Operational Procedures

Edition 1.0

Introduction, Annex 6 & Subpart A

INTRODUCTION

BASICS

- The **Operations Manual** must be followed except for **emergencies**
- **PIC** is responsible for following procedure

OPERATIONS MANUAL

- **Part A – General/Basic** (Company Wide)
- **Part B – Type Specific**
- **Part C – Aerodrome** and **Routes**
- **Part D – Training**
- Prepared in **English** but may be translated to suit staffing needs
- Crew members must receive Part A and B for personal study

DEFINITIONS

- **MOPSC -** Maximum Operational Passenger Seating Configuration
- **MCTOM –** Maximum Certified Take-Off Mass
- **Commercial Air Transport –** Transporting passengers, cargo or mail for remuneration or other valuable consideration

ICAO ANNEX 6 & SUBPART A

ICAO ANNEX 6

- Refers to operation of **commercial aircraft**
- Applies to **passenger** and **cargo** ops
- Provides Standards and Recommended Practices (SARPs)

ICAO ANNEX 6 SECTIONS

- **I – Definitions**
- **II – ARO – Authority**
- **III – ORO – Operators** (*Organization Requirements*)
- **IV – CAT – Commercial Air Transport**
- **V – SPA – Specific Approvals**

ALTERNATES

- **Alternate –** Usable aerodrome if required
- **Destination Alternate –** Alternate aerodrome if the destination is unusable
- **Enroute Alternate –** Alternate for enroute emergencies
- **ETOPS Alternate –** Alternate for emergencies occurring during ETOPS
- **Takeoff Alternate –** Alternate if departure aerodrome cannot be returned to
- **Flight Time –** Considered as brakes off brakes on time

MAINTENANCE RELEASE

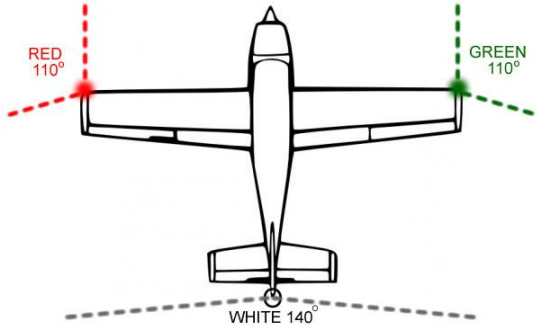
- Contains identity of the **AMO** (Part **145**) and identity of the **engineer** (Part **66**)

SAFETY MANAGEMENT

- Part of the **airline**
- Carry out **periodic audits**
- **Recommended** if **MCTOM >20,000kg**
- **Mandatory** if **MCTOM >27,000kg**
- Includes a **Safety Review Board**
  - Chaired by the **Accountable Manager** (or a **Line Captain**)
  - Allocates appropriate resources
- The **Safety Manager** should:
  - Carry out **periodic safety reports**
  - Facilitate **hazard identification**
- Communication to individual employees depends on their specific safety responsibilities

NAVIGATION LIGHTS

- **Wing** Lights (**Red** and **Green**)- **110°** Range
- **Rear** Light (**White**) - **140°** Range
- Only required at **night**
- Always **steady** (not flashing)



Operators Responsibilities

MASTER MINIMUM EQUIPMENT LIST

- Made by the **manufacturer** or **designer**
- Always **less restrictive** than the **MEL**
- Must be **approved** by the **Manufacturers State Authority**

MINIMUM EQUIPMENT LIST

- Found in **Ops Manual Part B**
- Written by the **Operator**
- Approved by the **Operators State Authority**
- Only relevant **stationary prior to departure**
- When **moving**, use the **Abnormal and Emergency Procedures Checklists**
- Operations outside the MEL only allowed with authority approval
- **90 days** to reflect changes from MMEL

RECTIFICATION INTERVALS

- **Category A –** Repaired by the time specified in the **Remarks/Exceptions**
- **Category B – 3** consecutive days
- **Category C – 10** consecutive days
- **Category D – 120** consecutive days
- Starts at midnight that night
- Expires 1 minute after midnight

COMMON LANGUAGE

- **Crew** members speak the **same language**
- **Ops Manual** must at least be in **English**

FLIGHT SAFETY

- Flight data monitoring program required if **MCTOM >27,000kg**

QUALITY SYSTEM

- Large companies have **Operations** and **Maintenance** systems
- **Approved** by the **authority**
- A form of *internal auditing* (feedback system)

MANAGEMENT STRUCTURE

- Must have an **accountable manager**
- Other post holders include:
  - Flight Ops
  - Maintenance System
  - Crew Training
  - Ground Operations
- **>21 employees = Complex** Company

OPERATOR/COMMANDERS DUTIES

They must prevent…

- People in parts of the plane not designed for accommodation
- Passengers using portable electronic devices
- Boarding of intoxicated individuals
- Unauthorized admission to the flight deck
- Carriage of unauthorized people/cargo

CREW MEMBERS

- Includes **flight and cabin crew**
- **Additional** crew member – **Not** associated with **operational** or **safety** duties
- **Cabin crew** must report anything they see to the **Commander**
- Anything that occurs that **affects safety of other flights** must be **reported to ATS immediately**
- Other occurrences reported within **72 hours**

PAPERWORK REQUIRED

- Certificate of Registration
- Certificate of Airworthiness
- Noise Certification
- AOC
- Aircraft Radio License
- Third Party Liability Insurance
- Valid Flight Crew License

COPIES ON THE GROUND

- **M**ass and Balance
- **O**perational Flight Plan
- **N**OTAMs
- **S**pecial Loads
- **T**ech Log

INSPECTIONS

- State does **ramp inspections** of paperwork within a **reasonable period** (10 days)
- **Commander** must **allow access** to the flight deck **unless** it **impacts safety**
- **FDR** kept after an accident for **60 days**

LEASING

- **Dry Lease – No crew** provided operated under **AOC of the lessee**
  - **Dry Lease In** must be **<7 months** in a **12 consecutive month** period (**non-EU**)
- **Wet Lease – Crew provided** operated under **AOC of the lessor**

Operator Certification & Operational Procedures

OPERATOR CERTIFICATION

AIR OPERATORS CERTIFICATE (AOC)

- Granted by the **NAA**
- Given to an **Operator** to conduct **CAT**
- Requires the **Operator** to have **personnel, assets** and **safety systems** for **employees** and the **general public**
- Also requires an **accountable manager** and an **Operations Manual**
- An **accident** does **not** mean it is **revoked**
- Contains **special authorizations**

OPERATIONAL PROCEDURES

DEFINITIONS

- **Adequate Aerodrome –** Satisfactory aerodrome that meets ops requirements
- **ETOPS –** Extended Range Twin Engine Operational Performance Standards
- **Isolated Aerodrome –** Has no destination alternate
- **Equivalent Position –** Suitable fix 3-5 miles from threshold
- **Critical Phases of Flight –** Take-Off, Climb Out, Final Approach, Landing and anytime the Commander decides
- **OEI –** One Engine Inoperative
- **AEO –** All Engines Operative
- **MASPS –** Minimum Aviation System Performance Standards

OPERATOR RESPONSIBILITIES

- Provide **checklists**
- **No activities** in **critical phases** of flights
- Ensure **ATS** used wherever possible
- Establish **Aerodrome Operating Minima**
- Use **instrument departures** and **approaches** where published

RVSM

- In RVSM airspace, **1,000ft** separation applies between **FL290** and **FL410**

MAX. DISTANCES FROM ADEQUATE ADs

Performance Class A

- MOPSC >=20 or MCTOM >45,360kg
- **60 mins** (OEI cruise speed)

Performance Class B

- MOPSC <=19 or MCTOM <45,360kg
- **120 mins** (OEI cruise speed)

Performance Class B and C

- **120 mins** (OEI cruise speed) or **300nm** (least)

*This is for **non-ETOPS** aircraft*

NO SMOKING/FASTEN SEAT BELTS SIGNS

- If not all seats are visible to flight crew, signs should be visible by **all pax** and **cabin crew**
- No Smoking sign on if oxygen is being supplied in the cabin

MINIMUM FLIGHT ALTITUDES

- Used in an engine failure
- **Operators must establish** this
- Methods are **approved by the State**
- Will account for **altimeter inaccuracies**

FUEL POLICY

- Established in the **Ops Manual**
- **Taxi**, **Trip**, **Reserves** (***not ETOPS***) and **Extra**
- **Crew** responsible for **in-flight re-planning**
- Must land with **Alternate + Final Reserve** or it is a **fuel emergency**
- **Final reserve** is **45 mins** (**reciprocating**) or **30 mins** at holding speed at 1500ft (**jets**)
- **Additional fuel** (**isolated aerodromes**) is **2 hours** normal cruise consumption

PASSENGERS WITH REDUCED MOBILITY

- Cannot sit where they will **impede crew**, **access to emergency equipment** or **evacuation** through **emergency exits**
- **Commander** must be **notified**

SPECIAL CATEGORIES OF PASSENGERS

- Includes children under 12, PRMs, inadmissible persons, deportees and people in custody
- **Commander** must be **notified**

TAKE-OFF ALTERNATE

No. of Engines	Time (OEI Cruise Speed)
2 (Non ETOPS)	60 mins
2 (ETOPS)	120 mins (or ETOPS value if lower)
3 and 4	120 mins

- Used if impossible to return to departure aerodrome
- May be **further restricted** by the **MEL**
- If no alternate is available, conditions must be **better than required for landing** with an **available instrument approach** (**AEO**)

DESTINATION ALTERNATE

Minimum 1 alternate IFR unless:

- Flight time **<6 hours**
- **2+ separate runways** available and/or Wx reports indicate **ceiling >2,000ft** or **circling height + 500ft** and **vis >5km ±1 hour of ETA OR**
- Aerodrome is **isolated**

2 destination alternates required if:

- Wx reports indicate **below planning minima ±1 hour from ETA**
  OR
- **No Wx information** is available

IFR PLANNING MINIMA

- Before dispatch, check **Wx ±1 hour from ETA**
- **Take-Off – Ceiling** and **RVR** considered
- **Destination – RVR/Visibility** (and ceiling as above) is met or 2 alternates are needed
  - **Ceiling not considered** for **PA**s
- Increased minima are used to allow for deterioration

Planning Alternate Minima

Approach	Minima Of…
ILS CAT II & III	CAT I RVR
ILS CAT I	NPA RVR and Ceiling > MDH
NPA	NPA but RVR +1000m and Ceiling > MDA +200ft
Circling	Circling

ETOPS PLANNING MINIMA

- Allows greater distance from an alternate
- Wx reports used from **ETA until 1 hour** from **latest possible landing time**

	Alternate Ceiling	Weather Minima
PA	DH **+200ft**	Vis +**800m**
NPA/Circling	MDH **+400ft**	Vis +**1500m**

SPECIAL VFR

- Requires **1500m flight visibility**, **<140kts** IAS and **Clear of Cloud** & **In-Sight of Ground**

REFUELING AND DEFUELING

- May be done with passengers boarding if Operator is authorized
- This requires **qualified person on-board**, **2-way comms**, crew, staff and passengers warned, FSB signs off, No Smoking on, Lights inside on, minimum number of cabin crew onboard & **emergency slides/exits clear**
- *Should be stopped if you smell fuel!*
- **Prohibited** for **wide-cut fuels/AVGAS**

CREW MEMBER STATIONS

- **Cabin crew** stationed for **take-off** & **landing**
- **Flight crew** always at stations **except** for **physiological needs**
- **≥1 suitably qualified pilot** at the controls
- Controlled rest permitted if the Commander decides (not a qualifying rest period)
- **Pilots** should be strapped in for **take-off**, **landing** and when the **Commander decides**
- **Safety belt always fastened** while seated

COMMENCEMENT

- Prior to **take-off**, expected conditions at **ETA** should be **above planning minima** at the **destination** and the **alternate**
- **In flight**, conditions at **ETA** and **1 alternate** **above operating minima**
- **VFR** requires **RVR >800m**

APPROACH AND LANDING

- Approach may be started, but cannot descend below **1,000ft** unless above minima
- Approach then be continued to DH/MDH

RVR TO VISIBILITY CONVERSION

- **Reported Vis x Value = RVR**

	Day	Night
High Intensity	1.5	2
Lit	1	1.5
Unlit	1	

- **TDZ RVR** is the **controlling** value
- Midpoint Minimum – 125m
- Stop End Minimum – 75m

OCCURRENCE REPORTING

- **72 hours** unless a **safety hazard** (including **birds**), **unlawful interference**, **ACAS advisory** or **air traffic incidents**
- In which case it should be reported **immediately** to the **Authority** of the **State of the Operator**
- Also reported to the **local authority** in the case of **unlawful interference**

Low Visibility

MINIMA

- **Operator Aerodrome Operating Minima not lower** than the **State minima**

CLASSIFICATIONS

- V_{AT}/V_{REF} = **1.3** V_{S0} or 1.23 VS_{1G}
- This is the speed over the threshold

Category	V_{AT} Speed
A	>91kts
B	91-120kts
C	121-140kts
D	141-165kts

DEFINITIONS

- **Circling –** Instrument approach finished by a visual circle to a different runway
- **LVP –** Low Visibility Procedure – Anything **less than CAT I ILS** (**not inclusive**)
- **LVO –** Low Visibility Operations
- **LVTO –** Low Visibility Take-Off
- **CDFA –** Continuous Descent Final Approach
- **SAp –** Stabilized Approach
- **NPA –** Uses **MDH** or ***DH if using CDFA***

LOW VISIBILITY OPERATIONS

- **Established** by the **Operator**
- For operator validation of DH:
  - **50ft or greater** for at least **30 approaches/landings**
  - **Less than 50ft** for at least **100 approaches/landings**
- Must be **monitored** and **reports retained** for **12 months**

LVO REQUIREMENTS

- **2 qualified pilots**
- **Radio altimeter** giving **callouts below 200ft above threshold elevation**
- System to record **success**/**failure** of **approach** and/or **Autoland**

LVTO

- Begins **below 400m RVR**
- Cannot go below **150m RVR** (**Categories A**, **B** and **C**) or **200m for Category D** unless authority approves
- If **no RVR reported**, **PIC** may **visually determine the RVR**

TRAINING

- **Training** and **checking syllabus** are **approved** by the **Authority**
- **All** flight crew members qualified and current
- **1st Phase – Normal** Operations
- **2nd Phase – Abnormal** and **Emergency** Operations
- Must do **at least 4 approaches**
- Includes **taxi**, **take-off**, **approach**, **flare**, **landing**, **roll-out** and **missed approach**

NPA MINIMA

- **Ceiling irrelevant** for **OPERATING minima**
- **Back-beam** approaches are **not approved**
- **VOR – 300ft** DH
- **VOR/DME** or **LOC – 250ft** DH
- **NDB – 350ft** DH
- **NDB/DME – 300ft** DH
- **SRA** (terminating at **1nm**) **– 300ft** DH

PA MINIMA

	DH (ft)	RVR (m)
CAT I	200	550
CAT II	100	300
CAT IIIA	100	200
CAT IIIB	No DH	75*

- **75m** RVR is only with **fail operational** roll-out guidance
- **Fail passive** roll-out guidance for **CAT IIIB** = **150m** RVR (**125m** if **DH <50ft**)

CIRCLING APPROACH MINIMA

	Aircraft Category			
	A	**B**	**C**	**D**
MDH (ft)	400	500	600	700
Vis (m)	1500	1600	2400	3600

CONTINUATION OF APPROACHES

Below MDA for ILS CAT I:

- Approach Lighting
- Runway Threshold
- PAPI
- TDZ
- Runway Edge Lights

Below DA/H for LTS CAT I and II:

3 consecutive…

- Approach centerline
- Runway centerline
- TDZ
- Runway Edge Lights

AND

- A lateral element of ground pattern

ITEMS NOT REQUIRING APPROVAL

- Fuses
- Electronic torches
- Accurate **time piece** (**minimum 1** required)
- Chart holder
- First aid kit
- Megaphone
- Survival and pyrotechnic equipment
- Sea anchors (for seaplanes)
- Child restraint devices (used for **infants**)

SPARE FUSES

- **Greater** of **10%** or **3** for **each rating**

WIPERS

- **MCTOM >5700kg** equipped each side

AUTOPILOT

- **Single pilot IFR** must include **altitude** and **heading hold** modes

IFR AND NIGHT OPS

- **2 sensitive pressure altimeters**
- **2 independent static pressure systems** (alternate static may be used for props <5700kg MCTOM)
- **Additional standby attitude indicator** if **MCTOM >5700kg** or **MOPSC >9** that must last **30 minutes**

ALTITUDE ALERTING SYSTEM

- Needed if **MCTOM >5700kg** & **MOSPC >9**
- **Alerts** when **approaching preselected altitude** by **900ft** or **deviating** by **>300ft**

GPWS

- **MOPSC >9** & **MCTOM >5700kg**

ACAS

- **MCTOM >5700kg** and **MOPSC >19**

AWR

- Required if **thunderstorms expected** or at **night** if **pressurized** or **un-pressurized** with **MCTOM >5700kg** or **MOPSC >9**

CREW MEMBER INTERPHONE

- **MCTOM >15,000kg** or **MOPSC >19** and **>1 crew member**

PUBLIC ADDRESS SYSTEM

- **MOPSC >19**
- Operated within **10 secs** at each station
- Audible **everywhere** in the aircraft

CVR

- Records the last **2 hours** of operation
- **<5700kg/before 1998** this is only **30 minutes**
- **Starts before aircraft can move** under own power, **stops after it can't** anymore
- Datalink has same requirements as CVR

FDR

- Records last **25 hours** of operation (**10 hours** if **>5700kg**)
- Equipped on **all aircraft >5700kg**, **all multiengine turbines** with **MOPSC >9**
- Same recording triggers as the CVR

SEATS

- **Adult – 12+**
- **Child – 2-12**
- **Infant – <2** (**do not need their own seat**)
- Must be aligned within 15° of the longitudinal axis

FIRST AID KITS

- **Minimum 1 per 100 seats**
- **Maximum 6 if over 500 seats**
- Must be **readily accessible**

EMERGENCY MEDICAL KIT

- Includes syringes, defibrillators and drugs
- Kept **secure** in **flight crew compartment**
- **Minimum 1** if **MOPSC >30** or **>60 mins** from an aerodrome with **qualified medical assistance**
- *Medical Kits = First Aid Kits + Emergency Medical Kits*

THERAPEUTIC OXYGEN (FIRST AID)

- **Undiluted** oxygen for **passengers/crew** that for **physiological reasons**, **require** it after a **decompression**
- **Required** on pressurized flights >25,000ft or cabin altitude **>8,000ft**
- Minimum **2 dispensing units**
- Average flow rate of 3 liters per minute (Standard Temperature Pressure Dry)
  - Starts at **4 liters per minute**
  - Decreases to 2 liters per minute minimum
- Enough for **2%** of the **passengers carried** but **never less than 1**

SUPPLEMENTAL OXYGEN

- **Utility** must be checked **before taxi** and **demonstrated before take-off**
- **Cabin altitude horn** sounds **>10,000ft**
- Flight deck needs **quick-donning** masks when operating **>25,000ft**
- Maximum altitude without oxygen for **100% efficiency** is **8,000ft**
- Total number of **dispensing outlets** must **exceed the number of seats by 10%**

UNPRESSURISED REQUIREMENTS

- **Flight Deck**
  - **Entire time above 10,000ft**
- **Cabin Crew**
  - **10-13,000ft - >30 minutes**
  - **13,000ft+ - Entire time**
- **Passengers**
  - **10-13,000ft – 10%** of **pax**
  - **13,000ft+ - All passengers**

PRESSURISED REQUIREMENTS

- **Flight Deck & Cabin Crew**
  - **10-13,000ft – >30 minutes**
  - **13,000ft+ - Entire Flight** (or **>2 hours**)
  - **41,000ft+ - 1 pilot** must wear a **mask**
- **Passengers**
  - **10-14,000ft – >30 minutes** for **10%** of pax
  - **14-15,000ft – 30%** of the passengers
  - **15,000ft+ – All** of the passengers will be automatically presented
  - Never less than **10 minutes**

HANDHELD FIRE EXTINGUISHERS

Minimum Requirements (Cabin):

- **7-30 seats – 1**
- **31-60 seats – 2**
- **61-200 seats – 3**
- *Then **1 additional** for **every 100** MOPSC up to **maximum of 8** extinguishers*

Additional Requirements:

- 1 in the cockpit
- 1 per galley
- 1 per cargo/baggage compartment
- *Only applies if minimum criteria not satisfied*

CRASH AXES OR CROWBARS

- Used to obtain access to a fire
- Located on the **flight deck**
- **1** if **MCTOM >5700kg** and **MOPSC >9**
- **MOPSC >200 additional 1** in **rear galley**

BREAK-IN POINTS

- Marked with **red**/**yellow** markings
- **Right angled** corners

MEGAPHONES

- Required **MOPSC >60**
- **Additional 1** required if over **100 per deck**
- **No requirement** if the aircraft is **empty**

EMERGENCY EVACUATION

- Slides installed if higher than **1.83m** (**6ft**)
- Tested with landing gear **extended** (**before 2000**) or **collapsed** (**after 2000**)
- Will inflate using **self-contained inflator**
- Manual inflation handle serves as a back-up
- Slide **won't** inflate if opened from **outside**

EMERGENCY LIGHTING

- Lighting must remain on for **10 mins**
- Lighting is **ARMED** in normal flight
- General illumination, floor level lighting and illuminated exit lights required if **MOPSC >9**

EMERGENCY LOCATOR TRANSMITTER

- Transmits on **121.5 MHz** and **406 MHz** **simultaneously**
- Battery lasts **48 hours**
- **MOPSC <19 – 1 of any type**
- **MOPSC >19 – 1 automatic** or **2 of any type**

LIFEJACKETS AND RAFTS

- **Lifejackets** required **>50nm** from shore or where **take-off/landing** could result in ditching
- Required for **each passenger**
- Must have a locator light
- **Life raft** required **>120 mins** at **cruise speed** or **400nm** (**lesser**) **from landing**
- **1 spare** required of **largest rated capacity**

SURVIVAL EQUIPMENT

Flying over areas where SAR is difficult…

- **<90mins** from suitable emergency landing area **without survival equipment**
- Should be equipped with **signaling** equipment, **>1 ELT** and whatever **additional** equipment is necessary

Comms and Nav Equipment & Maintenance

COMMS AND NAV EQUIPMENT

GENERAL

- Equipment must be operable by flight crew **all** members (whilst **IFR**)
- Where there is only **one device** it must be reachable by **all** **flight crew**
- Must be in accordance with the MEL

NAVIGATION EQUIPMENT

- For **IFR** or **VFR with no references**, **1 piece** of **VOR**, **ADF** and **DME** equipment is required
- **ADF** **omitted** if **not** **required** for that flight
- **1 equipment failure** should **not** **affect any** of the **other equipment**

RADIO EQUIPMENT

- All radio comms equipment must be able to communicate on **121.5 MHz**
- **Minimum** is **1 radio** and **1 transponder** (**VFR** with **visual references**)
- **IFR requires 2 independent radios** and a **headset/microphone** for **each pilot**
- Where **2 independent radios** are required, **each** must have their **own antenna**
- All ETOPS ops beyond 180 minutes requires reliable communication technology installed (either voice based or data link)
- **SSR Transponder** may be a **route-specific requirement**

REQUIREMENTS FOR MNPS OPS

- **All** MNPS nav equipment must be accessible from **both** **seats**
- **2 LRNS** systems are required for **unrestricted** **operations**

REQUIREMENTS FOR RVSM OPS

- **2 altitude measurement systems**
- **1 altitude alerting system**
- **1 automatic control system**
- **1 SSR transponder**

MAINTENANCE

APPLICABLE EU-OPS SECTIONS

- **Part M – Maintenance**
- **Part 145 – Approved Maintenance Organizations**
- **Part 66 – Licensed Engineers**
- Note that the **Pre-Flight Inspection** is carried out by the **pilot**, **not** a Part 145 AMO

COMPOSITION

- **Minimum 1 PIC**
- **Minimum 2 flight crew** for **IFR/night** on **turboprops with MOPSC >9** or **turbojets**
- Except for **approved single-pilot** operations
- Only **1 inexperienced** flight crew member

ZFTT

- **Zero Flight Time Training – solely** in the **simulator**

After ZFTT conversion course, the pilot must:

- Commence supervised line flying **within 21 days** of a **skills test**
- **6 take-offs/landings** in a **flight simulator** no later than **21 days after** the **skills test**
- Conduct the **first 4 take-offs/landings** on the line **under supervision**
- The sim and first take-offs and landings will be with a **TRI** in the pilot's seat

DIFFERENCES/FAMILIARISATION

Differences Training

- Used for variants of the same type/class
- Requires **Ground School and Sim Time**

Familiarization Training

- **Only** requires **Ground School**

COMMAND UPGRADE

- Operator must establish a **minimum level** of **experience** prior to upgrading
- **Command Course** is in the **Ops Manual** and includes **minimum 10 sectors** for pilots already qualified on type

PROFICIENCY CHECKS

- **2 per year** with **>4 months between** them
- Tests **flying technique**, **emergency procedures** and **IFR** skills

LPC – License Proficiency Check

- Valid for **1 year**
- Issued by the **Authority**

OPC – Operators Proficiency Check

- Valid for **6 months + remainder** of the **month** of issue
- Requirements covered in **LPC**
- Includes:
  - Rejected Take-Off
  - Engine failure between V_1 and V_2
  - 3D Approach with OEI
  - 2D Approach to minima
  - Missed Approach (OEI if Multi-Engine)
  - Landing with OEI or PFL (Single-Engine)

RECURRENT TRAINING

Comprises 3 major areas:

- **Ground and Refresher Training - includes** systems, operational procedures and an accident review
- **Airplane/Sim Training – Usually a LPC**
- **Emergency and Safety Equipment Training – All exits, firefighting, pyrotechnics and slides** every **3 years**, life vests, extinguishers and PBE **every year**
- Repeated every **12 months** but may be done **revalidated 3 months** prior to expiry

LINE CHECK

- Demonstrate competence for **normal ops**
- Valid for **12 months + remainder of month of issue**
- **Route/Aerodrome Competency** has same validity period
- Cannot fail solely on CRM
- Conducted by operator nominated CRM trained commanders

CRM

- **Major** topics to be covered every **3 years**
- Operator must **update** training over **3 years**

OPS IN THE OTHER SEAT

- Requires engine failure during take-off, OEI approach and go-around and OEI landing

CO-PILOT RECENCY

- **3 take-offs** and **landings** in the last **90 days** on same class/type (or in a sim)

MINIMUM EXPERIENCE (COMMANDERS)

- **3 take-offs/landings** in the last **90 days**
- **1-night** landing in the last **90 days**
- Can be extended to **120 days** if with a **TRI**
- **>120** days requires a **training flight/sim**

SINGLE PILOT IFR

- Requires **5 IFR flights** including **3 instrument approaches** in the last **90 days** in that type/class of aircraft

12/13/14

Cabin Crew, Logs and Records & Duty/Rest Limitations

CABIN CREW

GENERAL

- Any **member of crew** that **aren't flight crew**
- Required with **MOPSC >19**
- Then **1 crew for every 50 seats**
- **Minimum 18 years old**

SENIOR CABIN CREW

- **Minimum 1-year experience**
- Must complete a **training course** and complete the **associated skills test**
- **Nominated** by the **Operator**
- **Responsible** to the **Commander**
- May suspend **non-safety** tasks and tell the **Commander** to turn on the seatbelt sign

MULTIPLE TYPES/VARIANTS

- **3 types maximum**
- **4 allowed** if the **Authority approves**

LOGS AND RECORDS

JOURNEY LOG BOOK

- Kept by the **Operator** on the ground
- **Specific** to an **aircraft**
- Stores **flight hours** and **aircraft information**, **crew names etc**.
- **Not** the **tech log**

OFP

- Completed for **every flight**
- Must be **concurrent** and **permanent** (ink)

STORAGE PERIODS

- **Flight Prep Forms – 3 months**
- **Crew Duty/Rest/Recovery Records – 24 months**
- **Crew Member Experience – 15 months**
- **Tech Log – 36 months** after last entry
- **Training Records – 3 years**
- **Quality System Reports – 5 years**
- **Flight Crew Licenses –** Whilst **valid**

DUTY AND REST LIMITS

DEFINITIONS

- **Augmented Flight Crew –** Spare flight crew members that can take over (cruise pilots)
- **Break –** A period free of duties but that doesn't count as a rest period
- **Duty –** Doing anything for the Operator (except anything after post flight)
- **Duty Period –** The time on duty
- **Flight Duty (FDP) –** Report time (pre-flight) to the end of the post flight
- **Night Duty –** Duty between 02:00-04:59 in the time zone the crew are acclimatized to
- **Home Base –** Location where a crew member usually starts or ends their duty (
- **Single Day Free of Duty –** Must include 2 local nights (may be part of a day off)
- **Positioning –** Transferring a crew member from place to place. Counts as flight duty
- **Rest Period –** Uninterrupted and defined period free from all duties
- **Standby –** Defined period where crew are required to be available for duty. Counts as flight duty if then called in
- **Window of Circadian Low (WOCL) –** Period 02:00-05:59 within 3 time zones of base
- **Airport Standby –** Counts as duty hours

DUTY LIMITATIONS

Duty Period Limits

- **60 duty hrs** in any **7 consecutive days**
- **110 duty hrs** in any **14 consec. days**
- **190 duty hrs** in any **28 consec. days**

Total Flight Time Limits

- **100 hrs flight time** in any **28 consec. days**
- **900 hrs flight time** in any **calendar year**
- **1000 hours flight** time in any **12 consec. calendar months**

FLIGHT DUTY LIMITS

- **13 hours max. flight duty period**
- May be extended by **1 hour**
- Max. **2 extensions** in **7 consecutive days**
- Can be augmented with in-flight rest

REST PERIOD LIMITS

- **Minimum** rest of **12 hrs** before a duty period **at** the **home base**
- **Minimum** rest of **10 hrs** or the same allowing for an **8hrs sleep** before a duty period **away from** the **home base**

UNFORESEEN CIRCUMSTANCES

- **Commander** must submit a **report** to the **Operator** if discretion **>1hr** within **28 days**
- **Max. 2 hrs** (**3 hrs** for an **augmented crew**)
- **Everyone** must agree to go into discretion

Dangerous Goods

REGULATIONS ON DANGEROUS GOODS

- **ICAO Annex 18**
- **ICAO Technical Instructions** (Doc **9284**)
  - List of Dangerous Goods
  - Legal Basis for the Carriage of DGs

ALLOWED ITEMS

- **Safety matches only** carried on **oneself**
- **Batteries** and **small oxygen bottles** also **allowed onboard**
- Goods that would react with each other cannot be **next** to each other
- **Fire extinguishers**, **portable oxygen**, **self-inflating life jackets** and **first aid kits** are all **required** dangerous goods
- **Infected live animals** are **not allowed**
- Some items are **CAO** (**Cargo Aircraft Only**)

CARGO CLASSES

- **1 –** Explosives
- **2 –** Gases
- **3 –** Flammable Liquid
- **4 –** Flammable Solids
- **5 –** Oxidizing Agents
- **6 –** Toxic
- **7 –** Radioactive
- **8 –** Corrosive
- **9 –** Miscellaneous

LOAD NOTIFICATION

- **1st Column –** UN/ID Number
  - **4-digit number** assigned by UN
- **2nd Column –** Proper Shipping Name
- **3rd Column –** Class

SHIPPERS DECLARATION

- "**Dangerous Goods Transport Document**"
- **Shipper responsible** for the DGs
- **2 copies** are required
- Must be in **English**

ACCEPTANCE CHECKLIST

- Assists in checking appearance of packages
- Completed by the **Operator/Handling Agent**

OPERATOR RESPONSIBILITY

- Authorization to carry DGs will be on the **AOC**
- Will check for correct **labelling**
- Does **not** have to **open** and check
- Dangerous Goods Accident – Fatal or serious injury or major property damage

PIC RESPONSIBILITY

- Checks goods are not **damaged** or **leaking**
- If they are, they should be **removed**
- Incidents reported within **72 hours** to the **State of the Operator** and of **Occurrence**
- If **non-declared** goods found, must be **reported without delay**
- Will be given a **NOTOC** in **English**

EMERGENCY RESPONSE GUIDANCE

- Legally onboard and training on it received
- **Red** book, **pink** pages

Long Range Flight

DEFINITIONS

- **HMU –** Height Monitoring Unit
- **MNPS –** Minimum Navigation Performance Specification
- **OAC –** Oceanic Area Control
- **LRNS –** Long Range Navigation System

GENERAL

- Adequate ETOPS alternates selected based on operator **approved** **diversion time** or the **MEL** (**shortest**)
- Regulated by **ICAO Doc 7030**

MINIMUM TIME ROUTES

- Track that takes **least** **time** from A to B
- Adheres to **ATC** and **airspace** **restrictions**
- Accounts for **weather**
- Calculated on a **per-flight** basis

POLAR NAVIGATION

- **Polar Track System –** Fixed tracks from **Europe** to **Alaska**
- **Above** **70°N**, significant points every **20° longitude**
- **Above** **65°N**, nav aids referenced to **True North** (particularly **Canadian** airspace)
- Pilots should **plot** **position** on Polar Navigation charts as backup

MNPS AIRSPACE (MNPSA)

- Applies **FL285-FL420** between **27-90°N**
- Requires **2 LRNS** (**1 LRNS** on **special routes**)
- **60nm** **lateral** & **1,000ft vertical** separation
- Transit of **non-MNPSA** approved aircraft may be approved if **radar contact** is established

NORTH ATLANTIC TRACKS (NATs)

- **Class A** airspace **above FL55/2000ft AGL**
- **MNPS** and **RVSM** **approval** is required
- Significant points every **10° longitude**

FLIGHT PLANS

- ATS Flight Plan **Item 10** has:
  - **X** if **MNPS approved** (next to S)
  - **W** for **RVSM approved**
- Filed **3 hours** **before** departure

OCEANIC CLEARANCES

- Call **40 minutes** **before** the **entry point**
- If close to boundary, clearance required prior to departure
- Must inform **OAC** of **maximum attainable FL** at the boundary
- You must be **re-cleared** to the entry point from **domestic ATC** if the **NAT changes**
- **OAC** notified of **changes** to any **ETA >3 mins**
- **3 elements** of an oceanic clearance:
  - **Route** (Lateral Separation) – ***e.g NAT A***
  - **Mach Number** (Longitudinal Separation)
  - **Flight Level** (Vertical Separation)

ORGANISED TRACK SYSTEM (OTS)

	Flow	Cross 30°W
Day	E to W Departs EU in Morning	1130–1900 UTC
Night	W to E Departs NA in Evening	0100–0800 UTC

- **Day** OTS produced by **Shanwick** OAC
- **Night** OTS produced by **Gander** OAC
- **NAT Track Message** distributed by **AFTN**
- **Day** **at 2200** UTC and **Night** **at 1400** UTC

STRATEGIC LATERAL OFFSET PROCEDURE

- a.k.a '**SLOP**'
- Either **centerline**, **1nm right** or **2nm right**
- **Never** to the **left** or **beyond** **2nm**

OTHER ROUTE STRUCTURES

Blue Spruce Routes

- For aircraft with **1 LRNS**
- Requires state approval for MNPS
- **Fixed**, **2-way** **East-West** routes

Tango Routes

- **Fixed**, **2-way** **North-South** routes between ***Northern EU*** and ***Spain/Canaries/Lisbon FIR***
- Usually to get to the Azores/Canary Islands
- **T9** only requires just **1 LRNS**
- Uses **HF radio** (**Shanwick/Santa Maria**)
- Other routes are **T16** and **T213**

North American Routes (**NARs**)

- Interface between **NATs** and **domestic NA**
- Applies FL290-FL600

NAVIGATION FAILURES

1 LRNS fails before takeoff:

- Delay departure for repair, obtain clearance above/below MNPSA or use **special routes**

1 LRNS fails before OCA boundary:

- Divert to suitable aerodrome, return to departure aerodrome, divert to another special route or re-clear above/below MNPSA

1 LRNS fails inside OCA:

- Continue with clearance and advise ATC

Remaining LRNS fails in MNPSA:

- Immediately notify ATC, attempt visual sightings, consider **climbing/descending** **500ft** and broadcasting on 121.5 MHz

COMMUNICATIONS

- Keep last assigned squawk for **30 mins after NAT entry**
- Then squawk **2000** with Mode A/C
- After **10 minutes**, select **standby** (**only T9**)
- **123.45 MHz** established for pilot to pilot exchange of operationally significant information (out of VHF range)
- Maintain **listening watch** *unless using SELCAL*
- **SELCAL** checked ***at/prior*** to entering MNPSA

COMMS FAILURES

- **Follow FPL** or **re-join** at next significant point
- **Before clearance –** continue at **domestic cleared level** and **follow FPL** (*not Shanwick*)
- **After clearance – fly that clearance**

IF CAN'T RECEIVE REVISED CLEARANCE

- Broadcast intentions on **121.5 MHz**
- Use all available lights
- Turn **left/right 90°** to establish track **15nm parallel**
- **If able to maintain FL:**
  - **Above FL410 – climb/descend 1,000ft**
  - **Below FL410 – climb/descend 500ft**
  - **At FL410 – either option**
- **If unable to maintain FL**
  - **Minimize ROD** and select **Offset FL**
- If weather deviation required **>10nm** from track, FL must be changed:
  - Turn **North – Descend 300ft**
  - Turn **South – Climb 300ft**
  - ***SAND – South Ascend North Descend***

MACH NUMBER SEPARATION

- **Standard Separation** is **10 mins**
- **Reduce** by **1 minute** for each **0.01 Mach faster** (above 0.01M)
- *9 mins = +0.02M, 8 mins = +0.03M etc.*
- **Not less** than **5 mins**
- ***Add up to 11***
- Should **maintain Mach No**. from **NAT** when re-entering domestic airspace

RVSM TOLERANCES

- **2 primary** altimeters agree by **±200ft**
- Match **aerodrome elevation** by **±75ft**
- Error tolerance of assigned altitude is **±300ft**
- Should level off **<1500fpm**
- Should not over/undershoot level by **±150ft**

Special Operational Procedures

ICING

- **Commander** ensures critical surfaces free of **ice/snow/slush/frost** prior to **take-off**
- **Clean Aircraft Concept – All** contamination **removed** (**fuselage** is **OK**)
- Aircraft must be **certified** to fly into icing
- Can **reduce lift 30%** & **increase drag 40%**
- **Most likely** between **0°C** and **-10°C**
- **Rare** below **-18°C**
- Forms on leading edges first
- **PUD SOD** applies for **blockages**

KEY PRECIPITATION TYPES

- **Frost – Crystallized** deposits of ice on **surfaces below 0°C**
- **Wet Snow –** Will form **snowballs**
- **Dry Snow –** Falls **apart** when compacted

DE-ICE/ANTI-ICE

- **Holdover time –** Length of time that an application is effective
- Affected by **temperature, humidity, precipitation type, wind and fluid type**
- Starts at the **beginning** of the **last step** (**anti-ice** for a **2-step** procedure)
- Must be **repeated** if holdover time has **expired** (both **de-ice AND anti-ice**)
- If contaminants remain, repeat or check AFM
- **Jet/prop wash** will wash off fluid so should be **avoided**

From **Least** to **Most Dangerous**:

1. Frost
2. Freezing Fog
3. Snow
4. Freezing Drizzle
5. Freezing Rain
6. Rain Soaked Cold Wing

FLUID TYPES

- **Hot – De-Ice** Fluid (Pre-Existing Ice)
- **Cold – Anti-Ice** Fluid (Preventative)
  - Will have washed off by **rotation** (T/O)
- **4 Types** of Fluid:
  - **Type I – De-Ice** Fluid
  - **Type II – Anti-Ice** Fluid
  - **Type IV –** £££ **Anti-Ice** Fluid

BIRD STRIKES

- **IBIS –** ICAO Birdstrike Information System
- Risk propagated by **ATIS**, **NOTAM** or **PIREP**
- **Highest risk** is **closest to the ground**
- **Commander** must submit a **written report** after landing if they have hit a bird
- If seen **near** the airport, must be reported **immediately** to **ATS**
- Broadcasting **bird distress calls** and **shell crackers** are the most **effective** solutions
- Migration info found in the **AIP** (**ENR 5.6**)
- Attracted to **garbage sites**, **short grass**, **wet area**, **coastal areas** and **ploughed fields**
- **Long grass** is used as a **deterrent**

NOISE ABATEMENT

- **Regulations** in **ICAO Doc 8168**
- **Specific** information in **AIP AD 2**
- **Operator** will specify procedures applied at **all airports** for **each specific aircraft type**
- Found in **Ops Manual Part B** & **C**
- These must comply with the **State NADPs**
- Only used when there is **no safety impact**
- Does **not prohibit** the use of **reverse thrust**
- **No turns** allowed with a reduction in power

NOISE ABATEMENT PROCEDURES (NADP)

- From **800ft** (**power reduction**) to **3,000ft**
- **NADP1 – Close In**
  - Climb at **V2 + 10-20kts**
  - Flaps retracted at **3,000ft**
- **NADP2 – Distant**
  - Flaps up **>800ft**

EXCEPTIONS TO NADPs

Noise abatement is **not required** when:

- Runway is **contaminated**
- **No ILS/VASI** guidance
- Horizontal visibility **<1nm**
- Crosswind **>15kts**
- Tailwind **>5kts**
- **Windshear**
- Adverse weather expected
- **<500ft** ceiling
- Aircraft has a **failure**

FIRES

- Always ***follow the checklist***
- **PBE** provides oxygen **>15 mins**

FIRE MANAGEMENT

- **Fire after V1 –** Continue Take-Off
- **Carb. Fire –** Mixture Off Open Throttle
- **Tailpipe Fire – Dry** Cranking
- **Toilets – All** available extinguishers **simultaneously**
- **Cargo – Isolate ventilation** system

Special Operational Procedures

FIRE WARNING SYSTEM

- **Individual warning lights** & **common bell**
- **Lights** will not extinguish until **fire is out**
- Warning **bell** can be **cancelled**
- **Pulling** the handle **cuts off fuel**
- **Twisting** it will fire an **extinguisher**

TYPES OF FIRE

- **A –** Solid Materials
- **B –** Flammable Liquids
- **C –** Flammable Gas
- **D –** Metals
- **E –** Electrical
- **F –** Cooking Oil/Fat

EXTINGUISHERS

- **H_2O –** Class **A**
- **Foam –** Class **A** & **B**
- **Dry Powder/Chemical –** Class **A**, **B**, **C**, **D** & **E**
  - Ideal for **wheel-well** fires
- **CO_2/Halon (BCF) –** Class **A**, **B** & **C**
  - *Usually the **best** option!*
  - **CO_2** particularly good for **electrical** fire
  - **Halon** prevents **oxygen** fueling the fire
  - Used in the **engine** and **ideal** in **cabin**
- **Wet Chemical –** Class **F**
- Held **1.5-2.5m** from the **source**

OVERHEATED BRAKES

- Approach from the **front** or **rear**
- Do **not** set **parking brake**
- Use **water fog**, **sand** or **dry powder**
- Do **not** use **water**

SMOKE

- **Immediately** apply **oxygen mask** (**100%**)
- **Cabin crew** attempt to determine **source**
- If source cannot be determined, **divert**

DECOMPRESSION

See Chapter 8 – Equipment

- First sign of **rapid** decompression = **BANG!**
- Followed by **mist** & **cabin alt. increase**
- **Slow** decompressions caused by **leaks**
- **First** action = **don an oxygen mask**
- Then an emergency descent to **8,000ft** (***performance not affected***) or **MSA**
- Lack of O_2 **degrades performance >6,000ft**
- **Pure O_2** required **>FL320**

WINDSHEAR

- ***Rapid*** change in **wind speed** or **direction**
- **Vertical –** Causes turbulence
  - **Horizontal** vector changes with **vertical distance**
- **Horizontal –** Headwind/tailwind/crosswind component changes
  - **Horizontal** vector changes with **horizontal distance**

Procedure for Windshear Go-Around:

- **Aggressively** apply **full throttle**
- Pitch up to **stick shaker**
- **No configuration changes** (*Speedbrake OK*)

Effects of Windshear on Approach:

- **Headwind ↑ = Energy ↑**
- **Tailwind ↑ = Energy ↓**

MICROBURSTS

- **Downdraughts** in a **4km** area for **1-5 mins**
- Winds are **divergent** from the centre (because they are areas of **high pressure**)
- Wind speed is **0** in the **centre**
- Wind shifts from a **headwind** to an **equal** and **opposite tailwind**

WAKE TURBULENCE

- Created if generating **lift** (*nose wheel lifts*)
- Tip vortices will separate **upwards around** the **tip** and go **outwards** from **runway**
- **Left = Clockwise**, **Right = Anti-Clockwise**
- Travels **horizontally** at **½ wingspan height**
- **Worst** when aircraft are **heavy**, **clean** and **slow** in **light crosswinds**
- Avoid by flying **above** and **upwind** of the previous aircraft

RADAR WAKE TURBULENCE SEPARATION

Heavy	***BEHIND***	**Heavy**	**4nm**
Medium			**5nm**
Light			**6nm**
		Medium	**5nm**

- **Light = 8-**, **Medium – 3+**, **Heavy – 2+**

e.g Light behind Heavy = 8-2 = ***6nm***

NON-RADAR SEPARATION

- **3 mins** if from an **intermediate position** or **light** aircraft arriving behind **medium**/**heavy**
- **ALL** other categories are **2 mins**
- ***Not required*** to apply sep. if VFR are landing after medium or heavy aircraft or the aircraft behind has the other in sight (if cleared)

OBJECTIVES OF SECURITY

- **Safeguard** against **unlawful interference**
- Protect the safety of **passengers**, **crew**, **ground personnel** and the **general public**

Special Operational Procedures

SECURITY DEFINITIONS

- **Aircraft Security Check –** Inspection of passenger and cargo compartments
- **Airside – Movement** area of an airport and buildings to which access is controlled
- **Screening –** Application of means to **identify** prohibited articles
- **Security –** Safeguarding **international** civil aviation against unlawful interference
- **Security Control –** Application of means to prevent **introduction** of prohibited articles
- **Security Restricted Area –** Airside area identified as a risk priority where additional security measures are applied
- **Unidentified Baggage –** Baggage not **picked up** or identified by a passenger

RESPONSES TO UNLAWFUL INTERFERNCE

- Flight deck doors locks **only** from **inside**
- If hijacked, pilot should fly at an **IFR** level:
  - 1,000ft separation – fly **±500ft**
  - 2,000ft separation – fly **±1,000ft**
- Or use ***Regional Supplementary Procedures*** (ICAO **Doc 7030**)
- Also attempt to **broadcast warning**
- **State of Registry**, **State of Operator** & **ICAO** should be notified
- State to take ***appropriate measures*** for pax & crew safety until ***journey can be continued***

OPERATOR PROCEDURES

- **Operator** provides **training** and **checklists**
- If a **bomb** is found, **descend** to **cabin altitude** in **landing configuration**
- Will **not** have to remove **suspect packages**

EMERGENCIES

- **Commander** responsible for initiating emergency procedures in the **air**
- **Dispatcher** responsible on the **ground**
- **Safe Forced Landing – Inevitable** landing with **no** injuries in the **aircraft** or on the **surface** expected
- **Evacuation** required in **90 secs** (**50%** doors)

DITCHING

- Forced landing on **water**
- **Immediately** initiate evacuation
- Life jackets inflated **on exiting** the aircraft
- Ditch **parallel** and **on top** of the waves (*except for strong winds*)
- Gear **up**, flaps **down**, and **nose high**

PRECAUTIONARY LANDINGS

- Landing at the **earliest opportunity**
- *e.g. Onset of **night**, bad weather, passenger incapacitation etc.*

EMERGENCY LANDINGS

- *e.g. Uncontrolled fires, dual engine failure etc.*
- On a **runway**, stop there & turn systems off
- If over **trees**, aim for **low** trees with flaps **down** and gear **up**

FUEL JETTISONING

- Based on returning within **15 mins**
- Ensures a **3.2%** **go-around climb gradient**
- Also to get below **Max** **Landing Mass**
- Preferably over **water**, away from CBs and **above** **6,000ft** and in a **straight** **line**
- **ATC clearance** will be required

CONTAMINATED RUNWAYS

- Data usually **not** **validated** by flight tests
- If nothing in AFM, use **LDA +15%**
- **Damp –** Changes colour but **not shiny**
- **Wet – Shiny** but **no standing water**
- **Contaminated - >25%** covered **>3mm** deep, wet ice, ice or compacted snow

SNOWTAMs

- Valid for **24 hours**
- **2 figures –** measured using a **device** (e.g 37)
- **1 figure –** estimated by a **pilot**

Coefficient	Braking Action	Code
>0.4	**Good**	5
0.39 to 0.36	**Medium to Good**	4
0.35 to 0.30	**Medium**	3
0.29 to 0.26	**Medium to Poor**	2
<0.25	**Poor**	1
-	**Unreliable** (Slush)	9

- If multiple runways are in the same category, they are considered to have equal braking action

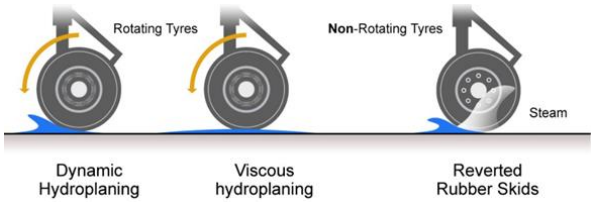
Sections:

- **D –** Cleared Runway Length (**4 Figure Group**)
- **F –** Deposits over Total Runway Length
  - **6 = Slush**
- **H –** Estimated Surface Friction on Each ⅓
- **T –** Plain Language Remarks (***including uncleared parts***)

HYDROPLANING

- Occurs when tyres hit water and lose grip
- **Approach speed** should be **increased**
- Landing technique is **positive landing**, **max reverse** and **immediately** on the **brakes**

TYPES OF HYDROPLANING



- **Dynamic Hydroplaning**
  - No braking action
  - Occurs if **water deeper** than tyre **grooves**
- **Viscous Hydroplaning**
  - **Smooth dirty** surface
  - Usually occurs at **touchdown**
- **Reverted Rubber Skids**
  - Tyre does not rotate
  - Prevented by anti-skid

HYDROPLANING CALCULATIONS

- **1 bar = 14.5 PSI**
- **Take-Off** (*Rotating*) **– $9\sqrt{\text{Pressure (PSI)}}$**
- **Landing** (*Non-Rotating*) **- $7.7\sqrt{\text{Pressure (PSI)}}$**