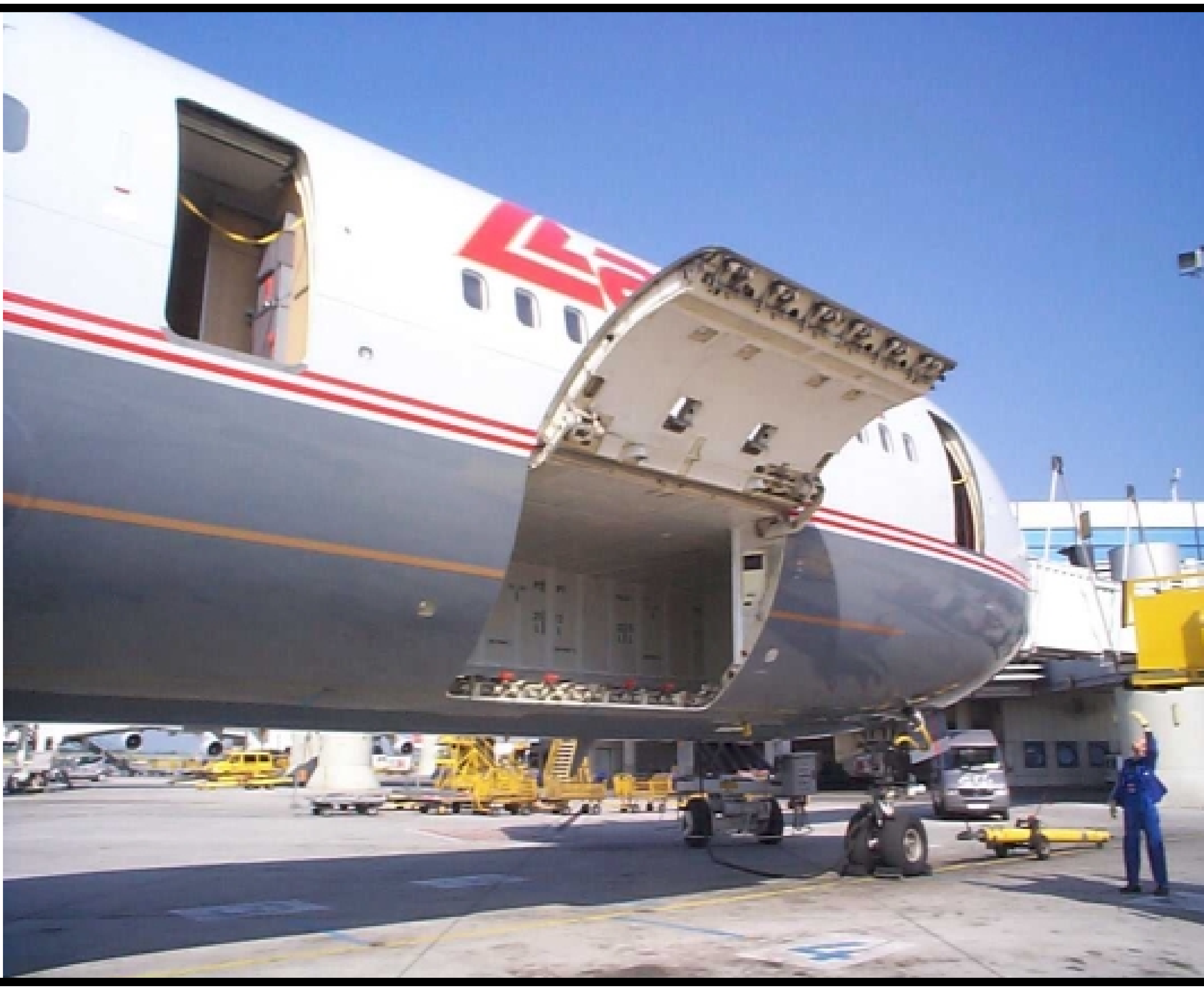

Training Manual for Boeing 767 Flight Crews

1. Edition 1999

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1. Edition, 1999

Welcome to the 767 fleet. The next three months will be very intensive for you as are all conversion courses.

To obtain maximum benefit from the program it requires commitment both from the trainee and the instructors.

This manual was put together with the intention of supporting you in achieving the outlined goals.

The objective of this program is to impart both knowledge and skills in systems, manipulation, management and crew coordination so as to allow you to operate the B767 in a safe and efficient manner in both normal and non normal operations.

The conversion course consists of 4 major sections, each split into sub sections.

Ground Training

The classes that are taught are listed below.

- Systems via CBT
- Operations manual General/Basic.
- Standard operating procedures (SOP)
- Performance
- All weather operations
- Review on the box (cockpit mock up)
- ETOPS
- North Atlantic operations
- Weight and balance
- Safety and security
- Aircraft external
- Technical training
- Introduction to Jeppesen.

Simulator

The simulator component of the conversion course if approached with the right attitude can be both rewarding and enjoyable.

As each day of training last for at least 7 hours including briefings, debriefings your own home study and the session itself you will become rather tired.

We will endeavour to obtain slots in the simulator at a reasonable hour, however, as we do not have our own simulator, this is not always possible.

Cockpit Systems Simulator

Cockpit systems simulator (CSS) or as it is commonly referred to “the fixed base” is, as its name implies, a systems simulator. Its primary role is to prepare the trainee so as to obtain maximum benefit from the full flight simulator.

There are three sessions, each four hours in duration which require extensive briefings and debriefings. The general recommendation would be a two hour briefing and an hour debriefing which would include an overview to the next session so as to give the trainees some guidance for their own study.

Full Flight Simulator (FFS)

Consists of ten sessions nine are training and one is a checkflight.
Sessions 1 to 4 are identical in format as sessions 5 to 9 are.
The format of sessions 1 to 4 consists of two components.

- Loft 3 hours in duration,
- Manipulation, 1 hour in duration, no ATC (blanket clearance to operate in the area), nobody in the cabin.

To obtain maximum benefit from the FFS, trainees should treat it as much as possible like the aircraft. It is recommended to wear the harness and the head sets.

The instructor will play the roll of all ancillary services, such as ATC, Purser Ground Engineer etc.

Flight Training

Only those pilots required by JAR-OPS will do this. Normally carried out at Bratislava.

Line Training

- Captain Minimum of 100 hours and 20 landings including at least one autoland. and 3 with auto pilot disconnect, under the supervision of a flight instructor or a line training commander.

- Minimum of 50 hours and 4 landings including at least one autoland. and 3 with auto pilot disconnect, under the supervision of a flight instructor or a line training commander.

This training manual is provided as an aid that tries to help you throughout your training, from CSS to line training. It is a living document, which means that suggestions and ideas to improve the text are welcome at any time.

By the nature of the subject, even with the best intentions, a manual cannot be entirely free from mistakes or entirely comprehensive. I would, therefore appreciate comments both from trainees and fellow instructor pilots in order to be able to improve this product and at the same time I would like to thank all those individuals who have already have shared their experience. I would also like to express my special thanks to Cdr. David Prior, who has now joined the B777 fleet and to Dr. Dieter Reisinger, F/O B767, for writing and editing this manual.

Once again welcome to the B767 fleet and I look forward to you being an integral member of the team.

Best Regards,

Cdr. Anton Hanausek.
(B767 Fleet Manager)

This chapter is no longer contained in the training manual. For systems description refer to your Boeing Aircraft Operations Manual, Vol. 2

The Cockpit Systems Simulator (CSS), commonly also referred to as the “Fixed Base Simulator”, features reduced capabilities compared to the “Full Flight Simulator” (FFS), however, it can be extensively used to the advantage of the students during initial conversion training, especially in the areas of cockpit familiarization and AFDS - work: at the first stage of training, motion is not required, so that at a fraction of the price of the FFS systems knowledge is enhanced. Students should therefore enter the sessions well-prepared, as they would on the FSS.

➢ Please re-read Automatic flight in the systems section.

What is to be covered during the three CSS-sessions is pointed out below. Generally speaking:

1. There are three lessons each four hours in duration, which require extensive briefings and debriefings.

2. The general recommendation would be a two-hour briefing and a one-hour debriefing which should include an overview to the next session so as to give the trainees some guidance for their own study. **Which is required.**

General Comments:

The 767 has been designed with an **automated cockpit** both in the systems and AFDS mode changes. The aircraft has a high degree of built in self-test capability as well a high level of redundancy. Under certain circumstances (with low-level malfunctions) it can reconfigure itself such as in fire detection. **As the aircraft is highly automated, one of the pilot’s roles is to monitor, and this requires an interface between pilot and machine.**

There are three main interfaces in the B 767. Two are read only, one is read and write:

1. The flight mode annunciator (FMA),
2. The engine indicating crew alerting system (EICAS)
3. The control display unit (CDU) which is read and write and is the interface for the flight management computer (FMC)

It is therefore imperative that at the conclusion of the three CSS sessions the trainees have a very good understanding of the areas listed below.

Areas covered during CSS-Training:

Engine Indication and Crew Alerting – System (EICAS)

Understand the philosophy of EICAS and the correct use of the associated non-normal checklists contained in the QRH.

With the advent of 2 man cockpits in large aircraft such as the B767, the third pair of eyes disappeared. A lot of the warning lights are outside the pilot's normal field of view.

If a non-normal situation develops, a system is required to bring it to the pilot's attention. This is done via master caution/warning lights and associated aural warning.

In the case of the B767, the pilots look at the upper screen where the message is displayed and carry out the non-normal checklist(s) depending on the situation. Hence the crew alerting system. (EICAS).

The B767 EICAS has weak points as pointed out below, however, it does work quite successfully.

Don't reinvent the checklist, unless you have good reason to do so.

The checklist covers all scenarios that would cause the message to appear.

If for example the "left center tank fuel pump" message were to appear, the "fuel pump" non-normal checklist asks you to turn the affected fuel pump off (in this case the left). Then open the cross feed valve switch (es). If the left engine was shut down, opening the crossfeed valve(s) achieves nothing. The pump is automatically turned off because N2 on the associated engine is less than 50%. This is why the message appeared, however, if the pump itself failed and both engines are operating, fuel must be supplied from the center tank to both engines otherwise a fuel imbalance will occur.

Another example is the "AC Bus(ses) off" non-normal checklist. The checklist asks you to do a reset on both tie switches, even if only one bus is off. Doing a reset on the other tie switch achieves nothing, but this checklist covers the scenario of either one or two bus(ses) off.

> **IF A SWITCH IS NOT ASKED TO BE TURNED OFF DON'T TURN IT OFF. IF IT DOES, FOR EXAMPLE IN THE CASE OF *YAW DAMPER*, THEN TURN IT OFF.**

The B767 does not have an electronic checklist associated with EICAS. You have to use a paper checklist (QRH). This creates two weak links.

1. Make sure you are reading the correct checklist. Some are similar in appearance such as Trailing Edge Flap disagree and Trailing Edge Flap Asymmetry
2. The checklists are rather abbreviated so you have to read them carefully.

> **Non-compliance with the checklist or reading the wrong checklist can aggravate the situation.**

The Lauda-Air SOP's comprehensively cover checklist reading, however please read AOM Volume 1 pages 04.01.01/02

Flight mode annunciator (FMA)

As the aircraft is always flown by the autopilot or manually with flight director guidance [1] the FMA advises the pilot as to the modes the aircraft is following in pitch and roll, as well as what mode the auto throttle system is using. The FMA also advises if the autopilot is engaged or not.

---

[1] Very rarely is it flown without the use of a flight director. An example when it is, is following a non-precision approach in VMC on final approach. Here, the flight director(s) are turned off.

- Good flight director and FMA discipline should be established.
- Always monitor the FMA and fly the flight director. If the flight director is not giving the correct guidance, than change the mode.
- Notwithstanding the above, the instrument scan must continue to take in information from the other instruments
- Acquire a good knowledge of the function and the protection or lack of, from the various modes. Appreciate that the modes can be changed either manually by the pilot via the MCP or automatically by the aircraft such as “SPD LIMIT”. It is essential to always understand what the aircraft is doing and to avoid “mode confusion.

Flight Management Computer (FMC)

A good understanding of the FMC-operation is essential - improvement will come with “hands on experience”. It should be noted that the FMC in the current simulator is an earlier version than the model used in the Lauda-Air B767. There are minor differences, however, they should be easily overcome.

Scans

Have a solid grounding in scans and checklist from “Safety Check” through to the “Secure” checklist so as not to lose time in the FFS.

This is required because the workload in the FFS sessions is quite high

- As a guide you would want to be in the air within 30 minutes by the third session

Limitations

Review the limitations from Volume 1 and the AFM (a copy of the AFM limitations is in the ships library).

Bulletins

Review the bulletins from AOM Volume 1.

SAS CSS Information

- Single FMC operation.
- Autopilot has to be engaged as soon as the CSS is airborne.

3.1.1 OBJECTIVES

1) Panel scans and checklists from “Electrical power NOT established”.

Covering the following,
- Pre flight
- Engine Start
- Taxi out & Take off
- Climb & Cruise
- Approach & Landing
- Taxi-in and Park

2) Standard Call outs
3) FMA and MCP familiarisation
4) FMC and CDU familiarisation

3.1.2 PREFLIGHT

Normal Procedures

3.1.3 TAKE OFF

- Normal Procedures
- Full de rate
- Hdg select than LNAV
- VNAV

3.1.4 CLIMB

- Unrestricted climb FL100, LNAV, V NAV
- Climb to FL200 with MCP and FMC ALTITUDE CONSTRAINTS

3.1.5 SESSION SPECIFIC TRAINING

- FMC operation
- FMA work
- Cruise L NAV V NAV Speed intervention

- DIR TO/INTC LEG TO
- Set up for ILS 16 VIE

3.1.6 DESCENT & APPROACH

- Vref calculations
- VNAV SPD/VNAV PATH, descent high/low on profile. Speed intervention
- FLCH
- Use of speed brake, observe change in vertical speed.

3.1.7 TAXI IN & SHUTDOWN

After landing, shut down & secure checklist.

3.1.8 SESSION INFORMATION

ROUTE	LOWW-LOWW			
ATC Clearance	SNU 1 LIMRA LNZ STO WGM ILS 16			
WEATHER	CALM CAVOK 15/5 1013 NOSIG			Flap 5
LOAD- and TRIMSHEET For **OE-LAX**	ZFW	105.0 t	Version. 3/0	V1 =
	FUEL	30.0 t	MAC TO 23	Vr =
	TOW	135.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

3.1.9 SESSION PROFILE

3.1.9.1 Part 1(PF - Captain)

- Pre flight actions
- Take off 16 (full de rate)
- Unrestricted climb to FL100 (LNAV,VNAV)
- Air work
- ILS 16 full stop
-

3.1.9.2 Part 2 (PF - Copilot)

- Reset 16
- As above

3.1.10 NOTES FOR INSTRUCTORS

Select “IP” page, Lesson 2 and change wind, temperature, dew point and QNH.

To obtain BKK and VIE
1. Push CUST. CONFIG.
2. Push 01
3. Push “IP”

Page 2 initial positions
5 BKK21R
9 VIE 29
10 VIE 16

3.2.1 OBJECTIVES

1) Panel scans and checklists from “Electrical power NOT established”
   Covering the following,
   - Preflight
   - Engine Start
   - Taxi out & Take off
   - Climb & Cruise
   - Approach & Landing
   - Go around 2 engines
   - Taxi-in and Park

2) Standard Call outs
3) FMA and MCP familiarisation
➢ Automatic mode changes between AFDS and A/Throttle
4) FMC and CDU familiarisation

3.2.2 PREFLIGHT

Normal Procedures

3.2.3 TAKE OFF

- Normal Procedures
- Full de rate
- Hdg select then LNAV
- FLCH

3.2.4 CLIMB

- Speed protection with flap extended
- Lack of stall protection in VS-mode
- ➢ Flaps protected initially by pitch, at ALT CAP, Flaps protected by the A/T

3.2.5 SESSION SPECIFIC TRAINING

- FMC operation
- FMA work
- DIR TO/INTC LEG TO
- Set up for ILS29 VIE
- Acceleration and deceleration
- ➢ Times and distance from 220Kts to 360Kts and back to 220Kts, with and without speed brake.

3.2.6 DESCENT & APPROACH

Speed protection VS (or lack of), FLCH, VNAV.

3.2.7 TAXI IN & SHUTDOWN

After landing, shut down & secure checklist

3.2.8 SESSION INFORMATION

ROUTE	LOWW-LOWW			
ATC Clearance	SID RWY 29 LIMRA LNZ STO WGM ILS29			
WEATHER	200/5 CAVOK 8/3 1015			Flap 5
LOAD- and TRIMSHEET For **OE-LAX**	ZFW	104.0 t	Version. 3/0	V1 =
	FUEL	24.0 t	MAC TO 27	Vr =
	TOW	128.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

3.2.9 SESSION PROFILE

3.2.9.1 Part 1(PF - Captain)

- Pre flight actions
- Take off 29 (full de rate)
- Level off at 3000’(THR HLD)
- FLCH climb to FL100 (LNAV)
- VNAV climb FL180
- Air work
- Speed protection
- Remote tuning of VOR (review the limitation of the Sim FMC)
- ILS 29
- Go-around LNAV to SNU
- Radar vectors to STO .hold at STO.
- ILS 16 full stop

3.2.9.2 Part 2 (PF - Copilot)

- Reset RWY 16
- Climb 4000’ALT CAP/HLD. Climb FL100.
- Review knowledge gained during the session
- Radar vectors ILS 16 Full stop.

3.2.10 NOTES FOR INSTRUCTORS

“IP” page number 1 set up

To obtain BKK and VIE
1. Push CUST. CONFIG.
2. Push 01
3. Push “IP”

Page 2 initial positions
5 BKK21R
9 VIE 29
10 VIE 16

3.3.1 OBJECTIVES

1) Panel scans and checklists from “Electrical power NOT established”
Covering the following,
- Pre flight
- Review conditions required for the use of Wing/Engine anti-ice (not required during this session).
- Engine Start Abnormal starts, HOT/HUNG/NO IGN
- Taxi out & Take off
- Climb & Cruise
- Approach & Landing
- Taxi-in and Park

2) Standard Call outs
3) FMA and MCP familiarisation
4) FMC and CDU familiarisation
5) EICAS Non-Normal checklists

3.3.2 PREFLIGHT

- Normal Procedures
- Abnormal starts

3.3.3 TAKEOFF

Normal Procedures

3.3.4 CLIMB

- Review Speed protection with flap extended. VNAV and FLCH.
- Stall protection FLCH, VNAV
- Track direct to TANEK,

3.3.5 SESSION SPECIFIC TRAINING

- FMC operation
- FMA work
- DIR TO/INTC LEG TO
- Lateral offsets.
- EICAS FL 310 Engine flame out
- VNAV descent
- Attempt relight (not Successful)
- Fuel jettison (reduce fuel on instructors panel to save time)

3.3.6 DESCENT & APPROACH

Speed protection VS, FLCH, VNAV.

3.3.7 TAXI IN & SHUTDOWN

After landing, shut down & secure checklist

3.3.8 SESSION INFORMATION

ROUTE	VTBD-LOWW			
ATC Clearance	21R TANEK 5A TANEK DWI BGO LOWW			
WEATHER	240/5 CAVOK 34/20 1009			Flap 5
LOAD- and TRIMSHEET For **OE-LAX**	ZFW	120.0 t	Version. 3/9	V1 =
	FUEL	65.0 t	MAC TO 22	Vr =
	TOW	185.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CACLULATIONS:

3.3.9 SESSION PROFILE

3.3.9.1 Part 1(PF - Captain)

- Pre flight actions
- Abnormal starts
- DIR TO/INTC LEG TO
- Lateral offsets.
- EICAS FL 310 Engine flame out
- VNAV descent
- Attempt a relight Fuel jettison
- ILS21R
- After landing, shutdown, secure checklist.

3.3.9.2 Part 2 (PF - Copilot)

- Depends on time available
- VTBD departure same weight
- Air work in the area
- NDB Approach
- Full stop landing

3.3.10 NOTES FOR INSTRUCTORS

“IP” page number 3 set up, change wind, temperature & dew point.

To obtain BKK and VIE
1. Push CUST. CONFIG.
2. Push 01
3. Push “IP”

Page 2 initial positions
5 BKK21R
9 VIE 29
10 VIE 16

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

CSS Session 1

- PREFLIGHT CHECK
- FMS: CDU PROGRAMMING & CHECK
- NAVAIDS & AFDS
- LOADSHEET & FUEL LOADING
- CDU & SPEEDS
- TRIMS
- ENGINE START
- AFTER ENGINE START CHECKLIST
- TAKE OFF BRIEFING, USE OF AFDS
- TMS
- TAKEOFF
- CLIMB ALTIMETER SETTING VS MCP ALTITUDE
- CRUISE LNAV/VNAV SPEED INTERVENTION
- DIR TO/INTC LEG TO
- DESCENT LANDING WEIGHT/SPEED VS VREF
- SPEED INTERVENTION
- AUTOBRAKE SETTING
- CDU PROGRAMMING NAV AIDS
- ILS APPROACH & AUTOLAND
- AFTER LANDING FLAP SETTING
- PARKING & SECURE CHECKLIST

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

CSS Session 2

- PRESTART CHECKLIST
- ENGINE START
- AFTER START CHECKLIST
- TAXI
- TAKE OFF
- LOW ALTITUDE LEVEL OFF
- FLCH CLIMB TO FL100
- SPEED PROTECTION DEMONSTRATION
- VNAV CLIMB TO FL180
- CRUISE
- REMOTE TUNING OF VOR
- USE OF FIX PAGE
- ALTITUDE CONSTRAINTS
- PROGRESS PAGE
- DESCENT METHODS
- LANDING WEIGHT / FLAP SPEEDS
- CDU PROGRAMMING
- ILS APPROACH
- GO AROUND
- HOLDING CDU
- APPROACH & AUTOLAND
- AFTER LANDING & SECURE CHECKLIST

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

SESSION 3

- PRE START CHECK LIST
- REVIEW CONDITIONS FOR THE USE OF WING AND ENGINE ANTI-ICE
- ENGINE START - HOT/HUNG/ABORTED START NO IGN
- AFTER START CHECK LIST - BLEED VALVE REMAINS CLOSED
- TAXI
- TAKE OFF
- CLIMB
- RADAR VECTORS TO INTERCEPT RADIAL INBOUND
- CRUISE
- LATERAL OFFSET ROUTE DATA PAGE
- ENGINE OUT DATA
- HSI MODE SELECTOR AIRPORTS
- WAYPOINTS 40/80 NM
- DIVERSION
- APPROACH CHECKLIST
- ILS APPROACH
- HOLDING
- NDB APPROACH & LANDING
- AFTER LANDING SHUT DOWN & SECURE CHECKLIST

COMMENTS / ITEMS NOT COMPLETED:

The Lauda-Air B767 type rating consists of 10 sessions - 9 training sessions and a check flight. Sessions 1-4 are identical in format as sessions 5-8 are.

The format of **sessions 1 to 4** is split into two components. The first is LOFT[1] and the second part is manipulation.

- LOFT style: three hours in duration, two or three sectors, depending on length. Captain is PF on one and the Copilot is PF on the other.
- Manipulation: 1 hour in duration. No ATC (blanket clearance to operate in the area), nobody in the cabin. The objective of the manipulation part is to allow the trainee to concentrate on basic manipulation and the associated SOPs and not to be distracted by other requirements. So at the end of the hour the maneuver is entrenched in the trainee‘s mind. It is then practised in the next session during the loft component.

Sessions 5 to 7 have only one component and that is a four-hour LOFT period. Building on the skills learned in the first 4 periods, more complicated exercises are introduced.

As well as learning skills that are type-specific to the B767 emphasis is placed on CRM[2].

In the simulator, the components of CRM that are focused on are
- Crew Coordination
- Situational Awareness
- Workload management
- Decision making

Along the lines of the **FOR-DEC** concept

[1] LOFT…line oriented flight training
[2] Lauda-Air runs a comprehensive CRM ground course

Crew co-ordination is an integral part of the two-men cockpit in both normal and non normal operations. It is imperative under all work load conditions both pilots **work together as a team**. The flight path of the aircraft is monitored at all times.

The basic role of the Captain is to provide LEADERSHIP and the basic role of the Copilot is to provide SUPPORT.

When the Captain is PNF he must provide all duties that is required of a PNF as well as <u>maintaining situational awareness and providing leadership</u>.

It is recommended during sessions 5 to 7 that the instructor plays a passive role, so as to allow the trainees to cultivate the above skills. This is to correctly identify problems. **As a team fly the aircraft and solve the problem with airmanship and in a professional manner.**

If the problem is not identified correctly in the first place, most if not all subsequent decisions are wrong.

Session 7 is the last of the Loft sessions.

TO OBTAIN MAXIMUM BENEFIT FROM THE FULL FLIGHT SIMULATOR, TRAINEES SHOULD TREAT IT AS MUCH AS POSSIBLE LIKE THE AIRCRAFT. IT IS RECOMMENDED TO WEAR THE HARNESS AND THE HEAD SETS.

Session 8 is Low visibility operations and recovery from unusual attitudes. Which requires a lot of instructor input.

Session 9 is a practice check flight. The format is up to the Instructor and the Trainees. There is a suggested session plan, however, it may be amended as required.

Session 10 is the Check flight conducted by an Examiner of Airman in accordance with the requirements of the Austrian “Oberste Zivilluftfahrt-behörde” and the JAR requirements for the issue of a B767 type rating.

During all the sessions the Instructor will play the role of all ancillary services such as ATC, Purser, Ground Engineer, Company operations.

The workload during each of the sessions is high therefore it is paramount that minimal amount of time is lost during cockpit setup, so as to complete the sessions without or at least kept to a minimum, re-positioning.

4.1.1 OBJECTIVES

Loft component
- Normal procedures
- Manual flight
- Rapid decompression

Manipulation component
- Traffic patterns

4.1.2 PREFLIGHT

- Normal start procedures
- Takeoff performance
- Taxi techniques

4.1.3 TAKE OFF

<u>Normal takeoff & departure</u>
- Rate of rotation
- Target attitude - no FD until attitude stable
- At 1000’ - normal clean up procedures

4.1.4 CLIMB

- Use of manual trim
- Use of AFDS

- Climb
- Session specific training

4.1.4.1 Airwork

FL100

STEEP TURNS

- Pitch attitude, S&l and 45^0 AOB
- Power requirements
- No ADI precession, electric altimeter & VSI
- Instrument scan

STALLS

- Normal SOP for flaps,gear & speed bug setting
- No height loss
- No secondary stall
- Immediate recovery at first onset of stickshaker/buffet

a) Clean (Flaps & Gear Up)

- N_1 40-45%, maintain S&L flight,
- V_{ss} approx V_{ref} +30.

Recovery:

- Full thrust & maintain wings level
- Pitch attitude to approx. 5^0
- Accelerate to v_{ref} +80.

b) Approach (Flaps 20 & Gear Up)

- N_1 40-45%, AOB 25^0 & level flight,
- V_{ss} approx V_{ref} -10.

Recovery

- Full thrust & roll wings level
- Pitch attitude to approx. $10\text{-}12^0$
- Accelerate to v_{ref} +80.

c) Landing (Flaps 30 & Gear Down)

- N_1 45-40%, maintain S & L fight,
- V_{ss} approx V_{ref} -20.

<u>Recovery</u>

- Full thrust & maintain wings level
- Pitch att to app 10-12^0
- Accelerate to v_{ref} +80.

Hold 10,000’ don’t go below, slowly increase pitch angle until stickshaker/buffet. Apply max thrust, roll the wings level if required, be gentle with the control inputs. Be aware of the nose pitching up caused by rapid thrust increase which may result in a secondary stall.

<u>**FL310**</u>

- High speed buffet
- High altitude stall (trying to climb over weather)

Disengage A/T via the thrust levers.
Observe no A/T or AFDS protection.
Observe changes on the FMA.
Pitch attitude about 5 degrees.
Altitude loss occur, the amount is dependent on current altitude, aircraft weight and the desired acceleration rate during recovery.

4.1.4.2 Cabin Altitude (Rapid Decompression)

Non - normal procedure — Left and right seat actions

Cockpit indications:

Oxygen mask

- Usage & communications
- Understand the use of the audio panel

Passenger oxygen:

- Automatic operation

Cabin altitude control:

- Manual, if outflow valve is open

4.1.4.3 Emergency Descent

Captain (Left seat):

- Autopilot........... Engaged
- Altitude .... 10000' or Minimum Safe Altitude
- Heading............. 90^0 off NAT track or 20 off the airways
- Pitch mode .... FLCH with speedbrakes
- Speed .... Max $V_{mo,}$, turb M.78/290kts, airframe damage actual speed

Copilot (Right seat):

- Passenger oxygen,
- Give MAYDAY,
- Squawk 7700,
- Check MSA,
- Check QNH

4.1.4.4 Traffic Patterns

- Takeoff to 1500ft AGL
- ILS and visual approaches
  - Use of VASI's
- Landing technique
  - Center line,
  - height over threshold,
  - flare & touchdown
- Landing roll
  - of reverse,
  - autobrake and
  - manual brake

4.1.5 DESCENT & APPROACH

- Normal procedures
- Approach briefing
- Standard callouts
- Crew coordination
- Demonstration with AUTO approach and Landing

4.1.6 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.1.7 SESSION INFORMATION LOFT

Captain and Co-Pilot

ROUTE	VTBD – VHHH			
ATC Clearance	VTBD RWY 21R –SELKA 5A – SELKA – VHHH			
WEATHER	VTBD 220/5 CAVOK 28/26 1013 NOSIG VHHH 270/5 5000m bkn 4500 30/17 1012 VMMC 260/8 4500m OVC 3000 31/16 1012			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	120.0 t	Version. 3/9	V1 =
	FUEL	20.0 t	MAC TO 24	Vr =
	TOM	140.0 t	STAB TO 3	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.1.8 SESSION INFORMATION TRAFFIC PATTERNS

ROUTE	LZIB - LZIB			
ATC Clearance	Operate unrestricted RWY 31 circuit area			
WEATHER	Calm, CAVOK 15/5 1013 NOSIG			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	95.0 t	Version. 3/0	V1 =
	FUEL	25.0 t	MAC TO 24	Vr =
	TOM	120.0 t	STAB TO 3	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.1.9 SESSION PROFILE

4.1.9.1 Part 1 (PF - Captain)

- Takeoff & climb to 10000ft.
- Airwork, Steep turns, Stalls
- Rapid climb to 31000ft
- High Altitude stall
- High speed buffet
- Emergency descent
- Automatic approach & landing
- Traffic patterns

4.1.9.2 Part 2 (PF - Copilot)

As above

4.1.10 NOTES FOR INSTRUCTORS

- Some repositioning/snapshots maybe required during the Co-pilot sector so as to allow 1 hour for traffic patterns
- To obtain Bratislava in the simulator select “LKIB” or “BTS”.

4.2.1 OBJECTIVES

Loft component

- Abnormal start procedures
- Revision of steep turns and stalls
- Hydraulic malfunctions
- Flight control malfunctions
- Instrument approaches (ILS, non precision, circling)
- Malfunctions during landing

Manipulation component

- Introduction to single engine operation

4.2.2 PREFLIGHT

- Normal procedures
- Abnormal start Use of non-normal checklist

4.2.3 TAKE OFF

- Normal procedures
- Use of engine anti – ice

4.2.4 CLIMB

- Normal climb

4.2.5 SESSION SPECIFIC TRAINING

4.2.5.1 Airwork (FL100)

Revision:
- Steep turns & stalls (both pilots)

4.2.5.2 Malfunctions

Hydraulic malfunction:
- Single system versus double system failure
- Systems lost
- Alternate flap operation - time 3mins flaps up to flaps 20
- Alternate gear
- Reserve brakes & steering
- Flaps 20 landing – flare

Flight control malfunctions:
- Flap/Slat asymmetry versus disagree

Landing malfunctions:
- Reverser failure,
- autobrake failure.
- Performance calculations, Hydraulic malfunction landing distance required.

4.2.5.3 Introduction to Single Engine Operation

Last hour of the session.

Start with clear day, become airborne and retard one thrust lever to idle, maintain wings level with a combination of ailerons and rudder, maintain a constant track , adjust rudder so there is no aileron input, observe pitch attitude and IAS. Advance thrust lever and retard the other and repeat fly around doing turns climbing descending.

Reset to the ground

- V1 cut progressively reducing the visibility and introduce night conditions as well as recall items.
- At the end of the session the trainees should have a good understanding of the relationship between rudder and aileron. And without thinking, realise if there is too much rudder input or not enough.
- If failure occurs whilst still on the ground maintain visual reference until “rotate” for correct rudder input.

Engine failure on takeoff

- Review FCTM
- Recall items
- Engine out acceleration altitude
- Clean up procedure

Cruise

- Use of checklist,
- Use of autopilot,
- Use of rudder trim

Approach

- Flaps 20

Landing

- Rudder trim zero to 5 for landing

4.2.6 APPROACH & LANDING

Copilot: ILS 16, NDB 29 Circle 11
Captain: ILS 11,

4.2.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.2.8 SESSION INFORMATION LOFT

ROUTE – Part 1	LOWW RWY 16 - KOXAR 2B-DCT LHBP			
ROUTE – Part 2	LOWW RWY 29 – KOXAR 5C -LOWW			
WEATHER	250/15 1000m OVC005 05/03 1013 BCMG 5000m OVC010			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	20.0 t	MAC TO 24	Vr =
	TOM	130.0 t	STAB TO 3	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.2.9 SESSION INFORMATION INTRODUCTION TO SINGLE ENGINE OPERATION

ROUTE	LOWW - LOWW			
ATC Clearance	Operate unrestricted RWY 16 Circuit Area			
WEATHER	Calm, CAVOK 15/5 1013 NOSIG			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	95.0 t	Vers. 3/0	V1 =
	FUEL	50.0 t	MAC TO 24	Vr =
	TOM	145.0 t	STAB TO 3	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.2.10 SESSION PROFILE

4.2.10.1 Part 1 (PF - Copilot)

- Takeoff & climb to 10000ft
- Airwork: revision of steep turns & stalls (both pilots)
- Recovery to LOWW
- Hydraulic malfunction
- ILS approach to land
- Second takeoff & climb to 5000ft
- FlapSlat asymmetry or disagree
- Non precision approach to circle & land

4.2.10.2 Part 2 (PF - Captain)

- Takeoff & climb to 5000ft
- Hydraulic malfunction
- ILS & Land

4.2.11 NOTES FOR INSTRUCTORS

- Some repositioning/snapshots maybe required during the Co-pilot sector so as to allow 1 hour for engine out familiarisation

4.3.1 OBJECTIVES

Loft component

- Instrument failures
- Loss of thrust both engines
- Revision of rapid decompression & emergency descent
- Asymmetric flight
- Rejected take off

Manipulation component

- Introduction to Go-Arounds
    - One & Two engines
    - above & below MLW

4.3.2 PREFLIGHT

- Abnormal start

4.3.3 TAKE OFF

- Evacuation (Left and right hand seat procedures, PA)
- Normal takeoff

4.3.4 CLIMB

- Instrument failure in climb
- Air conditioning malfunction

4.3.5 SESSION SPECIFIC TRAINING

4.3.5.1 Airwork

FL310:
- Rapid decompression & emergency descent
 (Captain not in the cockpit)

FL100:
- Loss of thrust both engines (Captain in the cockpit, after the emergency descent is completed)
- RAT - flight controls only, 130kts
- Relight

4.3.5.2 Go-Arounds

Two engines

Single engine
- above MLW follow take off, engine contingency procedure
- Single engine below MLW
- Engine failure during Go-Around
- Two engine Go-Around above 160t, use Flap 25 for approach

4.3.6 DESCENT & APPROACH

4.3.6.1 Captain

- 21R ILS
- 21R VOR/DME circle 03L

4.3.6.2 Copilot

- 21R ILS Circling

4.3.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.3.8 SESSION INFORMATION LOFT

ROUTE	VTBD RWY 21 - Radar Hdgs - VTBD			
ATC Clearance				
WEATHER	250/15 5000m OVC008 35/27 1008 NOSIG			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	120.0 t	Vers. 3/9	V1 =
	FUEL	25.0 t	MAC TO 24	Vr =
	TOM	145.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.3.9 SESSION INFORMATION GO-AROUNDS

ROUTE	LOWW - LOWW			
ATC Clearance	Operate in RWY 16 Circuit Area			
WEATHER	Calm, CAVOK 15/5 1013 NOSIG			
LOAD- and TRIMSHEET For **OE-LAX**	**BMLM**		**AMLM**	
	ZFM	95.0t	ZFM	95.0t
	Fuel	35.0 t	Fuel	60.0t
	LDM	130.0t	LDM	155.0t
	Vref 30		Vref 30	

CALCULATIONS:

4.3.10 SESSION PROFILE

4.3.10.1 Part 1 (PF - Captain)

- Takeoff & climb to 10000ft
- Rapid climb to 31000ft
- Emergency descent (Co-pilot acting alone)
- Recovery to VTBD
- Engine malfunction (Loss of thrust both engines)
- Asymmetric ILS to land
- Second departure (Rejected take off some time during the session)
- Engine malfunction during takeoff
- Asymmetric Non Precision Approach Circling to land
- Go-Arounds

4.3.10.2 Part 2 (PF-First officer)

- Takeoff Engine malfunction
- Inflight start
- Engine malfunction
- Asymmetric ILS 21R circling 03L
- Go-arounds

4.3.11 NOTES FOR INSTRUCTORS

- Some repositioning/snapshots maybe required during the Co-pilot sector so as to allow 1 hour for go arounds.

4.4.1 OBJECTIVES

Loft component
- High speed rejected take off
- Max weight take off
- ADC malfunctions
- Advanced asymmetric
- Circling approach
- Landing gear malfunctions

Manipulation component
- Windshear
- Cdr. Right hand seat training.
- Review Go-arounds & Asymmetric operations

4.4.2 PREFLIGHT

- Abnormal start

4.4.3 TAKE OFF

<u>80kts</u>
- Incapacitation and ASI check and required thrust has been set.

<u>High speed reject</u>
- Brake cooling
- Fire
- Emergency Evacaution

<u>Packs Off</u>
- Max weight engine failure at V_1 & V_1 +10
- Special engine failure procedure

4.4.4 CLIMB

- ADC malfunction

4.4.5 SESSION SPECIFIC TRAINING

4.4.5.1 Engine failure in the cruise

4.4.5.2 Fuel jettison

4.4.5.3 Landing gear malfunctions

4.4.5.4 Windshear

<u>Avoidance, precautions, recovery:</u>

- Review Windshear flight path control
- Use of pitch attitude and thrust to control flight path verses airspeed
- Airplane response characteristics
- Respecting Stick Shaker
- Go around considerations
- Use of Autopilot/Flight Director
- Difficulty of recognizing degrading flight path during transition from IMC to VMC.
- Crew coordination

<u>Practice</u>

- After Lift Off
- Approach (Go Around)
- Windshear on take off 170t CAVOK conditions
- Windshear on landing 145t CAVOK conditions

4.4.6 DESCENT & APPROACH

- Non - precision to circling

4.4.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.4.8 SESSION INFORMATION

Part 1: Captain and Co-pilot

ROUTE	LOWW – MDPC			
ATC Clearance	LOWW – LIMRA 6C - DCT MDPC			
WEATHER	LOWW: 200/15 800m OVC006 2/2 1004 BCMG 5000m OVC010			
	MDPC: calm CAVOK 23/15 1006 MDPP same Wx			
HIL / NOTAM	- NIL -			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	120.0 t	Vers. 3/9	V1 =
	FUEL	66.0 t	MAC TO 24	Vr =
	TOM	186.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.4.9 OTHER SESSION INFORMATION

Part 2: Co-pilot

ROUTE	LOWW – LPAZ			
ATC Clearance	LIMRA 6C FPR			
WEATHER	LOWW: 200/15 800m OVC006 2/2 1004 BCMG 5000m OVC010			
Weather	LPAZ and LPLA Calm Cavok 23/10 1011			
HIL / NOTAM	Fuel jettison U/S			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	120.0 t	Vers. 3/9	V1 =
	FUEL	50.0 t	MAC TO 24	Vr =
	TOM	170.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

WINDSHEAR PF CAPTAIN & FIRST OFFICER
3 TAKE OFFS & 3 LANDINGS/GO AROUNDS EACH

	WINDSHEAR Visual set up	**TAKE OFF & ARRIVAL RWY 16 CAVOK CONDITIONS DAY**
TAKE OFF	Airfield conditions	QNH 1008 OAT 28 WIND 160/20
	Flight status	ZFM 120t Fuel 50t
	Reposition page	TAKE OFF
		WINDSHEAR PROFILES
LANDING	Reposition page	6 NM FINAL ZFM 120t Fuel 25t
	Flight status	ZFW 120t Fuel 25t

4.4.10 SESSION PROFILE

4.4.10.1 Part 1 (PF - First Officer)

- Rejected takeoff some time during the session
- Takeoff & climb to 25000ft
- Engine malfunction
- Fuel jettison
- Recovery LOWW
- Asymmetric ILS to go around
- Non precision approach to land
- Second departure (170.0t)
- Engine failure on takeoff
- Non precision approach to circle & land
- Windshear
- Manipulation: Practice Go-arounds / asymmetric

4.4.10.2 Part 2 (PF - Captain)

- Engine failure on takeoff
- Asymmetric ILS to go around
- Non precision approach to land
- Windshear
- Manipulation:
    - ➢ Cdr. Right hand seat training
        - ❖ Engine failure on take off V1 or later,
        - ❖ Engine failure during go-around
        - ❖ Single engine approach and landing
    - ➢ Practice Go-arounds / asymmetric

4.4.11 NOTES FOR INSTRUCTORS

- Some repositioning/snapshots maybe required during the Co-pilot sector so as to allow 1 hour windshear and review of asymmetric operations and go arounds.

4.5.1 OBJECTIVES

- Use of MEL & DDG
- Use of supplementary procedures
- External air & power supply start
- Battery start
- Flight control problems
- Electrical malfunctions
- Cat 2 Manually flown

4.5.2 PREFLIGHT

- Battery start
- Ground air
- X bleed start

4.5.3 TAKEOFF

- Noise abatement
- Wet runway
- Low visibility take off

4.5.4 CLIMB

- Airwork flight control problems

4.5.5 SESSION SPECIFIC TRAINING

4.5.5.1 Stab Trim Malfunctions

- Unscheduled Stab trim
- Runaway Stab trim

4.5.5.2 Electrical Malfunctions

- Loss of IDG
- BTB failures
- Loss of AC power
- Flight with HDG operative and inoperative

4.5.5.3 Instrument Failures

- Symbol generator
- Loss of EADI's
- FD failure, raw data approach
- Standby instrument approach

4.5.5.4 Heavy-Weight Flight

- Packs-Off Takeoff
- Engine failure in the cruise
- Approach to Cat II minimum
- Landing

4.5.6 DESCENT & APPROACH

4.5.7 TAXI IN & SHUTDOWN

4.5.8 SESSION INFORMATION

Captains first sector

ROUTE	LIMC – LOWW			
ATC Clear. Pt 1	LIMC – SRN6D–DCT- MALUG– DCT SNU - LOWW			
WEATHER	LIMC: 250m RVR35L 350m RA ovc001 12/11 1010 RMK 35290193			
	LOWW: 310/15 1500 ovc004 12/11 1010 LOWL CALM 5000m bkn 2300 13/8 1009			
HIL / NOTAM	APU U/S			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	20.0 t	MAC TO 24	Vr =
	TOM	130.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

Captains and Co-pilots second sector

ROUTE	LOWW- VTBD			
ATC Clear.	Koxar2B dct VTBD			
WEATHER	LOWW 270/15 350m RVR 16 350m ovc001 12/08 1010 VTBD/VTCC CALM CAVOK 32/12 1003			
HIL / NOTAM	Fuel jettison u/s			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	116.7t	Vers. 3/9	V1 =
	FUEL	70.0 t	MAC TO 24	Vr =
	TOM	186.7 t	STAB TO	V2 =
			ASS. T. °C	Vref30

4.5.9 OTHER SESSION INFORMATION

Co-pilots first sector

<table>
<tr><td>ROUTE</td><td colspan="4">LOWW – LOWS</td></tr>
<tr><td>ATC Clearance</td><td colspan="4">SNU1C -LIMRA –SZG</td></tr>
<tr><td>WEATHER</td><td colspan="4">LOWW 230/5 250m RVR29 350m ovc001 12/8 1010</td></tr>
<tr><td>HIL / NOTAM</td><td colspan="4">- NIL</td></tr>
<tr><td rowspan="4">LOAD- and TRIMSHEET For OE-LAX</td><td>ZFM</td><td>110.0 t</td><td>Vers. 3/9</td><td>V1 =</td></tr>
<tr><td>FUEL</td><td>20.0 t</td><td>MAC TO 24</td><td>Vr =</td></tr>
<tr><td>TOM</td><td>130.0 t</td><td>STAB TO</td><td>V2 =</td></tr>
<tr><td></td><td></td><td>ASS. T. °C</td><td>Vref30</td></tr>
</table>

4.5.10 SESSION PROFILE

4.5.10.1 Part 1 (PF - Captain)

- Takeoff & climb 15000ft
- Stab trim malfunctions
- Climb to 27000ft
- Electrical malfunctions
- Raw data ILS to go around
- Standby instrument ILS to land
- Second departure (Maximum weight)
- Engine failure in takeoff
- Asymmetric CAT II ILS to land
- Pax evacuation

4.5.10.2 Part 2 (PF - Copilot)

- Takeoff & climb 5000ft
- Electrical malfunction
- Raw data ILS to go around
- Raw data ILS to land
- Second departure (Maximum weight)
- Engine failure in takeoff
- Asymmetric CAT II ILS to land

4.5.11 NOTES FOR INSTRUCTORS

- none -

4.6.1 OBJECTIVES

- Salzburg qualification
- Systems malfunctions
- Bomb threats
- SOPs
- Circling

4.6.2 PREFLIGHT

Aborted engine starts

4.6.3 TAKEOFF

System malfunctions

4.6.4 CLIMB

Systems malfunctions

4.6.5 SESSION SPECIFIC TRAINING

4.6.5.1 Salzburg Qualification

- Special procedure ILS 16 and go around
- Circling procedure to runway 34 and land
- Takeoff runway 16 with engine failure special procedure
- Noise abatement departure Rwy34 (noise monitoring sites track exactly as per the SID)

4.6.5.2 Navigation Malfunction

- Loss of FMC
- Loss of LNAV

4.6.5.3 Pneumatics Malfunction

- Duct leaks
- Rapid decompression and emergency descent

4.6.5.4 Fire

- Wheel Well Fire
- Cargo Fire

4.6.5.5 Bomb Threats

- Lauda-Air procedures OM General/Basic 10.1.8

4.6.6 DESCENT & APPROACH

- VOR approach to circle LNZ
- ILS approach to circle SZG

4.6.7 TAXI IN & SHUTDOWN

4.6.8 SESSION INFORMATION

Co-pilots first sector

ROUTE	LOWW – LOWS			
ATC Clear. Pt 1	LOWW SNU 1C SNU DCT SBG LOWS			
	Flap 5			
WEATHER	LOWW 310/5 250m Fog RVR29 300m ovc001 15/15 1003 LOWS 260/15 1000m ovc005 11/11 1003 Imp 290/15 5000m ovc027 LOWL 310/20 5000m ovc015 11/8 1003			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	15.0 t	MAC TO 24	Vr =
	TOM	125.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

Co-pilots second sector

ROUTE	LOWS – LOWW			
ATC Clear. Pt 1	LOWS LNZ 2V LNZ DCT STO LOWW			
	RUNWAY 16 Flap 20!			
WEATHER	LOWW 310/5 250m Fog RVR29 300m ovc001 15/15 1003 LOWS 190/19 3700m ovc050 11/8 1003 LOWL 310/20 5000m ovc015 11/8 1003			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	15.0 t	MAC TO 24	Vr =
	TOM	125.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

Captains first sector

ROUTE	LOWS – LOWW			
ATC Clear	LOWS LNZ 2S LNZ DCT STO LOWW			
	RUNWAY 34 Flap 5			
WEATHER	LOWW 310/5 250m Fog RVR29 300m ovc001 15/15 1003 LOWS 260/15 500m RVR 34 800m ovc003 11/11 1003 LOWL 310/20 5000m ovc015 11/8 1003			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	10.0 t	MAC TO 24	Vr =
	TOM	120.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

Captains second sector

ROUTE	LOWS – LOWW			
ATC Clear	LOWS LNZ 2V LNZ DCT STO LOWW			
	RUNWAY 16 Flap 20!			
WEATHER	LOWW 310/5 250m Fog RVR29 300m ovc001 15/15 1003 LOWS 190/19 3700m ovc050 11/8 1003 LOWL 240/20 5000m ovc015 11/8 1003			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	15.0 t	MAC TO 24	Vr =
	TOM	125.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

4.6.9 OTHER SESSION INFORMATION

- none -

4.6.10 SESSION PROFILE

4.6.10.1 Part 1 (PF - First Officer)

- Takeoff & climb 26000ft
- Emergency descent
- Special ILS 16 Salzburg & go around
- ILS 16 to circle 34 & land
- Second departure
- Engine failure on takeoff runway 16
- Divert to LOWL
- VOR 09 approach to circle 27

4.6.10.2 Part 2 (PF - Captain)

- Takeoff & climb
- Bomb threat
- Special ILS 16 Salzburg & go around
- ILS 16 to circle 34 & land
- Second departure
- Engine failure on takeoff runway 16
- Divert to LOWL
- VOR 09 approach to circle 27

4.6.11 NOTES FOR INSTRUCTORS

- none -

4.7.1 OBJECTIVES

- Puerto Plata Circling Procedures.
- Inadvertent Reverse thrust deployment
- North Atlantic procedures

4.7.2 PREFLIGHT

Normal start

4.7.3 TAKEOFF

Flight control malfunction

4.7.4 CLIMB

Unrestricted climb to FL 260

4.7.5 SESSION SPECIFIC TRAINING

In flight thrust reverser deployment.

Cockpit indications

- Green REV icon
- Fuel flow 700 kg/hr
- Thrust lever doesn't move on the PW4000
- Dramatic yaw and roll.

4.7.5.1 Landing Gear Malfunctions

- Door Disagree
- Gear Disagree

4.7.5.2 Door Malfunctions

- Cabin Door
- Cargo Door

4.7.6 DESCENT & APPROACH

4.7.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.7.8 SESSION INFORMATION

Co-pilot sector 1

ROUTE Part 1	MDPC – PNA - DIRECT PTA - MDPP			
ATC Clearance	W10 Pixar A636 PTA			
WEATHER	MDPC 080/15 6000 OVC 1100 28/24 1008 -RA MDPP 080/15 6000 BKN 1100 28/23 1008			
HIL / NOTAM	- NIL -			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	105.0 t	Vers. 3/9	V1 =
	FUEL	15.0 t	MAC TO 24	Vr =
	TOM	140.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.7.9 OTHER SESSION INFORMATION

Captains' sector 1

ROUTE	MDPP – KMCO			
ATC Clearance	PTA-A636- ZIN-A315-ZBV-DCT ORL			
WEATHER	MDPP 260/15 6000 –RA OVC 1100 28/20 1008 RUNWAY WET KMCO 160/15 CAVOK 20/12 1014 NOSIG			
	KMIA 170/10 CAVOK 21/11 1016 NOSIG			
HIL / NOTAM	- NIL -			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	115.0 t	Vers. 3/9	V1 =
	FUEL	35.0 t	MAC TO 24	Vr =
	TOM	150.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.7.10 SESSION PROFILE

4.7.10.1 Part 1 (PF - Copilot)

PUJ-POP.

- Normal Start
- Take-off runway 09
- Rejected Take-off some time during session
- Flight control problem
- Proceed to POP
- Reverser deploys in the cruise
- Door light on Descent (at instructors discretion)
- NDB 26 Approach, Circling 08 Runway

4.7.10.2 Second departure POP-MCO (PF - Captain)

- Depart RWY 26 Engine malfunction
- Approach (Wind change 080/20) VORDME 26 Approach, Circling 08
- Right main undercarriage fails to lock down.
- Gear collapses on landing
- Pax Evacuation

4.7.10.3 Third departure SHA-CUN (PF –Captain)

Refer to the attached flight papers for details.

4.7.11 NOTES FOR INSTRUCTORS

Increase the fuel on the SHA/CUN sector to reflect a take off mass of 186 800 kg

```
CFP INPUT MESSAGE DATE TIME REF 202158
START OF CFP REF : B72AT  -  LDA25    01 EINN MMUN

   ROUTES FROM EINN TO MMUN

   NAT TRACK SUMMARY IN BEST TIME SEQUENCE BASED ON MACH .800
         ---------------------------------------------------

          ENTRY      NAT. TRACK      EXIT        CPN     TIME
         ---------------------------------------------------

        73340 DOLIP      A      YYT    17702    50471    9.42
        84977 KENUK      C      BANCS  17705    50472    9.52
        84976 GIPER      B      COLOR  17704    50471    9.56


ROUTE VIA OPTIMUM TRACK A L P H A
HIGH SPEED FMA=.82
180 MINUTES COVERED

DATE OF FLIGHT 21/MAY/99


FLT RELEASE   LDA 25   EINN/MMUN FIXED MACH                   ASST/...
           FUEL  TIME       TOM      LDM      ZFM    AC 205   V1  /...
TRIP      52360  0932     183020   130660   124000   REG      VR  /...
CONT       1770            AWC M23  ISA DEV P01      OE-LAX   V2  /...
ALTERNATE  2730  0031    MMMD FL 260   159 M.70 W/C  P000     V.../...
                          ....     ...   ... ...      ....    MAC /...
FINAL RES  2160  0030                                         TRIM/...
MIN T/O   59020  1033   LDA 25    SLOT .. .. ..
TAXI        400         SCHEDULE ACTUAL                 DELAY CODE/TIME
MIN BLK   59420  1033   CUN 2340 ON BL .:.. LNDG .:..  .../.../.../...
EXTRA                   SNN 1140 OFFBL .:.. AIRB .:..  .../.../.../...
ACT BLK               BLOCK 1200 TIME  .:.. TIME .:..

FUEL DEP ...... WX.DEP:
FUEL ARR ......
FUEL USED.....
DIFF KG/PC.....

RWY: ..     FLAPS:. ..    RTOM: .. ...    SIGN.CDR  DSP-NAME
PAX: .. ..  AZFM:.. ..    ATOM: ..  ..    .. .. ..  EBNER
LDG FUEL : .. .. .. ..
ALDM     : .. .. .. ..    ATC CLEARANCE:

WX.ARR:


                        CPN  50471 ENTRY  73340 EXIT  17702

FREQ    MT      WIND     TMP       TAS GS   DIST TIME ETO RTO FL   BTGO
POSN    AWY     LAT      LONG      MN  W/C  DTGO TTGO     ATO GM   AFL

EINN            N5242.1 W00855.5            4243 0932              052360

113.30  M060    280/013 M08        364 373    11  002 ... ... CLB  052020
SHA     DCT     N5243.3 W00853.1       P009 4232 0930     ... 048  ...

        M260    270/082 M04        364 302    93  018 ... ... 310  048510
TOC     UN525                          M062 4139 0912     ... 048  ...

        M260    270/082 P00        482 406    30  005 ... ... 310  048040
DOLIP   UN525   N5200.0 W01200.0   820 M076 4109 0907     ... 048  ...

CFP INPUT MESSAGE DATE TIME REF 202158
START OF CFP REF : B72AT  -  LDA25    01 EINN MMUN

   ROUTES FROM EINN TO MMUN

   NAT TRACK SUMMARY IN BEST TIME SEQUENCE BASED ON MACH .800
         ---------------------------------------------------
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```
BELOW ZFW -2000 TIME 0935  BRNOF  51527  ZFW 122000   FMA   MAC.820
310/N52W020 330/YYT    350/INPIN   370/DHP     350/EYW
370/FIS     390

ABOVE ZFW  2000 TIME 0930  BRNOF  53028  ZFW 126000   FMA   MAC.820
310/YHZ     350/INPIN   370/DHP     350/EYW     370/FIS
350


ALT 2  CZM   FL  80  DIST   50 NM  M490  WC    1  FUEL   1190
```

ETOPS INFORMATION

```
ELAP TIME ENTRY  1.10 ETP1   2.28 ETP2   2.33 EXIT   4.36
ATD... ...ETA   .. ..       .. ..       .. ..       .. ..

EQT ALTNS EINN/BIKF   BIKF/CYYR
ENTRY AIRPORT EINN / EXIT AIRPORT CYYR
```

ETP1		MORA	TRK	FL	DST	TIME	IAS	TAS	G/S	FUEL REQD	CRIT FUEL	TWO ENG FUEL
N4958.8	EINN	48	81	100	1017	2.16	360	416	451	19730	0	17150
W03543.7	BIKF	71	26	100	943	2.16	360	412	417	19540	0	16990

FUEL REMAINING 41797 INCLUDES   1311 CONTINGENCY

FUEL REQUIRED INCLUDES 0.0/ 0.0 PC ANTICING   2.000 PC DEG

ETP2		MORA	TRK	FL	DST	TIME	IAS	TAS	G/S	FUEL REQD	CRIT FUEL	TWO ENG FUEL
N4947.0	BIKF	71	28	100	968	2.19	360	413	419	19920	0	17300
W03639.5	CYYR	53	283	100	912	2.19	360	416	395	20160	0	17500

FUEL REMAINING 41309 INCLUDES   1296 CONTINGENCY

FUEL REQUIRED INCLUDES 0.0/ 0.0 PC ANTICING   2.000 PC DEG

ALTERNATE REQUIRED AVAILABILITY TIMES

ALTERNATE	FROM	TO
EINN	12.51	17.24
BIKF	15.24	17.32
CYYR	15.32	18.17

```
START OF ICAO FLIGHT PLAN

(FPL-LDA25-IN
-B763/H-SXDIRWE/S
-EINN1140
-N0482F310 DCT SHA UN525 DOLIP UN523 52N015W/M082F310 NATA
 YYT/N0482F310 J575 YHZ/N0473F350 J575 BOS J55 HTO J174 SWL J121
 CHS J174 CRG J55 INPIN/N0472F370 J55 DHP/N0478F350 J79
 EYW/N0474F370 DCT FIS/N0469F390 B646 CANOA UB646 ROBIN B881 CUN
 DCT
-MMUN0932 MMMD MMCZ
-EET/EGGX0041 CZQX0159 CZQM0429 KZBW0526 KZDC0614 KZJX0704
 KZMA0755 MUFH0844 MMID0910
 EET/20W0108 30W0159 40W0250 50W0343
 REG/OELAX SEL/CEBR
 RALT/EINN/BIKF/CYYR)

END OF ICAO FLIGHT PLAN


PVR SUBMITTED        YES    O         NO    O

DUTY ASSIGNMENT AND NAME:( INSTR, CDR LT, CDR, CDR R, CDR C
                           COP, COP R, COP C, OBS, PUR, SEN, FA, CK )

.....   .......................       .....   .......................

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END OF CFP REF : B72AT  -  LDA25   01 EINN MMUN


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OO  0182 202108/MAY99
FDC361 202108
DD LOWWLDAX LOWWAUAO
202108 EGGXZOZX
(NAT-1/3
TRACKS FLS310/390 INCLUSIVE
MAY 21/1130Z TO MAY 21/1800Z
PART ONE OF THREE PARTS-
A 52/15 52/20 51/30 49/40 48/50 YYT
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST DOLIP
NAR N98A N102B
B 51/15 51/20 50/30 48/40 47/50 COLOR
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST GIPER
NAR N86B N88A
C 50/15 50/20 49/30 47/40 46/50 BANCS
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST KENUK
NAR N72B N78A
D 49/15 49/20 48/30 46/40 45/50 RAFIN
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST GUNSO
NAR N60A N66C
E ETIKI 48/15 48/20 47/30 45/40 44/50 BOBTU JAROM
EAST LVLS NIL
WEST LVLS 310 330 350 370
EUR RTS WEST REGHI
NAR N46E N54E
F ARMED 44/20 44/30 44/40 43/50 JEBBY CARAC
EAST LVLS NIL
WEST LVLS 330 350 370
EUR RTS WEST DIRMA
NAR N36E N44B

G 43/40 40/50 36/60 35/63
EAST LVLS NIL
WEST LVLS 330 350 370 390
EUR RTS WEST NIL
NAR NIL

H 41/40 34/50 28/60
EAST LVLS NIL
WEST LVLS 330 350 370 390
EUR RTS WEST NIL
NAR NIL

END OF PART TWO OF THREE PARTS)

NNNN
```

```
OO  0184 202109/MAY99
FDC364 202110  .
DD LOWWLDAX LOWWAUAO
202109 EGGXZDZX
(NAT-3/3
TRACKS FLS310/390 INCLUSIVE
MAY 21/1130Z TO MAY 21/1800Z
PART THREE OF THREE PARTS
J 39/40 30/50 24/55
EAST LVLS NIL
WEST LVLS 330 350 370 390
EUR RTS WEST NIL
NAR NIL

REMARKS
1. OPERATORS ATTENTION IS DRAWN TO CANADIAN NOTAMS A1501/99
AND A1503/99
2. OPERATORS ATTENTION IS DRAWN TO UK NOTAMS G0005/99 AND
G0180/99
3. TRACK MESSAGE IDENTIFICATION IS 141 AND OPERATORS ARE
REMINDED TO INCLUDE THE TMI NUMBER AS PART OF THE OCEANIC
CLEARANCE READ BACK.
4. MNPS AIRSPACE EXTENDS FROM FL285 TO FL420. OPERATORS ARE REMINDED
THAT SPECIFIC MNPS APPROVAL IS REQUIRED TO FLY IN THIS AIRSPACE
IN ADDITION RVSM APPROVAL IS REQUIRED TO FLY BETWEEN FL310 AND
FL390 INCLUSIVE.
5. EIGHTY PERCENT OF GROSS NAVIGATION ERRORS OCCUR AFTER A REROUTE
ALWAYS CARRY OUT WAY POINT CROSS CHECKS-
END OF PART THREE OF THREE PARTS)

NNNN
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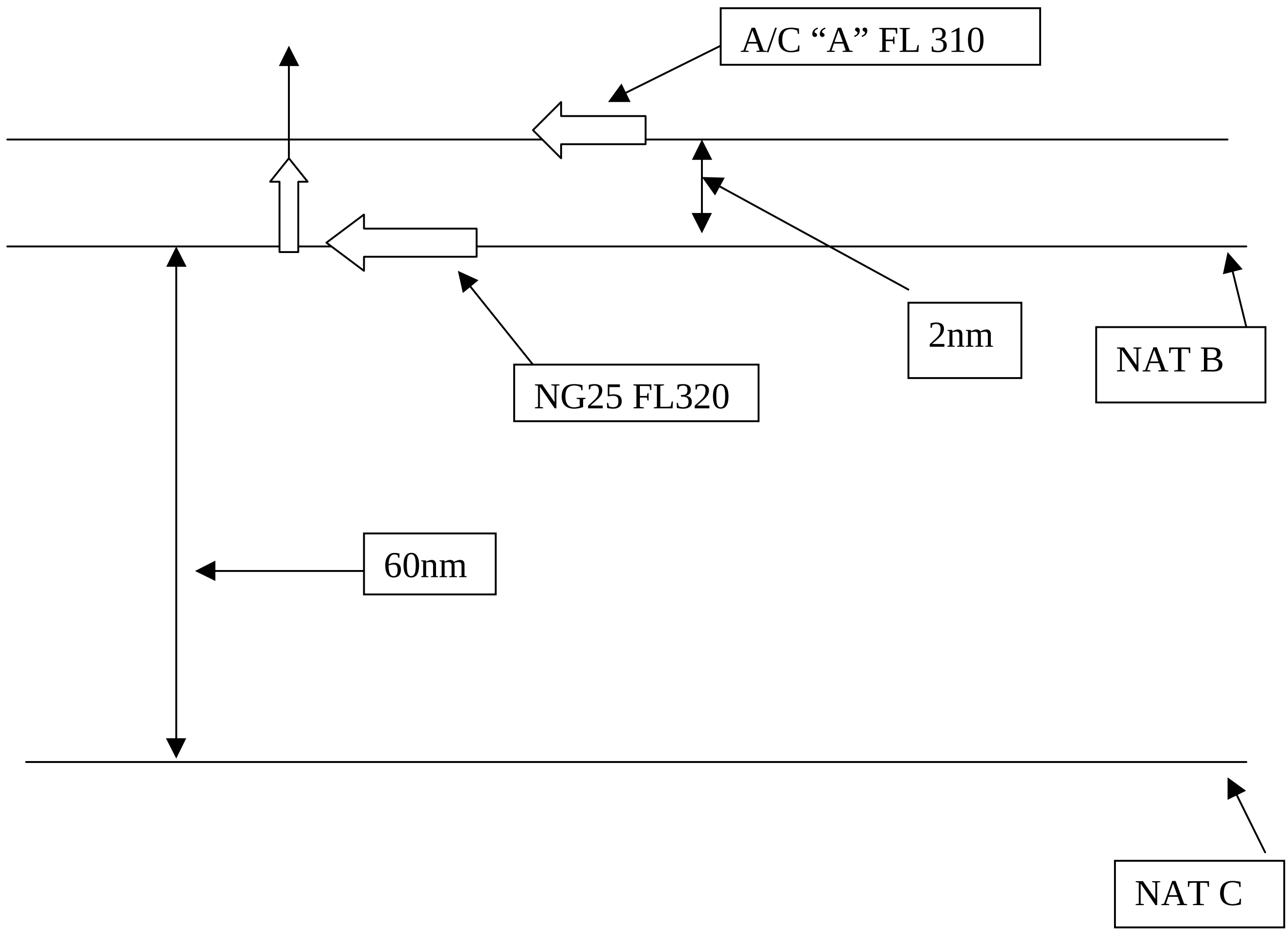
```
999
SX5
SAIE202200RRA
EINN 202200Z 23010KT 9999 -RA FEW008 SCT014 BKN025 13/11 Q1015
     NOSIG=
SAIL202200
BIKF 04005KT 5000 SN SCT002 BKN004 OVC011 02/00 Q0985=
SACN202100 CYYR 202100Z 07005KT 15SM -SHRA FEW045 BKN050 OVC080 09/07
A2972 RMK SC1SC6AC2 /BLUE/ SLP067=
SAMX202200
MMUN 202145Z 07009KT P6SM SCT018TCU BKN200 28/22 A2994 RMK 20399=
MMMD 202145Z 36020KT P6SM SCT030CB BKN060 32/21 A2995 RMK 36099
             ZNS PCPN AISL ALRD=
FTIE201600
EINN 201600Z 210018 22015KT 9999 SCT015 BKN030 BECMG 0003 -RA
     SCT007 BKN015 BECMG 0508 25017KT TEMPO 0310 RA 5000 BKN008
     BECMG 1012 SCT010 SCT018CB=
FTIL201600
BIKF 201818 19015KT 9999 SCT15CB BKN030 TEMPO 1821 5000 SHRAGR
            SCT010CB BKN030 BECMG 2124 VRB05KT FEW010 SCT015
            BKN050 BECMG 0306 32010KT BECMG 1113 32020KT TEMPO
            2118 SHRA SCT010 BKN030=
FTCN202200 CYYR 202123Z 202222 02012KT P6SM SCT030 BKN050 OVC080 TEMPO 2223
        4SM -SHRA BR SCT010 BKN025 OVC040
    FM2300Z 34015KT P6SM -RA SCT015 BKN025 OVC040 TEMPO 2303 3SM -RA
        BR BKN012 OVC020
    FM0600Z 36010KT P6SM SCT010 BKN025 TEMPO 0613 4SM -DZ BR BKN009
        OVC020
    FM1800Z 01008KT P6SM SCT040 TEMPO 1822 BKN030
    RMK NXT FCST BY 04Z=
FTMX201600
MMUN 201740Z 201818 12015KT 6SM HZ BKN020 BKN220 TEMPO 2104 3SM
     TSRA OVC015CB FM05 08010KT 6SM HZ SCT100 FM12 08010KT 6SM HZ
     BKN020CB=
MMMD 201740Z 201818 06015KT P6SM BKN025 VC CB FM03 00000KT 6SM HZ
     SKC FM14 06010KT 6SM HZ BKN020=
```

Please note the correct date for the MMUN and MMMD forecast is the 21st
The 2200 metar for BIKF should read BKN 010 not BKN 001
The 2200 metar for EINN has been amended to read,
2200 060/20 9999 –RA F800 0/-2 1015

ATC Clearance

Shanwick clears Lauda Air 25 to MMUN via Track Bravo, FL 320, Mach Decimal 80.



When operating in the MNPS you maybe required to operate the aircraft at or near its maximum altitude, due to the large amount of traffic operating over the North Atlantic.

In the above scenario NG 25 has suffered an engine malfunction and is diverting off NAT TRACK "B" 30nm, 90 degrees to the right, reducing speed to the E/O speed of 270kts (for this weight) and commencing descent.

Unfortunately aircraft "A" is cruising on the same track at FL310(1000' below) and due to wake turbulence is doing a 2 mile offset.

Obviously both aircraft are in danger of colliding.

In case of a diversion to an ETOPS alternate because of an engine failure perform these steps in the following sequence:

1. AT arm switch .... OFF
2. Select and set MCT
3. **MCP altitude** .... wind down
4. **Cruise Page**: ENG OUT .... EXECUTE
5. HDG select .... 90 deg. off-track, bank 25°
6. VNAV .... CHECK
7. RECALL items .... perform
8. ROUTE PAGE: enter 30 NM parallel offset
9. MAYDAY – MAYDAY – MAYDAY on both HF AND 121.5
10. Diversion Speed / Altitude
11. NON NORMAL CHECKLISTS

Note:

- it is essential to stay in this sequence, especially to wind down the altitude on the MCP first and then go to the ENG OUT page. This way, the aircraft will go from VNAV PATH to VNAV SPEED, i.e. it will target SE driftdown speed with pitch, descent rate depending on thrust. If ENG OUT is selected prior to winding down the altitude, FMA pitch mode will change from VNAV PATH to ALT HOLD. As thrust is reduced (you are now on one engine) the aircraft will reduce speed and as there is no speed protection, (because A/T is off), the aircraft will stall, unless descent is initiated by pressing e.g. FL CHANGE.or VNAV Because all this requires additional workload, do it in sequence as above.

The above actions until calling for the recall items is done by the PF.
The PNF must monitor the operation and select the transponder to “TA ONLY”
The reason is twofold,

- The aircraft when operating at or near its maximum altitude reduces speed fairly quickly when on one engine, and a stall may result if both pilots are distracted by doing recall items etc.
- By selecting “TA ONLY” aircraft “A” has to resolve the conflict (assuming it has TCAS).

4.8.1 OBJECTIVES

- All weather operations
- De icing procedures
- Contaminated runway
- Performance calculations
- Low Visibility take offs
- Cat II/III operations
- Recovery from unusual attitudes (airplane upset)

4.8.2 PREFLIGHT

Lauda air de-icing procedures

4.8.3 TAKEOFF

Contaminated runway take off

4.8.4 CLIMB

4.8.5 SESSION SPECIFIC TRAINING

4.8.5.1 All Weather Operations

4.8.5.2 Deicing Procedures

4.8.5.3 Contaminated Runway Performance

- Rejected takeoff at high speed
- Engine failure at V1

4.8.5.4 CAT II/III Operations

<u>Low visibility takeoff:</u>
(OM/Basic requirements: 150M RVR, 3 TAKE OFFS)

1) Normal Engine departure,
2) Engine failure between V1 and V2,
3) Engine failure before V1

<u>Auto approach:</u>
(to demonstrate visual reference at 200’/100’/50’/0’)

<u>Cat II/III Approach:</u>

- Ground equipment failure
- Aircraft equipment failure
  - LAND 3 to LAND 2
  - LAND 3/2 to NOAUTOLAND
  - AUTOPILOT DISCONNECT
  - FLARE fails to engage
- Runway offset
- Engine failures
  - Above 200ft
  - Below 200ft
  - During Go-Around: Go-Arounds flown Auto & manual

<u>Autolands:</u>

- Auto rollout & manual rollout

<u>Cat II Approach</u>
Auto approach & manual landing

<u>Pilot incapacitation</u>

4.8.6 DESCENT & APPROACH

4.8.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.8.8 SESSION INFORMATION

Part 1:Take offs

ROUTE	EDDM – EDDM			
ATC Clearance	Runway hdg climb to FL70			
WEATHER	EDDM 080/5 450m RVR08L 550m +0/-1 1013 BCMG 100m RMK 08690892			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	50.0 t	MAC TO 24	Vr =
	TOM	160.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.8.9 OTHER SESSION INFORMATION

Part 2:

ROUTE	EDDM – EDDM			
ATC Clearance				
WEATHER	EDDM 080/5 450m RVR08L 550m +0/-1 1013 BCMG 100m TEMPO 75m RMK 08690892			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	30.0 t	MAC TO 24	Vr =
	TOM	140.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.8.10 SESSION PROFILE

4.8.10.1 Part 1 (PF both pilots)

Contaminated runway	Rejected takeoff Engine failure on takeoff (both pilots)
Pilot incapacitation	Any time in the above approaches

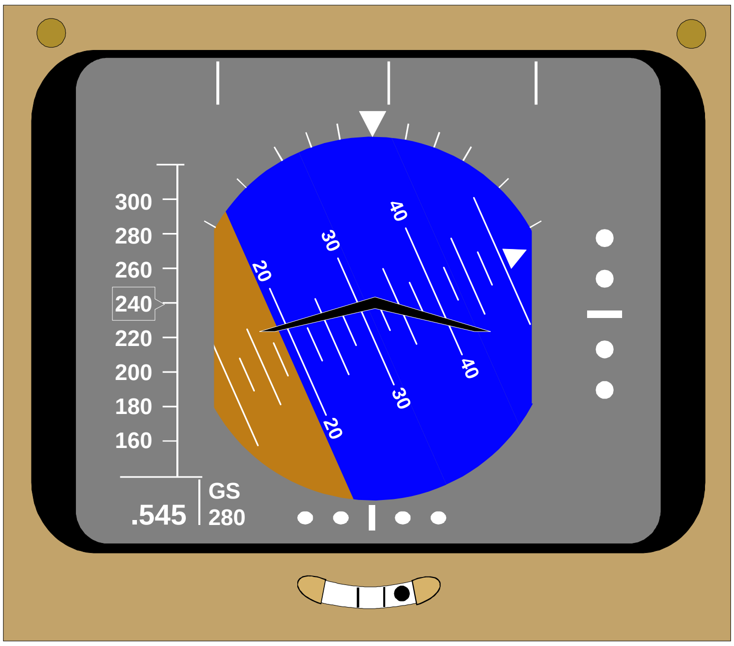
4.8.10.2 Part 2 (PF – Captain)

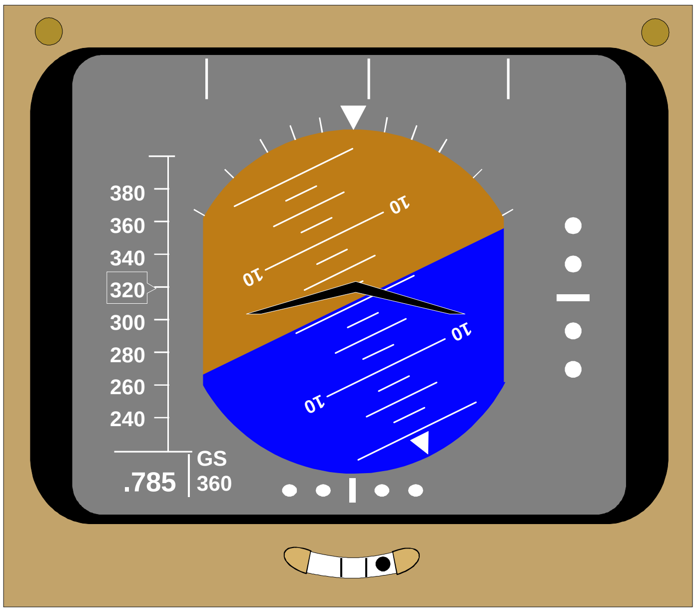
All weather operations	CAT IIIb approaches to go around & land
	CAT IIIa approaches to go around & land
	CAT II approaches to go around & land

4.8.11 NOTES FOR INSTRUCTORS

Minimum of 8 approaches are required.

4.8.11.1 Recovery from unusual attitudes





In keeping with modern phraseology we will refer to an unusual attitude as an airplane upset.

There are a number of reason why aircraft end up in an airplane upset none however are statistically significant.

Avoidance is the best solution, however it is possible in your flying career that you may find yourself in a loss of control situation and you require the skills to recover from that position.

The following is the recommended procedure from all three large airframe manufacturers, Boeing, Airbus and Douglas Products.

The four conditions that describe an airplane upset are,

- Pitch attitude more than 25 degrees nose up.
- Pitch attitude more than 10 degrees nose up.
- Bank angle more than 45 degrees.
- Flight within these parameters at airspeeds inappropriate for the conditions.

It is possible to incorporate recovery technique into two basic scenarios.

NOSE HIGH RECOVERY

- Recognise and confirm the situation.
- Disengage autopilot and autothrottle
- Apply as much as full down elevator
- Apply appropriate nose-down stabilizer trim.
- Reduce thrust (under slung engines).
- Roll (adjust bank angle) to obtain a nose down pitch rate.
- Complete recovery
  - When approaching the horizon roll wings level
  - Check airspeed and adjust thrust as required
  - Establish pitch attitude.

NOSE LOW RECOVERY

- Recognise and confirm the situation.
- Disengage autopilot and autothrottle.
- Roll in the shortest direction (find where the sky pointer is and roll towards it) to level the wings
- Recover to level flight.
  - Apply nose up elevator.
  - Apply stabilizer trim, if necessary.
  - Adjust thrust and drag as required.

If the aircraft has stalled recover from the stall before you initiate the recovery from the upset.

Only a small amount of rudder is required. Too much rudder applied too quickly or held too long may result in loss of lateral and directional control or structural failure.

4.9.1 OBJECTIVES

This session is to be a review and preparation for the Check Ride.

To Be Included:
- Max Weight T/O
- Abort at High Speed
- Engine Failures
- Overweight Landing

4.9.2 PREFLIGHT

Content to be composed by Instructor & Students.

4.9.3 TAKEOFF

Content to be composed by Instructor & Students.

4.9.4 CLIMB

Content to be composed by Instructor & Students.

4.9.5 SESSION SPECFIC TRAINING

Content to be composed by Instructor & Students.

4.9.6 DESCENT & APPROACH

Content to be composed by Instructor & Students.

4.9.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

4.9.8 SESSION INFORMATION (SUGGESTED)

Part 1: (consisting of sub-parts A and B)

- A: NG 9221 MUC/ VIE (PF: Captain)
- B: NG 9220 VIE / MUC (PF: Copilot)

ROUTE Part A	EDDM – LOWW			
ROUTE Part B	LOWW – EDDM			
ATC Part A	EDDM – KIRDI 3E - LNZ - STO - LOWW			
ATC Part B	LOWW – LIMRA - SBG - EDDM			
WEATHER	EDDM: 100/07 250m OVC 002 5/4 1007			
	LOWW: 200/10 1200m OVC005 8/6 1010 TEMPO 300m OVC001			
	EDDF: 080/10 2500m OVC006 8/4 1007			
HIL / NOTAM	At the discretion of the instructor-			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	20.0 t	MAC TO 24	Vr =
	TOM	130.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.9.9 OTHER SESSION INFORMATION

Part 2:

NG 939 VIE-PUJ

ROUTE	LOWW – MDPC			
ATC Clearance	LOWW – LIMRA 6C - SBG DCT - MDPC			
WEATHER	LOWW: 250/15 200m OVC001 12/12 1010 BCMG 5000m OVC010			
	MDPC/MDPP: 090/15 CAVOK 1024			
	EDDM: 100/7 2500m 0VC 006 8/4 1010			
HIL / NOTAM	At the discretion of the instructor			
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	60.0 t	MAC TO 28	Vr =
	TOM	170.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

4.9.10 SESSION PROFILE

BOTH PILOTS COMPLETE PARTS 1 & 2

4.9.11 NOTES FOR INSTRUCTORS

- none -

This flight profile includes those procedures and maneuvers that can be evaluated in a full motion visual simulator. The sequence may be changed and other Non-Normal procedures selected at the discretion of the check pilot.

The instructor will provide appropriate instruction, weather information, and Air Traffic Control clearances and, in so far as possible, conduct the flight on a real time basis. Simulated system faults will be removed after each full stop landing.

The crew will be expected to respond to instructions and situations as they would on a line flight (except for approach to the stalls and steep turn demonstrations), and to use all the cockpit resources available (Autopilot, Autothrottle, etc) unless specifically restricted by the check pilot.

Command qualities and crew coordination are part of the evaluation, as well as correct use of Lauda Operating Procedures.

** ** ** **

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 1

1.	Preflight	Normal SOP's Normal start Taxi techniques	
2.	Takeoff	Takeoff performance Normal takeoff	
3.	Airwork	Steep turns Stalls High speed buffet	 Clean Approach Landing High altitude
4.	Rapid decompression & emergency descent		
5.	Demonstration	Auto approach & landing	
7.	Manual flight	ILS approach Visual Traffic pattern Landings	
8.	Shutdown	Normal SOP's	

Note: Emphasis on Lauda Air SOP's.

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 2

1.	Preflight	Normal SOP's Abnormal start's	
2.	Takeoff	Normal takeoff	
3.	Revision	Steep turns Stalls	 Clean Approach Landing
4.	Malfunctions	Hydraulic Flaps/Slat asymmetry & disagree Reverser & autobrake (landing)	
5.	Approach	Precision (ILS) Non precision (NDB) Circling	
6.	Landings		
7.	Asymmetric Introduction		Engine failure on takeoff Asymmetric approach Asymmetric landing
8.	Shutdown		Normal SOP's

<u>Note:</u> Emphasis on Lauda Air SOP's !

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 3

1.	Preflight	Abnormal start
2.	Takeoff & climb	Instrument failures
3.	Revision	Rapid decompression & emergency descent
4.	Loss of thrust both engines	
5.	Aysmmetric	Rejected takeoff Engine failure on takeoff Asymmetric approach Asymmetric landing Asymmetric go around
6.	Go-Arounds	Two Engines all weights One Engine Above MLW One Engine Below MLW

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 4

1.	Preflight	Abnormal start
2.	Takeoff	Rejected takeoff Emergency evacuation Packs off Maximum weight takeoff Special engine out procedures
3.	Climb	ADC malfunction
4.	Cruise	Engine failure Fuel jettison
5.	Approach	Non - precision to circling Go around from circling
6.	Emergency evacuation	Rejected takeoff Landing

7.	Windshear	Takeoff Approach

8. Cdr. Right hand seat training

9.	Review	Go-Arounds Asymmetric

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 5

1. Preflight
   - Use of MEL
   - Use of supplementery procedures
   - External air start
   - External power supply start
   - Battery start

2. Electrical malfunctions
   - Loss of IDG
   - BTB failures
   - Loss of a AC bus
   - Loss of all AC power
   - Flight with HDG operative & inoperative

3. Instrument failures
   - Loss of a IRS
   - Loss of EADI
   - Loss of FD - Raw data approach
   - Flight with standby instruments only (Captains only)

4. Maximum weight flight
   - Engine failure on takeoff
   - Manually flown approach to CAT II
   - Landing maximum weight

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 6

1. Salzburg qualification
   - Special procedure ILS and go around
   - Circling procedure to runway 34
   - Takeoff runway 16 with engine failure
   - Runway 16 special engine out procedure

2. Navigation malfunctiom
   - Loss of FMC
   - Loss of LNAV

3. Pnematic malfunctions
   - Duct leaks
   - Rapid decormpression and emergency descent

4. Fires
   - Wheel well fire
   - Cargo fire

5. Bomb threat

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 7

Puerto Plata

1. Reverse Thrust Deployment

2. Landing gear malfunctions
   Door disagree
   Gear disagree

3. Door open warning
   Cabin door
   Cargo door

4. Non-Precision Approach/Circling
   No Slats

5. Flight Controls

6. North Atlantic procedures

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 8

1. Deicing procedures

2. Contaminated runway
   - Takoff performance
   - Rejected takeoff
   - Engine failure at V_1

3. Low visibility procedures
   - Takeoff
   - Rejected takeoff
   - CAT II / III approaches
     - Ground equipment failures
     - Aircraft equipment failures
     - Engine failures
     - Go-arounds (manual & auto)
       - Equipment failures
       - Weather
       - Runway offset
     - Landings auto & manual roll - out
   - Pilot incapacitation

4 Airplane upset recovery.

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 9

PREPARATION FOR CHECK RIDE - TO INCLUDE:

1. Engine start malfunctions

2. Rejected takeoff

3. Emergency evacuation

4. Steep turns & stalls

5. Rapid decompression & emergency descent

6. Engine failure

7. Asymmetric ILS & go around

8. Asymmetric non - precision approach

9. System malfunctions from one of the following:
   - Hydraulic
   - Electric
   - Flight controls
   - Flight instruments

COMMENTS / ITEMS NOT INCLUDED:

5.1.1 OBJECTIVES

- Salzburg qualification
- Airwork
    - Steep turns
    - Stalls

EXTENSIVE BRIEFINGS ARE REQUIRED TO ENSURE SOPs ARE KNOWN !

5.1.2 PREFLIGHT

Aborted engine starts

5.1.3 TAKE OFF

Normal “HDG select/LNAV” and “VNAV” departure.

5.1.4 CLIMB

As cleared by ATC climb to FL100 for airwork.

5.1.5 SESSION SPECIFIC TRAINING

5.1.5.1 Airwork

- Steep turns 1 each
- Stalls 1 each, gear down flap 30

5.1.5.2 Salzburg Qualification

- Special procedure ILS 16 and go around
- Circling procedure to runway 34 and land
- Takeoff runway 16 with engine failure special procedure

5.1.5.3 Pneumatics Malfunctions

- Rapid decompression and emergency descent

5.1.5.4 Fire [1]

- Wheel Well Fire
- Cargo Fire

5.1.5.5 Approaches

- Non Precision approach with circling
- ILS approach to circle

5.1.6 DESCENT & APPROACH

5.1.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

[1] At the discretion of the instructor

5.1.8 SESSION INFORMATION

Part 1:

ROUTE	LOWW - LOWS			
ATC Clearance	LOWW – SNU 1C – SNU – DCT SBG - LOWS			
WEATHER	LOWW 310/5 250m Fog RVR29 300m ovc001 15/15 1003			
	LOWS 260/15 800m ovc003 11/11 1003 Imp 290/15 5000m ovc027			
	LOWL 310/20 4500m ovc010 11/8 1003			
HIL / NOTAM				
LOAD- and TRIMSHEET For **OE-LAX**	ZFW	110.0 t	Vers. 3/9	V1 =
	FUEL	15.0 t	MAC TO 24	Vr =
	TOW	125.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

5.1.9 OTHER SESSION INFORMATION

Part 2:

! FLAPS 20 TAKE-OFF !

ROUTE	LOWS - LOWW			
ATC Clearance	LOWS - LNZ 2V - LNZ - DCT STO - LOWW			
WEATHER	LOWW 310/5 250m Fog RVR29 300m ovc001 15/15 1003			
	LOWS 190/15 3700m ovc015 11/8 1003 Imp 290/15 5000m ovc027			
	LOWL 310/20 5000m ovc015 11/8 1003			
HIL / NOTAM				
LOAD- and TRIMSHEET for **OE-LAX**	ZFW 110.0 t	Vers. 3/9	V1 =	
	FUEL 15.0 t	MAC TO 24	Vr =	
	TOW 125.0 t	STAB TO	V2 =	
		ASS. T. °C	Vref30	

CALCULATIONS:

5.1.10 SESSION PROFILE

Part 1 & 2 Completed by both pilots
Cockpit setup: From "No electrical power established"

5.1.10.1 Aborted engine starts

5.1.10.2 Takeoff & climb

- climb to FL100 Steep Turns & Stalls

<u>Continue climb to FL 260</u>

- Emergency descent
- Special ILS 16 Salzburg & go around
  - ⇒ WX CHANGES 330/15 5000m OVC 2700'
- ILS 16 to circle 34 & land
  - ⇒ WIND CHANGE 160/15
- Second departure
- Engine failure on takeoff runway 16
- Divert to LOWL
- Non Precision App 09 approach to circle 27

5.1.11 NOTES FOR INSTRUCTORS

Snapshots and re-positioning maybe required during the session.

5.2.1 OBJECTIVES

- Cat 2/3 training

EXTENSIVE BRIEFINGS ARE REQUIRED TO ENSURE SOPs ARE KNOWN !

5.2.2 PREFLIGHT

- Lauda Air de-icing procedures

5.2.3 TAKE OFF

- Contaminated runways
  - Performance calculations

5.2.4 CLIMB

5.2.5 SESSION SPECIFIC TRAINING

5.2.5.1 All Weather Operations

5.2.5.2 Deicing Procedures

5.2.5.3 Contaminated Runway Performance

- Rejected take-off at high speed
- Engine failure at V1

5.2.5.4 CAT II/III Operations

5.2.6 DESCENT & APPROACH

5.2.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

5.2.8 SESSION INFORMATION

TAKE OFF

ROUTE	EDDM – EDDM			
ATC Clearance				
WEATHER	EDDM 080/5 450m RVR08L 550m +0/-1 1013 BCMG 100m RMK 08690892			
HIL / NOTAM				
LOAD- and TRIMSHEET for **OE-LAX**	ZFM	110.0 t	Vers. 3/9	V1 =
	FUEL	50.0 t	MAC TO 24	Vr =
	TOM	160.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

5.2.9 OTHER SESSION INFORMATION

Part 2:

ROUTE	EDDM - EDDM			
ATC Clearance				
WEATHER	EDDM 080/5 450m RVR08L 550m +0/-1 1013 BCMG 100m RMK 08690892			
HIL / NOTAM				
LOAD- and TRIMSHEET For **OE-LAX**	ZFM	130.0 t	Vers. 3/9	V1 =
	FUEL	20.0 t	MAC TO 24	Vr =
	TOM	140.0 t	STAB TO	V2 =
			ASS. T. °C	Vref30

CALCULATIONS:

5.2.10 SESSION PROFILE

5.2.10.1 Take-Off

O/M General Basic REQUIREMENTS:
- To operate with RVR LESS THEN 200M
- 3 TAKEOFFS REQUIRED with RVR of 150m

  1) Normal 2 engine departure,
  2) Engine failure between V1 and V2,
  3) Engine failure before V1

5.2.10.2 Approach

- CAT 2, 3A, 3B
- Engine & System (both aircraft & ground) malfunctions on approach
- ASA Changes
- Autolands & Manual Landings
- Flare fail
- Auto pilot disconnect below DH during autoland with a RVR below 300m
- Pilot incapacitation

5.2.10.3 Go-Around

- Auto & manual,
- Two engines,
- One engine BELOW MLW,
- One engine ABOVE MLW,
- Engine failure during Go around.

5.2.10.4 Notes for Instructors

Minimum of 8 approaches are required.

If the trainees come from a JAA airline with a valid Cat2/3 rating an abbreviated ground course is only required.

If not a full ground course is required. Consult with the Fleet Managers' office if in doubt

5.3.1 OBJECTIVES

EXTENSIVE BRIEFINGS ARE REQUIRED TO ENSURE SOPs ARE KNOWN !

- Ensure that the standard that is required to issue an Austrian Validation is achieved.

5.3.2 PREFLIGHT

- Start Non-Normal

5.3.3 TAKE OFF

- Malfunction as per the instructor.

5.3.4 CLIMB

- Malfunction as per the instructor

5.3.5 SESSION SPECIFIC TRAINING

5.3.5.1 PART 1 Munich to Vienna

5.3.5.2 PART 2 Vienna to Punta Cana

Both pilots complete parts 1 and 2

5.3.6 DESCENT & APPROACH

- One precision approach
- One non-precision approach

5.3.7 TAXI IN & SHUTDOWN

AT THE END OF THE SESSION, PERFORM AFTER LANDING, SHUTDOWN & SECURE CHECKLIST

5.3.8 SESSION INFORMATION

PART 1: Call Sign LDA 9221

<table>
<tr><td>ROUTE</td><td colspan="4"></td></tr>
<tr><td>ATC Clearance</td><td colspan="4">EDDM KIRDI 3E LNZ STO LOWW</td></tr>
<tr><td>WEATHER</td><td colspan="4">LOWW: 130/10 1200m OVC005 8/6 1010 TEMPO 300m OVC001</td></tr>
<tr><td></td><td colspan="4">EDDM: 080/10 2500m OVC006 8/4 1007</td></tr>
<tr><td></td><td colspan="4">EDDF: 080/10 2500m OVC006 8/4 1007</td></tr>
<tr><td>HIL / NOTAM</td><td colspan="4"></td></tr>
<tr><td rowspan="4">LOAD- and TRIMSHEET For OE-LAW</td><td>ZFM</td><td>110.0 t</td><td>Vers. 3/9</td><td>V1 =</td></tr>
<tr><td>FUEL</td><td>20.0 t</td><td>MAC TO 28</td><td>Vr =</td></tr>
<tr><td>TOM</td><td>130.0 t</td><td>STAB TO</td><td>V2 =</td></tr>
<tr><td></td><td></td><td>ASS. T. °C</td><td>Vref30</td></tr>
</table>

CALCULATIONS:

5.3.9 OTHER SESSION INFORMATION

Part 2: Call Sign: LDA 3997

<table>
<tr><td>ROUTE</td><td colspan="4">LOWW - MDPC</td></tr>
<tr><td>ATC Clearance</td><td colspan="4">LOWW LIMRA 6C SBG DCT MDPC</td></tr>
<tr><td>WEATHER</td><td colspan="4">LOWW 330/15 200m OVC001 12/12 1010 BCMG 5000m OVC010</td></tr>
<tr><td></td><td colspan="4">MDPC 090/15 CAVOK 1024</td></tr>
<tr><td></td><td colspan="4">EDDM 100/7 2500m 0VC 006 8/4 1010</td></tr>
<tr><td>HIL / NOTAM</td><td colspan="4">Fuel Jettison u/s</td></tr>
<tr><td rowspan="4">LOAD- and TRIMSHEET For OE-LAW</td><td>ZFM</td><td>110.0 t</td><td>Vers. 3/9</td><td>V1 =</td></tr>
<tr><td>FUEL</td><td>60.0 t</td><td>MAC TO 28</td><td>Vr =</td></tr>
<tr><td>TOM</td><td>170.0 t</td><td>STAB TO</td><td>V2 =</td></tr>
<tr><td></td><td></td><td>ASS. T. °C</td><td>Vref30</td></tr>
</table>

CALCULATIONS:

5.3.10 SESSION PROFILE

5.3.10.1 First Departure

- SOPs BOTH NORMAL & NON-NORMAL
- FULL SETUP
- ABNORMAL START(S)
- NORMAL DEPARTURE
- FLIGHT CONTROL PROBLEM
- STEEP TURNS
- STALL GEAR DOWN FLAP 30
- EMERGENCY DESCENT
- ENGINE MALFUNCTION
- SINGLE ENGINE APPROACH & GO AROUND
- CAT II APPROACH & LANDING

5.3.10.2 Second Departure

- HIGH WEIGHT TAKE OFF
- ENGINE MALFUNCTION ON TAKE OFF
- NON- PRECISION APPROACH & LANDING

SOME TIME DURING THE ABOVE

- REJECTED TAKE OFF & PAX EVACUATION

5.3.11 NOTES FOR INSTRUCTORS

INSTRUCTORS NOTE, PLEASE USE SESSION 9 FOR THE PANEL SETUP

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 1

1. SOPs BOTH NORMAL AND NON NORMAL

2. Salzburg qualification
   - Special procedure ILS and go around
   - Circling procedure to runway 34
   - Takeoff runway 16 with engine failure
   - Runway 16 special engine out procedure
   - Noise abatement requirements runway 34

3. Pneumatic malfunctions
   - Rapid decompression and emergency descent.

4. Airwork
   - Steep Turns
   - Stalls

COMMENTS / ITEMS NOT COMPLETED:

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 2:

1. SOPs BOTH NORMAL AND NON-NORMAL

2. Deicing procedures

3. Contaminated runway
   - Takeoff performance calculations
   - Rejected takeoff
   - Engine failure at V_1

4. Low visibility procedures
   - Takeoff
   - Rejected takeoff
   - CAT II / III approaches
   - ◊ Ground equipment failures
   - ◊ Aircraft equipment failures
   - ◊ Engine failures
   - ◊ Go arounds (Manual & Auto)
   - ◊ Equipment failures
   - ◊ Weather
   - ◊ Runway offset
   - ◊ Landings auto & manual roll - out
   - ◊ Pilot incapacitation

COMMENTS / ITEMS NOT COMPLETED :

Student's Name LH RH	Date:	Instructor:
Duration PF PNF	Student's Signature:	Instructor's Signature

FFS Session 3:

SOPs BOTH NORMAL & NON - NORMAL

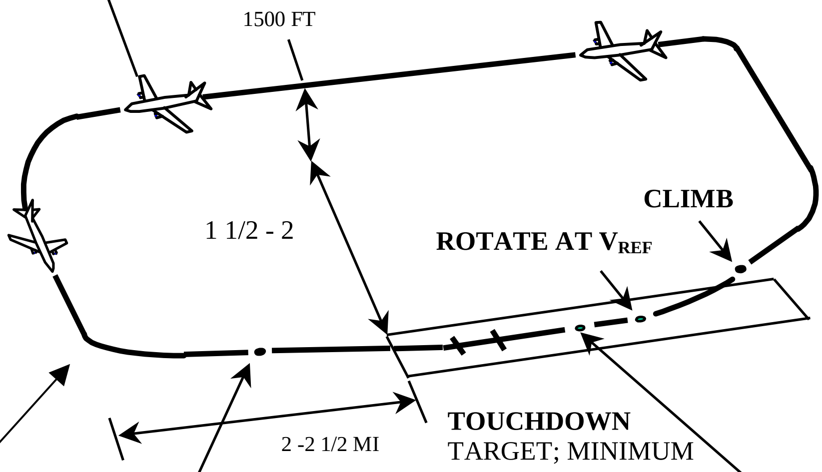
1. Engine start malfunctions
2. Rejected takeoff
3. Emergency evacuation
4. Steep turns & stalls
5. Rapid decompression & emergency descent
6. Engine failure
7. Asymmetric ILS & go around
8. Asymmetric non - precision approach
9. System malfunctions from one of the following:
    - Hydraulic
    - Electric
    - Flight controls
    - Flight instruments

COMMENTS / ITEMS NOT COMPLETED

TIME CHECK
AFTER 30 SEC elapsed:
GEAR DOWN
FLAPS 20 ($V_{REF\ 30}$+20)

ABEAM THRESHOLD
START TIMING

STABILIZED ON DOWNWIND:
RE-CHECK V_{REF}



FLAPS 5
($V_{REF\ 30}$ +40)
THRUST AS
NECESSARY

TOUCHDOWN
TARGET; MINIMUM
1000 FT
BUG + GUST

700 - 500 FT
STABILIZED IN SLOT

TURNING FINAL
LANDING FLAPS
V_{REF} + Gust +1/2 Wind
When established on Final:
Start Descend as VASIS or GS is captured

FINAL APPROACH:
COMPLETE LANDING
CHECKLIST
(For SE: Push Flaps
Override Switch)

AFTER TOUCHDOWN:
Candidate will maintain Directional Control with Rudder, ELEV (forward) and Aileron (into Wind)

Flight Inst. will set:
FLAPS 20
CHECK SPEEDBRAKES DOWN
TRIM FOR T/O

In case of F/O candidate Flight Inst.in LH seat will set
GO-AROUND THRUST
and call: ROTATE (at V_{REF})

In case of Capt Candidate, he will set:
GO-AROUND THRUST
on command of Flight Inst.

Flight Inst. will call : ROTATE (at V_{REF})

FOR TOUCH AND GO LANDING DO NOT USE:

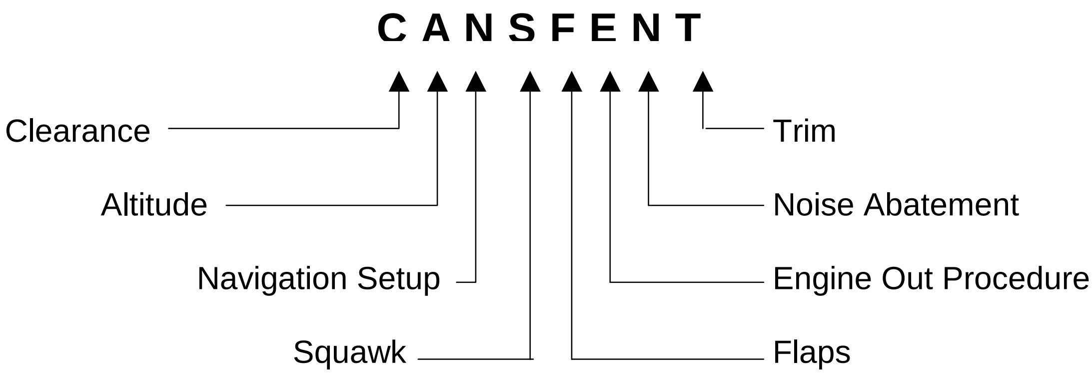
- SPEEDBRAKE
- AUTOBRAKES
- RUDDER TRIM (SE-LDG)
- AUTOTHROTTLE
- REVERSE THRUST

WARNING:
IF REVERSE THRUST IS APPLIED AFTER TOUCHDOWN; COMPLETE A FULL STOP LANDING

7.1.1 HANDLING

As the before take off check list is somewhat abbreviated! A **MENTAL** review whilst taxing to the runway (from an airmanship point of view) is required. You can make your own up to what you consider is important, a suggestion is below. It must be stressed that this is a thought process and not a verbal process.

7.1.1.1 Pnuemonic prior to departure



7.1.1.2 Target Pitch for Rotation

Target Pitch = 31 - TOW/100

- Valid for FLAPS 5, no derate, two engines.
- Reduce by approx. 1 deg. for FLAPS 15 or FLAPS 20.

For **derated takeoff** use the RTOW (instead of TOW) according AAM for the Assumed Temperature considered, e.g. if at 48°C a RTOW of 170 t is indicated, pitch attitude for takeoff will be 14 deg. ANU.

If thrust is already **derated to maximum ASS TEMP** and a margin between RTOW and TOW still exists, pitch will get progressively higher (compared to the value given by the formula, using RTOW) the larger the difference is.

Example:
RTOW = 170 t at ASS TEMP = 52°C (maximum)
TOW = 150 t

⇒ *Target Pitch = 14 deg. ANU*

7.1.1.3 Liftoff and Tailstrike

- Normal liftoff occurs at approx. 8 deg. ANU
- Tailstrike will occur by approx. 10 deg. ANU on the 767-300, wings level.
- If liftoff does not occur by 8 deg. ANU, reduce pitch rate or even hold pitch attitude until liftoff occurs (liftoff can be recognized easily by the clicking sound of the Auto Brake Selector Rotary Switch, which clicks to OFF).
- Tailstrike typically occurs during landing, when aircraft is held off the runway in order to attempt a smooth touchdown

See Figure 7.1-1 for ground clearance as a function of pitch and roll angles.

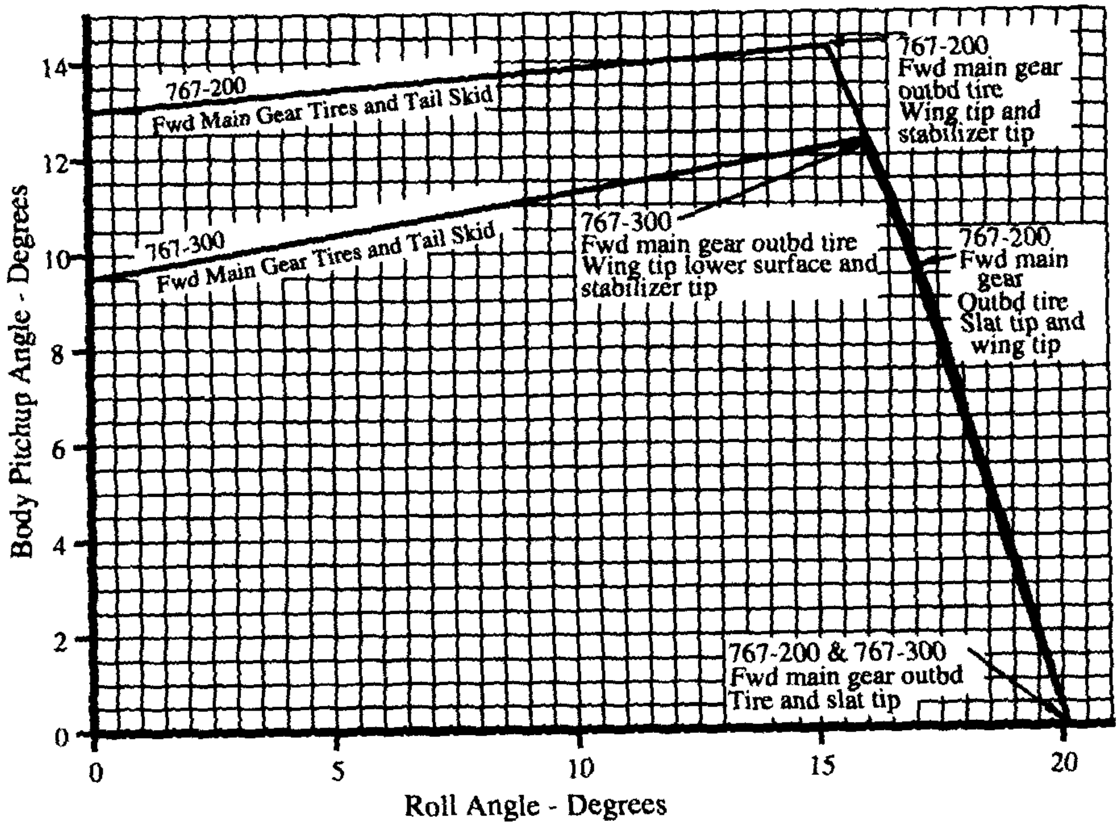


Figure 7.1-1: B 767 ground clearance for a combination of roll an pitch angles

High sink rates near the ground have to be avoided on the B767 as you do not have the luxury of pulling back on the stick to arrest the sink rate due to the length of the fuselage.

Be aware that under certain circumstances loss of lift can occur below 100 ft which will result in a firm and maybe a hard landing.

This can be caused by windshear or an inversion, especially on congested runways such as Miami where a heavy jet has just departed and its exhaust (very hot air) is sitting there waiting for you to fly into it.

7.1.2 TAKEOFF PERFORMANCE

7.1.2.1 Acceleration Check

- As a rule of thumb the aircraft should have obtained about 100 KIAS after 20 seconds in the takeoff roll.

7.1.2.2 Selection of Flaps-Setting

- As a rule of thumb for TORAs exceeding 3000 m FLAPS 5 will do.

7.1.3 REJECTED TAKEOFF

Up to **eighty knots** you should stop for all
- master cautions and
- master warnings as well as
- anything else that you consider is undesirable during a continued takeoff (such as tire failure).

After eighty knots and up to V1 stop for
- conditions, such as engine failure/fire, that severely effect the safety of the flight.
- **V1 IS A GO-SPEED**

The *"eighty-knots"* call by the PNF serves several purposes:

1. You are now in the "business end" of the take-off roll. The energy that has to be dissipated in the event of an RTO is rapidly increasing. Refer to the attached examples.
2. Ensure that the required thrust has been set: ensure that actual EPR equals required EPR and throttle hold is annunciated (electrical power as been removed from the auto throttle servos).
3. Crosscheck on the airspeed (Puerto Plata accident).
4. Pilot Incapacitation.

Throughout the take-off roll the PNF should spend most of the time monitoring the engine instruments, EICAS and to a lesser extent flight instruments and the outside. Any abnormality should be called, such as an N1 instrument failure. An engine failure should only be called when two or more engine instruments indicate a failure (loss of thrust on that engine). When the decision is made by the captain to reject the take-off he calls stop (if the F/O is flying the call "STOP" automatically indicates that the captain is now PF). Without delay the Captain closes both thrust levers and disengages the autothrottle (in a low speed RTO before throttle hold is annunciated, the thrust levers will advance and try to obtain take-off EPR), extends the speed brakes, selects the reverse and monitors the auto brakes. Do not manually brake unless the autobrake system has disarmed or is malfunctioning. Allow the autobrake system to do its job and only apply manual braking in the event that the autobrake system has malfunctioned. During the deceleration phase the First Officer cancels the master warning and advises the tower of the stopping and calls "60 knots". The Captain should start to reduce reverse thrust and stow the reverse thrust levers prior to coming to a stop. Reverse thrust can be kept in to the end of the takeoff roll, to prevent an overrun if required. When the aircraft has come to a full stop, the Captain sets the park brake (be aware that a maximum energy stop more than likely will result in a brake fire). You now want to identify the problem, read the messages off EICAS and carry out the appropriate drill. The Captain carries out all the recall items after confirmation with the F/O.

<u>Notes:</u>

- Master Caution lights and beeper are inhibited from 80 knots to 400 ft or twenty seconds after nose strut extension, whichever occurs first.
- Master Warning lights and fire bell are inhibited from nose gear extension to 400 ft or 20 seconds.
- All EICAS messages and warning lights are not inhibited.
- In RTO-mode above 85 knots when armed the autobrakes will apply maximum pressure, equivalent to maximum manual braking, in the event of an RTO
- Prior to the next take-off check the brake cooling schedule. Use category "C" brakes chart.(C=Carbon)
- Pilots coming off the RJ are used to that aircraft decelerating reasonably well however on the B767 this is not the case. Rejected take offs must be treated with absolute respect due to the high energy levels the aircraft has acquired.

- After a maximum energy stop a brake fire has a high probability of occurring within 3 minutes.
- If a take off is continued with an engine failure below V1 be aware that you may not achieve 35' (15'on a wet or contaminated runway) by the end of the TODA. As a very rough rule of thumb for every kt (this is rough due to the high weight range of the B767) below V1 that the failure occurred you will lose 1&1/2 feet, so 10kts below V1 will result in a height loss of 15'

7.1.3.1 Kinetic Energy of Aircraft during Takeoff Roll

It is nice to know how much energy the brakes have to dissipate in case of a rejected takeoff. There are tables in AOM Volume 3, but a fairly accurate estimate is given below:

$$\boxed{\mathbf{E_{kin} = \tfrac{1}{2} \,.\, TOW \cdot Groundspeed^{2}}}$$

Here,

- TOW is takeoff mass in kg
- Groundspeed is the speed were takeoff is aborted in m/s, and
- E_{kin} is the kinetic energy that will be converted into friction (heat). It has the dimension of Nm (Newton Meter) or J (Joule).

To give you an idea of the amount the energy the B 767 has at the instant of brake application refer to the following examples:

__Example 1:__
Mass at Take-off: 186 tons
Abort Speed: Ground Speed 170 kts = 84,9 m/s

Kinetic Energy = $\frac{1}{2} m v^2$ *= 670 Million Joule*

(assuming that the abort takes 30 seconds, i.e. the work is converted into thermal energy (heat) in this short amount of time, an equivalent power of 22 Megawatt has to be absorbed by the brakes. This equals the power needed by

22.000 average households, if all the electrical equipment in these households is turned on simultaneously.)

Example 2:
Mass at Take-off: 186 tons
Abort Speed: Ground Speed 80 kts = 41.1 m/s

Kinetic Energy = $\frac{1}{2} m v^2$ *= 157 Million Joule*

The kinetic energy increases with the square of the speed. Double speed results in a four times higher kinetic energy.

Note:

- The amount of energy that has to be dissipated by the brakes during an aborted take-off depends on the ground speed at the moment of brake application, not the indicated airspeed. With a performance decreasing windshear (tailwind) an aircraft might show a very low airspeed on the ASI but have attained a high enough GS that could result in an overshoot if the take-off is aborted.
- In the above example it is assumed that all of the kinetic energy is dissipated by the brakes (i.e. transferred into thermal energy). This is not entirely true as some of the retarding force will be provided by the ground lift dumping system (in the form of aerodynamic drag). However, this amount is small compared to the brakes' retarding capability and can, therefore, be neglected in this approximation.
- There is a graph in AOM Vol. 3 pg 23.10.28 that shows the work done per brake (Note: the B 767 has eight sets of carbon brakes, i.e. one set for each main wheel)
- Carbon brakes show their best efficiency at some intermediate temperature, i.e. they have the best grip when already warm. As with any brake, braking capability is lost when they are too hot
- The advantage of carbon brakes is their lower weight, this is the reason why they are mainly used on long-haul aircraft, as these spend a significant amount of time in cruise.

7.1.4 ENGINE FAILURE ON TAKE-OFF – GO DECISION

7.1.4.1 Initial Aircraft Handling

- If the engine failure occurs whilst on the ground, maintain visual reference as long as possible.
- Rotate through eleven degrees pitch attitude (2 degrees per second)
- Target speed V2 to V2+15
- PNF: “Positive Rate” - PF: “Gear Up !”
- NO CALLS until gear is retracting and the aircraft is stable flying away from the ground. Adjust rudder so that control wheel is neutral. Do not cross control !
- PNF identifies, PF confirms
- If the engine has flamed out: no further action is required
- If recall items are required: do it slow and deliberate
- 400 ft AGL select a roll mode
- At the appropriate time PNF starts the APU, disengages the auto throttle via the MCP and cancels the message by clicking on the thrust lever button, bank selector 15 degrees and gives a MAYDAY-call.

7.1.4.2 Clean Up (third segment, acceleration)

- Having achieved both required heading and acceleration altitude:
  - ∗ ALT HOLD or
  - ∗ VS (depending on weight of the aircraft),
- **Clean-Up with Vref30+80 = 225 KIAS or less**:
  - ∗ PNF winds speed up to Vref30+80.
  - ∗ At Vref30+40 PF calls “FLAP 1”
  - ∗ At Vref30+60 PF calls “FLAPS UP”
- **Clean-Up with Vref30+80 > 225 KIAS:**
  - ∗ PNF winds speed up to 225 KIAS
  - ∗ At Vref30+40 PF calls “FLAP 1”
  - ∗ PNF now winds speed up to 245 KIAS or Vref30+80 if lower

* At Vref30+60 PF calls “FLAPS UP”

7.1.4.3 Final Segment Climb

- When the flaps have been retracted and you have Vref30+80 PF calls for “Flight Level Change” (PNF sets the command bug over the F-Symbol) PF calls “Set Maximum Continuous Thrust”. PNF selects CON on the TMSP and (remember!) <u>manually</u> adjusts the thrust lever.
- When desired use the rudder trim
- Engage the autopilot (use the center. If that is not available, use the side with the running engine).

7.1.4.4 Checklist Reading and follow on actions

- Next accomplish the Checklist Reading:
  * If recall items were carried out the PF calls for the required non-normal checklist from the QRH. PNF also completes all non-normal checklists on the EICAS, thereafter.
  * If no recall items were carried out: PF calls for the “Engine Failure/Shutdown” non-normal checklist and PNF thereafter also completes all EICAS non-normal checklists.
  * When all non-normal checklists have been completed the PNF states it and the PF asks for the “After Takeoff Checklist”
  * If a flame out has occurred attempt a re-light
- Maintain terrain clearance all the time
- Advise the purser (using the NITS concept)
- Consider fuel dumping, re-landing, diverting to a takeoff alternate etc.
- If landing is to be made on
  * single engine use flap 20
  * two engines: above 160 tons use flap 25, below 160 tons use flap 30.

7.1.5 MISCELLANEOUS

7.1.5.1 Map Shift

When line-up is obtained it is a good thing to check for the RWY symbol in the map mode. In the (unlikely) event that a large map shift has occurred on the ground the runway symbol will not show up as there will be no airport at the position where the aircraft thinks it is.

Such a map shift could occur if the coordinates of the three IRSs were aligned accidentally to the wrong coordinates, e.g. because of an E-W-mistake. A North-South mistake is not possible since the system can determine latitude. It cannot determine its initial longitude and therefore depends on the correct input. Since it remembers the last coordinates, a message will appear if the new longitude entry is grossly wrong. However, if the wrong coordinates are entered twice, the system will accept it. A wrong entry of airport coordinates would have to be inserted via the IRS control panel on the overhead panel, as only here the individual platforms can be addressed.

7.2.1 SEQUENCE OF SCAN

A good landing starts with a good approach – an old saying that also holds true for a Boeing 767.

> **For a three degree glide path a pitch attitude of 1 deg. to 1,5 deg. ANU is needed !**

With 15 knots above Vref, pitch attitude during approach will be zero degrees.

The following are some hints that former trainees found helpful to them during their training. It may not work for you though.

Once close to the threshold a scan sequence as follows should be started.

Sequence of Scan:

At

40 ft RA .... check EPR between 1,06 (light LDW) - 1,09 (heavy)
30 ft RA .... flare (add about 2 deg. pitch)
20 ft RA
10 ft RA .... ease off the throttles

The thrust in 40 ft RA depends on:

- Weight
- Approach Path Angle

For heavy weights a higher thrust will be required, for lower weights less. For flat approaches higher then normal thrust will be necessary, for steeper approaches less. In order to keep aircraft behavior as predictable (constant) as possible during flare, it is necessary to have the thrust at 40 ft within the limits given above. So, if on a steep approach (with less thrust) add a little thrust at 40 ft. On a flat approach, with higher than normal EPR, reduce it.

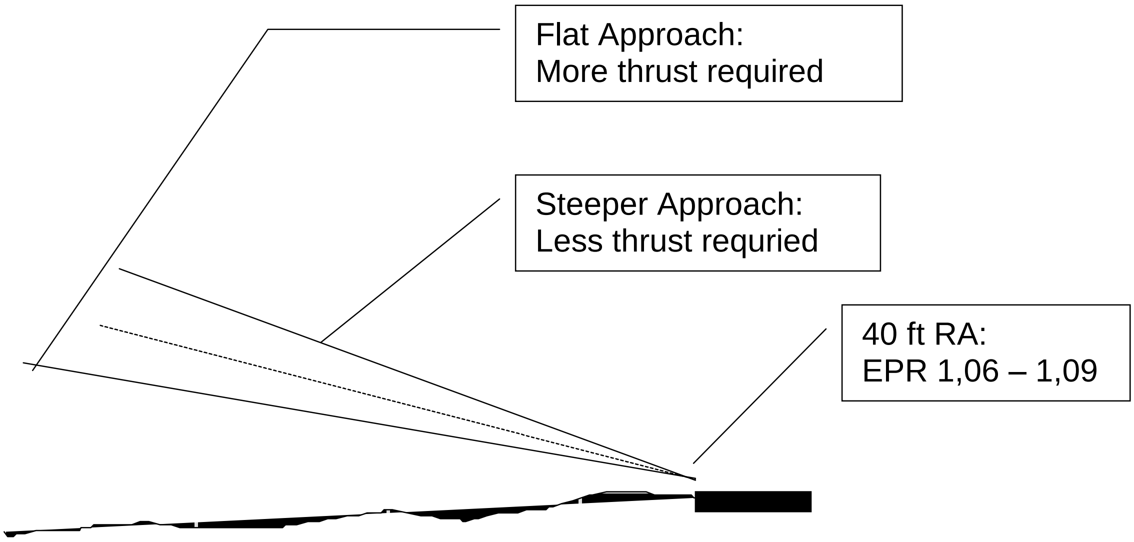


Figure 7.2-1: Thrust depending on approach slope angle.

7.2.2 HANDLING TECHNIQUE

7.2.2.1 Flare Initiation

- LDW > 120 t: flare at 30 ft (last RA call-out)
- LDW < 120 t: flare just after 30 ft (approx. 1 sec. after call-out)

7.2.2.2 Thrust to Idle

- On a cold day ease thrust off at 10 to 20 feet
- On a hot day land with thrust on (unless the aircraft is light)

7.2.2.3 Normal Landing Technique

It is recommended to add about 2 degrees of pitch just at or slightly below 30 ft RA and freeze it there. The aircraft will settle down on the runway, smoothly. Do not attempt to hold it off.

Adding some more pitch during the flare in an attempt to hold the aircraft off the runway (not recommended!) to achieve a smooth touchdown can result in just the opposite for several reasons:

- because of geometry reasons, this will add some downward movement to the main wheels before the lift increase associated with a higher pitch angle (i.e. angle of attack) can set in.
- Before the lift increase on the main wing sets in, the nose-up elevator produces a total lift loss, because main wing lift has not yet increased but the downward force on the elevator (opposing lift) has increased.

As a rule, below 30 ft do not increase your initial flare by too much as this will drive the main gear into the ground.

7.2.2.4 Landing the nose wheel

- especially at light weights, the deployment of the ground lift dumping system will result in a nose-up pitch tendency. This nose-up tendency is somewhat countered by a nose-down tendency when the auto-brake sets in a little later. Therefore, selection of AUTOBRAKE 2 is a good compromise where the pitch-up and pitch-down tendency cancel each other more or less out

7.2.3 CROSSWIND-LANDING

There are four crosswind landing techniques recommended by Boeing. For further information, refer to the B 767 FCTM.
All are acceptable, it is recommended that you use the technique that feels most comfortable to you.

As a general rule, do not let the airplane drift towards the downwind side, as it is much harder to fly it back to the centerline as compared to staying slightly on the upwind side and have the aircraft blown towards the centerline.

Most of the approach is done with wings level and crabbing along the extended centerline.

Proper alignment with the runway:

As a rule of thumb, for a 25 knots crosswind, the pilot will sit between centerline and runway edge, with a tendency of being slightly more towards the runway edge than towards the centerline.

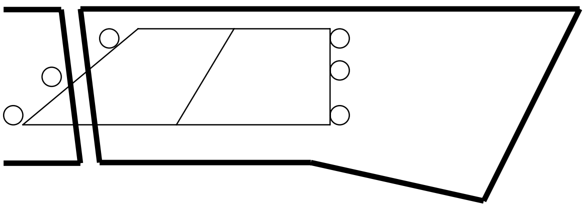


Figure 7.2-2: View from Copilot´seat during a 25 knots crosswind from the right, while wings are kept level.

One method suggests that for high crosswinds, some of the crab is taken out at 300 to 500 ft AGL. Otherwise it is difficult to judge the right amount of rudder to de-crab during flare. This method implies that in order to remain on the centerline, with less crab the upwind wing has to be dropped. You are flying cross-controlled now. During the flare the remaining crab is taken out by adding in some more rudder and at the same time adding some more bank. If at this phase bank is kept constant, the airplane will immediately drift down-wind of the centerline. As a general rule, the amount of rudder needed in the de-crabbing phase equals roughly the amount of rudder that has been kept in up to that point. Shortly before one main gear touches the ground, wings are put to level.

Note 1: It is no problem keeping one wing low almost until touchdown. However, touchdown itself on one wheel should be avoided for two reasons:

- If high sinkrate has been developed, the aircraft could bounce back.
- Ground lift dumping system will deploy only with both struts compressed.

Note 2: For right-handers a crosswind from the left tends to be easier than a crosswind from the right to cope with.

7.2.4 PITCH ATTITUDE VERSUS SPEED

For 10 knots below V_{ref} at touchdown, pitch attitude will be 3 deg. higher than normal !

Remember: during approach a pitch attitude of 1 deg. ANU is needed for a three degree glide path !

7.3.1 STARTING ENGINES

- Put your hand on the fuel cut-off levers when positive rise in oil pressure is indicated. Note: there are two independent sources for oil pressure (EICAS and PRESS lights, the light will extinguish at 70psi). Positive oil pressure usually comes with 20% N2.
- Minimum duct pressure for a X-bleed start is 30 psi.
- Fuel ON only after a minimum of 15% N2 is obtained.
- Initial Fuel Flow is about 200 - 300 kg/hr. If a higher value is obtained a hot start can be expected.
- N1 rotation has to be obtained by EGT rise
- EGT must rise within 20 seconds after fuel ON.
- EGT limit for starting engines is 535°C (red radial on EGT gauge)
- Throttle must not be moved to take-off thrust with oil temperature less than 50°C (i.e. temperature not in the white range). Oil temperature may be in the yellow range for taxi.
- Engine must stabilize within 2 minutes after fuel is on. It is stabilized when the red radial on the EGT gauge at 535°C is removed from the display.

Rule of Thumb:

Whenever N2 x 10 is less than the EGT you have got a problem with engine acceleration. Observe the 2 minute limit !

7.3.1.1 Battery Start

- Procedure as per AOM Vol. 1 page 02.21.01 which calls for the complete safety check before starting the engine.
- Note that the RED ANTI COLLISION light can be forgotten easily when doing a battery start as none of the checklists asks for it.

7.3.1.2 External Air Start

- If you are not sure if external air is connected (duct pressure gauge is not powered on a battery start) to the aircraft, turn on a pack. The valve will only open to the commanded position when duct is pressurized.

7.3.2 START MALFUNCTIONS

7.3.2.1 Hot Start

- High Fuel Flow (typically more than 400 kg/hr) will indicate an imminent HOT START.
- A good way to predict a hot start is by comparing the pointers on the EGT and N2 gauges:
- If EGT is **10 TIMES** N2 eg. N2 is 30% and EGT is 300 degrees there is a high probability of a hot start.

Whenever the EGT pointer leads the N2 pointer chances that a HOT START occurs are high.

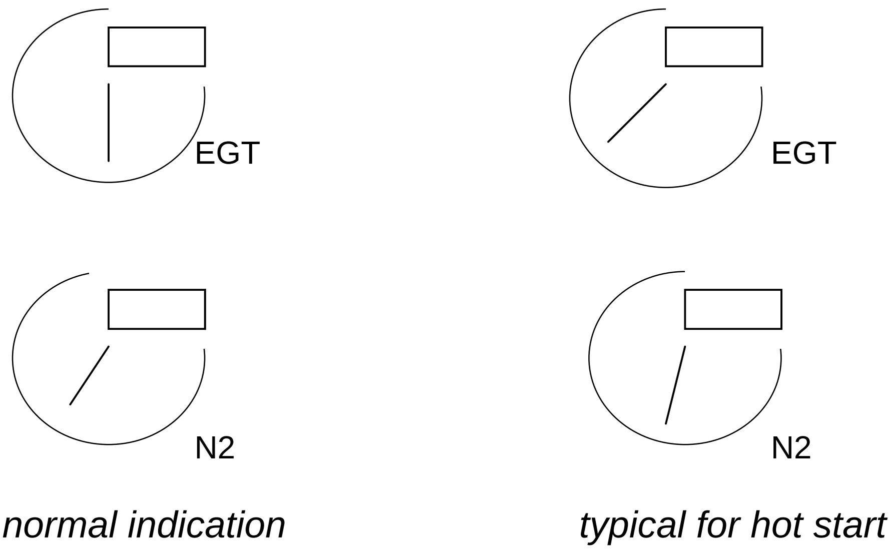


Figure 7.3-1: Hot Start – EGT pointer leading N2 pointer on the right engine.

7.3.2.2 No Fuel Flow

- If no fuel flow at all, fuel shutoff valve(s) have probably remained closed. An EICAS Msg will appear.

7.3.2.3 No N2-Rotation

- ENGINE STARTER message indicates that starter valve does not open, therefore, no airflow to the starter, therefore no N2

7.3.2.4 No Starter Cutout

- listen for the start selector to click from GND to AUTO by approx. 50% N2. If starter fails to cut by approx. 60% N2 a message (STARTER CUTOUT) will appear. If the switch does not release you have an electrical problem within the starter system.
- Check if the valve light cycles. If the light does not cycle, you have a valve problem.
- In either case the Captain will call for the STARTER CUTOUT non normal checklist to be read from the QRH

7.3.2.5 Slow Acceleration

- Engine has to be stabilized within 2 minutes from the fuel control switch being selected to the run position. (red radial disappearing on EGT gauge). Use rule of thumb (see previous page) as an aid.

7.3.3 ENGINE FAILURES IN FLIGHT

7.3.3.1 Engine Separation

- no indications (numbers) or zeros on the gauges

Note: Can be confused easily with TOTAL EEC failure
In contrast to total EEC failure
- several Caution/Advisory messages (pneumatic, hydraulic) will appear,
- watch for HYD leak and FUEL leak

(see Figure 7.3-2)

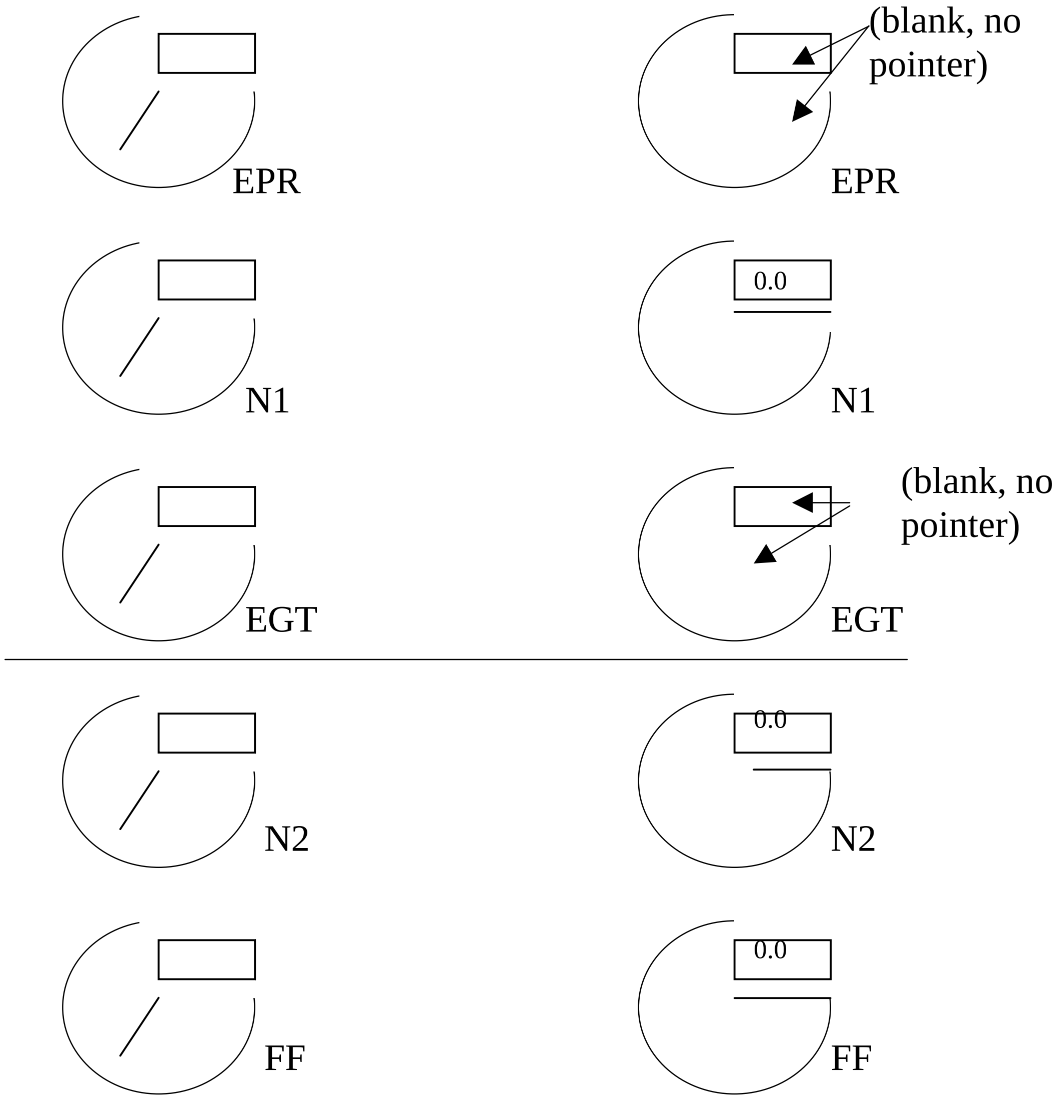


Figure 7.3-2 Engine Separation

7.3.3.2 Total EEC failure

- no indications (numbers) or zeros on the gauges
- no EICAS messages

Note: Can be confused easily with Engine Separation (very similar engine indications. EEC failure has some fuel flow!)

(see Figure 7.3-3)

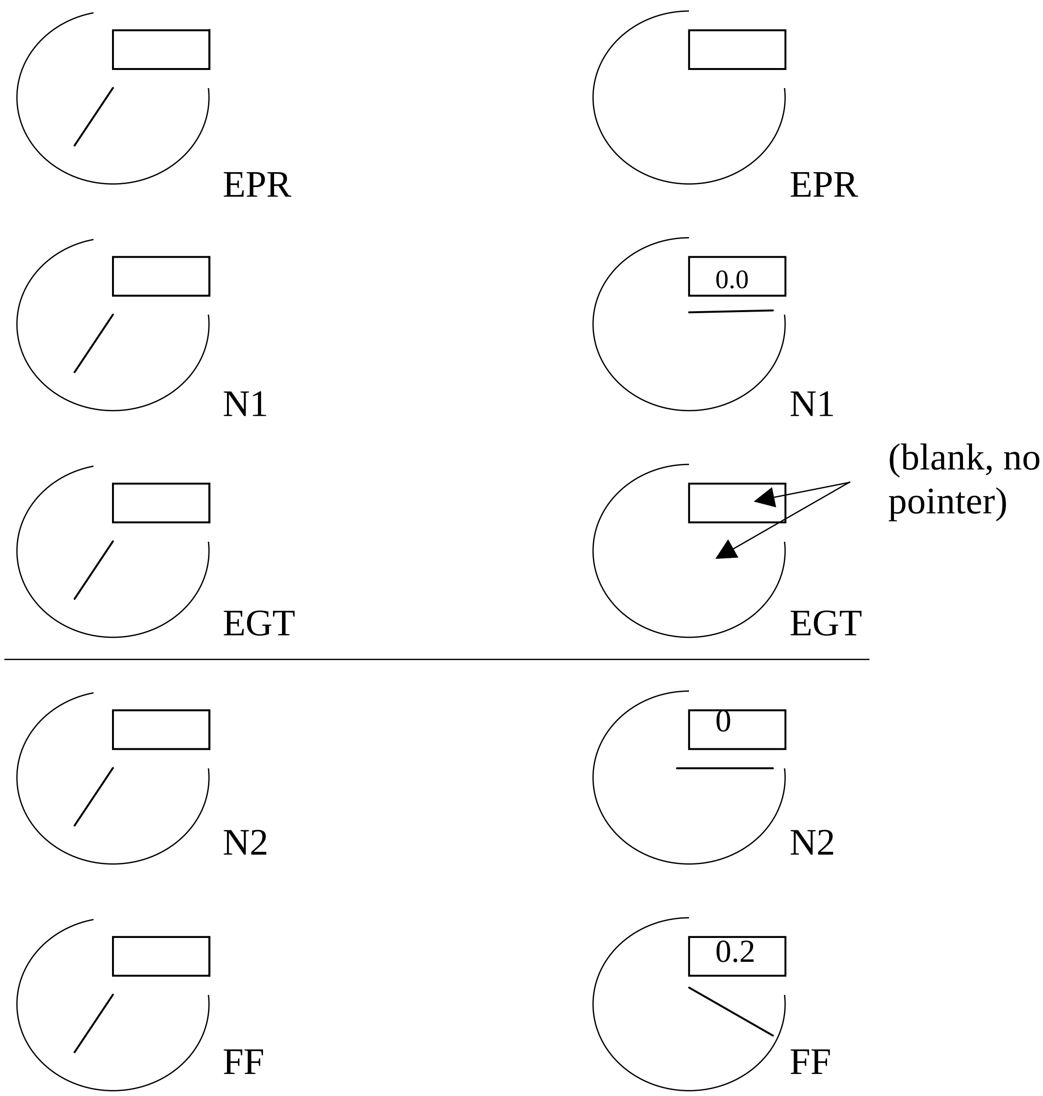


Figure 7.3-3: Total EEC-Failure of right engine

7.3.3.3 Flameout

- Oil Pressure dropping into the RED
- N1 and N2 slowly decreasing
- EGT dropping

(see Figure 7.3-4)

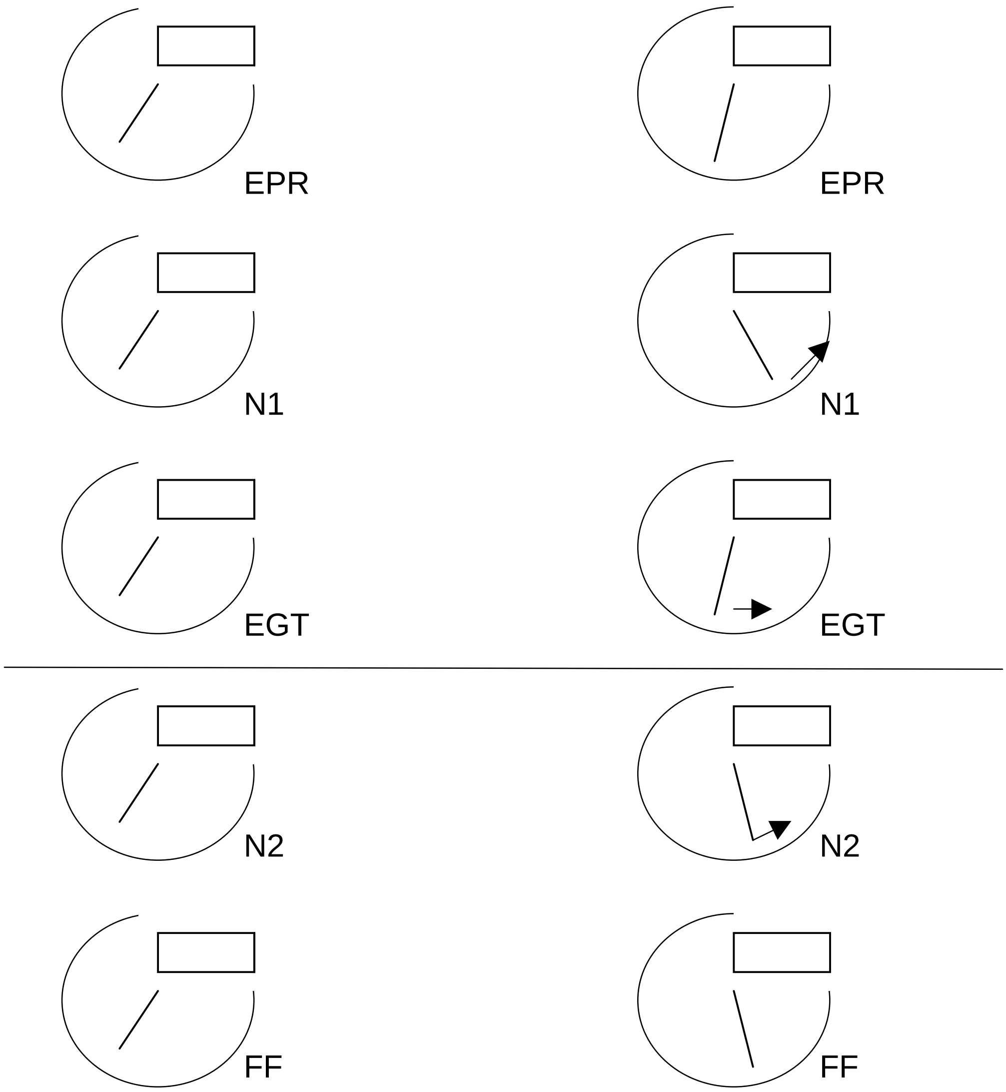


Figure 7.3-4: Flameout

7.3.3.4 Seizure

- N1 or N2 showing ZERO (it is usually the N1-Rotor that seizes)
- EGT well into the RED

(see
Figure 7.3-5)

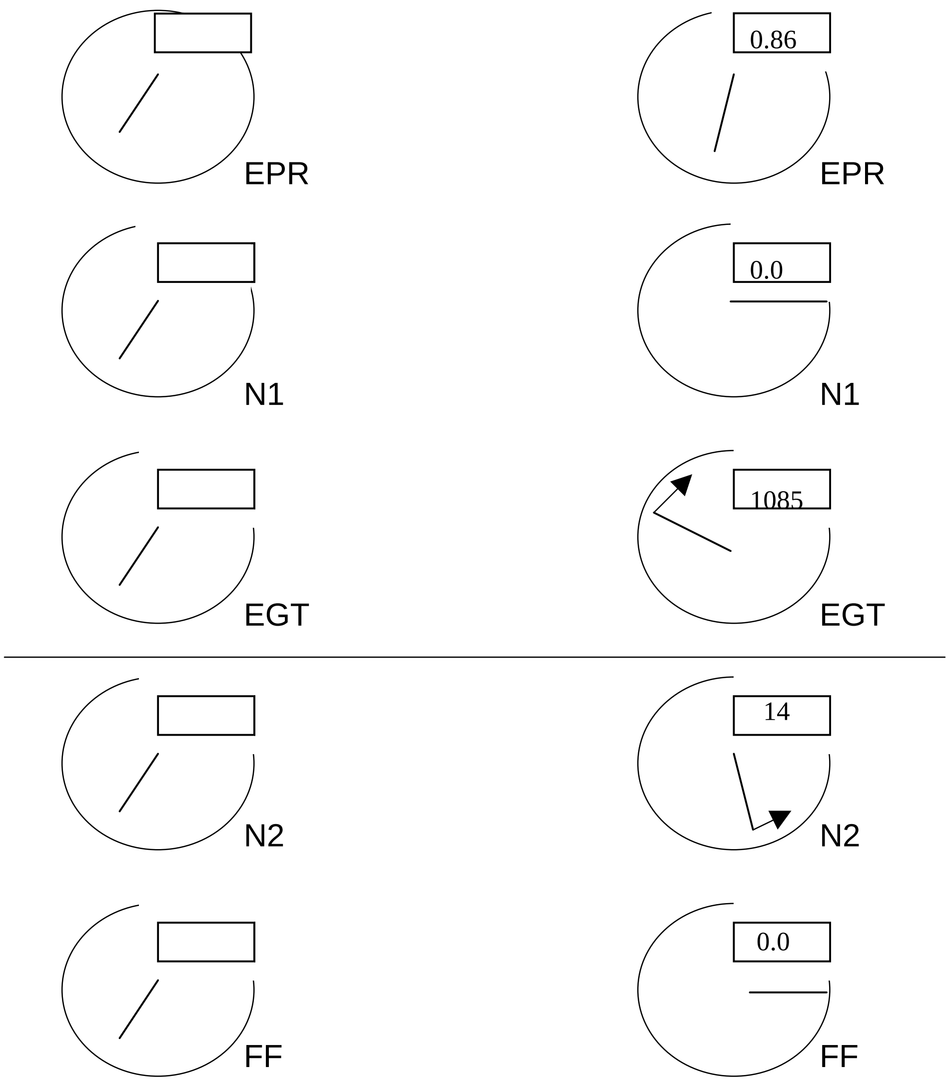


Figure 7.3-5: Seizure of right engine. This figure indicates that the right fan has seized.

7.3.3.5 Compressor Stall

- extremely loud banging noise (can be so loud that some pilots initially mistook it for the detonation of an explosive device)
- EPR and N1 are cycling
- EGT going into the RED (If this happens call for the Severe damage recall items)
- if banging noise continues with thrust lever in idle shut the fuel off to prevent further damage to the engine.

(see Figure 7.3-6)

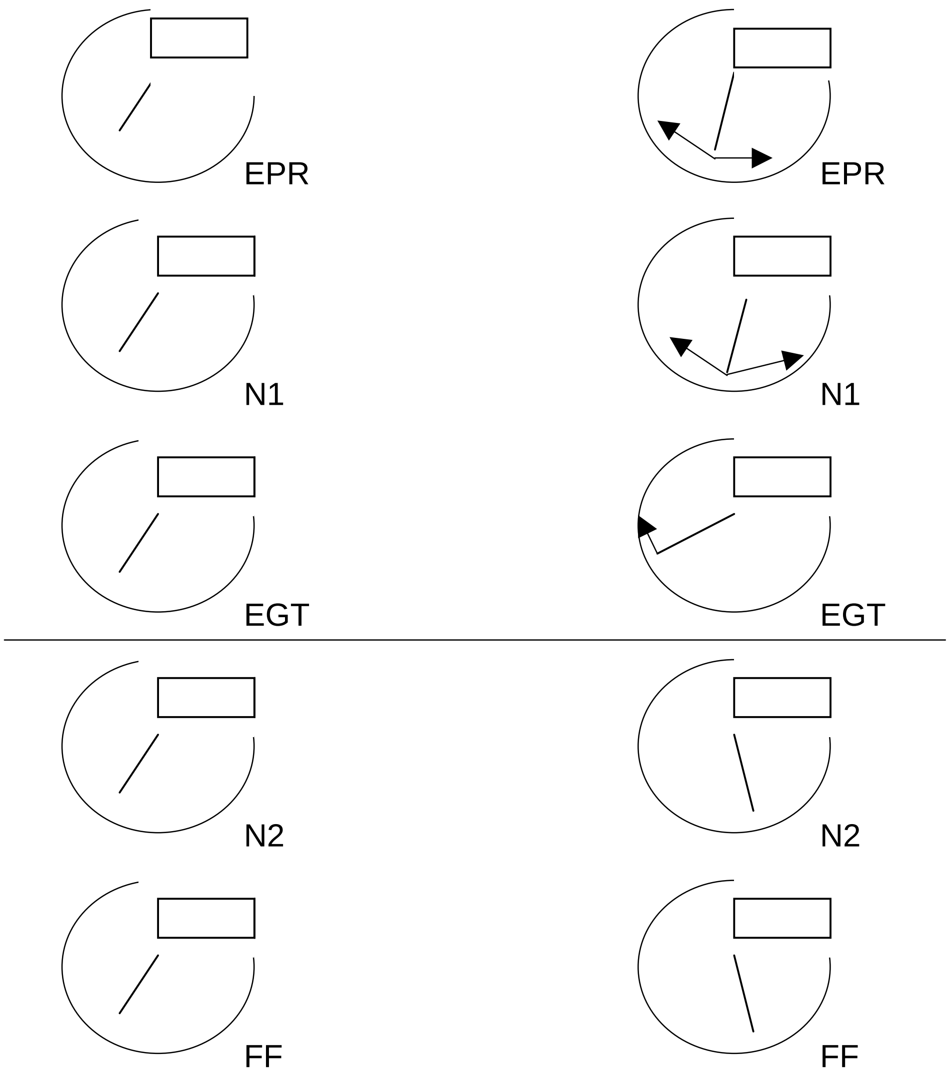


Figure 7.3-6: Compressor Stall

Note: Watch out for PIOs *(pilot induced oscillations)* as thrust will fluctuate during compressor stall. Do not try to work rudder and aileron simultaneously.

7.3.3.6 Engine Fire

- fire warning and fire bell
- engine initially producing plenty of thrust
- no need to rush the procedure

Note:
When PNF retards the thrust lever to idle be prepared for the asymmetry that now sets in. Therefore, do it slowly.

7.3.3.7 Loss of Thrust on Both Engines

This is indicated by all six screens blanking, the autopilot disconnects with the resultant noise caused by the siren. To get rid of the noise push the A/P disconnect button and fly the aircraft using the standby flight instruments which are:

INSTRUMENT	POWER SUPPLY	ACTION
Stby ADI	Stby DC bus	• Target Pitch minus 3 degrees, • never above zero
Stby ASI	no power required	• above FL 350: 240 KIAS • between FL200-FL350: 250 KIAS minimum • below FL200: 200 KIAS minimum
Stby Altimeter	no power required	-
Left RDMI	AC Stby bus	• turn away from high terrain and • toward a suitable airport
Stby Compass	no power required	
Navigation aids available	AC Stby Bus	• C ILS • L VOR/ Marker • R ADF

The only electrical power available at the moment is the battery. The APU is not running. Both IDGs are not being driven and neither is the hydraulic driven generator (HDG). Battery is guaranteed to last for 30 minutes.

These indications are similar to a loss of all electrical power including the HDG (except battery). The two key differences for a pilot to recognize loss of thrust on both engines versus loss of electrical power are:

- the green pressure light from the RAT illuminates (which would have auto deployed)
- the two oil pressure lights next to the auto brake selector which are illuminated.

PF flies the aircraft and calls for “Loss of Thrust on Both Engines Recall Items” which are

⇒ ENGINE START SELECTORS........................FLIGHT
⇒ FUEL CONTROL SWITCHES........................CUT OFF
when EGT decreases:
⇒ FUEL CONTROL SWITCHES........................RUN

When these are completed the PF calls for the “Loss of Thrust on Both Engines” non-normal checklist:

- Monitor the standby engine instruments.
- Before selecting cut off make sure the engine has not relit.
- It would be advisable to start the APU if you were unsuccessful in attempting to relight the engines after about the third or fourth time. Especially, in aircraft that are equipped with dual fuel crossfeed valves (with a single fuel crossfeed the DC fuel pump operates automatically inflight to provide fuel to the left engine when left engine N2 RPM drops below 67% and the left engine fuel manifold pressure is low.).
- The inflight engine start EGT limit is higher (650 degrees) due to the engine being warmer.

- In the event of a "dead stick" landing it maybe an idea to select the gear down earlier then you would normally because once the battery is depleted (the guarantee only last for 30 minutes) there is no electrical power to electrically break the under carriage up locks .Either that or turn the battery off during the descent assuming you are not in IMC or at night. (assuming the APU is not working).

7.4.1 INTRODUCTION TO SINGLE ENGINE FLIGHT

Engine failures on take off, especially during or after rotation where you have lost visual reference is one of the hardest maneuvers to accomplish successfully, due to the aircraft rotating to the required pitch angle and asymmetric thrust, causing the aircraft to roll and yaw.

If the correct technique is used they are quite straight-forward.

Consider the following example.

7.4.2 TYPICAL ENGINE FAILURE SCENARIO

Assuming you are at Puerto Plata at night in rain and departing at high takeoff weight for Vienna. The wind is from the west, which requires a departure on runway 26.

There is high terrain to the west of the field which necessitates a right turn at 1.5 DME (half a nautical mile beyond the end of the runway) onto a heading of north and a minimum altitude of 600 feet.

Note: *this is not a good situation to be in to suffer an engine failure.*

You takeoff down the runway and during rotation the right engine seizes. You no doubt realize you have an engine malfunction.

You must now really focus on the ADI more than you would normally, you rotate the aircraft (slowly, rotation rate about 2 degrees per second) to a pitch attitude of eleven degrees and with the combination of aileron and rudder maintain a wings level situation.

A lot is happening right now. You are in a grey area and your brain has to process a lot of data such as when the ADI starts to show a roll maintain wings level with both aileron and rudder.

Do not change your rudder input ! A heavy concentration on the ADI and TAKING in what it is telling you cannot be over-emphasized.

The PNF call "positive rate" and you respond "Gear Up !". The PNF complies and calls "right hand engine seizure, confirm ?".

There is no hurry to confirm or negate that call. Your job is to "fly the aircraft".

You are in a stable condition flying away from the ground and in a constant track. You now fine-tune the aircraft. If you have aileron input, which more than likely you will, it means you have too much rudder or not enough. So, now adjust the rudder input to level the control wheel, if you are cross-controlling you have too much rudder and if you have rudder and aileron in the same direction you require more rudder. You now have the correct rudder input, so don' t move it, i.e, " don' t walk the rudders". Next check how your tracking is going and use the ailerons alone to bring the aircraft onto the required track. Finally, adjust the pitch attitude to obtain the desired speed between V2 to V2+15.

Remember, your job is to fly the aircraft. That not only means keeping the aircraft stable around its three axis but also the flight path. You have to turn at 1.5 DME onto a heading north which you do. So you call for "heading select,right heading 360" (the PNF would already have selected 15 degrees AOB, started the APU and disengaged the autothrottle). You are now established into the turn with the aircraft settled nicely into the flight director. (Remember: the flight director recognizes the engine failure and you may now follow).

You can now confirm or negate the PNF' s call on the engine malfunction and call for the recall items. Both pilots confirm the required thrust lever, fuel control switch and fire switch has been selected prior to actioning.

When recall items are completed the PNF states "right hand engine seizure recall items completed !"

When you are on a heading of 360 degrees AND above 600 ft QNH you can commence to retract the flaps. When that has been achieved and you have Vref30+80 call for "Flight level change, set maximum continuous thrust". Engage the center autopilot and call for required non-normal checklist.

For more detailed information refer to section 7.1.4 "Engine Failure on take-off, go decision" of this manual.

Trimming out the rudder:

When you want to trim out the rudder forces do not relieve your leg but trim the rudder until the pressure has been relieved. You now can take the foot away from your rudder and the aircraft will maintain a constant track with wings level.

Depending on personal preferences some pilots do not trim out the rudder forces completely.

On approach you should have a maximum of 5 degrees.

7.4.3 HANDLING TECHNIQUES WHEN FLYING SINGLE ENGINE

- In order to center the control wheel and thus have a minimum drag configuration (as no roll spoilers will then be deployed with a control wheel deflection of less than 6,5 deg.) rudder has to be applied on the side were the control wheel is downward ("your hand is pointing towards the leg that needs to be pushed in").

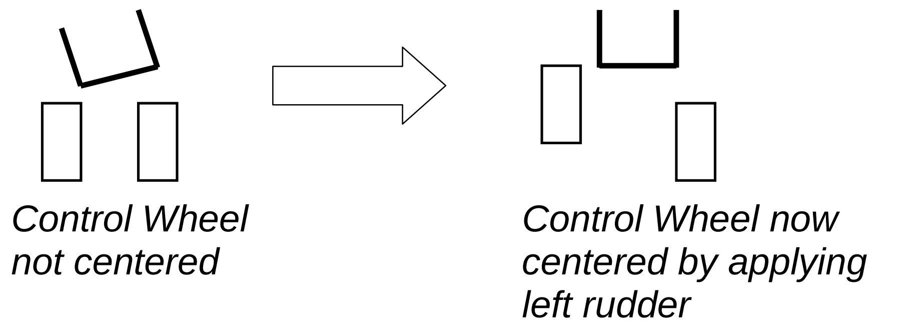


Figure 7.4-1

- To trim the rudder force out a certain amount of TRIM UNITS is needed, depending on thrust asymmetry. Keep the foot in and trim until no force is felt. **Do not** relieve leg gradually as trim is put in.

<u>Note 1:</u> *with gear down and Flaps 20 in level flight there will not be enough rudder trim available to trim out the rudder forces, completely. Therefore, ask for "Gear down, Flaps 20" not until 1 dot below GS or 2 NM before reaching the FAF (this by the way also makes a smooth transition when flying on two engines).*

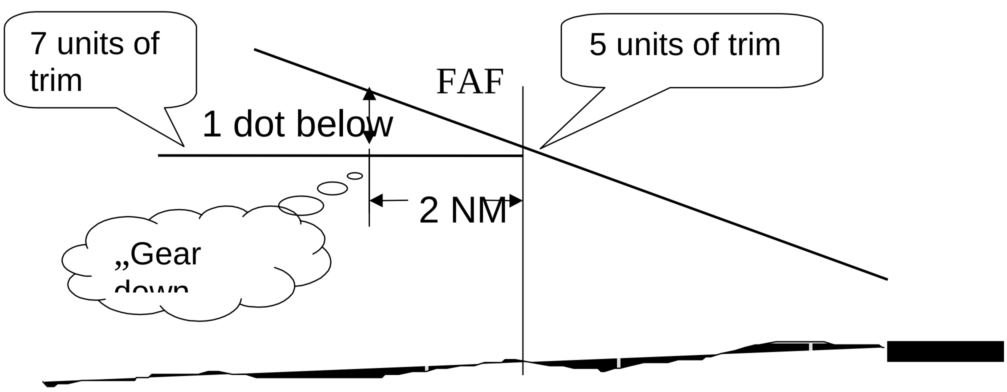


Figure 7.4-2

<u>Typical Values</u>: *(LDW 130 t)*

Level flight clean	1,14 EPR	4,5 t/h FF	7 Units
Approach, Gear down, F20	1,07 EPR	2,5 t/h FF	5 Units

Note 2: Airspeed itself does not have much influence on the trim required because the rudder limiter provides an amount of rudder deflection that is proportional to the speed. It is changing airspeed by means of thrust that induces additional yawing which has to be avoided !

- Therefore, it is recommended to do initial decelerations (for configuration changes) by means of speed brakes, since these do not introduce any additional yawing.
- Be mechanical with the rudder inputs: push it in - hold it there - correct with aileron - push in some more (or less, as required) - hold it there, etc.
- It is very unlikely that you can match the on-set of yawing with a smooth and gradual application of rudder.

7.4.3.1 Flying Single Engine on Autopilot

With only one AP engaged, it can counter-act the yawing moment only by application of aileron. Rudder is not available. Therefore, in order to put the control-wheel to neutral position rudder has to be applied by the pilot and trimmed accordingly, exactly as is the case during manual flight.

If this is not done, the AP will apply aileron up to a maximum of 18 degrees deflection. If the yawing moment would require even more aileron, the aircraft will start to turn in a direction opposing the control wheel deflection because the AP is not able to hold the heading any more.

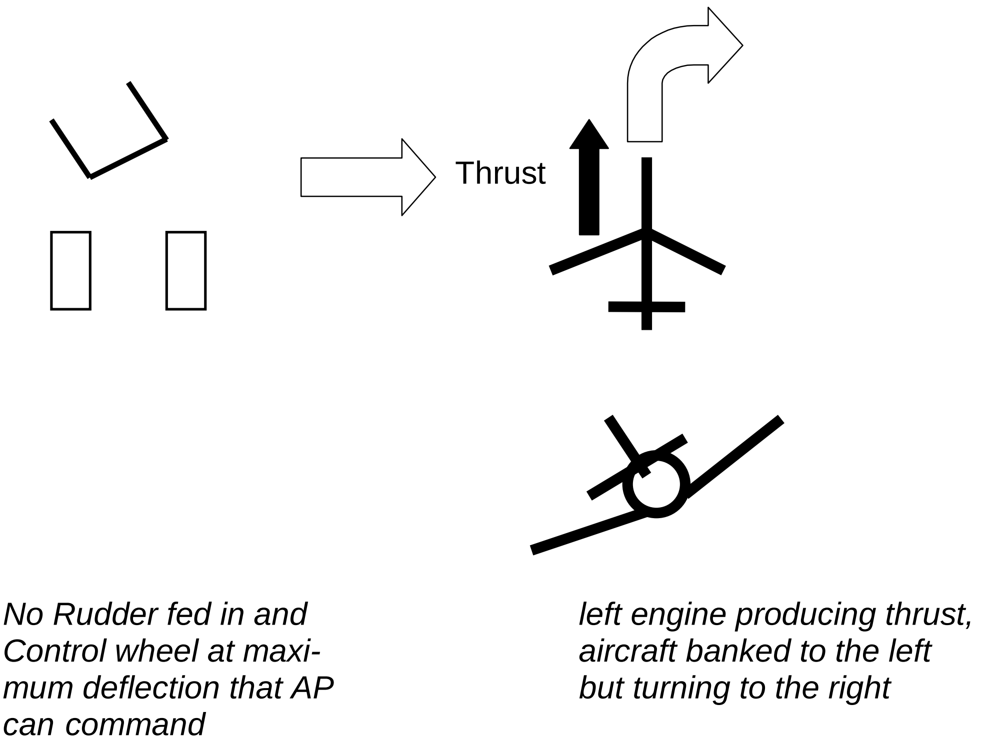


Figure 7.4-3 Single engine flight with engaged autopilot

When all three APs are engaged, which is the case during Autoland, a rudder channel will be used by the AP. Be prepared to take over the rudder manually when a different roll mode is selected, such as from GA to HDG SEL during go around.

7.5.1 GROUND PLOT OF MANEUVER

For explanation of the circling procedure refer to the following figure:

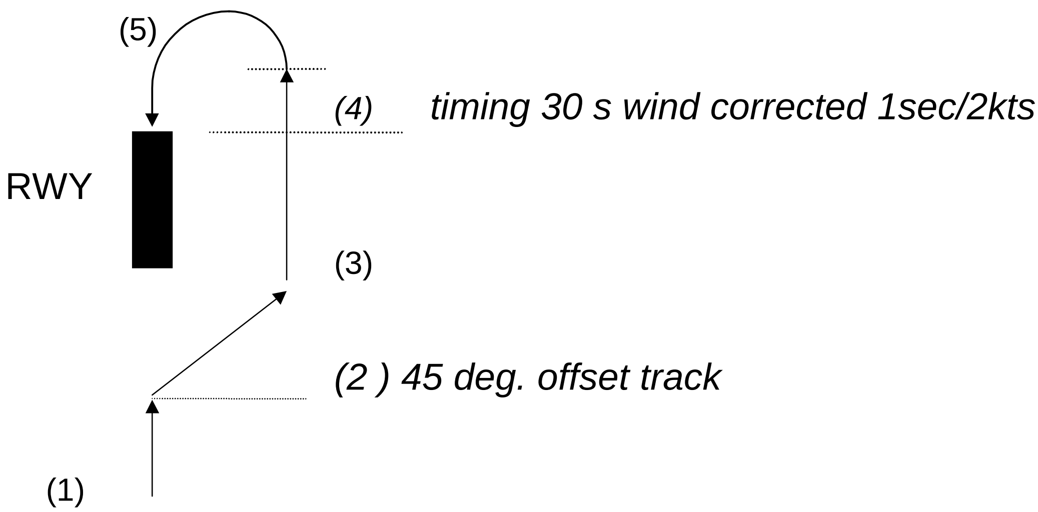
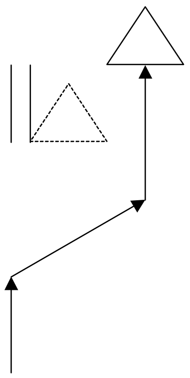


Figure 7.5-1

(1) When inbound track is established on the final portion of the instrument let-down procedure, fly it in HDG HOLD. This allows you to preselect the 45 deg-off heading for leg 2. At the break-off point, only HDG SEL needs to be selected.

(2) When rolling out on the 45-deg-off track, start timing for 20 seconds. This timing needs to be adjusted for wind. Select Map Mode.

(3) Fly a track parallel to the runway. The optimal offset of leg (3) to the runway can be judged by looking at the RWY and Aircraft Symbols (triangle) in the Map Mode:



If the distance between the aircraft symbol (triangle) and the runway symbol is such that another aircraft symbol would just fit in between, the offset is good.

Figure 7.5-2

(4) When abeam threshold, timing for 30 seconds starts. If you forgot to time as a rule of thumb start the inbound turn when the base of the triangle (aircraft symbol) is just abeam the end of the runway symbol, as depicted above in Figure 7.5-2 .

(5) Use the trend vector to establish yourself on the centerline. In smallest range (10 NM) on the map mode the end of the trend vector predicts the aircraft position after 30 seconds. With a rate-one turn, a heading change of 90 deg. can be accomplished within these 30 seconds, i.e. when the trend vector just touches the extended centerline while on a heading of 90 deg. to the runway, the inbound turn should be started (see figure):

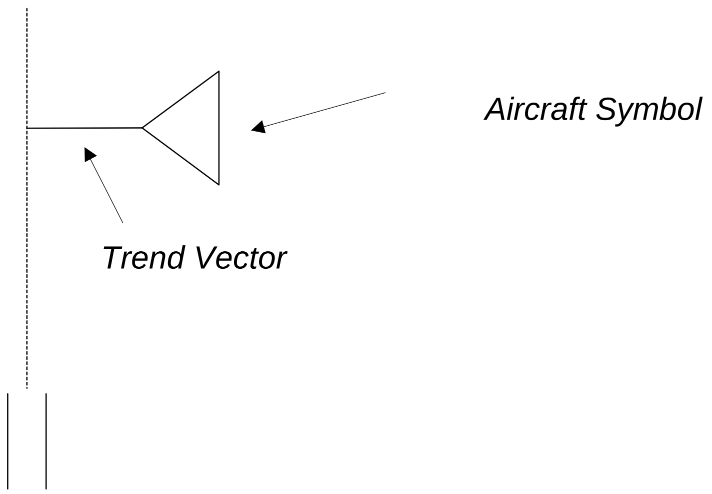


Figure 7.5-3

Adjust the bank so as not to undershoot or overshoot the extended centerline (dashed white line that spreads out for 7 NM):

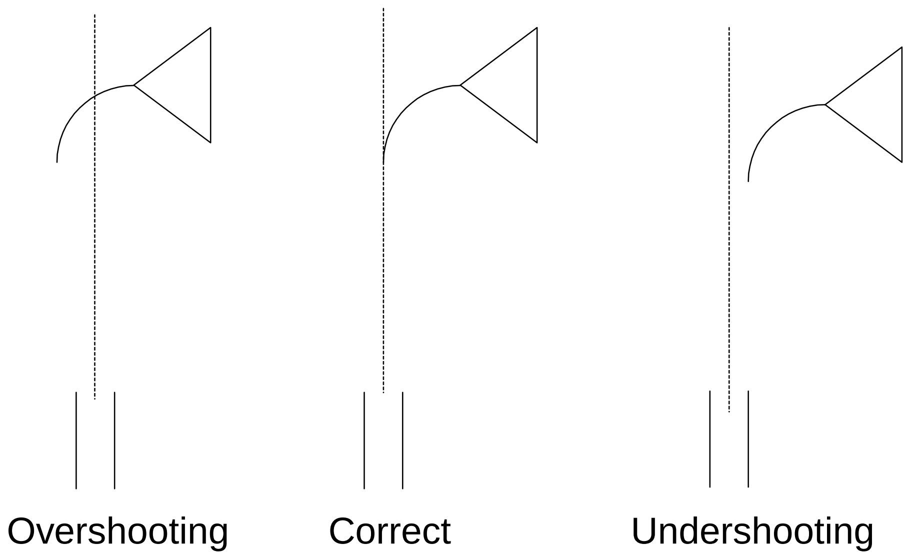


Figure 7.5-4

7.5.2 DESCENT DURING CIRCLING

When the base turn is initiated a shallow descent can be started. The rate of descent that is needed to stay on a 3 deg. flight path is obviously dependent on the difference between circling altitude and airport elevation, which is typically 800 ft.

Remember, when starting the base turn, time to the runway is approximately 60+30 = 90 seconds or even more, since the final flap setting (with lower airspeeds) and usually some head wind component (the reason for the circling) that further reduces ground speed will come into effect. Obviously, there is no need to rush the descent - an average of 600 fpm should do it. Boeing recommends not to descend below MDA until intercepting the visual profile (see FCTM 4.27)

The first 90 degrees through the base turn are the <u>most demanding</u> for several reasons:

- Black hole, Vertigo
- limited outside cues to the runway,
- turning after a fairly long straight and level flight with the need to put the nose up in order not to obtain high sink rates. Don´t let the nose drop too much at that point
- Successive closure to the terrain.

It is recommended to go into VS-mode if descent is necessary in this phase, select a maximum of -300 fpm and use the FD pitch bar as a vertical guidance. Nose attitude at that point will be approx. 2 ANU.

Remember, during a proper circling procedure the aircraft symbol should never have to drop below the horizon !

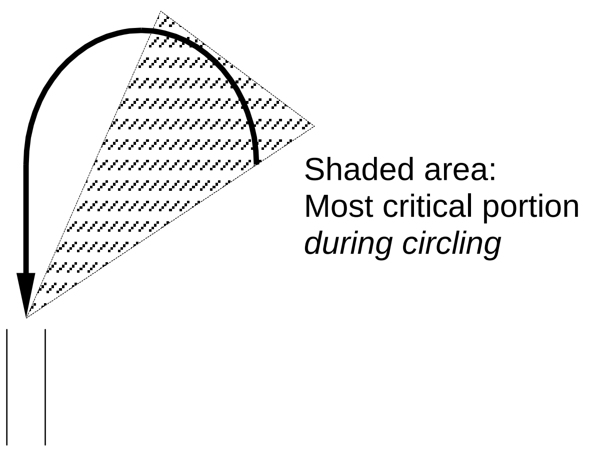


Figure 7.5-5

If **distance to the landing** runway is requested in order to be able to use the distance x 3 rule-of-thumb,

- the runway can either be put into the FMS by the PNF early enough or

- you use rules of thumb by looking at the geometries again: assume GS = 180 kts, i.e. 3 miles a minute. Abeam the threshold you will be 6 NM from the RWY, when 90 deg. to the centerline 3 NM and when rolling out on the centerline approximately 1.5 NM. This implies that the descent should be arranged as to be 450 ft AAL when rolling out on the centerline.

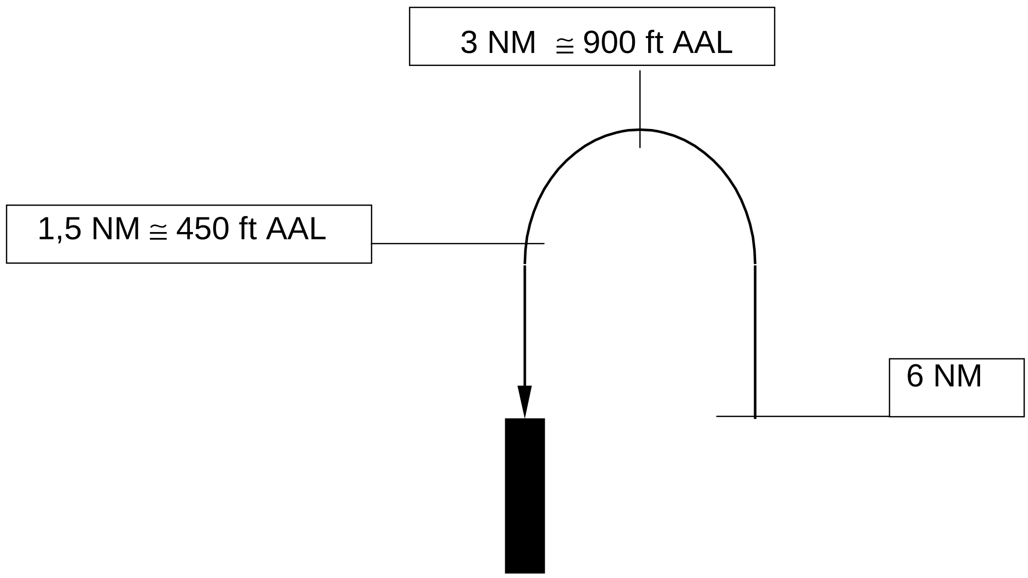


Figure 7.5-6

Clearly, where descent has to be started depends on the circling height.

When rolling out, visual approach aids can be picked up (PAPI, VASI). If these are not available, as a **rule of thumb**

When the beginning of the approach lights passes underneath the cockpit, RA should be approx. 300 feet.

This rule can be easily confirmed as follows:

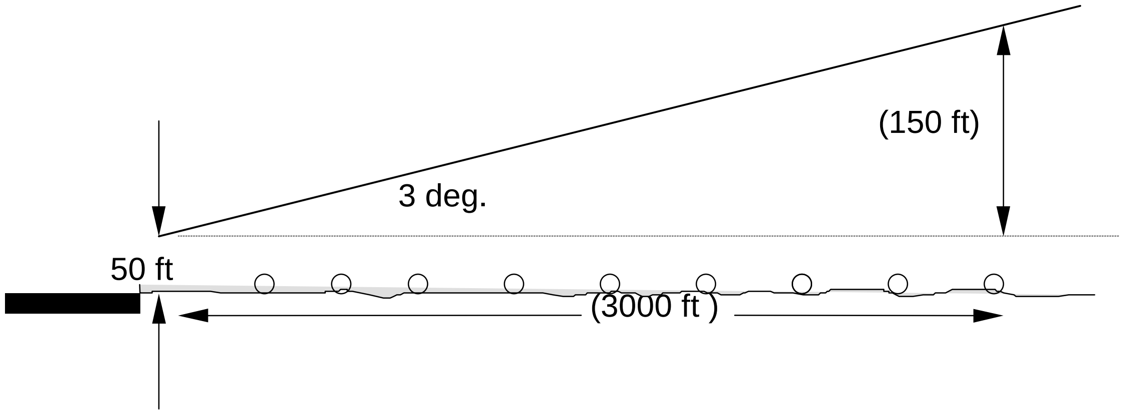


Figure 7.5-7

Note: Approach lights extend 2400 - 3000 ft from the threshold. Applying the 1:60-rule this gives 3 ft vertical displacement for every 60 ft of horizontal distance on a three degree glide slope. As 60 is 50 times in 3000 this gives 50 x 3 = 150 ft + 50 ft threshold crossing height = 200 ft. The additional hundred feet to give a total of 300 ft is attributed to cockpit cut-off angle, i.e when the first approach lights disappear under the nose the aircraft will not actually have over-flown these lights, yet.

7.5.2.1 Use of AP/FD during circling

Avoid manual flight while looking out to find the RWY during base turn, descending at the same time – this means the AP should not be turned off until the RWY appears in the windshields.

7.5.2.2 Speed loss during turns with constant thrust

If thrust is constant approx. 10 kts of airspeed will be lost for every 90 deg. of turn.

This rule is handy when flying SE circling maneuvers, where thrust changes shall be kept to a minimum. An overspeed of 20 knots on the downwind will be bleed off by the 2 ninety degree turns.

Constant thrust

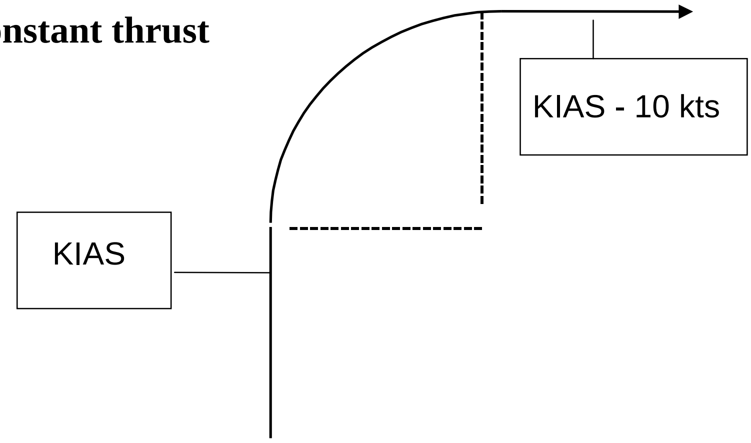
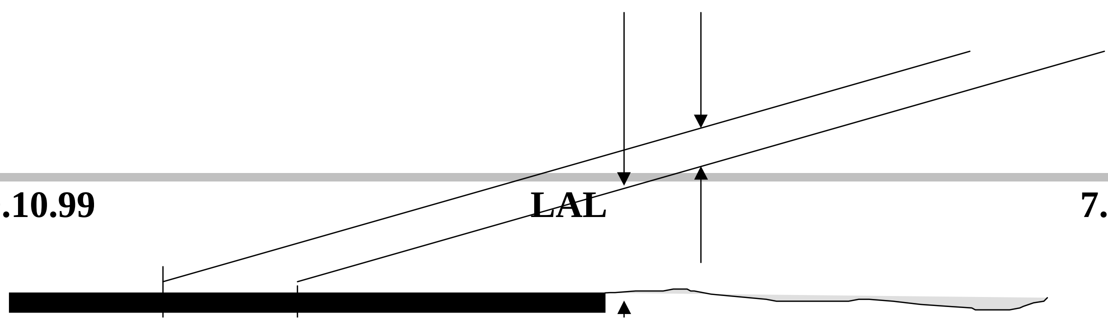


Figure 7.5-8

7.5.3 THRESHOLD CROSSING HEIGHT

For every 10 ft too high above the threshold, touchdown will be approx. 200 ft further down the runway.

This can be easily proved by applying the 1:60-rule, which gives a touchdown point at the 1000 ft marker with TCH = 50 ft over the threshold on a three degree path.



10 ft high

50 ft

1000 ft

1200 ft

Figure 7.5-9

7.6.1 STEEP TURNS

During the maneuver AP, FD and A/T are disconnected, after starting conditions are established. Normally, the maneuver is done at 10000 ft and 250 KIAS.

For Steep Turns (bank angle 45 deg.) strive for the following conditions:
- Roll in slowly, increasing scan rate.
- Slight increase in thrust to overcome the increasing drag
- A small amount of back stick
- First indication of altitude deviation will be on the VSI
- First indication of speed deviation will be on the trend vector on ASI
- Roll out slowly and smoothly 15 deg. before the nominated heading, applying a light forward stick and easing back on the thrust levers.
- If required roll in the other way.

THE SECRET TO STEEP TURNS IS A HIGH SCAN RATE.
<u>DON'T BE LAZY</u>

7.6.2 STALLS

Three different types of stalls are trained.
1. Clean Stall (level flight)
2. Base Turn Stall (Gear Up, Flaps 20, 25 deg. of bank)
3. Approach-to-Landing Stall (Gear down, flaps 30, level flight)

General rules

- In any of the stalls, maximum thrust is applied immediately with stick shaker/buffet onset.
- The objective is not to lose height, if you do, first get your speed, then correct for the altitude. Losing altitude cannot be avoided at stalls in high levels, as you have to trade altitude for speed because the available thrust is largely reduced (low density).
- A negative pitch attitude (nose below horizon) should not be necessary for most recoveries.
- Initially keep the pitch attitude that you had when stick shaker onset occured
- As recovery proceeds, target for a pitch attitude of 5 deg. ANU.
- Be aware of the pitch-up tendency that sets in with some time delay as the thrust gradually builds up. (approximately 5 to 7 seconds after “firewalling” the thrust levers.)
- No secondary stall, be gentle on the controls.
- Note 1: Thrust over time increases non-linear for a given thrust lever angle.

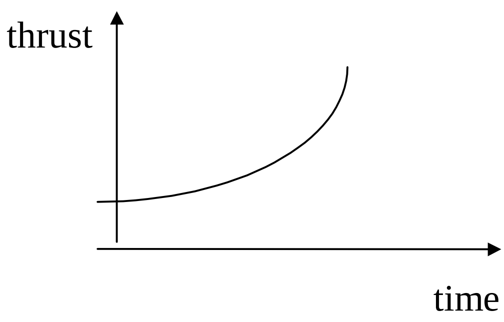


Figure 7.6-1

- Don´t let the aircraft get into pitch oscillations by over-controlling it.
- To avoid this, firmly lock both your arms onto the arm-rest.
- If the aircraft stalls in a turn, simultaneously roll the wings level and apply maximum thrust.

Note 2:

- When flying well into the stick-shaker, a “stick nudger” will gently push the yoke forward. This stick nudger only works when the aircraft is clean.
- For configurations with flaps extended a PLI will show up on the ADI. The PLI is used during wind-shear recovery and gives a pitch attitude that corresponds to maximum lift.

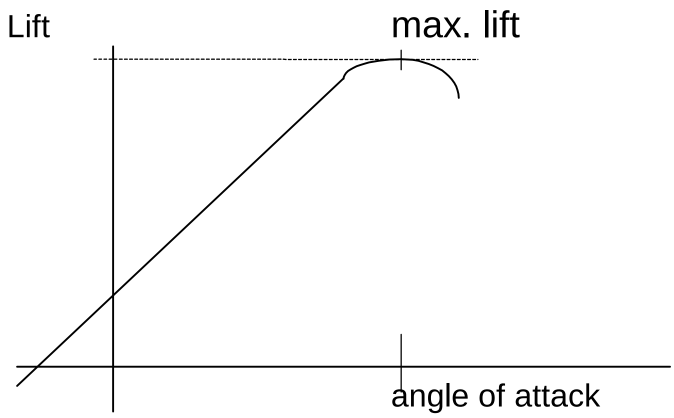


Figure 7.6-2

- You can´t have both, protection by PLI and stick nudger; you only have either one.

High altitude stall

Disengage A/T via the thrust levers.
Observe no A/T or AFDS protection.
Observe changes on the FMA.
Pitch attitude about 5 degrees.
Altitude loss occur, the amount is dependent on current altitude, aircraft weight and the desired acceleration rate during recovery.

8.1.1 FUEL TANKERING

Per one hour of flight time, tankering fuel is recommended only if difference in fuel price at destination exceeds 4%.

Example:
- *Flight time to destination: 3 hours*
- *Fuel costs at destination: 111% (i.e. 11% more expensive than at departure airfield)*

Rule of thumb: 3 x 4% = 12% (or higher savings percentage) would be needed to make tankering economical on a three hour trip. Here: savings only 11% ⇒ tankering not recommended. If fuel price was 13% more expensive at destination, tankering would be recommended.

Note: the rule of thumb does not take into account factors such as additional brake wear due to higher landing weight, increase engine wear on take off etc.

If the **additional fuel burn** due to the higher weight because of tankering, also referred to as surplus fuel burn, is known (see AOM VOL 3 on page 23.10.48 or rules of thumb below), another method can be used to determine, whether tankering is economical or not, see Figure 8.1-1. This figure gives fuel price in cents / gallon, which is equivalent to having numbers as a percentage.

The surplus fuel burn can be estimated as follows:

For every extra ton of fuel you tanker, trip fuel has to be increased by 0,3%. In other words, it takes 30 kg of fuel to transport one additional ton per hour.

(Source: AOM VOL. 3, pg. 23.30.19, valid for average weight of 160 t)
This rule is also handy when ATOM is higher than actually planned (e.g. because more cargo has to be carried). The higher weight requires more trip fuel and thus a higher minimum block fuel. Unless a new CFP is calculated (with the ATOM, resulting in a higher minimum block fuel) the anticipated higher trip fuel needs to be covered by taking enough extra fuel (see example 2).

Example 1:

- *Fuel price at departure airfield: 100 %*
- *Tankering 10.000 kg of fuel*
- *Trip Fuel 38.500 kg*

⇒ *Surplus fuel burn = 10 * 0,3 = 3000 kg, equals an increase in trip fuel by 7,8 % (rule of thumb)*

⇒ *tankering is economical if fuel at destination costs more than 109 % (see graph)*

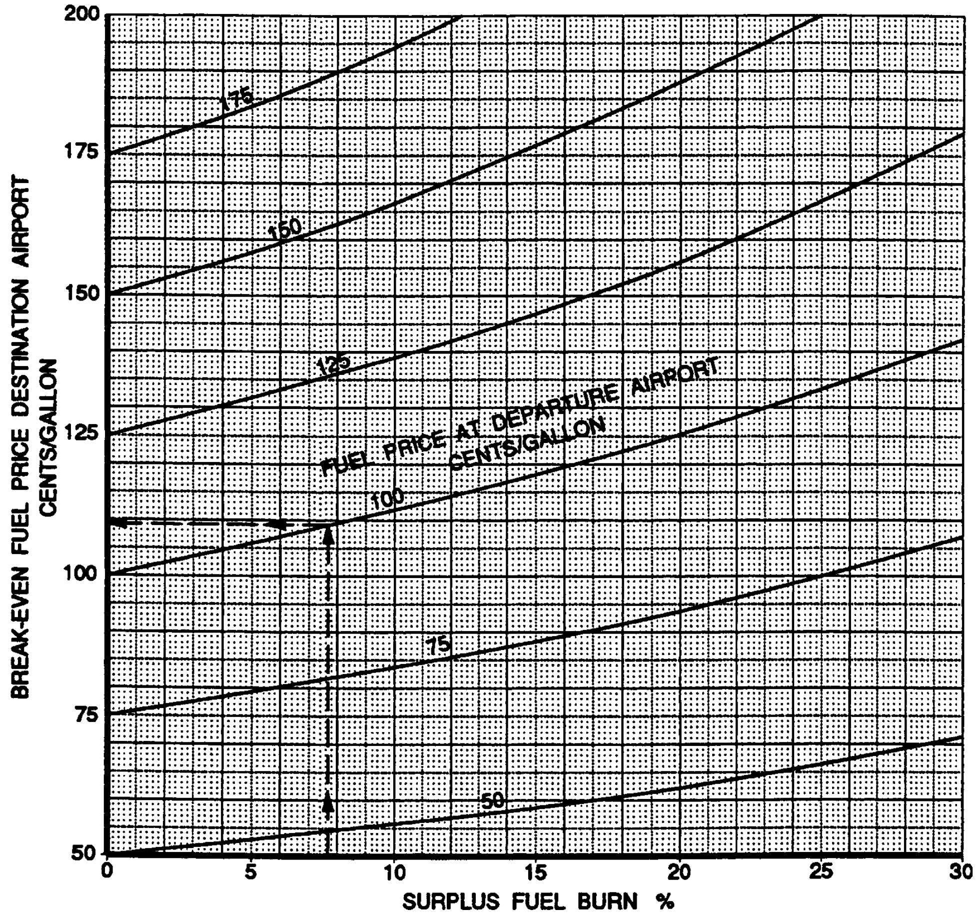


Figure 8.1-1 (Source: AOM VOL. 3, pg. 23.10.49)

Example 2:

- *Assume a 11:47-hour flight from KUL to VIE:*
- *Minimum block fuel at anticipated TOM according CFP: 58360 kg*
- *Actual Block Fuel: 60400 kg (i.e. a comfortable 2040 kg extra fuel carried)*
- *The load sheet finally arrives after fuelling is finished: AZFM is 5,65 tons higher than anticipated.*
- *You are in a rush because of a CTOT. The tanker is no longer attached to the aircraft.*

Result: 11,8 hours x 30 kg/ton = 354 kg (per one additional ton). With a AZFM that is 5,65 tons higher than anticipated, trip fuel will be 5,65 x 354 = 2000 kg plus 354kg x 2 = 708kg (2000kg of extra fuel) 2708kg higher during the flight. This means that all of the extra and some of the route reserve is eaten away by the heavier weight and a low fuel state upon arrival in VIE is very likely.

The estimated figures very accurately represent an actual flight, as can be seen by comparing the two CFPs of Figure 8.1-2 and Figure 8.1-3.

Note: The difference in average wind component (a result of calculating the second CFP after arrival in Vienna and the winds having changed slightly in the mean time) also results in a higher trip fuel: with a flight time that is longer by about 8 more minutes an increase in trip fuel due to wind of 720 kg (using an average fuel flow of 5,4 tons per hour) can be estimated. The wind corrected fuel burn for the higher ZFW is then 55360 kg –720 kg =54640 kg. This figure compares to 51850 kg for the lower ZFW. The difference is then 2790 kg. This is quite close to the ”rule of thumb” estimate of 2708 kg.

```
00019
QD KULOJMH
.QIFPMNG 080308
REF YR 080306
START OF PART 01 OF 07 FOR CFP REF : MDZXU  -  LDA0006 SF KUL  VIE
                                    32R: 30°        190.5          54°→ 166.3 (*, 0)
                                                  - 0,7 QNH
                                                    189.8
B777 NAV DATA: KULVIE7
DOF 01/08 OCT 98
NEW ZFW 98000 KGS
DATE OF FLIGHT 08/OCT/98

FLT RELEASE  LDA 0006 WMKK/LOWW LRC CRZ                                      ASST/54°
             FUEL   TIME      TOW      LDW       ZFW      AC 204             V1  /.160
TRIP         51850  1147     155960   104110     98000    REG                VR  /.160
CONT          2500            AWC M1   ISA DEV P06        OE-LAW             V2  /.164
ALTERNATE     1810  0023    LOWL FL 220   110 M.58 W/C M001                  VR30/.160
              3610          ....     ...   ... ...        ....               MAC /.17.7
FINAL RES     1800  0030                                                     TRIM/.5
MIN T/O      57960  1240   LDA 0006  SLOT .. .. ..
TAXI           400         SCHEDULE ACTUAL                         DELAY CODE/TIME
MIN BLK      58360  1240   VIE 1640 ON BL 17:35 LNDG 17:26         .../.../.../...
EXTRA         2040  :34    KUL 0440 OFFBL 05:08 AIRB 05:23         81./:28/.../...
ACT BLK      60400  13:14 BLOCK 1200 TIME 12:27 TIME 12:03
```

Figure 8.1-2: Company flight plan calculated for ZFW =98000 kg. Trip fuel 51850 kg and 2040 kg extra fuel.

```
CFP INPUT MESSAGE DATE TIME REF 081756
START OF CFP REF : MD5FP  -  LDA0006 SF KUL  VIE

B777 NAV DATA: KULVIE7
DOF 01/08 OCT 98
DATE OF FLIGHT 09/OCT/98

FLT RELEASE  LDA 0006 WMKK/LOWW LRC CRZ                                   ASST/....
             FUEL   TIME      TOW      LDW       ZFW      AC 204          V1  /....
TRIP         55360  1155     165340   109980    103650    REG             VR  /....
CONT          2500            AWC M8   ISA DEV P06        OE-LAW          V2  /....
ALTERNATE     1950  0025    LOWL FL 240   110 M.68 W/C M019               V..../....
                            ....     ...   ... ...        ....            MAC /....
FINAL RES     1880  0030                                                  TRIM/....
MIN T/O      61690  1250   LDA 0006  SLOT .. .. ..
TAXI           400         SCHEDULE ACTUAL                       DELAY CODE/TIME
MIN BLK      62090  1250   VIE 1640 ON BL ..:.. LNDG ..:..       .../.../.../...
EXTRA                      KUL 0440 OFFBL ..:.. AIRB ..:..       .../.../.../...
ACT BLK                  BLOCK 1200 TIME  ..:.. TIME ..:..

FLT PLAN BASED ON 06Z/12Z/18Z/ PROGS
```

Figure 8.1-3: Company flight plan for the same flight but with higher ZFW. Trip fuel now 55360 kg**.** ETOW resembling ATOW = 165340 kg.

8.1.2 HIDDEN CRITICAL FUEL

When looking at the CFP the following can happen (see Figure 8.1-4):

Extra Fuel is given, say 2000 kg. On the top of the CFP the dispatch officer writes ”PLS CON 2000 kg XFUEL IF POS”, which means ”please consider 2000 kg of extra fuel, if possible). The reason for the extra fuel can be an expected arrival delay for this airport.

Now assume that by AAM you are TOW limited, e.g. assume a departure on RWY 34 in Salzburg and you decide to depart with minimum block fuel, i.e. you don´t take the 2000 kg extra fuel.

```
PLS CON 2000KGS XFU IF POS/DOF 26OCT/09NOV/16NOV
TRANSIT PAX: C11/00/00  Y128/16/01
JOINING PAX: C07/00/00  Y 74/08/00
FILED NAT TRK [redacted]  OPTIMAL // TOO LONG
DATE OF FLIGHT 26/OCT/98

FLT RELEASE  LDA 3997 LOWS/MDPC FIXED MACH                               ASST/...
             FUEL   TIME      TOW      LDW       ZFW       AC 211       V1 /161
TRIP         55900  1103     177650   121750    113550     REG          VR /163
CONT          2500             AWC M19  ISA DEV P05        OE-LAS       V2 /169
ALTERNATE     1670  0019    MDSD FL 160    80 M.55 W/C     M004         Vr30/168
              3700          ....     ...  .... ...         ....         MAC /23.5
FINAL RES     2030  0030                                                TRIM/.5.2
MIN T/O      62100  1152    LDA 3997  SLOT .N/L ..
TAXI           400          SCHEDULE ACTUAL 17:25                  DELAY/CODE/TIME
MIN BLK      62500  1152    PUJ 1650 ON BL...    LNDG 17:23        14./A./17./.21
EXTRA         2000  0030    SZG 0620 OFFBL 06:34 AIRB 06:40        93./.14/.../...
ACT BLK      64500  1222 BLOCK 1030 TIME 10:51   TIME 10:43
```

Figure 8.1-4: CFP from SZG to PUJ. Note the 2000 kg extra fuel recommended by dispatch. On the top line it states ”PLS CON 2000 KGS XFU IF POS”

By not taking the extra fuel you might run into a critical fuel scenario trap:

Critical fuel is always put down in the line for extra fuel on the CFP because of software format reasons, i.e. there is no special line exclusively reserved for critical fuel. Unlike real extra fuel, which is taken at the captain´s decision, critical fuel is part of minimum block fuel and has to be considerd.

In order to check, if part of the 2000 kg are in fact not extra but critical fuel you can quickly do the following:

1. Look into the ETOPS section of the CFP (see <u>Figure 8.1-5</u>)
2. Where it says "FUEL REMAINING xxxx INCLUDES yyy CONTINGENY. Subtract your extra fuel from the fuel remaining to see what you would have if you did not take any extra fuel.

   <u>In our example</u>: 9826-2000 = 7826 kg includes 266 kg contingency

3. Check this fuel number with the fuel required.

   <u>In our example</u>: fuel required to TXKF is 8490 kg and to TJSJ 8610 kg. You take the larger of the two values, so not to limit yourself to one ETOPS alternate.

4. By comparing the two numbers you find that if you probably have to take some extra fuel as critical fuel, otherwise you will not meet the required fuel minimum !

   <u>In our example</u>: 7826 kg (what you have) – 8610 (what you should have) = -786 kg ! In other words, the 2000 kg of extra fuel given on the first page included 786 kg of critical fuel !

ETP3		MORA	TRK	FL	DST	TIME	IAS	TAS	G/S	FUEL REQD	CRIT FUEL	TWO ENG FUEL
N2528.1	TXKF	16	6	100	416	1.00	360	419	418	8490	0	7210
W06534.0	TJSJ	58	183	100	422	1.01	360	422	421	8610	0	7310

FUEL REMAINING 9826 INCLUDES 266 CONTINGENCY

FUEL REQUIRED INCLUDES 0.0/ 0.0 PC ANTICING 3.000 PC DEG

WARNING - FLIGHT PLAN ROUTE OUTSIDE RULE DISTANCE FROM LPAZ/TXKF

ALTERNATE REQUIRED AVAILABILITY TIMES

ALTERNATE	FROM	TO
LPPT	08.04	12.00
LPAZ	10.00	16.29
TXKF	14.28	18.12
TJSJ	16.12	18.42

END OF PART 08 OF 09 FOR CFP REF : MGLJC - LDA3997 99 LOWS MDPC

Figure 8.1-5: ETOPS section of CFP

8.2.1 PLANNING STEP CLIMBS

For every 100 ft higher above the present maximum FL one has to wait approximately 7 to 8 minutes.

<u>*Example:*</u>

- *Present maximum FL as given per FMC is FL 345.*
- *You want to climb to FL 350 (500ft above)*
- *Result: you will have to wait 5 x 8 = 40 minutes, i.e. after 40 min. FL 350 shows up as maximum level on the FMC*

<u>Note:</u> if speed is reduced an earlier climb is possible.

If you don´t get the optimum level on the 767 it is prudent to choose a level below optimum as performance penalty will not be as high compared to a level above optimum.

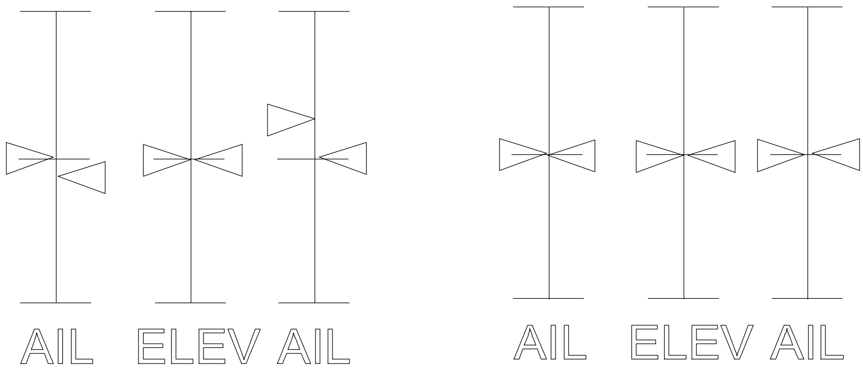
8.2.2 OPTIMUM ALTITUDE

Rule of thumb. Optimum Altitude increases by approximately 100 ft per 1000 kg of fuel used.

This rule-of-thumb is helpful when estimating the optimum flight level prior atlantic crossing. The fuel to go can be read-off the FMC (legs page, route data, next to the respective waypoint for which the optimum level is determined)

8.2.3 TRIMMING DURING CRUISE

To reduce drag due to control surface deflection in cruise it is recommended to trim the rudder so that no residual aileron deflection exists - trim rudder in direction of the up-aileron ! Reduction of drag can be observed by lower thrust setting and lower EGT.



Aircraft not trimmed properly; apply rudder rudder trim to the right.

Aircraft trimmed properly.

Remember: use of aileron trim is prohibited whilst the autopilot is engaged.

Figure 8.2-1

8.2.4 DESCENT

8.2.4.1 Descent Planning

1. When passing FL 100 target for 40NM range to go and 250 kts
2. Always monitor ALT x 3 + 10 (with engine anti-ice required from FL 370 to 1000 ft : ALT x 3 + 17)

Good planning obviously implies that the pilot always knows the track miles to touchdown fairly accurately. Track miles can be derived from the FMS which has to be set-up properly.

<u>Setting up the FMS:</u>

Do not assume that a full procedure (as published) will be available. Plan on the safe side by setting up a procedure with less track miles without deleting any points.

If the descent shall be flown in VNAV it is good practice to create an abeam point to the outer marker with a altitude and speed constraints (published MSA and speed 210). For straight-in approaches plan to be over the OM at 150 kts (or as required by ATC) at published altitude.

<u>Example</u>: Munich RWY 26L, ANDEC 3M-Arrival

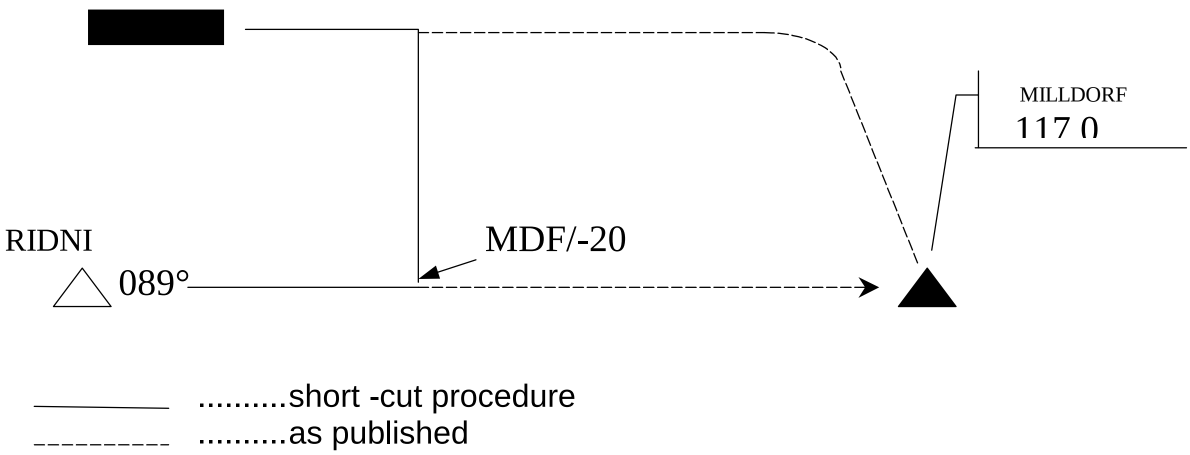


Figure 8.2-2

In order to get an abeam point to the outer marker along the track to MDF simply enter MDF/-20 (distance as appropriate) into the legs page.

<u>How to plan descents conservative:</u>

- Do not rely on the VNAV vertical guidance bar while descending in FLCH. If in FLCH, stay below the VNAV ”glide slope” in order to get yourself some margin for deceleration. The reason is that FLCH tries to bring back the speed while typically targeting a ROD of 1000 fpm. This makes deceleration very slow. VNAV assumes a much more positive deceleration – typically it uses a ROD of only 500 fpm to bleed speed off. The vertical deviation cue assumes this much more abrupt change in ROD when calculating descents.

  <u>Example:</u> assume a descent with 290 KIAS. The goal is to be 250 KIAS at FL 100.

  When in VNAV the system will target approx. ROD = 500 fpm in 10500 ft so it will reach 250 KIAS in FL100 and won't descend below FL 100 until the speed restriction has been achieved.

  When in FLCH with the VNAV ”glide slope” centered and commanding 250 KIAS on the MCP in 10500 ft, you will be fast and high (in relation to the vertical deviation symbol) when passing FL100. The effect of the higher descent rate during deceleration (compared to only 500 fpm in VNAV) does not help to get you below the profile because you are too fast, i.e. you are closing in on the airport faster than in VNAV.

- Additional margin can be achieved by going to DESCENT PAGE, prompting FORECAST and putting in a much higher altitude (e.g. cruise level) for ENG A/I then will actually be used. This will provide some margin because now a higher thrust will be assumed throughout the entire descent. Therefore, the profile will be flatter.
  <u>Note</u>: for that portion of descent where ENG A/I is off, the speed will be slower (e.g. 283 KIAS instead of 290 KIAS) as you fly a flatter profile with less thrust.

To avoid a high and fast situation on final approach target for the following flap extension schedule:

Straight-In Approach
Miles from
Threshold:

15 NM............210 KIAS
12 NM............F1
10 NM............F5
6-8 NM...........Gear down / F 20
6 NM..............F 30

Not straight-in:

Abeam RWY..............210 KIAS

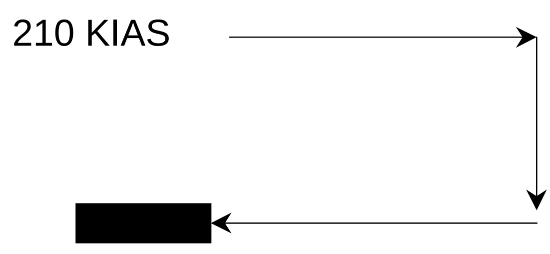


Figure 8.2-3

8.2.4.2 Descent Corrections

Whilst at all times it is desirable to descend in an unhurried manner, at times however due to ATC changes, Wx (having to maintain an altitude to over fly cumulus cloud), or simply pilot error, the aircraft can become high on profile.

When this occurs there are two methods available to correct the problem. Rember that during each descent potential (altitude) and kinetic energy (airspeed) both have to be reduced ! If on path but too fast the aircraft will not slow down in a clean configuration.

Method 1: HIGH and FAST when far out:

Wind up the speed. This gives a higher ROD. Go well below the VNAV ”glide path” to allow ample distance for deceleration. Catch the VNAV path at the appropriate speed (usually 0.80/290/250)

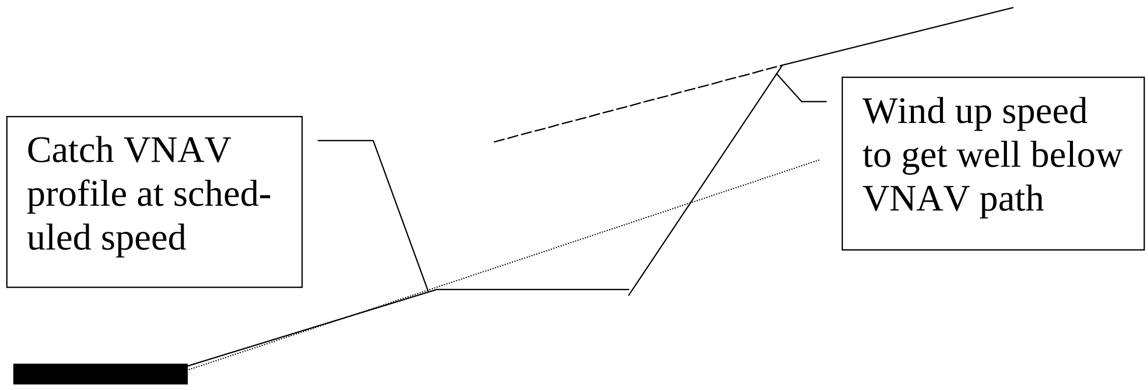


Figure 8.2-4

This method <u>absolutely will not</u> work when getting close to the airport because in a clean configuration speed is bled off very slowly while descending (you will have to fly level to get the speed off but if one is high anyways, people tend to be reluctant about adding a level flight segment).

In that case immediately revert to method 2.

Method 2: HIGH and FAST close to the airport:

The only way to correct a high and fast situation when close to the airport (i.e. within 20 NM) is to level off, bleed speed below flap placard and immediately increase drag (flaps at least equal or greater F20, gear down) and once the high drag configuration is achieved descend with a speed 5 knots less than placard speed (165 KIAS for F30). You will need a fairly large pitch down attitude. ROD is typically 2000 fpm. When back on profile, excessive speed will bleed off quickly because of the high drag. Don´t forget to put some power on (typically EPR 1,03) early enough so you don´t get on the slow side once established on the correct profile.

In Lauda Air it is not allowed to use speed brakes and flap together.

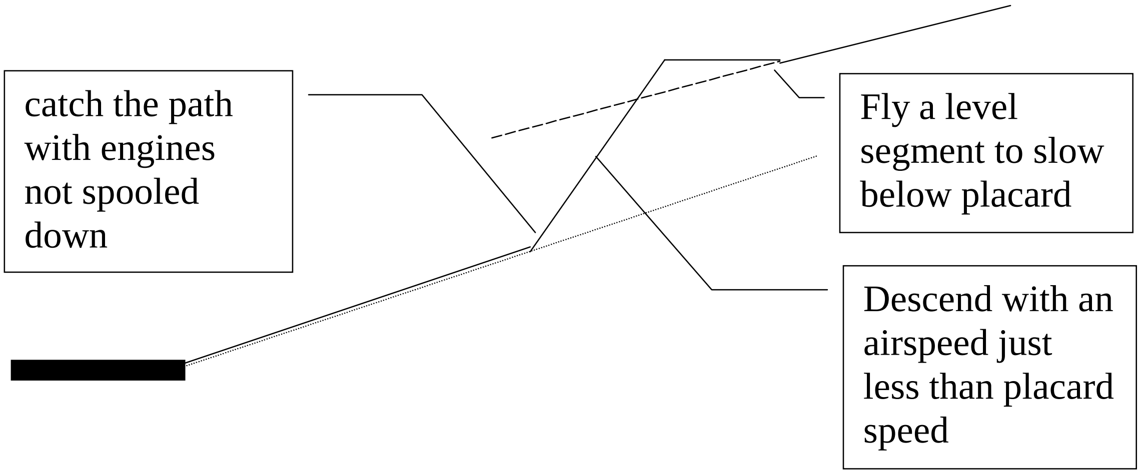


Figure 8.2-5

Mandatory to be stable in the landing configuration by 500' AGL in VMC and 1000' AGL in IMC. Iif this is not possible delaying action or a go around is required.

8.2.4.3 Flying descents without Auto Throttle

> **If A/T is INOP and cruise level has to be left, setting a fuel flow of 1,0 tons/hour will give a smooth initial descent at a rate of about 1000 fpm.**

With gear down and flap 30 with a landing mass of 130 (t) nil wind a descent rate of 700'/ mile is achieved.

8.2.4.4 Minimum Ground Speed During Approach

This is not a Lauda Air procedure, however situational awareness is required at all times and understanding the relationship between IAS and G/S and observing the difference both on take off and landing can be can be a precursor to the possibility of encountering wind shear.

The following formula is based on Vref30+5:

> **For every 5°C above standard add 1 kt,**
> **For every 5°C below standard subtract 1 kt.**
>
> **For each 1000 ft above MSL add 2 kts**
> **and then subtract the minimum headwind**.

Example:

RWY 30; W/V 300/15, OAT=25°C, elev.=600ft, Vref30+5 = 136 kt

⇒ Minimum GS in approach = 136 + 2 + 2 – 15 = 125 kts

The idea behind this concept is that by the higher speed on approach a sudden windshear can be accounted for. The increment is such that a sudden speed loss (increase in tailwind or loss of headwind) will not bring the aircraft below Vref.

8.3.1 FUEL REQUIREMENTS

Start with 3 tons of fuel (2 tons minimum reserve, 1 ton for approach) and then add 1 ton for every 100 NM

8.3.2 TIME TO ALTERNATE

Start with 11 minutes and then add 13 minutes for every 100 NM

8.3.3 ALTITUDE

Minimum: Distance x 1,5
Maximum: Distance x 2 – 10%

<u>Example:</u>
Divert 220 NM
⇒ Fuel = 3+2,2 = 5,2 tons
⇒ Time = 11+ 29 = 40 min.
⇒ Altitude = 220+110 = FL 330 (minimum)
= 440-44 = FL 390 (maximum)

8.4.1 SEQUENCE OF SCAN

The frequency band ranging from 2 to 30 MHz is referred to as high frequency. The major advantage of HF communication in comparison to VHF communication is the fact that significantly larger ranges, spanning almost the entire globe, can be achieved. While the maximum range of VHF is slightly larger than line of sight, there is no line of sight limit for HF waves. HF waves can be reflected several times by layers within the earths' ionosphere and the surface of the earth. This type of wave propagation yields much larger ranges. The distance travelled from the ground station to the ionosphere and back to the first point on the surface of earth is called the skip distance. It mainly depends on the frequency of the electromagnetic wave, the angle at which the waves impinge and the power level of the transmission. Typically, skip ranges vary from 1500 km to 3000 km.
On days with high reflectivity within the ionosphere and high transmission power levels, multiple hops are possible so a signal might even travel around the world. This may be correct in theory however in reality, once south of Singapore it would be impossible to call Stockholm radio.

One of the disadvantages of HF is the fact that due to the long range electromagnetic interferences (resulting from thunderstorm activity, solar activity) are picked up to a much larger extent, resulting in a characteristic, quite often very disturbing, background noise that makes communication difficult.

8.4.2 CHOICE OF FREQUENCY

8.4.2.1 Propagation of HF waves

As range (and thus quality) of a transmission is depending on frequency, the selection of the proper frequency is important, even more so as proper frequency depends on the condition of the ionosphere which itself depends on the time of day:

During daylight electromagnetic waves are reflected by different layers within the ionosphere compared to a reflection at night. With sunrise the so-called D and E layer within the ionosphere build up. These layers almost completely absorb electromagnetic waves with frequencies ranging from 0 to 7 MHz. This is called daylight damping which reaches its maximum when the sun is in its highest position. Consequently, a transmission on lower frequencies during daylight is next to impossible, not even if only short ranges have to be covered.

Frequencies ranging from 7 to 14 kHz can generally be used during day and night hours. They are not influenced by daylight damping and can be reflected by the F1 and F2 layers of the ionosphere (these are the highest reflecting layers).

At sunset, the F1 and F2 layers combine into one layer, descending from high altitudes into a medium altitude range. During this process, the lower layers which were responsible for daylight damping completely dissolve. So during nighttime hours the lower frequencies can be used for communication.

Frequencies above 14 MHz are reflected by the F2-layer which only exists during daylight hours as this layer is ionized by the sun light. Since the F2-layer is the highest known layer a reflection at this altitude results in much larger ranges. Unfortunately, the level of ionization is depending on the yearly seasons and underlies a 7 year cycle (variation of intensity of sun spots).[1]

This gives the following cycle seen over a 24 hour period (Figure 8.4-1):

---

[1] highest sun spot activity coincides with strong eruptions on the sun. This results in strong ionisation and consequently excellent reflection properties, leading to very high ranges. Stockholm Radio will be able to provide more detailed information on sun spot activity.

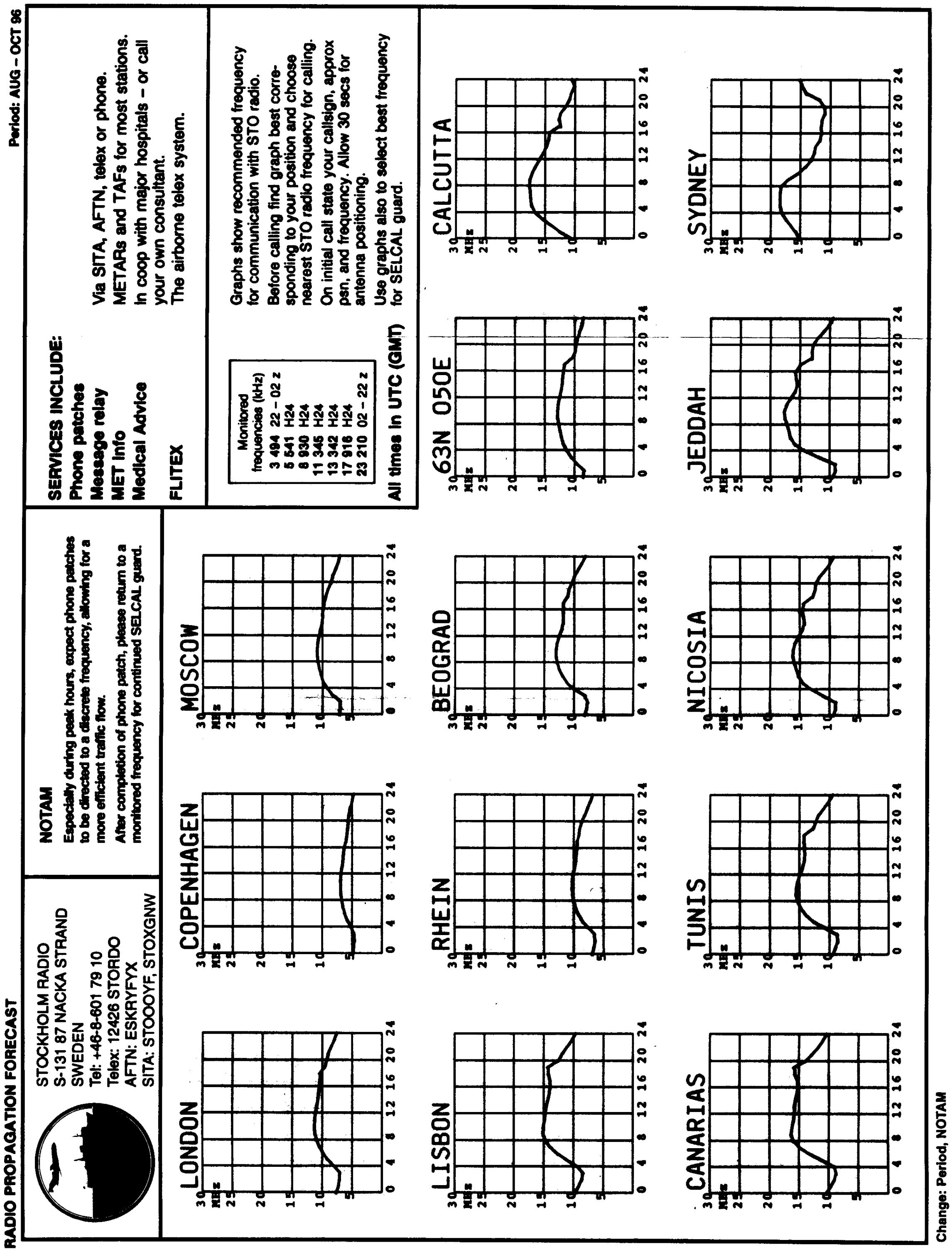


Figure 8.4-1: Radio Propagation Forecast for Stockholm Radio

Rule of thumb:

- during daylight hours: above 10 MHz
- during night time: below 10 MH
- during sun rise / sunset: 6 MHz - 14 Mhz

Service providers such as Berna-Radio provide a quarterly frequency-forecast that gives a choice of particular frequencies. The table below serves as a general reference for Berna-Radio frequencies, an example of a typical radio propagation forecast is also shown in Figure 8.4-1:

Frequency	Remarks
3 010 kHz	Night frequency (on request)
4 654 kHz	Night and short range frequency
6 643 kHz	Preferred night frequency (24 hours)
8 936 kHz	Frequency for general use within European area (24 hours), worldwide range during night
10 069 kHz	Frequency for general use within European area (24 hours), worldwide range during night
13 205 kHz	Frequency for general use (24 hours)
15 046 kHz	Frequency for general use (24 hours)
18 023 kHz	Long range frequency (24 hours)
21 988 kHz	Preferred frequency for Middle East and Africa, during daytime in Switzerland
23 285 kHz	Long range frequency, during daytime in Switzerland
25 500 kHz	Long range frequency, during daytime in Switzerland (on request)

8.4.3 EXAMPLE OF A TYPICAL OPERATION

Assume that the aircraft is overflying some point in SPAIN at 14:00 local time, so one would choose 11.345 MHz for the initial call with Stockholm Radio. The frequency can be found either in AERAD, page COM 225 and following, or in the Jeppesen airway manual.

Now the following steps are performed:

1. Set the frequency into the HF control panel and
2. make sure that USB is selected.
3. Press the mike button momentarily to fine tune the antenna. Note: do not hold down the mike button for a prolonged period of time.
4. Once the tuning process is accomplished the high pitch tone stops telling the pilot that the system is now ready to use.
5. Now Stockholm Radio can be called. Note: always use the aircraft registration when communicating. Do not use the flight number.

Example of an initial call:

„Stockholm Radio, Stockholm Radio, OE-LAX on 11 MHz over Spain"

The use of the aircraft registration rather than the flight number is essential for since Stockholm Radio now knows the operator (billing !) and the selcal code[2]

- *„on 11 Mhz"* tells Stockholm at which frequency the aircraft will be receiving. This phrase is not part of the official radio phraseology but can be heard quite often in daily flight operation.
- *„over Spain"* helps the ground station decide which antenna to use and into which direction to point it. Frequently, the pilot is asked to change to a different frequency after the initial call is established since Stockholm or Berna-Radio know the frequencies that produce best results.

Once the communication is established, different services are provided by Stockholm Radio or Berna-Radio, such as:

- weather information: TAF and METAR are available from most places over the world.
- medical assistance: medical assistance is available by direct phonepatch to the University Hospital Zurich (in case of Berna-Radio), or to a hospital requested by the caller.
- operational phonepatches: Conversations between an aircraft and a party on the ground
- private phonepatches: conversations between an aircraft and a private subscriber all over the world. These phonepatches are handled on non-aeronautical frequencies.
- Messages air-ground: all messages from aircraft are accepted and relayed via SITA, AFTN, ARINC, Telex or Telephone according to callers instruction.
- Messages ground-air: messages for aircraft may be sent either by SITA, AFTN, ARINC, Telex or Telephone. Messages are relayed immediately (SELCAL), or on next contact (store and forward)
- HOTAC: Request for hotel reservations with subsequent confirmation by next call.

[2] the selcal code is unique for an aircraft. There are no two same selcal codes worldwide.

The services are usually available 24 hours per day, 7 days a week. Typically, the user of the service is charged as follows (taken from Berna-Radio)

Finally, there are situations when no contact can be established despite the proper choice of frequency. Due to the characteristics of the propagation of the signals there are areas, usually the ones in close vicinity to the station, where no reception is possible. In such a case try a different operator, e.g. Berna Radio instead of Stockholm Radio[3].

8.4.4 NEW COMMUNICATION TECHNOLOGIES

8.4.4.1 Satellite Communication

Long range aircraft are increasingly fitted with satellite communication systems. The aircraft can be called via Satcom from any tone-coded telephone in the world and vice-versa calls from the aircraft to a ground station can be placed.

Presently, there are four communication satellites positioned in geo-synchronous (approx. 36 400 km) orbit above the equator.

Satellite	Location
AOR-W	55,5° WEST
AOR-E	15,5° WEST
IOR	64,5° EAST
POR	180° EAST

In order to call an aircraft, the approximate position has to be known to dial the appropriate satellite.

[3] Berna-Radio is owned and operated by the Swiss Telecom, Stockholm Radion by the Swedish Telecom.

8.5.1 ATC FLIGHTPLAN

A look at the ATC-flightplan (at the end of the CFP) shows whether the aircraft is certified to operate in RVSM and MNPS. For operations within the NAT (north atlantic track system) both RVSM and MNPS-approval are necessary.

```
START OF ICAO FLIGHT PLAN   [1]

(FPL-LDA9220-IS
-B767/H-SXDIRW/S
-EDDM0940
-N0469F310 DCT MIQ UA12 ERL UB5 ELDIN UL602 GOW/N0465F330 UN563
 56N010W/M080F330 NATB 57N040W/M080F350 NATB SCROD/N0463F350 DCT
 VALIE DCT QUBIS DCT FNE/N0471F390 DCT EMJAY J174 DIW AR14 METTA
 AR1 HOBEE DCT                                        [2]     [3]
-KMIA1018 KFLL KMCO
-EET/EDUU0013 EDVV0034 EHAA0046 EGTT0106 EGPX0137 EGGX0219
 CZQX0345 CZUL0616 CZQM0657 KZBW0703 KZDC0809 KZJX0906 KZMA0934
 EET/20W0303 30W0345 40W0428 50W0513
 REG/OELAW SEL/CEAS          [4]
 RALT/EINN/BIKF/CYYR
```

When operating between FL 310 and FL 390

Legend:

1: Equipment:
S . Standard (NAV, COM)
I .... IRS
D...... DME
R...... RNAV

W .... RVSM-approved
X...... MNPS-approved

(both approvals needed for operation within RVSM
)

2, 3: Routing:
via NAT B
Entry 56N010W
Level change at 57N040W
Scrod exit point

4: Enroute Alternates:
EINN......... Shannon
BIKF .... Keflavik
CYYR .... Goose Bay

Figure 8.5-1

By reference to the MEL it can be determined if the aircraft in its current status-quo is legally allowed to operate under ETOPS conditions within the NAT-system. Malfunctions that occur in-flight have to be considered, using the information on the north atlantic chart (AT (H/L) 1/2 as a guide.

8.5.2 PREPARATION FOR OCEANIC CROSSING

♣ ....*items according ATLANTIC ORIENTATION CHART*
♦ ....*items according WORKBOOK*

8.5.2.1 Preflight

♣ Time-Check (crosscheck also FMC-time ! If FMC-time is wrong, you will give wrong estimates with your position reports !)

♦ Altimeter-Crosscheck:
tolerance on ground:
- Capt to F/O: 40´(elev. at sea level); 45´(elev. at 5000ft)
- Capt or F/O to Stby: 40´(sea level); 50´(5000ft)

Switch ATC-transponder to **left system** as this is the altitude reporting system.when the ”C” or ”L” auto pilot is engaged.

8.5.2.2 Inflight

From an inflight-planning standpoint consideration has to be given to following points

- when to ask for the clearance
- Mach Number and FL requested for crossing before asking for a transatlantic clearance.
- Make sure that the estimate for the oceanic entry point is reasonably accurate (within two minutes)

When to ask for the clearance is determined by how far out the departure airport is from MNPS airspace (note: not Oceanic Airspace). The reason why it is MNPS is because you have to have a clearance for flying into MNPS airspace. Some airways (e.g. A699 out of Miami leading via BURTT, ODEAL, DANER, AKERS and FOCUS) terminate within MNPS airspace. **So even when cleared such an airway, make sure you also have a clearance to enter MNPS.**

If no clearance is received in time to enter MNPS airspace, you will have to descend and stay below !

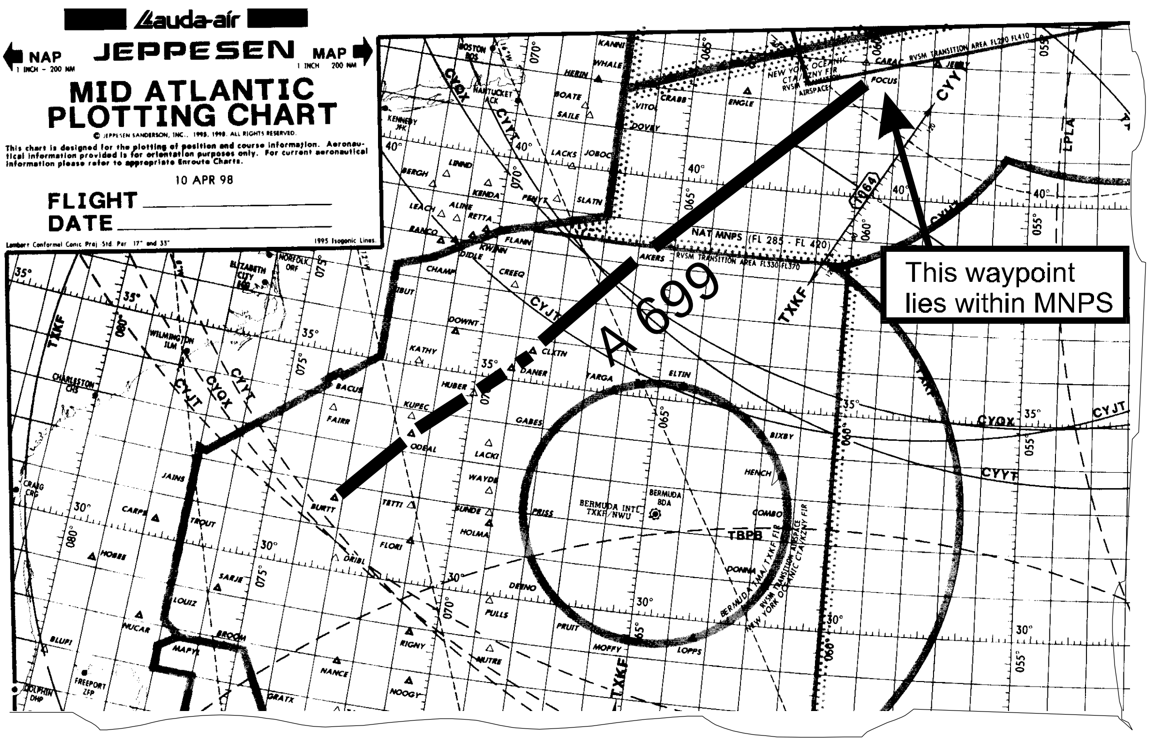


Figure 8.5-2

Mach Number is determined by whether the flight is on time or delayed.

An average of 10 Minutes per 0,01 Mach faster can be saved on a 10 hour flight.

If shortcuts can be anticipated and the flight is already ahead of time, M=0,80 instead of M=0,81 (if planned so on the CFP) can be considered to help conserve fuel.

Flight Level is determined by weather (convective clouds, turbulence reports) and weight considerations. If flying a track with little chance of getting the higher levels later during flight it might be prudent to start out at a higher level if weight permits.

Up to 4000 ft above the optimum level for the gross weight at oceanic entry can be accepted.

Remember though that performance above the optimum is more degraded compared to performance when flying below the optimum.

In order to get the FMC data (optimum level and maximum level) at the oceanic entry point, the weight at the entry point has to be known. By looking at the fuel (RTE DATA on legs page) the gross weight can be determined.

GW at entry point = Fuel at Entry + ZFW

If the flight is planned with Mach 0,80 (standard speed for the "crossing") look at the QRH table to get optimum and maximum levels for that weight.

For any other Mach number no tables are available in the QRH but the FMC can be used instead:

- Enter the appropriate Mach number in the cruise page
- Modify the ZFW so that

Present Fuel + Modified ZFW = GW at entry point

- After the ZFW-modification you will see a gross weight that corresponds to the estimated weight at the entry point and you now get maximum and optimum levels for that weight and Mach number in the FMC.

Don't forget to reset the ZFW to its original value, afterwards !

The ETA for the OCA entry-point has to be cross-checked for accuracy prior to giving the ETA to oceanic clearance delivery:

- Think of any dog-leg routings to the entry point. You might get a short-cut. This would cut off some minutes, making the estimate inaccurate.
- Think of the wind situation – if it is grossly different from the winds stated on the CFP, with the entry point still far away, this will give a wrong estimate on the FMC (remember: for way points beyond 200 NM only the winds entered into the FMC will be used in calculation).

Considering all this it is prudent to ask for clearance once you are established on a more or less straight routing to the entry point.

8.5.3 TRANSATLANTIC CLEARANCE

8.5.3.1 Asking for Oceanic Clearance

After doing the inital call on the appropriate clearance delivery frequency (e.g. Shannwick 127,65 MHz) the controller will either say *"Lauda 9220 go ahead"* so that you can state your full request (example 1) or (more likely since he has all the flight plan data) will ask you for

- the estimate at the oceanic entry point
- requested flight level and
- requested Mach number,

see Example 2.

Example 1:

"Shannwick, Lauda 9220"

"Lauda 9220, Shannwick, go ahead"

"Lauda 9220 estimating 49N15W at 1552, flight level 330 maximum 370, requesting Track Foxtrot, Mach decimal 80."

<u>*Example 2:*</u>

"Shannwick, Lauda 9220"

"Lauda 9220, Shannwick, state your estimate for 49N15W, requested flight level and Mach Number ?"

"Lauda 9220 estimating 49N15W at 1552, flight level 330 maximum 370, Mach decimal 80."

When entering the MNPS in Santa Marias airspace, clearance is obtained on HF (frequencies can be obtained from the Atlantic manual) from Santa Maria. If HF reception is bad, Lisbon ATC will coordinate.

8.5.3.2 Reading back the Transatlantic Clearance:

Generally, clearance shall be read back **using the exact same wording** as clearance delivery.

<u>*Example of a read-back by the pilot:*</u>

*"**New York Center clears** Lauda 9221 to Echo Delta Delta Mike **via at***
ELTIN (ENTRY POINT)
39N60W 42N50W 44N40W 51N30W 52N20W 52N15W (COORDINATES or TRACK)
DOLIP (EXIT POINT)
UN463 (FIRST AIRWAY)
KOKOS (WAYPOINT)
Airways to Destination,
***Flight Level** 330**, Mach decimal** 80,*
***Track Message Identification** 230"*

<u>Explanation:</u>
New York Center clears.......it is not the person that talks to you who clears you but some other station, e.g. N.Y. Center or Shannwick
Via at ....means that the route to the entry point has to be flown as per previous clearance and that the oceanic clearance starts at the entry point. This means that Mach number and FL for oceanic crossing have to be met latest by the entry point.
TMI ....it is important to add the track message identification during read-back even when on a random routing so that the controller knows that you

are aware of the other traffic. The TMI is added by the pilot during readback – it is not given to the pilot from the controller.
Note: the TMI is the number of the day in the year.

It is good operational practice to check mark (√) the entry point, coordinates, exit point and first airway on the CFP when receiving the clearance as this makes it much easier to understand the clearance compared to writing everything down. In order not to forget to add FL, Mach Number and TMI during read back write a line next to the exit point on the CFP where you enter these items while receiving the clearance.

8.5.4 ENTERING MNPS / RVSM

8.5.4.1 Prior Entering RVSM

On the ground the altimeters and clocks have been compared and cross-checked and the transponder was switched to the left system, as this system reports altitude.

In flight:
♣ Crosscheck primary altimeters within ± 200´ and record readings
♦ Required operational equipment:
- two primary altitude measurement systems
- one automatic altitude-control system
- one altitude-alerting device
- one ATC-transponder with altitude reporting system

8.5.4.2 Prior Entering MNPSA

- Perform a position check with a VOR (raw data, off route, if possible).
  - DME must be within 4 NM
  - Bearings within 8° at 50 DME
  - Bearings within 6° between 100 and 150 DME

- Check FMC average and individual IRS positions for reasonable agreement.
  - Put the stations which the FMC is using for its update into the fix page and
  - compare the FMC against Raw Data readout.

Crosscheck FMC entries with Track Message and FMC computations with CFP **tracks and distances** between waypoints, if the cleared routing is as filed:

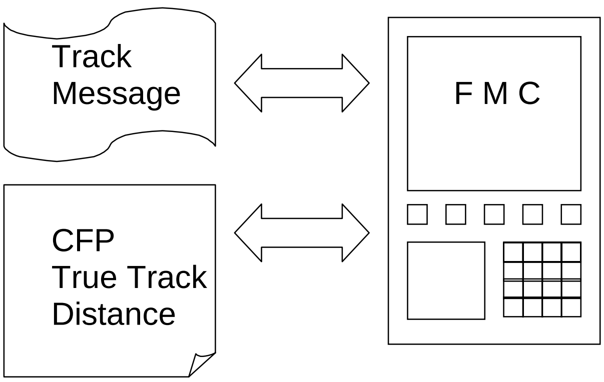


Figure 8.5-3

If the clearance received is different to what is on the CFP proceed as follows:

- Write down the clearance and check the FMC entries against the clearance.
- Work out distances and tracks between cleared waypoints, using the tables in the Atlantic Jeppesen. These tables are available for 10° and 5° difference in longitude.
- Write these values into the Atlantic Worksheet and
- Compare them with the FMC computations.

- At all times 2 separate sources must agree ie operational flight plan (OFP) and FMC or if on a track that is different to the OFP, the FMC and the Latitude & Longitude tables that are in the Atlantic manual.
- To even out the workload, one pilot should read out the tracks and distances from the OFP or latitude/longitude tables and the other checks the FMC.

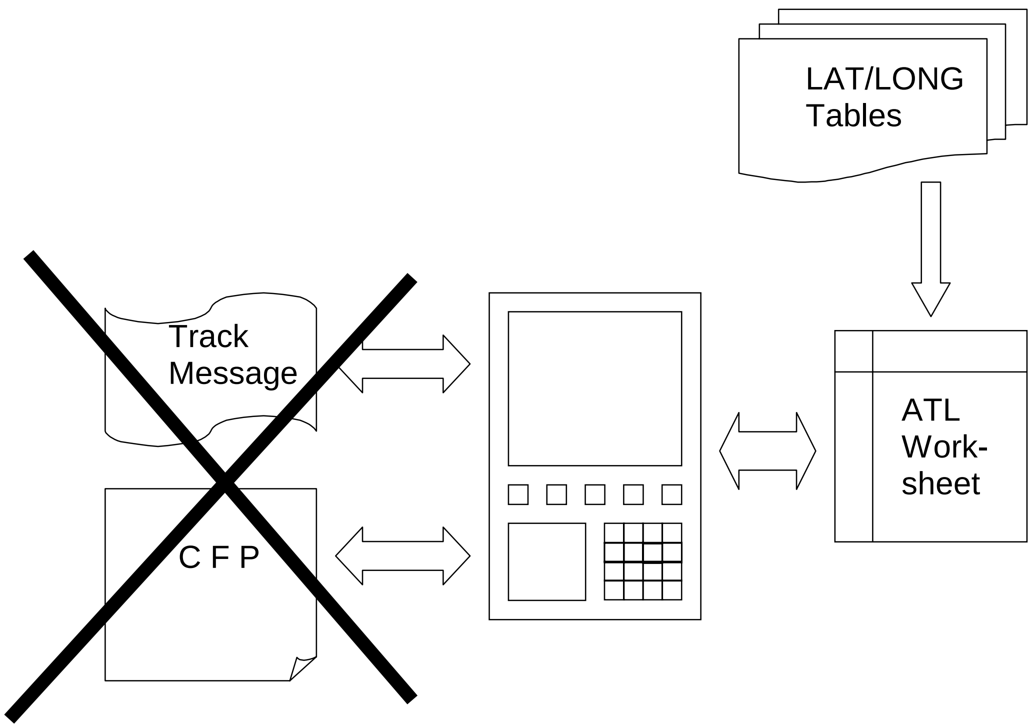


Figure 8.5-4

- Monitor the following VHF frequencies

  - 121,50 MHz
  - 131,80 MHz (130,55 MHz in Caribbean)

- Squawk 2000 thirty minutes after entering (make a time entry in FIX Page)
- Give a Position Report at entry point:
  - Include WHEN ABLE HIGHER entering N.Y. MNPSA or Santa Maria OCA; otherwise optional
  - Include MET DATA, except when on OTS & not requested.
- Maintain HF SELCAL watch even in NAT areas where VHF is used.

8.5.5 WITHIN RVSM / MNPS-PORTION OF FLIGHT

8.5.5.1 Within RVSM

- periodically (~ every hour) check altimeters within ± 200´
- report immediately leaving or reaching any new cruising level (re-clearance, step-climb, ...)
- in case of wake turbulence, see AT(H/L)1, text
- in case of TCAS RA, see AT(H/L)1, text

8.5.5.2 Within MNPSA

- Monitor and Record Enroute Alternate Weather
  - inbound USA: preferably on HF, to receive SIGMETS,
  - frequencies see AT (H/L) 1/2
- When passing a waypoint
  - Give position report (usually every 10 deg. long intervals) – shall also be copied to center serving adjacent area when operating at 60 NM or less from common boundary.

Phraseology:

"Santa Maria, copy Gander, copy Shannwick, Lauda 9220 position...."

Note:
"revised estimate" ....for next position if found to be in error by more than 2 minutes.

- Check initial true track and distance to next waypoint (PF)
- Note time / wind on worksheet and time on plotting chart (PNF)

- 10 Minutes after passing a waypoint (PNF)
  - Check average IRS-positions and FMC-position
  - Check individual IRS-positions
  - Plot FMC-position and time on the chart and check it is on track

A rectangular symbol with a cross is used for plotting FMC-position:

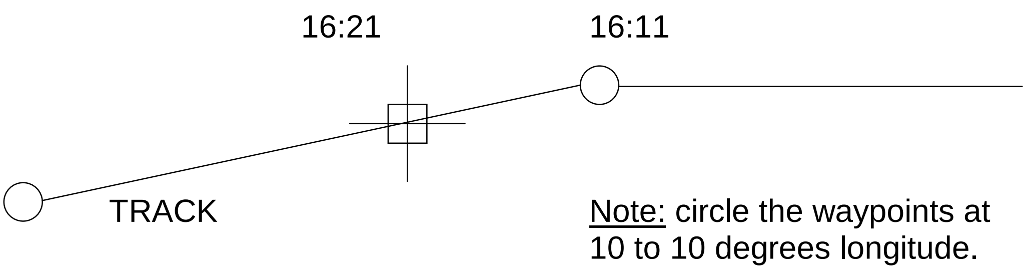


Figure 8.5-5

- Report immediately reaching new cruising levels following re-clearance or step climb
- Make a fuel check (every two hours)
- After frequency change: ask for SELCAL CHECK

"New York Radio, Lauda 9220 request"
"Lauda 9220 NewYork Radio go ahead"
"Lauda 9220 request SELCAL CHECK,
Juliet Sierra Mike Quebec"

Ding – Dong

”Lauda 9220 SELCAL OKAY, MAINTAINING SELCAL WATCH”

or:

“Lauda 9220, NEGATIVE SELCAL, TRY AGAIN”

- Squawk 2100 prior entering BERMUDA TMA

8.5.6 LEAVING MNPS

- Check position with VOR if available
- Receive VHF frequencies, transponder code as advised by radar.

8.5.7 INFLIGHT CONTINGENCIES

In case of a diversion to an ETOPS alternate because of an engine failure perform these steps in the following sequence:

1. AT arm switch.............................. OFF
2. select and set MCT
3. **MCP altitude**............................... wind down
4. **Cruise Page**: ENG OUT .... EXECUTE
5. HDG select.................................. 90 deg. off-track, bank 25°
6. VNAV... CHECK
7. RECALL items............................ perform
8. ROUTE PAGE: enter 30 NM parallel offset
9. MAYDAY – MAYDAY – MAYDAY
10. Diversion Speed / Altitude (land within 3 hours)
11. NON NORMAL CHECKLISTS

Note:

- it is essential to stay in this sequence, especially to wind down the altitude on the MCP first and then go to the ENG OUT page. This way, the aircraft will go from VNAV PATH to VNAV SPEED, i.e. it will target SE driftdown speed with pitch, descent rate depending on thrust. If ENG OUT is selected prior to winding down the altitude, FMA pitch mode will change from VNAV PATH to ALT HOLD. As thrust is now reduced (you are on now on one engine) the aircraft will gradually get slower and there is no speed protection. Because A/T is off, the aircraft can stall, unless descent is initiated by pressing e.g. FL CHANGE.or VNAV Because all this requires additional workload, do it in sequence as above.

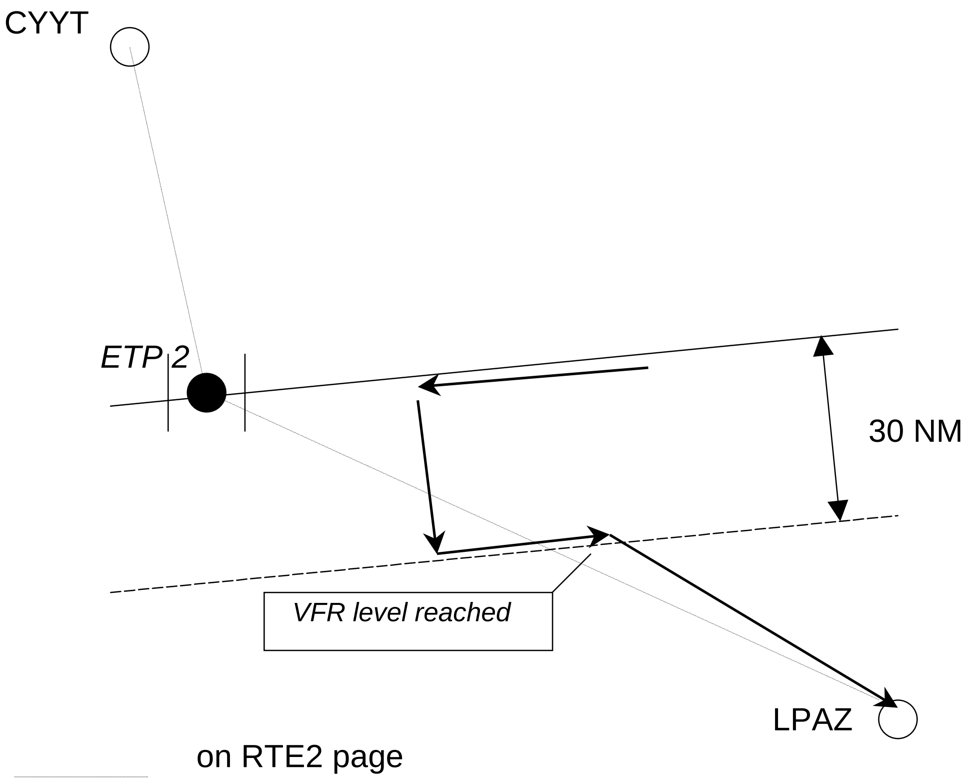
- If operating in the MNPS airspace, whenever cleared levels have to be left because of emergency, fly at VFR altitudes enroute to the alternate, e.g. FL245. If the emergency allows you to stay at level (no engine failure but some other problem), also leave the cruise level and climb or descend to a VFR level.
- The 30 miles offset-track track has to be flown until the intended VFR-altitude is reached (see Figure 8.5-6). Only then a turn towards the alternate may be initiated. This also holds true for flights on a RANDOM ROUTING !
- Always know the initial two turns (see RTE 2 page for ETPs and direction to alternate).

To facilitate decision-making RTE2 page is used: enroute alternates and the coordinates of all ETPs are entered in consecutive order, so that when selecting RTE2 page during an inflight emergency it immediately becomes evident in which direction to fly. Route information of the RTE2 page is superimposed on the Map display as a dashed blue line (see Figure 8.5-7). If the coordinate of an ETP has to be taken out of the plotting chart (rather than the CFP) because alternates have changed and a new ETP had to be determined, the procedure to determine the exact track coordinate is as follows:

1. Take the longitude coordinate off the plotting chart as accurately as possible, say it is 2950W

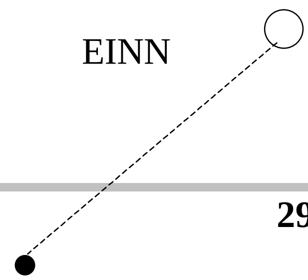
2. Next line select this coordinate on top of the legs page, without executing. The FMC will automatically determine the appropriate latitude and place the waypoint in respective sequence.
3. Downselect the waypoint into the scratchpad – you now have the accurate latitude that matches the longitude and lies along the track.
4. Enter both coordinates into the RTE2 page.

<u>EXAMPLE: </u>*TRACK or RANDOM Routing*



- First and second turns to the left

Figure 8.5-6: Turning towards the ETOPS alternate.



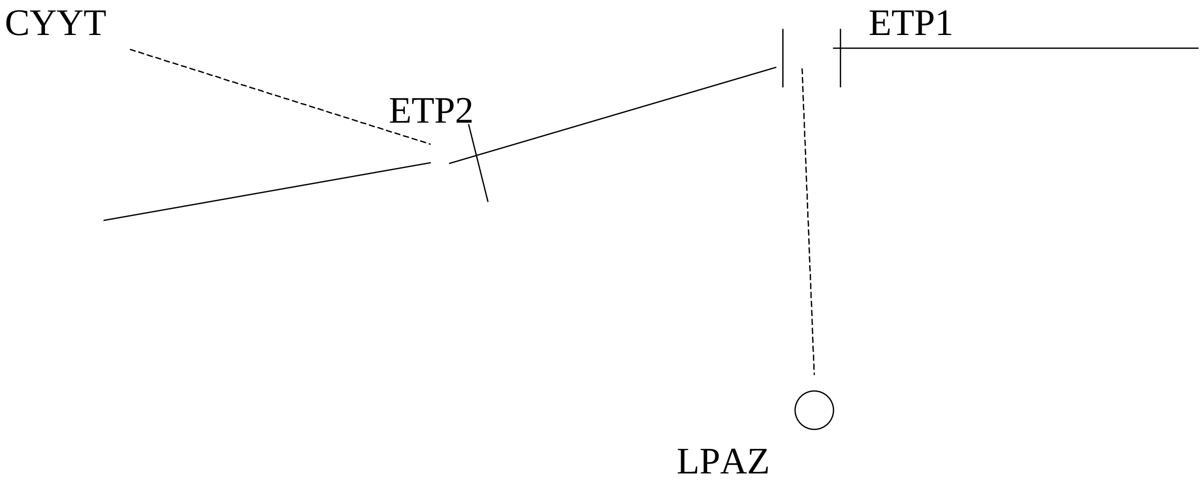
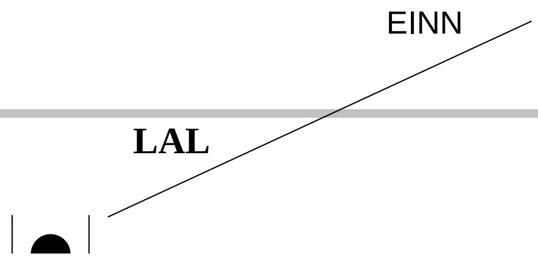


Figure 8.5-7: Dashed lines represent route 2 as programmed into the FMC.

8.5.8 EQUAL TIME POINTS

8.5.8.1 Plotting

- Use a red pen for the following procedure
- Plot ETPs into the North Atlantic Plotting Chart: use the symbol shown in
-
- Figure 8.5-8
- Number the ETPs (ETP1, ETP2 etc.)
- Optional: draw lines from the ETP to the respective alternates and write these alternates (e.g. EINN and LPAZ) next to the lines.



ETP 1

(track)

LPAZ

Figure 8.5-8: Equal Time Point: Symbol to be used in plotting chart

8.5.8.2 Constructing new ETPs

- Constructing a new ETP becomes necessary whenever one or both ETOPS alternates are changed.
- Use the winds in FL180 as this is the closest information you can get about winds in FL 100 (remember: worst scenario - engine failure and pressure loss !).
- Enter the Equal Time Point-Graph (see North Atlantic Plotting Chart) with the continuing and returning wind components to determine the equitime number (plus or minus)
- Multiply this number by 1% of the total distance between the two points in question. The product will be the number of miles the ETP is from midpoint.
- If the product is positive, the ETP will be in the continuing direction. If it is negative, the ETP will be in the returning direction.
- Draw a line perpendicular to the line that connects the two alternates in the appropriate distance, using the scale. Each dash represents 10 NM.
- The intersection with the track line is the new ETP.

<u>Example:</u> alternates EINN and LPAZ (distance 1164 NM). Wind component to EINN: +52 kts (tailwind), wind component to LPAZ –25 kts (headwind) ⇒ equitime number (derived from equitime graph) is +4,5. Therefore, the perpendicular line has to be moved 4,5 x 11,64 = 52 NM in continuing direction (the scale below the line represents 10 NM for each dash).

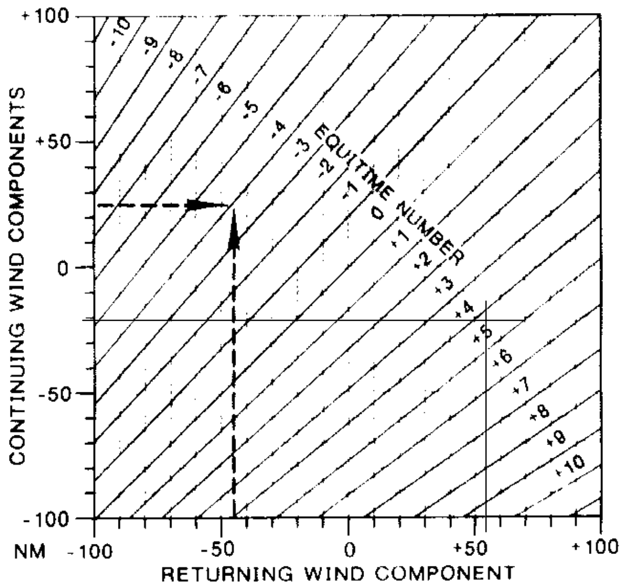


Figure 8.5-9: Constructing a new ETP.

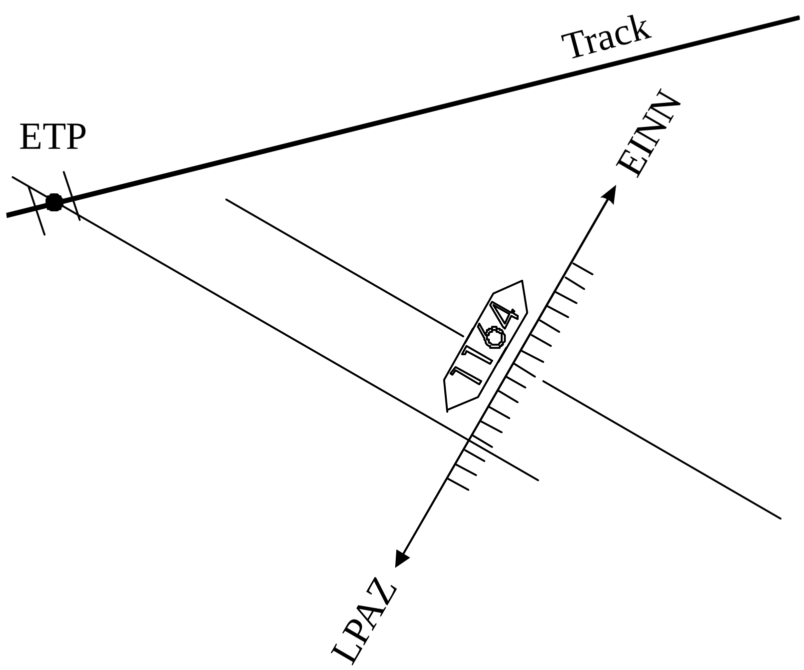


Figure 8.5-10

8.5.9 GETTING MID WIND POSITION-COORDINATES INTO THE FMC

On random tracks or on met reporting flights, weather reports have to be given. The weather for the mid-position is given at the compulsory reporting points, i.e. 20W, 30W, 40W etc. These mid-positions coordinates are not part of the flight plan. In order to get these mid-positions into the FMC,

select (for example)	**W025-10**

Alternatively, simply look at the IRS longitude coordinates on the overhead panel to determine crossing over mid-position.

Weather information (only temperature and wind !) is added to a regular position report using the following wording:

"Lauda 9220 position 46N040W 1443
flight level 340
estimating 48N50W 1522
next 47N60W
minus 47   220 diagonal 45
4730N 055 W
minus 48   330 diagonal 50"

Note: mid position is given in full four digits !

Despite repeated bulletins and company efforts to train flight crew how to avoid volcanic ash clouds, inadvertent entries still occur. Statistics show that over the last ten years there have been developments of approximately one hundred ash clouds and aircraft at an average have penetrated ten of them each year.

Cited below are only a few of the incidents to help you understand the gravity of the problem.

8.6.1 TYPICAL VOLCANIC ASH ENCOUNTERS

8.6.1.1 Boeing 727 flying through dust cloud

On May 26, 1980, a B 727 flew through the dust cloud. Inspection revealed that the first stage fan mid span shrouds had seized in all engines as a result of volcanic ash accumulation between the contact surfaces. The dust was released by tapping and shaking the blades and the aircraft was returned to service following a thorough inspection of each engine.

A second B 727 was exposed to volcanic ash during a landing and take off. Inspection revealed that the fan blades seemed exceptionally sharp, and that all mid span shrouds were seized. All engines were replaced. Subsequent inspections revealed that the engines were serviceable and were retained for spares.

8.6.1.2 Galunggung Eruption

In June 1982, the Galunggung volcano on the island of Java erupted. Two B 747 encountered the volcanic debris. One aircraft was powered by Rolls Royce RB 211-524 engines while the second was equipped with P&W JT9D-7A. Both incidents occurred at night.

In the first instance, power interruption were experienced on four engines while at an altitude of 37000 feet. For four and a half minutes all four engines were without power. One engine was restarted at 14000 feet, and the remaining engines were developing power by 12500 feet. In the second event, flame outs were experienced whilst the aircraft was at 33000 feet. One engine was successfully restarted at 26000 feet and an uneventful two engine landing was accomplished.

In both instances, the windshields and leading edges were abraded, an visibility through the windshields was restricted, but the aircraft landed safely at Chicago. After borescope inspections, three engines on the first aircraft had to be replaced. On the second aircraft all four engines had to be replaced prior to the next flight.

8.6.1.3 Mount Redoubt Eruption

Mount Redoubt, near Anchorage, Alaska experienced a second eruption on December 14, 1989. One operator reported the plume to rise higher than 35000 ft and extending about 100 miles from the crater. This eruption has had a significant impact on air operations in the area. On the following day, a B 747-400 powered by GE CF6-80-C2 engines entered the ash cloud at 25000 feet and experienced flame outs an all four engines. The flight crew restarted engines number 1 and 2 at 13000 feet and were able to maintain altitude as they restarted the remaining engines. The aircraft made an uneventful landing at Anchorage.

The aircraft had been cleared for descent from 39000 ft to 35000 ft and to 25000 ft at pilot’s discretion. ATC informed the crew that no rerouting was required. The aircraft entered light clouds at 26000 feet. The crew reported that the sky had suddenly turned black and lighted particles were observed. When intense smoke entered the flight deck, the crew donned oxygen masks. With the engines out, the crew initiated a left turn to escape the ash cloud.

Up to eight attempts were required to restart engines number 1 and 2. The descent was arrested at 13000 feet. Several additional restart attempts were required to restore power to remaining engines. The aircraft landed safely, but the damage to engines, avionics and aircraft structure on this encounter cost in excess of 80 Mio dollars.

Increased aircrew and ATC awareness and adherence to the current operating instructions which emphasize avoidance, lack of recognition and procedures to be followed in the event of inadvertent ash caused encounter should reduce the probability of ash caused aircraft accident.

8.6.2 ALERT AND WARNING SIGNALS

To inform disaster response agencies and the general public on volcano condition and activities and at the same time advise then on appropriate precautionary actions and safety measures, following are the alert and warning signals (table 1).

In order to protect against "lull before storm" phenomena, alert levels will be maintained for the following periods AFTER activities decreases to the next lower level.

- From level 4 to level 3: wait one week
- From level 3 to level 2: wait 72 hours

Alert Level	Criteria	Interpretation
	Background, quiet	No eruption in foreseeable future
	Low level seismic fumarolic, other unrest	magmatic, tectonic or hydrothermal disturbances; no eruption imminent.
No alert	Moderate level of seismic, other unrest, with + evidence for involvement of magma	Probable magmatic intrusion, could eventually lead to an erruption.
1	Relative high and increasing unrest including numerous b-types earthquakes, accelerating ground deformation, increased vigor of fumaroles, gas emissions.	If trend of increasing unrest continues, eruption possible within two weeks.
4	Intense unrest, including harmonic tremor and/or "long period" (= low frequency) earth quakes.	Eruption possible within 24 hours.
5	Eruption in progress	Eruption in progress

Table 1:

8.6.3 OPERATING RECOMMENDATIONS

8.6.3.1 Radar Capabilities

The operating wave length of commercially available weather radars are chosen specifically to see past small cloud droplets in order to detect the type of weather to be avoided inflight. That kind of weather is marked by rain or hail which is usually embedded deep within cloud interiors. Heavier particles ejected in a volcanic eruption quickly fall to earth, so that only very fine dust particles remain airborne after a short time. These particles are very small when compared to other cloud droplets or rain drops. Large rain drops reflect radar energy very well, smaller cloud droplets reflect poorly, and still smaller volcanic particles hardly reflect at all. In fact, the radar reflectivity of volcanic ash is roughly a million times less than that of a typical cumuliform cloud. Hence, the weather radar is not a useful tool for detecting volcanic ash particles. In at least one of the above cited incidences, the weather radar was reported to be on and no returns were observed. This is consistent with other reports in which the volcanic cloud was visually sighted with no returns observed on the radar.

Volcanic dust can cause rapid erosion and damage to the internal components of the engines. Volcanic dust build up causing blockages of the high pressure turbine nozzle guide vanes and high pressure turbine cooling holes and result in surge, loss of thrust and/or high EGT. Because the greatest constituent of volcanic ash is silicon it forms a glazing on the hot turbine components. Volcanic dust may block the pitot static system and result in unreliable airspeed indications.

Volcanic dust is highly abresive and may cause serious damage to the aircraft engines, leading edges, wind shields, and landing lights.

Also in the findings, was, that in general, the existing aircrew operating instructions dealing with volcanic ash environment are adequate. However, in order to facilitate transition from one aircraft model to another, these instructions should be standardized as much as possible. The aerospace industries association has suggested to aircraft manufacturers to use B 747 operating instructions as a guide.

Weather radar cannot be used to detect and/or avoid volcanic dust !

8.6.3.2 Avoidance

- Flight into areas of known volcanic activity must be avoided. This is particularly important during hours of darkness or in meteorological conditions when volcanic dust may not be visible.
- When a flight is planned into an area with a known potential for volcanic activity, it is recommended that all NOTAMS and ATC directives be reviewed for current status of activity.
- If a volcanic eruption is reported, the planned flight should remain well clear of the area and if possible stay on the upwind side of the volcanic dust.
- Do not rely on airborne weather radar to detect and display volcanic ash and dust. Airborne weather radar systems used on commercial aircraft are not designed to detect very small ash and dust particles.
- Should volcanic dust be encountered, exit as quickly as possible. **The most preferred method is a 180 degree turn.**

8.6.3.3 Recognition

Volcanic ash and dust may be difficult to detect at night or during flight through clouds; however, the following conditions have been observed by flight crew under these conditions:

- At night, heavy static discharges (St. Elmo’s Fire) around the windshield, accompanied by a bright, white glow in the engine inlet.
- At night, landing lights cast sharp, distinct shadows in volcanic ash clouds (unlike the fuzzy, indistinct shadows that are cast against weather clouds),
- Volcanic ash and dust (haze) appearing in the cockpit and cabin. Volcanic dust collecting on top of flat surfaces.
- An acrid odor similar to electrical smoke or burnt dust. The smell of sulphur may also be present.
- Multiple engine malfunctions, such as surge, increasing EGT, torching from tailpipe, and flameouts.

- Decrease in, or loss of indicated airspeed and false cargo fire warnings.
- An increase in cabin altitude or loss of cabin.

8.6.3.4 Procedures

If volcanic ash debris is inadvertently encountered, accomplish the following:

- Immediately reduce thrust to idle (altitude permitting). This will reduce the EGT, which in turn will reduce the debris build up on the turbine blades and hot section components. Volcanic dust can cause rapid erosion and damage to the internal components of the engines. In two of the B 747 incidents, all four engines flamed out within 50 seconds.
- Exit volcanic cloud as quickly as possible. Volcanic ash may extend for several hundred miles. A descending 180 degree turn (thrust levers to idle) will give the shortest distance/time out of the dust. Setting climb thrust and attempting to climb above the volcanic cloud is not recommended due to accelerated engine damage/flame out at high thrust settings.
- Disengage autothrottle: The autothrottles should be turned off to prevent the system from increasing thrust above idle. Due to the reduced surge margins limit the number of thrust adjustments and make changes with slow and smooth thrust lever movements.
- Turn on all accessory airbleeds including all air conditioning packs, engine and wing anti-ice. This provides additional surge margin. The increased bleed airflow improves engine stall margin. It may be possible to stabilise on one or more engines at idle thrust setting where the EGT will remain within limits. An attempt should be made to keep at least one engine operating at idle and within limits to provide electrical power and bleed air for cabin pressurisation until clear of the volcanic dust.
- Turn on the engine ignition switches as appropriate for the engine/aircraft configuration (position normally used for inflight start)
- Start the APU, if available. The APU can be used to power the electrical system in the event of a multiple engine power loss. The APU may also provide a pneumatic air source for improved engine starting, depending on the aircraft model.

- Monitor EGT limits. If necessary, shut down and then restart engines to keep from exceeding EGT limits. If an engine fails to start, repeated attempts should be made immediately. A successful engine start may not be possible until the engine is out of the volcanic dust and the airspeed and altitude are within the airstart envelope. Remember, engines are very slow to accelerate to idle at high altitude which may be interpreted as a failure to start or as an engine malfunction.

  Note: An engine inflight shutdown (IFSD) is a rare event. Many of the airline crews never encounter one. The need to air-restart an engine is even rarer. This, combined with the different air-start versus ground-start engine characteristics has made it plausible that the crew may not follow the optimum procedures for airstarts.
- Oxygen masks ON and 100% (if required). If a significant amount of volcanic dust fills the cockpit or if there is a strong smell of sulphur, don the oxygen mask and select 100%. Manual deployment of passenger oxygen maks is not recommended if cabin pressure is normal because the passenger oxygen supply will be diluted with volcanic dust filled cabin air. If the cabin altitude exceeds 14000 ft the passenger oxygen masks will deploy automatically.
- If unreliable or loss of airspeed indications occur, establish the appropriate pitch attitude as shown in the respective Ops Manual for Flight with Unreliable Airspeed (Note: volcanic ash may block the pitot system). If all airspeed indications are lost, IRS ground speed may be used to assist in approach and landing.
- Because of the abrasive effects of volcanic dust on windshields and landing lights, visibility for approach and landing can be markedly reduced. Should this condition occur on airplanes equipped with autoland capability, a diversion to an airport where an autoland can be accomplished should be considered.
- After exiting, land at the nearest suitable airport. A precautionary landing should be made if aircraft damage or abnormal engine operation occurs due to volcanic dust penetration.

8.6.3.5 Contaminated Runway Conditions

- During landings, limit reverse thrust. The use of maximum reverse thrust may impair visibility.

- The presence of a light layer of dust on a runway which obliterates the markings could have a detrimental effect on braking. The effects of a heavy layer are unknown.
- Avoid static operation of engines above idle power.
- Thrust during taxi should be limited to that which is required to sustain a slow taxi speed.
- Avoid operation in visible dust. Ash and dust should be allowed to settle prior to initiating a takeoff roll.
- Use a rolling takeoff procedure.
- Restrict ground use of APU to engine starts.
- For air conditioning systems, use ground/air setting, minimise ground operations, operate at full cold setting if dust is visible and use filtered ground carts, if available. Do not use air conditioning packs on take off.
- On airplanes equipped with recirculation fans, avoid use of air conditioning packs on the ground if recirculation fans will maintain adequate comfort level. If airconditioning on the ground is necessary, precondition at the terminal using filtered ground cart if available. Use no packs for takeoff. For airconditioning pack operation, consult the operations manual.
- Do not use windshield wipers for dust removal. Hose ash deposits off with water and wipe residual off with a soft cloth.
- For B 737 equipped with vortex dissipators: the dissipators must be operable and ON at all times on the ground. Do not use engine bleed for airconditioning with vortex dissipator on.

8.6.3.6 Reporting Form

In the Jeppesen Route Manual a form “Special Air-Report of Volcanic Activity, Model VAR” (PANS-RAC Doc. 4444) can be found in the ATC section on page 434E, see figure 1 The report is intended to be used for post-flight reporting, however, section 1 is also transmitted via RT:

- Transmit the information requested in items 1-8 (section 1) of this report as soon as possible after discovering volcanic activity and log the information on the form.
  - ⇒Aircraft identification
  - ⇒Position and Time
  - ⇒Flight level or altitude
  - ⇒Volcanic activity observed at (position and bearing)
  - ⇒Air Temperature and Spot wind

⇒Supplementary information (brief description of activity)

- Complete items 9-16 (section 2) as crew duties permit.
  - ⇒Density (wispy, moderate dense, dense)
  - ⇒Color of Ash Cloud (white, light grey, dark grey, black)
  - ⇒Eruption (continuous, intermittent, not visible)
  - ⇒Position of activity (summit, side, single, multiple, not observed)
  - ⇒Other observed features of eruptions (lightning, glow…)
  - ⇒Effect on aircraft
  - ⇒Other effects (turbulence, St. Elmos Fire, fumes, ash deposits)
  - ⇒Other information (any information considered useful)
- Submit the completed report form to airline operations so that the form may be forwarded to IATA

8.6.4 SUMMARY

Finally, to sum up, flight crew must be cognizant of any potential volcanic activity along their planned routs. They must check NOTAMS and ATC directives for the current status of any volcanic activity. Should an inadvertent penetration of a volcanic dust cloud be made, flight crews must be aware of the potential problems and be prepared to deal with the arising flight conditions. Crews should also be aware of the operational conditions at airfields which are contaminated with volcanic ash and dust.

If at all possible avoid penetration of a volcanic ash cloud !

JEPPESEN AIR TRAFFIC CONTROL 21 NOV 97 434E

ICAO RULES OF THE AIR AND AIR TRAFFIC SERVICES
PANS-RAC (DOC 4444)

2 SPECIAL AIR-REPORT OF VOLCANIC ACTIVITY (MODEL VAR)

MODEL VAR: To be used for post-flight reporting

Operator: .... Aircraft identification (as per item 7 of flight plan): .... Pilot-in command: .... Dep. from .... Date .... Time .... UTC
Arr. at .... Date .... Time .... UTC

	Addressee	
		AIREP SPECIAL
Section 1	1 Aircraft identification	
	2 Position	
	3 Time	
	4 Flight level or altitude	
	5 VOLCANIC ACTIVITY OBSERVED AT	(position or bearing and distance from aircraft)
	6 Air temperature	
	7 Spot wind	
	8 Supplementary information (Brief description of activity including vertical and lateral extent of ash cloud, horizontal movement, rate of growth, etc. as available)	

The following information is not for transmission by RTF

TICK ✔ THE APPROPRIATE BOX

Section 2			
9 Density of ash cloud	(a) wispy ☐	(b) moderate dense ☐	(c) very dense ☐
10 Colour of ash cloud	(a) white ☐ (d) black ☐	(b) light grey ☐	(c) dark grey ☐
11 Eruption	(a) continuous ☐	(b) intermittent ☐	(c) not visible ☐
12 Position of activity	(a) summit ☐ (d) multiple ☐	(b) side ☐ (e) not observed ☐	(c) single ☐
13 Other observed features of eruption	(a) lightning ☐ (d) ash fall out ☐	(b) glow ☐ (e) mushrooming cloud ☐	(c) large rocks ☐ (f) nil ☐
14 Effect on aircraft	(a) communications ☐ (d) pitot static ☐ (g) nil ☐	(b) nav. systems ☐ (e) windscreen ☐	(c) engines ☐ (f) windows ☐
15 Other effects	(a) turbulence ☐ (d) ash deposits ☐	(b) St. Elmos Fire ☐	(c) fumes ☐
16 Other information	(Add any information considered useful.)		

Figure 8-1: Special Air Report of Volcanic Activity

8.7.1 GENERAL

Weather radar detects droplets of precipitation size. The strength of the radar return depends on drop size, composition and amount. Water particles return almost five times as much signal as ice particles of the same size. This means that rain is more easily detected than snow, although at times large, wet snowflakes may give a strong return.

Hail usually has a film of water on its surface; consequently, a hailstone is often reflected as a very large water particle. Because of this film and because hailstones usually are large than raindrops, thunderstorms with hail return stronger signals than this with rain. Showers of less intense echoes and gentle rain, snow and dry ice return the weakest of all echoes.

A rapidly changing display may indicate a painting formation of a severe thunderstorm. When interpreting a return, the shape of the storm should be evaluated as well as moisture content. Irregular shapes such as scalloped edges may be good indications of turbulence, hail and vertical gusts, even if the return is not showing heavy rainfall. Such irregular shapes include U-shapes, hooks and thin protruding fingers. These shapes should be avoided by at least 20 NM.

It is possible for a nearby rainstorm to be so intense that the radar beam passing through the storm is severely attenuated, or even blocked entirely, see Figure 8.7-1. An attenuated signal passing through a storm cell will paint an erroneous picture of weather ahead and paint distant targets less intense. Very heavy precipitation can absorb all of the microwave energy, causing targets beyond the storm cell to disappear on the display. Characteristics of an attenuated display include a bowing out of the back side of a storm cell, steep rain gradients on the back side or a shadow with absence of any returns behind a dense storm cell. A steep rain gradient is shown as closely spaced or thin lines between color graduations.

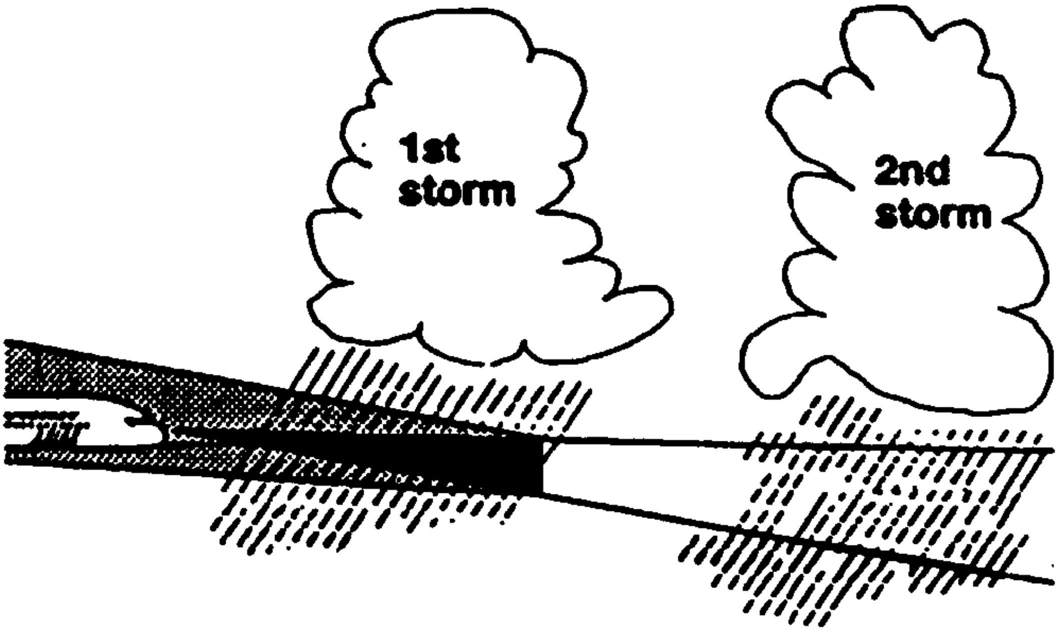


Figure 8.7-1: Attenuated radar signal

8.7.2 ANTENNA TILT AND RANGE MANAGEMENT

Thunderstorms generally include dense rainfall and turbulence. A fully developed thunderstorm can reach altitudes of more than 50.000 feet and extend horizontally up to 200 NM. However, above 30.000 feet, precipitation usually takes the form of ice crystals, snow or dry hail, which are generally not detectable by radar. Since radar detects precipitation, not clouds or turbulence, there may be insufficient moisture to paint a return on the radar unless the beam is aimed at or below freezing level of weather cells. Using the antenna tilt function the wettest level of storms ahead can be scanned (Figure 8.7-2). While the returns may diminish at higher altitudes, the turbulence might not. Turbulence can be assumed to be present above any storm with severe turbulence at the storm center.

The key to inflight weather detection is interpreting returns on the display. The tilt and range controls may require frequent use to get a comprehensive picture. Longer ranges are selected as to detect storms ahead and plan a flight path to avoid them. Shorter ranges are selected to evaluate shape and precipitation gradients of a specific storm cell. For example, selecting the 160 mile range may provide a view of several storms ahead, but may not provide enough detail to evaluate individual cells. A cell 40 miles away may appear to be non-threatening with longer ranges selected. Selecting a shorter range may show the target as severe weather. Select the shortest possible range to get the best definition and resolution of a radar return.

When selecting shorter ranges it is important to adjust antenna tilt to pick up precipitation, especially at lower altitudes. Any return showing all levels of precipitation should be considered to contain turbulence. Turbulence within the red portion of a storm should be assumed severe, but turbulence can occur throughout a storm cell, even at the fringes.

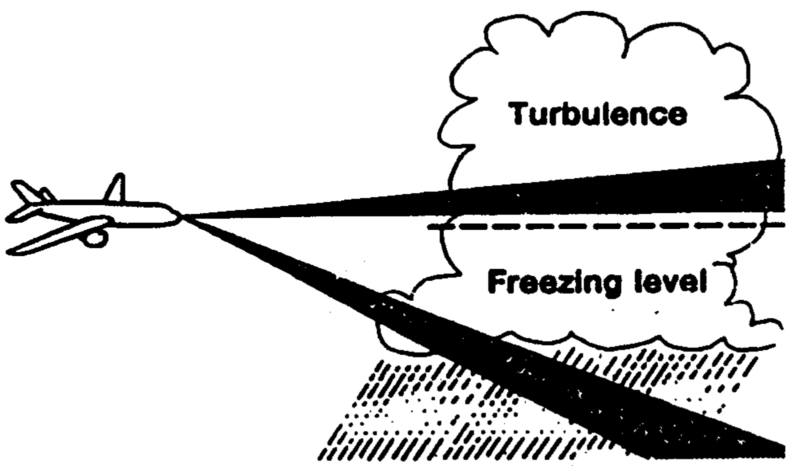


Figure 8.7-2: Using radar tilt to scan the wettest area of the storm.

8.7.3 RULES OF THUMB

- Keep returns within the upper third of the screen
- Keep the beam into the wet zone of the cloud as only water droplets can be detected

Decision to avoid target should be made before the target is closer than 40 NM. Targets inside the 40 NM-range may disappear because of the characteristics of the flat plate antenna.

When looking at targets in the 40 to 80 NM range, the following estimate can be used:

During climb reduce tilt by 1 deg. for every 5000 ft. **During descent vice versa.**

20 000 to 35 000 ft:

Antenna tilt for aircraft flying at 20 000 ft should be set near 0 degrees or slightly down. For overland operation, the best general rule is to tilt the antenna until a small amount of ground return appears at the outer edge of the display.

To view targets inside the 40 NM range large down tilt settings are necessary. The large down tilt may prevent more distant storms from being detected, and in overland operations, will cause excessive ground clutter to appear.

(see Figure 8.7-3)

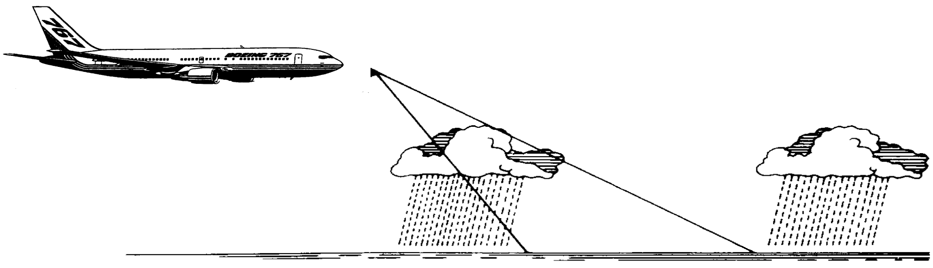


Figure 8.7-3: Missing storm cells at distance with a large down-tilt

35 000 ft and above:

- The cruise tilt angle recommendation for targets beyond 160 NM is 1° to 2° down tilt
- For targets 80 NM to 160 NM it is 3° to 4° down tilt
- For targets 40 NM to 80 NM it is 6° to 7° down tilt

Note: at high altitudes with normal tilt angles a storm cell may be over-scanned (see Figure 8.7-4).

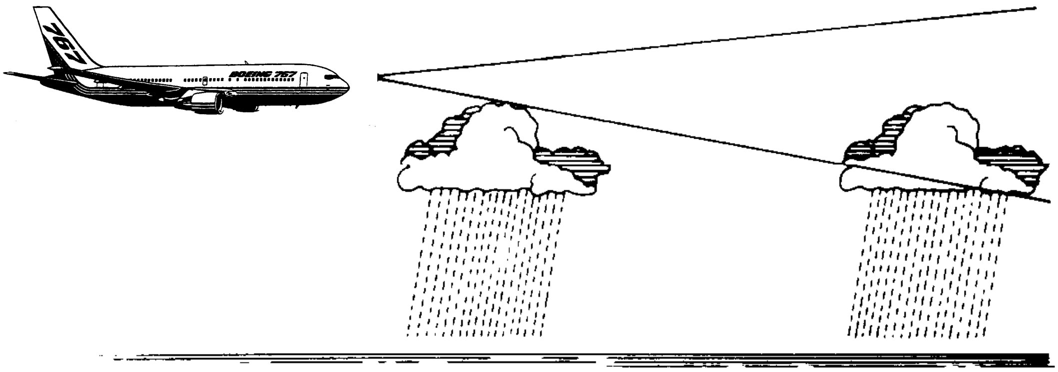


Figure 8.7-4 Over-scanning storm cells

Note:

The beam width is more focused (smaller width) on a large aircraft like the 767 because of the larger radar antenna, so the radar is very accurate but needs more adjustment.

9.1.1 FORCES ACTING ON AN AIRCRAFT

From basic and advanced pilot training it is well established that several forces are acting on an aircraft while airborne or on ground. While in flight, these forces are mainly

- weight,
- lift
- drag
- thrust and
- forces resulting from the inertia of the airplane during accelerations.

On the ground the situation is slightly more complicated, as in addition we also have to consider

- drag due to friction (interaction of the rubber of the wheels with a dry, wet or contaminated runway, brake application).
- a component of the weight in or in opposite direction to the thrust due to up-slope or down-slope of the runway.

9.1.2 DEFINITION

Generally speaking, “performance” is the term used to describe the capability of an aircraft to

- either gain altitude or
- to accelerate (this includes angular accelerations such as in turned flight) or
- to do both at the same time.

More specific, performance covers such areas as
- take off,
- climb (maximum climb gradient, maximum rate of climb, optimum climb trajectory etc.)
- cruise (maximum range, maximum altitude or flight level achieved)
- turning flight (turning radii, accelerations)
- descents,
- landing roll.

Performance results as a consequence of the forces acting on the aircraft. By using graphs, tables and, more recently, computer software, the pilot can take into account adverse factors such as

- high density altitudes
- high humidity
- unfavorable winds
- contaminants on the runway etc.

Because performance or actually lack thereof is a safety related issue minimum performance requirements are laid out in certification documents such as FAR Part 25/ JAR Part 25 for “Transport Category Airplanes”. An aircraft will only be certified if it meets these minimum requirements.

In the following chapter a review on how the above mentioned forces act together will be presented. Then, Boeing 767 specific performance issues will be covered.

9.1.3 INTERACTION OF AERODYNAMIC FORCES

The forces mentioned above do not stand by themselves. Rather, they interact which means that if one force is changed it always results in a change in the other. While on ground and not in motion, the only force that acts on an airplane is weight.

9.1.4 IMPORTANCE OF WEIGHT

The basic force by which all other forces are determined is the weight of the aircraft. This is why even in the very first steps of a to be developed aircraft, estimating weight and controlling weight changes throughout the development cycle is a most important issue. Once in service the weight also has to be monitored, finally by the pilot, who decides how much fuel he is going to take on board and can consider off-loading payload in exchange. The decision how much weight to hoist out of an airport is of big impact, not only for the takeoff itself, but also for the remainder of the mission.

Example:
If for takeoff performance reasons the fuel required to successfully accomplish a trip cannot be taken on board, an expensive intermediate stop could be necessary. If on the other hand, it is attempted to avoid such a stop by fuelling to a higher than permitted weight and the pilot looses an engine on takeoff, an even more costly scenario will develop: the loss of lives and the aircraft, doing damage to property on the ground and more than likely bringing a company close to bankruptcy.

Pilots, no matter whether they are flying gliders for pleasure or a Boeing 767 to a tourist destination in the out of Salzburg must therefore have an excellent understanding of performance.

Simply take a look at unaccelerated straight and level flight:

Example: Horizontal Flight

With a given weight the required lift is determined, as lift has to equal weight. With the lift being known and assuming a certain altitude (i.e. air density) and true air speed, you can now enter the lift curve (a graph that shows lift coefficient vs. angle of attack) and the drag polar. The first of which is used to determine which angle of attack will be needed, the second, more important, provides drag. Note that with the weight the drag is given ! In order to maintain speed and altitude this amount of drag has to be overcome by thrust, i.e. thrust is given as well.

As you change speed and/or altitude (i.e. changing dynamic pressure), you will enter the diagram with a different lift coefficient, which changes drag. It can well be that below a certain speed more drag is created because of the high angle of attack necessary to achieve large lift coefficients. As this high lift dependent drag sets in, with a given maximum thrust, the difference between thrust and drag for a given weight will get smaller. So not only does the weight itself have an influence on the difference between thrust and drag, it is also speed dependent.

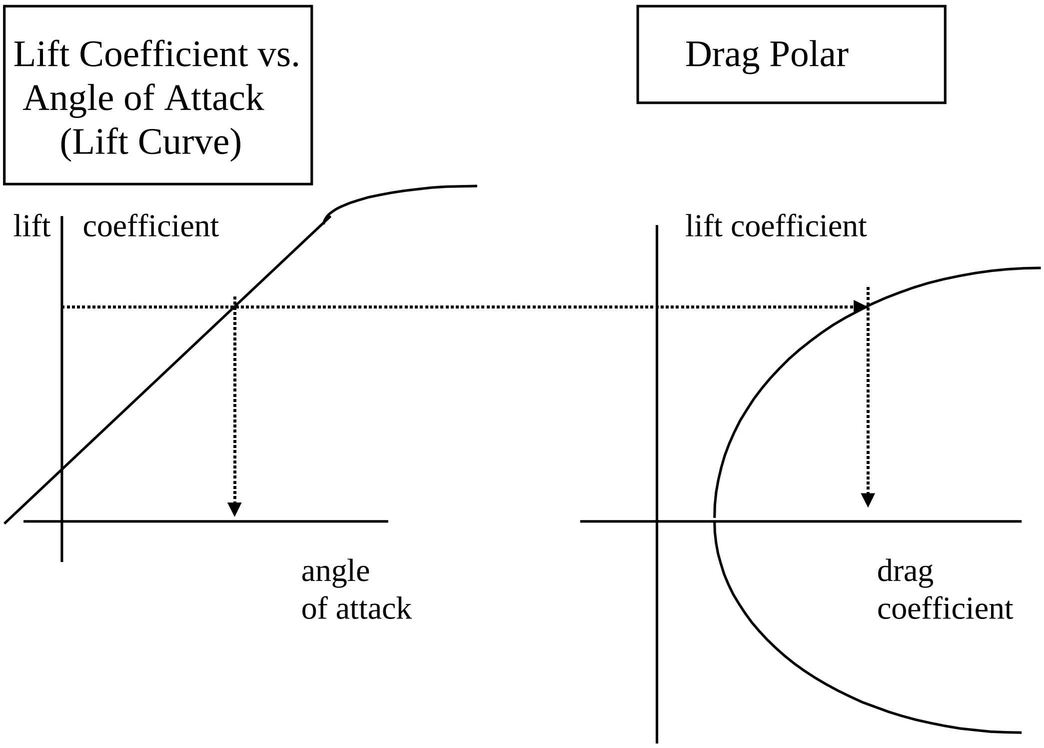


Figure 9.1-1 For a given weight the amount of lift, drag and thrust is fixed.

There are several established methods in textbooks on how to class drag (see aerodynamics). For the pilot a good way to think of drag is to separate **total drag** into

- Zero Lift Drag and
- Lift Dependent Drag[1]

and to remember that total drag has to be overcome by thrust, unless altitude and or/speed are traded.

9.2.1 ZERO LIFT DRAG

Zero lift drag is the drag that acts on the aircraft at a forward speed even if no lift is produced. Such is the case when flying vertical climbs or descents at an angle of attack that results in a lift coefficient equal to zero (this is where the lift curve intersects the horizontal axis in Figure 9.1-1, left).

On the drag polar, the drag coefficient (let us call it c_{D0} for easier reference) for zero lift can be found where the polar intersects the horizontal axis.

As is shown in Figure 9.1-1 right, this drag coefficient is always greater than zero.

The drag coefficient c_{D0} remains constant for a wide range of Mach numbers. It increases in the transonic through supersonic regime, but this is not of importance right now. What is important is the fact that zero lift drag (not the drag coefficient but the force itself) increases with the square of the true airspeed. If speed versus zero lift drag is plotted one gets Figure 9.2-1:

[1] Also referred to as "induced drag"

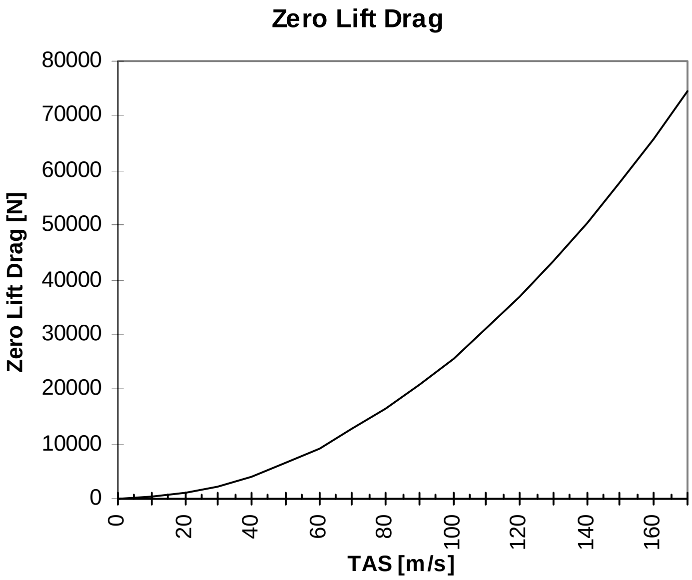


Figure 9.2-1: Zero lift drag versus speed for constant altitude

9.2.2 LIFT DEPENDENT DRAG

Normally, a wing produces lift and with the production of lift a certain amount of drag is created. That portion of drag that is depending on the amount of lift is called "lift dependent drag".

The amount of lift dependent drag for a certain weight, speed and altitude cannot be influenced by the pilot as it is a function of

- aspect ratio (ratio of span square divided by wing reference area) and
- span efficiency factor (whether the lift distribution is elliptic or not, ideally $e = 1$, more realistic: $e = 0.80$),

both of which are determined by design. Once the pilot "requests" a certain amount of lift, e.g. pulling into a steep turn, by doing this, he also "asks" for a certain amount of drag.

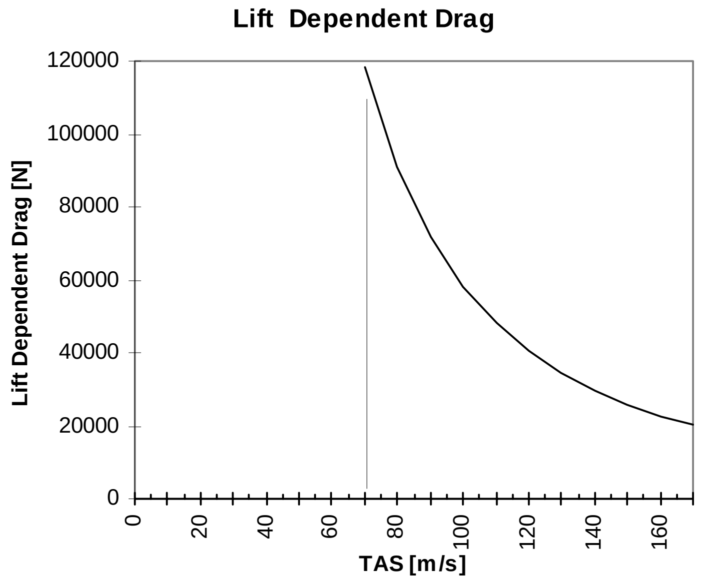


Figure 9.2-2: Lift dependent drag vs. Speed for a given weight and constant altitude. The vertical line in the graph indicates the stall speed.

9.2.3 TOTAL DRAG

The total drag simply is the sum of both zero lift drag and lift dependent drag. Again, assuming constant altitude and weight, a graph as follows can be plotted (see Figure 9.2-3)

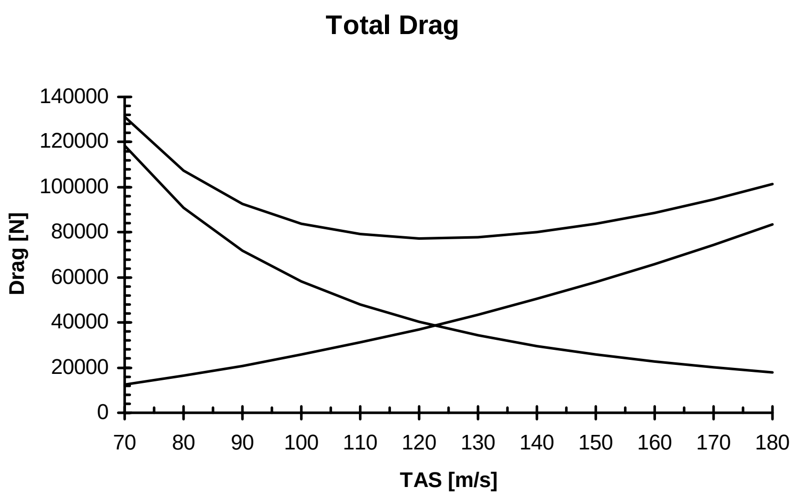


Figure 9.2-3: Total Drag as a function of TAS for horizontal flight. Minimum drag is where zero lift drag and lift dependent drag intersect. The horizontal line indicates a typical thrust characteristic of a jet engine. The difference between thrust and drag is called “excess thrust”. Maximum excess thrust is achieved at minimum drag speed.

For a given weight and thrust level, the difference between thrust and drag, called excess thrust determines how good the performance of the aircraft is going to be. Assuming constant thrust across the speed range the excess thrust will be low at low speed and will be highest at minimum drag speed. In a typical take off, V2 is less than minimum drag speed and therefore gives a smaller climb gradient compared to minimum drag speed. Therefore, in cases where the runway is long enough for additional acceleration higher V2-speeds are used to improve climb capability.

9.2.4 INFLUENCE OF FLAP SETTING

Before the takeoff is discussed, a brief summary of what influence the flap setting has on excess thrust shall be given.

Extending the flaps means both
- increasing zero lift drag and
- decreasing span efficiency (because of the change in spanwise lift distribution)

As a result the zero lift drag curve and the lift dependent drag curve change. A representative picture of the situation is displayed in Figure 9.2-4.

The upper total drag curve is with flaps extended, the lower with flaps retracted. As one can see, for a given thrust setting, the excess thrust is much smaller because of the additional drag and the speed where maximum excess thrust is obtained is lower compared to a clean aircraft. This means that in order to achieve the best possible climb gradient, which directly relates to excess thrust, a cleanup as soon as possible is advantageous. There are, however, operational aspects to be considered. As will be discussed in the takeoff chapter, the initial climb up to a safe altitude is carried out with flaps in takeoff configuration and once this is achieved, flaps are selected up and the aircraft is accelerated to a speed that gives maximum gradient.

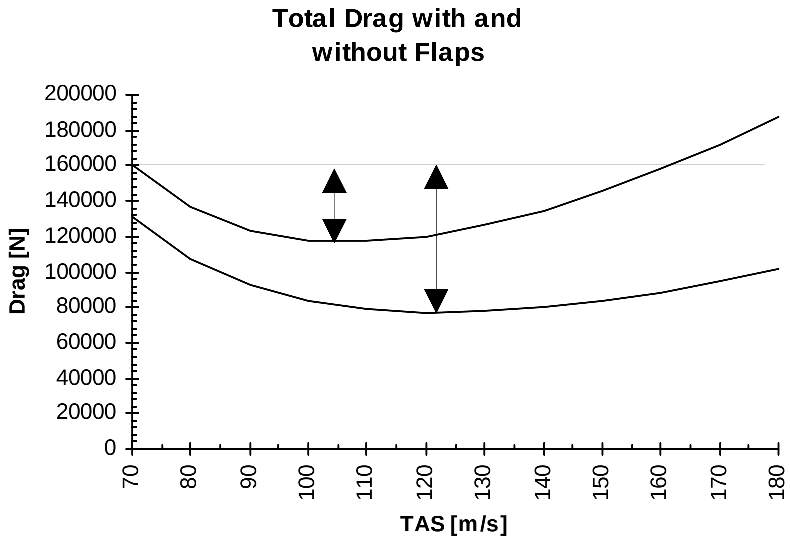


Figure 9.2-4: Total drag for two different flap settings. The lower of the two represents flaps up, the upper curve represents flaps in takeoff position. The horizontal line shows takeoff thrust.

As described in the section about rejected take off and engine failure, the take off is a portion of a flight that takes a lot of mental effort. There are many variables that a pilot has to absorb in very short time: keeping the aircraft straight down the runway, monitoring engine and flight instruments, take the proper action should a malfunction occur, rotate at the proper rate and establish a stabilized flight path after liftoff. By the end of a takeoff roll the aircraft attains a very high level of kinetic energy, so that an abort in this phase would result in an overrun.

A good understanding of both the operational and the theoretical side (certification, obstacle clearance requirements) is required. This section

- deals with reduced thrust take off (assumed temperature method)
- gives a definition of ASDA, TORA, TODA and
- a definition of take off speeds,
- explains the limiting factors (climb, obstacle etc.) as published in the Airport Analysis Manual (AAM).

9.3.1 ENGINE RATING - REDUCED THRUST TAKE-OFF

A very common practice to save engine life is to do a reduced thrust takeoff, whenever conditions permit. Because less then maximum thrust is set at takeoff, the associated lower EGT significantly increases the life of especially the high pressure turbine stage.

Note:
It is good to remember that the life of most jet engines is either limited by too high a pressure in the burner (high speed flight) or by too high an exhaust gas temperature.

To reduce thrust, the concept of the “assumed temperature method” is used. The following reasoning underlies this concept:

- At high ambient temperatures and thus high EGTs the maximum thrust has to be limited so as not to exceed a maximum EGT. The higher the SAT the lower the thrust to keep the EGT below maximum.
- Conversely, for low ambient temperatures a higher maximum thrust is possible. Generally, engine manufacturers limit the maximum thrust purposely to a lower than maximum level ("rating") below a certain ambient temperature. This is called "flat rating" an engine and the temperature to which it is flat rated lies in the vicinity of 30 deg. C. (ISA+15 at MSL).
- By assuming a higher than actual air temperature and setting the corresponding lower thrust level a colder EGT is achieved. This advantageous effect is used to increase engine life.

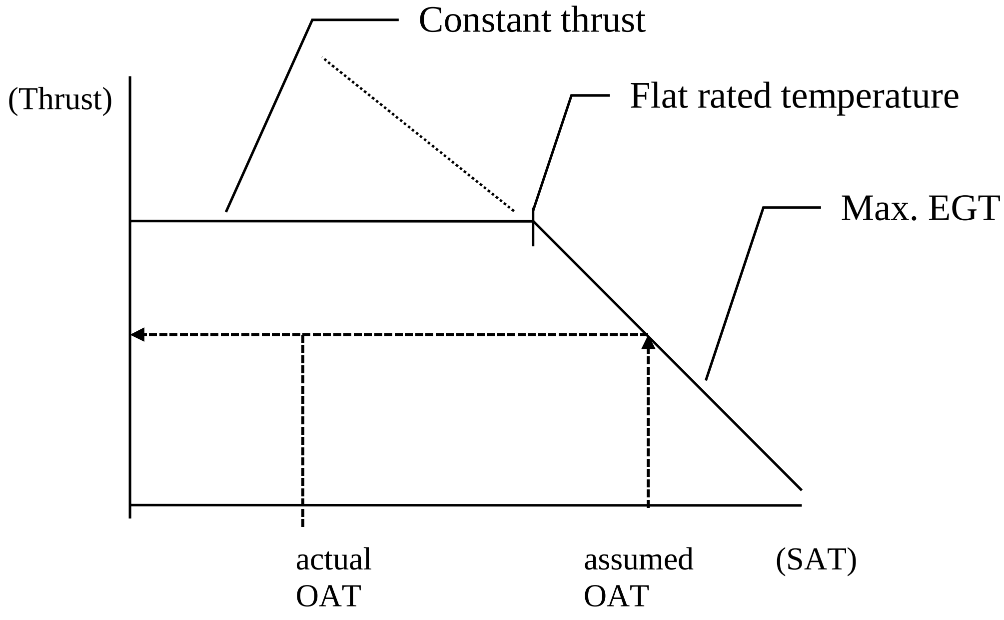


Figure 9.3-1: Assumed Temperature Method for reduced thrust take offs

Note:
- As can be seen easily, reduced thrust will only be available if the assumed temperature is above the flat rated temperature (Figure 9.3-1).
- For that range of SAT where thrust is constant the EGT margin will increase with lower SAT for maximum rated thrust.

9.3.2 THE TAKEOFF REQUIREMENTS

In our daily operation the maximum takeoff weight is not only a question of performance of the aircraft alone but also a question of whether the aircraft will be able to meet the regulatory requirements once it looses the critical engine. Regulations ask for either a stop or go decision and in both cases the situation must be survivable. As far as certification is concerned, the regulatory material can be found in ICAO Annex 8, FAR Part 1 and 25 and JAR Part 25.[1]

There are three basic regulatory requirements:

1. There must be adequate runway for the TOW,
2. the aircraft must be able to obtain a minimum climb gradient once airborne after an engine failure,
3. the aircraft must be able to avoid obstacles after an engine failure.

Besides these several other requirements exist, such as

1. TOW limited by landing weight
2. Approach and landing performance
3. Enroute limitations
4. Maximum Tire Speed
5. Brake energy limit
6. Minimum Control Speed
7. Runway bearing capacity

TOW limited by structure or ZFW are specific to the aircraft structural design rather than regulatory performance requirements.

In order to meet the take off requirements you as a pilot have several tools:
- weight reduction
- flap setting
- thrust setting (e.g. packs off)
- selection of takeoff speeds (e.g. improved climb)
- runway change

[1] FAR…Federal Aviation Regulations, issued by the Federal Aviation Administration (USA),
JAR…..Joint Aviation Requirements issued by the Joint Aviation Administration (Europe)

Weight reduction is often the only tool left that will allow you to meet the requirements under given ambient conditions, however, as it is our job to transport payload it should be considered last.

9.3.3 ACCELERATE-STOP DISTANCE

To understand field-length limited takeoff weight it is essential to review the definitions of the accelerate-stop distance. There are two definitions of the accelerate-stop distance (ASD) – an old one and a new one. The “new” definition is the one currently used in the regulations. The exact wording for JAR-certified transport category airplanes can be found in Chapter “Performance”, Section “JAR 25 Definitions” (paragraph JAR 25.109).

9.3.3.1 Old Definition

The old definition does not account for engine failure recognition time and for pilot´s reaction time between recognition and start of braking. It simply assumes an all-engine acceleration up to a speed of V1, at which a deceleration is initated with no delay, see Figure 9.3-2.

The old definition also does not differentiate between an all-engines operating case and an engine-inoperative case. It simply assumes that all engines operate up to V1 and thereafter, for whatever reason, the takeoff is aborted.

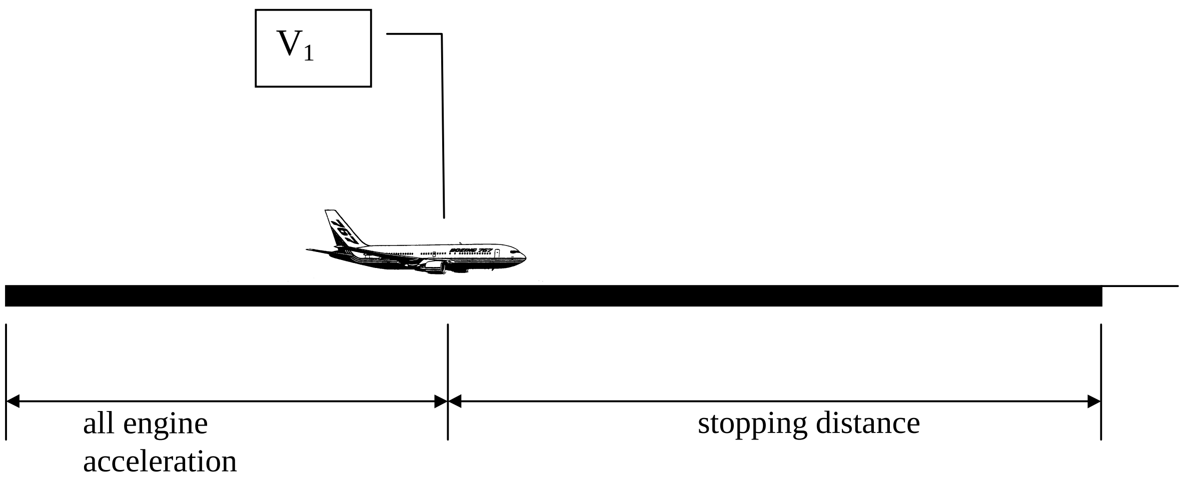
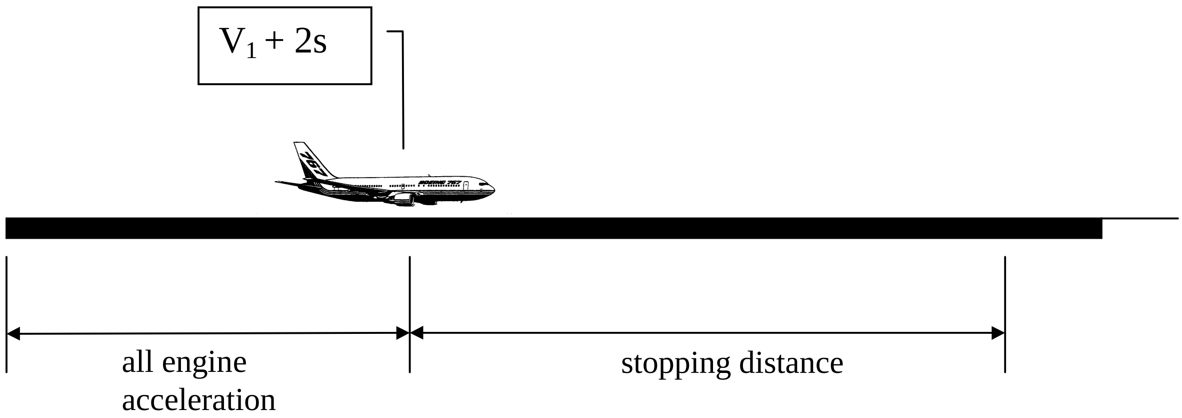


Figure 9.3-2: Old definition of accelerate stop distance

9.3.3.2 New Definition

The new definition accounts for one engine acceleration during the time between engine failure, pilot recognition and pilot action. In addition it differentiates between the all-engine operating case and the one-engine inoperative case.

All engines operative:



One-engine inoperative:

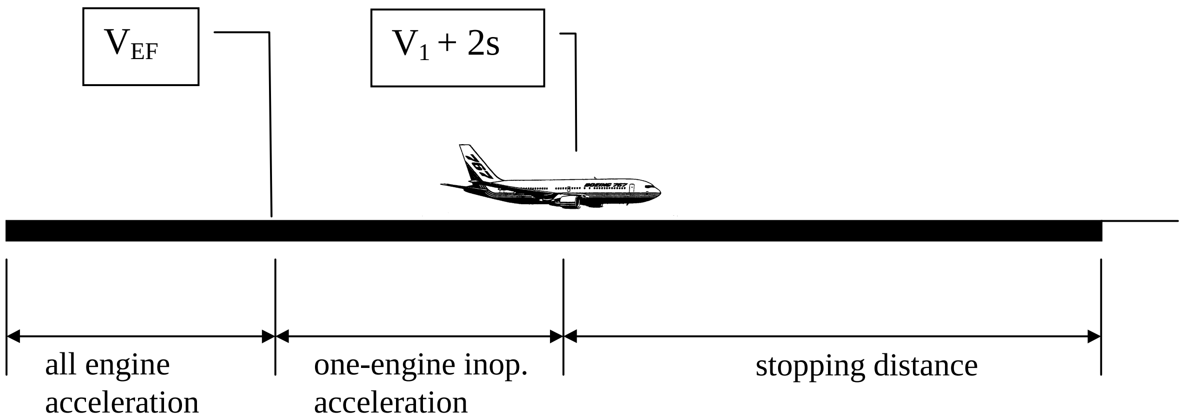


Figure 9.3-3: Current definition of accelerate-stop distance. Top: all-engine case, below: one engine-inoperative case. The larger of the two distances (in this case the one-engine inoperative scenario) applies.

9.3.4 MINIMUM REQUIRED TAKEOFF LENGTH

Obviously, an aircraft must be able to accelerate and stop within the confines of the runway, as it must – in case of a go decision – be able to be airborne within the confines of the runway.

The situation is somewhat more complicated as the runway itself might be outfitted with either a stopway, a clearway or both. A stopway can be part of a clearway.

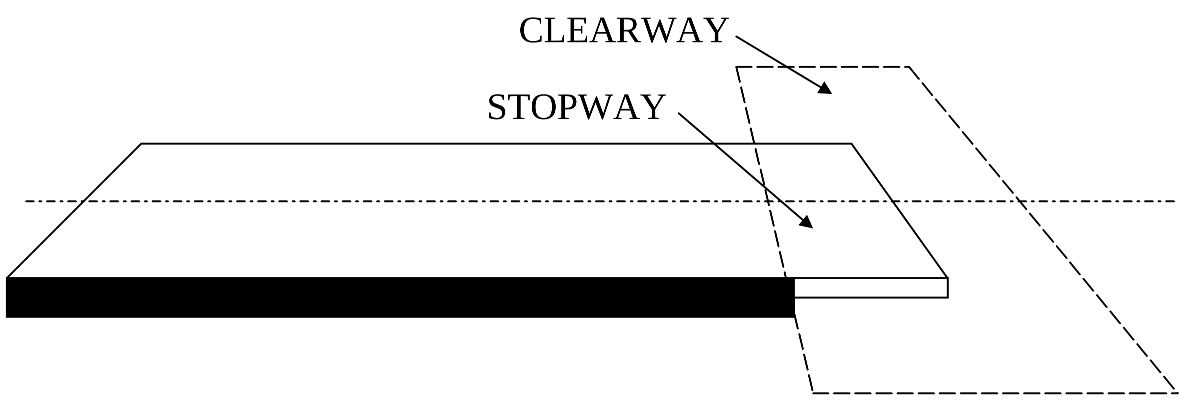


Figure 9.3-4: Stopway as part of the clearway.

If a stopway is available, it can be fully used in the stop-case. In other words, the runway length and all of the stopway must not exceed the accelerate-stop distance. This is valid both for the all-engine case and the one-engine inoperative case.

Only a stopway available:

The all-engines takeoff distance times 1,15 must not be greater than the runway length.

Only a clearway available:

With all engines operating, the maximum usable clearway is 1,15 times half the distance from liftoff to 35 ft.

9.3.5 SAFETY MARGINS IN REGULATORY REQUIREMENTS

Regulatory agencies appreciate the fact that in the real world of operation less then optimum conditions exist:

- aircraft not new with deteriorating engines,
- increased drag because of unpolished surfaces,
- flight crew tired, caught by surprise and with little practice (long vacation),
- etc.

Because of this, certain margins are incorporated.

Example:
The climb requirement for a twin engine aircraft asks for a gradient of 2.4% in the second segment. Because of the negative factors mentioned above, a safety margin of 0.8% is incorporated, so that it is assumed that the aircraft will only be capable of doing 1.6%.

9.3.6 FIELD LENGTH LIMITED TOW

Given a certain takeoff distance available an an aircraft must not exceed a certain maximum weight to be able to lift off and clear the end of the TODA. If field length is an issue, a higher flap setting can be considered as this gives more lift and will reduce the speed for liftoff and thus the take off run However, the progressively worse climb gradient with the higher flap setting may preclude the use of high flap settings.

9.3.7 CLIMB LIMITED TOW

With the field length limited TOW the manufacturer only proved that with that weight an aircraft can achieve 35 ft at the end of the runway. This does off course not automatically imply that the aircraft will be able to climb successfully, thereafter: For example, just think of a beneficial influence of the ground effect. It could well be that the aircraft achieved the 35 ft only because ground effect reduces drag[2] and will not be able to climb once out of ground effect. So regulations asks that the manufacturer proves a climb capability in the different segments of flight:

SEGMENT	EXTENDING FROM - TO	REQ. GRADIENT
1st	lift off to gear selected up	positive
2nd	35 ft to acceleration altitude	2.4% gross, 1.6% net
3rd	minimum 400 ft AAL	1.2% gross, 0.4% net
4th (final)	acceleration altitude to a minimum of 1500 ft AAL	1.2% gross, 0.4% net

Table 1: Climb requirement for twin engine aircraft, FAR Pt 25 / JAR Pt 25. For tri- and quad-jets the numbers are slightly (roughly 0.3%) higher.

<u>1st segment:</u>

- extends from point of lift off to 35 ft
- in this segment gear is selected up[3]
- twin jets such as the B 767 need to show only a positive gradient in this segment. Therefore, it is not limiting.

<u>2nd segment:</u>

In daily operation with a tired flight deck crew and a worn aircraft a <u>minimum</u> second segment climb gradient of 1.6% is required (this is called the “net gradient”). A brand new aircraft with a flight test crew that is not taken by surprise will do much better. In fact, to cope for the unfavorable conditions that the average line pilot is subjected to, a minimum of 2.4% is required for certification during flight test. This is called the “gross gradient”.
In this segment gear is up but the flaps are still in take off position. Thrust is at take off thrust and minimum speed is V2. Because of the low speed and the comparatively high drag configuration the climb gradient will not be very good. In fact, the 2nd segment is a fairly tough requirement to meet for an aircraft and that is why it quite often is limiting as far take off weight is concerned.

<u>3rd segment:</u>

[2] Ground effect reduces lift dependent drag. This can be explained as follows: lift dependent drag is a consequence of wing down-wash. High induced drag (same as saying that there is an aft-tilt of the resultant lift vector) is always a result of high down-wash angles. If a surface, such as a runway is in the immediate vicinity of the wing, the air cannot be deflected as much downwards, thus the induced drag is reduced. Vicinity means that the aircraft does not fly more than half a span above the ground. At higher altitudes the influence of the ground effect is gone.
[3] During certification it is assumed that the gear is selected up within 3 seconds after lift off.

This segment is used for acceleration (flap retraction) or for maneuvering. One could (wrongly) assume that no gradient is required in this segment since the aircraft best accelerates in horizontal flight. Moreover, in many textbooks the 3rd segment is shown as a horizontal line. This is all true but it would not be wise, however, not to specify some minimum climb requirement in the acceleration segment:

- Again, a brand new aircraft would show a much better performance compared to the worn out. If certification asked for just a zero-gradient, the worn aircraft would more than likely start a shallow descent into terrain. So a safety margin is applied. The gross gradient is (as always) reduced by 0.8% to give a net gradient of 0.4%.
- As discussed in the introduction section of this chapter, a climb gradient directly relates to excess thrust per weight. This excess thrust can be either used to accelerate the aircraft or to climb or to do both. In case of the 3rd segment, acceleration is what we want. The gradient can also be used to give yourself some maneuvering capability without losing altitude. However, with too much maneuvering, acceleration at the same time might not be impossible. Typically, a turn banked with 25 degrees reduces the gradient by 0.4%. This means that when the aircraft just about complies to the minimum, the net gradient in the turn will be reduced to 0.0%, i.e. no thrust left for acceleration. The following example shall demonstrate how gradients and acceleration inter-relate:

  Example:
  *An aircraft which has the minimum required net gradient of 0.4 % in the third segment can accelerate with 0.004g in level flight. Since 1g = 9.81 m/s^2 this translates into 0.004*9.91= 0.039 m/s^2. More practical, with 1 m/s equal to 1.94 kts, this is 0.08 kts per second. For an increase in speed by 40 kts an aircraft that is just capable of achieving the minimum required this will take 8 minutes and 43 seconds ?????*

Thrust in the third segment is take-off thrust.

The weights and acceleration altitude are adjusted so that five minutes after brake release the aircraft is clean and maximum continuous thrust can be set. If the acceleration were so slow that it took longer to clean the aircraft, the stipulated weight (i.e. the weight put down in the AAM tables) would have to be reduced.

Note: Lauda B 767 have 10 minute limits (rather than 5) for the engines running at take off thrust due to the Innsbruck operation..

4th segment:

The fourth segment is flown with the aircraft in clean configuration and the aim is now to gain further altitude. That is why, again, a climb gradient is specified. Because the aircraft is now clean and has accelerated the required angle of climb will be much easier to achieve. 4th segment climb requirements therefore are usually not limiting.
The 4th segment ends at a minimum of 1500 ft above the runway elevation. No takeoff analysis is carried any further and should high obstacles exist, which can't be avoided by turning flight, the pilot would have to look into the departure plate and judge if he can meet the stipulated gradients.

Thrust in this segment is MCT. As gaining altitude has the highest priority the correct sequence is of ordering is first level change and then thrust setting.

PF: "Flight level change, set maximum continuous thrust"

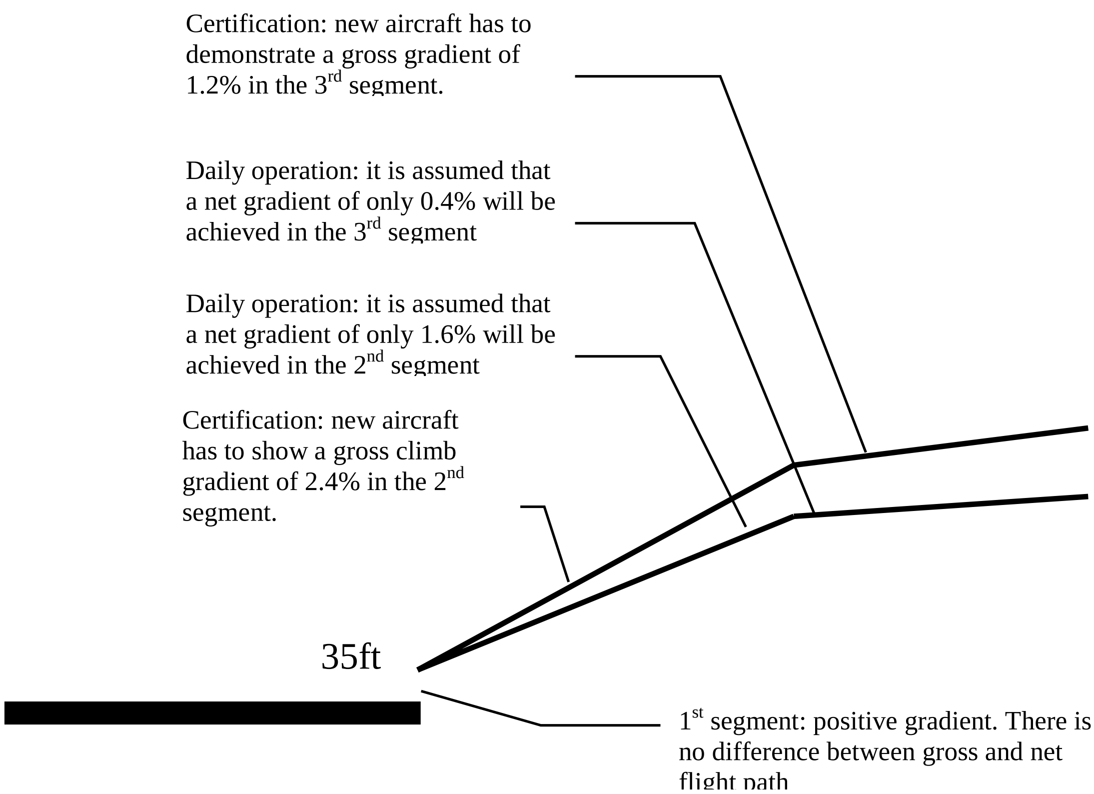


Figure 9.3-5: Gross flight paths and net flight paths with respective gradients for twin engine transport category aircraft.

Summary:

In this section we talked about the climb requirements up to a minimum of 1500 ft AAL. To summarize, there are 4 segments with different gradients put down in the respective regulations.

A net gradient is the gradient that a worn-out aircraft must achieve under operational conditions, while the higher gross gradient is the gradient which the aircraft will have to demonstrate during flight test. The safety margin, 0.8% for twin engine transport category aircraft, is there to cope for the unfavorable conditions such as worn out aircraft and tired crew.

Finally, we need to remember why climb requirements are put down in the regulations in first place. Minimum net flight path gradients are simply here to assure that the aircraft at a certain weight does not hit terrain when an engine fails at takeoff at the most critical moment. However, despite these laid down flight paths that all transport category aircraft have to meet, obstacles in the vicinity of the airport could prevent a pilot from taking off at that weight.

In the next section the obstacle clearance requirement is addressed.

9.3.8 OBSTACLE LIMITED TOW

There exists quite a lot of confusion even among experienced pilots as to what the obstacle clearance criteria in take off weight calculations exactly are. Up front, neither the climb limited TOW nor the obstacle limited TOW have anything got to do with the design of a departure route as is laid down in PansOps Doc. 8168. This document strictly describes, among other things, how to design a SID. It is not a document that lays down how an aircraft has to be certified.

A good way to look at obstacle clearance is to follow through two steps:

1. Remember, climb gradients in the 1st, 2nd, 3rd and 4th segment do not take into account the presence of any specific obstacles for a given runway. They are more of a general criterion by which it should be ensured that terrain is avoided.

Note:

- In this context an obstacle is any feature, man made or by nature, that protrudes into the **"Obstacle Identification Surface (OIS).**
- The OIS is a plane that runs 35 ft below the net gradients of the 1st through 4th segment, see Figure 9.3-6.

2. Should an obstacle protrude into the OIS (it could be a crane that is erected temporarily, or, terrain) a safety margin of 35 ft is applied to this obstacle and the prescribed net gradient (in case of the 2nd segment 1.6% is projected backwards to the runway. As can be clearly seen in Figure 9.3-7 this backward projection shortens the available take off run, i.e. the weight of the aircraft has to be limited so to be 35 ft at that point.

A margin of 35 ft applied to an obstacle does not sound much. Remember, that this margin is applied to a net flight path and an aircraft just being capable of flying along that path would be in a worse case scenario. In most cases, it should perform better than that.

Obstacle limited weights are indicated by "*" in the AAM.

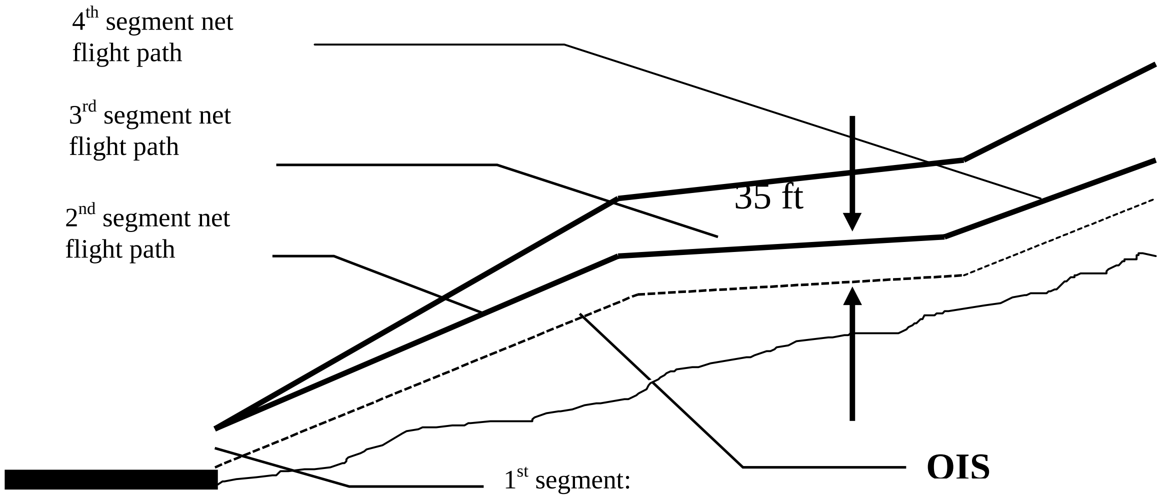


Figure 9.3-6: Obstacle Identification surface. Here, no obstacles protrude into the OIS

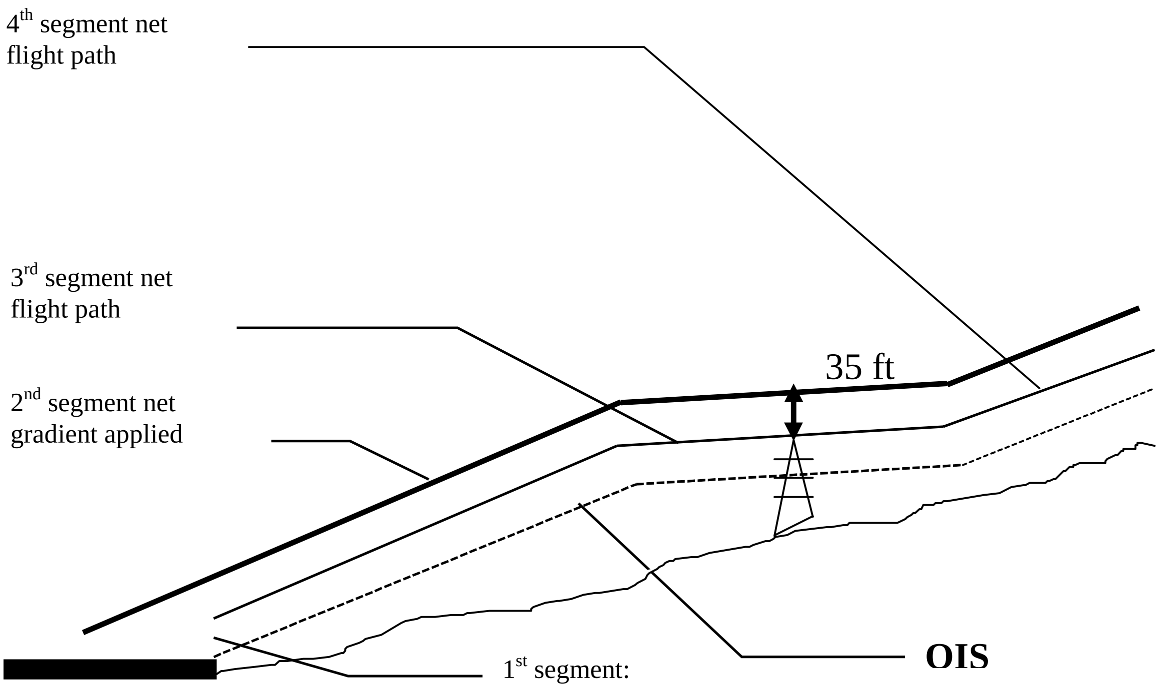


Figure 9.3-7: Obstacle protruding into OIS: 35 ft margin applied and gradients projected backwards to give new net flight paths.

9.3.9 IMPROVED CLIMB

Assume that a runway is very long so that the stop-decision can be delayed beyond the point where V1 is normally reached. This might sound confusing at the moment because people tend to believe that V1 always implies a speed at which an aircraft can be safely brought to a stop within the confines of the runway. This is certainly true but it is not the only factor that determines V1. To support this statement take the following example:

Assume a crane is erected in the second segment and this obstacle now necessitates in some recalculation of the take off weights. As we have seen before, a slanted plane at a gradient of 1.6% is projected backwards towards the runway and now the aircraft has to reach the 35 ft point much closer to the departure threshold. In order to meet this criterion the aircraft has to be airborne early enough, i.e. VR has to be moved to a slower speed and since V1 can' t exceed VR, also V1 (which in these situations would equal VR) will have to be lowered. So while the aircraft could stop within the confines at much higher V1 it can't go to this higher speed for obstacle clearance reasons.

<u>Back to the improved climb</u>: with a long enough runway both a climb and obstacle limited weight can be raised by accelerating the aircraft to a higher than normal takeoff speed. This procedure off course will bring the aircraft closer to the field length limit or a brake energy or max tire speed limit. To be more precise, we are looking for a higher V2 as this is the minimum speed used for the climb out in the second segment. The weight can be raised because the higher V2 gives a better excess thrust (see discussion about total drag curves) and thus the same gradient for the higher weight. In order to have a higher V2, which by definition is the speed the aircraft attains single engine 35 ft above the runway, VLOF and consequently VR and V1 need to be increased.

If a takeoff weight is obstacle limited, (not for close in obstacles) the benefits of improved climb can be used. In this case a higher weight can be taken because you don' t fully trade speed for weight. You add some weight but don' t add so much that the climb gradient remains the same as for the "normal" takeoff. Rather, you leave yourself some weight margin that now allows you to climb at a steeper gradient. You will need this steeper gradient since the obstacle moved closer to the point were the aircraft is lifting off.

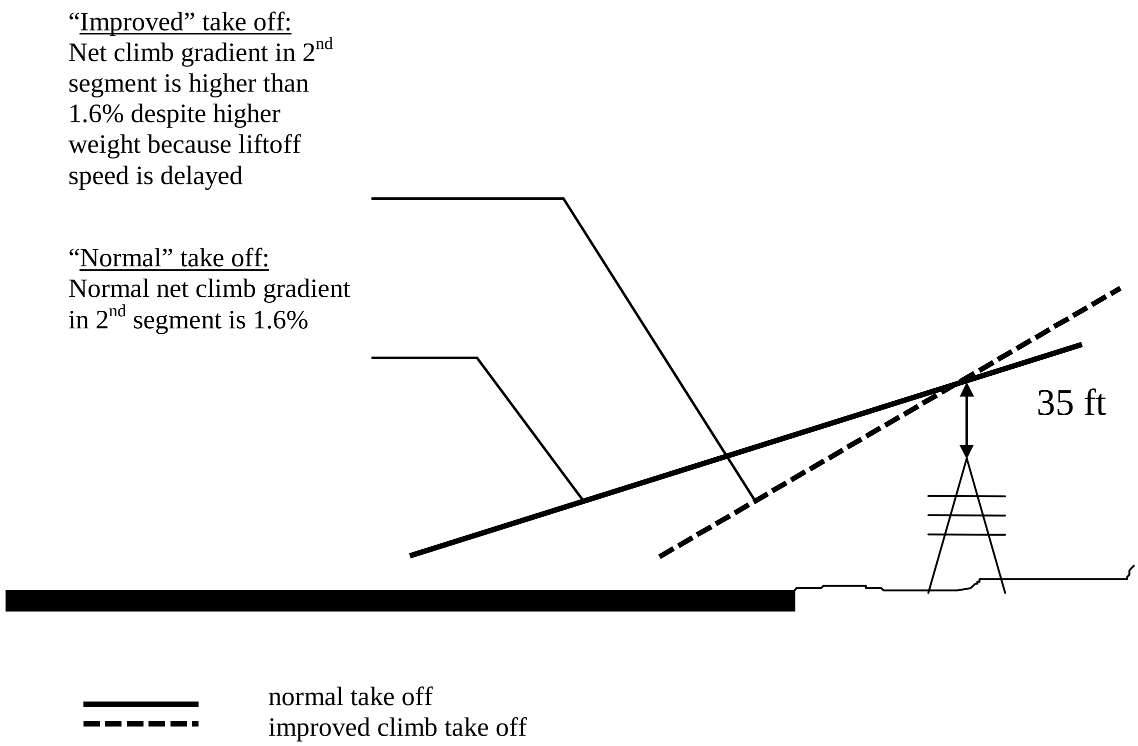


Figure 9.3-8: Using improved climb to clear obstacle with same margin but higher take off weight.

9.3.10 EFFECT OF WIND ON CLIMB SEGMENTS AND OBSTACLE CLEARANCE

Assume that an observer next to the runway is watching a departing aircraft. To him, an aircraft that is subjected to a tail wind will fly out at a flatter angle compared to one flying in a no wind-situation. For a head wind the opposite is true: the departing aircraft climbs at a steeper angle.

For better comprehension you can think of wind as follows: the aircraft is flying in a huge parcel of air that travels in one or the other direction. While the aircraft moves along in this parcel of air it is at the same time displaced because of the parcel' s relative motion to the ground.

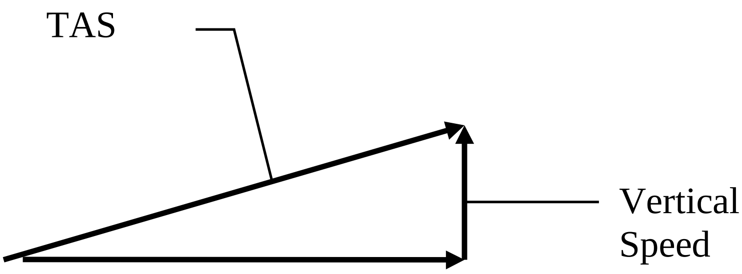
These relations can be expressed in a vector diagram, see Figure 9.3-9.

It is essential to understand that the **second segment climb** does not have to take into account the effect of wind as it is just a certification criterion that ensures, that an aircraft is able to climb at a minimum gradient, no matter which direction the parcel of air into which it is suspended travels, i.e. no matter what the wind is. In other words, 2nd to 4th segment climbs only make sure that the aircraft will produce a certain VS for a given TAS. As can bee seen in Figure 9.3-9 a, these two values are sufficient to determine a climb gradient.

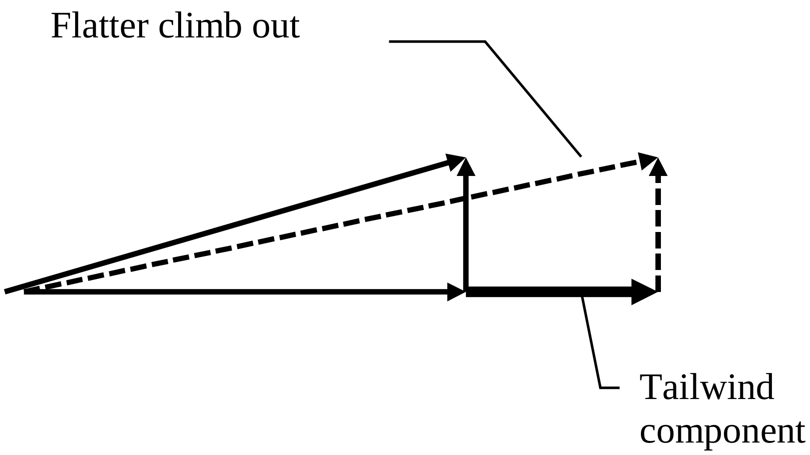
The opposite is true for **obstacle clearance requirements** as here it is certainly of importance what an aircraft does with respect to the ground. If obstacle limited, a head wind will allow higher take off weights, a tail wind lower.

As a result of this subsection, in the AAM climb limited weights need not be shown for different wind components whereas obstacle limited weights are.

a) no wind:



b) tail wind



c) head wind:

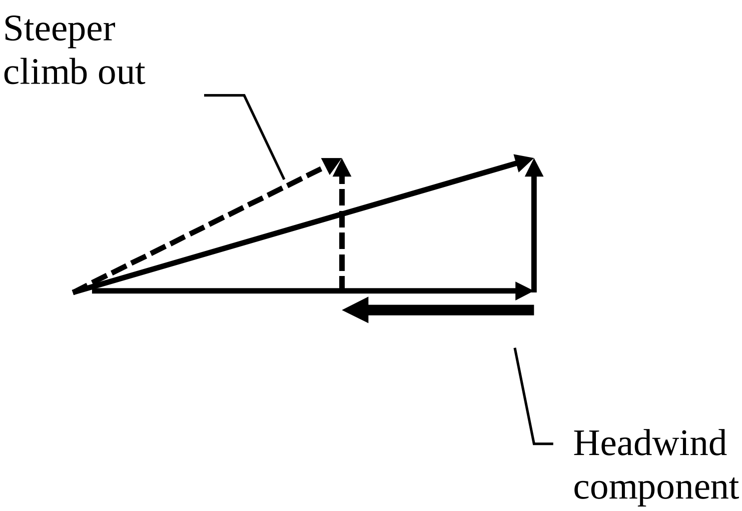


Figure 9.3-9: Effects of wind on the climb out path.

9.4.1 TAKEOFF ON SLIPPERY AND CONTAMINATED RUNWAY

There are several effects that slippery and contaminated runway surfaces have on the aircraft during takeoff roll:

- On slippery surfaces, the friction coefficient between the rubber of the tires and the runway surface is reduced. This increases the stop distance in case of a takeoff abort.
- On a contaminated runway acceleration will be slower because of the higher drag (tires will have to push away the contaminant). At the same time, especially if there is a layer of ice hidden under the contaminant, deceleration will be degraded, increasing stop distance.
- With less friction a lower crosswind limit must be observed as the cornering forces of the tires, which ensure the tracking, will be reduced.

To cover these effects, both a weight reduction and a V1-reduction are necessary, the amount of which depends on the braking action.

Two tables are provided to cover slippery runway and contaminated runway performance. Note that the data in these tables is not certified.

Slippery runway takeoff covers the following contaminants (Figure 9.4-1):

- Compacted or rolled snow,
- Frozen ruts or ridges,
- Rime and frost,
- Ice,
- Melting ice (takeoff not recommended !).

One advantage of the table is that it can be entered with either a braking action, the amount of contamination or the friction coefficient. Braking action is usually based on pilot´s reports and therefore subject to individual interpretation of the situation. A pilot touching down at a slow speed, pulling reverse early and coming to a stop within a short distance might report BA to be good, whereas one that touches down with some overspeed, applying reverse late and stopping further down the runway might report BA to be only medium.

When the friction coefficient is not available use the figures in the shaded areas for braking action MEDIUM, MEDIUM/POOR or POOR (the shaded areas are the most conservative in the respective “category”).

As stated in the table, the reductions both for weight and V1 need to be applied to the AFM values for dry runway. Deduct for one condition only and check the QRH for minimum V1 (MCG) if V1 is reduced. Note that reductions are presented for the “both reversers available” scenario and the “one reverser inop” situation.

B767 SLIPPERY RUNWAY TAKEOFF

T/O FIGURES	RWY CONDITION
USE SLIPPERY RWY CORR BASED ON DRY AAM	COMPACTED OR ROLLED SNOW FROZEN RUTS OR RIDGES RIME AND FROST ICE
TAKEOFF NOT RECOMMENDED	MELTING ICE

RUNWAY CONDITIONS/ limit WIND				TAKE OFF WEIGHT AND V1 REDUCTION			
FRICTION COEFFICIENT AVAILABLE				BOTH REVERSERS AVAILABLE		ONE REVERSER INOP	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GOOD		0,40	40	0,0	7	0,0	7
		0,39	38	0,5	7	0,6	7
		0,38	36	1,0	8	1,4	8
		0,37	34	1,5	9	2,2	9
		0,36	32	2,0	9	3,0	10
MEDIUM	10%	0,35	30	2,6	10	3,8	11
	11%	0,34	28	3,3	10	4,6	12
		0,33	26	4,0	11	5,5	13
		0,32	25	4,7	12	6,5	14
		0,31	23	5,5	13	7,5	15
	25%	0,30	21	6,3	14	8,6	16
MED/ POOR	26%	0,29	20	7,2	15	9,7	18
		0,28	19	8,1	16	10,8	19
		0,27	18	9,3	18	12,0	21
	50%	0,26	17	10,6	19	13,3	23
POOR	51%	0,25	15	11,8	20	14,8	25
		0,24	12	13,1	21	16,0	28
		0,23	10	14,6	21	18,6	32
		0,21	7	17,1	26	21,3	39
		0,20	6	19,7	30	24,0	45
		0,16	5	30,0	35	36,0	46

WHEN F/C NOT AVAILABLE USE FIGURES IN SHADED AREAS FOR B/A MEDIUM, MED/POOR, POOR

NOTE: FIGURES NOT SUBJECT TO CERTIFICATION, DEDUCT FOR ONE CONDITION ONLY. CHECK QRH FOR MINIMUM V1 (MCG) IF V1 IS REDUCED!
REVERSER AVAILABLE/INOP REFLECTS DISPATCH CONDITION

Figure 9.4-1: B 767 slippery runway takeoff. Gross weight and V1 reduction.

Contaminated runway table: covers the following situations (Figure 9.4-2):

- Dry snow,
- Wet snow,
- Slush,
- Standing water.

Observe the following:

Use the dry AAM figures (no additional correction) for
- Dry or wet snow with less than 2 mm and braking action good (equivalent to a friction coefficient of 0,4-0,36)
- Wet snow and slush with less than 2 mm and a contamination of up to 25%.

Use wet AAM figures (no additional correction) for
- Standing water up to 2 mm on an ungrooved runway

Use the correction given in the table for
- Standing water, slush and wet snow with a contamination of more than 25% and a measured depth of 2 mm and more. These corrections need to be applied to the dry AAM figures.

One advantage of the table is that "equivalent slush depth figures " are available.

Example:
- *9-11 mm of dry snow are equivalent to 7-8 mm of wet snow and 16-27 mm of very dry snow.*
- *You would enter the table with 4 mm for a given takeoff weight. Since the table shows reductions only for 2 mm, 6 mm and 13 mm you have to interpolate.*

Note 1:

For high depths the V1 reduction is not as significant as for the lower depths. There are two reasons – first, the contaminant with the larger depth will produce higher drag, thus making stopping not as much of a problem. V1 therefore need not be reduced so much. Secondly, if V1 were reduced significantly, you would have to accelerate to rotation speed on one engine with the wheels dragging through the deep contaminant. Obviously, this would delay the liftoff point very far down the runway and you would not be able to meet the takeoff distance criteria. As a consequence: V1 is only reduced slightly.

Note 2:

- If runway available is less than 8200 ft (2500 m) use slush / standing water takeoff table (AOM 23.10.17)
- Check QRH for minimum V1 (MCG).
- If V1 (MCG) limited then set V1 to V1 (MCG)
- Figures are not subject to certification.

B767 CONTAMINATED RUNWAY TAKEOFF PW 4060

T/O FIGURES	RWY CONDITION
DRY RWY AAM FIGURES	DRY or WET- LESS THAN 2mm and B/A is GOOD (F/C 0,4-0,36). WET SNOW, SLUSH - UP TO 25% CONTAMIATION LESS THAN 2mm
WET RWY AAM FIGURES	STANDING WATER UP TO 2mm on UNGROOVED RWY
FOR CONTAMINATED RWY USE CORRECTIONS SLUSH STANDING WATER BASED ON DRY RWY AAM	STANDING WATER, SLUSH, WET SNOW CONTAMINATION MORE THAN 25% MEASURED DEPTH 2mm AND MORE

EQUIVALENT SLUSH DEPTH TABLE

CONSIDER AS SLUS	WET SNOW	DRY SNOW	VERY DRY SNOW
2	5-6	6-8	10-15
4	7-8	9-11	16-27
5	9-10	12-14	28-33
6	11-12	15-17	34-40
7	13	18-20	41-47
8		21-23	48-50
9		24-26	
10		27-29	
11		30-31	
12		32-34	
13		35-37	

ALL UNITS IN MILLIMETER

WEIGHT TONS	WEIGHT AND V1 REDUCTIONS PW 4060								
	2 mm contaminationV1-25kt			6 mm contaminationV1-19kt			13 mm contaminationV1-10kt		
	SEALEVEL	1000ft	2000ft	SEALEVEL	1000ft	2000ft	SEALEVEL	1000ft	2000ft
100	[illegible]	[illegible]	6500	[illegible]	[illegible]	7100	[illegible]	[illegible]	[illegible]
105	5600	6700	7800	6350	7450	8550	7350	8450	9550
110	[illegible]	[illegible]	9100	7500	[illegible]	[illegible]	[illegible]	10200	[illegible]
115	8100	9200	10300	9150	10250	11350	10800	11900	13000
120	9300	10400	11500	10500	11600	12200	12500	13600	14700
125	10350	11450	12550	11800	12900	14000	14150	15250	16350
130	[illegible]	12500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
135	12300	13400	14500	14250	15350	16450	17350	18450	19550
140	13200	14300	15400	15400	16500	17600	18900	20000	21100
145	14050	15150	16250	16450	17550	18650	20350	21450	22550
150	14900	16000	17100	17500	18600	19700	21800	22900	24000
155	15650	16750	17850	18500	19600	20700	23150	24250	25350
160	16400	17500	18600	19500	20600	21700	24500	25600	26700
165	17000	18100	19200	20350	21450	22550	25800	26900	28000
170	17600	18700	19800	21200	22300	23400	27100	28200	29300
175	18200	19300	20400	21950	23050	24150	28300	29400	30500
180	18800	19900	21000	22700	23800	24900	29500	30600	31700
185	19250	20350	21450	23400	24500	25600	30550	31650	32750
190	19700	20800	21900	24100	25200	26300	31600	32700	33800

NOTE: IF RUNWAY AVAILABLE IS LESS THAN 8200 ft USE SLUSH/STANDING WATER TAKEOFF TABLE (AOM 23.10.17).
CHECK QRH FOR MINIMUM V1 (MCG) IF V1 (MCG) LIMITED SET V1 TO V1 (MCG)!
FIGURES NOT SUBJECT TO CERTIFICATION

Figure 9.4-2: B 767 contaminated runway takeoff. Gross weight and V1 reduction.

9.4.2 TABLES A1 AND A2

- Table A1 covers dry runway conditions, table A2 covers wet runway.
- For landing weights (LDW) above 160 tons the 25 deg. flap setting is used, for LDW below 160 tons 30 degrees.

The top section of tables A1 and A2 (Figure 9.4-6, Figure 9.4-7) shows the landing distance as per AFM for the expected LDW. This AFM-landing distance always include a 40% margin which means that the landing distance as determined per flight test is multiplied by a factor of 1,67 to account for non-optimum conditions, see Figure 9.4-3.

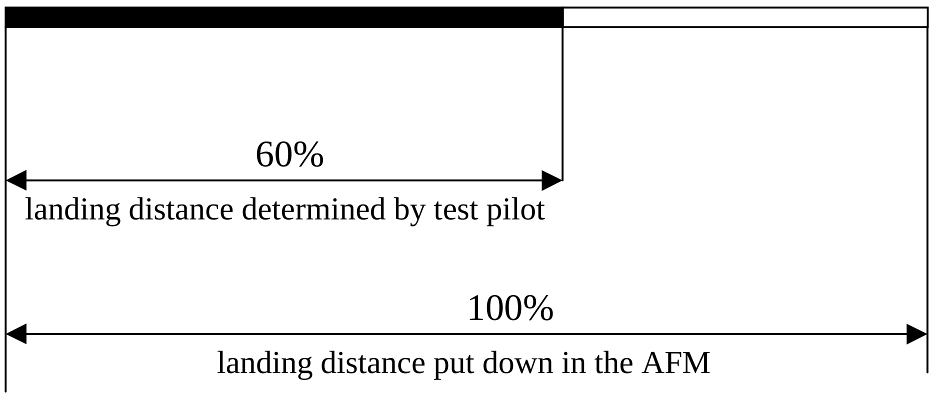


Figure 9.4-3: Landing distance as stated in AFM

In order to be able to operate more closely to actual conditions and not have to consider this conservative safety margin (which very often is just too conservative), another way of determining actual landing distance has been developed:

The idea is to look at the actual landing distance (the one determined by the test pilot) and increase this figure by a factor that depends on the system status, see Figure 9.4-4.

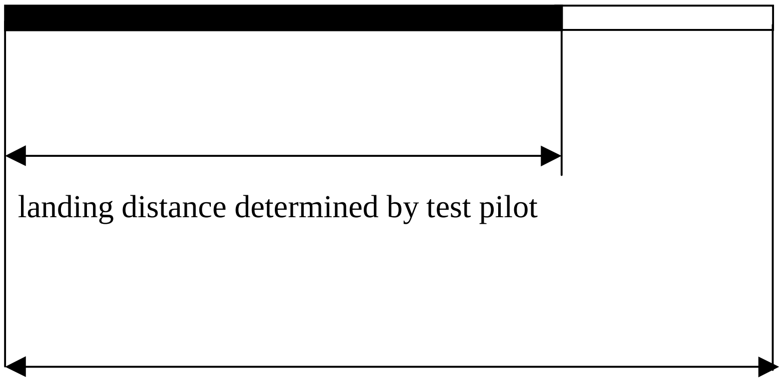


Figure 9.4-4: Actual landing distance with system malfunction.

A malfunction such as wheel brakes inoperative gives a larger factor than a one ENG INOP situation. These factors can be read off the malfunction table, see Figure 9.4-5.

With this method the pilot can determine his actual landing distance much more accurately. The table value is basically the AFM value multiplied by 0,6 and then multiplied by the appropriate malfunction factor.

Example:

- *LDW =130 t, WET RWY*
- *Malfunction: LE Edge Slat disagree*

Result:
AFM landing distance: 1433 m (includes 40% safety margin)
Actual landing distance: 1433 x 0,6 x 1,12 = 1107 m

This landing distance needs to be corrected for additional speed (above v_{ref}), height above the threshold, pressure altitude and wind (as explained below the table, see Figure 9.4-5, bottom).

Malfunctions	factors [illegible]	[illegible]
	30	25
one ENG inop (Flaps 20, 1 Reverser)	1,14	1,02
LE SLAT DISAGREE	1,12	0,99
LE SLAT ASYMMETRY FLAP < 20	1,37	1,21
LE SLAT ASYMMETRY FLAP > 20	1,30	1,15
LE SLAT extended, FLAP < 5	1,30	1,23
LE SLAT extended, FLAP 5-15	1,20	1,15
All configurations using Vref 20	1,12	0,90
No FLAP, No SLAT	1,45	1,45
REVERSER unlocked	1,37	1,25
HYDRAULIC SYSTEM C inop.	1,37	1,21
HYDRAULIC SYSTEM L + R inop.	1,48	1,43
HYDRAULIC SYSTEM C + R inop.	1,69	1,50
HYDRAULIC SYSTEM C + L inop.	1,69	1,50
ANTISKID inop.	2,14	2,11
WHEEL BRAKES inop.	3,40	3,40
Manual SPOILERS	1,18	1,08
SPOILERS inop.	1,43	1,35

Multiply landing distance by the following factors

for each 10 ft above normal threshold height	+ 70 m
for each 1000 ft above MSL	+ 60 m
for each 5 kts HWC	- 45 m
for each 5 kts TWC	+ 155 m

Figure 9.4-5: Malfunction correction factors (above) and correction factors for over-speed, height above threshold, wind component and airport elevation (below).

TABLE A 1

DRY

Flap	160 t	155 t	150 t	145 t	140 t	135 t	130 t	125 t	120 t	115 t	110 t
30	1617	1716	1616	1570	1524	1478	1433	1387	1341	1295	1250
1,14	1243	1174	1105	1074	1042	1011	980	949	917	886	855
1,12	1221	1153	1086	1056	1024	993	963	932	901	871	840
1,37	1493	1411	1328	1290	1253	1215	1178	1140	1102	1065	1027
1,30	1417	1338	1260	1224	1189	1153	1117	1082	1046	1010	975
1,30	1417	1338	1260	1224	1189	1153	1117	1082	1046	1010	975
1,20	1308	1236	1163	1130	1097	1064	1031	999	966	933	900
1,12	1221	1153	1086	1055	1024	993	963	932	901	871	840
1,45	1580	1493	1405	1366	1326	1286	1246	1207	1167	1127	1087
1,37	1493	1411	1328	1290	1253	1215	1178	1140	1102	1065	1027
1,37	1493	1411	1328	1290	1253	1215	1178	1140	1102	1065	1027
1,48	1613	1524	1435	1394	1353	1313	1272	1232	1191	1150	1110
1,69	1842	1740	1638	1592	1545	1499	1453	1406	1360	1314	1267
1,69	1842	1740	1638	1592	1545	1499	1453	1406	1360	1314	1267
2,14	2333	2203	2074	2016	1957	1898	1839	1781	1722	1663	1605
3,40	3706	3501	3295	3202	3109	3016	2922	2829	2736	2643	2549
1,18	1286	1215	1144	1111	1079	1047	1014	982	950	917	885
1,43	1559	1472	1386	1347	1308	1268	1229	1190	1151	1111	1072

Flap	182 t	180 t	178 t	176 t	174 t	172 t	170 t	168 t	166 t	164 t	162 t
25	2167	2134	2131	2097	2063	1999	1966	1936	1906	1876	1846
1,02	1326	1306	1304	1283	1263	1224	1203	1185	1167	1148	1130
0,99	1287	1267	1266	1246	1226	1188	1168	1150	1132	1115	1097
1,21	1573	1549	1547	1522	1498	1452	1427	1406	1384	1362	1341
1,16	1495	1472	1470	1447	1424	1380	1357	1336	1315	1295	1274
1,23	1967	1575	1572	1548	1523	1476	1451	1429	1407	1385	1363
1,16	1720	1472	1470	1447	1424	1380	1357	1336	1315	1295	1274
0,99	1287	1267	1266	1246	1226	1188	1168	1150	1132	1115	1097
1,45	1885	1856	1854	1824	1795	1740	1710	1684	1658	1632	1606
1,25	1625	1600	1598	1573	1548	1500	1474	1452	1430	1407	1385
1,21	1573	1549	1547	1522	1498	1452	1427	1406	1384	1362	1341
1,43	1859	1831	1828	1799	1770	1716	1687	1661	1636	1610	1584
1,50	1950	1920	1917	1887	1857	1800	1769	1742	1716	1689	1662
1,50	1950	1920	1917	1887	1857	1800	1769	1742	1716	1689	1662
2,11	2744	2701	2697	2655	2612	2531	2489	2451	2413	2375	2338
3,40	4421	4353	4346	4278	4210	4079	4011	3950	3889	3828	3767
1,08	1404	1383	1381	1359	1337	1296	1274	1255	1235	1216	1197
1,35	1755	1728	1726	1699	1671	1620	1592	1568	1544	1520	1496

Figure 9.4-6: Table A1 for dry Runway

TABLE A 2

WET

Flap	160 t	155 t	150 t	145 t	140 t	135 t	130 t	125 t	120 t	115 t	110 t
30	1817	1716	1615	1570	1524	1478	1433	1387	1341	1295	1250
1,14	1429	1350	1271	1235	1199	1163	1127	1091	1055	1019	983
1,12	1404	1326	1248	1213	1178	1142	1107	1072	1036	1001	966
1,37	1717	1622	1527	1484	1441	1397	1364	1311	1268	1226	1181
1,30	1629	1539	1449	1408	1367	1326	1285	1244	1203	1162	1121
1,30	1629	1539	1449	1408	1367	1326	1285	1244	1203	1162	1121
1,20	1504	1421	1338	1300	1262	1224	1186	1148	1110	1073	1035
1,12	1404	1326	1248	1213	1178	1142	1107	1072	1036	1001	966
1,45	1818	1717	1616	1571	1525	1479	1433	1388	1342	1296	1250
1,37	1717	1622	1527	1484	1441	1397	1354	1311	1268	1225	1181
1,37	1717	1622	1527	1484	1441	1397	1354	1311	1266	1225	1181
1,48	1855	1752	1650	1603	1556	1510	1463	1416	1370	1323	1276
1,69	2118	2001	1884	1830	1777	1724	1671	1617	1564	1511	1457
1,69	2118	2001	1884	1830	1777	1724	1671	1617	1564	1511	1457
2,14	2682	2534	2385	2318	2250	2183	2115	2048	1980	1913	1845
3,40	4262	4026	3790	3683	3575	3468	3361	3254	3146	3039	2932
1,18	1479	1397	1315	1278	1241	1204	1166	1129	1092	1055	1017
1,43	1792	1693	1594	1549	1504	1459	1414	1368	1323	1278	1233

Flap	182 t	180 t	178 t	176 t	174 t	172 t	170 t	168 t	166 t	164 t	162 t
25	2167	2134	2131	2097	2063	1999	1966	1936	1906	1876	1846
1,02	1525	1502	1499	1476	1452	1407	1384	1363	1342	1321	1300
0,99	1480	1457	1455	1432	1410	1366	1343	1323	1302	1282	1261
1,21	1809	1781	1779	1751	1723	1669	1641	1616	1592	1567	1542
1,15	1720	1693	1691	1664	1637	1587	1560	1536	1513	1489	1465
1,23	2262	1811	1808	1780	1751	1697	1669	1643	1618	1592	1567
1,15	1978	1693	1691	1664	1637	1587	1560	1536	1513	1489	1465
0,99	1480	1457	1455	1432	1410	1366	1343	1323	1302	1282	1261
1,45	2168	2135	2132	2098	2065	2000	1967	1937	1907	1877	1847
1,25	1869	1840	1838	1809	1780	1725	1696	1670	1644	1618	1593
1,21	1809	1781	1779	1751	1723	1669	1641	1616	1592	1567	1542
1,43	2138	2105	2102	2069	2036	1973	1940	1910	1881	1851	1822
1,50	2243	2208	2205	2170	2136	2069	2035	2004	1973	1942	1911
1,50	2243	2208	2205	2170	2136	2069	2035	2004	1973	1942	1911
2,11	3155	3106	3102	3053	3004	2911	2862	2819	2775	2732	2688
3,40	5084	5005	4998	4920	4841	4691	4612	4542	4472	4402	4332
1,06	1615	1590	1588	1563	1538	1490	1465	1443	1421	1398	1376
1,35	2019	1987	1985	1953	1922	1863	1831	1803	1776	1748	1720

Figure 9.4-7: Table A2 for wet runway

9.4.3 TABLES B1 AND B2

- Table B1 is for both reversers available, including a 15% margin for CAT I, II and III operations.
- Table B2 is for one or both reversers inoperative, again, including a 15% margin. The B767 can be dispatched with one reverser locked out.

These tables reflect the following thoughts:

On a given runway an aircraft shall be brought to a full stop within 80 percent of the runway. This means that if a runway is 3000 m in length (physical dimension), the landing distance must not exceed 3000 x 0,8 = 2400 m. For CAT I, II and III operations an additional safety margin of 15% is implemented, which means that in the above example that the landing distance must not exceed 3000 x 0,8 x 0,85 = 2040 m. (see Figure 9.4-8)

This calculation is reflected in the tables so the pilot does not need to do the mahts. A runway that has a physical length of 3000 m can only be used for an aircraft weight that results in a landing distance of less than 2040 m..

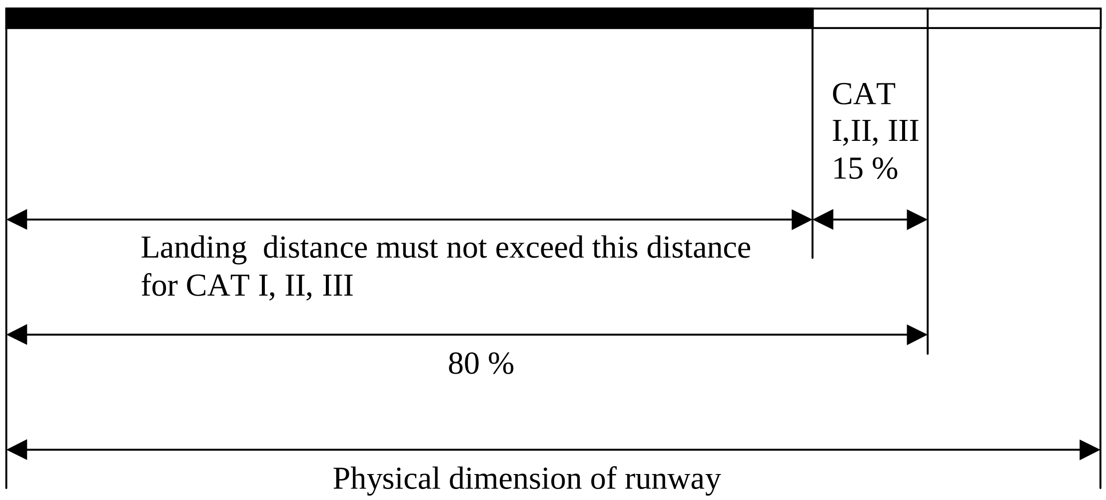


Figure 9.4-8: Reduction of physical runway length when it is dry.

Further reductions in "effective" runway length are possible when poor braking coefficients are reported. For the above example, a braking coefficient of 0,30 results in an effective runway length of only 1680 m. The worse the braking coefficient is, the smaller the effective runway length. As can be deduced from the table, in the above example a maximum crosswind component of 21 knots would apply. The lower the braking coefficient, i.e. a more slippery runway, the lower is the maximum allowable crosswind. The reduction in effective runway length because of a poor braking action is shown in Figure 9.4-8.

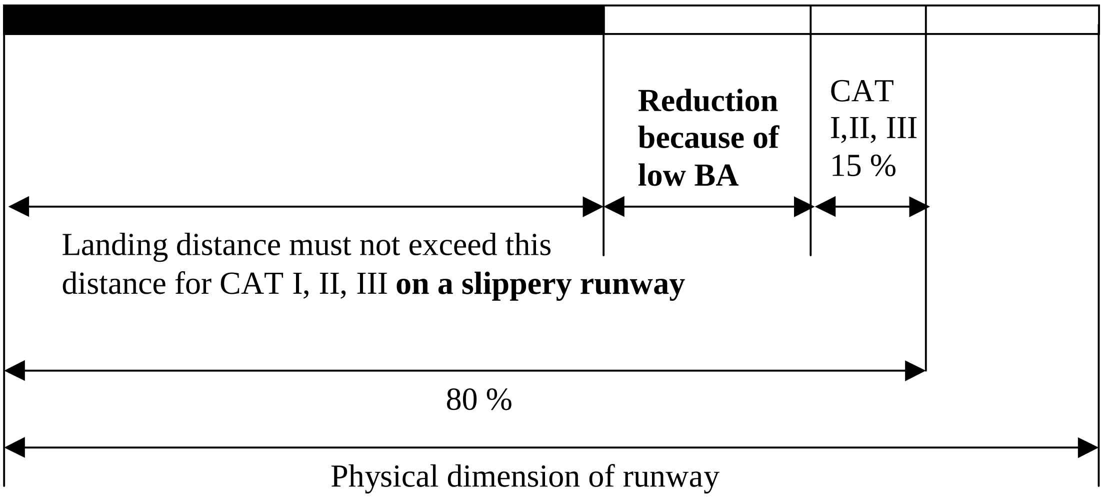


Figure 9.4-9: Reduction of physical runway length when it is slippery or contaminated.

Finally, tables B1 and B2 state runway reductions for "Speedbrake auto-deployment inoperative" and for "1 wheel brake deactivated". The reductions are 260 feet and 250 feet, respectively (not shown in the figures).

The landing distance data of tables A1 or A2 needs to be compared to the effective runway lengths of tables B1 or B2. If the values of the A-tables are smaller than the effective length shown on the B-tables, the aircraft can land safely.

TABLE B 1

RUNWAY REDUCTIONS -15 % for CAT I, II, III included

both REVERSERS

Available RWY in meters

	0,40	33	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
	0,39	32	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
	0,38	30	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
	0,37	28	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
	0,36	26	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
10%	0,35	25	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
11%	0,34	24	2512	2444	2376	2308	2240	2104	2036	1968	1900	1832	1764	1696	1628	1560	1492
	0,33	23	2440	2372	2304	2236	2168	2032	1964	1896	1828	1760	1692	1624	1556	1488	1420
	0,32	22	2368	2300	2232	2164	2096	1960	1892	1824	1756	1688	1620	1552	1484	1416	1348
	0,31	21	2296	2228	2160	2092	2024	1888	1820	1752	1684	1616	1548	1480	1412	1344	1276
25%	0,30	20	2224	2156	2088	2020	1952	1816	1748	1680	1612	1544	1476	1408	1340	1272	1204
26%	0,29	19	2152	2084	2016	1948	1880	1744	1676	1608	1540	1472	1404	1336	1268	1200	1132
	0,28	18	2080	2012	1944	1876	1808	1672	1604	1536	1468	1400	1332	1264	1196	1128	1060
	0,27	17	2008	1940	1872	1804	1736	1600	1532	1464	1396	1328	1260	1192	1124	1056	988
50%	0,26	16	1936	1868	1800	1732	1664	1528	1460	1392	1324	1256	1188	1120	1052	984	916
51%	0,25	15	1864	1796	1728	1660	1592	1456	1388	1320	1252	1184	1116	1048	980	912	844
	0,24	12	1792	1724	1656	1588	1520	1384	1316	1248	1180	1112	1044	976	908	840	772
	0,23	10	1720	1652	1584	1516	1448	1312	1244	1176	1108	1040	972	904	836	768	700
	0,21	7	1648	1580	1512	1444	1376	1240	1172	1104	1036	968	900	832	764	696	628
	0,20	5	1576	1508	1440	1372	1304	1168	1100	1032	964	896	828	760	692	624	556
			2024	1956	1888	1820	1752	1616	1548	1480	1412	1344	1276	1208	1140	1072	1004
			1464	1396	1328	1260	1192	1056	988	920	852	784	716	648	580	512	444
			-260														
			-250														

Figure 9.4-10: Table B1

TABLE B 2

RUNWAY REDUCTIONS -15 % for CAT I, II, III included

one or both REVERSER inop.

Available RWY in meters

	0,40	33	2584	2516	2448	2380	2312	2176	2108	2040	1972	1904	1836	1768	1700	1632	1564
	0,39	32	2504	2436	2368	2300	2232	2096	2028	1960	1892	1824	1756	1688	1620	1552	1484
	0,38	30	2424	2356	2288	2220	2152	2016	1948	1880	1812	1744	1676	1608	1540	1472	1404
	0,37	28	2344	2276	2208	2140	2072	1936	1868	1800	1732	1664	1596	1528	1460	1392	1324
	0,36	26	2264	2196	2128	2060	1992	1856	1788	1720	1652	1584	1516	1448	1380	1312	1244
10%	0,35	25	2184	2116	2048	1980	1912	1776	1708	1640	1572	1504	1436	1368	1300	1232	1164
11%	0,34	24	2104	2036	1968	1900	1832	1696	1628	1560	1492	1424	1356	1288	1220	1152	1084
	0,33	23	2024	1956	1888	1820	1752	1616	1548	1480	1412	1344	1276	1208	1140	1072	1004
	0,32	22	1944	1876	1808	1740	1672	1536	1468	1400	1332	1264	1196	1128	1060	992	924
	0,31	21	1864	1796	1728	1660	1592	1456	1388	1320	1252	1184	1116	1048	980	912	844
25%	0,30	20	1784	1716	1648	1580	1512	1376	1308	1240	1172	1104	1036	968	900	832	764
26%	0,29	19	1704	1636	1568	1500	1432	1296	1228	1160	1092	1024	956	888	820	752	684
	0,28	18	1624	1556	1488	1420	1352	1216	1148	1080	1012	944	876	808	740	672	604
	0,27	17	1544	1476	1408	1340	1272	1136	1068	1000	932	864	796	728	660	592	524
50%	0,26	16	1464	1396	1328	1260	1192	1056	988	920	852	784	716	648	580	512	444
51%	0,25	15	1384	1316	1248	1180	1112	976	908	840	772	704	636	568	500	432	364
	0,24	12	1304	1236	1168	1100	1032	896	828	760	692	624	556	488	420	352	284
	0,23	10	1224	1156	1088	1020	952	816	748	680	612	544	476	408	340	272	204
	0,21	7	1144	1076	1008	940	872	736	668	600	532	464	396	328	260	192	124
	0,20	5	1064	996	928	860	792	656	588	520	452	384	316	248	180	112	44
			1830	1745	1660	1575	1490	1320	1235	1150	1065	980	895	810	725	640	555
			1130	1045	960	875	790	620	535	450	365	280	195	110	25	-60	-145
			-260														
			-250														

Figure 9.4-11: Table B2

9.4.4 TABLES C1 AND C2

Tables C1 and C2 are equivalent to tables B1 and B2, except that the 15% margin is not considered. These tables, therefore, can be used whenever a 15% reduction in runway length is not needed, such as during landings other than in CAT I, II and III situations (visual approach, non precision approach)

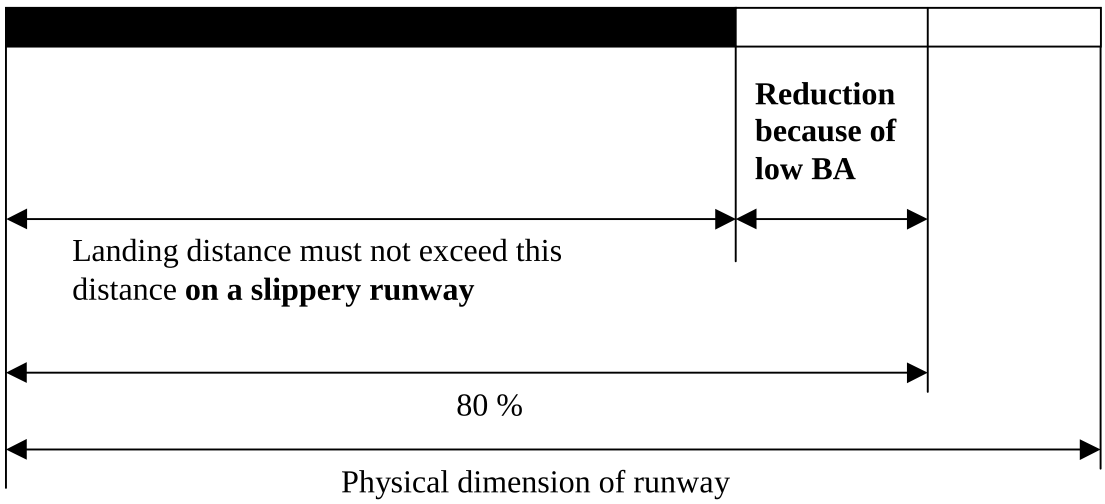


Figure 9.4-12: Reduction in physical runway length for other than dry runway. Here, a 15 % margin is not considered. Therefore, tables C1 and C2 are not valid for CAT I, II and III situations.

TABLE C 1

RUNWAY REDUCTIONS

both REVERSERS

Available RWY in meters

	0,40	33	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840
	0,39	32	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840
	0,38	30	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840
	0,37	28	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840
	0,36	26	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840
10%	0,35	25	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840
11%	0,34	24	2968	2888	2808	2728	2648	2568	2488	2408	2328	2248	2168	2088	2008	1928	1848	1768
	0,33	23	2896	2816	2736	2656	2576	2496	2416	2336	2256	2176	2096	2016	1936	1856	1776	1696
	0,32	22	2824	2744	2664	2584	2504	2424	2344	2264	2184	2104	2024	1944	1864	1784	1704	1624
	0,31	21	2752	2672	2592	2512	2432	2352	2272	2192	2112	2032	1952	1872	1792	1712	1632	1552
25%	0,30	20	2680	2600	2520	2440	2360	2280	2200	2120	2040	1960	1880	1800	1720	1640	1560	1480
26%	0,29	19	2608	2528	2448	2368	2288	2208	2128	2048	1968	1888	1808	1728	1648	1568	1488	1408
	0,28	18	2536	2456	2376	2296	2216	2136	2056	1976	1896	1816	1736	1656	1576	1496	1416	1336
	0,27	17	2464	2384	2304	2224	2144	2064	1984	1904	1824	1744	1664	1584	1504	1424	1344	1264
50%	0,26	16	2392	2312	2232	2152	2072	1992	1912	1832	1752	1672	1592	1512	1432	1352	1272	1192
51%	0,25	15	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120
	0,24	12	2248	2168	2088	2008	1928	1848	1768	1688	1608	1528	1448	1368	1288	1208	1128	1048
	0,23	10	2176	2096	2016	1936	1856	1776	1696	1616	1536	1456	1376	1296	1216	1136	1056	976
	0,21	7	2104	2024	1944	1864	1784	1704	1624	1544	1464	1384	1304	1224	1144	1064	984	904
	0,20	5	2032	1952	1872	1792	1712	1632	1552	1472	1392	1312	1232	1152	1072	992	912	832
			2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280
			1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800	720
			-260															
			-250															

Figure 9.4-13: Table C1

TABLE C 2

RUNWAY REDUCTIONS

one or both REVERSER inop.

Available RWY in meters

	0,40	33	3040	2960	2880	2800	2720	2640	2560	2480	2400	2320	-2240	2160	2080	2000	1920	1840
	0,39	32	2960	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760
	0,38	30	2880	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680
	0,37	28	2800	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600
	0,36	26	2720	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520
10%	0,35	25	2640	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440
11%	0,34	24	2560	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360
	0,33	23	2480	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280
	0,32	22	2400	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200
	0,31	21	2320	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120
25%	0,30	20	2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040
26%	0,29	19	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960
	0,28	18	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880
	0,27	17	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800
50%	0,26	16	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800	720
51%	0,25	15	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800	720	640
	0,24	12	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800	720	640	560
	0,23	10	1680	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800	720	640	560	480
	0,21	7	1600	1520	1440	1360	1280	1200	1120	1040	960	880	800	720	640	560	480	400
	0,20	5	1520	1440	1360	1280	1200	1120	1040	960	880	800	720	640	560	480	400	320
			2240	2160	2080	2000	1920	1840	1760	1680	1600	1520	1440	1360	1280	1200	1120	1040
			1360	1280	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680
			-260															
			-250															

Figure 9.4-14: Table C2

PERFORMANCE

JAR 25.101 General

(see AJC 25.101)

(a) Unless otherwise prescribed, aeroplanes must meet the applicable performance requirements of this Subpart for ambient atmospheric conditions and still air.

(b) The performance, as affected by engine power or thrust, must be based on the following relative humidities:

(1) 80%, at and below standard temperatures, and

(2) 34%, at and above standard temperatures plus 50°F.

Between these two temperatures, the relative humidity must vary linearly,

(c) The performance must correspond to the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in sub-paragraph (b) of this paragraph. The available propulsive thrust must correspond to engine power or thrust, not exceeding the approved power or thrust, less –

(1) installation losses, and

(2) The power or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight conditions (See AJC25.101 (c).)

(d) Unless otherwise prescirbed, the applicant must select the take-off, en-route, approach, and landing configuration for the aeroplane.

(e) The aeroplane configuration may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures established by the applicant for operation in service.

(f) Unless otherwise prescribed, in determining the accelerate-stop distances, take-off flight paths, take-off distances, and landing distances, changes in aeroplane´s configuration, speed, power and thrust, must be made in accordance with procedures established by the applicant for operation in service.

(g) Procedures for the execution of balked landings and missed approaches associated with the conditions prescribed in JAR 25.119 and 25.121 (d) must be established.

(h) The procedures established under sub-paragraph (f) and (g) of this paragraph must –

(1) Be able to be consistently executed in service by crews of average skill,

(2) Use methods or devices that are safe and reliable, and

(3) Include allowances for any time delays in the execution of the procedures, that may reasonably be expected in service. (See ACJ 25.101 (h)(3).)

JAR 25.103 Stall Speed

(a) The stall speed Vs must be determinded with –

(1) Zero thrust at the stall speed, or, if the resultant thrust has no appreciable effect on the stall speed, with engines idling and throttles closed;

(2) Propeller pitch controls (if applicable) in the position necessary for compliance with sub-paragraph (a) (1) of this paragraph and the aeroplane in other respects (such as flaps and landing gear) in the condition existing in the test in which Vs is being used;

(3) The weight used when Vs is being used as a factor to determine compliance with a required performance standard; and

(4) The aeroplane trimmed for straight flight at a speed selected by the applicant; but not less than 1.2 Vs and not greater than 1.4 Vs

(b) The stall speed Vs is the greater of –

(1) The minimum calibrated airspeed obtained when the aeroplane is stalled (or the minimum steady flight speed at which the aeroplane is controllable with the longitudinal control on its stop) as determined when the manoevre prescribed in JAR 25.201 and 25.203 is carried out with an entry rate not exceeding 1 knot per second (see ACJ 25.103 (b) (1); and

(2) A calibrated airspeed equal to 94% of the one-g stall speed, Vs_{1g}, determined in the same conditions.

(c) The one-g stall speed, Vs_{1q}, is the minimum calibrated airspeed at which the aeroplane can develop a lift force (normal to the flight path) equal to its weight, whilst at an angle of attack not greater than that at which the stall is identified. (See ACJ 25.103 (c).)

JAR 25. 105 Take-off

(a) The take-off speeds, described in JAR 25.107, the accelerate-stop distance described in JAR 25.109, the take-off path described in JAR 25.111, and the take-off distance and take-off run described in JAR 25.113, must be determined –

(1) At each weight, altitude, and ambient temperature within the operational limits selected by the applicant; and

(2) In the selected configuration for take-off.

(b) No take-off made to determine the data required by this section may require exceptional piloting skill or alertness.

(c) The take-off data must be based on a smooth, dry, hard-surfaced runway.

(d) The take-off data must include, within the established operational limits of the aeroplane, the following operational correction factors:

(1) Not more than 50% of nominal wind components along the take-off path opposite to the direction of take-off, and not less than 150% of nominal wind components along the take-off path in the direction of take-off.

(2) Effective runway gradients.

JAR 25,107 Take-off speeds

(a) V1 must be established in relation to VEF as follows;

(1) VEF is the calibrated airspeed at which the critical engine is assumed to fail. VEF must be selected by the applicant, but may not be less than VMCG determined under JAR 25.149 (e).

(2) V1, in terms of calibrated airspeed, is the take-off decision speed selected by the applicant; however, V1 may not be less than VEF plus the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed, and the instant at which the pilot recognises and reacts to the engine failure, as indicated by the pilot´s application of the first retarding means during accelerate-stop tests.

(b) V2min, in terms of calibrated airspeed, may not be less than –

(1) 1.2 Vs for

(i) Two-engined and three-engined turo-propeller powered aeroplanes; and

(ii) Turbo-jet powered aeroplanes without provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(2) 1.15 Vs for –

(j) Turbo-propeller powered aeroplanes with more than three engines; and

(ii) Turbo-jet powered aeroplanes with provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed; and

(3) 1.10 times VMC established under JAR 25.149

(c) V2, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by JAR 25.121 (b) but may not be less than –

(1) V2min, and

(2) VR plus the speed increment attained (in accordance with JAR 25.111 (c) (2)) before reaching a height of 35 ft above the take-off surface.

(e) VMU is the calibrated airspeed at and above which the aeroplane can safely lift off the ground, and continue the take-off. VMU speeds must be selected by the applicant throughout the range of thrust-to-weight rations to be certificated. These speeds may be established from free air data if these data are verified by ground take-off tests. [see ACJ 25.107 (d)]

(f) VR, in terms of calibrated airspeed, must be selected in accordance with the conditions of the sub-paragraphs (1) to (4) of this paragraph:

(1) VR may not be less than: -

(i) V1

(ii) 105% of VMC

(iii) The speed determined in accordance with JAR 25.111 (c) (2) that allows reaching V2 before reaching a height of 35 ft above the take-off surface; or

(iv) A speed that, if the aeroplane is rotated at its maximum practicable rate will result in a VLOF of not less than 110% of VMU in the all-engines-operating condition and not less than 105% of VMU determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition, except that in the particular case that lift-off is limited by the geometry of the aeroplane, or by elevator power, the above margins may be reduced to 108% in the all-engines operating case and 104% in the one-engine-inoperative condition. (See ACJ 25.107 (e) (1) (iv).)

(2) For any given set of conditions (such as weight, configuration, and temperature), a single value of VR, obtained in accordance with this paragraph, must be used to show compliance with both the one-engine-inoperative and the all engines-operating take-off provisions.

(3) It must be shown that the one-engine-inoperative take-off distance, using a rotation speed of 5 knots less than VR established in accordance with sub-paragraph (e) (1) and (2) of this paragraph, does not exceed the corresponding one-engine-inoperative take-off distance using the established VR. The take-off distances must be determined in accordance with JAR 25.113 (a) (1). (See ACJ 25.107 (e) (3).)

(4) Reasonably expected variations in service from established take-off procedures for the operation of the aeroplane (such as over-rotation of the aeroplane and out-of trim conditions) may not result in unsafe flight characteristics or in marked increases in the scheduled take-off distance established in accordance with JAR 25.113 (a). (See ACJ No. 1 to JAR 25.107 (e) (4) and ACJ No. 2 to JAR 25.107 (e) (4).)

(g) VLOF is the calibrated airspeed at which the aeroplane first becomes airborne.

JAR 25.109 Accelerate-stop distance

(a) The accelerate-stop distance (see ACJ 25.109 (a)) is the greater of the following distances:

(1) The sum of the distances necessary to –

(i) Accelerate the aeroplane from a standing start to VEF with all engines operating;

(ii) Accelerate the aeroplane from VEF to V1 and continue the acceleration for 2.0 seconds after V1 is reached, assuming the critical engine fails at VEF, and

(iii) Come to a full stop from the point reached at the end of the acceleration period prescribed in sub-paragraph (a) (1) (ii) of this paragraph, assuming that the pilot does not apply any means of retarding the aeroplane until that point is reached and that the critical engine is still inoperative.

(2) The sum of the distances necessary to –

(i) Accelerate the aeroplane from a standing start to V1 and continue the acceleration for 2.0 seconds after V1 is reached with all engines operating; and

(ii) Come to a full stop from the point reached at the end of the acceleration period prescribed in sub-paragraph (a)(2)(i) of this paragraph, assuming that the pilot does not apply any means of retarding the aeroplane until that point is reached and that all engines are still operating.

(b) Means other than wheel brakes may be used to determine the accelerate-stop distance if that means –

(1) Is safe and reliable;

(2) Is used so that consistent results can be expected under normal operating conditions; and

(3) Is such that exceptional skill is not required to control the aeroplane.

(c) The landing gear must remain extended throughout the accelerate-stop distance.

(d) If the accelerate-stop distance includes a stopway with surface characteristics substantially different from those of a smooth hard-surfaced runway, the take-off data must include operational correction factors for the accelerate-stop distance. The correction factors must account for the particular surface characteristics of the stopway and the variations in these characteristics with seasonal weather conditions (such as temperature, rain, snow, and ice) within the established operational limits.

JAR 25.111 Take-off path
(See ACJ 25.111)

(a) The take-off path extends from a standing start to a point in the take-off at which the aeroplane is 1500 ft above the take-off surface, or at which the transition from take-off to the enroute configuration is completed and a speed is reached at which compliance with JAR 25.121 (c) is shown, whichever point is higher. In addition –

(1) The take-off path must be based on the procedures prescribed in JAR 25.101 (‘f);

(2) The aeroplane must be accelerated on the ground to VEF, at which point the critical engine must be made inoperative and remain inoperative for the rest of the take-off; and

(3) After reaching VEF, the aeroplane must be accelerated to V2.

(b) During the acceleration to speed V2, the nose gear may be raised off the ground at a speed not less than VR. However, landing gear retraction may not be begun until the aeroplane is airborne. (See ACJ 25.111 (b).)

(c) During the take-off path determination in accordance with sub-paragraph (a) and (b) of this paragraph –

(1) The slope of the airborne part of the take-off path must be positive at each point;

(2) The aeroplane must reach V2 before it is 35 ft above the take-off surface and must continue at a speed as close as practical to, but not less than V2 until it is 400 above the take-off surfac;

(3) At each point along the take-off path, starting at the point at which the aeroplane reaches 400 ft above the take-off surface; the available gradient of climb may not be less than

(i) 1.2% for two-engined aeroplanes;

(ii) 1.5% for three-engined aeroplanes

(iii) 1.7% for four-engined aeroplanes, and

(4) Except for gear retraction and <u>automatic</u> propeller feathering, the aeroplane configuration may not be changed, and no change in power or thrust that requires action by the pilot may be made, until the aeroplane is 400 ft above the take-off surface.

(d) The take-off path must be determined by a continuous demonstrated take-off or by synthesis from segments. If the take-off path is determined by a segmental method –

(1) The segments must be clearly defined and must relate to the distinct changes in the configuration; power or thrust, and speed;

(2) The weight of the aeroplane, the configuration, and the power or thrust must be constant throughout each segment and must correspond to the most critical condition prevailing in the segment;

(3) The flight path must be based on the aeroplane´s performance without ground effect; and

(4) The take-off path data must be checked by continuous demonstrated take-off up tp the point at which the aeroplane is out of ground effect and its speed is stabilised, to ensure that the path is conservative to the continuous path.

The aeroplane is considered to be out of ground effect when it reaches a height equal to its wing span

(e) *not required for JAR-25*

JAR 25.113 Take-off distance and take-off run

(a) Take-off distance is the greater of –

(1) The horizontal distance along the take-off path from the start of the take-off to the point at which the aeroplane is 35 ft above the take-off surface, determined under JAR 25.111 or

(2) 115% of the horizontal distance along the take-off path, with all engines operating, from the start of the take-off to the point at which the aeroplane is 35 ft above the take-off surface, as determined by a procedure consistent with JAR 25.111. (See ACJ 25.113 (a)(2).)

(b) If the take-off distance includes a clearway, the take-off run is the greater of –

(1) The horizontal distance along the take-off path from the start of the take-off to a point equidistant between the point at which the aeroplane is 35 ft above the take-off surface, as determined by a procedure consistent with JAR 25.111. (See ACJ 215.113 (a) (2).)

(b) If the take-off distance includes a clearway, the take-off run is the greater of –

(1) The horizontal distance along the take-off path from the start of the take-off to a point equidistant between the point at which VLOF is reached and the point at which the aeroplane is 35 ft above the take-off surface, as determined under JAR 25.111; or

(2) 115% of the horizontal distance along the take-off path, with all engines operating, from the start of the take-off to a point equidistant between the point at which the aeroplane is 35 ft above the take-off surface, determined by a procedure consistent with JAR 25.111. (See ACJ 25.113 (a) (2).)

JAR 25.115 Take-off flight path

(a) The take-off flight path begins 35 ft above the take-off surface at the end of the take-off distance determined in accordance with JAR 25.113 (a)

(b) The net take-off flight path data must be determined so that they represent the actual take-off flight paths (determined in accordance with JAR 25.111 and with sub-paragraph (a) of this paragraph) reduced at each point by a gradient of climb equal to –

(1) 0.8% for two-engined aeroplanes;

(2) 0.9% for three-engined aeroplanes;

and

(3) 1.0% for four-engined aeroplanes.

(c) The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration along that part of the take-off flight path at which the aeroplane is accelerated in level flight.

JAR 25.117 Climb:general

Compliance with the requirements of JAR 25.119 and 25.121 must be shown at each weight, altitude and ambient temperature within the operational limits established for the aeroplane and with the most unfavourable centre of gravity for each configuration.

JAR 25.119 Landing Climb: all-engines operating

In the landing configuration, the steady gradient of climb may not be less than 3.2%, with –

(a) The engines at the power or thrust that is available 8 seconds after initiation of movement of the power or thrust controls from the minimum flight idle to the take-off position (see ACJ 25.119 (a)); and

(b) A climb speed which is –

(i) 1.15 Vs for aeroplanes with four engines on which the application of power results in a significant reduction in stalling speed; or

(ii) 1.2 Vs for all other aeroplanes;

(2) Not less than VMCL; and

(3) Not more than the greater of 1.3 Vs and VMCL.

JAR 25.121 Climb: one-engine inoperative
(See ACJ 25.121)

(a) *Take-off: landing gear extended*. (See ACJ 15.121 (a).) In the critical take-off configuration existing along the flight path (between the points at whicht the aeroplane reaches VLOF and at whicht the landing gear is fully retracted) and in the configuration used in JAR 25.111 but without ground effect, the steady gradient of climb must be positive for two-engined aeroplanes, and not less than 0.3% for three-engined aeroplanes or 0.5% for four-engined aeroplanes, at VLOF and with –

(1) The critical engine inoperative and the remaining engines at the power or thrust available when retraction of the landing gear is begun in accordance with JAR 25.111 unless there is a more critical power operating condition existing later along the flight path but before the point at which the landing gear is fully retracted (see ACJ 25.121 (a) (1)); and

(2) The weight equal to the weight existing when retraction of the landing gear is begun determined under JAR 25.111.

(b) *Take-off; landing gear retracted*. In the take-off configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in JAR 25.111 but without ground effect, the steady gradient of climb may not be less than 2.4% for two-engined aeroplanes, 2.7% for three-engined aeroplanes and 3.0% for four-engined aeroplanes, at V2 and with –

(1) The critical engine inoperative, the remaining engines at the take-off power or thrust available at the time the landing gear is fully retracted, determined under JAR 25.111, unless there is a more critical power operating condition existing later along the flight path but before the point where the aeroplane reaches a height of 400 ft above the take-off surface (see ACJ 25.121 (b) (1)); and

(2) The weight equal to the weight existing when the aeroplane´s landing gear is fully retracted, determined under JAR 25.111.

(c) *Final take-off*. In the en-route configuration at the end of the take-off path determined in accordance with JAR 25.111, the steady gradient of climb may not be less than 1.2% for two-engined aeroplanes, 1.5% for three-engined aeroplanes, and 1.7% for four-engined aeroplanes, at not less than 1.25 Vs and with –

(1) The critical engine inoperative and the remaining engines at the available maximum continuous power or thrust; and

(2) The weight equal to the weight existing at the end of the take-off path determined under JAR 25.111.

(d) *Discontinued Approach*. In a configuration in which Vs does not exceed 110% of the Vs for the related all-engines operating landing configuration, the steady gradient may not be less than 2.1% for two-engined aeroplanes, 2.4% for three-engined aeroplanes and 2.7% for four-engined aeroplanes, with –

(1) The critical engine inoperative, the remaining engines at the available take-off power or thrust;

(2) The maximum landing weight; and

(3) A climb speed established in connection with normal landing procedures, but not exceeding 1.5 Vs

(4) Landing gear retracted.

JAR 25.123 En-route flight paths
(See ACJ 25.123)

(a) For the en-route configuration, the flight paths prescribed in sub-paragraph (b) and (c) of this paragraph must be determined at each weight, altitude, and ambient temperature, within the operating limits established for the aeroplane. The variation of weight along the flight path, accounting for the progressive consumption of fuel and oil by the operating engines, may be included in the computation. The flight paths must be determined at any selected speed, with –

(1) The most unfavourable centre of gravity;

(2) The critical engines inoperative;

(3) The remaining engines at the available maximum continuous power or thrust; and

(4) The means for controlling the engine cooling air supply in the position that provides adequate cooling in the hot-day condition.

(b) The one-engine inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 1.1% for two-engined aeroplanes, 1.4% for three-engined aeroplanes, and 1.6% for four-engined aeroplanes.

(c) For three-or four-engined aeroplanes, the two-engine inoperative net flight path data must represent the actual climb performance diminished by a dimb gradient of 0.3% for three-engined aeroplanes and 0.5% for four-engined aeroplanes.

JAR 25.125 Landing

(a) The horizontal distance necessary to land and to come to a complete stop from a point 50 ft above the landing surface must be determined (for standard temperatures, at each weight, altitude and wind within the operational limits established by the applicant for the aeroplane) as follows:

(1) The aeroplane must be in the landing configuration.

(2) A stabilised approch, with a calibrated airspeed of not less than 1.3 Vs, must be maintained down to 50 ft height. (See ACJ 25.125 (a)(2).)

(3) Changes in configuration, power or thrust, and speed, must be made in accordance with the established procedures for service operation. (See ACJ 25.125(a)(3).)

(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over or ground loop.

(5) The landings may not require exceptional piloting skill or alertness.

(b) The landing distance must be determined on a level, smooth, dry hard-surfaced runway. (See ACJ 25.125(b).) In addition –

(1) The pressures on the wheel braking systems may not exceed those specified by the brake manufacturer;

(2) The brakes may not be used so as to cause excessive wear of the brakes or tyres (see ACJ 25.125 (b)(2)); and

(3) Means other than wheel brakes may be used if that means

(i) Is safe and reliable;

(ii) Is used so that consistent results can be expected in service; and

(iii) Is such that exceptional skill is not required to control the aeroplane.

(c) *Not required for* JAR-25

(d) *Not required for* JAR-25

(e) The landing distance data must include correction factors for not more than 50% of the nominal wind components along the landing path opposite to the direction of landing, and not less than 150% of the nominal wind components along the landing path in the direction of landing.

(f) If any device is used that depends on the operation of any engine, and if the landing distance would be noticeably increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of compensating means will result in a landing distance not more than that with each engine operating.

10.1.1 FULL FLIGHT SIMULATOR SESSION 1

PART 1 (PF - Captain)

1.0	SIM-Setup:	Rte: VTBD SELKA 5A SELKA VHHH
	WX: VTBD	220/5 CAVOK 28/26 1013 NoSig
1.1	Reposition page:	T/O & Arrival **VTBD Rwy21R**, AC Gate 22
1.2	Flight status:	ZFM: **120.0**TfUEL: **20.0t** Mac T/O: 24 Turbulence 3%
1.3	Airfield conditions:	QNH **1013**, OAT **28**, WIND **220/5,** Rwy roughness **3,**Rwy **DRY**
1.4	Visual setup:	Vis/RVR **15km, DAY**, Cloud base & top **7000ft**.
2.0	Preflight & Takeoff	
2.1	Normal start	PUSH BACK – BRAVO FACING NORTH
2.2	Normal takeoff	SELKA 5A SELKA
3.0	Airwork:	
3.1		**STEEP TURNS** 250kts, L&R, A/P A/T & FD – OFF
3.2		**STALLS** a. CLEAN Gear Up 0ºAOB 45-50% N_1 b. FLAPS20 Gear Up 25ºAOB 45-50% N_1 c. FLAPS30 Gear Down 0ºAOB 50-55% N_1
3.3	Climb FL330	**HIGH SPEED BUFFET & RECOVERY** **HIGH ALTITUDE STALL Both pilots**
3.4	Emergency descent	**RAPID DECOMPRESSION** (Aircondition & pressurization)
4.0	Demo app & ldg	VTBD ILS 21R & AUTOLAND

PART 2 (PF - First Officer)

1.0	SIM-Setup:	Rte: VTBD SELKA 5A SELKA VHHH
	WX: VTBD	220/5 CAVOK 28/26 1013 NoSig
1.1	Reposition page:	T/O & Arrival **VTBD Rwy21R**, AC Take off
1.2	Flight status:	ZFM: **120.0t** FUEL: **20.0t** Mac T/O: **24** Turbulence **3%**
1.3	Airfield conditions:	QNH **1013**, OAT **28,** WIND **220/5,** Rwy roughness **3**, Rwy **DRY**
1.4	Visual setup:	Vis/RVR **15km, DAY**, Cloud base & top **7000ft.**
2.0	Takeoff	
2.1	Normal takeoff	SELKA 5A SELKA
3.0	Airwork:	
3.1	Normal climb toFL100	LNAV, VNAV
3.4		**STEEP TURNS** 250kts, L&R, A/P A/T & FD – OFF
3.5		**STALLS** a. CLEAN Gear Up 0ºAOB 45-50% N_1 a. FLAPS20 Gear Up 25ºAOB 45-50% N_1 a. FLAPS30 Gear Down 0ºAOB 50-55% N_1
4.0	Manual app & ldg	VTBD ILS 21R

Manipulation SESSION 1

Traffic Patterns Both Pilots BTS

1.0	SIM –Set up:	
1.1	WX. LZIB	Calm Cavok 15/5 1013
1.2	Reposition page	T/O **LKIB RWY 31**,Arrival **LKIB RWY 31** A/C **T/O POSITION**
1.3	Flight status	ZFM **95.0 t** FUEL **25.0t** Mac T/O **24** Turbulence **3%**
1.4	Airfield conditions	QNH **1013** OAT **15** WIND **CALM** RWY roughness **1%** BA **GOOD RWY DRY**
1.5	Visual set up	**CLEAR DAY**

10.1.2 FULL FLIGHT SIMULATOR SESSION 2

PART 1 (PF - First Officer)

1.0	SIM-Setup:	Rte: LOWW KOXAR 2B DCT LHBP
	WX: LOWW	*250/15 1000m OVC005 05/03 1013 Bcmg 5000m OVC010*
1.1	Reposition page:	T/O & Arrival **LOWW Rwy 16**
1.2	Flight status:	ZFM: **110.0t** FUEL: **20.0t**Mac T/O**: 24** Turbulence **3%**
1.3	Airfield conditions:	QNH **1013**, OAT **5,** WIND **250/15**, Rwy roughness **3,** Rwy **DRY**
1.4	Visual setup:	Vis/RVR **1000m**, **DUSK**, Cloud base **500ft** & tops **7000ft.**
2.0	Preflight & Takeoff:	
2.1	Abnormal starts	**R ENG HOT START** (Engine start) **L ENG STARTER AUTO CUT-OUT FAILS** (Engine start)
2.2	Normal takeoff	Rwy 16 KOXAR 2B FPR
3.0	Normal climb FL100	
3.1	BOTH PILOTS!	**STEEP TURNS** 250kts, L&R, A/P A/T & FD – OFF
3.2	BOTH PILOTS!	**STALLS** a. CLEAN Gear Up 0°AOB 45-50% N_1 a. FLAPS20 Gear Up 25°AOB 45-50% N_1 a. FLAPS30 Gear Down0°AOB 50-55% N_1
3.3	Hydraulic malfunction	**HYDRAULIC C SYSTEM LEAK 75%** (Hydraulics)
4.0	First approach:	ILS 16 & Land

5.0 5.2 5.3	**Second departure**: Normal takeoff Flap/Slat malfunction During retraction	LOWW – LOWW Rwy 29 KOXAR 6C Flaps 1 - 0 **LE OUTBD SLATS STUCK** (Flight controls)
6.0	Second approach:	NDB Rwy 29 Circle Rwy 11
6.1 6.2	Reposition page: Visual setup:	T/O **LOWW Rwy 29** Arrival **LOWW Rwy 11** Vis/RVR **5000m** Cloud base **1500 ‘** **WIND CHANGE 110/15**

PART 2 (PF - Captain)

1.0	SIM-Setup:	Rte: LOWW KOXAR 2B DCT LHBP
  1.1 1.2 1.3 1.4	*WX: LOWW* Reposition page: Flight status: Airfield conditions: Visual setup:	*250/15 1000m OVC005 05/03 1013 Bcmg 5000m OVC010* T/O & Arrival **LOWW Rwy 16** ZFM: **110.0t** FUEL**: 20.0**tMac T/O: **24** Turbulence **3%** QNH **1013,** OAT **5,** WIND **200/15**, Rwy roughness **3,** Rwy **DRY** Vis/RVR **1000m, DUSK,** Cloud base **500ft** & tops **10000f**t.
2.0	Takeoff:	
2.1	Normal Take Off	Rwy 16 KOXAR 2B FPR
3.0	Airwork:	
3.1 3.2	Normal Climb FL50 Hydraulic Malfunction	 **HYD R SYSTEM LEAK 100%** (Hydraulics) **HYD C SYSTEM LEAK 60%** (Hydraulics)
4.0	Approach: Reposition page Visual setup	ILS 11 & Land **Wind change 120/15** Arrival **LOWW Rwy 11** Vis/RVR **1000m, DUSK**, Cloud base **300ft**

Manipulation SESSION 2
Engine out Familiarisation Both Pilots

1.0	SIM –Set up:	
1.1	Wx. LOWW	Calm Cavok 15/5 1013
1.2	Reposition page	T/O **LOWW Rwy 16,** Arrival LOWW Rwy 16 **A/C T/O POSITION**
1.3	Flight status	ZFM **95.0 t** FUEL **50.0t** Mac T/O **24** Turbulence **3%**
1.4	Airfield conditions	QNH **1013** OAT **15** WIND **CALM** RWY roughness 1 BA **GOOD** RWY **DRY**
1.5	Visual set up	**CLEAR DAY** Progressively reduce RVR and introduce Night during the hour.

10.1.3 FULL FLIGHT SIMULATOR SESSION 3

PART 1 (PF - Captain)

1.0	SIM-Setup:	Rte: VTBD – VTBD
 1.1 1.2 1.3 1.4	*WX: VTBD* Reposition page: Flight status: Airfield conditions: Visual Setup:	*250/15 5000m OVC008 35/27 1008 No Sig* T/O & Arrival **VTBD Rwy 21R** AC position **Take off** ZFM: **120.0t** FUEL: **25.0t**Mac T/O: **24** Turbulence **3%** QNH **1008**, OAT**35**, WIND **250/15**, Rwy roughness **3,** Rwy **DRY** Vis/RVR **5000m, DAWN**, Cloud base **800ft** & tops **10000ft**.
2.0	Preflight:	
2.1	Abnormal starts	**R ENG OIL PRESS SENSOR FAIL** (Engine oil) **L ENG TAILPIPE FIRE** (Report from grd eng)
3.0	First departure:	
3.1 3.2 3.3 3.4 3.6 3.7	Takeoff rwy 21R Instrument failure Pack malfunction Rapid climb FL310 Emergency descent without CAPTAIN Double Engine failure	NORTH EAST 5A SELKA FL330 **3000ft L SYM GEN FAILURE** (Flight instrument 2) **6000ft R PACK HIGH OUTLET TEMP** (Aircondition & pressurization) (Note: Increase IAS to 340kts before rapid climb) **RAPID DECOMPRESSION** (Aircondition & pressurization) Captain in cockpit at 10,000' **10000ft L& R ENG FLAMEOUT** (Engines)
4.0	First approach	Single engine ILS 21R & LAND

5.0	Second departure:	
5.1	Reposition page:	AC position **T/O Rwy 21R**
5.2	Takeoff Rwy 21R	Rwy hdg 3000ft
5.3	Rejected takeoff	**132kts R ENGINE FIRE (**Engines) **ATC Advises right engine is on fire** **Pax evacuation**
5.4	Reposition page:	AC position **T/O Rwy 21R**
5.5	Takeoff Rwy 21R	**147kts L ENG EFF VARY** (Engine efficiency)
5.6	Second approach	21R VOR/DME circle 03L **wind change 000/20** T/O **VTBD Rwy 21R** Arrival **VTBD Rwy 03L**

PART 2 (PF - First Officer)

1.0	**SIM-Setup:**	Rte: VTBD – VTBD
	WX: VTBD	*250/15 5000m OVC008 35/27 1008 No Sig*
1.1	Reposition page:	T/O & Arrival **VTBD Rwy 21R** AC position **Gate 22**
1.2	Flight status:	ZFM: **120.0t** FUEL: **25.0t**Mac T/O: **24** Turbulence **3%**
1.3	Airfield conditions:	QNH **1008, OAT 35**, WIND **250/15**, Rwy roughness **3**,Rwy **DRY**
1.4	Visual setup:	Vis/RVR **1000m**, **DAWN,** Cloud base **800ft** & tops **10000ft.**
2.0	**First departure:**	
2.1	Takeoff Rwy 21R	Radar vectors 5000ft **FLAMEOUT L** (malfunction panel) reset before relight
2.2	Engine indications	**FIRE L** (malfunction panel)
2.3		
3.0	**Approach:**	ILS 21R & Circle 03L T/O **VTBD Rwy 21R** Arrival **VTBD Rwy 03L**

Manipulation SESSION 3

GO-AROUNDS Both Pilots

1.0	SIM –Set up:	
1.1	Wx. LOWW	Calm Cavok 15/5 1013
1.2	Reposition page	T/O **LOWW Rwy 16,** Arrival **LOWW Rwy 16 A/C T/O POSITION**
1.3	Flight status	ZFM **95.0 t** FUEL **35.0t** Mac T/O **24** **(INC FUEL TO 60.0t For AMLM)**
1.4	Airfield conditions	QNH **1013** OAT **15** WIND **CALM** RWY roughness 1 BA **GOOD** RWY **DRY**
1.5	Visual set up	**CLEAR DAY** Progressively reduce RVR and introduce Night during the hour.

10.1.4 FULL FLIGHT SIMULATOR SESSION 4

PART 1 (PF - First Officer)

1.0	**SIM-Setup:**	
	WX: LOWW	*200/15 800m OVC006 2/2 1004 Bcmg 5000m OVC010*
1.1	Reposition page:	T/O **LOWW Rwy 29,** Arrival **LOWW Rwy 16** AC **T/O position**.
1.2	Flight status :	ZFM:**120,0 t** FUEL:**66.0t** Mac T/o: **24** Turbulence **3%**
1.3.	Airfield conditions:	QNH **1004,** OAT **2,** WIND **200/15**, RWY roughness **1**, BA **GOOD**, RWY **DRY**
1.4	Visual setup:	Vis/RVR **800m NIGHT** Cloud base **600ft** tops **10000ft.**
2.0	**First departure:**	
2.1	Start	**ENG N1 TAHC XMTR FAILS** (Eng efficiency)
2.2	Rejected takeoff:	**L ASI LOW INDICATION** (Flight instruments)
2.3	Takeoff	LIMRA 6C
2.4		5000FT **L ASI LOW INDICATION** (Flight instruments)
2.5	Cruise FL150	**L ENG FLAMEOUT** (Engines) **FUEL JETTISON**
3.0	**First approach:**	LOWW ILS16
3.1	Reposition page:	T/O & Arrival **LOWW Rwy 16**
3.2	Visual setup:	Cloud base **100ft**
4.0	**Go around:**	
4.1		Radar vectors to BRK
5.0	**Second approach:**	NDB 29
	WX: LOWW	*200/15 5000m OVC007 2/2 1004*
5.1	Reposition page:	T/O & Arrival **LOWW Rwy 29**
5.2	Visual setup:	Vis/RVR **5000m** Cloud base **700ft**

6.0	**Second departure:**	**MEL: FUEL JETTISON INOP**
6.1 6.2 6.3	Flight status: Visual setup: Takeoff Rwy 29	Fuel: **50.0t** (Takeoff speeds from QRH) Vis/RVR **5000m** Cloud base **1200ft** 160kts **R ENG EFF VARY** (Engine efficiency)
7.0	**Final approach:**	NDB 11 to CIRCLE 29
7.1 7.2	Reposition page: Visual setup:	T/O **LOWW Rwy 11** Arrival **LOWW Rwy 29** Lights **VASI's OFF**

PART 2 (PF - Captain)

1.0	**SIM-Setup:**	
  1.1 1.2 1.3. 1.4	*WX: LOWW* Reposition page: Flight status : Airfield conditions: Visual setup:	*200/15 800m OVC006 2/2 1014 Bcmg 5000m OVC010* T/O **LOWW Rwy 29,** Arrival **LOWW Rwy 16** AC **T/O position**. ZFW:**120,0 t** FUEL:**66.0t** Mac T/o: **24** Turbulence **3%** QNH **1004,** OAT **2,** WIND **200/15**, RWY roughness **1**, BA **GOOD**, RWY **DRY** Vis/RVR **800m NIGHT** Cloud base **500ft** tops **10000ft**
2.0	**First departure:**	
2.1 2.2	Takeoff Engine failure	LIMRA 6C 164 kts **R ENG SEIZE** (Engine) **FUEL JETTISON**
3.0	**First approach:**	LOWW CAT I ILS 16
3.1 3.2	Reposition page: Visual setup:	T/O & Arrival **LOWW Rwy 16** Cloud base **100ft**
4.0	**Go around:**	
4.1		Radar Vectors to BRK

5.0	**Second approach:**	NDB 29
	WX: LOWW	*200/15 5000m OVC007 2/2 1004*
5.1	Reposition page:	T/O & Arrival **LOWW Rwy 29**
5.2	Visual setup:	Vis/RVR **5000m** Cloud base **700ft**

WINDSHEAR-Training:
- **PF CAPTAIN & FIRST OFFICER**
- **3 TAKE OFFS & 3 LANDINGS/GO AROUNDS EACH**

	WINDSHEAR Visual set up	**TAKE OFF & ARRIVAL RWY 16 CAVOK CONDITIONS DAY**
TAKE OFF	Airfield conditions	QNH **1008** OAT **28** WIND **160/20**
	Flight status	ZFM **120t** Fuel **50t**
	Reposition page	TAKE OFF
		WINDSHEAR PROFILES
LANDING	Reposition page	**6 NM FINAL** ZFM **120t** Fuel **25t**
	Flight status	ZFM **120t** Fuel **25t**

Manipulation – SESSION 4

CDR Right hand seat training
- engine failure on take off V1 or later
- engine failure on approach and land
- engine failure during go-around

1.0	SIM –Set up:	
1.1	Wx. LOWW	Calm Cavok 15/5 1013
1.2	Reposition page	T/O **LOWW Rwy 16,** Arrival **LOWW Rwy 16 A/C T/O POSITION**
1.3	Flight status	ZFM **95.0 t** FUEL **35.0t** Mac T/O **24**
1.4	Airfield conditions	QNH **1013** OAT **15** WIND **CALM** RWY roughness 1 BA **GOOD** RWY **DRY**
1.5	Visual set up	Instructors discretion

Time remaining is to be used reviewing asymmetric operations and go-arounds.

10.1.5 FULL FLIGHT SIMULATOR SESSION 5

PART 1 (PF - Captain)

1.0	**SIM-Setup:**	Rte: LIMC BZO 7E DCT SNU DCT LOWW
	WX: LIMC	*230/5 250m RVR35R-300m RA OVC001 12/11 1010 85290193*
1.1	Reposition page:	T/O **LIMC Rwy 35R,** Arrival **LOWW Rwy 29** AC **T/O position**.
1.2	Flight status :	ZFM:**110,0t** FUEL:**20,0t** Mac T/o: **24** Turbulence **3%**
1.3.	Airfield conditions:	QNH **1010,** OAT **12,** WIND **230/5**, RWY roughness **1**, BA **MED**, RWY **WET**.
1.4	Visual setup:	Vis/RVR **300m**, **DAY,** Cloud base **100ft**, tops **10000ft.**
2.0	**LOFT MXP - VIE:**	**MEL - APU INOP.**
2.1	Start	**BATTERY PWR START.** External air start and cross bleed start
2.2	Takeoff Rwy 35R	BZO 7E (Climb FL270)
2.3	Instrument failure:	1500ft **R EADI ROLL & PITCH** (Flight instruments 2)
2.4	BOTH PILOTS, with & without Autopilot Stab Trim malfunctions	FL150 **RUNAWAY STAB TRIM & UNSCHED STAB TRIM NORM ELECT CONT** (Flight controls) RESET system after demonstration.
2.5	Electrical failure:	FL240: **R IDG OVERFREQUENCY** (Electics 2) .
2.6		FL270: **L AC LOAD HIGH** (Electrics 2)
2.7	x2 to reduce transit time	TOD **L OVERVOLTAGE** (Electrics 1)
3.0	**First approach:**	LOWW ILS 29 **RAW DATA (FD OFF)**
	WX: LOWW	*310/15 1500 OVC004 12/11 1010*
3.1	Airfield conditions:	WIND **310/15kt**, BA **GOOD**, RWY, **DRY**
3.2	Reposition page:	T/O & Arrival **LOWW Rwy 29**
3.3	Visual setup:	Vis/RVR **0m**, Cloud base **400ft**,

4.0	**Go around:**	Radar vectors
4.1	Standby instruments	**HDG FAILS** (Electrics 2) HMG
5.0	**Second approach:**	LOWW ILS 29 & Land
5.1	*WX: LOWW* Visual setup:	*310/15 1500 OVC004 12/11 1010* Vis/RVR **1500m**, Cloud Base **400ft.**
6.0	**Max Wt Eng Failure:**	**MEL – FUEL JETTISON INOP**
	WX: LOWW	*270/15 200m RVR 34/16 350m OVC001 12/8 1010*
6.1	Flight status :	ZFM: **116.7 t** FUEL: **70.0t** Mac: **24%**
6.2	Airfield conditions:	Wind **120/15**
6.3	Reposition page:	T/O & Arrival **LOWW Rwy 16**
6.4	Visual setup:	Vis/RVR **350m**, Cloud base **100ft.**
6.5	Takeoff Rwy 16	167kts **R ENG FIRE 2BTL** (Fire protection)
7.0	**Diversion & approach**	
7.1	CAT II ILS & landing	Note: If time permits go around & another CAT II ILS

PART 2 (PF - First Officer)

1.0	**SIM-Setup:**	
	WX: LOWW	*280/5 250m RVR35R-300m OVC001 12/11 1010 BCMG 1500m OVC004*
1.1	Reposition page:	T/O & Arrival **LOWW Rwy 29** AC T/O position.
1.2	Flight status :	ZFM:**110,0 t** FUEL:**20,0 t** Mac T/o: **24** Turbulence **3%**
1.3.	Airfield conditions:	QNH **1010,** OAT **12,** WIND **230/5**, RWY roughness **1**, RWY **WET.**
1.4	Visual setup:	Vis/RVR **300m**, **DAY,** Cloud base **100ft,** tops **10000ft**.

2.0	**LOFT VIE - MXP**	**APU SERVICABLE**
2.1 2.2 2.3 2.4 2.5 2.6 2.7	Takeoff Rwy 29 Normal takeoff Instrument failure: Electrical failure: Autoflight failure:	40kts **L ENG SEIZURE** (Engines) SNU 1C 1200ft **L EADI CRT FAILS** (Flight instruments 1) **R BTB FAILS TO OPERATE IN AUTO** (Electrics 1) FL180 **R IDG OUT TEMP** (Electrics 2) . Message from Lauda Air return to VIE TOD **L MAIN AC BUC SHORT** (Electrics 2) 15000ft **R FD FAIL** (Autoflight 2)
3.0	**First approach:**	LOWW ILS 29 RAW DATA (FD OFF)
 3.1 3.2 3.3	*WX: LOWW* Airfield conditions: Reposition page: Visual setup:	*310/15 1500 OVC004 12/11 1010* WIND **310/15kt,** T/O & Arrival **LOWW Rwy 29** Vis/RVR **0m,** Cloud base **400ft**,
4.0	**Go around:**	
4.1		Radar Vectors
5.0	**Second approach:**	LOWW ILS 29 & Land
 5.1	*WX: LOWW* Visual setup:	*310/15 1500 OVC004 12/11 1010* Vis/RVR **1500m**, Cloud base **400ft**.
6.0	**Max Wt Eng Failure:**	**MEL – FUEL JETTISON INOP**
  6.1 6.2 6.3 6.4 6.5 6.6	*WX: LOWW* Flight status: Airfield conditions: Reposition page: Visual setup: Takeoff Rwy 16 Engine failure	*270/15 200m RVR 34/29 350m OVC001 12/8 1010* ZFM: **116.7 t** FUEL: **70.0t** Mac: **24%** Wind **120/15** T/O & Arrival **LOWW Rwy 16** Vis/RVR **350m**, Cloud base **100ft.** SNU 1C 167kts **L ENG STALL** (Recovers) (Engine)
7.0	**Diversion & approach**	
7.1	CAT II ILS & landing	Note: If time permits go around & another CAT II ILS

10.1.6 FULL FLIGHT SIMULATOR SESSION 6

PART 1 (PF - First Officer)

1.0	**SIM-Setup:**	Rte: LOWW SNU 1C SBG LOWS
	WX: LOWW	*310/5 250m FG RVR29-300m OVC001 15/15 1003*
1.1	Reposition page:	T/O **LOWW Rwy 29,** Arrival **LOWS Rwy 16** AC **T/O position**.
1.2	Flight status :	ZFM:**110,0 t** FUEL:**15,0 t** Mac T/o: **24** Turbulence **3%**
1.3.	Airfield conditions:	QNH **1003,** OAT **15,** WIND **310/5**, RWY roughness **2**, Rwy, **DRY**
1.4	Visual setup:	Vis/RVR **300m**, **DUSK** Cloud base **100ft**, tops **7000ft.**
2.0	**LOFT VIE - SZG:**	
2.1	Start malfunction	**L ENG FUEL FEED V FAILS IN POSN** (Fuel)
2.2	Takeoff Rwy 29	SNU 1C
2.3	FMC failure	2000ft **R FMC FAILS** (FMS)
2.4	Pneumatic failures	FL100 **CTRE BODY PNEU DUCK RUPT** (Pneumatic) FL260 **RAPID DEPRESSURISATION 80%** (Air condition & pressurization 3)
3.0	**First approach:**	LOWS – Special ILS RWY16 with G/A
	WX: LOWS	*260/15 1000+RASH OVC005 11/11 1003*
3.1	Airfield conditions:	QNH **1003,** OAT **11**, WIND **260/15kt**,
3.2	Visual setup:	Vis/RVR **1000m**, Cloud base **500ft,** tops **2800ft**
4.0	**Go around:**	Instructed by ATC
4.1		Hold SZG VOR/DME
4.2		**FWD CARGO FIRE** (Fire protection 2)

5.0	**Second approach:**	ILS APP to circle RWY34 and land
	WX: LOWS	*290/19 5km RESH OVC015 11/8 1003*
5.1	Airfield conditions:	Wind **290/19**
5.2	Reposition page:	Arrival **LOWS Rwy 34**
5.3	Visual setup:	Vis/RVR **5km**, Cloud base **1500ft.**
6.0	**Engine failure:**	Rte: LOWS LNZ 2V STO LOWW
	WX: LOWS	*190/19 3700m OVC050 11/8 1003*
6.1	Flight status :	ZFM: **110,0 t** FUEL: **15,0 t** Mac T/o: **24**
6.2	Airfield conditions:	Wind **190/19**
6.3	Reposition page:	T/O **LOWS Rwy16,** Arrival **LOWL Rwy 27**
6.4	Visual setup	Vis/RVR **3700m,** Cloud base **5000ft,** tops **7000ft,**
6.5	Takeoff Rwy16	
6.6	Engine failure	138kts **L ENG FLAMEOUT** (Engine)
7.0	**Diversion & approach**	LOWL VOR 09 CIRCLE 27
	WX: LOWL	*310/20 5000m OVC015 11/8 1003*
7.1	Reposition page:	T/O **LOWL Rwy 09** Arrival **LOWL Rwy 27**
7.2	Airfield conditions:	Wind **310/20**
7.3	Visual setup:	Vis/RVR **5000m**, Cloud base **1400ft**

PART 2 (PF - Captain)

1.0	**SIM-Setup:**	Rte: LOWS LNZ 2S STO LOWW
	WX: LOWS	*260/15 500m SH RVR16-800m OVC003 11/11 1003*
1.1	Reposition page:	T/O **LOWS Rwy 34,** Arrival **LOWS Rwy 16** AC **T/O position**.
1.2	Flight status :	ZFM: **110,0 t** FUEL: **10,0 t** Mac T/o: **24**
1.3.	Airfield conditions:	QNH **1003**, OAT **11**, WIND **260/15**, RWY roughness **2**, Rwy **DRY**
1.4	Visual setup:	Vis/RVR **500m**, **DUSK,** Cloud base **300ft,** tops **7000ft**.

2.0	**Part 2a SZG - SZG**	
2.1 2.2 2.3	Takeoff Rwy 34 FMC failure Bomb threat:	LNZ 2S 500ft **L NAV CAPTURE FAIL** (Autoflight) FL60 **LAUDA HAS RECEIVED SPECIFIC BOMB THREAT TO YOUR FLT, DO NOT CLIMB ABOVE FL100 & RETURN TO SZG.**
3.0	**First approach:**	LOWS – Special ILS RWY16 with G/A
 3.1	*WX: LOWS* Visual setup:	*260/15 1000+RASH OVC005 11/11 1003* Vis/RVR **1000m**, Cloud base **100ft**, tops **3200ft**
4.0	**Go around:**	
4.1 4.2		3000ft **WHEEL WELL FIRE** (Fire Protection 2) Hold at SZG VOR/DME
5.0	**Second approach:**	ILS APP with Circling RWY34 and Land
 5.1 5.2 5.3 5.4	*WX: LOWS* Airfield conditions: Reposition page: Visual setup: Landing malfunction	*290/19 5km RESH OVC015 11/8 1003* Wind **290/19** Arrival **LOWS Rwy 34** Vis/RVR **5km**, Cloud base **1500ft** 110kts **R ENG STALL IN REV (Unrecoverable)** (Engine reverse thrust)
6.0	**Part2b**	Rte: LOWS LNZ 2V STO LOWW
 6.1 6.2 6.3 6.4 6.5	*WX: LOWS* Flight status : Airfield conditions: Reposition page: Takeoff Rwy 16 Engine failure	*190/19 3700m OVC050 11/8 1003* ZFM: **110,0 t** FUEL: **15,0 t** Mac T/o: **24** Wind **190/19** T/O **LOWS Rwy16,** Arrival **LOWL Rwy 27** 138kts **L ENG STALL (Unrecoverable)** (Engine)
7.0	**Diversion & approach**	LOWL VOR 09 CIRCLE 27
 7.1 7.2 7.3 7.4	*WX: LOWL* Reposition page: Airfield conditions: Visual setup: Flap/Slat malfunction:	*240/20 5000m OVC015 11/8 1003* T/O **LOWL Rwy 09** Arrival **LOWL Rwy 27** Wind **240/20** Vis/RVR **5000m,** Cloud base **1400ft** **LE OUTBD SLATS STUCK** (Flight Controls)

10.1.7 FULL FLIGHT SIMULATOR 7

PART 1 (PF - FIRST OFFICER)

1.0	**SIM-Setup:**	Rte: MDPC PNA DCT. PTA MDPP
	WX: MDPC	
1.1	Reposition page:	T/O **MDPC Rwy 09 ,** Arrival **MDPP 08** AC **T/O position**.
1.2	Flight status :	ZFW:**105.0 t** FUEL:**15.0 t** Mac T/o: **24** Turbulence **3%**
1.3.	Airfield conditions:	QNH **1008** OAT **28** WIND **080/15**, RWY roughness **2**, Rwy **WET.**
1.4	Visual setup:	Vis/RVR **6000m NIGHT** Cloud base **1100ft** tops **22000ft**
2.0		
2.1 2.2	Rejected take off Takeoff Rwy 09	**L ENG SEPARATION** (engine) RESET **LE OUTBD SLATS STUCK** (flight controls)
3.0	**CRUISE FL 260**	**INADVERTANT REV THRUST** (engine reverse thrust)
3.1	APPROACH	**ENTRY DOORS FWD** (emergency equipment) 26 NDB CIRCLING 08 Cloud base **1100** Vis/RVR **6000m** T/O **MDPP Rwy 26 ,** Arrival **MDPP 08**

PART 2 (PF - CAPTAIN)

1.0	**SIM-Setup:**	Rte: MDPP PTA DCT GRANN FPR SZG LOWS
	WX:MDPP	*260/10 6000m -RA OVC1100 28/23 1008*
1.1	Reposition page:	T/O **MDPP 26,** Arrival **MDPP 08** AC **T/O position**.
1.2	Flight status :	ZFW:**115.0 t** FUEL:**35.0 t** Mac T/o: **24** Turbulence **2%**
1.3.	Airfield conditions:	QNH **1008,** OAT **28,** WIND **260/15**, RWY roughness **2**, Rwy **WET**
1.4	Visual setup:	Vis/RVR **6000m NIGHT** Cloud base **1100ft** tops **8000ft**
	TAKEOFF	**ENGINE SEIZURE AT V1** (malfunction panel)
3.0	**Approach:**	26 VOR/DME CIRCLING 08 WIND CHANGE **080/15**
	WX: MDPP	*080/15 6000m OVC1100 28/20 1008* T/O **MDPP 26,** Arrival **MDPP 08**
	GEAR MALFUNCTION	**R GEAR FAILS TO LOCKDOWN** landing gear
5.1 5.2	PAX EVACUATION	**GEAR COLLAPSES ON LANDING**

FULL FLIGHT SIMULATOR SESSION 7 - NORTH ATLANTIC

PART 3 (PF - CAPTAIN)

1.0	**SIM-Setup:**	Rte: EINN TR" B" FL320 MACH .80 MMUN
	WX: EINN	*060/20 9999m –RA FEW 800 0/-2 1015*
1.1	Reposition page:	T/O **EINN 06,** Arrival **BIKF 11** AC **T/O position**.
1.2	Flight status :	ZFW:**124.0 t** FUEL:**62.6 t** Mac T/o: **24** Turbulence **2%**
1.3.	Airfield conditions:	QNH **1015,** OAT **0** WIND **060/20**, RWY roughness **2**, Rwy **DRY**
1.4	Visual setup:	Vis/RVR **9000m DAY** Cloud base **1100ft** tops **8000ft**
2.0	**TAKE OFF**	Radar vectors climb FL320
3.0	Reposition High speed climb	Slew control **ALT FWD/UP (**accelerate to 340 kts first) Slew control reposition to **N4855.4 W03600.0**
4.0	Malfunction	**Engine Fire L** (malfunction panel)
4.1	Flight status	During fuel jettison select **0** in the centre tank
4.2	Reposition	After the above exercise is finished Slew control reposition **N6334.4 W02230.0** (MOTAK)
4.3	Visual setup	Cloud base **400** Vis/RVR **1000m**
4.4	Reposition page:	T/O **EINN Rwy 06 ,** Arrival **BIKF 11**
	Airfield conditions:	QNH **1015,** OAT **0** WIND **060/20**, RWY roughness **2**, Rwy **DRY**

10.1.8 FULL FLIGHT SIMULATOR 8

PART 1 (Captain)

1.0	**SIM-Setup:**	
	WX: EDDM	*080/5 450m RVR08L 550m +0/-1 1013 BCMG 100m* *Rwy 90% Contam 8mm Slush*
1.1	Reposition page:	T/O **EDDM Rwy08L** Arrival **EDDM Rwy08L** AC **T/O position**.
1.2	Flight status:	ZFW:**110.0t** FUEL:**50.0t** Mac T/o: **24** Turbulence **3%**
1.3	Airfield conditions:	QNH **1013,** OAT **0,** WIND **080/5**, RWY roughness **2**, Rwy Contam **Slush**
1.4	Visual setup:	Vis/RVR **150m**, **DAWN**, Cloud base **1ft**, tops **1000ft.**
2.0	**Contaminated runway**	(BOTH PILOTS)
2.1	Start	Quick start on runway
2.2	Rejected takeoff	125kts **R ENG SEIZE** (Engines)
2.3	Engine failure	135kts **R ENG SEPARATION** (Engines)
2.4		Repeat 2.3 for First Officer
3.0	**All weather operations**	
3.1	Flight status:	FUEL:**30.0t**
3.2	Airfield conditions:	Rwy **Dry**
3.3	Reposition page:	AC **T/O Position**
3.3	Takeoff Position	**Demonstrate Take Off Visbility**
3.5	Visual setup:	Vis/RVR **As Reqd for Demonstration**
3.6	Reposition page	Arrival **EDDM Rwy08L 6 nm final**
3.7	Auto ILS 08L	**Demonstrate Visual Reference at 200'/100'/50'/0'**
3.8	Visual setup:	Vis/RVR & Cloud base **As Reqd for Demonstration**

4.0	**CAT IIIb approach**	
4.1	Visual setup:	Vis/RVR **100m** Cloud base **1ft**
4.2	Malfunction	1000’ **L SYM GEN FAILURE** (Flight instruments 2) 150' **INSERT CROSSWIND TO GIVE LOC DEVIATION**
4.3	ILS 08L	**AUTO GO AROUND**
4.4	Malfunction	500’ **R ENG FLAMEOUT** (Engines)
4.5	ILS 08L	**AUTO GO AROUND**
4.6	Malfunction	150’ **R ENG SEIZE** (Engines) 800' ATC report RVR **75m**
4.7	ILS 08L	**AUTOLAND**
4.8	Malfunctions	1200' **R IDG DIFF FAULT** (Electrics) 600' **L FD FAIL** (Autoflight 2) **THRUST RETARD AT FLARE FAIL** (TMS)
4.9	ILS08L	**AUTOLAND**
5.0	**Pilot incapacitation**	
5.1		500ft **NO RESPONSE FROM CAPT**
5.2	ILS 08L	**AUTOLAND ??**
6.0	**CAT IIIa approach**	
6.1	Visual setup:	Vis/RVR **200m** Cloud base **60ft**
6.2	Takeoff Rwy 08L	140kts **R ENG FLAMEOUT** (Engines)
6.3	Malfunctions	1000’ **L ENG FLAMEOUT** (Engines)
6.4	ILS 08L	**AUTOLAND & AUTO ROLLOUT**
6.5	Malfunctions	900’ **C RAD ALT FAILURE** (Flight intruments 2) **AUTOPILOT ROLLOUT FAILURE** (Autoflight 2)
6.6	ILS 08L	**AUTOLAND & MANUAL ROLLOUT**
6.7	Malfunctions	1100' **C IRS FAILURE** (Navigation 2) 900' **ILS STATION FAIL** (Control index, station index)
6.8	ILS 08L	**AUTO GO AROUND**
6.9	Engine failure on go around	200’ **R ENG FLAMEOUT** (Engines)

7.0	**CAT II approach**	
7.1	Visual setup:	Vis/RVR **0m** Cloud base **110ft**
7.2	Malfunctions	1000' **L FCC FAIL TO ENGAGE CMD** (Autoflight 2) 90' **AUTOPILOTS DISCONNECTS** (Autoflight 2)
7.3	ILS 08L	100' **WX GO AROUND** **MANUAL GO AROUND**
7.4	Visual setup:	Vis/RVR **350m**
7.5		800' **R ENG SEIZE (**Engines) 80' **FCC FAILURE** (Autoflight 1)
7.6	ILS 08L	**MANLAND**

PART 2 (First Officer)

1.0	**CAT IIIb approach**	
1.1	Visual setup:	Vis/RVR **100m** Cloud base **0ft**
1.2	Malfunction	500' **L ENG FLAMEOUT** (Engines)
1.3	ILS 08L	**AUTO GO AROUND**
1.4	Malfunction	1000' **R SYM GEN FAILURE** (Flight instruments 2)
1.5	ILS 08L	**AUTOLAND**
2.0	**CAT IIIa approach**	
2.1	Malfunction	1000' **C RAD ALT FAILURE** (Flight instruments 2)
2.2	ILS 08L	**AUTO GO AROUND**
2.3	Visual setup:	Vis/RVR **200m** Cloud base **60ft**
2.4	Malfunctions	1000' **R ILS/GS RECEIVER FAIL** (Navigation 1) **AUTOPILOT ROLLOUT FAILURE** (Autoflight 2)
2.5	ILS 08L	**AUTOLAND & MANUAL ROLLOUT**
3.0	**CAT II approach**	
3.1	Visual Setup:	Vis/RVR **350m** Cloud base **110ft**
3.2	ILS 08L	1000' **R ENG SEIZE** (Engines) **AUTO APPROACH** Met report RVR **300m** 80' **FCC FAILURE** (Autoflight 2) **MANLAND**

Unusual attitude recovery: Selection at the discretion of the instructor.

10.1.9 FULL FLIGHT SIMULATOR 9

PART 1a (PF - Captain)

1.0	SIM-Setup	Rte: EDDM KIRDI 3E LNZ STO LOWW
1.1	*WX: EDDM* Reposition page:	*100/7 100m RVR08R 250m SKY OBS 1007* T/O **EDDM Rwy 08R,** Arrival **LOWW Rwy 11** AC **T/O Position**
1.2	Flight status:	ZFW:**110.0t** FUEL:**20.0t** Mac:**20** Turbulence:**3%**
1.3	Airfield conditions:	QNH **1007,** OAT **5,** WIND **100/7,** Rwy Roughness **1** Rwy **DRY**
1.4	Visual setup:	Vis/RVR **250m, DUSK,** Cloud base **0ft,** tops **3000ft,**
2.0	**Preflight:**	
2.1	Abnormal start:	**L ENG STARTER AUTO CUTOUT FAILS** (Engine start)
3.0	**Departure:**	
3.1	Takeoff Rwy 08R	136kts **L FMC FAILS** (FMS) 6000' **L DIFFERENTIAL FAULT** (Electrics 1) Reset during QRH
3.2	Climb to FL100	
4.0	**Airwork:**	
4.1	**STEEP TURNS**	BOTH PILOTS 180 left or right
4.2	**STALLS**	BOTH PILOTS One stall approach or landing
4.3	Accelerate to 340kts Note:	Rapid climb to FL310 If both pilot to do emergency descent SNAPSHOT
4.4	Rapid decompression	**RAPID DECOMPRESSION 45%** (Air condition & pressurization) (Purser report ear problems) If second reset system & **RAPID DECOMPRESSION 85%**
4.5	Emergency descent	
4.6	Engine failure:	**L ENG EEC BOTH CHANNELS FAIL** (engine efficiency)

5.0	**First approach:**	LOWW ILS 11
	ATIS: LOWW	*130/10 1200m OVC005 8/6 1010 TEMPO 300m OVC010* *Rwy 16/34 Closed & ILS29 INOP*
5.1	Reposition page:	T/O & Arrival **LOWW Rwy 11**
5.2	Airfield conditions:	QNH **1010,** WIND **200/10**
5.2	Visual setup:	Vis/RVR **350m,** Cloud base **110ft**
6.0	**Go around:**	Rwy hdg 2000' left hdg 340 climb to 3000'
7.0	**Second approach:**	LOWW CAT II ILS 16 & LAND
7.1	Reposition page:	T/O & Arrival **LOWW Rwy16**
7.2	Flaps/Slat malfunction	**TE LEFT INBD & OUTBD FLAPS (5-20)** (Flight controls)

PART 1b (PF - First Officer)

1.0	SIM-Setup	Rte: LOWW LIMRA 6C SBG EDDM
	ATIS: LOWW	*330V200/10 1200m OVC005 8/6 1010 TEMPO 300m OVC010 Rwy 16/34 Closed & ILS29 INOP*
1.1	Reposition page:	T/O **LOWW Rwy 29** Arrival **LOWW Rwy 11** AC **T/O Position**
1.2	Flight status:	ZFW:**110.0t** FUEL:**20.0t** Mac:**20** Turbulence:**3%**
1.3	Airfield conditions:	QNH **1010,** OAT **12,** WIND **200/10,** Rwy Roughness **1** Rwy **DRY**
1.4	Visual setup:	Vis/RVR **1000m, DAWN**, Cloud base **500ft** tops **3000ft,**
2.0	**Departure:**	
2.1	Take Off Rwy 08R	2500' **R SYM GEN FAILURE** (Flight instrument 2)
3.0	**Airwork:**	If not completed in Part 1a
3.1	Climb to FL100	
3.2	Accelerate to 340kts	Rapid climb to FL310
3.3	Rapid decompression	**RAPID DECOMPRESSION 45%** (Air condition & pressurisation)
3.4	Emergency descent	

PART 1b (PF - First Oficer) Cont'd

5.0	**Cruise:**	
5.1	Engine failure:	**L ENG STALL (Unrecoverable)** (Engines)
6.0	**First approach:**	LOWW ILS 11
	ATIS: LOWW	*200/10 1200m OVC005 8/6 1010 TEMPO 300m OVC010* *Rwy 16/34 Closed & ILS29 INOP*
6.1	Reposition page:	T/O & Arrival **LOWW Rwy 11**
6.2	Airfield conditions:	QNH **1010,** WIND **200/10**
6.3	Visual setup:	Vis/RVR **350m,** Cloud base **110ft**
7.0	**Go around:**	Rwy hdg to 3000'
7.1	Flaps/Slat malfunction	**TE LEFT INBD & OUTBD FLAPS (5-1)** (Flight controls)
8.0	**Second approach:**	LOWW CAT II ILS 16 & LAND
8.1	Reposition page:	T/O & Arrival **LOWW Rwy16**

PART 2 (PF - Captain)

1.0	**SIM-Setup**	Rte: LOWW LIMRA 6C SBG MDPC
	WX: LOWW	*330/15 200m RVR29 300m OVC 001 Bcmg 5000m OVC010*
1.1	Reposition page:	T/O & Arrival **LOWW Rwy 29** AC **T/O Position**
1.2	Flight status:	ZFW:**110.0t** FUEL:**60.0t** Mac:**20** Turbulence:**3%**
1.3	Airfield conditions:	QNH **1010,** OAT **12,** WIND **330/15,** Rwy Roughness **1** Rwy **DRY**
1.4	Visual setup:	Vis/RVR **250m,** Cloud base **0ft** tops **3000ft**
2.0	**Departure:**	**MEL: FUEL JETTISON INOP**
2.1 2.2	Engine malfunction Take Off Rwy 29	165kts **L ENG STALL (Recovers)** (Engines)

3.0	**Cruise:**	
3.1	Electric malfunction:	**L BTB FAILS TO OPERATE AUTO** (Electrics 1) **L DIFFERENTIAL FAULT** (Electrics 1)
4.0	**Approach:**	LOWW NDB Rwy11 to CIRCLE Rwy 29 & LAND
4.1	Visual setup:	Vis/RVR **5000m,** Cloud base **1100ft** tops **3000ft**

PART 2 (PF - First Officer)

1.0	**SIM-Setup**	Rte: LOWW LIMRA 6C SBG MDPC
	WX: LOWW	*330/15 200m RVR29 300m OVC 001 Bcmg 5000m OVC010*
1.1	Reposition page:	T/O & Arrival **LOWW Rwy 29** AC **T/O Position**
1.2	Flight status:	ZFW:**110.0t** FUEL:**60.0t** Mac:**20** Turbulence:**3%**
1.3	Airfield conditions:	QNH **1010,** OAT **12,** WIND **250/15,** Rwy Roughness **1** Rwy **DRY**
1.4	Visual setup:	Vis/RVR **250m,** Cloud base **0ft** tops **3000ft**
2.0	**Rejected takeoff**	
2.1	Engine failure	140kts **L ENG FIRE** (Fire protection 1)
3.0	**Departure:**	
3.1 3.2	Engine malfunction Take Off Rwy 29	165kts **R ENG SEIZURE** (Engines)
4.0	**Cruise:**	
4.1	Hydraulic malfunction	**C HYDRAULIC SYS LEAK 80%** (Hydraulics)
5.0	**Approach:**	LOWW NDB Rwy11 to circle Rwy 29 & land
5.1	Visual setup:	Vis/RVR **5000m,** Cloud base **1100ft** tops **3000ft**
6.0	**Evacuation:**	
6.1	Malfunctions	140kts **AFT CARGO FIRE** (Fire protection 2) 120kts **APU FIRE FUEL** (Fire protection 2) ATC report thick smoke coming from rear of the AC.