introduces a system of audits to ensure that documented policies, processes, and procedures are consistently followed. It is the 'assurance' part of quality management.

A QA plan for an ATO should encompass well-designed and documented policies, processes and procedures for at least the following activities.

(a) Monitor training services and process controls;

(b) Monitoring assessment and testing methods;

(c) Monitor personnel qualifications and training;

(d) Monitor training devices and equipment qualification, calibration and functionality, as applicable;

(e) conduct internal and external audits;

(f) develop, implement, and monitor corrective and preventive actions and associated reporting systems; and

(g) utilise appropriate statistical analysis to identify and respond appropriately to trends.

3.4 An effective QA plan will aid significantly in the ATO's compliance with requirements, its conformity with the standards and the adequacy of its training activities. To take the ATO's performance to a higher level requires a structure that ensures that the combined QA effort of the employees reaches its full potential.

Note: Annex 1 only requires ATOs to establish and implement QA policies, processes, and procedures acceptable to the Licensing Authority granting the approval, which ensures that training and instructional practices comply with all relevant requirements.

3.5 QA plans by themselves are subject to breakdowns in human performance and therefore are in need of robust organisational structures that underpin the QA efforts of individuals. It is for this reason that ATOs and States should embrace the quality system governance model described in this Appendix.

4. Quality system for the ATO

4.1 A quality system is the aggregate of all the organisation's activities, plans, policies, processes, procedures, resources, incentives, and infrastructure working in unison towards a total quality management approach. It requires an organisational construct complete with policies, processes, procedures, and resources that underpins a commitment to achieve excellence in product and service delivery through the implementation of best practices in quality management.

4.2 An ATO that supports its QA plan with a well-designed, implemented and maintained quality system structure should be able to easily and repeatedly achieve results that exceed both the requirements of the applicable national regulations and the expectations of the ATO's clients.

4.3 The basic attributes of an effective quality system should include, but are not necessarily limited to:

(a) A managerial structure that facilitates and encourages clear and unencumbered access to the decision makers;

(b) An overarching company commitment to achieve excellence in training service delivery rather than meeting minimum requirements;

(c) Quality policies, processes, and procedures that are well-designed, consistently applied and subject to formalised review and refinement processes;

(d) An employee training plan that instils and promotes best practices in quality management efforts;

(e) an organisational risk profile and corresponding risk management plan, which together provide a comprehensive list of hazards that are tied to the ATO's activities and establish mitigating measures to effectively manage those risks, which threaten the achievement of desired standards of performance; and

(f) a strategic review of policies and procedures, which measures the organisation's current assumptions, objectives and plans by applying a relevance test matched to evolving trends in the industry or changes occurring within the ATO.

5. Organisational risk profile

5.1 An organisational risk profile is an inventory of identified hazards and threats that present risks, which are likely to prevent conformity with the required standards of performance. This 'threat to quality' list is normally derived at by first establishing a directory of those activities that routinely take place in order to deliver and administer a training programme. Once complete, the activity directory is then expanded to identify the hazards and threats associated with each individual activity. Some examples of routine activities that should be examined during this process are:

(a) selection and training of staff;
(b) training programme development, validation, and review;
(c) development and maintenance of training courseware;
(d) administrative staff duties in support of the training programme; instructors and evaluators, and students;
(e) delivery of training;
(f) record keeping;
(g) assessment and examination processes; and
(h) client and Authority feedback.

5.2 The risks identified through this exercise should not be limited to just those which currently exist, but should also include those potential risks that could arise from a change to existing circumstances or conditions.

6. Risk management plan

6.1 A risk management plan is designed to mitigate the identified risks, real or potential, which were derived from the organisational risk profile exercise. The plan's objective is not to eliminate risk so much as it is to effectively manage risk by putting in place risk controlling measures.

6.2 A well developed and implemented risk management plan will substantially aid in accurately scoping out the depth and frequency of planned QA related activities.

6.3 The plan should be subject to the management review process outlined in paragraph 4.3(f) of this Appendix.

6.4 The current risk management plan should be readily accessible to all employees so that it can be accurately followed and open to comment for improvement.

7. Coherence matrix

7.1 A coherence matrix, sometimes known as a correspondence matrix, is a very powerful addition to the ATO's compliance efforts. It is a detailed tabulated document that lists all the applicable regulatory requirements imposed on the ATO. Beside each listed provision there should be at least two descriptive elements that identify:

(a) the existing process(es) that is (are) designed to ensure continuous compliance with that specific regulatory rule or standard; and
(b) the individual managerial position responsible for the effective implementation of each process

7.2 The coherence matrix should indicate the next intended and most recently completed audits designed to validate the functionality of each of the identified process. Any recent audit findings should be listed in the matrix or referred to as being documented in a separate 'register of findings'.

The coherence matrix is developed and managed by the quality manager and is subject to the management review process.

7.4 The current coherence matrix should be readily accessible to all employees so that it can be accurately followed and open to comment for improvement.

8. Corrective and preventive action reports

8.1 Quality assurance plans should include a well-structured reporting system to ensure that suggestions by ATO personnel for both corrective and preventive actions are recorded and promptly addressed. Paragraph 3.3 (f) of this Appendix identifies this as a necessary component of QA.

8.2 After an analysis of the reports submitted, the reporting system should specify who is required to rectify a discrepancy and/or non-conformity in each particular case and the procedure to be followed if corrective action is not completed within an appropriate timescale. Just as important, the reporting system should identify who is required to investigate and act upon any report identifying measures that could prevent a non-conformity from occurring.

8.3 Corrective and preventive action reports should be able to be submitted anonymously, if individuals so choose, to maximise the opportunity for open and effective reporting.

Note: Since corrective and preventive action reports, in this instance, represent suggestions for improvement in conformity levels and deal with quality issues, this reporting system and its processes should be managed by the quality manager.

9. Quality-related documentation

9.1 Relevant documentation includes part(s) of the Training and Procedures Manual, which may be included in a separate Quality Manual.

9.2 In addition, the relevant documentation should include the following:

(a) quality policy and strategy;
(b) glossary;
(c) organisational risk profile;
(d) risk management plan;
(e) coherence matrix;
(f) corrective and preventive action procedures and reporting system;
(g) specified training standards;
(h) description of the organisation;
(i) assignment of duties and responsibilities, and
(j) training procedures related to the quality system to ensure regulatory compliance.

9.3 The QA audit programme documentation should reflect:

(a) the schedule of the monitoring process;
(b) audit procedures;
(c) reporting procedures;
(d) follow-up and corrective action procedures;
(e) the recording system; and
(f) document control.

10. Quality assurance audit programme

The QA audit programme should include all planned and systematic actions necessary to provide confidence that every training activity is conducted in accordance with all applicable requirements, standards and procedures.

11. Quality inspection

11.1 The primary purpose of a quality inspection is to review a document or observe a particular event, action, etc., in order to verify whether established training procedures and requirements are followed during the conduct of the inspection and whether the required standard is achieved.

11.2 Examples of typical subject areas for quality inspections are:

(a) actual training sessions;
(b) maintenance, if applicable;
(c) technical standards; and
(d) training standards.

12. Quality audits

12.1 An audit is a systematic and independent comparison between the way in which training is being conducted and the way in which it should be conducted according to the published training procedures.

12.2 Audits should include at least the following quality procedures and processes:

(a) a description of the scope of the audit, which should be explained to the audited personnel;
(b) planning and preparation;
(c) gathering and recording evidence; and
(d) analysis of the evidence.

12.3 The various techniques that make up an effective audit are:

(a) a review of published documents;
(b) interviews or discussions with personnel;
(c) the examination of an adequate sample of records;
(d) the witnessing of the activities which make up the training; and
(e) the preservation of documents and the recording of observations.

13. Auditors

13.1 The ATO should decide, depending on the complexity of the organisation and the training being conducted, whether to make use of a dedicated audit team or a single auditor. In any event, the auditor or audit team should have relevant training and/or operational experience.

13.2 The responsibilities of the auditors should be clearly defined in the relevant documentation.

14. Auditor's independence

14.1 Auditors should not have any day-to-day involvement in the area of the operation or maintenance activity that is to be audited.

14.2 An ATO may, in addition to using the services of full time dedicated personnel belonging to a separate quality department, undertake the monitoring of specific areas or activities through the use of part-time auditors. An ATO whose structure and size does not justify the establishment of full-time auditors may undertake the audit function using part-time personnel from within its own organisation or from an external source under the terms of an agreement acceptable to the Licensing Authority.

14.3 In all cases the ATO should develop suitable procedures to ensure that persons directly responsible for the activities to be audited are not selected as part of the auditing team. Where external auditors are used, it is essential that any external specialist has some familiarity with the type of activity conducted by the ATO.

14.4 The QA audit programme of the ATO should identify the persons within the organisation who have the experience, responsibility and authority to:

(a) identify and record concerns or findings, and the evidence necessary to substantiate such concerns or findings;
(b) initiate or recommend solutions to concerns or findings through designated reporting channels;
(c) verify the implementation of solutions within specific and reasonable timescales; and
(d) report directly to the quality manager.

15. Audit scheduling

15.1 A QA audit programme should include a defined audit schedule and a periodic review cycle. The schedule should be flexible and allow unscheduled audits when negative trends are identified. The quality manager should schedule follow-up audits when necessary to verify that a corrective action resulting from a finding was carried out and that it is effective.

15.2 An ATO should establish a schedule of audits to be completed during a specific calendar period. This schedule should be influenced by the organisational risk profile and be reflected in both the risk management plan and the coherence matrix documents. As a minimum, all aspects of the training should be reviewed within a period of twelve months in accordance with the audit programme.

15.3 When an ATO defines the audit schedule, it should take into account significant changes to the management, organisation, training or technologies, as well as changes to the standards and requirements.

16. Monitoring and corrective action

16.1 The aim of monitoring within the quality system is primarily to investigate and judge its effectiveness and thereby ensure that defined policy and training standards are continuously complied with. Monitoring and corrective action functions fall under the responsibilities of the quality manager. Monitoring activity is based upon:

(a) quality inspections;
(b) quality audits; and
(c) corrective and preventive action reports, and subsequent follow-up.

16.2 Any non-conformity identified as a result of monitoring should be communicated by the quality manager to the manager responsible for taking corrective action or, if appropriate, to the head of training or, when circumstances warrant, to the accountable executive. Such non conformity should be recorded, for the purpose of further investigation, in order to determine the cause and to enable the recommendation of an appropriate corrective action.

16.3 The QA audit programme should include procedures to ensure that corrective and preventive actions are developed in response to findings. Personnel implementing these procedures should monitor such actions to ensure that they have been completed and verify their effectiveness. Organisational responsibility and accountability for the implementation of a corrective action resides with the department where the finding was identified. The accountable executive will have the ultimate responsibility for ensuring, through the quality manager, that the corrective action has reestablished conformity with the standard required by the ATO and any additional requirements established by the Licensing Authority or the ATO.

16.4 As part of its quality system, the ATO should identify internal and external customers and monitor their satisfaction by measurement and analysis of feedback.

17. Continuous improvement process

17.1 The quality manager should be responsible for the review and continuous improvement of the established quality system's policies, processes and procedures. The following tools, on which the quality manager relies, are essential to the on-going continuous improvement process:

(a) organisational risk profile;
(b) risk management plan;
(c) coherence matrix;
(d) corrective and preventive action reports; and
(e) inspection and audit reports.

17.2 These tools and processes are interrelated and help define the continuous improvement efforts of the organisation. For example, any corrective or preventive action report could identify a deficiency or an opportunity for improvement. As outlined in paragraph 8.2 of this Appendix, the quality manager would then be required to ensure the identified issue was addressed and effectively implemented. The same would be true, if the discovery of an issue was identified during an inspection or audit.

17.3 The effective implementation of change and the subsequent validation that the change did indeed result in the desired outcome is critical to the continuous improvement process. Simply introducing a well-meaning suggestion for improvement into the organisation without carefully managing that change could have undesirable consequences. It is therefore incumbent upon the quality manager to responsibly introduce, monitor, and validate improvement efforts.

17.4 A simplistic but effective process to use in managing continuous improvement is known as the plan-do-check-act, or PDCA, approach. The following illustration depicts this continuous improvement process cycle:

(a) Plan. Map out the implementation of the recommended change, identifying at least:

(1) those people who will be affected by the change

(2) the required qualify control measures necessary to mitigate risk; and

(3) the desired outcome and its intended consequences.

(b) Do. Execute the implementation plan once all affected groups have accepted the proposal and understand their role in ensuring its success.

(c) Check. Apply sufficient quality control "stage" checks throughout the implementation phase to ensure any unintended deviations in the execution are identified and addressed without delay; and

(d) Act. Analyse the results and take appropriate action as necessary.

18. Management review and analysis

18.1 Management should accomplish a comprehensive, systematic and documented review and analysis of the quality system, training policies and procedures, and should consider:

(a) the results of quality inspections, audits and any other indicators;

(b) the overall effectiveness of the management organisation in achieving stated objectives; and

(c) the correction of trends, and prevention, where applicable, of future non-conformities.

18.2 Conclusions and recommendations made as a result of the review and analysis should be submitted in writing to the responsible manager for action. The responsible manager should be an individual who has the authority to resolve relevant issues and take action. The head of training should decide upon the frequency, format and structure of meetings for internal review and analysis, in coordination with the accountable executive, if different, as the accountable executive has the overall responsibility for the quality system including the frequency, format and structure of the internal management review and analysis activities.

19. Recording

19.1 Accurate, complete and readily accessible records documenting the result of the QA audit programme should be maintained by the ATO. Records are essential data to enable an ATO to analyse and determine the root causes of non-conformity so that areas of non-compliance can be identified and subsequently addressed.

19.2 Records should be retained at least for the period that may be mandated by national requirements. In the absence of such requirements, a period of three years is recommended. The relevant records include:

(a) audit schedules;
(b) quality inspection and audit reports;
(c) responses to findings;
(d) corrective and preventive action reports;
(e) follow-up and closure reports; and
(f) management review and analysis reports.

20. QA responsibility for satellite ATOs

20.1 An ATO may decide to subcontract certain activities to external organisations subject to the approval of the Licensing Authority.

20.2 The ultimate responsibility for the training provided by the satellite ATO always remains with the ATO. A written agreement should exist between the ATO and the satellite ATO clearly defining the training services to be provided and the level of quality to be assured. The satellite ATO's activities relevant to the agreement should be included in the ATO's QA audit programme.

20.3 The ATO should ensure that the satellite ATO has the necessary authorisation/approval when required and commands the resources and competence to undertake the task.

21. QA training

21.1 Appropriate and thorough training is essential to optimise quality in every organisation. In order to achieve the appropriate outcomes of such training, the ATO should ensure that all staff members understand the objectives as laid out in the quality manual to a level relevant to their duties, including the:

(a) concept of QA and associated systems;
(b) quality management;
(c) quality manual;
(d) inspections and audit techniques; and
(e) reporting and recording.

21.2 Time and resources should be allocated to provide appropriate levels of QA training to every employee.

21.3 QA courses are available from the various national or international standards institutions, and an ATO should consider whether to offer such courses to those likely to be involved in the management or supervision of QA processes. Organisations with sufficient appropriately qualified staff should consider the possibility of providing in-house training.

ICAO Doc 9841, Manual on the Approval of Training Organisations, Appendix B
IEM No. 1 to JAR-FCL 1.055

IS: 3.3.3 PERSONNEL FOR FLIGHT CREW TRAINING IN THE ATO

(a) The Head of Training shall have overall responsibility for ensuring satisfactory integration of flying training, flight simulation training and theoretical knowledge instruction and for supervising the progress of individual students. The Head of Training shall have had extensive experience in training as a flight instructor for professional pilot licences and possess a sound managerial capability.

(b) The CFI shall be responsible for the supervision of flight and synthetic flight instructors and for the standardisation of all flight instruction and synthetic flight instruction. The CFI shall:

(c) hold the highest professional pilot licence related to the flying training courses conducted;

(d) hold the rating(s) related to the flying training courses conducted;

(e) hold a flight instructor rating for at least one of the types of aircraft used on the course; and

(f) have completed 1,000 hours pilot-in-command flight time of which a minimum of 500 hours shall be on flying instructional duties related to the flying courses conducted, of which 200 hours may be instrument ground time.

(g) Flight instructors shall hold--

(h) a pilot licence and rating(s) in accordance with MCAR Part 2 related to the flying training courses they are approved to conduct; and

(i) an instructor rating or authorisation in accordance with MCAR Part 2, relevant to the part of the course being conducted e.g. flight instructor, flight instrument rating instructor, instructor for additional class or type rating(s), instructor for flight simulation training, as appropriate.

(j) Instructors for flight simulation training shall hold the authorisation in accordance with MCAR Part 2 related to the flight simulation training courses they are appointed to conduct.

(k) Instructors for flight engineer licences and rating training shall hold:

(l) the licence and the rating(s) in accordance with MCAR Part 2 related to the flight engineer licence and/or rating training courses they are appointed to conduct; and

(m) an instructor rating in accordance with MCAR Part 2, relevant to the part of the course being conducted.

(n) The Chief Ground Instructor shall --

(o) Be responsible for the supervision of all ground instructors and for the standardisation of all theoretical knowledge instruction; and

(p) shall have a practical background in aviation and have the appropriate ground instructor licence in accordance with MCAR Part 2.

(q) Ground instructors shall be responsible for conducting ground training in subject areas required for a licence or rating. Ground instructors may have either a licence or be approved by the Authority in accordance with MCAR Part 2, depending upon the subject matter to be taught.

(r) Ground instructors, who are approved by the Authority but not licensed, who teach knowledge subjects for licences sand ratings shall have appropriate experience in aviation and shall, before appointment, give proof of their competency by giving a lecture based on material they have developed for the subjects they are to teach.

14 CFR: 141.33, 141.35, 142.13, 142.47, 142.49, 142.53
JAR-FCL 1/2.055 App. 1a, para 10-20, App. 2 para 11-16

IS: 3.3.5.1 TRAINING MANUAL AND PROCEDURES MANUAL FOR ATO CONDUCTING FLIGHT CREW TRAINING

(a) The Training and Procedures Manual for use at an ATO conducting approved training courses should include the following:

Part 1

1. General

1.1 Preamble relating to the use and applicability of the manual.

1.2 Table of contents.

1.3 Amendment, revision and distribution of the manual:

(a) procedures for amendment;
(b) amendment record page;
(c) distribution list; and
(d) list of effective pages.

1.4 Glossary of definitions and significant terms, including a list of acronyms and/or abbreviations.

1.5 Description of the structure and layout of the manual, including:

(a) the various parts, sections, as well as their contents and use; and
(b) the paragraph numbering system.

1.6 Description of the scope of training authorised under the organisation's terms of approval.

1.7 Organisation (chart of the ATO's management organisation), and the name of the post holders.

1.8 Qualifications, responsibilities and succession of command of management and key operational personnel, including but not limited to:

(a) accountable executive;
(b) head of training;
(c) instructional services manager;
(d) quality manager;
(e) maintenance manager, if applicable;
(f) safety manager, if applicable;
(g) instructors; and
(h) examiners, evaluators, and auditors.

1.9 Policies dealing with:

(a) the training organisation's objectives, including ethics and values;
(b) the selection of ATO personnel and the maintenance of their qualifications;
(c) the training programme design and development, including the need for programme validation and review, as well as the outsourcing of training programme development to third-party providers;
(d) the evaluation, selection, and maintenance of training material and devices;
(e) the maintenance of the training facilities and equipment;
(f) developing and maintaining a quality system governance model; and

(g) developing and maintaining a culture focused on safety in the workplace, including, when applicable, implementing a safety management system governance model.

1.10 Description of the facilities and equipment available, including:

(a) general use facilities, including offices, stores and archives, library or reference areas);
(b) the number and size of classrooms, including installed equipment; and
(c) the type and number of training devices, including their location if other than at the main training site.

2. Staff training

2.1 Identification of persons or positions responsible for the maintenance of performance standards and for ensuring the competency of personnel.

2.2 Details of the procedures to validate the qualifications and determine the competency of instructional personnel as required by MCAR 3: 3.2.1.14.

2.3 Details of the initial and recurrent training programmes for all personnel as required by MCAR 3: 3.2.1.14.

2.4 Procedures for proficiency checks and upgrade training.

3.0 Client training programmes

The client training programmes cover each individual training programme conducted by the training organisation for its customers. The training programmes consist of a training plan, a practical training syllabus and a theoretical knowledge syllabus, if applicable, as described in paragraphs 3.1, 3.2 and 3.3 below.

3.1 Training plan

3.1.1 The aim of the course in the form of a statement of what the student is expected to be able to do as a result of the training, the level of performance, and the training constraints to be observed.

3.1.2 Pre-entry requirements, including:

(a) minimum age;
(b) education or qualification requirements;
(c) medical requirements; and
(d) linguistic requirements.

3.1.3 Credits for previous knowledge, experience or other qualifications, which should be obtained from the Licensing Authority before the training commences.

3.1.4 Training curricula, including the:

(a) theoretical training (knowledge);
(b) practical training (skills);
(c) training in the domain of human factors (attitudes);
(d) assessment and examinations; and
(e) monitoring of the training process, including the assessment and examination activities.

3.1.5 Training policies in terms of:

(a) restrictions regarding the duration of training periods for students and instructors; and
(b) if applicable, minimum rest periods.

3.1.6 Policy for the conduct of student evaluation, including the:

(a) procedures for authorisation for tests;

(b) procedures for remediation training before retest and knowledge test re write procedures;
(c) test reports and records;
(d) procedures for skill progress checks and skill tests;
(e) procedures for knowledge progress tests and knowledge tests, including procedures for knowledge test preparation, type of questions and assessments, and standards required for a pass; and
(f) procedures for question analysis and review and for issuing replacement exams (applicable to knowledge tests).

3.1.7 Policy regarding training effectiveness, including:

(a) liaison procedures between training departments;
(b) requirements for reporting and documentation;
(c) internal feedback system for detecting training deficiencies;
(d) completion standards at various stages of training to ensure standardisation;
(e) individual student responsibilities;
(f) procedures to correct unsatisfactory progress;
(g) procedures for changing instructors;
(h) maximum number of instructor changes per student; and
(i) procedures for suspending a student from training.

3.2 Syllabi for non-competency-based training programmes

3.2.1 Practical training syllabus

3.2.1.1 A statement of how the course will be divided into phases, indicating how the phases will be arranged to ensure completion in the most suitable learning sequence and that exercises are repeated at the proper frequency.

3.2.1.2 The syllabus hours for each phase and for groups of lessons within each phase and when progress tests are to be conducted.

3.2.1.3 A statement of the standard of proficiency required before progressing from one phase of training to the next. It includes minimum experience requirements and satisfactory exercise completion before undertaking the next phase.

3.2.1.4 Requirements for instructional methods, particularly with respect to adherence to syllabi and training specifications.

3.2.1.5 Instruction for the conduct and documentation of all progress checks.

3.2.1.6 Instruction, where applicable, given to all examining staff regarding the conduct of examinations and tests.

3.2.2 Theoretical knowledge syllabus

The syllabus for theoretical knowledge instruction should be structured generally as in paragraph 3.2 above but with a training specification and objective for each subject.

3.3. Syllabus for competency-based training programmes

3.3.1 Training programmes focused on achieving desired standards of performance for specific jobs or tasks should be competency-based.

3.3.2 Competency-based training programmes are based upon a job and task analysis to define the knowledge, skills and attitudes required to perform a job or a task. Such programmes use an integrated approach in which the training of the underlying knowledge to perform a task is followed by practice of the task so that the trainee acquires the underlying knowledge, skills and attitudes related to the task in a more effective way.

3.3.3 As a result, the syllabus is structured as a single document that is subdivided in modules containing a training objective and the same information as in 3.2.1, but applied to both the theoretical knowledge and practical training delivered by the module.

4. Tests and checks conducted by the ATO for the issuance of a licence or a rating

4.1 When a State has authorised an ATO to conduct the testing required for the issuance of a licence or rating in accordance with the Training and Procedures Manual, the manual should include:

(a) the name(s) of the personnel with testing authority and the scope of the authority;
(b) the role and duties of the authorised personnel;
(c) if the school has been given authority to appoint personnel to conduct the testing required for the issuance of a licence or rating, the minimum requirements for appointment as well as the selection and appointment procedure; and
(d) the applicable requirements established by the Licensing Authority, such as:
 (1) The procedures to be followed in the conduct of checks and tests; and
 (2) the methods for completion and retention of testing records as required by the Authority

5. Records

5.1 Policy and procedures regarding:

(a) attendance records;
(b) student training records;
(c) staff training and qualification records;
(d) person responsible for checking records and student personal logs;
(e) nature and frequency of record checks;
(f) standardisation of record entries;
(g) personal log entries; and
(h) security of records and documents.

6. Safety management system (if applicable)

6.1 The requirement to adopt SMS practices is intended to be restricted to only those training entities whose activities directly impact upon the safe operation of aircraft. Should that requirement apply to the ATO, the Training and Procedures Manual, as stated in paragraph 1.9 above, must address the ATO's SMS with reference to a separate manual or include the SMS practices within the Training and Procedures Manual.

7. Quality assurance

7.1 Provide a brief description of the quality assurance practices, as required by paragraph 5 of Appendix 2 to Annex 1, with reference to a separate quality manual or include the QA practices within the Training and Procedures Manual (refer to Appendix B, paragraph 9).

8. Appendices

8.1 As required:

(a) sample progress test forms;
(b) sample logs, test reports and records; and
(c) a copy of the approved training organisation's approval document.

Part II – Additional content for flight training organisations (utilising aircraft)

9. Flight training – General

9.1 Qualifications, responsibilities and succession of command of management and key operational personnel (in addition to paragraph 1.8 above), including but not limited to:

(a) chief flight instructor; and
(b) chief ground instructor.

9.2 Policies and procedures (in addition to paragraph 1.9 above) dealing with:

(a) approval of flights;
(b) responsibilities of the pilot-in-command;
(c) flight planning procedures – general;
(d) carriage of passengers;
(e) operational control system;
(f) reporting of safety hazards, incidents and accidents (see Appendix D for more details);
(g) duty periods and flight time limitations for flying staff members and students; and
(h) minimum rest periods for flying staff members and students.

9.3 Description of the facilities and equipment available (in addition to paragraph 1.10 of this Appendix), including:

(a) Flight simulation training devices and training aircraft;
(b) Maintenance facilities and apron parking areas for training aircraft;
(c) Computer-based classroom(s); and
(d) Dispatch control and briefing areas.

10. Aircraft operating information

10.1 Certification and operating limitations.
10.2 Aircraft handling, including:

a) performance limitations;
b) use of checklists;
c) standard operating procedures; and
d) aircraft maintenance procedures.

10.3 Instructions for aircraft loading and securing of load.
10.4 Fuelling procedures.
10.5 Emergency procedures.

11. Routes

11.1 Performance criteria, e.g. take-off, en route, landing, etc.
11.2 Flight planning procedures including:

(a) fuel and oil requirements;
(b) minimum safe altitudes;
(c) planning for contingencies (e.g. emergency or diversion scenarios); and
(d) navigation equipment.

11.3 Weather minima for all instructional training flights during day, night, VFR and IFR operations.
11.4 Weather minima for all student training flights at various stages of training.
11.5 Training routes and practice areas.

12. Flight training plan

12.1 Training curricula (in addition to paragraph 3.1.4 above), including, as applicable, the:

(a) flying curriculum (single-engine);
(b) flying curriculum (multi-engine);
(c) theoretical knowledge curriculum; and
(d) flight simulation training curriculum.

12.2 The general arrangements of daily and weekly programmes for flying training, ground training and flight simulation training.

12.3 Training policies (in addition to paragraph 3.1.5 above) in terms of:

(a) weather constraints;
(b) maximum student training times for flight, theoretical knowledge and flight simulation training, per day/week/month;
(c) restrictions in respect of training periods for students;
(d) duration of training flights at various stages;
(e) maximum individual student flying hours in any day or night period;
(f) maximum number of individual student training flights in any day or night period; and
(g) minimum rest periods between training periods.

ICAO Doc 9841, Appendix A

IS: 3.4.5.1 TRAINING AND PROCEDURES MANUAL FOR ATO CONDUCTING MAINTENANCE TRAINING

(a) The Training and Procedures Manual for use at an ATO conducting approved training courses should include the following:

Part 1

1. General

1.1 Preamble relating to the use and applicability of the manual.

1.2 Table of contents.

1.3 Amendment, revision and distribution of the manual:

(a) procedures for amendment;
(b) amendment record page;
(c) distribution list; and
(d) list of effective pages.

1.4 Glossary of definitions and significant terms, including a list of acronyms and/or abbreviations.

1.5 Description of the structure and layout of the manual, including:

(a) the various parts, sections, as well as their contents and use; and
(b) the paragraph numbering system.

1.6 Description of the scope of training authorised under the organisation's terms of approval.

1.7 Organisation (chart of the ATO's management organisation), and the name of the post holders.

1.8 Qualifications, responsibilities and succession of command of management and key operational personnel, including but not limited to:

(a) accountable executive;
(b) head of training;
(c) instructional services manager;
(d) quality manager;
(e) maintenance manager, if applicable;
(f) safety manager, if applicable;
(g) instructors; and
(h) examiners, evaluators, and auditors.

1.9 Policies dealing with:

(a) the training organisation's objectives, including ethics and values;
(b) the selection of ATO personnel and the maintenance of their qualifications;
(c) the training programme design and development, including the need for programme validation and review, as well as the outsourcing of training programme development to third-party providers;
(d) the evaluation, selection, and maintenance of training material and devices;
(e) the maintenance of the training facilities and equipment;
(f) developing and maintaining a quality system governance model and
(g) developing and maintaining a culture focused on safety in the workplace, including, when applicable, implementing a safety management system governance model.

1.10 Description of the facilities and equipment available, including:

(a) general use facilities, including offices, stores and archives, library or reference areas);
(b) the number and size of classrooms, including installed equipment; and
(c) the type and number of training devices, including their location if other than at the main training site.

2. Staff training

2.1 Identification of persons or positions responsible for the maintenance of performance standards and for ensuring the competency of personnel.

2.2 Details of the procedures to validate the qualifications and determine the competency of instructional personnel as required by MCAR 3: 3.2.1.14.

2.3 Details of the initial and recurrent training programmes for all personnel, including awareness training with respect to their responsibilities within the ATO's system governance processes.

2.4 Procedures for proficiency checks and upgrade training.

3.0 Client training programmes

The client training programmes cover each individual training programme conducted by the training organisation for its customers. The training programmes consist of a training plan, a practical training syllabus and a theoretical knowledge syllabus, if applicable, as described in paragraphs 3.1, 3.2 and 3.3 below.

3.1 Training plan

3.1.1 The aim of the course in the form of a statement of what the student is expected to be able to do as a result of the training, the level of performance, and the training constraints to be observed.

3.1.2 Pre-entry requirements, including:

(a) minimum age;
(b) education or qualification requirements;
(c) medical requirements; and
(d) linguistic requirements.

3.1.3 Credits for previous knowledge, experience or other qualifications, which should be obtained from the Licensing Authority before the training commences.

3.1.4 Training curricula, including the:

(a) theoretical training (knowledge);
(b) practical training (skills);
(c) training in the domain of human factors (attitudes);
(d) assessment and examinations; and
(e) monitoring of the training process, including the assessment and examination activities.

3.1.5 Training policies in terms of:

(a) restrictions regarding the duration of training periods for students and instructors; and
(b) if applicable, minimum rest periods.

3.1.6 Policy for the conduct of student evaluation, including the:

(a) procedures for authorisation for tests;
(b) procedures for remediation training before retest and knowledge test re write procedures;
(c) test reports and records;
(d) procedures for skill progress checks and skill tests;
(e) procedures for knowledge progress tests and knowledge tests, including procedures for knowledge test preparation, type of questions and assessments, and standards required for a

pass; and

(f) procedures for question analysis and review and for issuing replacement exams (applicable to knowledge tests).

3.1.7 Policy regarding training effectiveness, including:

(a) liaison procedures between training departments;

(b) requirements for reporting and documentation;

(c) internal feedback system for detecting training deficiencies;

(d) completion standards at various stages of training to ensure standardisation;

(e) individual student responsibilities;

(f) procedures to correct unsatisfactory progress;

(g) procedures for changing instructors;

(h) maximum number of instructor changes per student; and

(i) procedures for suspending a student from training.

3.2 Syllabi for non-competency-based training programmes

3.2.1 Practical training syllabus

3.2.1.1 A statement of how the course will be divided into phases, indicating how the phases will be arranged to ensure completion in the most suitable learning sequence and that exercises are repeated at the proper frequency.

3.2.1.2 The syllabus hours for each phase and for groups of lessons within each phase and when progress tests are to be conducted.

3.2.1.3 A statement of the standard of proficiency required before progressing from one phase of training to the next. It includes minimum experience requirements and satisfactory exercise completion before undertaking the next phase.

3.2.1.4 Requirements for instructional methods, particularly with respect to adherence to syllabi and training specifications.

3.2.1.5 Instruction for the conduct and documentation of all progress checks.

3.2.1.6 Instruction, where applicable, given to all examining staff regarding the conduct of examinations and tests.

3.2.2 Theoretical knowledge syllabus

The syllabus for theoretical knowledge instruction should be structured generally as in paragraph 3.2 above but with a training specification and objective for each subject.

3.3. Syllabus for competency-based training programmes

3.3.1 Training programmes focused on achieving desired standards of performance for specific jobs or tasks should be competency-based.

3.3.2 Competency-based training programmes are based upon a job and task analysis to define the knowledge, skills and attitudes required to perform a job or a task. Such programmes use an integrated approach in which the training of the underlying knowledge to perform a task is followed by practice of the task so that the trainee acquires the underlying knowledge, skills and attitudes related to the task in a more effective way.

3.3.3 As a result, the syllabus is structured as a single document that is subdivided in modules containing a training objective and the same information as in 3.2.1, but applied to both the theoretical knowledge and practical training delivered by the module.

4. Tests and checks conducted by the ATO for the issuance of a licence or a rating

4.1 When a State has authorised an ATO to conduct the testing required for the issuance of a licence or rating in accordance with the Training and Procedures Manual, the manual should include:

(a) the name(s) of the personnel with testing authority and the scope of the authority;

(b) the role and duties of the authorised personnel;

(c) if the school has been given authority to appoint personnel to conduct the testing required for the issuance of a licence or rating, the minimum requirements for appointment as well as the selection and appointment procedure; and

(d) the applicable requirements established by the Licensing Authority, such as:

 (1) The procedures to be followed in the conduct of checks and tests; and

 (2) the methods for completion and retention of testing records as required by the Authority

5. Records

5.1 Policy and procedures regarding:

(a) attendance records;

(b) student training records;

(c) staff training and qualification records;

(d) person responsible for checking records and student personal logs;

(e) nature and frequency of record checks;

(f) standardisation of record entries;

(g) personal log entries; and

(h) security of records and documents.

6. Safety management system (if applicable)

6.1 The requirement to adopt SMS practices is intended to be restricted to only those training entities whose activities directly impact upon the safe operation of aircraft. Should that requirement apply to the ATO, the Training and Procedures Manual, as stated in paragraph 1.9 above, must address the ATO's SMS with reference to a separate manual or include the SMS practices within the Training and Procedures Manual.

7. Quality assurance

7.1 Provide a brief description of the quality assurance practices with reference to a separate quality manual or include the QA practices within the Training and Procedures Manual.

8. Appendices

8.1 As required:

(a) sample progress test forms;

(b) sample logs, test reports and records; and

(c) a copy of the approved training organisation's approval document.

ICAO Doc 9841, Appendix A

4.1 General rules concerning licenses and ratings for personnel other than flight crew members

4.1.1 An applicant shall, before being issued with any license or rating for personnel other than flight crew members, meet such requirements in respect of age, knowledge, experience and where appropriate, medical fitness and skill, as are specified for that license or rating.

4.1.2 An applicant, for any license or rating for personnel other than flight crew members, shall demonstrate, in a manner determined by the Licensing Authority, such requirements in respect of knowledge and skill as are specified for that license or rating.

4.2 Aircraft maintenance (technician/engineer/mechanic)

Note.— The terms in brackets are given as acceptable additions to the title of the license. Each Contracting State is expected to use in its own regulations the one it prefers.

4.2.1 Requirements for the issue of the license

4.2.1.1 *Age*
The applicant shall be not less than 18 years of age.

4.2.1.2 *Knowledge*
The applicant shall have demonstrated a level of knowledge relevant to the privileges to be granted and appropriate to the responsibilities of an aircraft maintenance license holder, in at least the following subjects:

Air law and airworthiness requirements

a) rules and regulations relevant to an aircraft maintenance licence holder including applicable airworthiness requirements governing certification and continuing airworthiness of aircraft and approved aircraft maintenance organization and procedures;

Natural science and aircraft general knowledge
b) basic mathematics; units of measurement; fundamental principles and theory of physics and chemistry applicable to aircraft maintenance;

Aircraft engineering
c) characteristics and applications of the materials of aircraft construction including principles of construction and functioning of aircraft structures, fastening techniques; powerplants and their associated systems; mechanical, fluid, electrical and electronic power sources; aircraft instrument and display systems; aircraft control systems; and airborne navigation and communication systems;

Aircraft maintenance
d) tasks required to ensure the continuing airworthiness of an aircraft including methods and procedures for the overhaul, repair, inspection, replacement, modification or defect rectification of aircraft structures, components and systems in accordance with the methods prescribed in the relevant Maintenance Manuals and the applicable Standards of airworthiness; and

Human performance
e) human performance relevant to aircraft maintenance.
Note.— Guidance material to design training programmes on human performance can be found in the Human Factors Training Manual *(Doc 9683).*

4.2.1.3 *Experience*
The applicant shall have had the following experience in the inspection, servicing and maintenance of aircraft or its components:

a) for the issue of a license with privileges for the aircraft in its entirety, at least:
1) four years; or
2) two years if the applicant has satisfactorily completed an approved training course; and

b) for the issue of a license with privileges restricted in accordance with 4.2.2.2 a) 2) or 3), a period of time that will enable a level of competency equivalent to that required in a) to be attained, provided that this is not less than:
1) two years; or
2) such a period as the State considers necessary to provide an equivalent level of practical experience to applicants who have satisfactorily completed an approved training course.

4.2.1.4 *Training*
Recommendation.— *The applicant should have completed a course of training appropriate to the privileges to be granted.*
Note.— The Training Manual *(Doc 7192), Part D-1, contains guidance material on a training course for applicants for an aircraft maintenance license.*

4.2.1.5 *Skill*
The applicant shall have demonstrated the ability to perform those functions applicable to the privileges to be granted.
4.2.2 Privileges of the holder of the license and the conditions to be observed in exercising such privileges

4.2.2.1 Subject to compliance with the requirements specified in 4.2.2.2 and 4.2.2.3, the privileges of the holder of an aircraft maintenance license shall be to certify the aircraft or parts of the aircraft as airworthy after an authorized repair, modification or installation of a powerplant, accessory, instrument, and/or item of equipment, and to sign a maintenance release following inspection, maintenance operations and/or routine servicing.

4.2.2.2 The privileges of the holder of an aircraft maintenance license specified in 4.2.2.1 shall be exercised only:

a) in respect of such:
1) aircraft as are entered on the license in their entirety either specifically or under broad categories; or
2) airframes and powerplants and aircraft systems or components as are entered on the license either specifically or under broad categories; and/or
3) aircraft avionic systems or components as are entered on the license either specifically or under broad categories;
b) provided that the license holder is familiar with all the relevant information relating to the maintenance and airworthiness of the particular aircraft for which the license holder is signing a Maintenance Release, or such airframe, powerplant, aircraft system or component and aircraft avionic system or component which the license holder is certifying as being airworthy; and
c) on condition that, within the preceding 24 months, the license holder has either had experience in the inspection, servicing or maintenance of an aircraft or components in accordance with the privileges granted by the license held for not less than six months, or has met the provision for the issue of a license with the appropriate privileges, to the satisfaction of the Licensing Authority.

4.2.2.3 A Contracting State shall prescribe the scope of the privileges of the license holder in terms of the complexity of the tasks to which the certification relates.

4.2.2.3.1 **Recommendation.—** *Details of the certification privileges should be endorsed on or attached to the license, either directly or by reference to another document issued by the Contracting State.*

4.2.2.4 When a Contracting State authorizes an approved maintenance organization to appoint non-licensed personnel to exercise the privileges of 4.2.2, the person appointed shall meet the requirements specified in 4.2.1.

U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Certification and Operation of Aviation Maintenance Technician Schools

Date: 6/5/15
Initiated by: AFS-300

AC No: 147-3B
Change:

This advisory circular (AC) provides guidance to assist persons in obtaining and maintaining Federal Aviation Administration (FAA) certification of an Aviation Maintenance Technician School (AMTS). This AC is not mandatory and does not constitute a regulation. This AC describes acceptable means, but not the only means, to meet the requirements of Title 14 of the Code of Federal Regulations (14 CFR). However, if you choose to follow this AC as the means to meet the provisions of 14 CFR part 147, then you must follow the AC in its entirety. New content in AC 147-3B will provide part 147 AMTS applicants and currently certificated AMTSs with information concerning comprehensive detail of AMTS operations to include Distance Learning and Operations Specifications (OpSpec) informational guidance for industry.

John Barbagallo
Deputy Director, Flight Standards Service

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CHAPTER 1. INTRODUCTION

1-1. PURPOSE.

a. General. This advisory circular (AC) provides guidance to assist persons in obtaining and maintaining Federal Aviation Administration (FAA) certification of an Aviation Maintenance Technician School (AMTS). This AC is not mandatory and does not constitute a regulation. This AC describes acceptable means, but not the only means, to meet the requirements of Title 14 of the Code of Federal Regulations (14 CFR). However, if you choose to follow this AC as the means to meet the provisions of 14 CFR part 147, then you must follow the AC in its entirety.

b. Additional Information. All definitions and references relevant to this AC are listed in the appendices. In addition, Appendix 3, Frequently Asked Questions (FAQ) Regarding AMTS Certification and Operation, contains a list of FAQ regarding AMTS certification and operation.

1-2. CANCELLATION. AC 147-3A, Certification and Operation of Aviation Maintenance Technician Schools, dated January 18, 2005, is canceled.

1-3. PRINCIPAL CHANGES. This AC was edited to apply the formatting and language requirements of the current edition of FAA Order 1320.46C, Advisory Circular System. This revised AC includes new language regarding an optional Aviation Maintenance Technician (AMT) curriculum that would be acceptable to the FAA, which is included as Appendix 5, Optional AMT Curriculum. In addition, this AC includes distance learning delivery method guidance.

1-4. APPLICABILITY. Currently certificated AMTSs should use this AC to increase the understanding of part 147. This AC also provides information on suggested curriculum modifications. A person seeking FAA certification for an AMTS program should use this AC as a tool to understand the certification process and the requirements of part 147.

1-5. BACKGROUND.

a. Part 147. Part 147 specifies requirements for the certification and operation of an AMTS. The regulation includes both the curriculum requirements and the operating rules for all certificated AMTS. The regulation's origin was in Civil Air Regulations (CAR) part 53. When the CARs were recodified in 1962, CAR part 53 became 14 CFR part 147. In 1970, part 147 was completely revised. The revision increased the required core curriculum hours from 1,650 to 1,900 and further defined the subject content and teaching guidelines.

b. Exception. Frequently, the FAA-approved program is only part of a school's overall instruction program (for example, bachelor degrees that include an FAA Airframe and Powerplant (A&P) mechanic certificate). The requirements of part 147 should not be interpreted as applicable for any courses other than those required by the part 147 curriculum.

1-6. DISCUSSION. An AMTS is an educational facility certificated by the FAA to train the AMT for careers in the airline industry, in aviation maintenance facilities, and in commercial and General Aviation (GA). The knowledge, skills, and abilities required of AMTs are considerable and demand high quality training. Therefore, the FAA requires high standards of AMTS.

a. Time and Capital. From the initiation of the AMTS certification process to the issuance of the certificate, the amount of time and capital for required facilities, equipment, and curriculum development can be significant.

b. Exceed FAA Minimums. AMTS applicants are encouraged to exceed the FAA minimum standards for facilities, curriculum, and teaching levels. AMTS applicants are encouraged to teach subjects beyond those required by the regulations; for example, make enhancements in composite material repair, solid-state electronics, nondestructive inspection (NDI) techniques, and built-in test equipment, and add courses in human factors and inspection principles. (See Appendix 6 for additional course material recommendations.) Whenever an AMTS desires to change location, facilities, or ratings, it must first notify the FAA to ensure recertification procedures are followed.

c. Satisfying Requirements. Because an AMTS is certificated and inspected by the FAA, satisfying part 147 requirements should be the primary concern of an AMTS. When local and state educational requirements conflict with the FAA's regulation of an AMTS, FAA regulations take precedence over those requirements.

NOTE: For distance learning information on requirements see Appendix 11.

CHAPTER 2. CERTIFICATION REQUIREMENTS FOR SCHOOLS CERTIFICATED UNDER PART 147

2-1. AMTS RATINGS. An AMTS may be FAA-certificated for the following ratings: airframe, powerplant, or combined A&P. The general portion of the curriculum is not a rating, but it is a required part of all the ratings. Schools certificated for only combined A&P ratings cannot grant single ratings such as airframe or powerplant. Students enrolled in a combined curriculum are required to finish the entire combined curriculum before becoming eligible for FAA certification testing.

2-2. OPERATIONS SPECIFICATIONS (OpSpecs). OpSpecs will be issued utilizing the following paragraphs, as appropriate and applicable to the AMTS ratings.

- A001, Issuance and Applicability (Mandatory).
- A002, Definitions and Abbreviations (Mandatory).
- A003, Rating(s) (Mandatory).
- A004, Summary of Special Authorizations and Limitations (Mandatory).
- A005, Exemptions (Optional).
- A006, Management Personnel (Mandatory).
- A007, Designated Persons (Mandatory).
- A012, Affiliated Designated Mechanic Examiners (DME) (Optional).
- A013, Instructors (Mandatory).
- A025, Recordkeeping System (Mandatory).
- A026, Authorizations/Limitations (Optional).
- B002, Required Minimum Curriculum for General (Part 147 Appendix B) (Mandatory).
- B003, Required Minimum Curriculum for Airframe (Part 147 Appendix C) (Optional).
- B004, Required Minimum Curriculum for Powerplant (Part 147 Appendix D) (Optional).

a. Web-Based Operations Safety System (WebOPSS). All AMTS OpSpecs are initially prepared and maintained by the FSDO using standard paragraphs and an FAA automated system known as Web-based Operations Safety System (WebOPSS). Industry can gain access to WebOPSS by contacting their local office and requesting training on WebOPSS. They should also request a login password for future use.

b. Relevant Information. If the certificated entity does not choose to have access to the WebOPSS program, or does not have the resources to do so, they must provide the relevant information necessary to the FSDO to process the AMTS OpSpecs. The FSDO will then provide the AMTS with a hard copy of the OpSpecs with the following information:

- Primary points of contact (POC) and their contact information;
- Management personnel and their contact information;

- Location of the AMTS's recordkeeping system; and
- Person(s) at the AMTS designated to receive OpSpecs. The AMTS must have one person (or more) identified in OpSpec A007 as a designated person authorized to receive OpSpecs. The authorized designated person will sign and date the OpSpec once issued.

c. Two Copies for Signature. An AMTS can be issued OpSpecs by the FSDO manually. Two copies will be provided to the AMTS for signature. One copy must be kept at the AMTS for review and display; the other copy must be returned to the FSDO.

NOTE: OpSpecs are legal documents which indicate FAA approval. Any additional language in the OpSpecs should clearly specify the authorizations, ratings, and/or limitations being approved.

2-3. DURATION OF CERTIFICATE. An AMTS's FAA certificate remains in effect until it is surrendered, suspended, or revoked. Whenever an AMTS desires to change location, facilities, or ratings, it must first notify the FAA to ensure recertification procedures are followed.

2-4. DISPLAY OF CERTIFICATE. An AMTS is required to display its FAA certificate in a prominent location that is accessible and visible to the public. The AMTS must also make the certificate available for FAA inspection.

2-5. ADVERTISING. The holder of an AMTS certificate may not make any statement relating to itself that is false or designed to mislead any person considering school enrollment. Course literature must clearly distinguish between those courses that have been approved by the FAA, and those that have not. For example, an FAA-certificated AMTS that is part of a college or university system may offer other aviation courses, such as aviation management. These other aviation courses must clearly state in their literature that they are not FAA-approved.

2-6. INSPECTION REQUIREMENTS. When a formal application is made to the FAA for certification, the applicant must be ready for the FAA to inspect its facilities and equipment. After certification, FAA inspections are conducted annually to determine whether the school continues to meet its certification requirements. However, the FAA will perform more inspections if required (refer to part 147, § 147.43).

2-7. CURRICULUM REQUIREMENTS. The AMTS curriculum is comprised of the courses needed to meet part 147 requirements. The curriculum is the single most important document an AMTS applicant will submit. Once approved by the FAA, the curriculum shows how the AMTS will train students for AMT certification while meeting regulatory requirements. Elements comprising an AMTS curriculum can vary widely. However, many AMTS include all or some of the required operating rule compliance documents in their curriculums. Because these documents must be supplied to the FAA, this has an advantage in that it incorporates all part 147 school requirements in a single document. Curriculum revisions that must be approved by the FAA are indicated by a stamp on the List of Effective Pages (LEP). All revisions should be listed for future reference on a page that serves as a log of revisions indicating the page location of each revision, revision insertion date, revision number, and initials of who inserted the revision.

a. Curriculum Structure. Section 147.21 provides an overview of the curriculum requirements. Maintenance of the curriculum requirements is covered in § 147.38.

(1) An AMTS is required to adhere to its approved curriculum. Any part 147 course material the school wishes to add must be incorporated into the approved curriculum and approved by the FAA before it may be used. This does not prohibit an AMTS from teaching non-FAA-approved courses such as refresher courses or academic courses required to complete a degree program. However, those courses must be clearly distinguishable from FAA-approved AMTS courses.

(2) An AMTS should strive to keep its approved AMTS curriculum current to meet industry needs by revising courses as appropriate. These revisions require FAA approval before implementation.

(3) Practical projects, referred to in § 147.21(d), include all functions specified in the curriculum that involve hands-on tasks. Therefore, practical projects include any task taught at level 2 or level 3, because all of these require some practical application, as specified in part 147 appendices.

b. Curriculum Development. Curriculum development generally progresses through several stages, as discussed below. Practical examples may be found in Appendices 4 and 6 of this AC.

(1) Stage 1. The first stage of the curriculum development is to conceptualize the knowledge, skills, and abilities an aviation mechanic must acquire to become certificated by the FAA. To determine the knowledge, skills, and abilities requirements, the FAA commissioned a study of the AMT occupation. Some of the results of the study, A Survey of the "Aviation Mechanic Occupation," were used in developing part 147. This study is often called "The Allen Study," after the chief researcher, Dr. David Allen. Although it does not constitute an AMTS curriculum, the Allen Study does provide a partial foundation for developing a sound curriculum that addresses the requirements of the regulations. The study also identifies the training, knowledge, skills, and abilities a student must acquire to qualify as an A&P mechanic.

NOTE: Additional information can be obtained from the Allen Study from the late 1960s; the U.S. Office of Education survey of the National Aviation Mechanics Occupation (1970); the University of California, Los Angeles National Study of the Aviation Mechanics Occupation (1974); the Northwestern University Study from the 1990s; and the General Accounting Office Report Number GAO-03-317 entitled "Aviation Security: FAA Needs to Update Curriculum and Certification Requirements for Aviation Mechanics (2003).

(2) Stage 2. The second stage of the curriculum development involves identifying which specific tasks must be performed, determining specific performance standards that must be reached for each task and subject area, and ensuring the proper amount of instructional time for theory, laboratory, and shop to achieve that performance standard. For this phase, the aviation safety inspector (ASI) reviewing and approving the curriculum is specifically looking for all subjects to be taught to the stated proficiency as directed by 14 CFR part 147 appendices B, C, and D. In this phase, most of Level (2) and all of Level (3) incorporates a demonstrated hands-on task performance and completion.

(3) Stage 3. The third stage in curriculum development must produce a curriculum that contains all the elements required to teach, test, and conform to the rule. Stage 3 must also develop practical projects and objective project grading criteria. The AMTS may present practical projects and associated tests within the main body of the curriculum or in associated workbooks, workbook supplements, or project guides. Wherever the practical projects are presented, they ultimately must be submitted to the FAA for approval and become part of an FAA-approved curriculum. The testing and evaluation of practical projects may represent the most difficult task in curriculum development. No one method is "best." Instead, there are a number of methods used by AMTS that have proven to be valid. Appendix 7, Sample Curriculum Outlines, offers a brief description of practical project guides and the various methods AMTSs use to objectively grade practical projects. Minimally, a complete curriculum should:

- Conform to part 147;
- Provide a method to teach the knowledge, skills, and abilities an AMT student is required to learn;
- Have clearly expressed objectives;
- Provide objective test criteria that conform to subjects studied in the laboratory, shop, and in the classroom;
- Show the appropriate teaching level and number of required laboratory, shop, and theoretical hours to complete the program for a given rating;
- Include a complete description of each practical project and the methods and materials required to accomplish each one; and
- Show the relationship of practical projects to the required subjects.

c. Curriculum Components. An acceptable part 147 curriculum consists of at least the following elements:

- Subjects conforming to part 147 appendices B, C, and D;
- Course content conforming to part 147 appendices A, B, C, and D;
- Teaching level requirements conforming to part 147 appendices A, B, C, D, and to part 147;
- Objective testing and grading criteria;
- Classroom or theory hours conforming to § 147.21;
- Laboratory or shop hours conforming to § 147.21;
- Total number of hours conforming to § 147.21;
- A schedule of required tests that shows the sequence of examinations for each subject in the curriculum; and
- The order of instruction for each subject.

d. Additional Requirements.

(1) Each subject item must be taught at least at the indicated level of proficiency as defined in part 147 appendices. When the school wishes to teach a subject item to a level beyond the requirements, the teaching level must be approved by the FAA and made part of the FAA-approved curriculum. Subject items cannot be taught at a level less than that shown in the FAA-approved curriculum, or less than those shown in the part 147 appendices. Subject items may be taught at a higher level than the minimum required if the school's curriculum allows for it.

(2) Additional subjects/courses required by the school for its own purposes, e.g., degree program subjects such as geography, should not be submitted for FAA approval as part of the curriculum.

(3) Subjects such as basic aerodynamics or theory of flight can be taught within pertinent, related subjects such as physics and aircraft rigging. This would not necessarily increase required instruction hours.

(4) The teaching of additional subject material beyond the requirements of appendices B, C, and D to part 147 may require additional instruction hours beyond those required to be offered by § 147.21.

e. Curriculum Focus.

(1) Many AMTSs enhance portions of their curriculums to develop graduates who are directed toward particular areas of the aviation industry. Examples are schools that tend to train graduates specifically for employment at commercial airlines, helicopter operations, repair stations, or agricultural aircraft operations. Enhancement of the curriculum generally results in a curriculum with more hours of instruction than the minimum that must be offered under § 147.21 for A&P ratings. The FAA may permit schools with focused curriculums to reduce teaching hours (but not teaching levels) in areas they want to deemphasize, and increase teaching hours (and sometimes teaching levels) in areas targeted for enhancement. The following are two examples of focused curriculums:

NOTE: In addition to meeting the minimum requirements in all tasks and subject matters in part 147, an AMTS may add course subject matter to enhance skills based on local aviation industry opportunities.

(a) Example 1. A small AMTS in a rural area may wish to concentrate on preparing AMT students for GA and aircraft operations such as agricultural operations. A rural area is a geographic area that is located outside metropolitan cities and towns. Typical rural areas have a low population density and small settlements. Agricultural areas are commonly rural, though so are others such as forests. In this case, airframe subjects such as wood, dope, fabric, welding, rigging, and corrosion control would be emphasized by increasing the teaching hours and perhaps teaching levels for these subjects. Powerplant courses such as propellers and reciprocating powerplants, including radial and opposed, would also be emphasized in the same ways and further by exploring better or more efficient instruction and/or methods. On the other hand, turbine engines, electronics, and air conditioning may be reduced in teaching hours. Part 147 does not permit a reduction in teaching level.

(b) Example 2. A large AMTS in a metropolitan area may concentrate on preparing AMT students for employment at major airlines. This AMTS would tend to emphasize areas such as turbine engines, nondestructive inspection, air conditioning systems, autoflight, electronics, and airline maintenance systems. This AMTS may want to reduce its teaching hours in wood, dope, fabric, welding, and reciprocating engine subjects.

(2) In both examples, the number of teaching hours for certain subjects may be either reduced or increased, as appropriate. However, course content cannot be lowered in teaching levels and the number of teaching hours for each subject would require FAA approval. It is obvious from this discussion that it is permissible to concentrate curriculums toward certain areas to prepare the students for the appropriate service market. It is recommended that the AMTS develop its curriculum direction during the initial certification.

(3) It is important to note that the teaching level of each subject in the curriculum directly affects the number of hours required to teach that subject. An AMTS must offer a sufficient number of hours for each subject to permit an average student to perform at the required subject level.

f. Curriculum Format. There is not a format specifically required for a curriculum. However, as testing is part of the teaching validation process, the curriculum is required to show testing and grading, as stated in § 147.21(d)(3).

g. Hours of Instruction. The number of hours of instruction offered for any rating must be at least the minimum specified by § 147.21. The school may offer more hours of instruction than the FAA requires. The following blocks of time are not to be included in calculating the minimum number of instructional hours specified in § 147.21:

(1) Time used to take the FAA oral and practical test.

(2) Time spent in taking the FAA knowledge test or time spent registering for the test.

(3) Time set aside for FAA test review and testing at the conclusion of the course. This is not to preclude review and testing for curriculum courses but to differentiate between the time spent in learning approved curriculum material and that spent in review for the FAA certification test.

(4) Time used for meals, breaks, class changes or maintenance of lab/shop equipment.

h. Order of Instruction. The curriculum should list the order of course progression in a logical sequence for each rating offered. For example, basic electricity would be completed before taking aircraft electrical systems. The FAA will discuss with the AMTS applicant the need to develop AMTS operating policy and procedure addressing allowances to deviate from the approved curriculum order of instruction on a case-by-case basis due to unexpected interruptions, such as inoperative mock-ups or hospitalized instructor, etc. The FAA will also discuss with the AMTS applicant the need for the AMTS to incorporate policy and procedure addressing the reporting interruptions that cause deviations in the order of instruction in the approved curriculum to the principal inspector (PI).

i. Curriculum Structure. An AMTS offering separate ratings of airframe or powerplant, but not combined A&P, is required to have a clearly defined general subject curriculum. It is recommended that the general curriculum follow the format prescribed in appendix B to part 147. This ensures a student graduating from one rating curriculum meets the FAA requirements to receive the same general curriculum courses a student graduating from another rating curriculum receives (see Appendix 8, Maintenance of the General Curriculum).

NOTE: For distance learning information on requirements, see Appendix 11.

j. Testing and Grading. Testing must be included as part of the required curriculum hours and must be directly related to the subject matter covered (see sample 3 in Appendix 7).

(1) Passing grades must be sufficient to achieve the required teaching level in part 147. Within the requirements, an AMTS can set its own standards for passing grades in the laboratory, shop, and classroom. Theoretical portions may have different grading standards from those required in laboratory and shop classes. A common academic standard for passing is a minimum score of 70 percent. FAA written tests also use the 70 percent standard. An AMTS may choose to require a different minimum passing grade, although many AMTSs elect to use the 70 percent passing standard.

(2) Students must pass all theoretical and practical portions of each subject listed in the curriculum based on the AMTS-approved grading standard. While theory and practical portions must be tested separately, the grades may be averaged before assessing passage. Students must complete all required laboratory and shop projects with passing grades. Practical project testing and grading criteria must be explicit. The requirements for successful completion must be sufficient to maximize objective grading and reduce any subjective project grading to a minimum.

(3) Upon completion of each curriculum subject, a test must be scheduled. In addition, at the school's discretion, quizzes may be scheduled at any time. From an educational standpoint, it is more effective and appropriate to schedule a test after a subject unit such as welding, rather than after a comprehensive subject such as airframe structures that contains welding and six other subject units. When testing for subjects that have many hours of instruction (for example, sheet metal structures), an AMTS should consider planning more than one test or quiz during the instructional unit.

(4) The AMTS should have a system to provide test security. This system may include provisions for regular test changes and secure storage of tests and quizzes.

k. Practical Application Projects.

(1) The curriculum must list each of the practical projects that must be completed for each subject item. There must be a sufficient number of practical projects to address the requirements of appendices B, C, and D to part 147, as applicable. The curriculum should include enough detail to identify the practical projects for the correct teaching level and to clearly define performance standards and objective grading criteria.

(2) The AMTS must specify the teaching level (2 or 3) for each practical project to be covered in each subject item. The minimum teaching level is specified in part 147 appendices. If the teaching level for practical projects is to exceed those requirements, it must be specified as such in the curriculum.

(3) The curriculum should show an appropriate amount of time for an average student to complete each project. Although there is no set time by rule, it is good to establish time parameters for curriculum development and class scheduling. Data contained in the Allen Study provides useful information on project completion times. However, the Allen Study guidelines are only suggestions.

(4) The curriculum should be designed so that each task in each subject item is accomplished. For example, if a subject element listed in the appendices requires that the student inspect and repair to accomplish a level 2 or level 3 subject, a project requirement for both inspection and repair must be included in the curriculum. It is possible that one project may satisfy all the requirements for that subject element.

l. Absence and Missed Material. Section 147.31(e) requires an approved system for recording student attendance. The system must show hours of absence allowed and how the missed material will be made available to the student. The system must ensure that all graduates will have completed all appropriate curriculum requirements (see § 147.31(c)).

(1) Instructors shall supervise and verify completion of practical project requirements; other missed materials may be made available through:

(a) Communication of subjects and/or chapters covered in a course textbook;

(b) Availability of an instructor presentation;

(c) Availability of class materials; and

(d) Assignments directly attributable to the missed subject matter, such as:

- Supplementary reading assignments;
- Student completion of a written essay;
- Student completion of questions, answers, and references;
- A student oral presentation based on an outline; and/or
- Any other method acceptable to the Administrator.

(2) All makeup assignments, class assignments, and exams missed in a module must be completed before any written, oral, or practical test can be administered.

(3) Failure of a student to complete all makeup assignments and material within the school's approved allotted time period may result in the student being required to repeat that subject.

m. Revisions to the Curriculum. Changes to an approved curriculum must be approved by the FAA before an AMTS can implement the revision. Changes in the curriculum may include changes in any of the following:

- Teaching level (Appendix A to part 147);
- Hours of instruction;
- Business hours during which instruction is conducted;
- Testing/grading criteria;
- Makeup procedures;
- Course content;
- Equipment or facilities affecting instruction in theoretical subjects or the accomplishment of practical projects;
- Order of instruction, such as changes in the logical sequence of instruction;
- Addition or deletion of a rating;
- Changes in the student-to-teacher ratio; or
- Distance learning.

NOTE: For distance learning information on requirements, see Appendix 11.

n. Crediting Procedures for Previous Instruction or Experience. The AMTS should use either a reliable method of evaluating a student's instruction or an entrance test to ensure previous instruction is comparable to that offered by the crediting school. When not using an entrance test, an AMTS should use authenticated transcripts, along with catalog reference course descriptions, and other documents to determine the credit to be granted.

(1) Credit for the General Curriculum. When a student successfully completes a course of study for one rating and obtains that rating, that course of study will have included the general portion of the curriculum. When that student returns to the AMTS to study for a second rating after having graduated from the course and obtained the first rating, the student will not have to retake the general portion of the curriculum. This benefit applies provided the general portion is clearly separate and distinct from either the airframe or the powerplant portions, and conforms to the requirements of appendices A and B to part 147. (See Appendix 7.)

(2) Credit for Previous Instruction from Other Schools (Accredited Non-Aviation Schools). In general, at schools that are not certificated under part 147, credit may be granted only for a limited range of subjects that apply to the general portion of the curriculum; that is, mathematics, basic physics, and similar subjects.

(3) Credit for Previous Instruction from U.S. Military Technical Schools. If an AMTS chooses to grant credit for previous instruction from U.S. military technical schools, it may be granted only on the basis of an entrance test, as specified in § 147.31(c)(2)(iii).

(4) Credit for Previous Experience (Military and Civilian). As a rule, creditable previous mechanic experience must be aviation maintenance experience comparable to the required AMTS curriculum subjects. For example, a person applying for credit for powerplant experience gained while working in the military or at an airline could be considered as previous experience.

(5) Exceptions to Crediting Procedures for Previous Instruction or Experience.

(a) Except for certain mitigating circumstances, if a certificated AMTS is under suspension by the FAA, courses taught during the suspension period cannot be credited retroactively, even if the school becomes recertificated later.

(b) An AMTS applicant may not teach students as an AMTS before receiving the FAA certification and then give credit for that training after the school becomes certificated.

(c) With discretion, an AMTS may credit a student with prior instruction received for certain non-aviation courses with content similar to the part 147 curriculum.

2-8. FACILITIES.

a. General Guidelines for Facility Development and Maintenance. The instructional aids, laboratory and shop equipment, and physical layout of the building must meet the requirements outlined in §§ 147.15, 147.17, and 147.19. The applicant should keep in mind that the facility must constitute an environment suitable for learning. Distractions from learning, such as excessive noise, dust, fumes, heat, cold, and clutter must be considered during development of the AMTS facility.

(1) Facilities must be of adequate size for the number of FAA-authorized students to accomplish any of the laboratory or shop projects designated for that area, and all classroom instruction.

(2) Facilities must be located and classes scheduled so that students can travel between classes without cutting into instructional time. An AMTS should avoid scheduling situations in which the students cannot go from one class to another within the time the school specifies for class transit.

(3) The school should ensure the laboratory and shop floors are free from clutter, such as extension cords and air hoses.

b. Facility Layout. All facilities must conform to local, state and federal codes. Discussion of those requirements is beyond the scope of this AC. The layout of the AMTS facilities will be influenced by the ratings the school plans to obtain. The following sections provide basic information on facility layout according to the requirements of each subject area (see Appendix 9, Sample Facility Layout).

(1) General Subjects (Appendix B to Part 147). The facility layout should ensure lead acid and nickel-cadmium battery charging stations are appropriately isolated from each other. Laboratory storage facilities and electrical/laboratory work stations must be appropriate. Heat treatment furnaces and metal working equipment must be safe and well ventilated. NDI (including magnetic particle inspection equipment) should be a design suitable for inspection of aircraft components. High-pressure fluid line and pressure hose test devices must be safe to use.

(2) Airframe Subjects (Appendix C to Part 147). The shop layout must provide painting facilities that are force-ventilated. Paint spray booths should meet state, local, federal and industry standards. The aircraft assembly area should be adequate and clean. The equipment for gear retraction demonstration and service (whether live aircraft or an instructional aid) should be in a clear area, safe to use, and accessible to a maximum of eight students. The sheet metal area must have a sufficient number of benches, air supply connections, and vises to accommodate the number of students for which the training area has been approved. Facility layout should incorporate doors adequate to move aircraft in and out. This facility should constitute a learning environment appropriate for simulation of return to service.

(3) Powerplant Subjects (Appendix D to Part 147). The layout of the facility must provide appropriate and ventilated cleaning facility areas. A clean area for powerplant and accessory inspection and repair must be provided. There must be a safe engine run-up area and an engine test cell or engine run-up stand with appropriate test monitoring instrumentation. A propeller service and balancing area should be provided. As in the case of the airframe facility, the powerplant shop facility should constitute a learning environment appropriate for simulation of return to service.

2-9. TECHNICAL DATA LIBRARY REQUIREMENTS. An AMTS must provide a suitable technical data reference facility or area. The technical data reference area should have appropriate facilities for study and data examination. It should have an area isolated from high noise levels. The technical data must be of a type appropriate for the AMTS ratings. At a minimum, the technical data should include the following:

- Title 14 of the Code of Federal Regulations (14 CFR) parts 1 through 199.
- Aircraft, engine, propeller, and Type Certificate Data Sheets (TCDS) and specifications.
- Airworthiness Directives (AD).
- Supplemental Type Certificates (STC).
- Maintenance manuals.
- ACs.
- Other instructional materials, such as textbooks on basic physics, math, hydraulics, and powerplants.

2-10. INSTRUCTIONAL AIDS AND AIRCRAFT.

a. Scope and Depth. The instructional aids required by § 147.17 must be appropriate for the scope and depth of the curriculum of the school. The applicant should ensure the complexity of instructional aids is appropriate to the specific teaching level of the subject item. An inventory of instructional aids is required.

b. FAA Type-Certification Aircraft. Section 147.17(a)(2) requires a school to have (for instructional purposes) an aircraft of a type currently certificated by the FAA. In this case, certification refers to FAA type-certification. While many schools use surplus military aircraft to show compliance with this rule, at least one aircraft must be a type eligible for an FAA type certificate (TC). As an example, many light observation military aircraft have FAA TCs but most fighter aircraft do not; therefore, fighter aircraft would not meet the rule requirements. In some situations, an AMTS may choose to use an airworthy aircraft for certain instructional purposes in shop classes. This is permissible as long as the aircraft is on the school premises at the time of instruction. Active aircraft used to comply with § 147.17(d) become part of the approved instructional equipment; therefore, the aircraft must be listed in the instructional aids inventory.

c. Instructional Aids to Student Ratio. An AMTS must comply with the requirements for the ratio of instructional aids to students in each shop course. Section 147.17(c) permits no more than eight students to work on any one unit of equipment at a time. This does not necessarily mean that a school must have each type of instructional aid for at least every eight students enrolled. However, as an example, if a school has an enrollment of 30 students in the powerplant course of study and has only two turbine engines, the school must clearly demonstrate in the curriculum what project the students who exceed the 16 permitted on the turbine engines at any one time will be doing, for example, projects on piston engines or carburetors. However, the FAA or the AMTS may determine that eight students are too many in number to safely and competently conduct a certain project. As an example, instruction on a currently certificated aircraft used for the demonstration of gear retraction systems, eight students may be deemed as too many students involved in this training event.

2-11. SHOP EQUIPMENT REQUIREMENTS.

a. Equipment Quantity and Condition. An AMTS is required to have enough shop equipment in place and in satisfactory operating condition to adequately serve the student enrollment and meet shop/project subject requirements.

b. Equipment Placement. The equipment must be located so students can operate it in a safe and efficient manner. Large, standing equipment must be securely installed. Placement of large shop equipment should provide sufficient aisle space so that students can move about freely. The equipment must be listed and the list maintained in the shop where the equipment is located.

2-12. SPECIAL TOOLS STANDARDS. The AMTS must provide an inventory of special tools required to provide instruction. For subjects taught at level 3, when meeting return to service standards, all special tools must be in satisfactory working condition, maintained in accordance with § 147.19, and of the proper kind for the purpose for which they are intended. When meeting simulated return to service standards, all special tools must be in satisfactory working condition for the purpose for which they are to be used. Section 147.19 requires the AMTS to furnish an adequate supply of special tools appropriate to the ratings and curriculum of the AMTS. Special tools may be custom fabricated for the intended purpose and furnished by the AMTS.

2-13. STUDENT HAND TOOL REQUIREMENTS. The AMTS may either provide common hand tools or require students to furnish their own. In either case, the school must establish a policy on provision of common hand tools. The school must provide a list of required hand tools to the students. Any tools the school requires the student to furnish must be listed specifically in the curriculum and that list must be provided to students.

2-14. MATERIAL REQUIREMENTS. The AMTS must provide a list of materials required for instruction. The school must have sufficient materials in stock and properly stored to provide for the approved student enrollment. To ensure adequate instruction, the amount and variety of stocks should directly reflect the requirements of the curriculum. For example, sufficient quantities of rivets, hydraulic fluid, gaskets, and sheet metal are needed to complete a course of study.

2-15. INSTRUCTOR REQUIREMENTS AND RESPONSIBILITIES.

a. Instructor Requirements. Individuals listed as instructors must be FAA-certificated with an FAA mechanic certificate having ratings appropriate to those subjects taught in A&P subject areas as identified in Appendix C and D. The AMTS may provide specialized instructors that are not certificated mechanics to teach general subject areas such as mathematics, physics, basic electricity, basic hydraulics, drawing, and similar subjects. The suitability of noncertificated instructors to teach certain general courses is evaluated by the FAA on an individual basis. As an example, a school may propose to use a non-FAA-certificated, but experienced, engineering instructor to teach the mathematics and physics requirements of the general curriculum.

b. Student/Teacher Ratios. Section 147.23 requires at least 1 certificated instructor for every 25 students in each laboratory or shop class. The AMTS may choose to provide a lower student to teacher ratio according to the needs of the class or subject. The AMTS must have procedures to maintain the required minimum instructor ratios when regular instructors are on leave.

2-16. FOREIGN SCHOOLS. Part 147 does not make any provisions for FAA certification or surveillance of aviation mechanic schools located outside the United States. Foreign AMTS applicants are not eligible for FAA certification.

2-17. SATELLITE SCHOOLS. An AMTS may not operate as a satellite facility. All AMTS must be FAA-certificated as separate facilities.

CHAPTER 3. OPERATING RULES

3-1. CHANGE OF LOCATION.

a. Notification. An AMTS may not make any change in the school's location unless the FAA reviews and approves the changes in advance. The AMTS is required to notify the FAA in writing at least 30 days before the location change is to be executed. During the change in location, no disruption may be made to student instruction or normal classroom attendance. Equipment, facilities, and instructors must be at least at the same level as the standards approved for the vacated facilities or revised and explained as part of the application process. Application for a change of location is made by completing FAA Form 8310-6, Aviation Maintenance Technician School Certificate and Ratings Application.

b. Amendment to or Transfer of Certificate. The AMTS must apply for a change to its certificate if changing the location of the AMTS. The air agency must notify the FAA in writing at least 30 days before the date of the change. The FAA may prescribe conditions the air agency must follow while moving to the new address/location. If the AMTS location is changed without approval, the air agency certificate will be revoked. (Refer to § 147.41.)

(1) Change of FAA District. When the location is a change to another FAA district office or region, the application for approval must go to the district office and receive coordination through each respective region that has current and/or future certificate responsibility. The originating district office will contact and coordinate directly with the receiving district office while maintaining close coordination with the affected Regional Office(s) (RO). The school remains the responsibility of the originating district office until approval of the change or transfer. Refer to Volume 2, Chapter 1, Section 2 for additional information.

(2) Sale or Transfer of Assets. The privileges of an AMTS Air Agency certificate are not transferable. If the holder of the Air Agency certificate sells or transfers its assets, the new owner must apply for an amended certificate in accordance with § 147.41. There are occasions when AMTS ownership changes without a corresponding change in location, facilities, or personnel.

(3) The Freedom of Information Act (FOIA). The inspector should recommend a new certificate number due to the FOIA and liability issues. ASIs should inform prospective owners that they may be held liable for the work performed under previous management if they keep the same certificate number. New owners must stipulate in writing that they clearly understand the potential of release of information under the FOIA before receiving permission to retain the old certificate number.

(4) Retaining or Re-issuing the Certificate Number. If the new owner elects to retain the original certificate number, the revised air agency certificate (FAA Form 8310-6) will show the original certification date in the "Date issued" field. If issuing a new certificate number, prepare a new air agency certificate using the effective date of the new certificate. The "Date issued" should always reflect the original certification date for the certificate number identified on the air agency certificate.

(5) Change in Ownership. A change in ownership may or may not affect the status of an AMTS. If the operational relationship that established an AMTS continues unchanged, a change to the certificate number may not be required. If that relationship no longer exists, the certificate number identifying the AMTS cannot be retained by the new owner.

(6) Regional General Counsel Office. ASIs should contact their regional general counsel office when faced with questions concerning whether limited liability corporations or changes in stockholder ownership constitute a transfer of AMTS assets.

3-2. TIME AND ATTENDANCE. An AMTS must specify in the approved curriculum the number of instructional hours the school intends to offer. An AMTS must ensure typical time loss items do not affect approved curriculum hours. Student attendance requirements are specified in § 147.31(a). Some typical time loss items are as follows:

- Instructors ill or on leave. In small schools, this could result in canceled classes or students sent to a study room;
- Teachers' strikes;
- Weeks scheduled for private study and/or testing outside of the approved curriculum;
- Class outings, not related to aviation maintenance, that take time away from instructional hours;
- Student achievement days, sports days, and special event days;
- Teachers' meetings and grading days;
- Student absences beyond those permitted in the FAA-approved curriculum;
- Classroom or laboratory and shop time spent on non-instructional activities such as school administrative work and pep rallies, cleaning, painting, repair and maintenance of instructional aids; and
- Any other activity that intrudes on instructional time.

3-3. ENROLLMENT. An AMTS applicant cannot have more students enrolled than the number stated on the certificate application. As enrollment increases or decreases, an AMTS may choose to change either the number of certificated or noncertificated instructors, or the subjects to be taught by each. However, when instructors are changed or if enrollment exceeds the FAA-approved figures, the school must notify the FAA in advance.

3-4. RECORDS, TRANSCRIPTS, AND GRADUATION CERTIFICATES. An AMTS must maintain and, upon request, make available to the FAA documents that show records on each student. (New AMTS applicants must also show the proposed method of meeting FAA records requirements.)

a. Records. Records must clearly show attendance, tests, quizzes, and practical projects grades received on subjects required. Student records should clearly distinguish between successful performance and unsuccessful performance. The record should show how credit was granted for previous experience and/or previous instruction. Progress records or charts do not need to show student grades for practical projects or laboratory work if those grades are available in another record at the school. However the progress record should show the practical projects and lab work completed and/or to be completed. Student attendance records should show the number of hours of absences. Section 147.33 requires schools to retain student records for

2 years. This does not refer to each student's personal tests but to the grades received on tests given to the student for each subject. Examples of the forms used for these records should be in a document such as the curriculum.

b. Transcripts. Upon request, each certificated AMTS shall provide a transcript of the student's grades to each student who is graduated from that school or who leaves it before being graduated. An official of the school shall authenticate the transcript. The transcript must state the curriculum in which the student was enrolled, whether the student satisfactorily completed that curriculum, and the final grades the student received.

c. Graduation Certificates or Certificates of Completion. An official of the AMTS must authenticate all student certificates issued. This should be accomplished by verifying the student has passed the specified courses or has received prior credit based on the AMTS approved curriculum requirements. The certificate cannot be issued unless all curriculum requirements have been completed for the certificate sought. All students meeting the AMTS graduation or completion requirements must be issued the appropriate certificate. Each school shall give a graduation certificate or certificate of completion to each student that it graduates. The certificate must show the date of graduation or completion and the approved curriculum title. The certificates should contain the name of the AMTS, its certificate number, the approved course name, and date of graduation.

d. Student Graduation Lists. Schools with affiliations must provide a student graduation list to the assigned Flight Standards District Office (FSDO), Designated Mechanic Examiner (DME), and the Testing Center with the following content:

- Name and certificate number of the AMTS,
- Graduation date,
- Curriculum from which the applicant graduated (i.e., Airframe and/or powerplant),
- Name of the applicant, and
- Signature of the authorized school official.

3-5. MAINTENANCE OF FACILITIES. Under part 147, an AMTS is required to continuously maintain the same standards as those under which it was certificated originally. This includes the maintenance of all facilities and equipment required for initial certification.

3-6. MAINTENANCE OF INSTRUCTOR REQUIREMENTS. After an AMTS is certificated or has added or dropped a rating, the AMTS must continue to provide an appropriate number of instructors with the ratings and certificates required by the FAA. The AMTS must continue to provide at least one FAA-approved instructor for each 25 students in each laboratory or shop class.

3-7. MAINTENANCE OF INSTRUCTIONAL AIDS. An AMTS must continue to maintain all instructional aids and equipment in good working order and in a condition for safe operation. Examples of instructional aids include diagrams, visual aids, computers, interactive software, aircraft, and mock-ups of aircraft, engines, and components, as well as actual components, such as magnetos and fuel controls. An instructional aid is not required to meet return to service standards. Broken or deteriorated instructional aids must be repaired or replaced. The school must continue to provide sufficient instructional aids so that there will not be more than eight students per instructional aid unit at any one time.

3-8. MAINTENANCE OF TECHNICAL DATA REFERENCE MATERIALS. An AMTS should provide a system that identifies the individual by position responsible for updating the technical data/reference materials. The procedure must clearly show the methods for maintaining and upgrading the data.

3-9. MAINTENANCE OF SHOP EQUIPMENT. Shop equipment should be maintained in good working order and be in a condition for safe operation. A system should be in place for routine preventive maintenance and component replacement on all shop equipment.

3-10. MAINTENANCE OF TOOLS AND SPECIAL TOOLS SUPPLY. The school must continue to provide all tools, as required. During school operation, tools may not be removed from the AMTS inventory without being replaced. A system should also be in place to maintain special tools in satisfactory working condition.

3-11. MAINTENANCE OF INSTRUCTIONAL MATERIALS. The AMTS must continue to provide required materials specified in the instructional materials list.

3-12. MAINTENANCE OF QUALITY OF INSTRUCTION. An AMTS must continue to provide instructions of the same quality as it demonstrated to the FAA, during and ongoing after certification. The instrument used by the FAA to measure AMTS instruction quality is a document titled "School Norms vs. National Passing Norms". The national norm is a measure of the performance of AMTS graduates from each school who are taking the FAA A&P Mechanic Test measured against the performance of other applicants taking the FAA A&P Mechanic Test. This information is available by review of the following reports:

- School Norms vs. National Passing Norms (8080-08); and
- Aviation Maintenance Test Applicant Listing.

a. Corrective Action. Corrective action may need to be initiated if the percentages fall below those specified in § 147.38(a).

b. Test Performance. While poor test performance alone may not indicate poor instruction, it may be an indication that some aspects of the school operation are inadequate or ineffective.

c. AMTS Norm. Use of the AMTS norm.

d. School Norms. When an individual school norm is significantly lower than the national norm, i.e., in excess of the requirements of § 147.38(a), an asterisk (*) will appear next to the 2 year school norm score on the 8080-08 report. The responsible region/district office may obtain more detailed performance information to assist in determining problem areas by requesting an Aviation Maintenance Test Applicant Listing from the Airman Testing Standards Branch, AFS-630. The 8080-08 report and the Aviation Maintenance Test Applicant Listing data may be shared freely with the school to which it refers.

3-13. AMTS NORM VS. NATIONAL PASSING NORMS, AC FORM 8080-08, AND ASSOCIATED REPORTS IN THE SERIES. This series of reports provides information to the school and the responsible FAA region and district offices about the test performance of school graduates. The reports are used to monitor school performance and to determine whether schools meet the quality of instruction provisions of § 147.38(a). The reports are posted quarterly (6 weeks after the end of each calendar year quarter) to the publicly accessible FAA Norms Web site at http://www.faa.gov/data_research/aviation_data_statistics/test_statistics/. Two years of norms reports are maintained and available on the Web site. The report data is available to the public and may be shared freely with the school to which it refers as well as any other party.

a. 8080-08 Report. The 8080-08 is the basic report of the series. It contains a record of test activity and performance of graduates of the subject schools who apply for a mechanic written test for the first time within 60 days after graduation.

b. Applicant Listing. Aviation Maintenance Test Applicant Listing contains a record by applicant name of the test performance for graduates from a subject school for a time period specified by the requestor and is produced on request by AFS-630.

c. Non-School Reports. "Non-school" reports are quarterly reports arranged by the region in which the testing occurred. These reports are made for the following:

- Applicants who graduate from a certificated school and who take the mechanic tests for the first time within 60 days of graduation (8080-09);
- Applicants who graduate from a certificated school, but who take the mechanic tests for the first time more than 60 days after graduation (8080-07), and
- Applicants who qualify for testing through actual experience and are not graduates of a certified school (8080-04).

3-14. AVAILABILITY OF TYPE-CERTIFICATED AIRCRAFT. Section 147.17(a)(2) requires an AMTS to provide a type-certificated aircraft for student instruction. Specific requirements are discussed in Chapter 2, par 2-10, Instructional Aids and Aircraft.

CHAPTER 4. CERTIFICATION PROCEDURES

4-1. GENERAL INFORMATION ON CERTIFICATION PROCEDURES.

a. Certification Process. The AMTS certification process is an interaction between the AMTS applicant and the FAA. The certification process extends from the initial inquiry by the school applicant, to the final issuance of the Air Agency Certificate and OpSpecs. This process ensures the school's curriculums, programs, policies, facilities, and methods of compliance with the regulations are thoroughly reviewed, evaluated, and validated. A certification schedule flowchart for the AMTS certification process is shown in Appendix 10, Certification Process Flowchart. Figure 4-1, AMTS Certification Process Guide, provides a certification checklist as an aid to ensure all documents and procedures are complied with and recorded.

FIGURE 4-1. AMTS CERTIFICATION PROCESS GUIDE

AMTS CERTIFICATION PROCESS GUIDE				
NAME OF SCHOOL:	INSPECTION			
	Date	SAT.	UNS.	NA
1. Initial inquiry to FAA				
2. Obtain copy of regulations/FAA Form 8400-6				
3. Develop Form 8400-6				
4. Submit Form 8400-6 to FAA				
5. Preapplication meeting with FAA				
6. Develop formal application				
• Detailed curriculum • Distance learning Process and Procedures (if applicable)				
• Grade/credit/record system				
• Attendance system				
• Library and text requirements				
• Tool/instructional aids inventory				
• Complete FAA Form 8310-6				
• Facility description				
• List of instructors/qualifications				
• Statement of maximum number of students				
• Draft the OpSpecs in Web-based Operations Safety System (WebOPSS)				
7. Formal application meeting				
8. Curriculum evaluation				

9. AMTS facility inspection by FAA					
• Basic facility check					
• Instructional aids check					
• Shop equipment check					
• Special tool/calibration					
10. Discrepancy meeting, if applicable					
11. FAA certification					

b. Five Phases. The FAA certification process consists of the five separate phases listed below:

- Preapplication phase;
- Formal application phase;
- Document compliance phase;
- Demonstration and inspection phase; and
- Certification phase.

NOTE: These phases may often overlap and can proceed concurrently. As an example, the document compliance phase may begin as soon as documents are received, before or during the formal application phase. The AMTS applicant is highly encouraged to review Volume 2, Chapter 12, Section 1 in order to be informed of the guidance the ASI is required to follow to complete the part 147 Air Agency certification process.

4-2. PREAPPLICATION PHASE.

a. Initial Inquiry. An applicant seeking to develop an AMTS for certification must contact the local FAA FSDO and advise the office of the intent to pursue part 147 school certification. The FAA will advise the applicant of the necessity for a preapplication meeting as well as provide the AMTS certification applicant with a blank copy of FAA Form 8400-6, Preapplication Statement of Intent, (see Figures 4-2 and 4-3), and an explanation of where to send the form after completion. The FAA should provide the applicant with information on how to obtain regulatory requirements and guidance associated with acquiring an FAA part 147 certification. Information on additional guidance material associated to the part 147 certification process such as orders and ACs may also be provided to the applicant at this time. The FAA informs the applicant of the necessity to review the regulatory requirements and return the completed Preapplication Statement of Intent (PASI) to the FSDO before a preapplication meeting can be scheduled.

b. PASI. An applicant should submit copies of the PASI only after reviewing the appropriate regulations and advisory materials. Before PASI submission, the applicant should consider the personnel, facility, equipment, and regulatory requirements for certification and operation.

FIGURE 4-2. PREAPPLICATION STATEMENT OF INTENT (FRONT)

Form Approved
OMB No. 2120-0008

PREAPPLICATION STATEMENT OF INTENT

US Department of Transportation
Federal Aviation Administration

Agency Display of Estimated Burden: The FAA estimates that the average burden for this report form is 5 hours for the requirements in FAR Part 121.26 and 40 hours for the requirements in FAR Part 121.47 for each response. You may submit any comments concerning the accuracy of this burden estimate or any suggestions for reducing the burden to the Office of Management and Budget. You may also send comments to the Federal Aviation Administration, Air Transportation Division, AFS-200, 800 Independence Avenue, SW, Washington, DC 20591, Attention: OMB number 2120-0008.

Section 1A. To Be Completed By All Applicants

1. Name and mailing address of company

2. Address of principal base where operations will be conducted *(do not use post office box)*

3. Proposed Start-up date

4. Requested three-letter company identifier in order of preference
1. 2. 3.

5. Management Personnel

Name (Last, first, middle)	Title	Telephone (including area code)

Section 1B. To Be Completed By Air Operators

6. Proposed type of operation (check as many as applicable)

- ☐ Air Carrier Certificate
- ☐ Operating Certificate
- ☐ Part 121
- ☐ Part 125
- ☐ PArt135
- ☐ Passengers and Cargo
- ☐ Cargo Only
- ☐ Scheduled Operations
- ☐ Nonscheduled Operations
- ☐ Single Pilot Operator
- ☐ Single Pilot-in-Command Operator
- ☐ Basic Part 135 Operator

Section 1C. To Be Completed By Air Agencies

7. Proposed type of agency and rating(s)

- ☐ Part 145 Repair Station
  - ☐ Domestic
  - ☐ Foreign ☐ *New* ☐ *Renew*
  - ☐ Satellite
    - ☐ Airframe ☐ Instrument
    - ☐ Powerplan ☐ Accessory
    - ☐ Propeller ☐ Specialized Service
    - ☐ Radio
- ☐ Part 147 Maintenance Technical School
  - ☐ Airframe
  - ☐ Powerplant
  - ☐ Both
- ☐ Part 149 Parachute Loft

Section 1D. To Be Completed By Air Operators

8. Aircraft Data

Numbers and types of aircraft (by make, model, and series)	Number of passenger seats or cargo payload capacity

9. Geographic area of intended operations

FAA Form 8400-6 (6-95) Supersedes Previous Edition NSN: 0052-00-889-4002

FIGURE 4-3. PREAPPLICATION STATEMENT OF INTENT (BACK)

Section 1A. To Be Completed By All Applicants		
10. Additional information that provides a better understanding of the proposed operation or business *(attach additional sheets, if necessary)*		
11. The statements and information contained on this form denote an intent to apply for FAA certification.		
Signature	Date	Name and Title

Section 2. To Be Completed By FAA District Office	
Received by (district office):	**Date forwarded to Region:**
Date:	**For:** ☐ Action ☐ Information only
Remarks	

Section 3. To Be Completed By Regional Office	
Received by:	**Precertification Number:**
Date:	**Date coordinated with AVN-120:**
District office assigned responsibility:	**Date forwarded to district office:**
Remarks	

FAA Form 8400-6 (6-95) Supersedes Previous Edition NSN: 0052-00-889-4002

c. Preapplication Meeting. Following receipt of the completed PASI, the FAA will contact the AMTS applicant and arrange a preapplication meeting. During this meeting, the applicant should ask any questions that he or she may have concerning FAA certification. The following events take place during the preapplication meeting:

(1) FAA personnel will brief the applicant on the regulatory requirements and policies regarding certification and operation of an AMTS.

(2) The applicant informs the FAA as to which of the three types of ratings are sought: airframe, powerplant, or combined A&P.

NOTE: Because of the complexity and costs involved in certification, many AMTS applicants initially choose to seek certification for only one rating to reduce certification time and to get classes under way.

(3) The applicant is given a blank FAA Form 8310-6, to complete. See Figure 4-4.

NOTE: For distance learning information on requirements see Appendix 11.

FIGURE 4-4. FORM 8310-6, AVIATION MAINTENANCE TECHNICIAN SCHOOL CERTIFICATE AND RATINGS APPLICATION (FRONT)

Form Approved. OMB No. 2120-0040

US Department of Transportation
Federal Aviation Administration

AVIATION MAINTENANCE TECHNICIAN SCHOOL CERTIFICATE AND RATINGS APPLICATION

INSTRUCTIONS: Type or print in ink. Submit original and two copies of this form (complete this side ONLY) and two copies of all attachments to the nearest FAA General Aviation District Office or Air Carrier District Office as set forth in Federal Aviation Regulations, Part 147.

[illegible]	2. TELEPHONE NO.
3. ADDRESS *(Number, street, city, state & ZIP Code)*	4. TRAINING DIRECTOR

5. APPLICATION SUBMITTED FOR *(Check as applicable)*

	ORIGINAL CERTIFICATE
	CHANGE IN RATING *(Specify)*
	CHANGE IN OWNERSHIP *(Specify)*
	CHANGE IN LOCATION, FACILITIES, AND EQUIPMENT *(Specify)*
	CHANGE IN ENROLLMENT *(Specify)*
	OTHER *(Specify)*

6. RATING(S) APPLIED FOR AND TOTAL HOURS PER COURSE / **7. MAXIMUM NO. OF STUDENTS ENROLLED AT ANY ONE TIME**

	RATINGS	TOTAL HOURS	DAY	EVENING
	AIRFRAME (A)			
	POWERPLANT (P)			
	A & P			
	7A. MAXIMUM TOTAL SCHOOL ENROLLMENT			

8. SCHOOL STATUS *(Check as applicable)*

	PUBLIC		PRIVATE		NON-PROFIT
[illegible]					
	ON AIRPORT		IN CITY		IN SUBURBS

10. COURSE CHARACTERISTICS

RATINGS	HOURS PER WEEK		WEEKS PER COURSE		INSTRUCTION HOURS PER		ENROLLMENT PERIODS PER YEAR FOR		[illegible]							
									DAY		EVENING		DAY		EVENING	
	DAY	EVENING	DAY	EVENING	DAY	EVENING	DAY	EVENING	YES	NO	YES	NO	YES	NO	YES	NO
AIRFRAME (A)																
POWERPLANT (P)																
A & P																

11. ATTACHMENTS *(Check applicable items)*

	A. PROPOSED CURRICULUM		E. LIST OF REQUIRED PRACTICAL PROJECTS
	B. LIST OF FACILITIES AND EQUIPMENT TO BE USED		F. SCHEDULE OF REQUIRED TESTS
	C. PHOTOGRAPHS OF FACILITIES		G. COPY OF STUDENT RECORD SYSTEM
	D. LIST OF INSTRUCTORS, NAMES, CERTIFICATE NOS., TYPE, AND RATINGS HELD, AND SUBJECTS TO BE TAUGHT		[illegible]

12. APPLICANT'S CERTIFICATION

NAME OF OWNER *(Include name(s) of individual owner, all partners, or corporation name giving State and date of incorporation)*

I hereby certify that I have been authorized by the school identified in item 1 to make this application and that statements and attachment hereto are true and correct to the best of my knowledge.

DATE	TITLE	AUTHORIZED SIGNATURE

13. CERTIFICATION ACTION *(FOR FAA USE ONLY)*

	ACTION	CERTIFICATE NO. ASSIGNED	RATINGS	INDICATE RATING(S) ISSUED DAY	INDICATE RATING(S) ISSUED EVENING	APPROVED MAXIMUM ENROLLMENT FOR DAY	APPROVED MAXIMUM ENROLLMENT FOR EVENING
	APPROVED		AIRFRAME (A)				
	DISAPPROVED	FAA FORM 8310-4 FORWARDED ON	POWERPLANT (P)				
			A & P				

REMARKS

14. DATE CERTIFICATE ISSUED	15. OFFICE IDENTIFICATION	16. ISSUING OFFICIAL'S SIGNATURE

FAA Form 8310-6 [illegible]

FIGURE 4-5. FORM 8310-6, AVIATION MAINTENANCE TECHNICIAN SCHOOL CERTIFICATE AND RATINGS APPLICATION (BACK)

RIS: FS 8310-4

AVIATION MAINTENANCE TECHNICIAN SCHOOL INSPECTION REPORT

(FOR FAA USE ONLY)

INSTRUCTIONS: The items listed below are applicable to certification inspection and/or to surveillance. Complete each item. If an item is not applicable indicate entry as "NA".

1. NAME OF SCHOOL	2. CERTIFICATE NO.	3. TYPE OF INSPECTION AND DATE		
		SESSION	SURVEILLANCE	CERTIFICATION
		DAY		
		EVENING		

4. SCHOOL CHARACTERISTICS

SESSION	a. PRESENT ENROLLMENT			b. TOTAL NUMBER OF INSTRUCTORS		c. MAXIMUM HRS. TRAINING PER WEEK PER STUDENT *(Exclusive of lunch or rest periods)*			d. RATINGS APPLIED FOR OR NOW IN EFFECT			e. DATE OF APPROVAL FOR CURRICULUM NOW IN USE		
	AIRFRAME	POWER-PLANT	A&P	CERTIFICATED	NONCERTIFICATED	AIR-FRAME	POWER PLANT	A&P	AIR-FRAME	POWER PLANT	A&P	AIR-FRAME	POWER PLANT	A&P
DAY														
EVENING														

		AIRFRAME (A)	POWERPLANT (P)	A&P
5. How many students were graduated during the previous 12 months?				
6. Instructor/student radio.	a. Classroom	1 to	1 to	1 to
	b. Shop	1 to	1 to	1 to
7. Number of hours in approved curriculum.		Hrs.	Hrs.	Hrs.

	YES	NO
8. Is certificate current and properly displayed?		
9. Does the curriculum in use meet the requirements of FAR 147?		
10. Is the approved curriculum actually being followed?		
11. Do facilities and equipment continue to meet the certification requirements of FAR 147?		
12. Are necessary materials, tools, and equipment available and serviceable for training?		
13. Is there a sufficient number of qualified instructors?		
14. Has there been any change in instructor or administrative personnel since the last inspection? *(If "YES, " explain in Remarks)*		
15. Is classroom and shop space suitable for courses given and number of students?		
16. Are the instructional aids *(mockups, projectors, charts, films, etc.)* current, specifically applicable to the curriculum, and sufficient for all phases of training?		
17. Are there sufficient copies of FAR's. manufacturer's instructions, etc.?		
18. Have proper safety measures been taken to insure protection of students operating hazardous equipment including facilities for running engines?		
19. Are student records current and do they reflect: a. Daily actual hours students have been in class?		
b. Progress through courses in the curriculum including accomplishment of laboratory and shop projects?		
c. Grades for all courses including quizzes, tests. and practical projects?		

20. REMARKS AND ITEMS TO FOLLOW UP ON NEXT INSPECTION *(Use additional sheets if more space is needed)*

21. INSPECTION RESULTS		22. OFFICE IDENTIFICATION	23. INSPECTOR'S SIGNATURE
	SATISFACTORY		
	UNSATISFACTORY		
	OTHER		

(4) The applicant is given a thorough briefing on required attachments to the formal application. The applicant is briefed on how to comply with these requirements, because the quality of these documents is a positive determining factor in FAA certification review.

NOTE: These attachments can be presented to the FAA in writing either before or during formal application. The attachment documents needed to be prepared and brought to the formal application meeting and include the following:

(a) A letter of compliance, i.e., statement of compliance (SOC), listing each applicable part 147 section. The statement should provide either a brief narrative or, preferably, a specific reference to a manual, curriculum, or other document that describes the manner of compliance with each part of that regulation.

(b) A Schedule of Events (SOE) to be completed for certification with projected due dates.

(c) Standards for graduation.

(d) An attendance policy, a system for recording student attendance, and subject makeup procedures.

(e) A system providing procedures for maintenance of precision/special tools.

(f) A letter requesting that the application be processed and indicating when the facilities and equipment will be ready for a formal inspection by the FAA.

(g) Two completed copies of FAA Form 8310-6.

(h) A detailed description of the proposed curriculum. Since the curriculum must be approved by the FAA before the school can be certificated, an applicant can save time and money if the proposed curriculum is submitted before the formal application. Typically, a curriculum may take several FAA/AMTS review sessions before approval is granted. See curriculum requirements in Chapter 2, paragraph 2-7.

(i) A written description or diagram of the facility layout to be used for instruction. The applicant should also provide detailed drawings with dimensions of the classrooms, the technical library, and laboratory and shop facilities. Drawings should show the relative location of each school's facilities to each other. If classrooms or laboratories and shops are located at significant distances from each other, the applicant should describe whether and how travel time will affect required class attendance time.

(j) A proposed inventory of the following items:

- Instructional aids that include the numbers and types of mockups, aircraft, aircraft components, charts, or other visual instruction tools;
- All shop equipment;
- All special tools;

- Required student hand tools (the applicant must list in detail which hand tools will be provided by the school and which tools the student will be required to provide); and
- Laboratory and shop instructional materials (for example, rivets and sheet metal).

(k) A list of proposed instructors indicating all required certificate number(s) and rating(s), and the subjects to be taught by each instructor. Every subject in the proposed curriculum must be accounted for on the instructor listing. At least one FAA-approved instructor is required for every 25 students in each laboratory and shop class. This requirement must be reflected in the list of instructors.

(l) A statement indicating the maximum number of students to be taught for each rating during each enrollment period. This information must be shown on the application form as well.

(m) A written description of the contents and location of the proposed technical data reference area, including the appropriate and current technical data necessary for the ratings sought. The description should contain procedures on how, when, and by whom the technical data will be updated.

(n) A written description of the method the school will use to grant credit to students with previous AMT experience. Section 147.31(c)(3) requires that only documentary evidence and testing may be used to grant credit for experience. Previous experience must be aviation maintenance experience and must be comparable to the required curriculum subjects.

(o) A written description of the method the school will use to grant credit to students for previous AMT training. Section 147.31(c)(1) permits several methods to be used for granting credit for previous training. School transcripts, catalog references, and other course documentation may be used to grant credit.

(p) If it is not specifically included in the curriculum, a written description of the method the school will use to record and maintain student time, attendance, and course grades. The system must include a method of determining final course grades, which are a combination of classroom, laboratory, and practical project grades. All required practical projects must be completed to at least the minimum grading standards.

(q) A system that indicates how testing and grading security will be maintained

(r) A listing of any texts that will be used in the approved curriculum. These must be appropriate to the instructional material, curriculum, and the FAA ratings sought.

4-3. FORMAL APPLICATION PHASE.

a. Document Review. After the AMTS submits the required PASI and preapplication information to the FAA, the FSDO will review the documents. When the FSDO has determined that all the documents are complete and acceptable, the FSDO will contact the school and arrange for a formal application meeting.

b. The Formal Meeting. In the formal application meeting, the AMTS applicant's key decision-making personnel should be available to meet with the FAA and discuss the entire application package. Any open questions or discrepancies should be resolved at this time. Based on the document review and the results of these meetings, the FAA will accept or reject the application at that time. The FAA will document the results of the meeting in writing. In the case of a rejected application, the FAA will return the application and attachments to the applicant with the reasons stated for rejection.

4-4. DOCUMENT COMPLIANCE PHASE. This phase generally overlaps the preapplication phase and extends through the formal application phase. It is recommended that this phase be initiated as early as possible in the certification process.

a. Evaluation of Documentation. The FAA will carefully review all documents submitted during the preapplication phase. The FAA can be expected to place particular emphasis on the curriculum content and the methods within the curriculum used to comply with the regulations. The FAA will maintain contact with the applicant during this phase. If deficiencies are found in the curriculum or in any other preapplication documents, the FAA will return these documents to the applicant with a letter outlining the deficient areas. The FAA generally offers suggestions on modifying the product, but will not write the applicant's documents. A future meeting between the FAA and the applicant will be scheduled to discuss each deficiency in detail. If the documents, as a whole, are not of sufficient quality to complete the certification, the FAA will terminate the entire certification process.

b. Termination. In the case of termination of the certification process, the applicant must submit a new PASI to begin the certification process again.

4-5. DEMONSTRATION AND INSPECTION PHASE.

a. Inspection Schedule. Following a successful formal application phase, the FAA will arrange with the applicant to inspect the facility. At this point, the FAA expects the AMTS facility to be complete with all the shop equipment, instructional aids, instructional aircraft, special tools, and other required laboratory or shop installations in place. Before scheduling an inspection, the applicant should be certain the facility is ready to meet the standards.

b. Emphasis. During the inspection, the FAA inspectors will carefully examine the facilities and equipment to ensure that procedures, programs, facilities, and equipment meet FAA requirements and are safe and sufficient for the training program in the shop to be effective.

c. Demonstration Criteria. In particular, the AMTS must demonstrate compliance with the following regulations:

- Facilities must meet the requirements of §§ 147.13 and 147.15;
- Instructional equipment must meet the requirements of § 147.17; and
- All special tools, hand tools, shop equipment, and instructional materials must meet the requirements of § 147.19.

d. Demonstration Deficiencies. When deficiencies in the demonstration arise, the FAA will provide a written list of the discrepancies to the applicant. Depending on the magnitude of the deficiencies, the FAA may schedule a meeting to discuss in detail the appropriate corrective actions that must be taken. At or immediately following the meeting, the applicant must provide the FAA with a list of all corrective actions taken. No AMTS will be FAA-certificated with outstanding discrepancies. All discrepancies must be corrected before certification may be granted. If the discrepancies cannot be resolved and/or the applicant does not demonstrate compliance with the regulations, the FAA will terminate the certification process and send the applicant a letter of rejection and a list of the discrepancies still outstanding.

e. Termination. If the FAA terminates the application, the applicant must correct the discrepancies and submit a new PASI to reinitiate the certification process.

4-6. CERTIFICATION PHASE.

a. Successful Application. When all the regulatory requirements have been met, the school will be issued an AMTS Air Agency certificate and appropriate OpSpecs. The original FAA Form 8000-4, Air Agency Certificate, signed by the district office manager will contain the name of the school and its ratings. At this time, the FAA will return the AMTS curriculum with each page of the LEP signifying FAA approval with a date and the PI's stamp, initials, or signature.

b. Surveillance. A newly certificated school should expect that the FAA will inspect and observe the school frequently during the first 90 days of operation to determine compliance with the applicable regulations. The FAA may also identify needed changes in the methods or techniques of the school's operation.

APPENDIX 1. GLOSSARY OF TERMS

This listing contains clarifications of some of the terms defined in 14 CFR part 147. When used within the context of part 147, these terms apply to Aviation Maintenance Technician School (AMTS) requirements.

1. Accreditation. Accreditation is the process used in U.S. education to ensure that schools, postsecondary institutions, and other education providers meet, and maintain, minimum standards of quality and integrity regarding academics, administration, and related services. This term refers exclusively to schools accredited within the United States.

2. Affiliated. A procedure allowing an AMTS Designated Mechanic Examiner (DME) to administer oral and practical tests to graduates/applicants, without an FAA signature in block V of FAA Form 8610-2, Airman Certificate and/or Rating Application only when a graduation certificate or certificate of completion is presented and the AMTS provides the DME with the certified list of graduates.

3. Asynchronous Learning. The method of teaching that takes place utilizing prerecorded developed training, preserved for the learner to participate in whenever the time is most convenient. Technology such as email, e-courses, online forums, and audio and video recordings make this possible. Asynchronous learning is considered more flexible than synchronous learning.

4. Aviation Safety Inspectors (ASI). FAA aviation safety maintenance inspectors are comprised of two principal inspector (PI) specialties, principal maintenance inspectors (PMI), and principal avionics inspectors (PAI).

a. PMI. The maintenance representative of the FSDO with principal responsibility for the certification and surveillance of a part 147 AMTS.

b. PAI. The avionics representative of the FSDO with principal responsibility for the certification and surveillance of a part 147 AMTS.

5. Aviation Technician Education Council (ATEC). The AMTS industry association.

6. Certificated Instructors. Those instructors who hold FAA mechanic certificates and the ratings appropriate for the AMTS subjects to be taught.

7. Certification. This term refers to AMTSs certificated as an Air Agency by the FAA.

8. Certification Project Manager (CPM). FAA personnel assigned as a team lead during an air carrier or air agency initial certification that provides guidance and written notification to the applicant during each phase of the certification project.

9. Check. To verify proper operation. A check is performed to verify proper operation without the item necessarily qualifying for return to service condition. At an AMTS, the item checked does not have to be the item overhauled.

10. Common Hand Tools. Small, ordinary tools such as ratchets, sockets, and screwdrivers.

11. Distance Education or Distance Learning. A method of delivering education and instruction, often on an individual basis, to students who are not physically present with an instructor in a traditional setting such as a classroom. Distance learning enables participation access to learning when the source of information and the learners are separated physically by time or distance, or both.

12. Flight Standards District Office (FSDO). The FAA office with geographic oversight of a particular part 147 AMTS.

13. Focused Curriculum. Curriculum directed toward a particular area of the aviation industry. An example is rotorcraft, Transport Category Agriculture, etc.

14. Instructional Aids. Equipment used to provide instruction. Examples include diagrams, visual aids, computers, interactive software, aircraft, and mock-ups of aircraft, engines, and components; as well as actual components, such as magnetos and fuel controls. An instructional aid is not required to meet return to service standards.

15. Instruction Hour. The educational unit hour, as used by an AMTS, that consists of a time period of 50 to 60 minutes. This instructional time period conforms to the existing practices at many education institutions.

16. Inspect. An organized examination or formal evaluation by sight, sound, touch, smell or any combination thereof, completed with or without inspection enhancing tools or equipment.

17. Laboratory. Facilities for providing instruction in general principles that may require student demonstrations or participation. Determination of what laboratory equipment is required depends on the subject taught and the teaching level at which it is taught.

18. Letter of Compliance or Statement of Compliance (SOC). A compliance statement listing each applicable part 147 section and providing either a brief narrative or a specific reference within the document(s) describing the manner of compliance with the regulation.

19. Maintenance Training Review Board (MTRB). The MTRB is an advisory board to plan, coordinate, and advise the FAA regarding the certificated AMTS required curriculum specific to part 147 appendices A, B, C, and D.

20. Noncertificated Instructors (Specialized Instructors). Individuals who are not FAA certificated but whom the AMTS has found qualified to teach mathematics, physics, basic electricity, basic hydraulics, drawing, and similar subjects. The applicant is required to maintain a list of the names and qualifications of specialized instructors, and upon request, provide a copy of the list to the FAA.

21. Operations Manual. Document that the institution may use to show compliance with part 147.

22. Operations Specifications (OpSpecs). OpSpecs are approved documents indicating authorizations, limitations, and certain procedures under which each kind of operation is to be conducted. OpSpecs are maintained in an Internet-accessible program known as Web-based Operations Safety System (WebOPSS).

23. Overhaul. To disassemble, inspect, repair as necessary, and check in accordance with FAA-acceptable instructions; that is, manufacturers' maintenance manuals, FAA directives, and Service Bulletins (SB). For an AMTS, the overhaul requirement in a teaching scenario does not require the overhauled component to meet approval for return to service mechanical tolerances. For example, a turbine engine that is not Airworthy or serviceable may be used for instructional purposes associated with component replacements or overhaul practices and techniques, but must not be used for engine run up demonstrations due to potential safety hazards and concerns.

24. Practical Project. A hands-on assignment that requires the use of manipulative skills taught at a teaching level of 2 or 3. A practical project generally does not include non-manipulative activities such as book reports. However, for certain required subjects such as maintenance publications, the use of FAA directives or manufacturers' data constitutes a practical project.

25. Practical Test Standards (PTS). PTS are a guide for students, instructors, FAA, and examiners to know what is expected on a test.

26. Quality Standards. The performance level at which a student understands their responsibilities and can simulate returning an item to service. However, it is not necessary for the item itself to meet "return to service" standards.

27. Ratings. An AMTS may be certificated for the following ratings: airframe, powerplant, or combined Airframe and Powerplant (A&P). The general portion of the required curriculum is not a rating, but it is a required part of all the ratings.

28. Shop. Facilities for providing instruction on projects taught at teaching level 2 or 3. The shop environment should resemble a typical aviation repair facility.

29. Shop Equipment. Machinery, such as fabricating devices, sheet metal equipment, and battery chargers.

30. Simulated Approval For Return to Service. A measured standard of instructing students' academic and manipulative skills in which to prepare them with the needed skills to maintain and properly return aircraft, parts, or components to service.

31. Special Tools. Highly specialized tools, such as tensionometers, micrometers, and torque wrenches.

32. Synchronous Learning. Learning that takes place when two or more people are communicating in real time, "live". Sitting in a classroom, talking on the telephone, and chatting via instant messaging are examples of synchronous communication.

33. Teaching Levels.

a. Level 1. Level 1 requires knowledge of general principles and instruction by lecture, demonstration, and discussion, but no practical application or development of manipulative skill. Teaching aids or instructional equipment may include charts, books, diagrams, or other visual teaching aids. If an AMTS chooses to teach level 1 courses incorporating actual components, the components do not have to be operational.

b. Level 2. Level 2 requires knowledge of general principles, limited practical application, and development of sufficient manipulative skill to perform basic operations, as well as instruction by lecture, demonstration, discussion, and limited practical application. This teaching level requires some hands-on manipulative skills and their accompanying actual or simulated components/equipment; but still may be taught primarily in the classroom environment.

c. Level 3. Level 3 requires knowledge of general principles, performance of a high degree of practical application, development of sufficient manipulative skills to simulate return to service, and instruction by lecture, demonstration, and discussion. This teaching level requires hands-on manipulative skill, as well as sufficient and appropriate instructional aids to train the student to develop manipulative skills sufficient to simulate return to service. At this level, the teaching aids must be similar to, or the actual items of, equipment on which the student is expected to develop required skill levels. A level 3 subject cannot be taught solely by lecture in the classroom; the appropriate training aids and hands-on experience must be used.

34. Troubleshoot. To systematically analyze and identify malfunctions, and to identify the source of trouble in an airframe, powerplant, or aircraft component. For the purposes of AMTSs, the item of equipment or simulator training aids must be in operating condition. For example, a turbine powerplant must be operational for the student to troubleshoot.

APPENDIX 2. RELATED REFERENCES

1. RELATED PUBLICATIONS (current editions). Current Advisory Circulars (AC) are available online at http://www.airweb.faa.gov/rgl.

a. AC 20-37, Aircraft Propeller Maintenance.

b. AC 20-77, Use of Manufacturers' Maintenance Manuals.

c. AC 20-107, Composite Aircraft Structure.

d. AC 43-4, Corrosion Control for Aircraft.

e. AC 43-9, Maintenance Records.

f. AC 43-16, Aviation Maintenance Alerts.

g. AC 43-204, Visual Inspection for Aircraft.

h. AC 43.9-1, Instructions for Completion of FAA Form 337.

i. AC 43.13-1, Acceptable Methods, Techniques and Practices — Aircraft Inspection and Repair.

j. AC 43.13-2, Acceptable Methods, Techniques, and Practices — Aircraft Alterations.

k. AC 65-30, Overview of the Aviation Maintenance Profession.

l. AC 65-31, Training, Qualification, and Certification of Nondestructive Inspection Personnel.

m. AC 91-82, Fatigue Management Programs for In-Service Issues.

n. AC 120-72, Maintenance Resource Management Training.

o. FAA Order 8900.1, Flight Standards Information Management System.

p. FAA Order 8900.2, General Aviation Airman Designee Handbook.

q. FAA-H-8083-30, Aviation Maintenance Technician Handbook—General, Chapter 14, Addendum/Human Factors.

r. FAA-H-8083-32, Aviation Maintenance Technician Handbook—Powerplant.

s. FAA-H-8083-9, Aviation Instructor's Handbook.

t. FAA-H-8083-31, Aviation Maintenance Technician Handbook—Airframe.

u. FAA-H-8083-1, Aircraft Weight and Balance Handbook,

v. Human Factors in Aviation Maintenance and Inspection, documents are maintained at the following website: http://www.faa.gov/about/initiatives/maintenance_hf/.

w. Job Task Analysis of the Aviation Maintenance Technician, Northwestern University, The Transportation Center. See: http://www.faa.gov/about/initiatives/maintenance_hf/.

x. The National Study of Aviation Mechanics Occupation (Allen Study). The Allen Study is available to the public through the National Technical Information Service (NTIS), Alexandria, VA 22312 or at http://www.ntis.gov.

y. Type Certificate Data Sheets (TCDS) available at http://av-info.faa.gov.

2. RELATED PARTS OF TITLE 14 OF THE CODE OF FEDERAL REGULATIONS (14 CFR).

a. Part 1, Definitions and Abbreviations.

b. Part 43, Maintenance, Preventative Maintenance, Rebuilding, and Alteration.

c. Part 65, Certification: Airmen Other Than Flight Crewmembers, Subpart D, Mechanics.

d. Part 91, General Operating and Flight Rules.

e. Part 145, Repair Stations.

f. Part 147, Aviation Maintenance Technician Schools.

g. Part 183, Representatives of the Administrator.

APPENDIX 3. FREQUENTLY ASKED QUESTIONS (FAQ) REGARDING AMTS CERTIFICATION AND OPERATION

1. **Question:** How should I include additional items in my curriculum that are above and beyond the subject areas included in part 147?

   Answer: You have two options. You can make it part of your curriculum or you can make it a separate class. Subjects may be taught to a higher level in the curriculum than required by part 147 appendices, but if they are taught to a higher level, the school must include them as part of the approved curriculum.

2. **Question:** What is an exemption from part 147? For which type of items can I request an exemption from part 147 and how does this process work?

   Answer: An exemption is a request to the FAA to allow a school to deviate from existing regulations.

   NOTE: Currently there are no provisions for waivers.

   A school can apply for an exemption for any items governed by part 147.

   The process for requesting an exemption is detailed in 14 CFR part 11, General Rulemaking Procedures. The school must submit a request that:

   - Clearly defines and specifies the exemption requested;
   - Explains why the school is requesting the exemption;
   - Explains why it is in the public interest for the exemption to be granted; and
   - Explains how, if the exemption is granted, public safety would not be affected.

   Also, refer to the FAA Web site, http://aes.faa.gov/, enter “147” into the “Regulation” field, and select “Search” to see examples of past regulatory clarification requests by schools, as well as the FAA responses.

3. **Question:** Does the rule establish a standardized method of proof of student time and attendance?

   Answer: No, neither the regulation nor FAA policy established standardized procedures to record student time and attendance. Each school must develop and have approved by their Flight Standards District Office (FSDO) a method of taking time and attendance for each student.

4. **Question:** Are the actual student tests required to be kept for 2 years, or only the results of those tests (grades)?

   Answer: Only the test grades must be kept for 2 years. By extension, completed laboratory project sheets do not need to be kept for 2 years. As with tests, only laboratory project grades must be retained for that period of time. The generic project sheet or test is a part of the curriculum, and kept with the curriculum.

5. **Question:** Do we keep time and attendance records for students' individual projects or for the block of time required for the subject area?

   Answer: There is no need or requirement for time and attendance to be maintained on an individual project basis.

   - Time and attendance can be documented on a "subject area" basis, recording only the students' attendance in the subject area.
   - A school's curriculum should specify total hours for the subject area, the amount of time that is dedicated to classroom, the amount of time that is dedicated to laboratory, and the total number of required projects for that subject area.

   NOTE: If a school, in its approved curriculum, specifies hours assigned to individual projects, then time and attendance must be kept on that basis.

6. **Question:** What guidelines should we use as the basis for writing a part 147 manual?

   Answer: Guidelines can be found in the current edition of AC 147-3, 14 CFR part 147, and FAA Order 8900.1, Volume 2, Chapter 12, Certification of a Part 147 Aviation Maintenance Technician School. Refer to http://fsims.faa.gov/.

7. **Question:** Do the scope and details of the lesson plans have to be included in the AMTS curriculum?

   Answer: AMTS curriculum lesson plans are not required to be part of the approved curriculum. Lesson plans should be available upon request by AMTS management and instructors and upon request by the FAA.

8. **Question:** What is the rationale for not allowing students enrolled in the general curriculum to be administered the general computer test upon completion of that course? I have contacted several part 147 schools/colleges and have found that approximately 50 percent of those queried give general computer tests upon completion of the general course.

   Answer: Title 14 CFR part 65, § 65.77 specifies tests for ratings, not the program, in which the student is enrolled. As a result, if a student completes all the general portion hours and completes the airframe, powerplant, or A&P rating and the school issues a certificate of completion for a rating, then the student may take the general test. In other words, to take the general test, the student must have completed a rating plus all the general material and been issued a certificate of completion by the school for at least one rating.

9. **Hypothetical Scenario:** During a recent inspection, the FAA commented that to be in compliance, training aids must be available and in working order even if the subject is not being taught at the time. The same training aids are used in subjects requiring troubleshooting. If a subject being taught requires a teardown, the school should not be cited for non-compliance.

Response: Training aids/devices that are required and on the current school equipment list should be in good working order for the course(s) of instruction they are identified and intended to support. Multiple use or different use of training equipment is acceptable as long as the unit is available for each project individually and is not being used for multiple projects at the same time. Some exceptions to this will exist, such as using a complete aircraft for propeller removal while simultaneously checking control surface travel. For such exceptions, the AMTS should ensure the objective of each project is being met and safety is not compromised.

10. **Hypothetical Scenario:** During a recent inspection, a comment was made that a complaint had been filed and the FAA was required to inspect the facilities. Regulations state that the school is to receive a copy of the complaint listing, the nature of the complaint, and all parties involved. The school had to request a copy of the complaint. We received a notice that we could request a copy from the Freedom of Information Act (FOIA) and pay a fee for the report.

    Response: The FAA is not required by regulation to supply any information contained in a complaint filed against a part 147 school. In many cases, the FAA does discuss the nature and content of a complaint with school administrators, but the decision to do so is up to the FAA and is based on the nature and implications of the allegations contained in the document.

11. **Question:** Section 147.31(a) states a “school may not require any student to attend classes of instruction more than 8 hours in any day…” For schools that have both day and night shift classes, may a school permit a student to attend both classes when the student requests to do so?

    Answer: Not normally, but there are exceptions. An exception must be approved by the school’s principal maintenance inspector (PMI) on a case-by-case basis. The FAA/ Aviation Technician Education Council (ATEC) panel believes that a blanket form of approval could compromise the integrity of the quality of instruction. This would allow for special exceptions that the school and student find themselves involved with such as sickness, illness, accidents, family problems, weather, or any other special circumstances.

12. **Question:** What authority does the FAA have pertaining to the buildings that hold our classrooms and laboratories? I once had an inspector who walked into my hangar and stated that I had to increase the lighting in the area for the students. This was based on his opinion; no measuring equipment was used to check the actual lumens. Section 147.15 states that facilities must be “…properly heated, lighted, and ventilated…as are appropriate to the rating” sought. Who is he to determine how many lumens or British thermal units (BTU) we use in our buildings? If we meet the local building codes and Occupational Safety and Health Administration safety regulations, are we not meeting the standard?

    Answer: What would a reasonable person expect to find in a normal classroom and laboratory environment? It would be apparent if there were a woeful lack of heat or light in the school, but at the same time, the PMI is not trained as a building inspector. What would be more critical to the school would be the school meeting the codes of the city and the state that it operates within. The school should be able to show the PMI that it has met the standards by displaying or showing, on request, building permits, building inspections, and any other safety inspection documentation from local fire departments, health agencies, and other regulatory agencies.

13. **Question:** The FAA/ATEC panel needs to clarify the use of intimidation and ultimatum with the use of ACs and handbooks to enforce “rules.” We find that inspectors tend to deviate from the rule and try to make ACs “regulatory,” rather than useful as suggestions or guidance in the process of working with schools. This tends to give each inspector the space needed to bring individual “causes” into the process and make them appear to have the force of law. One example is the use of AC 147-3 as the standard that will be used rather than the regulation being the standard and the AC being helpful in that process.

    Answer: The current edition of AC 147-3 was developed to further clarify part 147. It is to be used as a guidance. While AC 147-3 is not regulatory, it should be understood that ACs are developed to a standard that is found acceptable, and if the document does not meet the requirements set forth in an AC, then it could be considered not acceptable to the FAA?

14. **Question:** There needs to be some clarification regarding the use of military surplus aircraft in performing practical projects. While AC 147-3 states that the use of such aircraft is acceptable as long as the model is eligible for an FAA type-certificate, our inspector is telling us that no military surplus aircraft will be used. In our case, we have two twin bonanzas and one Sabreliner that we use as part of our program. Both are aircraft that are type certificated (TC) in civilian use; they are not made differently (as would be a fighter aircraft, for example), and should be acceptable to use. In addition, what difference does it make regarding systems work, such as brake replacement, whether it is certificated or not? We do recognize that, for example, while a sheet metal repair to industry standards would be a completely different issue, it should not make any difference on systems training as noted.

    Answer: There is nothing in the rules that prohibits the use of military aircraft for training at a part 147 AMTS, provided the school has at least one complete aircraft of a type currently certificated by the FAA for private or commercial operation.

    It is reasonable to assume that systems training in many areas such as brakes, landing gear, hydraulics, and many others, is no different on military than on civilian aircraft. Schools are cautioned that there are subjects where differences exist, such that military aircraft may not be adequate or applicable trainers, for example, documentation research including airworthiness directive compliance and type certification. This is particularly true for aircraft without a civilian counterpart, for example, fighters.

15. **Question:** AC 147-3 was last issued in 1991, and it put great emphasis on the Allen Study and how schools may use it to assist in the establishment of their curriculum. Again, this is a suggestion rather than the rule, and if a curriculum meets the FAA regulatory requirement, the Allen Study should not be used instead of the rule to say that the curriculums do not meet the requirements. Is there a more recent guideline, such as the Airlines for America (A4A) 104 Training Standard, in use that would be more current in its guidelines than the now quite old Allen Study?

Answer: Schools may choose to use the more current JTA of the Aviation Maintenance Technician Northwestern University to help develop or update their curriculum. This is available at http://hfskyway.faa.gov. Select "Documents," and under "Publications," select "Bibliography of Publications 1989-1998," then enter "job task analysis" into the search field. However, schools should be sure to meet the requirements of part 147.

16. Question: In the curriculum in part 147 Appendix C, under Airframe Systems and Components, Cabin Atmospheric Control Systems, items C34 and C35 have always presented a challenge for us. Both seem to be the same with the exception of item C33 mentioning air cycle machines. So under item C33, we cover cabin atmospheric control systems for both large turbine engine aircraft with air cycle machines, as well as smaller reciprocal engine aircraft that are supercharged/turbocharged along with combustion heaters. We suggest item C34 be deleted.

Answer: The redundancy has been previously identified. This will be addressed by the FAA at the next revision of the rule.

17. Question: Is 1,900 hours a minimum or maximum number of hours permitted under part 147?

Answer: One thousand nine hundred hours is the minimum an AMTS must offer for a combined A&P curriculum. A school may provide additional hours at its discretion to meet institutional program objectives or align with specific industry needs.

18. Question: The FAA has the responsibility to enforce the content in a school's part 147 curriculum. Can the following items be omitted from the curriculum and kept on file at the school?

- List of instructors.
- Equipment list.
- Forms created and used by the school.

Answer: The curriculum is the official document of the school.

- The curriculum should reference the instructor list and where it is kept at the school. Upon request, the school should be able to provide the PMI a current list to the instructional staff. The curriculum should discuss the lesson plans and where they would be kept for availability to the PMI on an inspection visit.
- The equipment list should be discussed in the curriculum, and should be kept current and available to the PMI upon his or her request. The student manuals should not be included as part of the curriculum. The methods of recording and tracking time and attendance should be in the curriculum, but the actual records should be kept separate.
- The curriculum should also address the procedures for meeting the requirements of part 147. It should not include other student policies such as financial aid processing, add-drop policies, or other school activities.

19. Question: If a school and its PMI disagree on the interpretation/enforcement of a particular part 147 regulation, will the part 147 FAA/ATEC panel resolve it?

Answer: No. All attempts should be made to resolve a disagreement at the local/regional level. The school should contact the local FSDO office manager or, if the dispute continues, contact FAA headquarters (HQ), Aircraft Maintenance Division (AFS-300), for additional guidance on application of the regulations. Some of the other clarifications in this document will be helpful in resolving a school PMI disagreement. The current FAA/ATEC panel may be brought together periodically to help clarify particular issues; it is an ad hoc advisory group. AFS-300 will make all final determinations.

20. Question: Can the PMI be a member of the school's advisory board?

Answer: The PMI may not be a member of the advisory board of a school. However, the school may invite the PMI to attend these meetings as a guest with no voting rights.

21. Question: When an inspector came in, he inspected our school as if we were a repair station returning everything to service. All of our gauges, the battery charger, torque wrenches, measuring instruments, and measuring tools are required to be calibrated. We are a school, not a repair station. All the gauges located on hydraulic boards must be calibrated. They are not required to be there, but if they are, they must be calibrated. Reciprocating engine overhaul is level 2. We overhaul the engine and operate it (not at all airworthy), but the gauges on the test stand must be calibrated. These additional costs and time consuming activities make it very difficult to operate efficiently. Gauges and measuring instruments should be operational, but not necessarily calibrated at a school.

Answer: Some level of calibration may be necessary, depending on what level of simulated RTS is being taught. It is up to the school and FAA inspector to determine what these areas of instruction are. However, it is not mandatory for all tools/gauges to be calibrated.

22. Question: Our school's class schedule is based on a clock hour, which must be at least 50-minutes in length. In January 2001, the school requested approval to change the class schedule to 4 days per week, 30 hours per week.

During an inspection in July 2001, the FAA stated that approval was not given and stated the school must reverse the schedule. To do so would be an extreme hardship on students who have set work schedules by the new schedule as well as the school, which took a financial hit to start the schedule in January. After several discussions with the FAA, the decision regarding the 50-minute hour rule is under review by the FAA. The school did remain on the 4 day week, but adjusted the class schedule (which has been very inconvenient for many students) until an interpretation of the regulation can be made.

Answer: The 50-minute hour is based on the Carnegie rule of instruction that a 50-minute instructional period may be combined with a 10-minute break time to equate to an hour of instruction. The question relates to two items: the interpretation of the 50-minute hour and the approval of schedule change. Historically, the 50-minute hour must be tied to the 10-minute break time. An AMTS is not able to bank the break time and offer longer breaks at a greater time interval. A school may offer a 50-minute educational period with a 10-minute break time and then take a second 10-minute break time with the next 50-minutes of instruction tied to the second break time.

The second part of the question is based on approval of change. The school has a responsibility to request a change far enough in advance to allow the FSDO to research the request and then make a decision and convey it to the school with proper justification for the approval or disapproval. The request and approval must be in writing for the benefit of both parties and to avoid confusion and/or misunderstanding.

23. Question: An FSDO stated, one of our schools must graduate a student when he or she has completed the part 147 program, even though the student has not met his financial obligations to the school. The school's catalog states that in addition to meeting all academic and administrative requirements for graduation, the student must satisfy all financial obligations to the school. Should the FSDO dictate policy that interferes with the administrative and financial operation of a school as long as the school is operating in compliance with part 147?

Answer: A school may require students to meet certain requirements and/or obligations before issuing a graduation certificate, diploma, or degree.

A common example is that many schools require that all financial obligations of a student be met before issuing transcripts of completion certificates, diplomas, or degrees.

However, those administrative requirements of the school may be in conflict with the regulation. The regulation is clear on this issue: § 147.35(a) states that, upon request, an AMTS must provide a transcript of student grades to a student who graduates or leaves the AMTS before graduation.

24. Question: Course testing (not FAA exams), including preparation and post-test reviews, is an important part of the learning process. Are these activities part of the minimum 1,900 hours?

Answer: No, Reference AC 147-3, Chapter 2, and FAA Order 8900.1, Volume 2, Chapter 12, Section 2. The rule states, however, that time spent to prepare or review for the FAA general, airframe, or powerplant test may not be included as part of the hours to satisfy a school's approved curriculum requirements.

APPENDIX 4. FREQUENTLY ASKED QUESTIONS (FAQ) REGARDING AMTS OPERATING SPECIFICATIONS

1. **Question:** What are Operations Specifications (OpSpecs)?

   Answer: OpSpecs are approved documents identified by OpSpec paragraphs containing the authorizations, limitations, and certain procedures under which each kind of operation is to be conducted. Operational variables such as: multiple ratings, management and designated personnel, affiliated Designated Mechanic Examiners (DME), exemptions, authorization/limitations, and approved manual systems are identified in applicable OpSpec paragraphs and approved through the issuance of those OpSpec paragraphs. OpSpecs are maintained in an internet accessible program known as Web based Operations Safety System (WebOPSS).

2. **Question:** Who originates the OpSpecs for a particular Aviation Maintenance Technician School (AMTS)?

   Answer: The OpSpecs for an AMTS are prepared by the Flight Standards District Office (FSDO) using standard templates, known as paragraphs, and an automated system called the WebOPSS. In some cases, data for OpSpec fields will come out of an FAA database, Program Tracking and Reporting Subsystem (PTRS). The AMTS however, may need to provide the FSDO with some of the information that is required to prepare an OpSpec that is not currently in the database. This information should be readily available by the AMTS and would include:

   - AMTS primary points of contact and their contact information.
   - AMTS management personnel and their contact information.
   - Identification of person(s) at the AMTS designated to receive OpSpecs.
   - Location of the AMTSs recordkeeping system.

3. **Question:** Will incorporating OpSpecs into an AMTS require a curriculum change?

   Answer: The initial set of OpSpecs that will be issued to AMTSs mirror the existing part 147 rule. This includes the curriculum requirements found in Appendices B, C, and D. An AMTS will therefore not need to change its curriculum to incorporate the OpSpecs.

4. **Question:** What OpSpecs would an AMTS be issued?

   Answer: Some OpSpec are mandatory and others are optional. All AMTSs would be issued a set of mandatory OpSpecs consisting of the following:

   - A001, Issuance and Applicability (Mandatory).
   - A002, Definitions and Abbreviations (Mandatory).
   - A003, Rating(s) (Mandatory).
   - A004, Summary of Special Authorizations and Limitations (Mandatory).
   - A006, Management Personnel (Mandatory).
   - A007, Designated Persons (Mandatory).
   - A013, Instructors (Mandatory).

- A025, Recordkeeping System (Mandatory).
- B002, Required Minimum Curriculum for General (Part 147 Appendix B) (Mandatory). This B002 AMTS OpSpec is issued to all certificated AMTS(s) regardless of ratings issued.

NOTE: Some AMTS will also be issued one or more optional OpSpecs depending on their applicability.

The optional OpSpecs consist of the following:

- A005 Exemptions (Optional).
- A012, Affiliated Designated Mechanic Examiners (DME) (Optional).
- A026, Authorizations/Limitations (Optional).
- B003, Required Minimum Curriculum for Airframe (Part 147 Appendix C) (Optional). This OpSpec is issued only if the AMTS holds an airframe, and/or airframe and powerplant rating.
- B004, Required Minimum Curriculum for Powerplant (Part 147 Appendix D) (Optional). This OpSpec is issued only if the AMTS holds a powerplant, and/or airframe and powerplant rating.

5. Question: Who at the AMTS is authorized to receive OpSpecs?

Answer: The AMTS must have one or more persons identified in paragraph A007 of the OpSpecs as a designated person authorized to receive OpSpecs. When the AMTS receives an OpSpec, an authorized designated person will sign and date the OpSpec at the bottom of the page after the statement "I hereby accept and receive the operations specifications in this paragraph." The signed OpSpec(s) would then be incorporated into the AMTSs manual, superseding the now outdated paragraph.

6. Question: Who develops the OpSpecs?

Answer: Standard templates are developed by Flight Standards Service, Aircraft Maintenance Division (AFS-300), FAA Headquarters (HQ), Washington DC. The process used at HQ for developing standard templates ensures appropriate coordination with regional flight standards personnel and with other FAA services and offices that could be affected. The process also ensures that before the standard templates are finalized, appropriate coordination is accomplished with affected industry groups. Since standard templates specify limitations, conditions, and other provisions which operators must comply with, coordination with industry is essential to a mutual and clear understanding of the effect they will have on industry. After appropriate coordination with the Technical Programs Branch (AFS-260) has been completed, drafts of the new standard paragraphs/templates, or revisions to existing paragraphs/templates are finalized and incorporated into the WebOPSS.

APPENDIX 5. OPTIONAL AMT CURRICULUM

The following optional curriculum may be used by an AMTS and is based on the regulatory requirements listed in part 147 appendices B through D. The optional curriculum may be adopted as a means of compliance for only one section such as appendix C (Airframe), or it can be utilized for the General, Airframe and/or Powerplant (appendices B, C, and D). The number in parentheses indicates the level of proficiency at which a particular element must be taught. Items in italics indicate additions to what is currently found in part 147 Appendices B through D.

> **NOTE: The term "capstone" is a term utilized to reference topics and/or areas of study recommended as important final or closing subject matter that would be suitable to be taught.**

Area of Study	Subject Description	Teaching Level
	General Curriculum Subjects	
a. Basic electricity	*An AMTS may choose to incorporate training on circuits and devices for complex aircraft. The AMTS may choose to incorporate these subjects into the six subject areas of this section or add them as separate subjects.*	
	1. Calculate and measure capacitance and inductance.	(2)
	2. Calculate and measure electrical power.	(2)
	3. Measure voltage, current, resistance, and continuity	(3)
	4. Determine the relationship of voltage, current, and resistance in electrical circuits	(3)
	5. Read and interpret aircraft electrical circuit diagrams, including solid-state devices and logic functions.	(3)
	6. Inspect and service batteries.	(3)
b. Aircraft drawings	*An AMTS may choose (with FAA approval) to teach the subject only to the proficiency required to perform normal aircraft inspections or typical repairs or alterations. For example, interpretation of drawings required to perform an actual or simulated airworthiness directive (AD).*	
	7. Use aircraft drawings, symbols, and system schematics.	(2)
	8. Draw sketches of repairs and alterations.	(3)
	9. Use blueprint information	(3)
	10. Use graphs and charts.	(3)
c. Weight and balance	*An AMTS may place emphasis on out-of-center-of-gravity conditions and load calculations to ensure any alterations that would affect forward or aft center of gravity are recorded properly.*	
	11. Weigh aircraft.	(2)
	12. Perform complete weight-and-balance check and record data	(3)
d. Fluid lines and fittings	*An AMTS may choose to focus on fabricating rigid lines because most flexible fluid lines are purchased. Students should be instructed in the inspection of flexible lines.*	
	13. Fabricate and install rigid and flexible fluid lines and fittings	(3)
e. Materials and processes		
	14. Identify and select appropriate nondestructive testing methods.	(1)
	15. Perform dye penetrant, eddy current, ultrasonic, and magnetic particle inspections.	(2)
	16. Familiarize students with basic heat-treating processes.	(1)
	17. Identify and select aircraft hardware, composites, and materials.	(3)
	18. Inspect and check welds. *Familiarize students with inspecting and checking welds created by the student using visual, non-destructive, and other NDI technologies.*	(3)

Area of Study	Subject Description	Teaching Level
	19. Perform precision measurements.	(3)
f. Ground operation and servicing		
	20. Start, ground operate, move, service, and secure aircraft and identify typical ground operation hazards. For aircraft starting and ground movement operations, a high fidelity simulator may be used with prior FAA approval.	(2)
	21. Identify and select fuels from among the common types of aircraft fuels in current use.	(2)
g. Cleaning and corrosion control		
	22. Identify and select cleaning materials and perform aircraft cleaning.	(3)
	23a. Inspect for aircraft corrosion.	(3)
	23b. Identify, remove, and treat aircraft corrosion.	(3)
h. Mathematics	*An AMTS may elect to test students out of mathematics without teaching it as part of its AMT curriculum. (See § 147.31(c)(4).)*	
	24. Extract roots and raise numbers to a given power.	(3)
	25. Determine areas and volumes of various geometric shapes.	(3)
	26. Solve ratio, proportion, and percentage problems.	(3)
	27. Perform algebraic operations involving addition, subtraction, multiplication, and division of positive and negative numbers.	(3)
i. Maintenance forms and records		
	28. Write descriptions of work performed, including aircraft discrepancies and corrective actions, using typical aircraft maintenance records.	(3)
	29. Complete required maintenance forms, records, and inspection reports.	(3)
j. Basic physics	*An AMTS may elect to test students out of basic physics without teaching it as part of its AMT curriculum. (See § 147.31(c)(4).)*	
	30. Use and understand the principles of simple machines; sound, fluid, and heat dynamics; basic aerodynamics; aircraft structures; and theory of flight.	(2)
k. Maintenance publications		
	31. Demonstrate ability to read, comprehend, and apply information contained in FAA and manufacturers' aircraft	

Area of Study	Subject Description	Teaching Level
	maintenance specifications, ATA codes, air carrier background elements, minimum equipment lists, configuration deviation lists, data sheets, manuals, publications, and related Federal Aviation Regulations, AD, and advisory material.........	
	32. Read technical data.	(3)
l. Mechanic privileges and limitations	*An AMTS may provide level 1 teaching to students on related regulations to include Parts 21, 23, 25, 43, 121, 135, and 145.*	
	33. Exercise mechanic privileges within the limitations prescribed by Part 65 of this chapter.	(3)
m. Human factors/ maintenance resource management (MRM)	*Human factors principals are encouraged and may be taught as a separate subject and/or incorporated throughout the curriculum. Emphasis should be placed on common maintenance problems such as failure to follow procedures and situational awareness.*	
	34. Provide instruction on Human Factors by implementing basic human factors techniques and applications.	(1)
n. Aircraft electrical introduction		
	35. Teach basic concepts of aircraft electronics, including digital electronics and operational principles.	(1)
o. Fire protection systems	*An AMTS may teach this subject in the general curriculum, instead of separately in the A&P curriculums, to avoid teaching the subjects twice. This may only be accomplished by a school teaching a combined A&P curriculum. A school teaching only airframe or powerplant as separate ratings may not follow this approach.*	
	36. Inspect, check, and service smoke and carbon monoxide detection systems.	(1)
	37. Inspect, check, service, troubleshoot, and repair aircraft fire detection and extinguishing systems.	(3)
p. General aircraft inspection principles		
	38. Perform a capstone inspection module. *This module should include research into regulations, maintenance manuals, and other relevant documentation encountered during a normal inspection. Students should become familiarized with applications of Type Certificate Data Sheet (TCDS),*	

Area of Study	Subject Description	Teaching Level
	Illustrated Parts Catalogs (IPC), Structural Repair Manuals (SRM), Service Difficulty Reporting (SDR), AD, and similar documentation. Additional focus may be placed on human factors principles, such as norms, shift turnovers, situational awareness, and inspection integrity. Students may also receive initial training in principles of visual inspection, including defect recognition, detection, and classification..	(2) or (3)
	Airframe Curriculum Subjects	
I. Airframe Structures		
a. Wood structures	*An AMTS may focus on only familiarization with the basic concepts of this subject.*	
	1. Service and repair wood structures.	(1)
	2. Identify wood defects.	(1)
	3. Inspect wood structures.	(1)
b. Aircraft covering	*An AMTS may focus on familiarization with the concepts of this subject.*	
	4. Select and apply fabric and fiberglass covering materials.	(1)
	5. Inspect, test, and repair fabric and fiberglass.	(1)
c. Aircraft finishes		
	6. Apply trim, letters, and touchup paint.	(1)
	7. Identify and select aircraft finishing materials.	(2)
	8. Apply finishing materials. An AMTS may primarily focus on application of corrosion prevention materials.	(2)
	9. Inspect finishes and identify defects.	(2)
d. Sheet metal and nonmetallic structures		
	10. Select, install, and remove special fasteners for metallic, bonded, and composite structures.	(2)
	11. Inspect bonded structures.	(2)
	12. Inspect, test, and repair fiberglass, plastics, honeycomb, composite, and laminated primary and secondary structures, and focus on the detection and inspection of defects and the repair of damage, using manufacturer's structural repair manual guidelines.	(2)
	13. Inspect, check, service, and repair windows, doors, and interior furnishings.	(2)
	14. Inspect and repair sheet metal structures.	(3)
	15. Install conventional rivets.	(3)

Area of Study	Subject Description	Teaching Level
	16. Form, lay out, and bend sheet metal.	(3)
e. Welding		
	17. Weld magnesium and titanium.	(1)
	18. Solder stainless steel.	(1)
	19. Fabricate tubular structures.	(1)
	To encourage the understanding of and preparation for material identification, filler materials, compatible alloys, gas welding system setup, and methods associated with welding safety.	
	20. Solder, braze, gas-weld, and arc-weld steel.	(2)
	21. Weld aluminum and stainless steel.	(1)
f. Assembly and rigging		
	22. Rig rotary-wing aircraft.	(1)
	23. Rig fixed-wing aircraft.	(2)
	24. Check alignment of structures.	(2)
	25. Assemble aircraft components, including flight control surfaces.	(3)
	26. Balance, rig, and inspect movable primary and secondary flight control surfaces. An AMTS may elect to focus specifically on FAA-required inspection items.	(3)
	27. Jack aircraft.	(3)
g. Airframe inspection	*An AMTS may move this subject to the end of the airframe curriculum, combine it with other elements, and teach it as a capstone inspection project.*	
	28. Perform airframe conformity and airworthiness inspections.	(3)
II. Airframe Systems and Components		
a. Aircraft landing gear systems		
	29. Inspect, check, service, and repair landing gear, retraction systems, shock struts, brakes, wheels, tires, and steering systems.	(3)
b. Hydraulic and pneumatic power systems		
	30. Repair hydraulic and pneumatic power systems components.	(2)
	31. Identify and select hydraulic fluids.	(3)
	32. Inspect, check, service, troubleshoot, and repair hydraulic and pneumatic power systems.	(3)

Area of Study	Subject Description	Teaching Level
c. Cabin atmosphere control systems		
	33. Inspect, check, troubleshoot, service, and repair heating, cooling, air conditioning, pressurization systems, and air cycle machines.	(1)
	34. Inspect, check, troubleshoot, service, and repair heating, cooling, air conditioning, and pressurization systems.	(1)
	35. Inspect, check, troubleshoot, service, and repair oxygen systems.	(2)
d. Aircraft instrument systems		
	36. Inspect, check, service, troubleshoot, and repair electronic flight instrument systems and both mechanical and electrical heading, speed, altitude, temperature, pressure, and position indicating systems to include the use of built-in test equipment. An AMTS that teaches a combined A&P curriculum may elect to combine this subject with the instruction of powerplant instrument systems.	(1)
	37. Install instruments and perform a static pressure system leak test.	(2)
e. Communication and navigation systems		
	38. Inspect, check, and troubleshoot autopilot, servos, and approach coupling systems.	(1)
	39. Inspect, check, and service aircraft electronic communication and navigation systems, including very high frequency (VHF) passenger address interphones and static discharge devices, aircraft Very high frequency Omnidirectional Range (VOR), instrument landing system (ILS), Long Range Aid to Navigation (LORAN), Radar beacon transponders, flight management computers, and ground proximity warning system (GPWS). An AMTS may also elect to instruct in GPS and integrated autoflight systems.	(1)
	40. Inspect and repair antenna and electronic equipment installations.	(2)

Area of Study	Subject Description	Teaching Level
f. Aircraft fuel systems	*An AMTS may combine appropriate elements of this material with elements of the engine fuel system instruction located in the powerplant curriculum.*	
	41. Check and service fuel dump systems.	(1)
	42. Perform fuel management transfer and defueling.	(1)
	43. Inspect, check, and repair pressure fueling systems.	(1)
	44. Repair aircraft fuel system components.	(2)
	45. Inspect and repair fluid quantity indicating systems.	(2)
	46. Troubleshoot, service, and repair fluid pressure and temperature warning systems.	(2)
	47. Inspect, check, service, troubleshoot, and repair aircraft fuel systems.	(3)
g. Aircraft electrical systems	*An AMTS may elect to combine aircraft electrical system subjects with the basic electricity subject in the general curriculum.*	
	48. Repair and inspect aircraft electrical system components, crimp and splice wiring to manufacturers' specifications, and repair pins and sockets of aircraft connectors. An AMTS may elect to increase the teaching level to 3 in repair of pins/sockets and crimping/splicing of wiring.	(2)
	49. Install, check, and service airframe electrical wiring, controls, switches, indicators, and protective devices.	(3)
	50a. Inspect, check, troubleshoot, service, and repair alternating and direct current electrical systems.	(3)
	50b. Inspect, check, and troubleshoot constant speed and integrated speed drive generators.	(1)
h. Position and warning systems		
	51. Inspect, check, and service speed and configuration warning systems, electrical brake controls, and antiskid systems.	(2)
	52. Inspect, check, troubleshoot, and service landing gear position indicating and warning systems.	(3)
i. Ice and rain control systems		
	53. Inspect, check, troubleshoot, service, and repair airframe ice and rain control systems.	(2)

Area of Study	Subject Description	Teaching Level
j. Fire protection systems	*An AMTS may teach this subject in the general curriculum to reduce teaching these subjects twice. This may only be accomplished by a school teaching a combined A&P curriculum. A school teaching airframe or powerplant separately may not follow this approach.*	
	54. Inspect, check, and service smoke and carbon monoxide detection systems.	(1)
	55. Inspect, check, service, troubleshoot, and repair aircraft fire detection and extinguishing systems.	(3)
k. Airframe inspection		
	56. Perform a capstone airframe inspection module. *This module should include research into regulations, maintenance manuals, and other relevant documentation encountered during a normal airframe inspection. The module could use the general inspection principles established in AC 43-204, Visual Inspection for Aircraft, and other relevant documents.*	(2) or (3)
	Powerplant Curriculum Subjects	
I. Powerplant Theory and Maintenance		
a. Reciprocating engines		
	1. Inspect and repair a radial engine. *An AMTS may include a discussion of basic principles only.*	(1)
	2. Overhaul reciprocating engine. *Schools may elect to limit the teaching of this subject by having students observe and participate in the overhaul of a reciprocating engine. An AMTS could instruct students in basic principles of engine design and maintenance.*	(2)
	3. Inspect, check, service, and repair reciprocating engines and engine installations.	(3)
	4. Install, troubleshoot, and remove reciprocating engines. *An AMTS could focus instruction on normal inservice maintenance such as magneto timing and exchanging cylinders.*	(3)

Area of Study	Subject Description	Teaching Level
b. Turbine engines	*Curriculum should focus on modular engines, breakdowns, disassembly, reassembly, and understanding of basic principles.*	
	5. Overhaul turbine engine.	(2)
	6. Inspect, check, service, and repair turbine engines and turbine engine installations. Curriculum should focus on common inservice maintenance issues, such as hot-section service and repair.	(3)
	7. Install, troubleshoot, and remove turbine engines.	(3)
c. Engine inspection	*This element may be combined into the capstone inspection module.*	
	8. Perform powerplant conformity and airworthiness inspections.	(3)
II. Powerplant Systems and Components		
a. Engine instrument systems	*An AMTS may combine portions of this subject with basic electricity elements in the general curriculum or aircraft instrument systems in the airframe curriculum.*	
	9. Troubleshoot, service, and repair electrical and mechanical fluid rate-of-flow indicating systems.	(2)
	10. Inspect, check, service, troubleshoot, and repair electrical and mechanical engine temperature, pressure, and revolutions per minute (rpm). indicating systems.	(3)
b. Engine fire protection systems	*An AMTS may consider teaching this subject in the general curriculum to avoid teaching the subjects twice. This may only be accomplished by a school teaching a combined A&P curriculum. A school teaching only airframe or powerplant may not follow this approach.*	
	11. Inspect, check, service, troubleshoot, and repair engine fire detection and extinguishing systems.	(3)
c. Engine electrical systems	*An AMTS may combine portions of this material with airframe or general electrical systems.*	
	12. Repair engine electrical system components.	(2)
	13. Install, check, and service engine electrical wiring, controls, switches, indicators, and protective devices.	(3)
d. Lubrication systems		
	14. Identify and select lubricants.	(2)
	15. Repair engine lubrication system components.	(2)
	16. Inspect, check, service, troubleshoot, and repair engine lubrication systems.	(3)

Area of Study	Subject Description	Teaching Level
e. Ignition and starting systems		
	17. Overhaul magneto and ignition harness. The students should be presented with the overhaul procedures and the opportunity to follow the procedures to overhaul the magneto, install and time the magneto, and install the wiring harness. They should accomplish repairs as necessary and correctly time the magneto to the engine.	(2)
	18. Inspect, service, troubleshoot, and repair reciprocating and turbine engine ignition systems and components.	(2)
	19a. Inspect, service, troubleshoot, and repair turbine engine electrical starting systems.	(3)
	19b. Inspect, service, and troubleshoot turbine engine pneumatic starting systems.	(1)
f. Fuel metering systems		
	20. Troubleshoot and adjust turbine engine fuel metering systems and electronic engine fuel controls.	(1)
	21. Overhaul carburetor. The AMT will focus on overhaul and setup of float type aircraft carburetors of proven and new designs as well as operational performance characteristics, testing, and adjustment upon installation.	(2)
	22. Repair engine fuel metering system components.	(2)
	23. Inspect, check, service, troubleshoot, and repair reciprocating and turbine engine fuel metering systems.	(3)
g. Engine fuel systems	*An AMTS may combine portions of these subjects with the airframe curriculum.*	
	24. Repair engine fuel system components.	(2)
	25. Inspect, check, service, troubleshoot, and repair engine fuel systems.	(3)
h. Induction and engine airflow systems		
	26. Inspect, check, troubleshoot, service, and repair engine ice and rain control systems.	(2)
	27. Inspect, check, service, troubleshoot, and repair heat exchangers, superchargers, and turbine engine airflow and temperature control systems.	(1)
	28. Inspect, check, service, and repair carburetor air intake and induction manifolds.	(3)
i. Engine cooling systems		
	29. Repair engine cooling system components.	(2)
	30. Inspect, check, troubleshoot, service, and repair engine cooling systems.	(3)

Area of Study	Subject Description	Teaching Level
j. Engine exhaust and reverser systems		
	31. Repair engine exhaust system components.	(2)
	32a. Inspect, check, troubleshoot, service, and repair engine exhaust systems.	(3)
	32b. Troubleshoot and repair engine thrust reverser systems and related components.	(1)
k. Propellers		
	33. Inspect, check, service, and repair propeller synchronizing and ice control systems.	(1)
	34. Identify and select propeller lubricants.	(2)
	35. Balance propellers.	(1)
	36. Repair propeller control system components.	(2)
	37. Inspect, check, service, and repair fixed-pitch, constant-speed, and feathering propellers, and propeller governing systems.	(3)
	38. Install, troubleshoot, and remove propellers.	(3)
	39. Repair aluminum alloy propeller blades.	(3)
l. Unducted fans	*An AMTS can discuss basic principles briefly by lecture.*	
	40. Inspect and troubleshoot unducted fan systems and components.	(1)
m. Auxiliary power units		
	41. Inspect, check, service, and troubleshoot turbine-driven auxiliary power units.	(1)
n. Powerplant inspection		
	42. Perform a capstone powerplant inspection module. This module may include research into regulations, maintenance manuals, and other relevant documentation encountered during a normal powerplant inspection. The module may also include evaluation of powerplant performance in a test cell.	(2) or (3)

APPENDIX 6. ADDITIONAL COURSE MATERIAL RECOMMENDATIONS

The introduction of technological advances in aircraft, powerplants, and associated systems presents an ever changing need for adequately trained AMTs to meet aviation industry needs. Although the current regulations do not require it, a significant number of AMTSs are establishing these courses to satisfy industry demands. Following are some examples of courses offered:

1. Composite Material Repair. A composite repair course can be as simple as teaching fiberglass repair using prepackaged student instruction kits available from various sources, or as complex as a full scale repair facility. Full-scale composite repair facilities teach and repair many types of composite materials, such as fiberglass, Kevlar, boron, and carbon materials. Instructional aids and shop equipment can include clean rooms, downdraft worktables, positively vented rooms, composite autoclaves, refrigerated material storage, and various aircraft composite structures for instruction. Some AMTSs offering composite repair courses combine a nondestructive inspection course along with the basic course.

2. Nondestructive Inspection. A nondestructive inspection course that teaches beyond the requirements of 14 CFR part 147 (for example, magnetic particle) generally includes training in radiography (x-ray), ultrasound, eddy current inspection, and borescope techniques. Information on and equipment for nondestructive inspection course development are widely available from commercial sources.

3. Solid-State Electronics/Avionics/Built-In Test Equipment (BITE). Many AMTSs currently offer enhanced training or stand-alone course work leading to an electronics subspecialty in addition to an FAA A&P mechanic certificate. The specialized subject matter for these courses may be incorporated into existing required AMTS courses, such as basic electricity and basic physics. Course material, curriculums, and laboratory and shop equipment are readily available from commercial sources.

4. Principles of Troubleshooting. Broad-based principles of troubleshooting are well known and may be available commercially or developed by the school. An AMTS should focus on logical approaches to solving common aircraft problems. An AMTS may also include hands-on workshops using simulated aircraft system malfunctions.

5. Human Factors. Human factors principles should be incorporated throughout an AMTS's curriculum as the mechanic written examination contains test questions on human factors. Many training programs are available commercially. The FAA also maintains a list of human factors reference materials at http://www.faa.gov/about/initiatives/maintenance_hf.

6. Service Difficulty Reports (SDR). A key component to the proper reporting of service difficulties is the maintainer. Part 147 AMTSs should cover the importance of service difficulty reporting when addressing the requirements of part 147 appendix B, section i, "maintenance forms and records," in the general curriculum. The SDR program is an information system designed to provide assistance to aircraft owners, operators, maintenance organizations, maintainers, manufacturers, and the FAA with the identification of aircraft problems encountered during service. The SDR program provides for the collection, organization, analysis, and dissemination of aircraft service information to improve service reliability of aeronautical products. The FAA requests the cooperation of all aircraft owners, operators, mechanics, pilots, and others in the reporting of service difficulties experienced with airframes, powerplants, propellers, and components.

APPENDIX 7. SAMPLE CURRICULUM OUTLINES

Chapter 2 states that curriculum development may evolve from several developmental stages. An example of working through a curriculum is found in samples 1, 2, and 3 below. The first stage in curriculum development is the evaluation of performance goals and prominent issues that the applicant should grasp. The Allen Study is one example that demonstrates how these issues could be developed. The Allen Study makes general recommendations as to the hours of instruction, the teaching level, and the performance standards required of the student, but each AMTS must assign these values according to its own requirements and, in the case of teaching levels, the requirements of 14 CFR.

Sample 1 is an excerpt from the Allen Study.

SAMPLE 1. STAGE 1, THE ALLEN STUDY

THE NATIONAL STUDY OF THE AVIATION MECHANICS OCCUPATION
Part 147 Appendix B, Subject F, Ground Operation and Servicing

Item 21. Identify and Select Fuels.

Identify Aircraft Fuels

Student Performance Goal

- Given: Aircraft operator's manual, a list of colors and octane rating ranges, and a fuel system of an airplane.
- Performance: The student will obtain fuel samples from the fuel system of an airplane and verify that the fuel at least equals the minimum required octane rating. The student will associate each color with the correct octane range, describe how volatility is related to vapor lock, and discuss the advantages and limitations of kerosene as a turbine fuel.
- Standard: Matching of color to octane rating will be 100 percent correct.

KEY POINT	FEEDBACK
Significance of octane/performance number in identification of fuel.	▪ What is iso-octane? ▪ What is normal heptane? ▪ How do these produce the octane number? ▪ Why are performance numbers used when a fuel exceeds 100 octane rating? ▪ What is the significance of the second number in fuel rating that is, 100/130? ▪ What happens if the octane rating is a. Too low? b. Too high? ▪ Which is more critical? ▪ How is the minimum octane rating of fuel for each engine installation determined?

KEY POINT	FEEDBACK
Color identifying octane performance number.	▪ What colors are used in identification of fuels? ▪ Do they adversely affect combustion? ▪ How do colors aid in detecting leaks?

SAMPLE 2. STAGE 2, CONTINUING CURRICULUM DEVELOPMENT

The following sample shows an example of the second stage in developing a curriculum. It addresses the same subject area as stage 1 but it also defines the amount of instruction time, the specific 14 CFR section addressed, the teaching level, and the performance standard the student is expected to achieve. However, testing and grading criteria are not yet developed.

DEPLANE AMTS

Part 147, Appendix B, Subject F, Ground Operation and Servicing

Unit Title: Identify and Select Fuels. Subject Item 21.
Teaching Level: 2

Classroom teaching time	2.5 hours
Laboratory or shop time	2.5 hours
Instructional time	5 hours

Identify Aircraft Fuels
Given: Aircraft operator's manual, a list of colors and octane rating ranges, and fuel samples or illustrations.
Student Performance: The student will obtain fuel samples and/or aircraft specifications. The student will associate each color with the correct octane range according to aircraft specifications, describe how volatility is related to vapor lock, and discuss how octane ratings affect engine performance.
Standard: Matching of color to octane rating will be 100 percent correct.

SAMPLE 3. STAGE 3, COMPLETE CURRICULUM ELEMENT

The following sample on the subject of aircraft cleaning and corrosion control contains all the elements required to teach, test, and conform to the rule. It is not intended to be an expansive text. It is a short outline of elements expected in the final curriculum product. Sample 3(A) describes the typical contents of a single subject element, and samples 3(B) through 3(E) provide information on practical projects, tests, and grading criteria.

DEPLANE AMTS
Part 147 Appendix B, Subject G

Subject: Cleaning and Corrosion Control

Item 23. Perform Aircraft Cleaning and Corrosion Control

Classroom time	3 hours
Laboratory or shop time	2 hours
Total time	5 hours

(Sample 3(A)) Curriculum Subject Guide
(Sample 3(B)) Practical Project Guide
(Sample 3(C)) Theory Test
(Sample 3(D)) Practical Test
(Sample 3(E)) Practical Project Grading Criteria

SAMPLE 3(A). CURRICULUM SUBJECT GUIDE

In a typical curriculum, the elements included in this subject guide may be separated or combined in different ways. The following teaching items should be identified in a written description narrative as part of an FAA-approved AMTS curriculum.

(1) Introduction and subject element objectives (purpose).

(2) Instructors' guide (teaching outline).

(3) Technical information and equipment — references (manuals, tools, materials).

(4) Workbooks or other guidance for classroom, laboratory, and shop (procedures).

Sample 3(B), Practical Project Guide, demonstrates how teaching items 1 through 4 may be incorporated into practical project requirements.

NOTE: These teaching items may appear in any format as long as the description narrative is in sufficient detail to explain the item completely, and should be present in all subject elements, both theory and practical projects. For example, the instructors' guide/teaching outline may be combined with procedures. In some cases, certain items' outlines may be combined with procedures. Many other concepts also are in common usage.

SAMPLE 3(B). PRACTICAL PROJECT GUIDE

The following is a sample practical project guide (Guide for General Curriculum Subject Item 23, Perform Aircraft Cleaning and Corrosion Control). When preparing a practical project guide, instructions should be accompanied by photographs, diagrams, or technical illustrations showing methods and techniques expected of the student, as applicable.

DEPLANE AMTS
Practical Project Guide for General Curriculum Subject Item 23
Part 147, Appendix B, Subject G

Item 23. Perform Aircraft Cleaning and Corrosion Control

Purpose: To acquaint the student with emulsion-type cleaners and processes associated with the proper cleaning of exterior aircraft components.

References:

(1) Appropriate FAA ACs.
(2) Product information on cleaners, lubricants, waxes, and aircraft or component manufacturer's service information.
(3) Aircraft or component manufacturer's service information.

Equipment and Tools Needed:

(1) Water supply and bucket.
(2) Brush, sponge, and soft, clean rags.
(3) Component to be cleaned.

Supplies and Materials Needed:

(1) Emulsion-type cleaner (an emulsion cleaner of MIL-C-125769 specifications will be satisfactory).
(2) Water displacing lubricant and corrosion inhibitor.
(3) Paste or liquid wax suitable for aircraft exterior.

Procedure:

(1) Assemble all materials.
(2) Chock main wheels.
(3) Prepare aircraft: Close aircraft windows and vent doors, and cover static port and pilot tube.
(4) Install all maintenance struts or locking devices.
(5) Remove all electrical power from aircraft.
(6) Read the aircraft or component manufacturer's cleaning instructions.
(7) Read the manufacturer's cleaning instructions.
(8) Mix cleaner with the appropriate amount of water.
(9) Prerinse aircraft with water to eliminate dirt. See Figure A6–1.

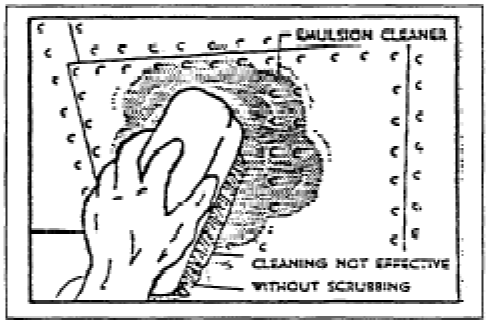


Figure A6–1. Prerinse Aircraft

NOTE: Certain areas may require light scrubbing with a soft bristle brush.

(10) Systematically apply premixed cleaner and water to small areas working from the top down using rags wet with solution. See Figure A6–2.

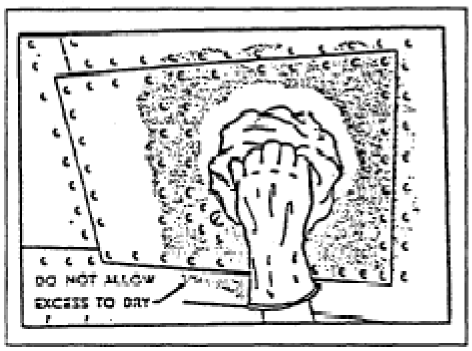


Figure A6–2. Apply Premixed Cleaner

(11) Rinse component and lubricate and/or spray corrosion inhibitor on all areas according to aircraft manufacturer's instructions. Wax as appropriate. See Figure A6–3.

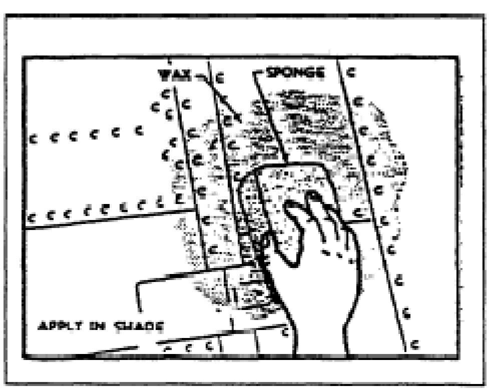


Figure A6–3. Rinse and Apply Corrosion Inhibitor

SAMPLE 3(C). THEORY TEST

DEPLANE AMTS TEST
Aircraft Cleaning and Corrosion Control Theory Test
Part 147, Appendix B, Subject G

Item 23. Determining Students' Knowledge of Aircraft Cleaning and Corrosion Control

THEORY TEST

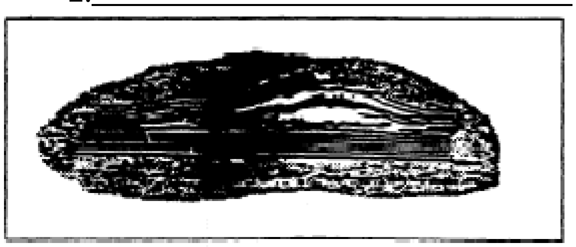
A. Complete these factual statements related to corrosion:

1. Electrochemical process that can reduce aluminum alloys to powder:____________________________________.
2. Sheet metal construction formed by laying one piece partly over another piece at the edge:
____.
3. Cleaner that mixes with water or solvent in an emulsion:_________________.

B. Based on information you have learned, describe the type of aircraft structural corrosion shown in the illustrations below:

1.________________________________

2.________________________________



NOTE: The sample theory test outlined here is very limited in scope and is intended only to serve as an example. An actual theory test would necessarily have to be more comprehensive to address the key points related to this subject.

SAMPLE 3(D). SAMPLE PRACTICAL TEST

DEPLANE AMTS PRACTICAL TEST
Part 147, Appendix B, Subject G

Item 23. Perform Aircraft Cleaning and Corrosion Control

PRACTICAL TEST 1: CORROSION CONTROL

Moisture held in contact with a metal surface by an accumulation of dirt or grease is a significant cause of corrosion. Therefore, cleanliness of the exterior surface of the aircraft is one of the best methods to control corrosion. If the surface can be kept reasonably dry and clean, corrosion has little chance of getting started. The essence of corrosion control is prevention rather than removal.

The student will be provided with an aircraft component showing evidence of corrosion.

The practical test for this subject consists of the following steps:

A. Identify part to be inspected.

B. Identify type of corrosion.

C. Use reference materials and technical publications.

D. Discuss the corrosion control process to be used for this specific type of corrosion.

E. List cleaning and corrosion preventive chemical to be used.

F. Correctly perform mechanical corrosion removal.

G. Correctly apply corrosion preventive.

H. Correctly apply primer coating.

SAMPLE 3(E). PRACTICAL PROJECT GRADING CRITERIA

There are no established FAA criteria for grading completed practical projects. No matter which method an AMTS applicant uses, whether to the one shown here or a method the school is choosing, the grading should be objective and repeatable. The grading method should reflect both the required teaching level of the subject and the subject proficiency requirements (for example, a student may be required to construct, adjust, or overhaul). An AMTS should avoid assigning points for student “good grooming” and “most improved” student, since they do not directly relate to the accomplishment of a practical project and are subjective in nature. Although many different methodologies are employed for grading practical projects, AMTS practical project grading systems previously approved by the FAA may be broadly grouped into three general methods.

Method A. In this method, practical projects are graded by establishing grading standards for job accomplishment or completeness, work performance or workmanship (airworthiness), verbal knowledge, and development of professional AMT skills. Typically, method A assigns more weight to some skill elements in a project than others. It also may assign numerical grades to each project element. See method A grading example.

Method B. This method grades projects on a more specific criteria, such as competency in general skills and degree of skill accomplishment for specific elements and critical aspects of the task. For example, grade points, such as superior or average, may be assigned for the competency of the student’s work. Additional points may be assigned for specific elements of the project, such as the use of correct procedures, proper reference materials, overall airworthiness, completion to a return to service condition, or on-time completion. Further, certain project tasks or portions of a practical project may be considered “must pass” items, requiring 100 percent conformity with FAA airworthiness standards. See method B grading example.

Method C. This type of grading procedure is more suitable for practical projects in which a component is fabricated, for example, subjects such as welding or sheet metal. For these projects, grading criteria can be clearly defined by measurement of the completed project, such as sheet metal patch size, rivet size and pitch, weld quality, and fillet configuration. This method is less suitable and less frequently used for practical projects involving the development of manipulative skills in projects such as gear retraction mechanism adjustments and engine troubleshooting. See method C grading example.

METHOD A

The following section presents an example of the practical project grading criteria as shown in method A. In this case, the project to be graded is from Sample 3(D), Practical Test 1: Corrosion Control.

SUBJECT ELEMENTS	GRADE POINTS
A. Identification of part to be inspected	10
B. Identification of type of corrosion	10
C. Selection of correct reference data	5
D. Verbal knowledge of corrosion control process	5
E. Performance of corrosion removal	50
F. Performance of preventive measures	5
G. Performance of primer application	5
H. Job completeness (includes cleanup)	5
I. Workmanship (airworthiness)	5
TOTAL POINTS POSSIBLE	100
Minimum Passing Grade	70

NOTE: The selection of numerical values for each subject element is left to the discretion of the school. In this case, the actual performance of the corrosion removal process is considered the most important element, and failing this section (that is, no points) prevents a student from passing this project. In most cases, an AMTS will choose to assign more weight to areas considered critical.

METHOD B

This section presents an example of the practical project grading criteria as shown in method B. In method B, the grading criteria are more specific than in other methods shown. In this method, student performance is graded on a scale from failure to superior. Although the example here shows a limited student performance range, some schools may choose to develop more elaborate criteria.

(1) Consider the following student performance grade scale:

F	=	Failure of element by student	=	0	points
P	=	Passing to standard by student	=	1	point
S	=	Superior performance by student	=	2	points

(2) Within each practical project, a value is assigned to each project step or element. In this example, the value for any specific element ranges from 5 to 20, in increments of 5.

(3) In this example, certain elements of the project are “must pass” items. All “must pass” project elements are to be completed to the approved standard to successfully finish the practical project.

NOTE: Not all projects within a curriculum may use “must pass” items; however, the practice is widespread in AMTS grading systems.

(4) In this example, it is possible to successfully complete this practical project by failing an element of the project. However, the other elements would have to have superior performance and all the “must pass” items would have to be successfully completed.

(5) This method of project grading is accomplished as follows. The grade that a student achieves on the performance scale for each subject element is multiplied by the value of the subject element to determine the points a student can achieve on each subject element. As an example, on one subject element, a student passes to the grading standard and achieves a grade of P, which equals 1 point. If the subject element has a value of 5 points, the grade points on this element are 1 x 5 = 5 grade points. If the student achieves a superior performance, or S, which equals 2 points, the grade points on this element would be 2 x 5 = 10 grade points.

In this example, the project to be graded by method B is the same one shown in method A, Practical Test 1: Corrosion Control.

NOTE: Project elements with an asterisk (*) are "must pass" items. Project element values are shown in parentheses.

Performance scale values are Fail = 0, Pass = 1, Superior = 2.

SUBJECT ELEMENTS	PERFORMANCE SCALE	GRADE POINTS
A.* Identification of part to be inspected		Pass
B.* Identification of type of corrosion		Pass
C. Selection of correct reference data (5)	1	5
D. Verbal knowledge of corrosion control process (10)	1	10
E.* Performance of corrosion removal		Pass
F. Performance of preventive measures (20)	1	20
G. Performance of primer application (20)	1	20
H. Finish application (5)	1	5
I. Job completeness (includes cleanup) (10)	1	10
J. Workmanship (airworthiness) (10)	1	10
TOTAL POINTS		80
Minimum Passing Grade		80 points

The maximum number of points possible would be 160, indicating fully superior performance. In the example shown, the student has received a passing grade for each subject element, resulting in a grade of 80.

METHOD C

The following example shows how an AMTS might grade a practical project using method C. As stated before, this system is more suitable for practical projects where a student constructs a piece of hardware, that is, sheet metal, wood, fabric, or welding.

Method C, Practical Test 1: Repair Aircraft Structures Built From Sheet Metal

INSTRUCTION 1: STUDENT WILL ACCOMPLISH A SHEET METAL REPAIR BY PATCHING A DAMAGED WING RIB SECTION.

In this case, a drawing or blueprint of the patch should be supplied to the student. The drawing will show the size, shape, thickness, and other details of the patch to be made. The student will be expected to correctly use the rivet size, rivet pitch, edge distance, and other criteria shown on the drawing. For example, if the grading standard at the AMTS is 70 percent, at least 70 percent of the rivets, patch sizes, shapes, and other criteria must meet the drawing specifications. In addition, points may be subtracted for general workmanship, scribe marks, scratches, riveting damage, and other workmanship that may detract from airworthiness. In many cases, the criteria may be simply a pass/fail type based on the drawing specifications.

INSTRUCTION 2: STUDENT WILL ACCOMPLISH THE FOLLOWING STEPS TO THE APPROVED STANDARD USING THE SUPPLIED DRAWING.

A. Determine size and shape of patch.

B. Plan and layout rivet patterns.

C. Select proper number and types of rivets.

D. Use proper riveting techniques on repairs.

E. Perform all work to an airworthy standard.

F. Unless otherwise stated, conform all work to the criteria specified in the current edition of FAA AC 43.13-1, Acceptable Methods, Techniques, and Practices — Aircraft Inspection and Repair.

AMTSs may use several different types of grading systems to grade practical projects as can be seen from the information discussed in these methods. In fact, an AMTS may use several different grading methods in the curriculum, depending on the types of practical projects to be evaluated. However, regardless of which method or methods a school elects to use, the grading methods must be clearly described in the curriculum.

APPENDIX 8. MAINTENANCE OF THE GENERAL CURRICULUM

AMTSs are encouraged to keep the subjects within the curriculum areas shown in part 147, appendices B, C, and D. When subjects are taught in the areas shown in the appendices, it is not difficult for the FAA to determine whether all the required subjects for a particular rating are taught. This practice is recommended to ensure a school can also determine clearly that all required subjects are taught, particularly when a school offers more than one rating. For example, consider the following sample curriculum development cases.

AMTS XYZ and AMTS ABC are two schools that hold the same rating, in this case, airframe.

CASE 1: AMTS XYZ is an approved school with an airframe rating and teaches all required general subjects within the general curriculum.

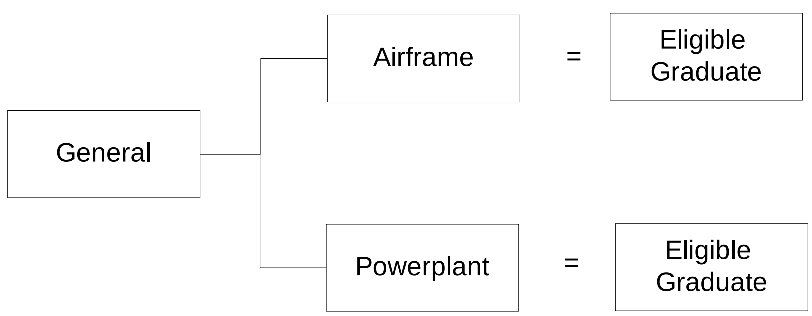
General curriculum subjects G1, ... G33	+	Airframe curriculum subjects A1, ... A55	=	Student graduates; eligible for airframe certificate

CASE 2: AMTS ABC has an airframe rating only and teaches all required general subjects mixed with subjects from the airframe curriculum.

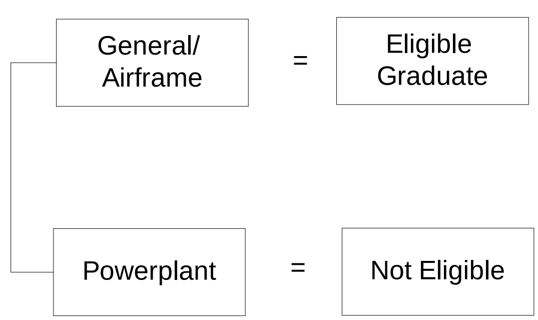
General curriculum subjects G1, ... G30	+	Airframe curriculum subjects A1, ... A55 + G31, G32, G33	=	Student graduates; eligible for airframe certificate

Both schools now elect to add a powerplant rating:

CASE 3: AMTS XYZ



CASE 4: AMTS ABC



A student at school ABC taking only the powerplant curriculum would not be eligible for graduation from the powerplant curriculum because some of the required general subjects are in the airframe curriculum and would be missed if the student took only the powerplant curriculum. To properly graduate students in the powerplant curriculum, AMTS ABC would be required to either teach a parallel set of the missed general subjects in the powerplant curriculum, or teach all general subjects only in the general curriculum. From an administrative standpoint, the most desirable method is to teach all general subjects in the general curriculum (cases 1 and 3).

APPENDIX 9. SAMPLE FACILITY LAYOUT

FIGURE A9-1. FACILITY LAYOUT, AREA 1

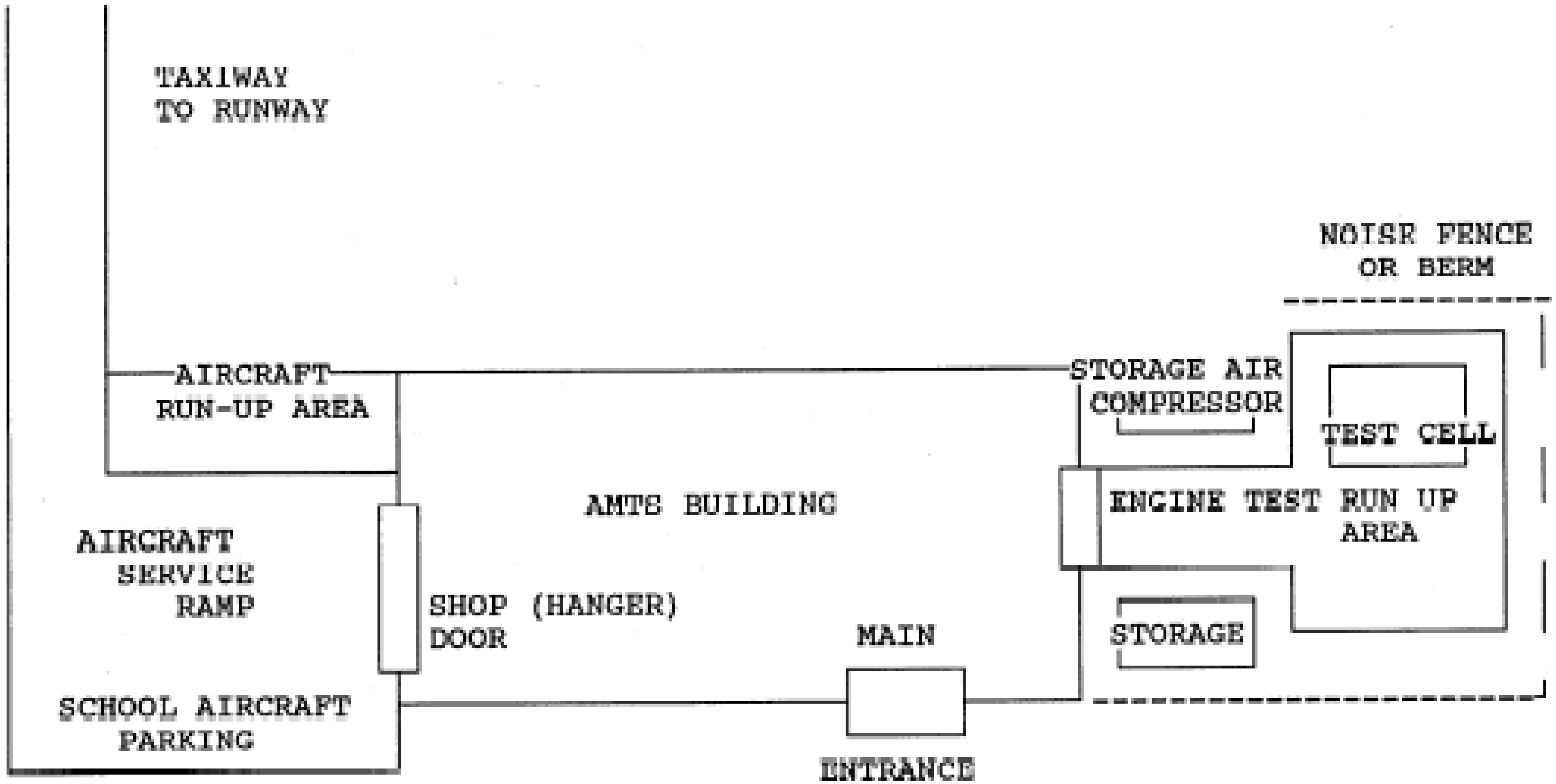
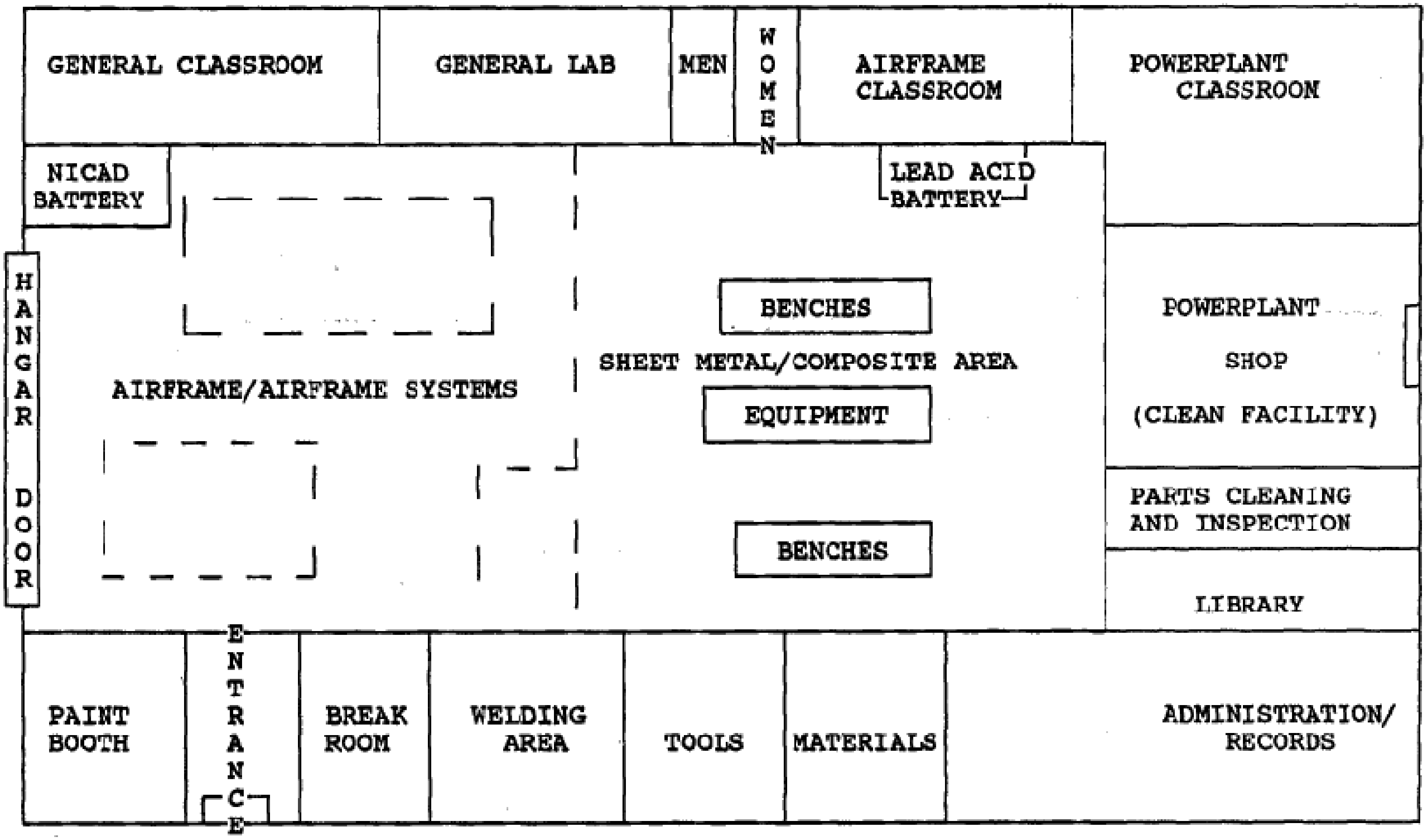
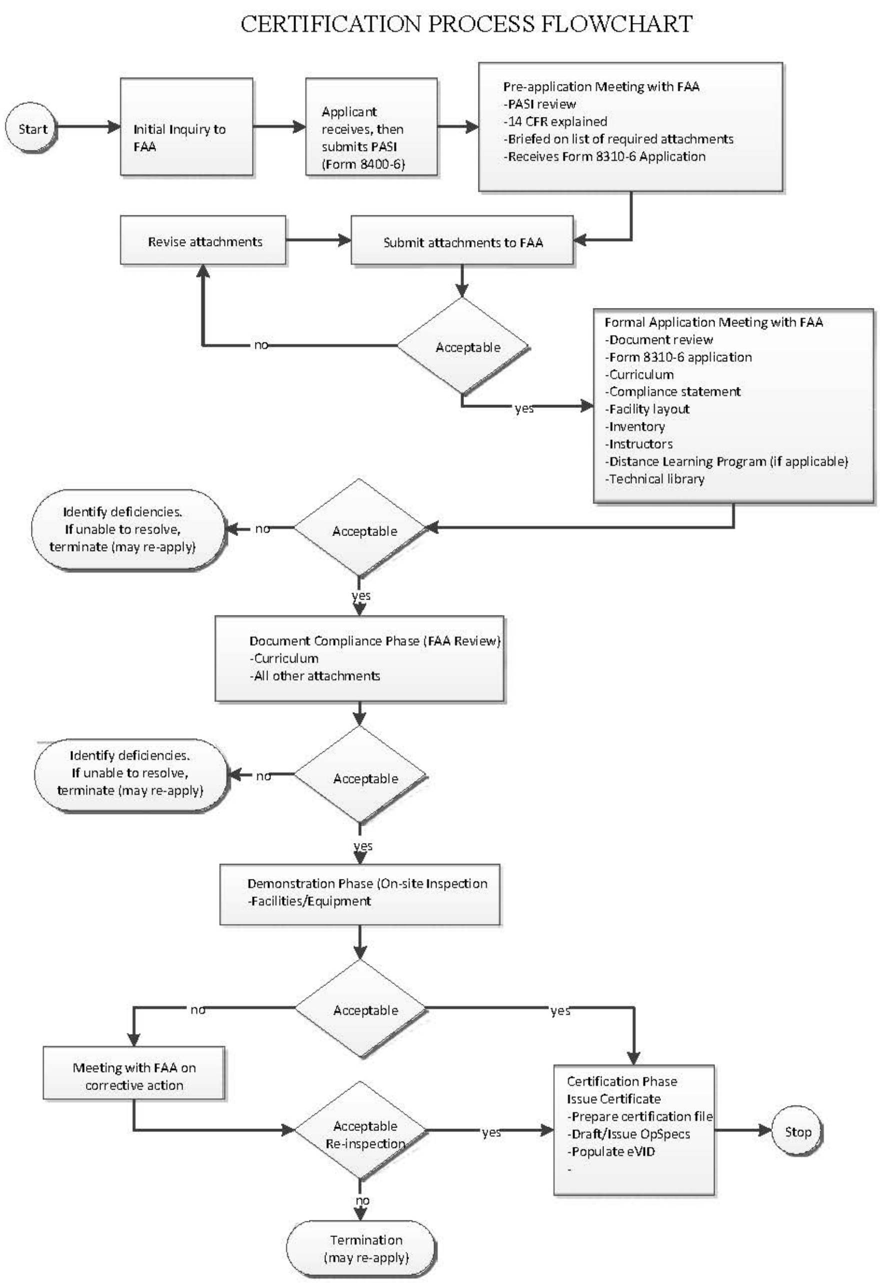


FIGURE A9-2. FACILITY LAYOUT, AREA 2



APPENDIX 10. CERTIFICATION PROCESS FLOWCHART



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APPENDIX 11. DISTANCE LEARNING:

A. Background. A form of information sharing for educational purposes using computer systems instead of the traditional classroom has become known as distance learning (also known as e-learning, home study, self-guided training, virtual classroom, distributed training, computer-based training (CBT), Web-based training (WBT), etc.). Distance learning systems are being effectively utilized by accredited universities and approved air carrier training programs as a low-cost alternative that allows for flexible scheduling and location settings. Distance learning is a welcome addition to any Aviation Maintenance Technician School (AMTS) curriculum.

B. Distance Learning Program Requirements. A distance learning program will ensure compliance with all 14 CFR part 147 requirements, including curriculum approval as required by part 147, § 147.37. Issuance of operations specification (OpSpec) A026 is required prior to conducting distance learning. Specifically, an acceptable distance learning program will include written policy and procedures describing:

(1) How the distance learning program will be administered;

(2) A description of the examination and testing process;

(3) Methods for ensuring the integrity of student work and compliance with FAA minimum standards, as listed in part 147 appendices A, B, C, and D;

(4) Procedures for proctoring computer-based exams in a remote location;

(5) Procedures to ensure distance learning course records are kept in compliance with the approved curriculum;

(6) A description of the technology hardware and software to be utilized;

(7) Proper identification of courses available through distance learning;

(8) A sophisticated electronic Learning Management System (eLMS) to track all aspects of the distance learning program, including attendance, participation, and performance (including comparisons to traditional classroom test scores and completion rates); and

(9) FAA “read only” access to the eLMS (to facilitate surveillance).

C. Program Creation.

(1) Not all courses are suitable for distance learning. Criteria for determining what subject matter may be provided through distance learning includes:

- Subjects that have historically been taught through lecture or written papers;
- The level of computer competency required for successful completion of a course delivered via distance learning;

- The amount of in-person work required, such as lab work; and
- A system and methods to be used for timely and appropriate interaction between students and instructor(s).

(2) An AMTS may design a combination distance learning and onsite format for courses that require in-person session(s), such as lab work and testing.

(3) Distance learning curriculum may also be made available as an in-person course.

D. Evaluation, Testing, and Assessment.

(1) Testing for students participating in distance learning activity can be a special challenge. Testing can be accomplished through a variety of methods, including:

- Oral evaluation;
- Practical exercises on desktop computers or specialized part-task training devices;
- Paper-based; or
- Computer-based exams proctored by an evaluator.

NOTE: Proctored exams (testing) at a remote location may only be accomplished within the facilities of another active AMTS or accredited educational institution, or through an approved remote proctoring system. The procedure must be documented in a written agreement between each participating AMTS while holding the originating part 147 school responsible for all aspects of the test.

(2) The testing method used and the types of questions employed should suit the objectives to be tested and the demographics of the target population. Keep in mind that knowledge objectives are typically assessed by written, electronic, or oral testing.

(3) Skill objectives are typically assessed by a combination of written, electronic, oral testing, and through task performance demonstration. Skill elements utilizing specialized tools and equipment or any form of measurement device, therefore, are not suitable for accomplishment within the distance learning approval process.

E. Other Considerations for Distance Learning.

(1) Reliability & Availability. A distance learning system must have sufficient redundancy and fault tolerance capability to provide continuous availability of required training materials 24 hours per day, 7 days per week (barring scheduled system maintenance outages).

(2) Security. Access to the eLMS should be limited to authorized personnel of the AMTS, students, and FAA (read only).

(a) The certificate holder may choose to allow various users to access the system via different methods, links, and times. Access rights must be controlled by a system administrator. The certificate holder's security plans must describe how the system will recognize and deal with attempted unauthorized access.

(b) Care should be exercised to ensure that system security is adequate to ensure proper protection of materials and users, but not so rigid that it impacts the ability for training management and training development personnel to efficiently accomplish their duties. Deficiencies found within the distance learning program during surveillance must be identified and brought to the attention of the AMTS for necessary correction. An AMTS with approval to conduct distance learning must continually operate to meet the requirements of the approved distance learning program to enable continued approval authorization to conduct distance learning.

APPENDIX 12. EXPLANATION OF A "LETTER OF COMPLIANCE," I.E., STATEMENT OF COMPLIANCE

Subject: Letter of Compliance

Authority for Letter of Compliance. Title 49 USC, Section 44702, issuance of certificates provides the Administrator the authority to prescribe the form and content of applications and certificates.

Purpose of the Letter of Compliance. The letter of compliance must describe how the applicant complies with each individual section of 14 CFR part 147.

The sequence should be the same as the regulations. The letter should be reviewed to determine that the applicant has a clear understanding of the regulations which will be applicable to the proposed operations. The manner in which the applicant describes compliance with the specific regulation should be reviewed for adequacy. Deficiencies should be discussed with the applicant, and an acceptable letter of compliance submitted.

Explanation of the "Compliance Statement"

To benefit the applicant, the compliance statement ensures that all applicable regulatory requirements are addressed during the certification process. The compliance statement must list each part 147 section and provide a brief narrative or a specific reference to a manual or other document describing the planned method of compliance with the regulation.

This document serves as a template for applicants to complete a properly formatted and comprehensive Compliance Statement. As is required in the Compliance Statement, each applicable part 147 section is listed below. Following each section, the template provides sample responses (in italics) which may assist the applicant in crafting a complete response. References to specific documents, training equipment, and school personnel are for illustrative purposes, and should not be construed as the only approved methodology for school compliance.

Compliance Statement for
[Applicant Name]
[Date]

This document provides the manner in which [Applicant] intends to comply with the provisions of part 147.

Subpart A—General

147.1 Applicability.
This part prescribes the requirements for issuing aviation maintenance technician school certificates and associated ratings and the general operating rules for the holders of those certificates and ratings.

[Applicant] is prepared to comply with all part 147 requirements and general operating rules, as defined in this document, the [Applicant] Operations Manual, and Curriculum and/or other [Applicant] publications.

147.3 Certificate required.
No person may operate as a certificated aviation maintenance technician school without, or in violation of, an aviation maintenance technician school certificate issued under this part.

[Applicant] attests that will not operate or represent itself as a certificated school without proper certification issued under this part.

147.5 Application and issue.
(a) An application for a certificate and rating, or for an additional rating, under this part is made on a form and in a manner prescribed by the Administrator, and submitted with—

[Applicant] seeks certification for the combined Airframe and Powerplant Rating and is submitting the following:

(1) A description of the proposed curriculum;

[Applicant] has submitted as part of its application materials a copy of the document labeled as Curriculum Manual. A description of the curriculum is found in Section [X] of the Curriculum Manual.

(2) A list of the facilities and materials to be used;

The description of the [Applicant] facility and a listing of tools and equipment have been attached to the FAA Form 8310-6 application. See Attachment [X].

(3) A list of its instructors, including the kind of certificate and ratings held and the certificate numbers;

The listing of instructors, including certificates and ratings held has been attached to the FAA Form 8310-6 application. See Attachment [X]. The list of active instructors is maintained by the [Applicant] Director and is available for FAA inspection at any time. See Operations Manual page [X].

(4) A statement of the maximum number of students it expects to teach at any one time.

[Applicant's] program will have a maximum enrollment of [X] day students and [X] night students as stated on the application Form 8310-6.

(b) An applicant who meets the requirements of this part is entitled to an aviation maintenance technician school certificate and associated ratings prescribing such operations specifications and limitations as are necessary in the interests of safety.

[Applicant] shall operate the school according to the policies and procedures presented in the Operations Manual which is a part of this submission.

147.7 Duration of certificates.
(a) An aviation maintenance technician school certificate or rating is effective until it is surrendered, suspended, or revoked.

[Applicant] recognizes that the aviation maintenance technician school certificate is effective until it is surrendered, suspended or revoked, and will comply with the requirements of this section.

(b) The holder of a certificate that is surrendered, suspended, or revoked, shall return it to the Administrator.

In the event that [Applicant's] certificate is surrendered, suspended, or revoked, the certificate shall be returned to the Administrator.

Subpart B—Certification Requirements

147.11 Ratings.
The following ratings are issued under this part:

(a) Airframe.
(b) Powerplant.
(c) Airframe and powerplant.

[Applicant] seeks the Airframe and Powerplant rating.

147.13 Facilities, equipment, and material requirements.
An applicant for an aviation maintenance technician school certificate and rating, or for an additional rating, must have at least the facilities, equipment, and materials specified in §§ 147.15 to 147.19 that are appropriate to the rating he seeks.

[Applicant's] school is set to be located at [Address]. Drawings [and/or photographs] of the facility have been attached to the application package as Attachment [X]. This facility shall house all classroom, reference library, lab and shop facilities.

As a certified AMTS, [Applicant] will have and continue to maintain facilities, equipment and materials specified in §§ 147.15 through 147.19 of the regulation. For detailed information, refer to page [X] of the Operations Manual.

147.15 Space requirements.
An applicant for an AMTS certificate and rating, or for an additional rating, must have such of the following properly heated, lighted, and ventilated facilities as are appropriate to the rating he seeks and as the Administrator determines are appropriate for the maximum number of students expected to be taught at any time:

[Applicant's] facility has been designed to meet the requirements of this part. All areas [are/shall be] properly heated, lighted and ventilated and [are/shall be] appropriate for the number of students indicated in this submission.

(a) An enclosed classroom suitable for teaching theory classes.

[Applicant's] facility [provides/shall provide] two separately enclosed, fully equipped classrooms, with additional classroom/lab space being designated for specific portions of the curriculum.

(b) Suitable facilities, either central or located in training areas, arranged to assure proper separation from the working space, for parts, tools, materials, and similar articles.

[Applicant] will maintain separate tool and material storage areas, as well as appropriate storage cabinets and bins for each lab/shop area.

(c) Suitable area for application of finishing materials, including paint spraying.

A portion of the shop area will be segregated and ventilated whenever finishing materials are in use. Particular attention will be paid to comply with local, state and federal regulations regarding finishing materials.

(d) Suitable areas equipped with washtank and degreasing equipment with air pressure or other adequate cleaning equipment.

A parts cleaning station equipped with a solvent wash tank and compressed air is installed in the lab/shop area.

(e) Suitable facilities for running engines.

An engine run area is provided outside the shop/lab area. Access to the area is provided by personnel doors and rolling hangar doors large enough to move engines, engine stands and aircraft through.

(f) Suitable area with adequate equipment, including benches, tables, and test equipment, to disassemble, service, and inspect.

All lab/shop areas are equipped with adequate equipment, benches, tables and specialized tools to disassemble, service and inspect all components and systems listed in the curriculum. A listing of tools and equipment is attached to the application form. See Attachment [X].

(1) Ignition, electrical equipment, and appliances;

A supply of magnetos, turbine engine ignition components, starters, generators and other electrical equipment and appliances is present in the lab/shop areas and mounted on system trainers.

(2) Carburetors and fuel systems;

A supply of float and pressure carburetors, fuel injection system components is available for student use.

(3) Hydraulic and vacuum systems for aircraft, aircraft engines, and their appliances.

A supply of hydraulic and vacuum system components for aircraft, aircraft engines and their appliances are available for student use.

(g) Suitable space with adequate equipment, including tables, benches, stands, and jacks, for disassembling, inspecting, and rigging aircraft.

The designated shop area provides suitable space and contains adequate equipment for disassembling, inspecting and rigging aircraft.

(h) Suitable space with adequate equipment for disassembling, inspecting, assembling, troubleshooting, and timing engines.

The lab/shop areas provide suitable space and contain adequate equipment for disassembling, inspecting, assembling, troubleshooting, and timing engines.

147.17 Instructional equipment requirements.

(a) An applicant for a mechanic school certificate and rating, or for an additional rating, must have such of the following instructional equipment as is appropriate to the rating he seeks:

The instructional equipment to be used by [Applicant] is included as Attachment [X] to the application form. The equipment meets the needs of the required standards defined in this section of the Rule for type and quantity required for the maximum number of students to be approved.

(1) Various kinds of airframe structures, airframe systems and components, powerplants, and powerplant systems and components (including propellers), of a quantity and type suitable to complete the practical projects required by its approved curriculums.

A variety of airframe structures, airframe systems and components, powerplants, and powerplant systems and components, including propellers is available for student use. They are of a quantity and type suitable to complete the practical projects required by the approved curriculum.

(2) At least one aircraft of a type currently certificated by FAA for private or commercial operation, with powerplant, propeller, instruments, navigation and communications equipment, landing lights, and other equipment and accessories on which a maintenance technician might be required to work and with which the technician should be familiar.

A(n) [Aircraft Make and Model] shall serve to meet the specific requirements of 147.17 (a) (2).

(b) The equipment required by paragraph (a) of this section need not be in an airworthy condition. However, if it was damaged, it must have been repaired enough for complete assembly.

The [Aircraft Make and Model] is complete and operational.

(c) Airframes, powerplants, propellers, appliances, and components thereof, on which instruction is to be given, and from which practical working experience is to be gained, must be so diversified as to show the different methods of construction, assembly, inspection, and operation when installed in an aircraft for use. There must be enough units so that not more than eight students will work on any one unit at a time.

The Operations Manual establishes class size and requires the school to schedule classes in such a way that no more than eight (8) students will be required to work on any one piece of equipment at the same time (147.17(c)). See Operations Manual, page [X].

(d) If the aircraft used for instructional purposes does not have retractable landing gear and wing flaps, the school must provide training aids, or operational mock-ups of them.

The [Aircraft Make and Model] to be used for instructional purposes has retractable landing gear and wing flaps (147.17 (d)). Additional aircraft and mock-ups shall also be available to meet this requirement.

147.19 Materials, special tools, and shop equipment requirements.
An applicant for an aviation maintenance technician school certificate and rating, or for an additional rating, must have an adequate supply of material, special tools, and such of the shop equipment as are appropriate to the approved curriculum of the school and are used in constructing and maintaining aircraft, to assure that each student will be properly instructed. The special tools and shop equipment must be in satisfactory working condition for the purpose for which they are to be used.

The inventory of tools and equipment is included as Attachment [X] to the application form. Training shall be performed to at least the indicated level of proficiency as defined in Appendix A of part 147. Equipment will be maintained in satisfactory working condition for the purpose for which they are to be used. [Applicant] will maintain an adequate supply of expendable materials to support the requirements of the approved curriculum, for the number of students enrolled. See Operations Manual page [x].

147.21 General curriculum requirements.
(a) An applicant for an aviation maintenance technician school certificate and rating, or for an additional rating, must have an approved curriculum that is designed to qualify his students to perform the duties of a mechanic for a particular rating or ratings.

The curriculum for this program has been submitted as the Curriculum Manual.

(b) The curriculum must offer at least the following number of hours of instruction for the rating shown, and the instruction unit hour shall not be less than 50 minutes in length:

(1) Airframe—1,150 hours (400 general plus 750 airframe).

A single rating program is not included in this application.

(2) Powerplant—1,150 hours (400 general plus 750 powerplant).

A single rating program is not included in this application.

(3) Combined airframe and powerplant—1,900 hours (400 general plus 750 airframe and 750 powerplant).

[Applicant] has submitted a curriculum designed to provide instruction for the combined Airframe and Powerplant rating. This document is titled Curriculum Manual and accompanies the application package. The curriculum indicates a program length of [X] total hours for the combined rating. This includes [X] hours in the General Subjects, [X] hours in Airframe Subjects and [X] hours in Powerplant Subjects. A program summary by section may be found in the Operations Manual on page [X].

(c) The curriculum must cover the subjects and items prescribed in appendices B, C, or D, as applicable. Each item must be taught to at least the indicated level of proficiency, as defined in appendix A.

Complete descriptions of the curriculum content for the General, Airframe and Powerplant sections which comply with part 147, Appendices B, C, and D, is contained in Curriculum Manual. The description includes course outlines, proficiency levels, practical projects, and required tests for each subject in the curriculum.

(d) The curriculum must show:

(1) The required practical projects to be completed;

The performance objectives required to meet the standards of part 147 are presented under the heading ***Required Projects*** *for each subject area are presented in the Curriculum Manual.*

(2) For each subject, the proportions of theory and other instruction to be given;

The proportions of classroom and shop time for each subject are shown under Course Duration for each subject area presented in the Curriculum Manual.

(3) A list of the minimum required school tests to be given.

A subject Final Exam is required for each subject in the curriculum. To receive credit for a subject, the student must achieve a minimum of 70% on the subject final exam. This policy is presented in the Operations Manual on page [X].

(e) Notwithstanding the provisions of paragraphs (a) through (d) of this section and § 147.11, the holder of a certificate issued under subpart B of this part may apply for and receive approval of special courses in the performance of special inspection and preventive maintenance programs for a primary category aircraft type certificated under §21.24(b) of this chapter. The school may also issue certificates of competency to persons successfully completing such courses provided that all other requirements of this part are met and the certificate of competency specifies the aircraft make and model to which the certificate applies.

[Applicant] does not intend to offer any special courses at this time.

147.23 Instructor requirements.
An applicant for an aviation maintenance technician school certificate and rating, or for an additional rating, must provide the number of instructors holding appropriate mechanic certificates and ratings that the Administrator determines necessary to provide adequate instruction and supervision of the students, including at least one such instructor for each 25 students in each shop class. However, the applicant may provide specialized instructors, who are not certificated mechanics, to teach mathematics, physics, basic electricity, basic hydraulics, drawing, and similar subjects. The applicant is required to maintain a list of the names and qualifications of specialized instructors, and upon request, provide a copy of the list to the FAA.

[Applicant] will provide FAA Certificated Airframe and Powerplant Mechanics for the instruction and supervision of students. A listing of instructors and their certificate numbers is included as Attachment [X] of the application. A list of current instructors is maintained by the [Applicant] Director and is available to the FAA upon request.

Subpart C—Operating Rules

147.31 Attendance and enrollment, tests, and credit for prior instruction or experience.
(a) A certificated aviation maintenance technician school may not require any student to attend classes of instruction more than 8 hours in any day or more than 6 days or 40 hours in any 7-day period.

Students will attend school [X] hours per day, [X] days per week. See Operations Manual page [X].

(b) Each school shall give an appropriate test to each student who completes a unit of instruction as shown in that school's approved curriculum.

To receive credit for a subject, the student must achieve a minimum of 70% on the subject final exam. See Operations Manual page [X].

(c) A school may not graduate a student unless he has completed all of the appropriate curriculum requirements. However, the school may credit a student with instruction or previous experience as follows:

[Applicant] may award credit to a student with prior instruction according to the policies seen in the Operations Manual, page [X].

(1) A school may credit a student with instruction satisfactorily completed at:
(i) An accredited university, college, junior college;
(ii) An accredited vocational, technical, trade or high school;
(iii) A military technical school;
(iv) A certificated aviation maintenance technician school.

[Applicant] may award credit to a student with instruction satisfactorily completed at one of these institutions as evidenced by an Official Transcript.

(2) A school may determine the amount of credit to be allowed:

(i) By an entrance test equal to one given to the students who complete a comparable required curriculum subject at the crediting school;

(ii) By an evaluation of an authenticated transcript from the student's former school; or

(iii) In the case of an applicant from a military school, only on the basis of an entrance test.

[Applicant] will determine the amount of credit to be awarded based on an authenticated transcript from the former school, or in the case of military technical schools, based on the results of bypass examination(s).

(3) A school may credit a student with previous aviation maintenance experience comparable to required curriculum subjects. It must determine the amount of credit to be allowed by documents verifying that experience, and by giving the student a test equal to the one given to students who complete the comparable required curriculum subject at the school.

[Applicant] does not credit students with previous maintenance experience comparable to required curriculum subjects.

(4) A school may credit a student seeking an additional rating with previous satisfactory completion of the general portion of an AMTS curriculum.

Students who hold a valid FAA Mechanic Certificate with either the Airframe or Powerplant Rating may receive credit for the General Section and other subjects based on the rating held. This is stated in the Operations Manual on page [X].

(d) A school may not have more students enrolled than the number stated in its application for a certificate, unless it amends its application and has it approved.

[Applicant] has applied for certification for a maximum of [X] day students and [X] night students. See FAA Form 8310-6.

(e) A school shall use an approved system for determining final course grades and for recording student attendance. The system must show hours of absence allowed and show how the missed material will be made available to the student.

Details regarding [Applicant's] system for determining final course grades, for recording attendance, and showing how missed material will be made available to the student may be found in the Operations Manual on page [X].

147.33 Records.

(a) Each certificated aviation maintenance technician school shall keep a current record of each student enrolled, showing:

(1) His attendance, tests, and grades received on the subjects required by this part;

(2) The instruction credited to him under §147.31(c), if any; and

(3) The authenticated transcript of his grades from that school.

[Applicant] employs a system of hard copy records and electronic records which is designed to meet both the requirements of part 147 and those of other regulatory bodies with jurisdiction over the school. The details of this system as it applies to part 147 are presented in the Operations Manual on page [X], along with sample forms and instructions for their use.

It shall retain the record for at least two years after the end of the student's enrollment, and shall make each record available for inspection by the Administrator during that period.

As stated in the Operations Manual, hard copy records will be retained for at least two years. Electronic records will be maintained longer.

(b) Each school shall keep a current progress chart or individual progress record for each of its students, showing the practical projects or laboratory work completed, or to be completed, by the student in each subject.

During the course of instruction the [student transcript and/or other documentation] serves to meet the requirements of this part. Progress records are maintained by the [Instructor/Registrar] and are available for inspection at any time.

147.35 Transcripts and graduation certificates.

(a) Upon request, each certificated aviation maintenance technician school shall provide a transcript of the student's grades to each student who is graduated from that school or who leaves it before being graduated. An official of the school shall authenticate the transcript. The transcript must state the curriculum in which the student was enrolled, whether the student satisfactorily completed that curriculum, and the final grades the student received.

The Transcript is utilized to record student grades in each subject and serves to meet the requirements of 147.35(a). A sample Transcript can be found in the Operations Manual on page [X].

(b) Each school shall give a graduation certificate or certificate of completion to each student that it graduates. An official of the school shall authenticate the certificate. The certificate must show the date of graduation and the approved curriculum title.

The Graduation Certificate is issued to students who successfully complete all requirements of the program. A sample Graduation Certificate meeting the requirements of 147.35(b) can be found in the Operations Manual on page [X].

147.36 Maintenance of instructor requirements.

Each certificated aviation maintenance technician school shall, after certification or addition of a rating, continue to provide the number of instructors holding appropriate mechanic certificates and ratings that the Administrator determines necessary to provide adequate instruction to the students, including at least one such instructor for each 25 students in each shop class. The school may continue to provide specialized instructors who are not certificated mechanics to teach mathematics, physics, drawing, basic electricity, basic hydraulics, and similar subjects.

[Applicant] shall continue to provide the number of instructors with the appropriate certificates and ratings as is necessary for adequate instruction of the students. See Operations Manual

page [X]. At no time will [Applicant] exceed a ratio of 25 students to 1 instructor in the lab/shop setting. See Operations Manual page [X].

147.37 Maintenance of facilities, equipment, and material.

(a) Each certificated aviation maintenance technician school shall provide facilities, equipment, and material equal to the standards currently required for the issue of the certificate and rating that it holds.

[Applicant] shall maintain its facilities, equipment and materials to a standard at least equal to the standards currently required to obtain certification.

(b) A school may not make a substantial change in facilities, equipment, or material that have been approved for a particular curriculum, unless that change is approved in advance.

No substantial changes will be made to facilities, equipment or materials without receiving approval in advance. This policy is seen in the Operations Manual on page [X].

147.38 Maintenance of curriculum requirements.

(a) Each certificated aviation maintenance technician school shall adhere to its approved curriculum. With FAA approval, curriculum subjects may be taught at levels exceeding those shown in appendix A of this part.

To ensure adherence to its approved curriculum, [Applicant] will conduct internal audits by the [Director or other appropriate individual]. Currently, the curriculum that has been submitted for approval includes teaching levels which meet, but do not exceed, those shown in Appendix A of this part. However, should [Applicant] determine that a revision to the curriculum is necessary, any and all changes, including the elevation of teaching levels, shall be submitted to the FAA for approval prior to implementation.

(b) A school may not change its approved curriculum unless the change is approved in advance.

[Applicant] will adhere to its approved curriculum, and at no time will changes be made to the approved curriculum without first submitting changes to and receiving approval from the FAA Administrator. Details of this procedure may be found in the Operations Manual on page [X].

147.38a Quality of instruction.

Each certificated aviation maintenance technician school shall provide instruction of such quality that, of its graduates of a curriculum for each rating who apply for a mechanic certificate or additional rating within 60 days after they are graduated, the percentage of those passing the applicable FAA written tests on their first attempt during any period of 24 calendar months is at least the percentage figured as follows:

[Applicant] will provide instruction of such a quality as to comply with the passing percentages outlined in this section of the FAR. The school's results and the national passing norms are continuously monitored by the school administration.

(a) For a school graduating fewer than 51 students during that period—the national passing norm minus the number 20.

(b) For a school graduating at least 51, but fewer than 201, students during that period—the national passing norm minus the number 15.

(c) For a school graduating more than 200 students during that period—the national passing norm minus the number 10.

As used in this section, “national passing norm” is the number representing the percentage of all graduates (of a curriculum for a particular rating) of all certificated aviation maintenance technician schools who apply for a mechanic certificate or additional rating within 60 days after they are graduated and pass the applicable FAA written tests on their first attempt during the period of 24 calendar months described in this section.

[Applicant] is aware of the criteria for monitoring schools and the use of national norms to determine quality of education. [School administrator] will monitor these numbers on a quarterly basis and use that information as part of a continuous improvement process.

147.39 Display of certificate.

Each holder of an aviation maintenance technician school certificate and ratings shall display them at a place in the school that is normally accessible to the public and is not obscured. The certificate must be available for inspection by the Administrator.

[Applicant] will display its AMTS Certificate and ratings on the lobby wall at the facility.

147.41 Change of location.

The holder of an aviation maintenance technician school certificate may not make any change in the school's location unless the change is approved in advance. If the holder desires to change the location he shall notify the Administrator, in writing, at least 30 days before the date the change is contemplated. If he changes its location without approval, the certificate is revoked.

[Applicant] will not change its location without providing written notice at least 30 days prior to the date that the change is contemplated. A change of location will require a new FAA Form 8310-6 to be completed and submitted to the FSDO.

147.43 Inspection.

The Administrator may, at any time, inspect an aviation maintenance technician school to determine its compliance with this part. Such an inspection is normally made once each six months to determine if the school continues to meet the requirements under which it was originally certificated. After such an inspection is made, the school is notified, in writing, of any deficiencies found during the inspection. Other informal inspections may be made from time to time.

[Applicant] acknowledges that the AMTS may be inspected at any time by the Administrator. [Applicant] also understands that such inspections shall be normally made once every six months to determine if the school continues to meet the requirements under which it was originally certificated. Inspections should begin with notification given to the [Director] as seen on page [X] of the Operations Manual.

147.45 Advertising.

(a) A certificated aviation maintenance technician school may not make any statement relating to itself that is false or is designed to mislead any person considering enrollment therein.

(b) Whenever an aviation maintenance technician school indicates in advertising that it is a certificated school, it shall clearly distinguish between its approved courses and those that are not approved.

[Applicant] officials will not knowingly make false or misleading statements to any person considering enrollment in its AMTS program. All school advertising must be approved by the [Director in charge of Compliance] prior to publication or broadcast. This policy appears in the Operations Manual on page [X]. [Applicant] will, in its advertising, clearly distinguish between those courses that are FAA Approved and those that are not.

Doc 9401-AN/921

Manual on Establishment and Operation of Aviation Training Centres

FIRST EDITION — 1983

Approved by the Secretary General and published under his authority

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Published in separate English, French, Russian and Spanish editions by the International Civil Aviation Organization. All correspondence, except orders and subscriptions, should be addressed to the Secretary General.

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Thailand. ICAO Representative, Asia and Pacific Office, P.O. Box 11, Samyaek Ladprao, Bangkok 10901.

United Kingdom. Civil Aviation Authority, Printing and Publications Services, Greville House, 37 Gratton Road, Cheltenham, Glos., GL50 2BN.

11/95

Manual on Establishment and Operation of Aviation Training Centres

(Doc 9401- AN/921)

First Edition — 1983

AMENDMENTS

The issue of amendments is announced in the *ICAO Journal* and in the monthly supplements to the *Catalogue of ICAO Publications,* which holders of this publication should consult. These amendments are available free upon request.

No.	Date	Entered by	No.	Date	Entered by

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CHAPTER 1

INTRODUCTION

1.1 The expansion of international civil aviation has created work for large numbers of new pilots and maintenance engineers, and this has been particularly so in the developing countries of the world. Although some fluctuation in requirements will occur, new training centres will undoubtedly be needed to meet growing demands for well-trained aviation personnel.

1.2 The aim of this manual is to give guidance to field advisers and to States on the facilities, manning and operation of an aviation training centre providing courses leading to professional pilot and maintenance engineer licences. Licences obtained by graduates of the centre should be internationally recognized and must, therefore, conform to Annex 1 standards, and usually also to the Annex recommendations. Successful students must achieve levels of skill, competence and knowledge appropriate to the licence granted.

1.3 A successful training centre has to look beyond the immediate licensing objective. Careful selection, high standards of training and character development are required to produce graduates who have the professional ability to make the most of their natural aptitude and potential. Such graduates can then make a full contribution to the growth and international standing of their State's aviation industry.

1.4 In developing countries particularly, there are many demands on public funds, such as food, education and health, which have greater political and emotional appeal than aviation. Aviation and aviation training may be in competition with these other needs. If priorities in allocating resources are such that the aviation centre will be starved of finance and management skill, the establishment of the centre should be deferred.

1.5 A badly equipped school, short of money and lacking instructional and management abilities, can only produce graduates with low levels of piloting and engineering skills which will put at risk operational standards and safety. Such a situation cannot be tolerated; pilots and engineers have to cope with increasingly complex and demanding tasks in the operation of modern aircraft. It is essential that standards of selection and training are maintained at the highest possible level and that candidates who are inadequately prepared are not allowed to present themselves for licence examinations and tests.

1.6 Training is most effectively done in a total training environment where all necessary educational resources can be assembled and where student training can be properly controlled and supervised while following a carefully designed syllabus. Such a training programme conforms to the valuable concept of 'approved training', defined in Annex 1. In many countries it is the schools providing such training which are approved rather than the courses of training. This manual discusses and makes recommendations in respect of the facilities, staff and curricula of establishments which would merit approval. Maintenance of approval, once granted, will clearly require continued supervision of facilities and standards of instruction.

1.7 Appendix 1 contains an example of one State's interpretation of the Annex 1 licence specifications and approved training courses. Further material is contained in Annex 1 and the ICAO training manuals. What follows is, in general, supplementary to this material, although there is inevitably some duplication.

1.8 Comments on this manual would be appreciated from all States and ICAO Technical Assistance field missions. These comments will be taken into account in the preparation of subsequent editions. Comments concerning the manual should be addressed to:

The Secretary General
International Civil Aviation Organization
1000 Sherbrooke Street West, Suite 400
Montreal, Quebec
Canada H3A 2R2

CHAPTER 2

SIZE OF TRAINING EFFORT

2.1 - GENERAL

2.1.1 In the development of the civil aviation industry in some States it has been possible to recruit civil air pilots and engineers from those who had obtained useful and often extensive experience in the military. However, even in those States where such trained personnel are available, the output of qualified military personnel is sufficient to meet only part of the long term civil need.

2.1.2 If there are to be sufficient training facilities to meet the need, a close analysis of the economic, technical and manpower factors is necessary. A high degree of co-operation between operators and the licensing authority is required in making this analysis. The decision to establish a national aviation training centre is not one to be taken lightly. A very considerable investment is required which can only be justified if there is a genuine demand for a reasonable number of newly qualified pilots and maintenance engineers, and if this demand will persist for several years.

2.1.3 Two questions must be answered before it can be said that a school is necessary:

a) What is the duration of the manpower training requirement?

b) What is the minimum required output per year of pilots and/or maintenance engineers?

2.1.4 In making the assessment no account should be taken of the possibility of external contracts for training of students except in those cases where a school is to be established and funded by two or more States, each of which is pledged to send its nationally sponsored students to the centre. Suggestions that students might be attracted from other States should be discounted.

2.1.5 There are plenty of training places available in schools with established facilities and reputations. These schools compete vigorously for any available business. It is unlikely that a new school still in the process of setting up its facilities, writing its syllabus and recruiting instructors, will be able to attract students from other States.

2.2 - DURATION OF TRAINING REQUIREMENT

2.2.1 This question should be looked at first. It is pointless to set up a school capable of producing a viable output of students annually, if the demand exists for only two or three years. This may often prove to be the case. The national airline in a developing State may need a surprisingly large number of pilots and engineers, but only at a certain stage, to replace expatriate staff and facilitate the opening of new routes.

2.2.2 After a few years, however, the requirement may reduce to the number required to meet wastage (by which is meant the total loss of personnel through age retirement, early retirement on medical grounds, transfer to other employment and emigration), together, perhaps, with a modest expansion in traffic growth. It may even prove to be the case that after a few years there is no demand at all; this has happened several times already, even in some States with very large air transport systems. Some State schools have even had to close in such circumstances. It is difficult to predict the future of any commercial undertaking; aviation seems to be a field of especial uncertainty!

2.2.3 The analysis should show a definite requirement for the planned output for at least four years, and a probable requirement for a further four before a decision to go ahead is made. The longer term situation should be studied more in respect of wastage replacement than of projected expansion.

2.2.4 The calculations are more reliable for engineers than pilots. An increase in traffic may or may not lead to an increase in demand for pilots. It depends whether larger aircraft are introduced which, although having greater carrying capacity, may well have the same crew complement. For example, in one very large airline a ten-fold increase in traffic was carried without any increase in the pilot work force as the airline changed from YS-11s to 727s and then to Tristars. However, the engineering maintenance and overhaul task for the Tristar is many times greater than for the YS-11, so the traffic expansion was matched to some extent by an increase in the number of engineers required.

2.2.5 Retirements caused by staff reaching normal retiring age can be forecast accurately in a specific airline or State where the retiring age of every employee is on record. This stage of the analysis can therefore be made with precision.

2.2.6 Early retirements are not so easy to predict. Since aviation is an attractive industry in which to work, not many pilots and engineers leave to find other employment although some may emigrate in search of better conditions. There is a higher wastage for reasons of ill health amongst pilots than for maintenance engineers, because pilots must meet specific medical standards. In a small airline this may prove to be a very erratic and unpredictable factor. Industry experience suggests that, discounting emigration, early retirement may cause a loss of about 2 per cent per annum for pilots and 1.5 per cent for maintenance engineers.

2.2.7 Over the long term, the age retirement factor will work out to about 2.5 per cent. Added to the early retirements, this produces overall average wastage factors of approximately 5 per cent for pilots and 4 per cent for maintenance engineers; these figures can be used to predict the numbers of new staff required for job replacement.

2.2.8 No useful guidance can be given about the number of additional staff required for expansion. All that can be said is that those responsible should guard against the temptation to assume that expansion will go on for ever; it will not. The sensible rule is to considerably reduce the numbers attributed to expansion after the first four years or so. The figures should be reviewed annually and thus can be adjusted to match actual experience and revised forecast conditions.

2.3 - ANNUAL OUTPUT

2.3.1 It is usual for pilot training courses to start with several weeks of ground training before the students begin the basic flying phase. Additionally, there is a requirement for pilot trainees to progress to flying an advanced type of aircraft towards the end of the course, but this will hold true for no more than about 15 per cent of the total flying hours required.

2.3.2 It can be seen that if the school has only one intake of student pilots each year, the aircraft utilization rate, especially for the advanced aircraft, will be quite unacceptable. Similar considerations apply to engineer trainees in respect of utilization of some practical training facilities. These problems must be avoided if costs are to be kept in reasonable bounds. One way around the difficulties is to stagger the course intakes at even intervals, say three times a year.

2.3.3 However, staggered intakes may mean small numbers of students per course, and this is wasteful of the work of the classroom instructors. Theoretical instruction can readily and usefully be given to groups of up to sixteen, possibly twenty students. An instructor lecturing a group of less than eight to ten is not fully productive.

2.3.4 It can therefore be deduced that the absolute minimum size at which a pilot training school can operate sensibly is based on three intakes of ten students per year. If the course (for the commercial pilot licence with multi-engine and instrument ratings) has a duration of sixteen to eighteen months, there will be a total trainee population of forty students at any one time. This will be reduced by any failures, and the output of the school will be only about twenty-five successful students per year. For the maintenance engineer school, the duration of an approved course will be two years or more. On the same basis, the minimum population of an engineering school is sixty.

2.3.5 The school may be able to carry out other related training activities in addition to the primary work of professional *ab initio* licence courses, such as:

a) Private pilot training - for those taking licences for personal reasons, or as part of another course, e.g., air traffic control officers;

b) Military pilot and engineer courses. Military forces usually wish to train their own personnel, but can sometimes be persuaded, on grounds of economy, to do the first stage in a civil school;

c) Civil licence conversion courses for experienced military pilots and engineers; and

d) Industrial training courses.

2.3.6 If some of these secondary courses can be operated successfully, it may be possible to accept a reduction in the throughput of the primary courses for which the school is being established. Unless the total training requirement is at least of the order suggested, it will be better to defer the start of operations.

CHAPTER 3

MANAGEMENT AND ORGANIZATION

3.1 - MANAGEMENT

3.1.1 The management of an aviation training centre does not differ in principle from that of any other business. There has to be central overall direction of the entire organization, and management of the operational (and/or production), commercial and financial functions.

3.1.2 In an aviation school, these functions are carried out by the Principal, Chief Instructor, Registrar and Accountant, respectively. (Alternative titles may be used in some schools, of course.) These are the essential functions related to training. There may be others, depending on the extent to which the school operates its own support services and facilities, such as maintenance, airport management and catering, or whether it hires them from outside contractors.

3.2 - ORGANIZATION

3.2.1 Any organization, if it is to function properly, must have clearly defined lines of responsibility. Precise terms of reference are not necessarily helpful in this respect. They may lead to jealously guarded lines of demarcation. It is preferable to have a more loosely structured organization in which, although it is basically quite clear who does what (the Chief Instructor's job will not be confused with that of the Accountant), there is a degree of flexibility and adaptability.

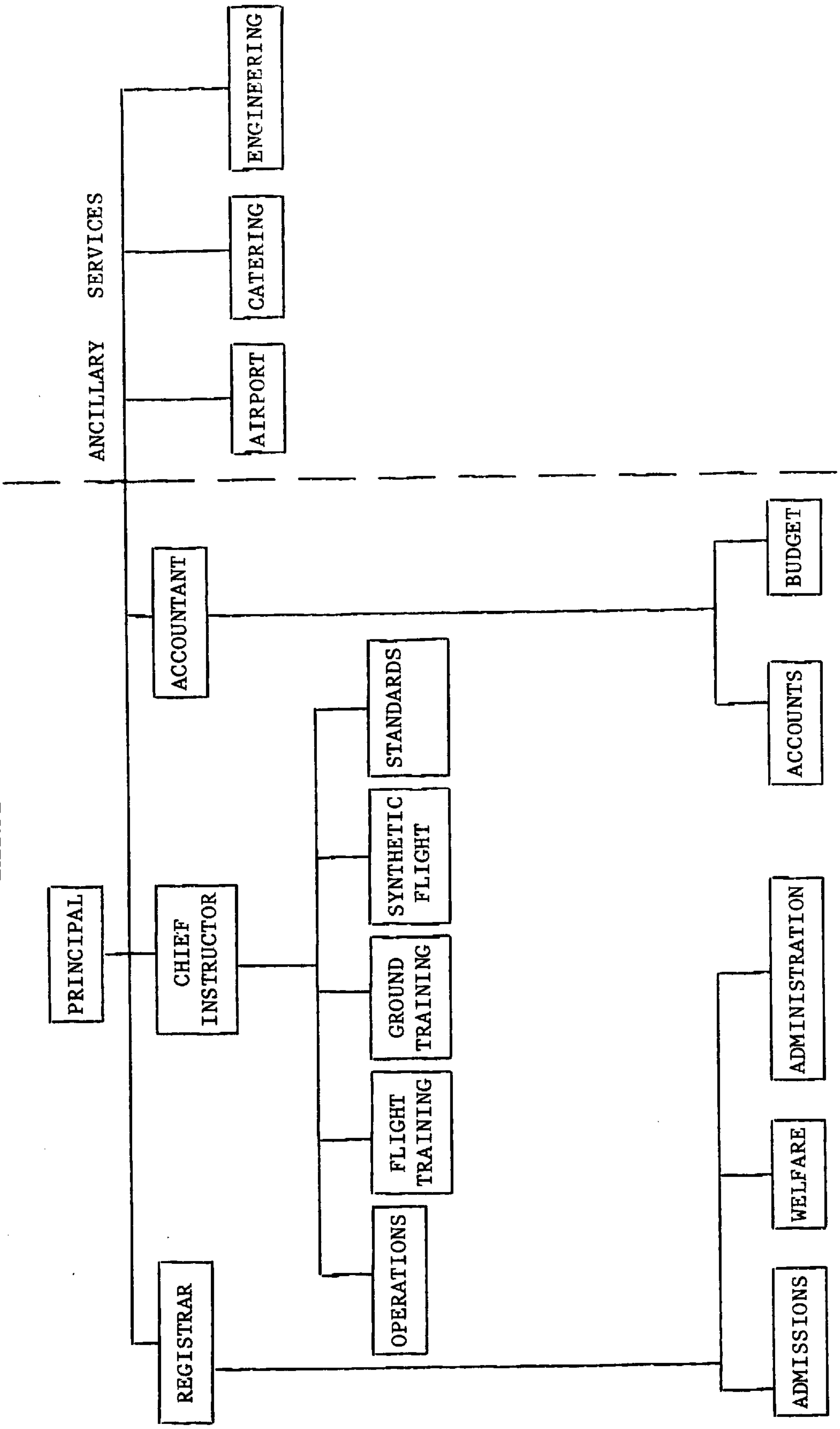
3.2.2 The suggested organization chart on the following page relates to a pilot training school. Brief descriptions of the main tasks of the top management team follow, with some thoughts and recommendations on qualification and experience requirements.

3.3 - PRINCIPAL

3.3.1 The Principal of the school will be responsible to some superior organization, such as a Department of Government, or an airline, or board of directors, which has taken the initiative in setting up the centre.

3.3.2 He will be responsible for ensuring that the centre carries out its task successfully in accordance with the directives laid down by the superior organization. This will include planning of current and future activities, leadership of the management team and overall supervision of the day-to-day operation of the school. He will also have an important role to play in liaison with the State licensing authority (which will not necessarily be the State department involved in setting up and financing the school). This will relate to State-approved training and licensing requirements, and regulations in respect of air navigation, operations and safety.

EXAMPLE ORGANIZATION CHART



Note: Except for the top management appointments discussed in this chapter, functions rather than titles are shown.

3.3.3 To carry out these duties means that the Principal should have wide experience in many aspects of aviation. An operational background as pilot or engineer is absolutely essential and part of this should have been in an active role in training. To carry out the liaison function he will need to have considerable knowledge of international and national operations and regulations. The school management function makes it necessary that he should have extensive management and administrative experience. To a large degree, the training standards and discipline achieved in the school will depend on the Principal's personal example and authority, and these are therefore important factors in selection of the right man.

3.4 - CHIEF INSTRUCTOR

3.4.1 The Chief Instructor will be responsible to the Principal for ensuring that the training plan is carried out to the required standards. He will prepare the curriculum for each course, in consultation with State training and licensing authorities, and will supervise preparation of the detailed syllabus by the Chief Flying Instructor and Chief Ground Instructor. One of his most important duties will be selection and training of instructors. He will be responsible for ensuring that a satisfactory integration of practical and theoretical training is maintained and for overall supervision of individual student progress.

3.4.2 Very considerable experience as a pilot or engineer in the training of students at the ab initio level is essential. He must have extensive administrative and management experience in a training role. Knowledge of all the appropriate licensing and examination regulations is necessary. For the Chief Instructor in a flying school, a current pilot licence and an instructor rating are assets as they will enable him to participate directly to some extent in the instructor training programme and some aspects of student flight testing. However, it is not absolutely essential; these duties may be delegated to the Chief Flying Instructor.

3.5 - REGISTRAR

3.5.1 The Registrar can be regarded as the commercial manager of the school. He will be responsible to the Principal for all matters concerning students except training. This includes activities with students prior to their joining the school, such as selection, allocation of places, joining instructions, and fees. He will afterwards deal with student requirements and welfare in non-training activities such as accommodation, fees, allowances, leave, and transport. He may be required to take responsibility for some extra-curricular training activities such as sports and games and the related studies programme, though this must be in consultation with the Chief Instructor.

3.5.2 The Registrar should also supervise the general administration arrangements in the school, secretarial service, printing, records and statistics, etc. Administrative skill is the most important requirement and the main factor in success. The Registrar will be closely connected with students at all stages, and a sympathetic appreciation of their problems is needed. For this, and a general understanding of the work of the school, previous experience in an active operational role in aviation is very desirable.

3.6 - ACCOUNTANT

Although the accounting function is of vital importance in the successful operation of the centre, no special aviation experience or qualification is required, and normal criteria for making this kind of appointment apply.

3.7 - SECOND LEVEL MANAGEMENT

3.7.1 In a small school some of the tasks of second level management (as shown on the example organization chart) may be carried out by the appropriate manager. In other cases, more than one function can be carried out by one person; for example, the Chief Flying Instructor may also manage the synthetic trainer.

3.7.2 In large organizations, the management tasks will have to be divided. The appointment of deputies with ill-defined responsibilities is not to be recommended. The total management task in each area should be carefully analyzed. Where necessary a further level of management can be introduced, consisting of persons appointed to assist the top manager, each having clearly allocated responsibilities.

3.7.3 The role of second and third level managers and supervisors is dealt with in more detail in Chapter 6, Staff.

CHAPTER 4

PHYSICAL FACILITIES

4.1 - GENERAL

4.1.1 Reference was made in Chapter 1 to the desirability of the concept of a total training environment, as provided by an 'approved school'. Although it is not essential that such an aviation training centre be entirely self-contained in a single location, the concept is, nonetheless, best met if all the centre facilities, administration, accommodation and training, share the same location. For a school providing fixed-wing flying courses, this must be at an aerodrome.

4.1.2 The ideal location for ab initio flying training is a busy general aviation aerodrome and not a major international airport. The aerodrome should be near, and have easy access to, airways and other controlled airspace. It must also have some free airspace readily available nearby in which to practise general handling and basic instrument flight.

4.1.3 The national authority may wish to establish the training centre at a major airport. It may be cheaper to do this initially, and it may make some aspects of government supervision, examination and flight testing easy. Nevertheless, it is not the best solution. The types of small training aircraft which will be used in the flying school do not mix easily with modern jets. The circuit size and circuit and approach speeds are different for the two types. If they have to operate together in the circuit, or on instrument approach procedures, then irritating delays to the transport aircraft will occur. There will also be frequent interruptions in the flight training programme, as priority for take-off and landing will often be given to the jets. Consideration of wake turbulence danger will also cause delays to the school training aircraft.

4.1.4 If, despite these considerations, the decision is made to locate the centre at a major airport, most of the discussion which follows is irrelevant. All such matters as runway size, approach aids and lighting will have been determined by the operating characteristics of the jet aircraft. These facilities will generally be satisfactory, although in some respects far from ideal, for commercial pilot licence training. If the training centre is located at a general aviation aerodrome, the following requirements must be met.

4.2 - AERODROME

4.2.1 Location

4.2.1.1 The aerodrome should not be located within or close to the traffic pattern of any other aerodrome. It should not be far from the airways system and another aerodrome with instrument landing system (ILS) and VHF omnidirectional radio range (VOR) facilities. To reduce positioning time, it should be in or close to an uncontrolled airspace area large enough to allow basic manoeuvring and basic instrument flying training to take place.

4.2.1.2 Problems arise with high ground in the circuit pattern or with mountainous terrain along the cross-country routes and clearly pose complications in respect of safety. It is true that many aerodromes apparently unsuitable in this respect have been used for training with good safety records, but the requirements for flight discipline and careful supervision are even more stringent than normal.

4.2.2 Landing Surfaces

4.2.2.1 Preferably, both paved runways and grass or sand landing areas should be available. Basic training aircraft with inexperienced pilots are severely limited in cross-wind conditions, quite commonly having a 20 km/h (10 kt) limit for solo flying. In many parts of the world, aerodromes with only one or two paved runways will suffer frequent interruptions to the flight training programme because of cross-winds being above limits.

4.2.2.2 All-grass aerodromes, on the other hand, may be virtually unusable in rainy seasons, and do not encourage accuracy in directional control on take-off and landing. This can be avoided by marking out narrow landing areas which, unfortunately, may accentuate surface deterioration and wet weather problems.

4.2.2.3 Ideally, therefore, a grass aerodrome offering a choice of take-off and landing direction, but with one or more paved runways favourably orientated with respect to likely wind conditions, is the best solution.

4.2.3 Runway size

4.2.3.1 Runway length requirements are dictated by aircraft performance, taking into account take-off mass, airfield elevation, and the worst winds and temperatures in which operations are contemplated. The sorts of aircraft used in commercial flying schools do not need very long runways, and a runway length of about 1 200 m, favourably orientated with reference to the prevailing wind, will be adequate, except for the hot and high cases, when a considerable increase may be necessary.

4.2.3.2 Runway width should be in reasonable proportion to runway length, so as to provide correct visual cues on the approach. Considering the now traditional runway proportions of 2 000 m x 50 m or 2 500/3 000 m x 65 m, a general aviation runway 1 200 m long should be 30/35 m wide.

4.2.4 Facilities

4.2.4.1 Approach Aids

There must be at least one instrument approach aid to facilitate operation in instrument meteorological conditions, recovery from airways exercises, etc., otherwise operations will be limited to visual meteorological conditions. It is useful to have ILS, enabling ILS training to take place at any time and permitting recoveries in much lower weather conditions. However, ILS training at base can interfere seriously with visual circuit training so it is desirable to have easy access to ILS at least at one other aerodrome.

4.2.4.2 Lighting

Night flying is an essential part of the training of commercial pilots, so runway lighting must be available. Electric runway lights and visual approach slope indicators (VASI) are necessary. If ILS is installed, approach lighting will be mandatory, and is in any case very desirable on at least the main runway.

4.2.4.3 Air Traffic Control

Much flying training used to take place in a non-radio controlled environment. This can hardly be regarded as acceptable today for commercial pilot training. As an ideal, there should be full active radio control of all flying, so that from the beginning the student becomes familiar with modern air traffic control practice and terminology.

4.2.4.4 Fire and Emergency Services

These are essential and the scale of provision will be as prescribed by State rules. As a minimum guideline, at least one rapid-intervention fire vehicle is required. This vehicle must be continually manned whilst flying is actually taking place, but manning can be combined with refuelling and flight line servicing crews.

4.2.4.5 Fuel

Aviation gasoline (AVGAS) is usually specified for the types of piston-engined aircraft used in commercial pilot training. The supply of AVGAS is becoming progressively more restricted and it is not available at all in some parts of the world. It is always very expensive and may be even more so if uplifted at out-of-the-way aerodromes. Availability and cost of AVGAS is therefore a consideration in choosing the location of a flying training school. Some States have now approved the use of motor spirit (MOGAS) in the less powerful piston engines used in some single-engined aircraft and smaller twin-engined types. MOGAS should always be readily available, but it must be stressed that MOGAS for use in aircraft is subject to more stringent conditions for storage, filtering, water checks, etc., than is the case with motor spirit available at ordinary garages.

4.3 - STUDENT ACCOMMODATION

4.3.1 In this section, and the section which follows relating to ground training and flight operations, advice is given on various aspects of the accommodation required to house all the activities of the aviation training centre. The discussion centres on the ideal requirements but it is recognized that, in practice, use may have to be made of existing buildings adapted to meet the requirements as best may be.

4.3.2 Students are being prepared for a lifelong career in aviation as pilots or maintenance engineers. Many of them may never have been away from home and family; yet after graduation their work may take them anywhere in the world, possibly for long periods. They should be prepared for the change of life style and consequent problems which they may encounter as a result. This suggests that although the students must obviously be carefully supervised in their work, they must be given a considerable degree of freedom and independence in the organization of their leisure time.

4.3.3 The first question to be considered is whether or not the school should be residential. Circumstances are quite different for pilot and engineer trainees. The working arrangements for pilots will certainly include a requirement for early morning flying, night flying and probably some week-end flying. Pilot trainees should, therefore, preferably live at the aerodrome, at least during the main part of the commercial pilot course. Further advantage can be taken of this to arrange evening lectures and synthetic flight training programmes. During any preliminary training phases, such as language training, living out may be appropriate for pilots.

4.3.4 Engineering students are more likely to work during normal hours on a five-day week. They may therefore be allowed to live out if suitable accommodation and transport are available. Opportunities for extra-curricular activities may, however, be more limited. Accommodation is only suitable if there are satisfactory arrangements for private study. All outside accommodation offered should be inspected to ensure that this is the case.

4.3.5 All students will be expected and encouraged to undertake a reasonable amount of private study during their free time, and this will prove less satisfactory if each student does not have a private quiet place to work. For this reason dormitory-type sleeping arrangements in residential blocks are not the most suitable arrangement. Single rooms should, therefore, be provided for all students if possible.

4.3.6 Each room should be big enough to accommodate furnishings as follows:

a) Single bed;

b) Flat top desk (at least 1.2 m x 0.8 m) with reading lamp;

c) Desk chair;

d) Comfortable chair for reading and relaxation;

e) Wardrobe;

f) Drawers in wardrobe or separate chest; and

g) Bookshelf.

It is helpful if washbasins are provided in each room. A minimum room size of 10 m^2 is suggested.

4.3.7 Toilets, baths and showers, may be shared but must of course be provided on a reasonable scale. Laundry facilities (washing and ironing) must be provided unless there is a fast, frequent and cheap laundry service.

4.3.8 Residential blocks must provide for recreational facilities. These need not necessarily be in each block. They should include:

a) Lounge/reception room where visitors may be entertained;

b) Quiet room for reading. Newspapers, magazines and non-technical library should be provided;

c) Games room with games such as billiards and/or table tennis and/or computer games;

d) T.V. room; and

e) Students' bar with soft drinks and food from vending machines; some facilities for providing food outside the normal catering hours are quite essential, and students should not be allowed to cook in their bedrooms.

4.3.9 Some form of night-time supervision at the school is necessary. The ideal solution is to have a warden resident in the accommodation area. If suitable housing is available, instructors and families may be accommodated near the aerodrome and this will be a very satisfactory arrangement. It is important that there be some supervisory presence to handle any problems that may arise, to whom students can turn in the event of an emergency such as illness or accident.

4.3.10 Few schools will be large enough to warrant permanent resident medical facilities. Suitable arrangements must be made for calling out medical attention if required. If skilled nursing is available amongst the residential staff, that would be ideal. One or two bedrooms should be allocated for use as sickrooms, when required.

4.3.11 Associated with the residential accommodation must be some facilities for open air recreation and sports. Very expensive facilities are not essential; such activities as keep-fit classes, jogging and orienteering can be carried out with virtually no equipment. Some facilities for appropriate team games, such as football, cricket, hockey or volleyball, will also be very valuable. Swimming pools and squash and tennis courts are extremely expensive, but if they can be provided they will be much appreciated.

4.4 - CATERING FACILITIES

4.4.1 If all staff and students live out, the catering facilities will be required only for midday meals and morning and afternoon refreshments. If students live on the aerodrome, arrangements will have to be extended to provide breakfast and evening meals, and catering will also be required on week-ends.

4.4.2 Student catering is usually provided in cafeteria-type canteens, supplemented by some form of snack bar. Administration staff and instructors will probably wish to have restaurant-type facilities. It is most undesirable that a barrier be created, segregating students to the cafeteria and staff to the restaurant. If both types of facility are provided, staff and students should be able to use either, paying the appropriate charges, and subject to dress requirements in the restaurant (no dirty overalls, etc.). Some staff members should use the students' canteen every day. This may come about naturally, but, if necessary, some form of rostering should be used.

4.4.3 Catering requires management and trade skills quite different from all others in the operation of an aviation school. Management should appreciate the importance of good quality, attractive food to the morale and well-being of staff and students, and insist on its availability. It may be better and easier to hire the services of a separate, specialist contractor, but however the catering services are provided, high standards must be maintained.

4.5 - GROUND TRAINING ACCOMMODATION

4.5.1 All the following facilities are required to accommodate the ground training of pilots. The requirements for maintenance engineers are detailed in 4.7.

a) Classrooms;

b) Assembly hall and cinema;

c) Management and instructor accommodation;

d) Technical library;

e) Demonstration equipment room;

f) Video room; and

g) Printing and copying room.

To accommodate possibly changed requirements in the future, it would be useful if buildings had large, open interiors with moveable room partitions which can be rearranged.

4.5.2 Classrooms

4.5.2.1 The size of classrooms must be adequate for the number of students in class. Ideally this should be limited to sixteen and certainly should not exceed twenty. Of course, larger groups are acceptable for certain special types of training - films, visiting lecturers, etc.

4.5.2.2 A reasonably sized flat top desk, big enough for plotting and technical drawing (about 1.2 m x 0.8 m) must be provided for each student together with a comfortable upright chair. Lockable drawers should be fitted to each desk or separate lockers should be provided. The instructor needs a similar desk and chair, and a lectern to use when lecturing standing.

4.5.2.3 All classrooms must be fitted with a chalkboard (the green type is preferred to the old style blackboard) and an overhead projector and screen. Provision of a screen with back projection for films and slides is very useful, but expensive and not necessary in all classrooms. Student response systems which enable each student to visually signal an answer to a question posed by the instructor are very valuable teaching devices. The best ones with a full range of indicating and monitoring facilities are expensive and are preferably installed when the classroom is first built and fitted out. Wiring (even empty wiring conduits) for possible future equipment installations is also much less expensive if installed during original building construction.

4.5.2.4 A typical classroom fitted with individual desks for sixteen students should have about 55 m^2 of floor space, which should be increased to about 65 m^2 if classes of twenty are expected.

4.5.2.5 A satisfactory arrangement is to have an adequate number of classrooms of 55 to 65 m^2 to cope with the planned training task, with one or two larger rooms capable of accommodating a double class. These larger rooms could have the student response and back projection facilities.

4.5.2.6 All classrooms must, of course, be well lit and ventilated. Heating and/or air conditioning must be provided as necessary to maintain a satisfactory working temperature. The learning process will be seriously impeded if classrooms are too hot or too cold.

4.5.3 Assembly Hall and Cinema

4.5.3.1 There will always be an occasional requirement for bringing together all the students, or at any rate large sections of the student body, for special purposes such as examinations, special lectures and addresses, prize-giving ceremonies and film shows.

4.5.3.2 The simplest way to meet the need is to have a large hall capable of seating the entire staff and student body. This will, of course, be in rows of seats without desks. With a suitable raised platform together with a microphone system and film projection facility, the hall will meet the needs for film and lecture facilities.

4.5.3.3 The seats should be of the stackable type which will enable some of them to be moved out of the way, allowing desks, also stackable, to be brought in. This will enable the hall to be used as an examination room capable of seating many more students than the standard classroom, which assists with the problem of invigilation. A large hall of this kind may also prove quite valuable for social occasions such as student dances, and for some indoor games.

4.5.3.4 An alternative way of meeting the requirement is to have a theatre with comfortable cinema-type seats without desks. With a platform, screen and projection facilities, this can be used for lectures and films. Examinations will then need to be carried out in the classrooms.

4.5.4 Management and Instructor Accommodation

4.5.4.1 Each instructor must have a place where he can work in reasonable privacy and quiet for such purposes as preparing lectures and setting and marking examinations. He must have a desk for his books and other working material, and a locker for personal possessions. Individual private offices are not necessary, and double or even limited multi-occupation is acceptable provided there is a minimum floor space of about 5 or 6 m^2 per instructor.

4.5.4.2 Management instructors on the other hand, and particularly the Chief Ground Instructor, do need reasonably sized private rooms for private interviews with staff and students. Secretarial accommodation and facilities should be adjacent to the management rooms.

4.5.5 Technical Library

4.5.5.1 A reasonably comprehensive library is needed by instructors and staff. The primary purpose of the library is to provide those textbooks and lecture notes which are absolutely necessary to cover the essential parts of the curriculum. All students should be supplied with individual copies of these items for their personal use and retention. At least one additional master set should be held in the library.

4.5.5.2 The libary should also contain works which supplement, explain and expand on the course material. It will also be helpful and interesting for both staff and students if the library contains other works on related aspects of aviation.

4.5.5.3 The total holding of books need not be very large. There should be some tables and chairs for students to use in the library. In a small school, a room of about 30 m^2 with bookcases on the walls and five or six tables will be adequate. Stocking, supervision and control of issues is a management instructor function, but interested students willing to assist can usually be found. The library should be open for at least one or two evenings per week, in addition to the normal daytime hours.

4.5.6 Demonstration Equipment Room

A room is required in which to locate suitable demonstration equipment to support the lecture programme. Such equipment will include sectioned aircraft components and instruments, working rigs, models and wall diagrams. Instructors may choose to take some of the smaller items to the classroom, but the demonstration room should be large enough for the equipment to be well spaced out so that a full class is able to observe demonstrations.

4.5.7 Video Room

Either a separate room, or one of the larger classrooms especially fitted out, should be equipped for video training. A large-screen television with video tape recorder and player is required. More and more training films previously available only on 16 mm film are now being produced on video tape. The television should have an aerial for the reception of outside broadcasts; not many public programmes are specifically of use in an aviation training programme, but some schools' broadcasts may be very useful in mathematics and language courses.

4.5.8 Printing and Copying Room

The ground training programme will use a surprisingly large amount of internally produced printed paper - lecture notes, exercise and data sheets and examination papers. A small school may manage with a copy typist and a photocopying machine. Larger schools will need a proper printing service, with a word processor, photocopier and possibly even a lithograph printing machine.

4.6 - FLIGHT OPERATIONS CENTRE

4.6.1 General

The purpose of the operations centre is to house support services for the flying training programme. This includes meteorological information, flight planning and in-flight documentation, aircraft and student records, and briefing facilities. The synthetic flight trainer section should also be located here. The accommodations required are as follows:

a) Operations room;

b) Flight planning room;

c) Briefing room and classroom;

d) Crew rooms;

e) Management pilots' and instructors' offices;

f) Records office; and

g) Synthetic flight trainer section.

4.6.2 Operations Room

This should have suitable facilities for control of all flying. Space is required for one or more operations clerks with the necessary telephone links, aircraft serviceability states and technical records, and full flying programme details, which may be either in the form of a computerized print out, or manually listed wall boards.

4.6.3 Flight Planning Room

The room should have provision for storage and display of all information required for making flight plans for cross-country flights, either visual or instrument. This includes maps and charts, in-flight documentation, aeronautical information and meteorological information. Flat-top desks or, preferably, one or more large tables on which maps can be spread and folded are required. There should be easy physical access to, and also telephone links with, operations and ATC. A large-faced clock/chronometer displaying GMT must be provided. Each student in the advanced stage of flying should have his own set of an appropriate flight guide such as Jeppesen which, of course, he must be responsible for keeping up to date.

4.6.4 Briefing Rooms and Classrooms

A number of small briefing rooms should be provided for use by individual instructors and their students. Each room should have a table and four or five chairs, a board on which to draw diagrams and some appropriate simple training aids, such as wall diagrams and a model aircraft with moveable control surfaces. At least one classroom large enough to seat an entire course for group briefings and for use in the weather programme should be available.

4.6.5 Crew Rooms

Some reasonably comfortable rooms with lounge-type chairs and one or two working tables should be available for the use of student pilots who are not actually flying. A loud speaker call system from the operations room is very useful.

4.6.6 Offices for Management Pilots and Instructors

The same arrangement suggested earlier for the ground instructors is quite suitable. The Chief Flying Instructor and flight managers should have private offices but shared offices with individual desks and lockers are satisfactory for the flying instructors.

4.6.7 Records Office

The school must maintain accurate detailed records of flying for each student. These will be compiled from daily flying returns made by the instructors and operations office. In a small school the student's flying record sheet can be made out by the management pilots' secretarial unit. A large school with more than 100 flying students will need a separate records office and clerks.

4.6.8 Synthetic Flight Trainer Section

Accommodation for the machines, staff offices and maintenance workshop should be located in or immediately adjacent to the operations centre. Synthetic flight training should be integrated and standardized with flight training. Also, if possible, flying instructors should assist with synthetic flight instruction to some extent. These arrangements are facilitated if synthetic trainers are located with flight operations.

4.7 - ENGINEERING SCHOOL ACCOMMODATION

4.7.1 Engineering school requirements for classroom, assembly hall, offices, etc., for theoretical training will conform to the pattern described in 4.5.

4.7.2 A quite different range of accommodation is required for the practical training aspects of maintenance engineer training. The success of engineering training depends to a great extent on the quality of practical training.

4.7.3 It is important that the students should work for some part of their practical training on aircraft which are certificated to fly, and which do fly from time to time. This ensures that the disciplines of flight safety practices are inculcated in the students. It is hardly possible to operate a successful engineering school except in association with a flying school or club.

4.7.4 Hangar

All the practical training can be carried out in one or more small general aviation-type hangars with suitable interior partitioning. This type of hangar averages about 50 to 60 m x 25 to 30 m plan area, with a working height of 6 or 7 m. One hangar of this size will house the basic maintenance training, workshops, stores and offices for a school of 100 engineering trainees (of whom only about 40 per cent will be engaged in practical training at any one time). The hangar must be heated to a comfortable working temperature and have the usual electrical, water and compressed air services.

4.7.5 Basic Workshop

4.7.5.1 Practical training will not be done on aircraft in the early stages of the course. Students have to be taught the care and use of hand tools and simple machine tools (basic workshop practice). The requirement is for a workshop area with bench, vice and set of appropriate hand tools for each student, and a range of simple machine tools, such as lathe, drill and grinder. A chalkboard is also necessary.

4.7.5.2 The workshop can be located either in the classroom building or in the hangar. There are advantages and disadvantages either way. It may be advantageous to integrate the first stage of practical training with theoretical training in the classroom area. This may, however, cause some noise problems. Training in basic workshop practice will be given by practical instructors who will be involved in other stages, such as aircraft maintenance, in the hangar area. On balance, therefore, the basic workshop is best located in the training hangar.

4.7.6 Specialist Maintenance Bays

Appropriately equipped bays or shops for specialized maintenance purposes are necessary. These will include engine strip and overhaul, wheels and tires, skin and structure repair (including fabric if still required), hydraulics and pneumatics, and battery servicing and charging. Completely separate enclosed avionics, electric, and instrument workshops are necessary where these additional licence courses are provided.

4.7.7 Management and Supervisory Offices

Offices for the manager, supervisors and instructors must be built into the hangar. Preferably they will be elevated along one of the long walls, or they can be placed as a divider between the aircraft maintenance and workshop areas. They should have large windows, so that instructors in their offices can observe activities in the hangar, and have good sound insulation to maintain reasonable quiet for normal conversation.

4.7.8 Stores

Work done in practical training will require a lot of support in components, special tools and consumables (paper, polishes, oils, etc.). An efficient stores system is necessary and will be mandatory for the flyable aircraft. Both 'bonded' and 'quarantine' stores for aircraft components are necessary. Different terms may be used in some States. In this manual they are used as follows:

a) Bonded Store. Aircraft and engine components which have been checked and verified as being fit and serviceable for installation in aircraft.

b) Quarantine Store. Newly delivered components not yet checked for proper part number, etc., and not verified for installation. Separate stores for special tools and consumables will also be required.

4.7.9 Students' Tool Kits

Proper care and maintenance of tools and pride in possession of an appropriate tool kit are important elements in engineering training. Whether tool kits are purchased by students or issued as part of the course equipment, kits could be complete at the start of practical training or built up as needed; these are matters for local decision. It is not a particularly good idea that the tool kit should be on loan to be returned at the end of training. It is far better that it should be for the student's permanent retention, encouraging him to care for and add to the kit as necessary.

4.7.10 Other Facilities

Lockers for all staff and students are essential. All personnel must have suitable protective clothing, with arrangements for issue, cleaning, repair and replacement as necessary. The best modern practices in respect of health and safety at work should be followed. If first aid and nursing facilities are available in the school, that will be a great advantage. A comprehensive first aid kit should be available in the hangar, and some of the instructors should have completed basic first aid training.

CHAPTER 5

TRAINING EQUIPMENT

5.1 - AIRCRAFT TYPES

Even the smallest aircraft, be they aeroplanes or helicopters, are expensive to buy and operate; in the interests of keeping initial investment and subsequent running costs to a minimum, the basic ab initio aircraft should be as small and light and low-powered as is compatible with the training of professional pilots.

5.2 - BASIC STAGE TRAINING AEROPLANES

5.2.1 The following comprehensive table lists the requirements for the ideal ab initio trainer. It is doubtful if an aeroplane meeting all these requirements is available, and some degree of compromise will be necessary.

a) Conventional control system with good handling qualities. Primary control (including brakes) must be duplicated;

b) An engine of at least 100 horsepower (h.p.) with conventional engine handling;

c) Cruise speed of at least 100 kt true airspeed (TAS), with two crew and full fuel, to make reasonable cross-country distances in reasonable time;

d) Fuel for at least three hours' flight with two crew;

e) Air/ground/air communication, intercom and ADF or VOR or both;

f) Instrumentation and equipment for instrument flying and night flying, with suitable screens and blanking arrangements for basic and limited panel instrument flight;

g) Strong structure and hard-wearing furnishings, easy to maintain; and

h) Ability to carry a third person (observer, examiner or second student).

5.2.2 These requirements show that what are now called micro-light aircraft are not suitable for professional pilot training, being far too slow and inadequately equipped. This applies equally to motorized or self-launching gliders.

5.2.3 Aeroplanes such as the Piper Tomahawk and Cessna 150 have proven successful in this role, although lacking the ability to carry a third person (observer, examiner, or second student). These types are at the lower range of the suitable size and speed range and, if they are used, a heavier, faster and more comprehensively equipped single-engined aeroplane, such as the Cessna 172 or Piper Warrior or Arrow, should be used in the latter stages. If one type is to be used all through, it should be similar to these latter types.

5.3 - TWIN-ENGINED AEROPLANES

5.3.1 Twin-engined aeroplanes are used in the advanced stage of flight training, to teach:

a) Handling of multi-engined aeroplanes, including asymmetric power situations;

b) Applied (procedural) instrument flying;

c) Radio navigation; and

d) Introduction to systems handling and, possibly, two-crew operation.

5.3.2 The requirements of the twin-engined aeroplane are as follows:

a) Good handling qualities in normal operations and with one engine inoperative;

b) Good instrument platform;

c) Comprehensive flight instruments and radios, suitable for operation on airways and into international airports;

d) Retractable undercarriage;

e) Simple electric system and simple hydraulic system, when installed;

f) Airways cruise speed of at least 150 kt TAS;

g) Airframe, engine and propeller icing protection if needed; and

h) Minimum of four hours endurance at economical cruise speed, carrying three crew.

Several suitable aircraft are available from major aircraft manufacturers.

5.3.3 In some schools, instrument rating training may be done on an advanced type of single-engined aeroplane, rather than on a twin-engined aeroplane. If this procedure is followed, the advanced single-engined aeroplane should conform to the requirements set out above except, of course, in respect of teaching multi-engined and asymmetric handling.

5.3.4 Standardization between all aeroplanes of each particular type should be sought. A different layout may be appropriate in the different fleets, but it is not satisfactory for example to have different flight instrument layouts in individual aeroplanes in the twin-engined fleet.

5.4 - HELICOPTERS

5.4.1 All rotary aircraft used in a helicopter school will be single-engined. The chief consideration is whether to use piston or turbine-powered helicopters, or both. Small turbine-powered helicopters are more reliable than the piston-engined types, and are probably easier to fly, although some turbine types have engine handling characteristics, particularly on start-up, which are not suitable for the novice pilot.

5.4.2 Taking into account initial investment and operating costs, the best compromise is to start helicopter training on a basic piston-engined helicopter (e.g. Enstrom F 28, Hughes 300, or similar) making a transition to a turbine type for the advanced stage. Helicopter pilot training may begin with a short introductory flying training course on fixed-wing aircraft. The comparative merits of this approach are discussed in the syllabus chapter.

5.5 - NUMBER OF AIRCRAFT REQUIRED

5.5.1 Careful consideration has to be given to many factors in making this calculation, although the basic equation is simple. Planned flying hours required for each type will be derived from the training plan. Dividing by the annual utilization per aircraft gives the number of aircraft required. If there are not enough aircraft available, delays in the training programme will occur, but it is probably better to have one aircraft too few rather than one too many, which is a needless expense. With one too few, operations, maintenance, instructors and students are kept on their toes making the best use of the aircraft and every minute of available flight time in suitable weather. The following points must be taken into account in estimating the forecast annual utilization:

a) Basic type serviceability. This depends on serviceability of engine and aircraft components, and on the maintenance schedule (frequency and duration of minor and major inspections, and major overhauls).

b) Engineering effort. Level of maintenance capability, working arrangements of the maintenance departments, and availability of flight line servicing to provide rapid rectification of minor defects. If minor maintenance can be done when the school is not flying, at night or on days off, this will improve flight utilization.

c) Spares availability. The amount of time lost through technical defects and routine maintenance is greatly affected by the spares position. Determination of the proper level of spares provisioning is a skilled engineering task, but a good holding of problem components is essential. There must also be rapid support and supply from aircraft, engine, radio and instrument manufacturers, and availability of support facilities should be taken into account when making a choice of aircraft types.

d) School working arrangements. Daily, weekly and annual patterns of work have a considerable effect on utilization. Closing for a long vacation each year during which no flying is done is clearly less productive than flying on a year-round basis, with a staggered holiday schedule. Similarly, flying may take place five days each week or on six or seven days each week with solo flying programmes at the week-ends. Instructors and students must be limited to an eight-hour day to avoid fatigue; this may, in fact, be a matter of State regulation. Utilization will be improved if hours of operation are staggered or a double shift system is used to take advantage of all the available hours of daylight.

e) Weather. Ab initio training is particularly susceptible to interruption by weather. Poor visibility, low cloud base, excessive turbulence and strong winds will all stop solo flying and may severely curtail useful dual flying. Local meteorological offices should be able to provide statistical records which will help to predict an average weather factor. Seasonal weather effects must be taken into account.

5.5.2 Pilots working in major airlines which operate 24 hours a day, 365 days per year, with the best possible engineering back-up are often surprised at the low utilization achieved on basic training aircraft. The following hypothetical case is an example of the calculations necessary to estimate the number of aircraft required at a flying school.

5.5.2.1 The training plan in a pilot training school requires completion of 12 000 hours of single-engined flying per annum. The flying is to be spread out equally over the year in three terms of fifteen weeks each, with short holidays at Christmas and in the Spring, and a four-week vacation in the summer intervening. Weather is very good in the summer, but frequent interruptions in the autumn and winter terms are expected. The school plans to operate eight hours per day over a five-day week with no week-end flying. Only 5 per cent of the flying will be at night, so it is decided to ignore this in the calculation. Although these figures will vary for different aircraft types, we will assume that each aircraft needs annually one major overhaul which will take about twenty-one working days, and ten minor and intermediate checks for which a further fifteen days must be allowed, for a total of thirty-six days per year for scheduled maintenance. This equates to a loss of twelve days per term for scheduled maintenance. Engineering work will not be carried out at week-ends or during school holidays. Unscheduled maintenance for rectification of defects, aircraft fuelling and between-flight inspections, is estimated at forty-five minutes per day. It is also assumed that a further thirty minutes per day must be allowed for administrative delays such as late starts.

5.5.2.2 The weather problem can be included in the calculation by estimating the percentage of working hours each day which will be suitable for flying training, either dual or solo. This may be done empirically, based on the knowledge of instructors with local experience, or statistically by calling on the resources of the local meteorological service. For this hypothetical example assume that the percentage is 70 per cent for the autumn and winter terms, and 100 per cent for the summer term.

5.5.2.3 With the above basic information available, the calculations can now be made. In these calculations, since the training centre must have aircraft available in numbers sufficient to meet the worst-case requirements, the 70 per cent weather factor which was assumed for the autumn and winter terms has been used throughout.

a) Each aircraft will be available, on average, per term:

15 weeks @ 5 days per week = 75 days

75 days - 12 days (scheduled maintenance) = $\boxed{\text{63 days}}$

b) Each aircraft can be flown, on average, a maximum per day of:

8 hours
-0.75 (unscheduled maintenance etc.)
-0.50 (administrative delays)
=6.75 hours

6.75 hours x 0.7 (weather factor) = $\boxed{\text{4.7 hours per day}}$

c) The expected utilization per term, therefore, will be:

63 days x 4.7 hours per day per aircraft = $\boxed{\text{296 hours per aircraft}}$

d) The number of aircraft required to accomplish the 4 000 hours planned for the term (12 000 hours per year of three terms) will be:

4 000 hours ÷ 296 hours per aircraft = $\boxed{\text{13.5 aircraft}}$

A decision must now be made. Can the flying task of 12 000 hours per year be achieved with 13 aircraft only, or will it be necessary to have 14 available?

5.5.2.4 If it is decided to use 13 aircraft, it will be necessary to achieve approximately 308 hours per aircraft per term (4 000 ÷ 13) as against the calculated figure of 296. However, if it is decided to have 14 aircraft, then the required utilization would drop to about 286 (4 000 ÷ 14), which would seem to be wasteful. Because it was decided to use the weather factor of 70 per cent (the autumn and winter terms) throughout the calculation, it may be safe to assume that, even with the four-week planned holiday, the better weather during the summer could create some spare capacity which would make up for any shortfalls in the flying programme in the autumn and winter terms.

5.5.2.5 On this basis, it might be a reasonable decision to opt for 13 aircraft to meet the flying training task of 12 000 hours per year. This will require an annual utilization rate of 923 hours. If this decision is taken, it will be necessary for the supervisory staff to ensure that unscheduled administrative delays are kept to a minimum, and certainly below the 30 minutes built into the calculations. It should be noted that when making these calculations for a much smaller flying task which will therefore require fewer aircraft, the decision process described above should always err on the pessimistic side.

5.5.2.6 An annual utilization rate of between 750 and 1 000 hours is quite typical of what can actually be achieved in temperate zones, although schools in areas with year-round good weather can do better. Similar utilization should be achieved by twin-engined aeroplanes and all turbine-powered aircraft. Piston-engined helicopters do not have the same levels of serviceability and will be off-line for longer periods for both scheduled and unscheduled maintenance. In a helicopter, a piston engine usually operates higher up in the power range and, as a result, the time interval between engine overhauls is only about 50 per cent of that for the identical engine installed in a fixed-wing aircraft. Additional maintenance is also needed for the complicated power transmission systems and the rotor head. Basic piston-engined training helicopters should not be expected to exceed annual utilization of 500 to 600 hours.

5.6 - ADDITIONAL AIRCRAFT REQUIRED FOR ENGINEER TRAINING

5.6.1 If student engineers work on flying school aircraft, down-time for maintenance will increase considerably. Checks, inspections and defect rectification will all take much longer. Friction between flying school and engineering school instructors can easily develop if aircraft needed for the flying programme, and which could quickly be made serviceable, are kept back for maintenance training.

5.6.2 For this reason, although integration of engineering school and flying school aircraft is desirable, it is best done in the form of temporary detachments of three or four months at a time. This practice will, of course, mean extra aircraft in addition to those required by the above calculation. Two singles and one twin should be adequate for an engineering school of about 100 students of whom about twenty-five will be engaged in practical aircraft maintenance training at any one time.

5.6.3 Additional non-flyable aircraft are required for the engineering students. These need not be of the same standard or type of equipment as the flying school fleet. At least one of them should be of a reasonably modern sophisticated type: pressurized airframe, turbine-powered with modern electric, hydraulic, and avionics systems. This aircraft need not fly, but should be ground operational: i.e., engines and systems capable of being run.

5.7 - SYNTHETIC FLIGHT TRAINERS

5.7.1 Synthetic flight training should be, and almost certainly will be, a requirement in the curricula of approved pilot training schools. One or more of the basic instrument flight trainers will meet the requirements in a small school. A larger school with more than 100 pilot trainees should also have a more sophisticated twin-engined trainer.

5.7.2 The basic instrument flight trainers need not be modelled on school aircraft and expensive modifications should not be carried out in an attempt to duplicate appearance and control layout. However, to ensure standardization of instrument procedures and scan, they must have the same instrument panel layout. The simulated flight performance of the trainers is usually adjustable so that reasonable approximations of power settings, attitudes and speeds can be achieved.

5.7.3 The development and application of micro-processors and micro-computers is rapidly encouraging design of a new generation of basic instrument flight trainers which will have some of the advantages of the digital flight simulators now extensively used in the airlines, such as more faithful reproduction of aircraft characteristics and handling, stability of performance, and reliability. It seems unlikely that these developments will lead to availability at reasonable cost of machines which will permit substitution to any substantial extent for actual aircraft training in visual manoeuvres.

5.7.4 A really good visual system, permitting training in circuits and landings and other visual exercises would be necessary to accomplish this. Unfortunately such a system would cost more than a basic training aircraft and there seems little prospect of any improvement in this respect. In any case, the problem of visual navigation training seems insurmountable. There is no advantage in motion systems at this stage. Motion systems may cause more false cues than good, unless they are extremely sophisticated with four or six axes and are very precisely controlled.

5.7.5 If a twin-engined synthetic trainer is employed, it should be reasonably representative of the school aircraft. It must have the same instrument panel and radio equipment to facilitate parallel training in controlled airspace and instrument approach procedures. If the engine operation and instrumentation systems and controls are well simulated, then such a trainer will be very useful in the type conversion process at the start of the advanced stage of training. Ability to operate with a two-pilot crew will also be very useful. Motion and visual systems are not necessary and will prove a needless expense.

5.7.6 Trainer utilization can be expected to be fairly high. Serviceability should be good, training can be done in the evenings and there is no weather problem. Serviceability does, of course, depend on adequate maintenance effort and spares provisioning. Environment is also very important and trainers can only be expected to function well in a reasonable atmosphere, free of dirt and dust, with humidity and temperature properly controlled. Given good facilities and good integration and programming, annual utilization of 1 500 hours per trainer should be achieved.

5.8 - ELECTRIC POWER SUPPLIES

5.8.1 Electricity supplies may be subject to interruption anywhere in the world. In many places this may be owing to maintenance problems and a shortage of generating capacity; other countries may suffer from transmission problems caused by snow and high winds.

5.8.2 Even without electricity, much of the work of the centre can continue, using natural light in classrooms and hangars. Electricity is essential for air traffic control communications and navigation aids, and for runway lighting (unless paraffin flares are used as a standby). Synthetic flight trainers and some other training aids, such as projectors, will not operate without electricity.

5.8.3 If it is decided that interruptions to the training programme are not acceptable, standby generators of adequate capacity will be required at strategic locations. If it is decided to accept the risk of interruption to ground training, standby facilites can be limited to the minimum necessary to ensure safe recovery and landing of aircraft airborne at the time when power supplies are cut off.

5.9 - TRAINING AIDS

5.9.1 The term 'Training Aids' comprises the books and other devices which support and supplement the work of instructors in carrying out their tasks.

5.9.2 Text Books and Lecture Notes

Everything that a student needs to know to complete the course satisfactorily should be available to him in writing in one form or another. Textbooks may be available which cover some, or even a large part, of the material which is needed. Very rarely, however, will the examination syllabi, prescribed by the State authority, reflect exactly the contents of particular books. Instructors should, therefore, be expected to prepare written lecture notes to supplement prescribed textbooks. The school should reproduce these in a reasonably permanent format. Students should have personal copies of textbooks and these supplementary lecture notes.

5.9.3 Audio Visual Aids

5.9.3.1 Much of what is heard in a single lecture or gleaned from a single reading, will be forgotten. Retention of the material will be improved if it is presented to the student in an interesting way. Audio visual aids, including films, video tapes, slide/tape presentations, models and wall diagrams, make this possible.

5.9.3.2 Many useful films are available from ICAO (see the current edition Catalogue of ICAO Audio Visual Aids) and from manufacturers of aircraft, engines and components. Increasingly, these are also being made available on video tapes for reproduction on a television screen. A library of films and tapes which students can see, possibly more than once, should be available. Weather which is too bad for flying offers an opportunity for showing films or video tapes.

5.9.3.3 Instructors should be encouraged to put suitable sections of their lectures into the form of tape recordings, illustrated by slide projections. Students can then see these from time to time, even when the instructor is not present. The more different ways in which a piece of information can be presented to a student, the greater will be his retention of that information.

5.9.4 Teaching Machines and Computer-assisted Teaching

5.9.4.1 These are related systems, both of which have been developed as natural extensions of programmed instruction. Programmed instruction was originally conceived to provide a means of reinforcing lessons taught in the classroom. It gave students an opportunity to test themselves on selected subject matter. It did this by presenting, in changing sequence depending on the student response, instruction, information, examples, questions and answers.

5.9.4.2 Programmed instruction is used extensively in airline and major training institutions for aircraft type-transition courses, but some important limitations exist and the management of a centre must be aware of advantages as well as disadvantages of this technique.

a) Among the advantages are:

- Setting a programmed instruction subject requires a careful task analysis which usually leads to a good course and good standardization.

- Instructors are freed from repetitive teaching tasks. The time can be used to give more individual support to students. The productivity of each instructor is also increased.

- It is economically possible to handle small groups of students. This offers more flexibility in programming.

b) Among the disadvantages are:

- A considerable amount of time and money is needed to build and keep updated a programmed instruction course. A widely accepted figure is that 100 hours of preparation are required for one hour of classroom material.

- A programme is designed for people with a similar level of knowledge; students who don't fall into this category face great difficulties.

- It is sometimes difficult to keep motivated students working alone with a machine.

- To run a programmed instruction course, expensive equipment is needed at each working position in the classroom. This can be either a teaching machine or a computer.

5.9.4.3 A teaching machine is a sophisticated device using slides and recorded tapes linked together by a logic unit. The machines are expensive and are of questionable value in an ab initio programme. Computers tend to surpass teaching machines, but this technique is not yet mature either from a hardware standpoint (low cost computers are unable to provide good pictures), or in the development of software (no language for computer-assisted teaching has yet emerged as a standard). Although computer-assisted teaching has great potential for the future, this form of programmed instruction cannot be recommended for an ab initio centre at least as long as no standard programmes (software and hardware) are available for a significant part of ground instruction.

5.9.4.4 Notwithstanding this, one or more micro-computers would certainly be an asset. They could be used to introduce students and instructors to the principles of the digital computer which plays an increasingly large part in air transport operations. The computers could be used to supplement teaching of basic subjects such as English and mathematics. Some instructors might become sufficiently interested to produce their own programmes of some sections of the syllabus. A micro-computer might also prove of use in day-to-day operations of the school in planning flying and lecture programmes and for some forms of records.

CHAPTER 6

STAFF

6.1 - GROUND INSTRUCTIONAL STAFF

6.1.1 Ground instruction in the classroom is a most difficult and demanding task. (See ICAO Training Manual, Doc 7192 - AN/857, Part A-1, General Considerations, Chapter 4, for a discussion of the problems.) Poor instructors will soon dissipate the initial enthusiasm of their students, and apathetic, disinterested students will not achieve the standards required.

6.1.2 Chief Ground Instructor (CGI)

6.1.2.1 Selection, training and motivation of the ground instructional team is primarily the responsibility of the CGI. He will also be responsible for all other ground school management tasks, such as preparation of the overall syllabus, instructor and lecture programming, lecture note production, and student records and reports. He should be a person of great experience in aviation, particularly in training and management.

6.1.2.2 The CGI will have little time for actual lecturing but should endeavour to do some. It will be very useful if he regularly gives one or two selected lectures, in any subject of his choice, to each and every course as it enters the school. As well as observing the ability of some individual students and the average level of ability, it will give him an insight into that curious factor which is often of major significance in the level of success achieved - the attitude and spirit of the class as a group.

6.1.3 Other Management Instructors

6.1.3.1 Only in very small schools, with just two or three classes in ground school at any one time, will the CGI be able to carry out all the management functions. In larger schools, assistant managers should be appointed as necessary and given responsibility for specific tasks. The most obvious tasks to be delegated are services (library, printing, copying, and equipment) and programming. Programming is a surprisingly complicated task in a large school, requiring great skill to avoid waste of instructor resources.

6.1.3.2 In very large schools where several instructors are required to participate in lecturing on the same subject, heads of departments may also be required. The responsibility of a department head is to ensure commonality of lesson plans and instructional techniques and procedures, and standardization of examination marking and student assessment.

6.1.3.3 Management instructors in both of these categories should be expected to participate in the lecture programme to a substantial extent - 50 per cent or so of the norm.

6.1.4 Ground Instructors

6.1.4.1 Although ground instructors do not require current licences, they should have had extensive experience in aviation, as pilot or navigator or engineer, as is appropriate. Most importantly, they must have been trained to teach. In some countries a teaching certificate, or approval by the State authority, will be required before a ground instructor may teach at an 'approved' school.

6.1.4.2 Qualifications and experience by themselves do not guarantee the required standards. Instructor selection must be done most carefully. The selection process should include tests of knowledge in the appropriate technical field and of instructional skill, and also include an assessment of intelligence, disposition, personality and enthusiasm. It has to be borne in mind that there will probably be very few, if any, promotion prospects for the ground instructors, so that maintenance of enthusiasm for the work over a period of many years requires special qualities of dedication and a very disciplined approach.

6.1.4.3 The subjects to be taught in class in an aviation school may be grouped into three categories.

a) Educational subjects - English language (technical), mathematics, elementary sciences;

b) Technical theory, not specific to aviation - magnetism, electrics, principles of mapping, radio and radar principles, meteorology, mechanical principles and structures; and

c) Specialist aviation subjects - aviation law, flight rules and procedures, navigation, flight planning, aircraft performance, principles of flight, aircraft instruments, aircraft structures, propulsion units and avionics.

6.1.4.4 Few people can have the knowledge, experience, qualifications and ability to teach over the whole range of topics, even to the comparatively modest level of the basic licences. Some degree of specialization amongst the instructors is inevitable.

6.1.4.5 School management should, however, be careful not to employ ground instructors on the basis of excessively rigid subject specialization; for example, meteorology instructors who will not accept work in other subjects. Given adequate time for study and subject and lesson preparation, all instructors should be able to work in alternative fields at least in the elementary stages. This point is made because, from consideration of the above list, it is evident that without some degree of flexibility even the smallest school would require a great many instructors.

6.1.5 Ground Instructor Utilization

6.1.5.1 A ground instructor cannot spend all his time in the classroom, lecturing and supervising students. A proportion of the working hours must be used in such other tasks as lecture preparation, setting and marking examinations, writing reports and assessments, and student counselling.

6.1.5.2 The ICAO Training Manual, Part A-1, Chapter 4, recommends that, as an ideal, the weekly total of hours spent lecturing not exceed fourteen. This figure can be used for the long-term assessment of instructor requirements, but for syllabus planning purposes, experience suggests that a weekly load of seventeen to eighteen hours is acceptable. This should not necessarily be regarded as the week-by-week figure, otherwise the instructor's enthusiasm - and therefore effectiveness - may suffer. Instructors can accept even higher workloads than this for short periods, to cope with programming peaks, or when standing in for other absent instructors. They should, however, never be expected to lecture for more than four and one half hours in any one day, or for more than about twenty hours in any one week.

6.1.5.3 Provided that classroom instructors who are able to teach a reasonably wide range of subjects have been selected, and that working practices allow for satisfactory flexibility in respect of workload, calculation of the number of instructors required is a fairly simple matter. The factors to be taken into account are planned syllabus hours, number of courses, the integration programme and expected instructor utilization. Allowance should be made for the contribution of the management instructors.

6.1.6 Ground Instructors for Practical Work (Engineering)

6.1.6.1 The student contact hours of the practical instructors can be expected to be somewhat higher, less time being required for lesson preparation and examination setting and marking. About twenty-five to thirty hours per instructor per week should be achievable.

6.1.6.2 The work of the practical instructor is normally thought of as being less demanding than that of the classroom instructor. It is less stressful in that work is done with smaller groups of students, and there is less difficulty in keeping their attention. However, it remains true that the engineering school is training licensed engineers, who in their working lives will be essentially practical men; therefore, it is of great importance that the highest standards of practical instruction be maintained. The standards of professional or trade skill amongst the practical instructors must also be maintained at the highest possible level. All the instructors should have some training in teaching and lecturing techniques, report writing, and examination and assessment methods.

6.2 - FLYING INSTRUCTIONAL STAFF

6.2.1 To the student pilots in a flying training school, the flying instructors are a pre-eminent group. The personal and operating examples which the instructors set and the quality of the instruction they impart are key factors in determining the standards achieved by the school.

6.2.2 All flying instructors, including the Chief Flying Instructor and other management pilots must hold the minimum qualifications of commercial pilot licence, instrument rating, flight instructor rating and the necessary type ratings for the school aircraft. Ideally, all instructors should be rated for all school types to provide maximum flexibility. The use of some instructors in the basic phase who do not have multi-engine and/or instrument ratings may be legally permissible but cannot be recommended. The basic phase instructors should have a full understanding of the training demands which face the student entering the advanced phase. Many instructors may hold airline transport pilot licences although this is not essential.

6.2.3 Chief Flying Instructor (CFI)

6.2.3.1 The influence of the CFI on the flying standards achieved is paramount. Maintenance of morale amongst staff and students is vital and is a major factor in safety, as well as in standards and productivity. It is the CFI who most directly affects morale through his own personal leadership, motivation, effort and skill. Careful consideration must be given to making this appointment.

6.2.3.2 The CFI must participate extensively in the flying training programme, not with students of his own, but in sampling and testing of students, and also in instructor selection and training. He must, therefore, have a current pilot's licence with all appropriate ratings. Except perhaps for short periods of unfitness, this rule should be rigorously enforced, even though, unfortunately, it might mean that a CFI has to relinquish his appointment if he loses his licence on medical grounds.

6.2.4 Management Pilots

6.2.4.1 Only in very small schools could the CFI manage a complete flying programme and do enough flying himself. In a larger school he will require management assistance from selected senior flying instructors. The organization will depend on the number of flying students and the hours to be achieved. The total pilot management task must be analyzed, and appropriate sections delegated.

6.2.4.2 One way to do this is to appoint separate managers for each phase, basic and advanced. (If two types of single-engined aircraft are used, an intermediate manager should be appointed, as well.) Flight managers should usually have two or three students, but should also carry out sampling and progress tests on other students. They will be responsible for records and assessments of students in their flights.

6.2.4.3 Consideration should be given to the appointment of a Flight Standards Manager. He would be responsible directly to the CFI for the standards of flying instruction, and his duties would include instructor refresher training and competency testing, supervision of the student progress test programme, and preparation of flying syllabus guidance material. He should also be charged with ensuring standardization of the synthetic flight training section.

6.2.5 Flying Instructors

6.2.5.1 The core of instructors in an established school should be very experienced. A minimum of 1 200 hours total flying time, including 600 hours instructing, is suggested as a criterion for the appointment of full instructors. Only pilots with previous experience in another school, or in military or airline service, can meet this requirement.

6.2.5.2 Schools should appreciate the need for adding to the pool of available instructors and should be prepared to train a small number of new instructors in-house. These can be selected from pilots holding a commercial pilot licence and instrument rating (CPL/IR), but with less flying experience than suggested above. Newly qualified graduates of the school itself who show a particular bent for, or interest in, instructing might be considered. There are several advantages to this, not the least of which is a clear demonstration to the students of the high quality of the graduates from the school.

6.2.5.3 After a suitable flight instructor course, such pilots can be employed as junior instructors. Some States have an official rating of "Assistant Instructor," corresponding to this. Such instructors should be used only in the basic phase, and should be supervised by a full instructor until they have the minimum instructional hours referred to above. They should not be authorized to send students solo. The number of junior instructors should not exceed 25 per cent of the total flying instructor strength. If this method is adopted, it is essential to ensure that these instructors are qualified in accordance with Annex 1, and have been issued with an instructor rating.

6.2.6 Utilization of Flying Instructors

6.2.6.1 A typical CPL/IR and multi-engined course includes about 230 to 250 hours of flying. The present Annex 1 standard requires 150 hours of pilot-in-command time, so that the hours of dual instruction will be about 80 to 100 hours; i.e., approximately 35 to 40 per cent of the total. Some States accept flying as pilot-in-command under supervision towards the command requirement. This increases the proportion of flying in which instructors participate to approximately 50 per cent.

6.2.6.2 A flying instructor's task also involves briefing, supervision of solo flying, debriefing and maintenance of records. At least half of an instructor's working hours will be spent on these activities. Allowing also for serviceability and weather problems, twelve to fifteen hours of flying per week is a reasonable target. Allowing for holidays, this equates to about 500 to 600 hours per year. One instructor is, therefore, required for every four to six students on the flying course.

6.2.7 Selection of Flying Instructors

6.2.7.1 The supply of experienced, fully qualified and enthusiastic flying instructors for an *ab initio* flying training school is often inadequate. It is just at the time when the school is being established that the local airlines may also be most actively recruiting pilots.

6.2.7.2 Military and general aviation pilots with training experience may be attracted to the airlines by congenial working conditions, better pay and the opportunity to fly modern sophisticated jet aircraft. Use may be made of ex-patriate pilots, airline pilots retiring at age 55 or 60 years (but with previous flight training experience) and newly qualified junior instructors, to overcome this problem. Minimum standards of technical knowledge and flying and instructional skill must be maintained. A flight test of instructional as well as flying skill, conducted by either the CFI or the Flight Standards Manager should always be included in the selection process.

6.2.8 Synthetic Flight Trainer Instructors

6.2.8.1 An absolutely essential element in operation of the synthetic trainers is maintenance of standardization in the system of instrument flight techniques and procedures as taught by flying instructors and synthetic flight trainer instructors. It has proved all too easy, in both airlines and flying schools, for the teaching of different techniques and procedures to occur. If this is allowed to happen, students will inevitably lose confidence in the value of synthetic training.

6.2.8.2 It would be ideal for flying instructors to do some, if not all, of the trainer instruction with their own students. Unfortunately, because of programming problems, as well as a shortage of flying instructors, this is rarely achieved in practice, and a separate group of grounded or retired pilots is usually used. Standardization must still be maintained, and this is the responsibility of the CFI or Flight Standards Manager. Flight trainer instructors should fly as observers on appropriate exercises whenever possible.

6.2.8.3 To assist in standardization, the same flight study guide, manuals, and airways and approach charts should be used on both aircraft and trainers. Common exercise numbers should be used.

6.3 - STAFF FLEXIBILITY AND INTERCHANGEABILITY

6.3.1 Staff flexibility and inter-departmental co-operation are essential to smooth and efficient operation of the school. All staff members should be prepared to carry out any task within their capacity and qualifications, regardless of the particular role for which they were engaged.

6.3.2 Flying instructors can do some ground lectures, aircraft maintenance engineers can do vehicle maintenance, air traffic controllers can do the work of operations and flight planning officers. This is not meant to suggest that all instructors can undertake another job or that they are always interchangeable. It is, however, important that artificial lines of demarcation and job specialization are not allowed to become established.

6.4 - REFRESHER TRAINING AND COMPETENCY TESTING OF INSTRUCTORS

6.4.1 If they are properly selected and trained in the first place, and in regular practice, the continued competence of professional persons ought to be assured. For pilots and other technical flight crew members the search for safety has led to the adoption of a system of periodic tests of operational skill. These tests now usually include an element of refresher training.

6.4.2 Flying instructors will necessarily be required to undergo these tests to maintain the validity of their pilot licences and ratings. This will ensure that their own personal flying skills are satisfactory. There remains the matter of the ability to instruct. This will have been tested when they qualified for their flight instructor ratings. But if an instructor develops the habit of teaching poor or incorrect procedures, the safety of his students will be at risk. Standards must be maintained and the only reliable way to ensure this is to conduct regular tests of competence.

6.4.3 Some States prescribe these in legislation, some do not. The tests may be required at twelve or twenty-four month intervals. The latter seems to have proved satisfactory in practice and may be adopted unless the State specifies the shorter interval.

6.4.4 The argument concerning instructing ability also applies to classroom and synthetic trainer instructors. Their influence on flight safety is not quite so direct but is of very great importance, so that their instructing abilities should be tested in the same way as the flight instructors'.

6.4.5 It is the Chief Instructor's responsibility to specify the frequency and nature of the tests. They should be carried out by the CFI or CGI as appropriate, or in larger schools they may be delegated to nominated management instructors.

6.4.6 The tests should always include an element of refresher training and should be designed in such a way that the instructors do not come to regard them as a trap. The tests should include:

a) Observation of at least one period of briefing or classroom lecturing;

b) Observation of one period of flying or flight trainer instruction for these categories of instructor;

c) Review of technical knowledge in the appropriate field; and

d) Review of students' results achieved during the preceding period.

CHAPTER 7

COURSE DESIGN

7.1 - GENERAL

7.1.1 Course design is defined as the complete specification of those activities which have to be followed in order to achieve the required graduation standard. It includes the programmed sequence of curricular and extra-curricular activities, progress tests, final examinations, graduation and licensing requirements, and also vacations.

7.1.2 The first step in designing a course is to define the major training objectives. In summary, these are to equip successful students with the knowledge, skills, experience, professional attitudes and qualifications which they need in order to embark on the next step in their career, which may be, and often will be, a further course of training.

7.1.3 To do this in the necessary detail for pilot or maintenance engineer requires the difficult and complicated exercise of doing a complete task and behavioural analysis. Fortunately, much of this has already been done by international and State authorities when drawing up licence standards and specifications. In many privately operated flying and engineering schools the appropriate licence will be the deciding factor in determining training objectives. In an ICAO-sponsored aviation training centre there will be additional objectives in terms of professional and personal qualities.

7.2 - FACTORS TO BE CONSIDERED - PILOT TRAINING

7.2.1 Legal Requirements

State licensing authorities lay down criteria for pilot licences and ratings in terms of age, medical standard, flying experience and skill. The criteria for skill will be further defined by specifying ground and flight training curricula and appropriate ground and flight qualifying examinations. There is considerable variation in the way in which States lay down these criteria. They may be given in considerable detail, or only in very broad terms. In the latter case the course designers (Principal and Chief Instructors acting in consultation with State authorities) will have to amplify them, taking into account the guidance material available in the ICAO training manuals.

7.2.2 Task Analysis

Almost certainly, pilot graduates of the school will need additional skills, knowledge and experience, in order to embark on the next task. For example, an aerial application pilot (agricultural pilot) will need additional knowledge about chemicals and application rates, and additional skill in low-level manoeuvring. These may be specified by the State for an agricultural rating, or they may be purely an operator's responsibility. In either case, it remains a training school responsibility to analyze the knowledge and skill required for satisfactory task performance. Such analysis should make it quite clear what the pilot must be able to do, the standard to which it is to be done, and what he needs to know in order to do the job to the standard. The additional skill and knowledge required form a sub-set of training objectives in the curriculum.

7.2.3 Standards

The basic licensing criteria and the further sub-set of training objectives discussed in the last paragraph may together still not meet all requirements, and a sponsor or potential employer may lay down additional standards to be achieved. This may be done in either a specific way, such as demanding higher pass marks in qualifying examinations, or in much more general terms, such as requiring potential for command at a later date. Any such higher standards must be defined in writing. Where it is a matter of examination pass marks, this may be a simple matter, but it is not always easy to define flying skills or professional attitudes. The attempt must be made, however, otherwise success or failure on the course may become just a matter of unsubstantiated personal opinion. By way of example, an airline sponsoring pilot trainees might specify: "All successful pilot trainees shall have reached a level of technical knowledge and flying skill which will enable them to achieve a type rating for the ...... aircraft, after completion of the standard manufacturer's course. No examination failures or requirements for additional training are expected."

7.2.4 School Working Arrangements

These are important factors in course design and will include:

a) Integration of flying and ground training. This is usually done on a daily or weekly basis, but in either case it must be done in such a way that, as the various flying training exercises are carried out, the student will be able to apply knowledge which he has gained during his ground training, and vice versa.

b) Working hours and holidays. Together these determine the maximum number of hours of organized training which a student can achieve in a given period. They are, therefore, of importance in assessing the total duration of the course. Students should be expected to work hard, but working them too hard will not shorten the course. It will merely lead to fatigue and underconfidence, with consequent failures and drop-outs.

7.2.5 Course Duration

7.2.5.1 There are some external factors which have a bearing on desirable course starting and completion dates; for example, school examinations and graduations. There are also some internal factors, not directly related to the curriculum. Courses should fit into the school term or semester arrangements, so that one course will not commence before the preceding one has graduated. This may cause unacceptable peak training and accommodation problems.

7.2.5.2 Obviously, courses cannot be shortened to periods less than that necessary to complete the curriculum. They can, however, be lengthened by a month or two to take account of these factors. Extra time thus made available may be used in various ways, for revisions, extra-curricular activities, or simply as an allowance for catching up any arrears in training. The planned course duration thus itself becomes an element in course design. The minimum duration for a full CPL/IR course to training manual standards is normally about one year, excluding any preliminary language or foundation courses. The maximum duration for such a course should be about two years.

7.3 - DESIGN OF COURSES FOR MAINTENANCE ENGINEERS

7.3.1 There is a wide variety of engineers' licences and ratings. Even a fairly large school will not be able to provide the full range of licence courses - airframe, engine, systems, instruments and avionics - at the different levels, aircraft maintenance technician Types 1 and 2, specified in Annex 1. (Part D-1 of the ICAO Training Manual gives a full description of these courses and options.)

7.3.2 Even before any steps related to setting up the school are taken, therefore, it is necessary to decide, in consultation with potential employers and the licensing authority, which courses and combination of courses are to be provided.

7.3.3 Once this is done, course design will follow the same steps as described for the pilot licence courses. Integration of theoretical and practical training is equally necessary for the engineer; the time required to accomplish some of the practical tasks (e.g. an engine strip) is such that integration is usually planned on a term-by-term basis. Course duration is also greater, with minimum and maximum times for the Maintenance Engineer Licence, Type 2, being two and three years, respectively.

7.4 - EXTRA-CURRICULAR ACTIVITIES

7.4.1 In very short courses of training, with a duration of only a few weeks, it is possible to concentrate attention entirely on the subject matter. On longer courses, it is important that students are given regular breaks from the essential heavy workload of the course, in the form of alternative studies and games.

7.4.2 Extra-curricular activities, although not specified in the licensing objectives, play an important part in developing the personal qualities and professional attitudes which graduating students are expected to achieve. They are essential in meeting industry performance standards, and may be both compulsory, in that the students are required to participate, and voluntary, in that students may be given options from which to choose. These extra-curricular activities may be discussed under four general headings, namely:

a) Liberal studies;

b) Related studies;

c) Sports and games; and

d) Bad weather programmes for pilot trainees.

7.4.3 Liberal Studies

7.4.3.1 It is frequently suggested that some part of the time available should be devoted to formal mandatory study of material not only additional to the licence requirements, but unrelated to the aviation industry. The aim is to broaden the cultural horizon of the student, in the expectation that this will enable him to have a clearer understanding of the part which his professional work will play in community and national life.

7.4.3.2 Although the objective is laudable, it is unlikely to be achieved in the limited time which will be available. Courses should not be artificially extended to make it possible to include several hundred hours in a liberal studies programme. One of the major considerations in student selection should be to choose those who do have active minds and a broad range of interests. The comparatively few hours available will not significantly make any change in this aspect of their personalities.

7.4.3.3 Students should be encouraged to join, in their free time, with other students in completely voluntary activities such as photography, making models, motoring or production of a school magazine. The school should assist as much as possible with the provision of facilities - transport, darkroom, copying and printing. Instructors who share these interests, and can lead them, will be very valuable. This type of activity must be entirely voluntary, for staff and for students.

7.4.4 Related Studies

7.4.4.1 Related studies are quite different from liberal studies. They have a different, more specialized aim in helping the student to develop an intelligent interest in some wider aspect of aviation not directly involved in the curriculum. How this is to be done will depend on the resources available, both in the school and externally.

7.4.4.2 The ideal is to provide a co-ordinated series of lectures and films illustrating different facets of the total aviation scene. Visiting lecturers from airlines, State authorities, aircraft manufacturers, etc., can be extremely helpful, and maximum use should be made of them. Not only will this be of value to the students, but useful opportunities for liaison between school management and the outside agencies will be promoted. Totally disconnected sets of lectures on individual topics are of doubtful value; one or two dull lectures presented in a boring way will undermine the whole programme.

7.4.4.3 All staff members in the school, from Principal downwards, should be encouraged to take an interest in this programme. Even those who do not serve as lecturers should be expected to participate in panel discussions, question and answer sessions, and as guides on outside visits.

7.4.4.4 Some possible themes are:

- History of commercial aviation, nationally and internationally;
- Airline and aircraft economics;
- Development of the airliner - history and possible futures;
- Airline engineering (for pilots);
- Aircraft operation (for engineers); and
- The roles of ICAO and IATA.

7.4.4.5 Related studies courses of this nature should be compulsory. They should, therefore, be carried out during normal working hours and be limited to one or two hours per week. Full attendance should be required, and some attempt should be made to assess results achieved by individual students.

7.4.5 Sports and Games

7.4.5.1 A reasonable level of physical fitness is required for pilots, and should also be one of the selection factors for trainee engineers. Fit young people need exercise. If facilities are available, most students will exercise enthusiastically, but there are always some who will neglect to do so. It is very easy to get badly out of condition and overweight during long periods of sedentary study.

7.4.5.2 Some time during normal working hours should, therefore, be allocated for outdoor activities in which students will be required to take part. There are plenty of opportunities for exercise, such as jogging and orienteering, for which expensive equipment is not required. The important thing is that the school should recognize the need, and provide as many facilities as is reasonably possible.

7.4.6 Bad Weather Programmes for Pilots

7.4.6.1 In most parts of the world, ab initio flying training programmes are subject to interruption from bad weather from time to time. When flying has to stop for short periods, instructors must make good use of the time for briefings, quizzes, student counselling, etc. Where seasonal effects cause more persistent interruptions, arrangements must be made so that lost time, which individual instructors cannot fill in a useful way, is not wasted. The professional response to unexpected free time is to use it in a productive way. Students should not simply be stood down.

7.4.6.2 The onset of bad weather should be anticipated and contingency programmes drawn up. This is the responsibility of the Chief Instructor as both flying and ground instructors will be involved. Many forms of bad weather training programmes can be devised. Some examples:

a) Ground school revision. If lectures and classrooms are available, revision periods can be arranged. At certain times during the syllabus, practice examinations may be very useful;

b) Films. Suitable films from the school library can be shown. There is no harm in students seeing films more than once, but there is a limit to this; the fifth showing of "The Formation of Radiation Fog" begins to have a negative value. Availability of more than one projector will be very useful, as not all students will need to see the same film;

c) Internal visits to other school and airfield departments. Groups of students can be escorted on visits to air traffic control, aircraft maintenance and engine overhaul departments, instrument and radio shops, and to the computer centre if there is one;

d) External visits to aircraft manufacturers, aviation museums, international airports and air traffic control centres; and

e) Students can be called upon to give flying briefings or meteorological briefings to their classmates. They can also be asked to prepare short lectures on any aspect of aviation, which they may be called upon to give at any time.

The all-important point is that ideas to use bad weather times to best advantage must be carefully worked out in advance.

CHAPTER 8

DEVELOPMENT OF THE SYLLABUS

8.1 - GENERAL

Reference has already been made in Chapter 7, Course Design (paragraph 7.2.4), and in Chapter 3, Management and Organization (paragraph 3.4.1), to the need for integration of the theoretical and practical aspects of training. It is most important to see that a balance of standards and progress is maintained. This is the responsibility of the Chief Instructor. In this chapter, practical and theoretical syllabi are dealt with separately, but advisers must always have in mind the need for integration when considering these notes.

8.2 - TRAINING OBJECTIVES

8.2.1 The training objectives of the course must be clearly stated in a preamble to the syllabus. The objectives should not be expressed only in terms of the licences, ratings and experience to be achieved, but should also provide a written statement of the skills and performance standards expected at the end of each phase of the course.

8.2.2 Written definitions of skill are not very easy to write, but a simple statement should be attempted. For example, the training objective for the first phase of a professional pilot course might be: "On completion of the basic phase of flying training the pilot will be able to handle the training aircraft safely and accurately on solo flights in good weather, both in the circuit and on short cross-country flights, and to pass the flight test for a private pilot licence."

8.2.3 Similar short statements can specify the requirements for each phase. The final training objectives will be dictated by the task facing the student in the next stage of his career. For pilots intended for general aviation duties on uncomplicated aircraft in non-congested, good weather areas, the minimum course to meet State licensing requirements may be adequate. For pilots intended to go straight into air transport operations as co-pilots on sophisticated aircraft, considerably more training will be necessary.

8.3 - GROUND TRAINING COURSES.

8.3.1 Ground Syllabus

8.3.1.1 For all ground training courses, a master syllabus must be prepared containing both outline and detailed sections. The outline section is no more than a summary of the total ground training curriculum by phases, subjects, and hours of tuition for each subject, with the appropriate allocation of hours of revision, progress tests and examinations.

8.3.1.2 The detailed syllabus is essential to ensure complete coverage of the curriculum and standardization between instructors. It should specify the teaching sequence and exactly what subject matter is to be covered in each lecture period. Although not liable to interruption in the same way as flying training, ground training cannot be expected to proceed entirely according to plan, and at appropriate stages there should be an adequate allowance of time which can be used to regain lost ground. If not required for this purpose, such periods can always be used for supervised private study in the form of additional revision, practice examinations, etc.

8.3.1.3 It should be the firm intention to have a formal lesson plan for each period of instruction, although in a new school it may not be possible to complete this task before training begins. Plans should be in fairly standard form, beginning with a statement of the lesson objective; in some cases the objective may cover several periods of instruction forming one coherent block of material. Each lesson plan should specify in detail what is to be taught, highlighting all items of knowledge regarded as essential. The lesson plan should list all textbook references, training aids and equipment to be used during the lectures. Although prepared by individual instructorsso that they will reflect individual methods to some extent, they must be available to other instructors for use when the preparing instructor is absent.

8.3.2 Preparatory or Foundation Course

8.3.2.1 It is imperative that before students begin professional training they have an adequate base on which to build the new knowledge required. If a school is obliged to accept students who are not competent in the language of instruction or whose educational background is inadequate in technical content, the deficiencies must be remedied before commencing the licence course.

8.3.2.2 An appropriate foundation course can only be designed when the general level of academic knowledge of the average student of the group is known. Generally, the contents of the foundation course will include:

a) Technical language - concentrating on extension of technical vocabulary, rather than grammar.

b) Mathematics.

c) Elementary sciences relevant to aviation.

(b and c) taught both for general revision and as a vehicle for exercising the language

8.3.2.3 The duration of the foundation course depends on the work to be done. As a guide:

a) two months should suffice for students who are sufficiently competent in mathematics and science, and have a good knowledge of the language of instruction, but whose technical vocabulary is inadequate;

b) four months - if revision of mathematics and science is required as well as development of a technical vocabulary; and

c) eight months (minimum) for students who have virtually no knowledge of the language of instruction when they start training. This course may consist of an initial crash language course, followed by a modified type (b) course.

8.3.2.4 An appropriate final examination should be set in all cases. Students should be made to understand that they will not be allowed to proceed to the licence course until they have reached the required standard. Keenness to start professional training will prove to be a strong motivating factor in the foundation course.

8.3.2.5 In a multi-discipline school, where all trainees do a foundation course, it is worth considering delaying the final part of the selection and streaming process until the end of this. The final foundation course examination results can be combined with aptitude tests and selection board results to stream students on to the appropriate courses.

8.3.3 Licence Phase, Ground Training (Pilots)

8.3.3.1 For the ground training part of the course, ICAO training documents provide guidance on the knowledge required for each category of licence. There is an outline specification in the relevant part of Annex 1 to the ICAO Convention and composite ground subject curricula for the different licences and ratings are contained in Part B-1 of the ICAO Training Manual. The curricula are expressed in terms of subject matter to be learnt and the depth of understanding required.

8.3.3.2 It causes some surprise to find that ground training courses have been developed in different parts of the world which have very diverse durations for the same licence. For a commercial licence, for example, courses are available with a duration of a very few weeks, while others last for over a year.

8.3.3.3 The reason is that, despite the best intentions, it has not proved possible to express any curricula in writing in terms which define the exact standard to pass examinations based on these curricula. The final determination of standards rests with the State licensing authority, and the approach varies from setting simple questions on the main essentials to setting difficult and unusually orientated questions on obscure corners of the syllabus.

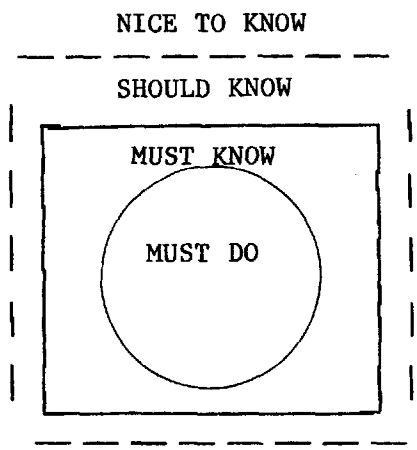
8.3.3.4 Sample examination papers with questions and model answers are very useful in showing the extent of knowledge expected. However, when questions are of an "essay" or "arithmetical" format, the major drawback is that, inevitably, both student and instructor will limit themselves to the topics covered by the sample questions and answers. When the licensing authority decides - with every justification - to examine another area of the published examination curriculum, invariably complaints are made.

8.3.3.5 When a licensing authority uses "multi-choice" or "objective" type questions, the above problems do not apply. It can be argued that if a complete list of such questions is published for each subject area, then the student is forced to learn the correct answers. In this way, the licensing authority is, in fact, assisting in raising standards. Provided that a fully comprehensive list of questions is prepared - and this means a "library" of perhaps two to three hundred - then it is possible by random selection to choose thirty questions for each examination without excessive repetition. It is, of course, necessary to analyze the results very carefully and to delete the questions which are not proving effective in eliminating the poor candidate. In addition, new questions must be added continually to the "library".

8.3.3.6 The ICAO documents, licensing authority examination syllabi, and sample examination papers, when taken together, will enable the school to determine the total content of the licensing elements of the ground training course.

8.3.3.7 Insofar as any flexibility is allowed, the school should always bias its courses in favour of the 'need-to-know' approach. Pilots do not need, and certainly cannot use, information about the inner workings of radio sets and other 'black boxes'.

8.3.3.8 The 'need-to-know' concept is a very rigorous tool in curriculum definition. Extension to the 'should-know' and 'nice-to-know' concepts opens the way to a variety of subjective opinions which will lead to situations which are very difficult to manage. Training programmes should concern themselves only with what must be known, understood and done. The following diagram illustrates this theme:



8.3.3.9 To the licensing requirements must be added any specific additional knowledge which task analysis has revealed as essential. This extra knowledge will not be tested during licence examinations. The school ought to take the view that if such knowledge is sufficiently important to be included in the syllabus, it is important enough to warrant examination, and arrange internal tests accordingly.

8.3.3.10 The ground training curriculum will now have been completely defined. It must then be subjected to the process of phasing and sequencing. To achieve balance in the integrated programmes, this must be in consultation with the flight training management. The outline and detailed syllabus can then be written, phase by phase, hour by hour, for each subject.

8.3.3.11 In order to conform to the pattern of integration of flight and ground training which has previously been stressed, PPL and CPL ground training must run in parallel with appropriate stages of flight training. Multi-engine instrument rating ground training may either run in parallel with the associated flying course or may usefully be combined with the CPL level course. This will allow the advanced flying training to be done on a full-time, concentrated basis. This is an advantage, as the step up to the twin-engined aircraft and the applied instrument rating training is a very big hurdle for the trainee pilot.

8.3.4 <u>Licence Phase, Training (Engineers)</u>

8.3.4.1 The suggested ICAO curriculum for the aircraft maintenance engineer licences is contained in Part D-1 of the Training Manual, and is very satisfactory as the basis of the engineering school syllabus. As is the case with pilots, States have expected widely varying levels of depth of knowledge in their final examinations, resulting in courses with durations of as short as one year and as long as three years.

8.3.4.2 For engineers, much less stress needs to be placed on final examinations and success on the course should be measured much more by a process of continuous assessment. Great care should, therefore, be taken in setting, marking and recording results of all progress tests and practical work. Not until students have demonstrated that they have completely mastered the skills of the current stage should they be allowed to pass on to the next.

8.3.4.3 Very close consultation with the licensing authority will be necessary from the outset, firstly to establish their interpretation of the ICAO standard and, secondly, to secure their full approval of this continuous assessment procedure. If this is done, then the final examination can become something of a formality and success of students who complete the course will hardly be in doubt.

8.4 - FLYING COURSES

8.4.1 Experience

8.4.1.1 In operation, it is necessary to have some measure of the level of competence that a pilot can be expected to have achieved. It has been the practice in the past to express this measure in flying hours, called 'experience'.

8.4.1.2 It is an important principle in the concept of 'approved training' that the value of the training programme should not be measured in flying hours alone. Training may in fact be defined as a method by which experience is gained in the least possible time. If this is accepted, it follows that the dual training elements of the course are all-important and should be set out in a precise and detailed way, and followed very closely. The main purpose of solo flying then becomes to provide opportunities for practice and consolidation, and it should be carefully supervised and directed towards this goal. It is accepted, of course, that solo flying does have value in confidence building, and also in building up further experience, but without the careful direction referred to, this may be in a spasmodic and unreliable way.

8.4.2 Flying Syllabus

8.4.2.1 The outline syllabus of flying hours will contain a summary of the flying hours and exercises expected to be achieved each week. A methodical system of numbering of the flight exercises should be used in each phase of the flying syllabus, in all progress test forms, and also in the synthetic flight training programmes.

8.4.2.2 Supporting the outline syllabus should be an expanded syllabus detailing the exact content and purpose of each exercise. Any further information required by the instructors or students on the methods and procedures to be used in carrying out the flying training programme should be placed either in the expanded syllabus or in a separate document. The students should have free access to all this information so that they know exactly what is expected of them. As with all manuals connected with aircraft operation and training, a careful system for making and recording amendments in this document must be established, so that there is no possibility of operations following inaccurate or out-of-date information.

8.4.2.3 Some matters to be included are:

a) The procedure to be followed when the planned sequence of exercise cannot be followed exactly, for reasons such as bad weather or equipment unserviceability;

b) The maximum duration of training flights which in the early stages should not exceed one hour;

c) Maximum solo flight time permissible between dual flights;

d) The required frequency of training or testing on essential emergency exercises;

e) Limitations on exercises which may only be flown dual, such as spinning and practising engine failure after take-off;

f) Arrangements for the logging of flight time, including rules under which time flown as pilot-in-command under supervision can be logged;

g) The sequence and content of flight tests which students have to take during the course;

h) The method of assessment to be used with guidance as to the assessment standards; and

i) The procedure to be followed when an individual student fails to make progress as expected. This should take the form of a precise, step-by-step review procedure.

8.4.2.4 The aim of an 'all-through' professional pilot course is to graduate a student with a commercial pilot licence and instrument rating on a twin-engined aeroplane. Although the natural progression of the 'all-through' course curriculum should not be diverted specifically to cater for the private pilot licence, it is inevitable that during the early part of the course, the student will cover all the requirements, both ground and flight, for the private pilot syllabus. At some appropriate stage, therefore, the student can undergo the necessary examinations and flight test and, if successful, be issued with a private pilot licence. This practice has the following advantages:

a) A student holding a PPL can legally carry passengers, including other students; this enables students to fly together for certain training purposes (sometimes called 'mutual' flying) such as acting as safety pilot on practice instrument flying exercises.

b) The PPL ground and flight examinations will, together, constitute a precise and meaningful progress test, which may be conducted by examiners from the State or from an independent agency. If a student fails either the ground examinations or the flight test, serious consideration must be given to the student's suitability for further training to the professional level.

c) If during a later stage in the course a student has to be suspended, then that student has at least gained a private pilot licence. There have been instances when the private pilot licence has not been issued, and the student has been so demoralized at being suspended late in the course that he or she has been unable to cope with either the ground examinations or flight test for the private pilot licence.

8.4.2.5 After completion of the initial PPL phase, pilots will continue their basic training on the single-engined aircraft. The training objectives of this phase must also be set out clearly, involving continual improvement of proficiency in general handling, navigation (radio as well as visual), basic instrument flight and night flying.

8.4.2.6 Reasons of economy may dictate that flying hours in the twin-engined aircraft used in the advanced phase be kept to the minimum dual hours necessary to achieve multi-engine and instrument ratings. For potential airline co-pilots, soon to be faced with a very difficult type-transition course, it is a great advantage to extend the course so that they can achieve solo standards on the twin. This will greatly improve the students' ability and confidence. It will require an increase in the hours flown on the twin-engined aircraft from about 30 to 35 hours dual, needed for the multi-engine and instrument ratings, to approximately 50 to 55 hours. A compensating reduction in single-engined aircraft flying may be possible.

8.4.3 Helicopter Syllabus

Where schools provide helicopter licence courses, similar outline and detailed syllabi, with appropriate training objectives, are necessary. Annex 1 provides that the hours necessary to achieve a commercial helicopter pilot licence may be reduced (below the 100 hours specified for an approved course) "in accordance with the degree of skill and experience of the holder of a licence to fly aeroplanes". States may vary in their application of this proviso, but some amount of fixed-wing flying is usually acceptable. It is for consideration whether an introductory flying course on fixed-wing aircraft should be included for helicopter trainees. It will be cheaper to do this, as the fixed-wing aircraft will be less expensive to operate than the training helicopter. The helicopters are also considerably more difficult to fly, and it is often preferable to allow students to get their first air experience and acquire some confidence in the easier aircraft.

8.5 - SYNTHETIC FLIGHT TRAINING SYLLABUS

8.5.1 General

8.5.1.1 There are no specific ICAO requirements for synthetic training in pilot licence and rating courses. Rarely will there be any State licensing authority requirements either. Annex 1 provides that up to 50 per cent of specified instrument time may be "Instrument Ground Time," which is defined as "Time during which a pilot is practising, on the ground, simulated instrument flight on a synthetic flight trainer approved by the Licensing Authority". Note 'practising' - not necessarily receiving instruction.

8.5.1.2 The advantages of synthetic trainers are well known. They do not collide with each other, or crash in other ways. They do not use valuable air space on airways or in airport traffic patterns. They do not create pollution, or make a noise, or waste energy. They also have practical training advantages. Instructor concentration on what the student is doing can be improved, as the instructor is not carrying a responsibility either for the safety of the flight or for lookout. Training exercises can be repeated without wasting much time in re-positioning, weather is no problem and conditions can be standardized.

8.5.1.3 Maximum use should, therefore, be made of this type of training. It should be used in ab initio programmes to improve standards rather than to reduce costs, and to supplement rather than replace training in flight. Synthetic training should be done in such a way that, as the various flying training exercises are carried out, trainees are able to apply skills and knowledge they have gained from the synthetic training programmes. Arrangements should be made so that problems encountered in airborne instruction can be referred back to synthetic flight training for assistance and possible resolution.

8.5.1.4 The synthetic flight training syllabus should be the responsibility of the Chief Flying Instructor. Standardization of techniques and instruction between synthetic and in-flight training is vital. The syllabus should be laid out in the same way as the flight syllabus, with a detailed specification of each exercise, using the same exercise numbering system.

8.5.1.5 The synthetic training programme should be divided into phases. The object in each case is to introduce the trainee to the use and inter-relation of all flight instruments for the manoeuvres and procedures required in the corresponding flight exercises.

8.5.2 Pre-flight Phase

8.5.2.1 This phase includes demonstration of control effects, basic flight manoeuvres and circuit procedures. This will help the student to master the problems of initial flight training. Most flying instructors support the use of synthetic trainers at this stage, although some feel it may develop a 'head-in-cockpit' attitude, which could be difficult to eradicate in flight and result in the lack of proper look-out.

8.5.2.2 This is a matter for decision by individual Chief Instructors and Chief Flying Instructors. However, what is now usually known as 'Integrated Flight Instruction' (not to be confused with the integration of classroom and flight instruction stressed elsewhere in this manual) is becoming widely accepted. In this system each basic flight manoeuvre is practised using both flight instrument and external visual references. Schools which use this system will also readily adopt the pre-flight synthetic phase.

8.5.3 Basic Instrument Phase

In this phase students are taught to handle the aircraft entirely by reference to instruments. Teaching a proper system of instrument scan is of very great importance; if a pilot starts to use a poor system at this stage, it may result in his failing ever to become a really competent instrument pilot. Exercises will be taught on both the full instrument panel and on the limited panel. Techniques of recovery from unusual attitudes are also usually taught during this phase.

8.5.4 Instrument Rating Phase

The requirements for an advanced twin-engined trainer which can be used both for type conversion and instrument rating training were discussed in Chapter 5. If such a machine is not available then the basic instrument flight trainer must necessarily be used. This will still be of great value in preparing for the flight exercises. The full range of departure, airways, holding and instrument approach procedures should be taught and practised on the ground before the equivalent exercise is done in the air.

8.6 - EXAMINATION AND ASSESSMENT

8.6.1 'Assessment' is comparing an individual's skill or knowledge with some given or accepted scale, so as to reflect his achievement or ability as accurately as possible. (Note - this excludes the field of personality assessment, which is primarily a matter of psychological measurement. This type of assessment is important in selection and promotion procedures, but should play little or no part in training assessment.)

8.6.2 'Examination' or 'test' is the use of oral, written or practical exercises to measure performances against a standard. In the training context, the two words are really synonymous, but it is more usual to use 'examination' for verbal processes, oral or written, and 'test' for practical exercises.

8.6.3 An examination is one way of making an assessment. Another way is to use the subjective judgement of a teacher or instructor to rate the student's ability. Either or both of these methods of assessment can be used to measure the extent to which training objectives are being (progress tests) or have been (final tests) achieved.

8.6.4 Types of Examinations

8.6.4.1 Practical and written examinations may take many different forms: performance tests (such as the flight test), oral examinations, or objective and subjective (essay) examinations. The whole matter has been the subject of detailed investigation and research in the academic field, less so in respect of practical training. There is a vast amount of literature on the subject. Advisers should refer to the outline contained in Chapter 5 of Part A-1 of the Training Manual to supplement these brief comments.

8.6.4.2 An objective examination is one in which every question is set so as to have only one right answer, and the subjective opinion of the examiner does not decide whether the answer is right or wrong. Objective examinations take many forms, of which the best and most widely used is the multiple choice question paper. The chief advantages of the objective test are:

a) Answers can be marked very quickly even by persons not familiar with the subject matter;

b) Good coverage of the syllabus is possible;

c) Since there is no choice of questions, the test is uniform for all candidates; and

d) Speed of writing gives no advantage.

The main disadvantages are that question writing is an exceedingly difficult and time consuming task, that questions test practical knowledge rather than reasoning or originality, and that students not fluent in the language may have difficulty interpreting questions and optional answers with the required precision. The multiple choice remains potentially the most reliable of all written tests.

8.6.4.3 Essay-type examinations pose questions of a kind which require a more or less lengthy written response. The accuracy and quality of the answers has to be judged subjectively by an examiner knowledgeable on the subject. The chief advantages of this system are:

a) Understanding and reasoning can be tested;

b) The examination is cheap;

c) Questions are fairly easy to set; and

d) The system is easy to administer.

The disadvantages are:

a) There may be inconsistencies in marking;

b) The emphasis is placed on speed of writing and quick wittedness;

c) The element of luck is introduced by lack of full subject coverage; and

d) The expense in examiners' time in marking is considerable.

Compared to objective examinations, the essay examination is unreliable and should be used primarily when one of the main objectives of the examination is to test clear and precise written communication.

8.6.4.4 A performance test is one which seeks to measure the proficiency with which a task or series of tasks is performed, measured against a specified standard. If the required standards can be defined with precision, and actual performance can be measured accurately, this will be the best type of practical test. In some cases, assessment of performance may become rather subjective, owing to variations in test conditions. This applies particularly to flight tests and the capability of standardizing test conditions is one of the major advantages of synthetic flight testing.

8.6.4.5 Setting and marking examinations is a difficult and demanding task. State and school authorities must work closely together to achieve a system which is comprehensive and accurate, and which will necessarily include both practical and written tests. The examiner's job will be made easier, or at least more straightforward, if he has access to statements of clear and detailed training objectives from the school syllabus.

8.7 Integration in Theoretical and Practical Testing

8.7.1 Stress has been laid at various points in this manual on the importance of integrating practical and theoretical training. Schools should try to follow this objective in their flight test and ground examination procedures.

8.7.2 A flight progress test should not be regarded solely as a test of practical flying skill. The flight test examiner should carry out an oral examination of associated aspects of theoretical knowledge, such as principles of flight, and flight rules and procedures. Flight plans, performance calculations and flight logs should be assessed and marked as written practical tests.

8.7.3 Similarly, the theoretical ground school examinations should relate as much as possible to practical aspects of the course. Another method of examination now being used in many airline-type transition courses, is the 'open book' examination. This option may be useful in integration, in that practical questions may be included in theoretical examinations on matters closely connected with the flight side, i.e., aircraft documentation, flight guides, operations manuals, emergency procedures, etc.

CHAPTER 9

STUDENT ENTRY, PROGRESS AND GRADUATION

9.1 - PRE-SELECTION REQUIREMENTS

9.1.1 The problems of selection are largely a result of the ratio of applicants to places available. If the number of applicants is low, selection becomes a matter of specifying minimum entry standards, rather than choosing the best candidates. For the very interesting technical courses which an aviation training centre provides, leading on to worthwhile careers, it is likely that there will be a large number of applicants. This will particularly be the case if the cost of the training is substantially, if not completely, paid for by a sponsoring airline or State scholarship.

9.1.2 For pilot training courses especially, a ratio of ten or more applicants for every available place is not unusual. If all these applicants are interviewed and tested, the process becomes a major administrative task. But justice must be seen to be done, and arbitrary methods of selection are not acceptable. The ratio can only be reduced by drawing up a rigorous pre-selection specification to which aspiring candidates must conform before they can be considered for selection.

9.1.3 Educational Qualifications

9.1.3.1 The work of a pilot or maintenance engineer requires intelligence, technical comprehension and a good standard of literacy and arithmetic skill. It is doubtful if particularly high educational qualifications are necessary; certainly not the university degrees sometimes demanded. Many people have become successful pilots and engineers without any formal academic qualifications at all. Without any educational specifications, however, the flood of applicants may be unmanageable.

9.1.3.2 The majority of applicants will have undertaken some form of secondary or higher education. Those who are intelligent, well motivated and capable of sustained hard work, will have achieved success and the appropriate qualification in their school careers. The minimum educational qualification for entry should be set at the level a good average secondary or high school student can expect to achieve. The pre-entry requirements should lay stress on and give preference to candidates whose courses of study emphasized sciences and mathematics, but should not completely exclude those with backgrounds in arts and classics.

9.1.3.3 A university degree is certainly not required. It has, in fact, been argued that university graduates may find the work of a pilot or engineer insufficiently stimulating, leading to dissatisfaction with the career. On the other hand, it would be unfair to exclude all those who want to do a university course and yet are really keen on an aviation career. On balance, it is likely that a proportion of university graduates will prove to be a valuable asset, both in the school and in the industry generally.

9.1.4 Age

9.1.4.1 The minimum age of entry should be consistent with the educational qualifications demanded. Generally, eighteen seems to have become recognized as the lower limit. A maximum upper age limit should also be set and should be kept fairly low. Firstly, particularly on pilot courses, success in training is more easily achieved by young students, and some people in their late twenties or thirties may find it surprisingly difficult to learn to fly to the standard required. Secondly, a high age limit may encourage some applications from those who are just seeking to change careers, having become dissatisfied with their first choice. This may be justified in some cases; often, however, it represents a grasshopper mentality and a lack of staying power.

9.1.4.2 An age bracket of eighteen to twenty-one years at time of entry is quite wide enough for the high school applicant. The upper limit can be increased to twenty-four years for university applicants, and also for any who have been obliged to undertake compulsory military service. Any such service required by the State should preferably be done before professional aviation training begins. If it is done afterwards, some of the knowledge and skills acquired in the aviation training centre will be forgotten. A refresher course will then be necessary at the end of the period of military service, unless use is made of the aviation skills while in the forces, which rarely seems to happen.

9.1.5 Medical Standards

9.1.5.1 All professional pilots are required to have a Class 1 medical assessment as laid down in Annex 1. To avoid waste of time and money, the necessary medical examination should be passed before training begins. Where possible, pilot entrants should be examined to check long-term medical prospects. Good preventive medical practice indicates that applicants with an adverse prognosis should not be accepted. Licensing medical authorities do not always take account of this, and an independent examination by an airline medical department or similar organization should be arranged.

9.1.5.2 There are no specific medical assessment standards laid down for maintenance engineer licences. A reasonable degree of medical fitness should be required and candidates with obvious physical defects such as deafness or severe physical handicaps should be excluded. Normal colour perception is necessary, and, since colour blindness is not obvious, it should be checked.

9.2 - SELECTION STANDARDS AND PROCEDURES

9.2.1 The first objective of the selection process is to eliminate those who, despite having met the entry specification, do not have the ability and aptitude necessary to cope with the course. The second objective is to choose the best applicants from those who meet the entry criteria and have also been assessed as having the necessary ability and aptitude.

9.2.2 Thus, the complete selection process consists of three stages:

a) Criteria for entry;

b) Aptitude and ability assessment; and

c) Competition for available places.

9.2.3 The aptitude and competitive stages can be conducted simultaneously. This is easier, quicker and better from the applicant's point of view, because it avoids delay and suspense between success at one stage and attendance at the next. When there is a very large number of applicants, it may be better, administratively, to separate the two processes, thus reducing the number attending the final competitive stage.

9.3 - APTITUDE TESTS

9.3.1 Aptitude testing should be done in a comparatively simple way, using an appropriate battery of pencil and paper tests of intelligence, mechanical comprehension and dexterity. The mechanical comprehension test, in particular, has proved to be a reasonably reliable way of assessing pilot and engineer aptitude.

9.3.2 It is not easy to set the cut-off levels correctly for these pencil and paper tests; advice from local educational authorities should be sought. Feedback from actual results achieved in training can subsequently be used to refine the process.

9.3.3 For pilots, strenuous efforts have been made by some authorities to develop the aptitude testing process, with the aim of reducing failures in flight training. Further tests have been added, including psychological personal inventory tests and various kinds of machine tests purporting to give an indication of aptitude for flying. In some cases, actual flights have been included and even extended courses of flying of five hours or more. There are differing opinions as to whether any of these flights are of much real value. Such in-flight screening is expensive and time-consuming and may not be worth the investment.

9.4 - COMPETITIVE STAGE

9.4.1 This stage can comprise a selection of further tests, examinations and interviews. The results of these, combined with the scores derived from educational qualifications and the aptitude tests, will produce a graded list of applicants in order of merit.

9.4.2 In some institutions, this stage consists of no more than a single interview. In others, it takes the form of a very detailed probe into the applicant's ability and motivations conducted over a period of two or three days by a team of experienced personnel managers and industrial psychologists. The single interview is not an adequate and reliable test, but the expense and effort required at the other extreme is not really necessary.

9.4.3 A satisfactorily accurate assessment should be obtainable using a one-day selection process covering:

a) A fairly short written examination designed to test the candidate's general knowledge, as well as his interest in and knowledge of aviation;

b) Some form of group exercise and discussion to evaluate the candidate's performance in group situations; and

c) A selection board interview aimed at assessing the candidate's general motivation, enthusiasms and interests.

9.4.4 The selection board should consist of experienced line, training and personnel managers. However knowledgeable and experienced they are, they should be very wary about relying too heavily on their own subjective judgements.

9.4.5 The only honest and sensible approach is to assemble and evaluate all the information which is available about each candidate. This includes educational qualifications, aptitude test results, examination marks and the selection board assessments. A numerical assessment or percentage score should be given for each section. It is legitimate for the selection managers to weight the sections appropriately (so that in selecting pilots, for example, more account is taken of aptitude tests than of educational qualifications).

9.4.6 Apart from this, there should be no juggling of the scores. The final outcome should be a single list of candidates, each having a single total selection score. The list will reflect the order in which their probable success in training and subsequent career has been evaluated. Available places should be offered to the candidates achieving the best selection results.

9.5 - JOINING PROCEDURE

9.5.1 The first few days which a group of new students spends in the training centre can be of vital importance in the development of the right attitude, discipline and a spirit of co-operation and goodwill between students and school management.

9.5.2 School rules and regulations should be published in a booklet made available to all students on arrival. Every effort must be made to avoid framing these regulations in a dictatorial and threatening way; nevertheless, all organizations must operate within a framework of rules. Flight safety particularly demands that students be aware of the need for compliance with regulations and orders at all times.

9.5.3 The school Principal, supported by the Chief Instructor, should address new students very early in the course to explain the need for co-operation and discipline. These welcoming addresses are important, but their value should not be exaggerated. Morale, attitudes and co-operation cannot be created by a few words, but only by fostering them in a constant environment of firmness and fairness.

9.6 - PROGRESS TESTS

9.6.1 It is vital that progress of each student is monitored closely throughout the course. Frequent progress examinations and progress tests are necessary and must be treated, not as isolated events, but as part of an overall record of effort and achievement.

9.6.2 Minimum pass standards should be set for every test. Individual subject or practical exercise failures may be re-tested. More serious failures require more drastic action. This may range from requiring a period of refresher training and revision followed by complete re-examination to, in the most serious cases, termination of training.

9.6.3 The Chief Instructor should consult with school training managers to decide on the proper course of action. The deliberations and decisions of this review board should be formally recorded in the student's file and the student should be advised. Where appropriate, sponsors must be informed and may have to be consulted about additional training requirements or terminations. All cases of failure to progress as expected should be treated very seriously, and students should be left in no doubt that minimum pass standards will not be waived.

9.6.4 It is always regrettable when it is necessary to terminate the training of a student who has been carefully selected and who has completed part of the course, but it will prove necessary on occasions. In cases of persistent failure to meet the required standards, or of unacceptable disciplinary behaviour, the school management must not hesitate to act.

9.6.5 It is sometimes argued that really effective selection procedures will reduce wastage in training almost to nil. In practice this is not possible. There will always be some students whose ability, aptitude or motivation has not been measured with sufficient accuracy. The school will benefit if such misfits are expelled; it is better to do this early rather than continue training only to be faced with failures or withdrawals at a late stage in the course.

9.6.6 Calculations of the student intakes needed to meet the output requirement must make allowance for wastage. Failure rates of 20 per cent or more indicate defective selection procedures. Failure rates of 5 per cent or less suggest that standards are not being maintained at a high enough level. Failure rates of about 10 to 15 per cent are to be expected and should be allowed for when deciding on the size of training effort required.

9.6.7 The need for discipline cannot be over-emphasized. This is not to suggest a rigorously imposed form of military discipline. Entry into the aviation profession will involve the trainee in a more or less continuous process of training, extending throughout his career. The school must inculcate the will to persevere with personal studies and the maintenance of self-discipline in personal performance.

9.7 - STUDENT RECORDS

9.7.1 Separate personal records and training records must be kept for each student. At the time of joining the school, a personal data sheet should be raised containing information such as name, date of birth, home address, next of kin, previous experience, and educational and professional qualifications, together with essential course details such as starting date, course type and number, and planned completion date.

9.7.2 The training file should be kept by the Chief Instructor. It must contain a detailed record of all lectures attended, practical and flying exercises completed, hours flown, instructors' remarks and assessments, and detailed results of all practical tests, flight tests and examinations.

9.7.3 It will probably be a legal requirement to keep a flying log book and students will wish to keep a log anyway. This is customary amongst pilots, but checking and verifying them is a time-consuming chore for the flying instructors. Some schools provide a photocopy of the official school flight record which the student can retain as a personal log upon completion of training. For pilots, the flying training record should use the same exercise numbers as the syllabus, and should use the same breakdown and layout of flight hours (dual, solo, day, night) as the student's flying log book. This will make checking of log book entries easier.

9.7.4 The student's personal file should be kept by the Registrar. In addition to the data sheet it will contain information about the student not specifically connected with training such as fees, leave and travel arrangements, sickness, etc.

9.8 - GRADUATION

9.8.1 The year or two which students spend in the school in the company of a group of like-minded young people preparing for a lifetime career is one of the highlights of their lives, and will remain so in memory. Graduation, marking the culmination of this period, is therefore an important event and should be suitably treated.

9.8.2 It may not be practicable in an aviation school to hold a course graduation ceremony. The nature and timing of the combination of written, oral, practical and flight tests required to qualify for a licence means that it is rarely possible to complete training of all members of a particular course at precisely the same time.

9.8.3 It may be better to hold a simple graduation ceremony for each student. The Principal or Chief Instructor should present the student with an attractive diploma, of a kind suitable for framing and display, together with certified log books and records of work. If at all possible, the official licence should be presented at the same time. It is, in fact, the licence which is the all-important aspect. The school administration and the State Licensing Authority should liaise to ensure that there are no unnecessary delays in completing and checking licence applications and issuing licences.

9.9 - PRIZES

9.9.1 This is rather a controversial matter. In educational institutions, it is the practice to present some prizes to outstanding students each year. Where there are several student entries each year, it may not be easy to compare the merits of the best students in each course. In any case, the awards are often rather unfair, in that the top three or four students are just about equal in ability, and the final choice may be an arbitrary one. This may cause the student body to feel, rightly or wrongly, that a degree of personal bias or favouritism has entered into the decision.

9.9.2 It is very doubtful if prizes have any effect in motivating students to work harder with the object of securing one, unless there is a very considerable financial value attached. The matter is one for decision by school management and local authorities, but it is strongly recommended that, if there are any prizes at all, there should be one or two for the best students on each course, rather than each year.

CHAPTER 10

FINANCE

10.1 - INITIAL CAPITAL INVESTMENT

10.1.1 The range of possible variations in size, types of course, equipment, etc., makes it quite impossible to give even a broad indication of the level of financial investment required to establish an aviation training centre. Only when fundamental decisions on size of training effort, throughput and range of courses have been made can the cost of the project be evaluated.

10.1.2 A privately owned company considering starting a venture of this kind would follow a well-tried and established procedure. They would set up a team of experts, including accountants, architects and training specialists, to produce a detailed feasibility study. In the study, the experts would address location, building design and specification, staff and equipment, initial investment summary, revenue and expenditure estimates, cash flow projections, etc. If the study showed that the project was viable, then the necessary initial funding would be sought through private investment, public subscription, or bank loans.

10.1.3 Very probably, in the case of a State aviation school, these decisions will be made in reverse order, need and national aspirations taking priority over financial considerations. Even so, it is important to create an atmosphere of strict financial discipline, and an initial feasibility study and cost analysis are the essential first steps. If a firm decision to go ahead has preceded the study, it may be possible for some members of the proposed school management (Principal, Chief Instructor and Accountant) to be included in the evaluation team.

10.1.4 Initial funding for a school of this kind will come from State authorities, possibly with assistance from supra-national or international agencies such as EEC, OAU or UNDP. Government financing, without well-defined public accountability, can lead to waste and lack of financial control. Injection of private capital might avoid this, but private backing seems unlikely for a project not designed to make a profit. Investment from potential employers of school graduates is a possibility always worth looking at.

10.1.5 If only national funds are available, without private or international agency involvement, then it is wise to arrange finance through more than one section of government. Involving the Departments of Education and Employment, as well as Aviation, may produce bureaucratic tendencies but will certainly assist in ensuring adequate financial supervision.

10.1.6 Also in the interest of financial discipline, the initial grants, from whatever source, should not simply be written off. They should be treated as a liability subject to eventual repayment, and serviced by payment of at least a notional rate of interest.

10.1.7 The budgeting and accounting procedures of any government will almost certainly require a long lead time before final approval and allocation of funds takes place. Advisers should carefully investigate the procedures involved. *Ad hoc* arrangements may make it possible for the school to start operations before final approval of total investment, but it is necessary to ensure that such facilities are entirely adequate or serious interruptions in school development may arise.

10.2 - CURRENT INCOME AND EXPENDITURE

10.2.1 Once operations have started, regular revenue and expenditure accounts must be produced. The aim should be to keep them in approximate balance. This means charging a proper level of fees for all courses, and any other services provided, based on accurate costings.

10.2.2 Courses carried out to the full ICAO specifications or even higher standards are expensive; in a small, newly established school with high overheads and low student output, operating costs per student may be amazingly high. Nevertheless, the school has been set up in response to a demand for its product, and its services should be paid for. Who pays is a matter for consideration.

10.2.3 A system of annual block grants or guaranteed deficiency payments will lead to a feeling that high costs and operating losses do not matter. If all parties concerned - State, sponsors, school, students and their families - appreciate just how expensive professional aviation training is, that will be all to the good. A published scale of fees is the best way of making this clear.

10.2.4 The costs of the courses are largely dictated by course design, curriculum, aircraft types, flying hours, etc. Efficient school management can do much to reduce costs by achieving high instructor and aircraft utilization, low maintenance costs, and firm control of day-to-day running costs and general overheads.

10.3 - SCHOOL FEES

10.3.1 The bulk of the fees will come either from a State department or from sponsoring airlines. In accordance with standard world-wide educational practice, fees should be charged and paid terminally or quarterly in advance. This will provide the school with a substantial source of current operating finance once training operations have actually begun.

10.3.2 Students should make some contribution to the cost of their course, so that they, too, understand the financial implications, and appreciate the many benefits of the professional training they are getting. If student contributions are charged and paid directly, it will very often be their families who pay, which will rather defeat the objective. Alternatively, their part of the fees could be paid by loans which they will be required to repay from their earnings after graduation. Another method is to accept their contributions in the form of modest amounts of work carried out for the school in their free time. This could involve work in aircraft and building cleaning, maintenance of the grounds, canteen services, etc. This is a good idea except that it is rather difficult to organize and find enough work for all.

10.4 - BUDGETS AND MANAGEMENT ACCOUNTS

10.4.1 The accounting procedures related to day-to-day control of running costs will follow the pattern used in most businesses.

10.4.2 There should be carefully prepared annual and term budgets. Department heads in the school should be given responsibility for the preparation of their own expenditure budgets, subject to final approval by the Principal and Accountant.

10.4.3 Management accounts should be produced for each monthly or four-weekly period. These will facilitate comparison with budgeted expenditures and quickly highlight any adverse trends. It is one of the Principal's major responsibilities to ensure that a full appreciation of the need for economy, consistent with maintenance of standards and achievement of the school's goals, percolates through all levels of staff.

APPENDIX 1

Requirements for the Approval of Flying Training Courses for the Commercial Pilot's Licence and Instrument Rating

CAA London - January 1977

NOTE: The example given in this Appendix is typical of the requirements issued by a State for approval of a flying training school. It must be stressed that the terminology used may not be in accordance with any that is familiar to the reader. The details should only be used as a guide to the extent of the standards which a school must meet before being granted the status of an "Approved Flying Training School."

1 INTRODUCTION

1.1 The purpose of this document is to explain the procedure for the issue, renewal and variation of Civil Aviation Authority (CAA) Approval of a course of training for the Commercial Pilot's Licence and Instrument Rating (CPL/IR) and to indicate the minimum requirements to be met by schools conducting such a course in respect of equipment, organisation, staffing, training and other matters affecting the operation of the course of training.

2 ADMINISTRATION OF THE APPROVAL

2.1 Unless an applicant for the CPL/IR has gained certain minimum flying experience, he is required to complete a full-time course of training at a school approved by the Authority to conduct such courses. A school wishing to offer such training must have received CAA Approval of its proposed course before students commence training.

NOTE: For the purpose of these requirements a school is considered to be an establishment, located at a particular aerodrome or airport, staffed and equipped to offer flying training, synthetic flight and ground training facilities for the conduct of a specific training programme or programmes for the Commercial Pilot's Licence and Instrument Rating. This definition of a school is not intended to rule out the possibility of a school making use of satellite airfields as relief landing grounds.

2.2 A school wishing to obtain CAA Approval should apply in the first instance to the Director of Flightcrew Licensing. The application should be accompanied by the relevant Operations Manuals and Training Manuals and a full description of the Training Scheme. After consideration of the application and associated documents, the school will be inspected to ensure that it meets the Authority's standards in flying training, synthetic flight training, ground training and overall facilities. Subject to satisfactory inspection, CAA provisional approval will normally be granted in the first instance for a period of one year, but this may be varied at the discretion of the Authority. Upgrade from provisional approval may be granted after subsequent inspections.

2.3 CAA Approval of a course of CPL/IR training may be varied, suspended or revoked at the discretion of the Authority. Renewal of Approval will normally be made annually after visits of inspection. During these visits, the school will be required to show its maintenance of minimum standards with respect to the approved course and compliance with requirements, made by the Authority and whose interpretation has been agreed with the schools, to ensure that the minimum acceptable standard is achieved. If a school conducting an approved course of CPL/IR training wishes to make significant amendments to the agreed pattern of approved training, eg introducing a lengthy break in the continuity of training, varying the agreed allocation of day and night flying etc, the Authority is to be advised in advance as the conditions under which the Approval was issued or renewed would then be changed. A school need not however advise the Authority of minor changes, eg in the use of transit checks, landing lights by day, etc. Where any doubt exists as to whether a proposed change is minor the Authority must be consulted.

2.4 During the currency of the Approval, the Authority will require periodic reports on the standard of the approved course of training. The reports may be obtained during routine visits and inspection visits made to the school by staff of the Authority throughout the year. During such visits access may be required to school training records, authorisation sheets, technical logs, lectures and briefings; further, the Authority's examiners may require to sample training flights with students under arrangements agreed with individual schools.

3 SCHOOL ORGANISATION

A satisfactory management structure will be required to allow supervision of all grades of staff by persons having the experience and qualities necessary to ensure the maintenance of high professional standards. Details of this management structure, indicating individual responsibilities, are to be included in the School Operations Manuals. It is expected that the structure will be headed by a Principal.

4 SCHOOL STAFFING

4.1 The school will be required to satisfy the Authority that, bearing in mind its size, an adequate number of staff are employed to permit a high standard of training. It is particularly important that a satisfactory training staff/student ratio is maintained and that all grades of training staff are both qualified and currently competent both in their specialisation and in training techniques.

4.2 At large schools, appointments will normally be required as indicated below:

4.2.1 Chief Instructor

The Chief Instructor will normally be responsible for the co-ordination of the ground and flying training on approved courses. He is to be responsible for ensuring that satisfactory integration of flying, synthetic flight and ground training is maintained throughout the course and for supervising the individual progress of students. In addition to having extensive experience in the training of pilots and possessing a sound managerial capability, the Chief Instructor shall hold or have held in the previous three years:

(a) a valid professional pilot's licence and Instrument Rating,

(b) a Commercial Flying Instructor Rating valid for all the aircraft used on the approved course,

(c) an aircraft rating valid for at least one of the aircraft types used on the approved course.

4.2.2 Chief Flying Instructor

The Chief Flying Instructor shall:

(a) be the holder of a current and un-restricted professional pilot's licence and Instrument Rating,

(b) hold a current Commercial Flying Instructor rating valid for all types of aircraft used on the course,

(c) hold valid aircraft ratings for all aircraft used on the approved course,

(d) have completed 3000 hours PIC, including a minimum of 2000 hours on flying instructional duties and 100 hours on instrument flying instructional duties.

4.2.3 Flying Instructors

All Flying Instructors engaged in the flight training of candidates for the CPL/IR shall hold:

(a) a Commercial Flying Instructor Rating valid for all types of aircraft used on the approved course; a current and unrestricted professional pilot's licence and Instrument Rating; and aircraft ratings valid for the aircraft types in which instruction is to be given.

OR

(b) a Commercial Flying Instructor Rating valid for all the single-engined aircraft types used on the approved course; a current and unrestricted professional pilot's licence and Instrument Rating; and aircraft ratings valid for the single-engined aircraft in which instruction is to be given. Such instructors may extend the validity of their Commercial Flying Instructor Ratings to cover instruction on the twin-engined aircraft used on the approved course after gaining a minimum of 12 months' experience, as holders of Commercial Flying Instructor Ratings, training students on approved CPL/IR courses. This requirement may be relaxed in the case of instructors with extensive previous instructional experience, eg as military or private flying instructors. Extension of a rating to cover training on twin-engined aircraft is expected to be completed within 25 months of gaining a Commercial Flying Instructor Rating.

OR

(c) a Commercial Assistant Flying Instructor Rating valid for the single-engined aircraft types used on the approved course; a current and unrestricted professional pilot's licence and Instrument Rating; and aircraft ratings valid for the single-engined aircraft types in which instruction is to be given. Holders of such a Commercial Assistant Flying Instructor Rating may only give elementary instruction to students on approved CPL/IR courses and are subject to compliance with the provisions of the ANO concerning the privileges of the holders of Assistant Flying Instructor Ratings.

Subject to completing six months of flying instructional duties, to gaining at least 200 hours experience as a flying instructor, and to having a minimum of 400 hours experience as pilot-in-command of aeroplanes, a holder of a Commercial Assistant Flying Rating may take the CAA test for the Commercial Flying Instructor Rating. This upgrade is expected to be completed within 12 months of gaining the Commercial Assistant Instructor Rating.

4.2.4 The ratio of Commercial Assistant Flying Instructors to Commercial Flying Instructors is to be not more than 1:6.

4.2.5 For the purpose of approved CPL/IR training, type ratings - on the aircraft used for the approved training - on the licences of holders of Commercial Flying Instructor

Ratings shall be renewed as follows:

(a) For each single-engined type used on the approved course - renewals to be every six months by alternate Certificates of Test and Certificates of Experience.

(b) For twin-engined aircraft - renewals to be by Certificates of Test every six months.

4.2.6 The Commercial Flying Instructor Rating and the Commercial Assistant Flying Instructor Rating shall be renewed by flight test every 25 months and 13 months respectively. The renewal flight test may be conducted by the school's delegated examiners and is to be conducted alternately on single and multi-engined aircraft when both classes are endorsed on the Rating.

4.3 Synthetic Flight Trainer Instructors

4.3.1 Synthetic Flight Trainer Instructors shall:

(a) hold or have held professional pilot's licences and have instructional experience

OR

(b) have at least two years' experience as Synthetic Flight Trainer instructors

OR

(c) have relevant experience as military flying instructors.

4.4 Ground Instructional Staff

4.4.1 Chief Ground Instructor

The Chief Ground Instructor shall:

(a) hold or have held a Flight Navigator's Licence or a Senior Commercial/Airline Transport Pilot's Licence and

OR

(b) have had experience as a pilot or navigator in civil aviation or equivalent military air experience and

(c) have undergone a course of instructor or teacher training and have had extensive previous experience as a ground instructor.

4.4.2 Ground Instructors

Ground Instructors in licence examination subjects are to have extensive experience in aviation and previous experience in teaching.

4.5 Numbers of Instructors (including part-time instructors)

4.5.1 The number of flying instructors employed on approved CPL/IR training shall be such that, in general, no instructor has more than six students allocated to him.

4.5.2 At least two full-time ground instructors, including the Chief Ground Instructor, shall be employed. The number of ground instructors employed on approved CPL/IR training duties shall be such that, to conform with sound educational practice, classes are not in excess of 24 students in subjects where the teaching does not involve significant amounts of practical or demonstration work, nor in excess of 16 students in subjects involving a high degree of supervision of practical work by students or extensive use of demonstration equipment. Ground instructors who are not involved in additional responsibilities should not exceed more than 23 contact hours in any one week or more than an average of 18 hours per week in any continuous period of 12 months.

4.5.3 Synthetic Flight Trainer instructors should not normally instruct for more than 1000 machine hours in any year.

4.5.4 The agreement of the Authority shall be obtained before part-time instructors instruct approved course students in synthetic flying or licence examination subjects. Part-time instructors shall not be employed on flying instructional duties.

4.6 Administrative Staff

Administrative staff shall be provided to maintain:

(a) satisfactory records of the entry of students in accordance with the specified educational requirements,

(b) detailed records of ground and flying training given to individual students,

(c) detailed and regular progress reports, based on individual reports from instructors, and regular progress flight tests and ground examinations.

5. TRAINING

5.1 Training Programme

A training programme shall be provided covering all aspects of the training to be conducted on the approved course. This training programme is to include a breakdown of the flying and ground training in either a week-by-week or phase presentation, a list of standard exercises and a syllabus summary. The content and layout of the training programme is to be agreed with the Authority and be such as to permit assessment, in some depth, of the standard and coverage of the training proposed.

5.2 Flying Training

Flying training shall be to the standard required by the licence flight tests and is to include sufficient flying experience to meet the requirements specified. The minimum hours to be spent on particular aspects of training are specified in Attachment 1 to this document.

5.3 Synthetic Flight Training

Synthetic flight training shall be integrated with the flying and ground training in a manner which will ensure that, as the various flying training exercises are carried out, the students will be able to apply to them the knowledge gained from the synthetic flight training. Arrangements should be made so that problems encountered in airborne instruction can be resolved during synthetic flight training subsequent to the air exercise.

5.4 Ground Training

5.4.1 Ground training shall be integrated with the flying training in a manner which will ensure that, as the various flying training exercises are carried out, the student will be able to apply to them the knowledge gained from the ground training, and vice versa as appropriate.

5.4.2 Ground training shall be given in the form of lectures and practical demonstrations. 'Directed Study' will not be accepted in lieu of lectures but students will be expected to carry out private study in their own time. The ground training shall be so arranged as to prepare students for the technical examinations in accordance with Attachment 2 and the examination syllabus.

6 TRAINING EQUIPMENT AND FACILITIES

6.1 Training Aeroplanes

6.1.1 An adequate number of training aeroplanes shall be provided having regard to the number of students and the organisation of courses. The fleet of aircraft shall comprise:

(a) Single-engined trainers for the ab-initio stage.

(b) Multi-engined trainers for the advanced stage.

(c) Aircraft suitable for demonstrating stalling, spinning and aerobatics.

(d) Aircraft equipped to allow flight in instrument flying conditions in Controlled Airspace.

6.1.2 No twin-engined training aeroplane shall be used for the purposes of approved CPL/IR training unless it and its equipment - including screens for instrument flying and blanking-off devices for limited panel flying - are approved by the Authority. A proportion (about 20%) of the single-engined aeroplanes used for approved CPL/IR training (including their equipment such as screens used for instrument flying and blanking-off devices for limited panel flying) must also be approved by the Authority. Minimum requirements for approval are specified in Attachment 3. Aircraft approvals shall be renewed annually.

6.2 Aerodrome

The aerodrome from which training is conducted and any satellite aerodromes used shall be suitable in every way for the types of aeroplane to be used on the course bearing in mind the special needs of student pilots and the performance of the aeroplanes.

6.3 Flying Wing Accommodation

The following accommodation shall be provided:

(a) An Operations Room with suitable facilities to control all flying operations.

(b) A flight Planning Room with suitable facilities including

(i) appropriate current maps and charts,

(ii) current AIS information,

(iii) current meteorological information,

(iv) suitable communications to ATC and the Operations Room,

(v) maps showing standard cross-country routes,

(vi) maps showing current Danger and Restricted areas.

(c) Briefing Rooms/Cubicles of sufficient size and number equipped with a blackboard, table, chairs and model aircraft or other appropriate training aids. Briefing rooms should be well-ventilated, heated and lit and either be isolated from the Crew or Ops Rooms or sound-proofed to allow briefings without external distractions.

(d) Suitable offices for the supervisory staff and room(s) suitably equipped to allow flying instructors to write reports on students, complete training records, etc.

(e) Suitably sized and furnished crew-rooms for instructors and students.

(f) Adequate lavatory and washing facilities.

6.4 Synthetic Flight Trainers

Suitably equipped synthetic flight trainers shall be provided having regard to the number of students and organisation of courses.

6.5 Ground School

6.5.1 The ground school and its associated facilities shall be situated within or close to the boundaries of the base flying aerodrome.

6.5.2 The lecture room accommodation collectively shall be such as to accommodate 60% of the entire student body at any one time with the proviso that, in the event of cancellation of the flying programme on an integrated course of approved training, other accommodation is available for the conduct of consequential ground training for the students scheduled for flying.

6.5.3 An equipment demonstration room shall be provided containing suitable demonstration equipment to support the ground lectures. The equipment is to include sectioned components and instruments, appropriate wall diagrams, transparencies, slides and models, systems demonstration equipment and mock-ups.

6.5.4 An R/T training and test facility shall be provided.

6.5.5 A reference library shall be provided containing sufficient publications to give adequate coverage of the syllabus.

6.5.6 Suitable offices shall be provided for the instructional staff.

6.5.7 Heating, lighting and ventilation of the ground school accommodation should have regard to the relevant recommendations made by the Department of Education and Science.

6.5.8 Adequate lavatory and washing facilities shall be provided.

6.6 Residential Accommodation

Residential accommodation provided for all students on approved CPL/IR courses shall be within approximately 30 minutes travelling time of the main aerodrome. Individual study/bedrooms are desirable and adequate recreation facilities should be provided. The catering arrangements are to be such as to allow flexibility of meal times to cater for night flying, etc.

6.7 Medical

Satisfactory arrangements are to be made to allow students to consult a physician about personal ailments and a delegated CAA Medical Examiner to renew Medical Certificates. A sick-bay is to be provided, preferably controlled by qualified nursing staff.

7 STUDENTS

7.1 Requirements for Entry to Training

A student accepted for training on an approved CPL/IR course shall satisfy the following minimum entry requirements:

(a) He shall have undergone a medical examination for a United Kingdom Commercial Pilot's Licence and have been assessed as fit by the Medical Branch of the Civil Aviation Authority.

(b) He shall hold a General Certificate of Education of England and Wales, or equivalent qualifications, with passes in 5 subjects at 'O' level including English Language, Mathematics and a recognised Science subject.

Commonwealth or foreign students will not in all cases hold British educational qualifications but the Chief Instructor shall satisfy himself that their educational attainments are comparable with those set out above and particularly that the candidate has attained a satisfactory standard in English (written and spoken), Mathematics and an appropriate Science subject before the CPL/IR course begins. Where any doubts exist with regard to educational qualification, these shall be resolved in consultation with the Civil Aviation Authority.

7.2 Abridged Courses of Training

If, as a result of gaining previous flying experience, a student wishes to apply for an abridged course of flying and/or ground training the school must arrange for an application for assessment to be made to CAA prior to the student entering training. The assessment will specify the minimum amount of dual and solo flying training and ground training required on the approved course to qualify for licence issue and the school is to ensure that the specified minimum amount of training is conducted on the approved course before application for licence issue is made.

7.3 Student Personal Records

The school shall maintain a record of personal information about each student, including the expiry date of his medical certificate and, if applicable, licence. It is also to include a statement of the minimum amount of flying training required to qualify for licence issue in the case of students on abridged courses.

7.4 Student Training Records

The form of the student training records shall be agreed with the Authority and be specified in the Training Manuals. These records are to include limited personal details of the student, including a summary of any abridged training requirement, a cumulative flying training record and a day-to-day record of flying training, including details of exercise and sub-exercises covered, instructor comments on performance, progress test and summary reports and the results of licence tests. Similar records are to be maintained in respect of synthetic flight training and ground instruction.

8 OPERATIONS AND TRAINING MANUALS AND ORDER BOOKS

8.1 A school applying for initial approval will be required to prepare Operations and Training Manuals containing such information and instructions as may be necessary to enable staff to perform their duties and students to conduct themselves while on course. A school holding approval will be required to satisfy tha Authority that the information required by paragraph 8 and by Attachments 4 and 5 is available in written form to staff and students as appropriate.

8.2 The Operations Manual will normally comprise several volumes, possibly under one cover, each providing relevant information to particular groups of staff, eg flying staff, ground training staff, operations staff, etc. Typical Information to be included in the Operations Manual is at Attachment 4.

8.3 The Training Manuals shall define the flying, synthetic flying and ground training, and should cover the items listed at Attachment 5.

8.4 The amendment policy and procedure shall be clearly stated and temporary orders or amendments catered for by use of Instructor and Student Order Books.

9 TIME LIMITS FOR THE COURSES

Full-time ab-initio courses for the Commercial Pilot's Licence and Instrument Rating, inclusive of all ground and flying training, shall have a planned duration of not less than 12 months, exclusive of holidays. Similar courses of training for the Commercial Pilot's Licence only shall have a planned duration, inclusive of all ground and flying training, of not less than 9 months, exclusive of holidays.

ATTACHMENT 1 SYLLABUS OF FLYING TRAINING

1 FOR THE CPL/IR

1.1 The syllabus of flying training for the Commercial Pilot's Licence and Instrument Rating shall be approved by the Authority and be designed to give the student both the flying experience specified in UK and ICAO licence requirements and adequate knowledge and ability in respect of the flight test manoeuvres and procedures specified by the Authority in the Combined General Flight Test and Instrument Rating Test.

1.2 To receive approval, the syllabus of flying training should include the following target periods of dual flying instruction and solo flying, including pilot-in-command under supervision (P1 u/s):

	Dual Instruction (Hours)	Solo Practice (Hours)
Navigation Flying Training	8	50 (incl 5 hr P1 u/s)
Night Flying Training	5	5 (may be P1 u/s)
Instrument Flying Training	35	25 (mutual or P1 u/s)

The remainder of the 230 hours of flying training may be made up with training in General Aircraft Handling. The precise allocation of flying hours is to be agreed with each school.

1.3 The syllabus shall include sufficient solo flying to allow the ab-initio student to complete 150 hours as pilot-in-command during the course and to meet in full the detailed requirements for issue of a CPL/IR.

2 FLYING TRAINING FOR THE CPL ONLY

Should a candidate be training for the Commercial Pilot's Licence only, the syllabus of flying training shall include an agreed portion of the approved CPL/IR flying training syllabus so as to give the student the flying experience specified in UK and ICAO licence requirements and adequate knowledge and ability in respect of the flight test manoeuvres and procedures specified by the Authority in the General Flight Tests (GFT) for the Commercial Pilot's Licence.

3 P1 u/s FLYING

3.1 The 150 hours as pilot-in-command obtained on a CPL/IR course may contain not more than 34 hours as pilot under supervision (ie with a flying instructor on board but with the student acting as pilot-in-command). In the case of a CPL-only course, 20 hours may be as pilot under supervision.

3.2 The intention of the P1 u/s concession is to permit:

(a) An instructor to fly with a student at least once per fortnight throughout the course to assess if additional dual flying is required.

(b) Flying instructors to act as safety pilots during instrument flying practice.

(c) Flying instructors to act as safety pilots during night cross-country flights in twin-engined aircraft.

3.3 Each flight credited as P1 u/s is to be flown subject to the following conditions:

(a) The student must be responsible for flight planning and clearance, including load sheet and fuel computations, if applicable.

(b) The student must comply with all checks, drills and emergency procedures specified by the school.

(c) Throughout the flight the student must carry out all the duties and functions of a pilot-in-command.

(d) He must take-off and land the aircraft and resolve unaided all problems of air traffic procedures, communications and meteorological conditions.

(e) P1 u/s may in no way be regarded as additional dual.

(f) Should the instructor have to overrule any course of action proposed or taken by the student, none of the flying time on that particular flight may be claimed as P1 u/s.

4 ....

5 ....

6 FLIGHT TESTING AND SAMPLING

6.1 Subject to a school maintaining satisfactory flying training records for inspection by the Authority and satisfactory arrangements being made for the Authority's examiners to make sample observations at any stage of a student's course of training, students undergoing approved CPL/IR courses of flying training may undertake the Combined General Flight Test and Instrument Rating in lieu of General Flight Tests 1, 2 and 3 and a separate Initial Instrument Rating Flight Test.

6.2 The procedures for sample testing are to be as follows:

(a) At least 25% of the students on each approved course are to undergo a sample test.

(b) Sample tests may be conducted on School Progress Tests (either conducted or witnessed by an examiner of the Authority) or on Student solo (P1 u/s) flights.

(c) CAA will make detailed arrangements for the sample testing (direct with the Chief Flying Instructor at the school concerned) so that the sample testing is conducted with minimum disruption to the student's routine training and so as to maximise examiner productivity.

(d) Either before or after a sample test, the examiner may require to review the training records of students on the approved course.

(e) Following a sample test, the examiner will invariably give a verbal de-briefing to the school's Chief Flying Instructor or his Deputy about any weaknesses in performance revealed during the sample flight test.

(f) When sample testing reveals deficiencies common to a range of students, CAA will write giving details to the school's Chief Flying Instructor.

ATTACHMENT 2 SYLLABUS OF APPROVED GROUND TRAINING FOR THE CPL/IR

1 The course of training shall be sufficiently detailed to give the student a sound basic knowledge of the subject matter as shown in the examination syllabus.

1.1 The time allocated to instructional work in ground school should be a minimum of 550 to 600 hours. This total should be broadly apportioned as follows:

Subject	Instructional Hours
Aviation Law, Flight Rules and Procedures	60
Flight Planning	50
Form of the Earth and Aeronautical Charts	35
Earth's Magnetism, Compasses and Instruments	30
Navigation (including revision of elementary maths, pilot navigation, use of computer, plotting etc)	100
Radio and Radar Aids (including simple propagation theory)	30
Meteorology	70
Radiotelephony	25
Signals	20
Theory of Flight	35
Airframes and Engines (General and Specific)	75
Performance	50
	580

1.2 Adequate time should be allocated to practical work, classroom exercises, progress tests, revision, demonstrations, films etc, and it is estimated that this may amount to some 40% of the total time. The actual balance between total hours, lectures, practical work, revision etc, must necessarily be made by the school authorities.

2 RELATED STUDIES

Additionally, at least 50 hours of the course should be devoted to additional studies related to the Aviation Industry. The aim of these studies should be to prepare the student for professional life in the Industry by helping him to take an intelligent interest in its problems. There is no set syllabus for these additional studies but the following arrangements would be acceptable:

Fortnightly talks on different aspects of aviation and related matters by well-informed people followed, in the alternate weeks, by discussions held under the supervision of a competent teacher.

3. AEROMEDICAL TRAINING

A course of basic training in aviation medicine for aviators shall be included. It is expected that this will require a minimum of 6 hours of instruction by a doctor qualified in aviation medicine.

ATTACHMENT 3 MINIMUM REQUIREMENTS FOR AEROPLANES TO BE USED FOR APPROVED CPL/IR TRAINING

1 No aeroplane shall be used for the purposes of the course unless it is approved by the Authority in accordance with the following minimum requirements:

(a) Each aeroplane shall have a valid Certificate of Airworthiness in either the Public Transport or the General Purpose Category and be maintained accordingly.

(b) Each aeroplane shall be fitted with duplicated primary flight controls for use respectively by the instructor and the student. (Swing-over flight controls will not be acceptable.)

(c) All flight, engine and associated ancillary instruments shall be readily visible to both the instructor and the student when sitting normally in their customary seats with safety belts or harnesses fastened.

(d) Trimmer, wheel brakes, wing-flap and (if applicable) undercarriage controls and all engine and fuel controls and cabin fire extinguisher shall either be duplicated or be positioned so that they are accessible to both the instructor and student when sitting normally in their customary seats with safety belts or harnesses fastened. (Some single-engined aircraft with fuel controls fitted on the portside and not readily accessible to the Examiner may be accepted.)

(e) Each aeroplane shall be fitted with at least one VHF Transceiver with 360 channels at 50 kHz spacing, controllable from both the student's and the instructor's stations. Two-way electrical intercommunication, which also permits the monitoring from one station of RTF communication made from the other, for use by both the instructor and the student, shall also be fitted. Handheld microphones are not acceptable. Separate transmit facilities shall be provided for the instructor and student. All radio apparatus shall be in Class 1, when so required by regulations.

(f) In addition to meeting the provisions of the British Civil Airworthiness Requirements (BCAR), each single-engined aeroplane shall have a turn and slip indicator (or turn co-ordinator and slip indicator), a gyroscopic bank and pitch indicator, a gyroscopic direction indicator and a sensitive pressure altimeter adjustable for changes in barometric pressure.

(g) Each aeroplane used for basic training shall be cleared for spins of at least two turns when loaded to the Utility Category weight limit. Exceptionally, spinning may be done on a different type specially provided for the purpose and it too shall satisfy all the requirments stated above in sub-paragraphs (b) and (c) and in this sub-paragraph, as applicable.

(h) Each aeroplane, except for those to be used for twin-engined training, shall be certificated in either the Aerobatic or Semi-Aerobatic Category or alternatively be cleared for Load Factors of +4.4g and -1.76g in accordance with BCAR in the Non-Aerobatic Category.

(j) Each aeroplane used for Aerobatic training shall be in either the Semi-Aerobatic or Aerobatic Categories as defined by BCAR and be certified as capable of performing loops, barrel rolls, slow rolls, stall turns, half rolls, half rolls off the top of loops and spinning.

(k) Twin-engined aeroplanes may be in a Non-Aerobatic Category as defined in BCAR.

(l) In addition to meeting the provisions of BCARs, each twin-engined aeroplane shall be equipped with radio receivers for navigation.

(m) When so required, provision shall be made for a stop watch readily usable by the student in flight. This may be part of the aircraft equipment, failing which a stop watch holder must be provided.

2 A means of screening the student from external references shall be provided to simulate instrument flight conditions. Head worn visors or similar devices are not acceptable for test purposes. Screening must meet the following requirements:

(a) Permit the visual take-off by means of a hinged flap or sliding shutter(s).

(b) Preclude the use by the student of any external references when in simulated IF conditions:

(i) for single-engined aircraft, through 75°

(ii) for twin-engined aircraft, through 60°

either side of straight ahead of the student

(c) Allow both the student and the instructor an unimpeded access to all controls and an unrestriced view of the instruments, especially the magnetic compass during limited panel flying.

(d) Be angled to ensure minimum interference to the all-round lookout from the normal seating position of the instructor.

(e) Be simple to erect and remove in flight, and be constructed in a material which will bend or collapse easily on impact.

3 Devices for blanking-off the Artificial Horizon/Attitude Indicator and the Direction Indicator shall be provided for the limited panel Instrument Flying Training.

ATTACHMENT 4 TYPICAL INFORMATION TO BE INCLUDED IN OPERATIONS MANUALS AT A SCHOOL APPROVED TO CONDUCT CPL/IR COURSES

Operations Manuals for use at a school approved to conduct CPL/IR courses shall contain the following information:

(a) In the Operations Manual (General):

A list and description of all volumes in the Operations Manual

Administration (function and management)

Responsibilities (all management and executive staff)

Student discipline and disciplinary action

Approval/authorisation of flights

Preparation of flying programme (restriction of numbers in poor weather)

Command of aircraft - responsibilities of aircraft commander

Carriage of passengers

Aircraft documentation

Retention of documents

Flight crew qualifications

Records (licences and ratings)

Renewal (licences and ratings)

Flying duty period and flight time limitations (staff)

Flying duty period and flight time limitations (students)

Rest periods (staff)

Rest periods (students)

Pilots' log books

Aeroplane maintenance and technical logs (A/c to be maintained to Public Transport standards)

Flight planning (general)

Safety (general) - equipment, radio listening watch, hazards, accidents and incidents (including reports) etc

(b) In the Operations Manual (Technical)

Aircraft descriptive notes

Aircraft handling (including check lists, limitations, etc)

Emergency procedures

Radio and radio aids

Allowable deficiencies

(c) In the Operations Manual (Route)

Performance (legislation, T/O, route, landing etc)

Flight planning (fuel, oil, minimum safe altitude, nav equipment etc)

Loading (loadsheets, weight, balance, limitations)

Weather minima (staff)

Weather minima (students - at various stages of training)

Training routes/areas

(d) In the Operations Manual (Training) Staff

Appointments of persons responsible for standards/competence of flying staff

Initial training

Refresher training

Standardisation training

Competency checks

Upgrading training

Upgrading tests

ATTACHMENT 5 TYPICAL INFORMATION TO BE INCLUDED IN TRAINING MANUALS AT SCHOOLS APPROVED TO CONDUCT CPL/IR COURSES

A Training Manual for use at a school approved to conduct CPL/IR courses should be divided into sections, as necessary, containing the following information:

Part 1 - The Training Plan

The Aim of the Course	A statement of what the student is expected to be able to do as a result of the training, the level of performance to be achieved, and the training constraints to be observed
Pre-entry requirements	Minimum age Educational requirements Medical requirements
Reductions for previous experience	Flying training Ground training Training period } to be obtained from CAA before training begins
Customer requirements	A full statement of any additions to the minimum approval requirements
Training Syllabi	The Flying Syllabus (Single-engine) The Flying Syllabus (Twin-engine) The Synthetic Flight Trainer Syllabus The Ground (Technical) Syllabus
The Time Scale and Integration of Syllabi	Arrangement of the course and the time scale, in weeks, for each Syllabus
Training Programme	The general arrangement of daily and weekly programmes for flying, ground and synthetic flight training Bad weather programmes Programme constraints in terms of maximum student training times, including flying, ground, simulator and directed private study, eg per day/week/month. Restrictions in respect of duty periods for students.

	Duration of dual and solo flights at various stages. Maximum flying hours in any day/night; maximum number of sorties in any day/night. Minimum rest period between duty periods.
Training records	The form of training records to be kept.
	Persons responsible for checking records and students' log books. The nature and frequency of record checks.
	Standardisation of entries in training records. School rules concerning log book entries. Licence signatures, Log Book certificates.
Safety training	Individual responsibilities
	Essential exercises
	Emergency drills (frequency)
	Dual checks (frequency at various stages)
	Requirements before first solo day/night/navigation etc
	Certification
Tests and examinations	Flying (a) Progress checks
	(b) Qualifiying tests
	(c) Qualifying experience
	Ground (a) Progress tests
	(b) Qualifying Examinations (Internal)
	(c) Qualifying Examinations (External)
	CAA Authorities for test
	School rules concerning refresher training before retest
	Series of 3 attempts at Combined GFT/IR
	Test reports and records

Training effectiveness	Individual responsibilities
	General assessment
	Liaison between departments
	Identification of unsatisfactory progress (individual students)
	Actions to correct unsatisfactory progress
	Procedure for changing instructors
	Maximum number of instructor changes per student
	Procedure for suspending a student from training
	Discipline
	Reporting and documentation
Standards and standardisation	Individual responsibilities
	Level of performance at various stages
	Standardisation requirements and procedures
	Application of test criteria

Part 2 - Briefing and Air Exercises

Air exercise specification	A detailed statement of the content of all the air exercises to be taught, arranged in numerical order with main and sub titles. This should normally be the same as the Air Exercise Specification in the CAA Training Manual for the Commercial Flying Instructor Rating Course.
Air exercise reference list	An abbreviated list of the above exercise giving main and sub titles only for quick reference, and preferably in flip-card form to facilitate daily use by flying instructors.
Course structure - phases of training	A statement of how the course will be divided into phases, indicating how the above air exercises will be divided between the phases and how they will be arranged to ensure that they are completed in the most suitable

	learning sequence and that essential (emergency) exercises are repeated at the correct frequency. Also, state the syllabus hours for each phase and for groups of exercises within each phase and when progress tests are to be conducted, etc.
Course structure - integration of syllabi	State the manner in which technical, simulator and flying training will be integrated so that as the flying training exercises are carried out students will be able to apply the knowledge gained from the associated ground and simulator instruction.
Student progress requirement	State the school requirements in this respect and include a brief but specific statement of what a student is expected to be able to do, and the standard of proficiency he must achieve before progressing from one phase of air exercise training to the next. Include minimum experience requirements in terms of hours, satisfactory exercise completion, etc as necessary before the commencement of significant exercises, eg night flying.
Instructional methods	State the school requirements (not covered in Part 1 of this Attachment particularly in respect of pre- and post-flight briefing, adherence to syllabi and training specifications, the authorisation of solo flights, etc.
Progress tests	State the instructions given to examining staff in respect of the conduct and documentation of all progress tests.
Glossary of terms	Define significant terms as necessary.
Appendices	Progress test report forms
	Qualifying test report forms
	School certificates of experience, competence, etc as required.

Part 3 - Synthetic Flight Training

Structure generally as for Part 2.

Part 4 - Ground Training (Technical)

Structure generally as for Part 2 but with a training specification for each subject. Individual lesson plans to include mention of the specific training aids available for use.

Part 5 - Ground Training (Related Studies)

Aim of training and proposed programme.

APPENDIX 2

GLOSSARY

A number of terms used in this guide may be found in Annex 1 and the Training Manuals. Some are repeated here for convenience, in some cases with modified wording.

Approved Training	Training carried out in accordance with a detailed syllabus derived from special curricula approved by a State authority, and subject to a continuous process of monitoring and supervision.
Assessment	Measuring an individual's performance using some given or accepted scale, intended to portray his achievement or ability as accurately as possible.
Competence	The level of ability which an individual demonstrates in carrying out specific tasks, and which he can be relied upon to maintain consistently.
Curriculum	The total content of knowledge and skill to be acquired during a course of training.
Examination/Test	The use of oral, written, or practical exercises to measure performance against a standard.
Experience	The total exposure which an individual has had in a particular field through training, practice and operational work, which may give some indication of his probable level of performance.
Essay Examination	A set of questions requiring the examinee to compose answers in writing and for which no single pattern of response is uniquely correct, so that marking calls for subjective evaluation by a skilled and informed examiner.
Objective Examination	An examination in which every question is set in such a way as to have only one right answer.
Syllabus	The detailed content of each and every subject in a course of training, presented in order corresponding to the teaching sequence.
Training	The complete process of formal instruction and practice through which new skills and knowledge are acquired and retained.

APPENDIX 3

ACKNOWLEDGEMENTS

In the compilation of these guidance notes, frequent reference has been made to Annex 1 and the ICAO Training Manuals. Use has also been made of the following documents, from which many ideas and suggestions have been taken. The help given in this way by authors and organizations involved is acknowledged.

Examination and Assessment Methods	Royal Air Force School of Education. 1974.
Flying Syllabus of the Oxford Air Training School.	O.A.T.S., U.K. 1980/1981.
International Seminar on Civil Aviation Training (Proceedings).	Nigeria. 1977 & 1980.
Professional Pilot Licensing. Symposium (Proceedings).	Guild of Air Pilots and Navigators. U.K. 1975.
Requirements for the Approval of Flying Training Courses.	Civil Aviation Authority. U.K. 1977.
Training Airline Co-Pilots. Training and Development of Public Transport Training Pilots.	Air Transport and Travel Industry Training Board U.K. 1973 - 1982.

- END -

ICAO TECHNICAL PUBLICATIONS

The following summary gives the status, and also describes in general terms the contents of the various series of technical publications issued by the International Civil Aviation Organization. It does not include specialized publications that do not fall specifically within one of the series, such as the Aeronautical Chart Catalogue *or the* Meteorological Tables for International Air Navigation.

International Standards and Recommended Practices are adopted by the Council in accordance with Articles 54, 37 and 90 of the Convention on International Civil Aviation and are designated, for convenience, as Annexes to the Convention. The uniform application by Contracting States of the specifications contained in the International Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of international air navigation. Knowledge of any differences between the national regulations or practices of a State and those established by an International Standard is essential to the safety or regularity of international air navigation. In the event of non-compliance with an International Standard, a State has, in fact, an obligation, under Article 38 of the Convention, to notify the Council of any differences. Knowledge of differences from Recommended Practices may also be important for the safety of air navigation and, although the Convention does not impose any obligation with regard thereto, the Council has invited Contracting States to notify such differences in addition to those relating to International Standards.

Procedures for Air Navigation Services (PANS) are approved by the Council for world-wide application. They contain, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome.

Regional Supplementary Procedures (SUPPS) have a status similar to that of PANS in that they are approved by the Council, but only for application in the respective regions. They are prepared in consolidated form, since certain of the procedures apply to overlapping regions or are common to two or more regions.

The following publications are prepared by authority of the Secretary General in accordance with the principles and policies approved by the Council.

Technical Manuals provide guidance and information in amplification of the International Standards, Recommended Practices and PANS, the implementation of which they are designed to facilitate.

Air Navigation Plans detail requirements for facilities and services for international air navigation in the respective ICAO Air Navigation Regions. They are prepared on the authority of the Secretary General on the basis of recommendations of regional air navigation meetings and of the Council action thereon. The plans are amended periodically to reflect changes in requirements and in the status of implementation of the recommended facilities and services.

ICAO Circulars make available specialized information of interest to Contracting States. This includes studies on technical subjects.

6/83, E/P1/2200; 3/92, E/P2/250;
12/95, E/P3/250

Order No. 9401
Printed in ICAO