



A320neo PW Flight Ops Summary

October 2016



Flight Ops Summary

This document provides a quick overview of the operational impacts observed on the A320neo equipped with PW 1100G engines.

This list is not exhaustive and the published Airbus operational documentation (**FCOM, QRH**) remains the main reference.

CEO: Current Engine Option

NEO: New Engine Option



Introduction

A320neo Flight Crew Training

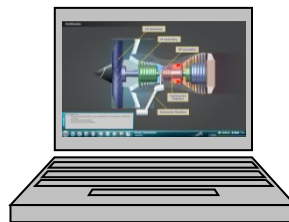
A320



A320 Type Rating



A320neo



Level B



Level A

eLearning + FCOM

= Pilot qualified on A320 CEO and NEO



Sharklets

New engines



PW1100G

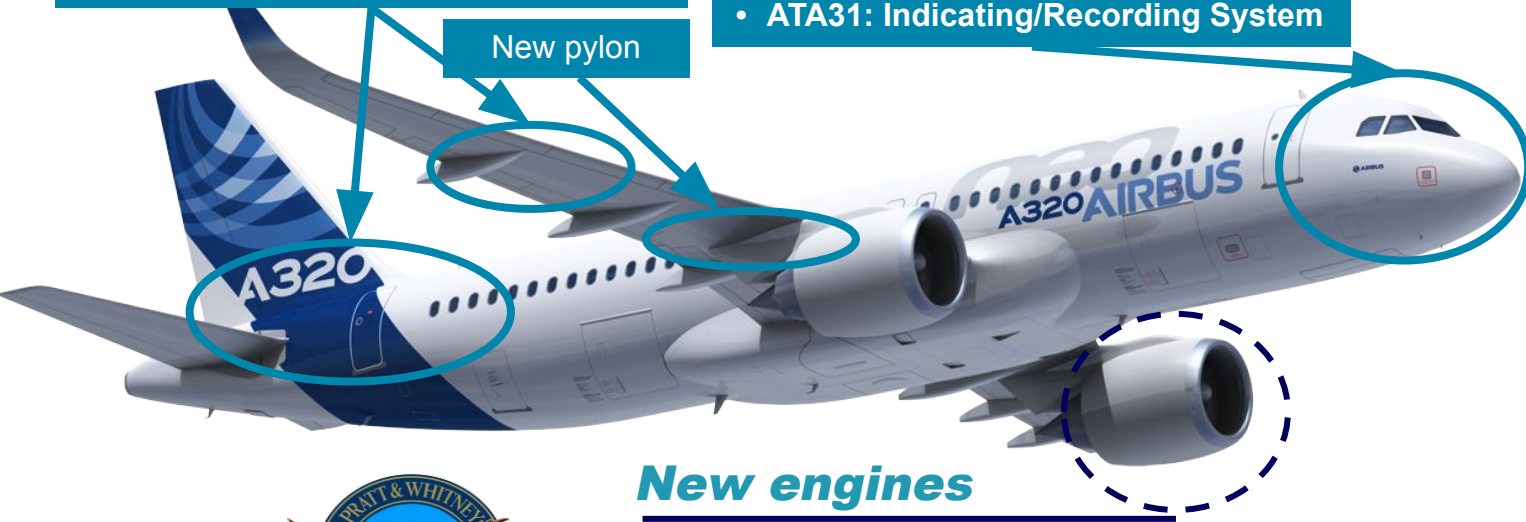
- High Bypass ratio
- Lower Noise Levels
- Complete system redesign (pylon, nacelle, bleed)

15% overall
fuel burn
reduction

Wing structure, fuselage and cabin adaptations to accommodate new engine

New pylon

- Adapted systems
- ATA22: Autoflight
 - ATA27: Flight Control
 - ATA31: Indicating/Recording System



PW1100G

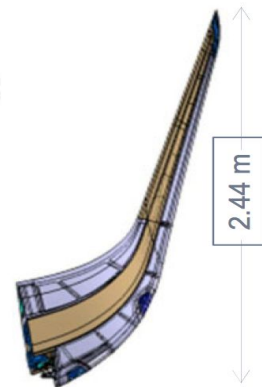
New engines

- New systems
- ATA24: Electrical Power
 - ATA30: Ice and Rain Protection
 - ATA36: Pneumatic

Sharklets:



Same for A319 / A320 / A321



Nav and strobe lights are on the sharklet

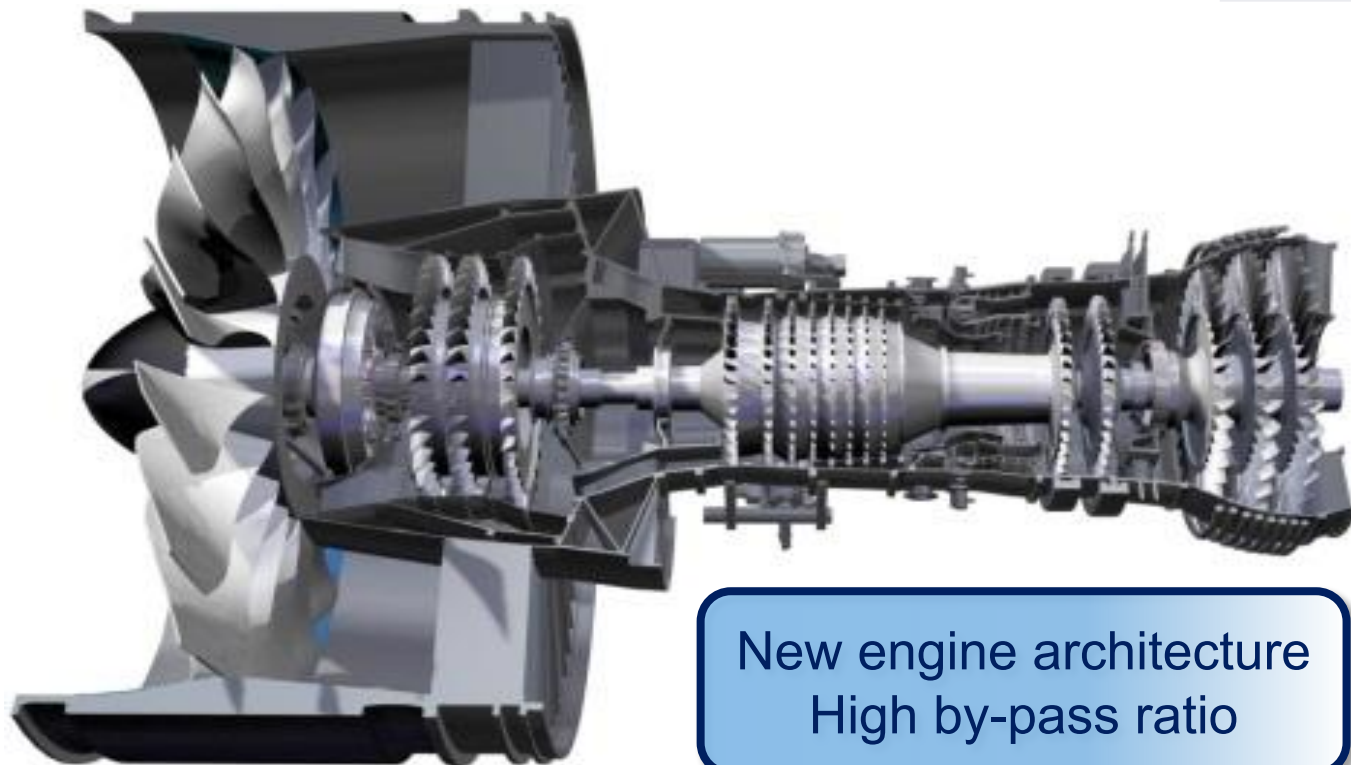
Hardware modifications

ATA	Equipment
73	Engine Interface Unit (EIU)
24	Integrated Drive Generators (IDG)
30	Nacelle Anti-Ice (NAI)
36	Engine Bleed Air System (EBAS)

Software modifications

ATA	Equipment
22	Autoflight - FG & FAC
27	Flight Control - ELAC 98
31	Flight Warning Computer - FWC H2F8C

Minimum cange, Maximum commonality with A320 CEO

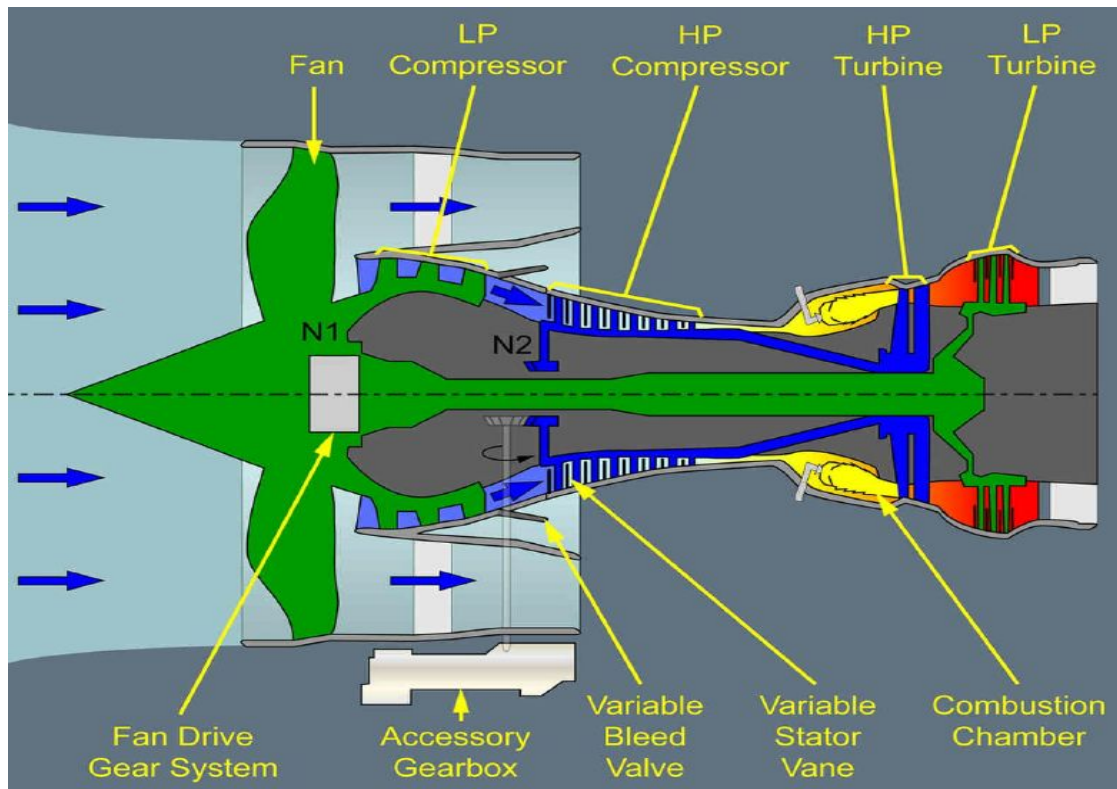


PW1100G

New engine architecture
High by-pass ratio

ATA 70

—
Powerplant



[DSC-Aircraft Systems](#)

[DSC 70-Power Plant](#)



[LIM-Limitations](#)

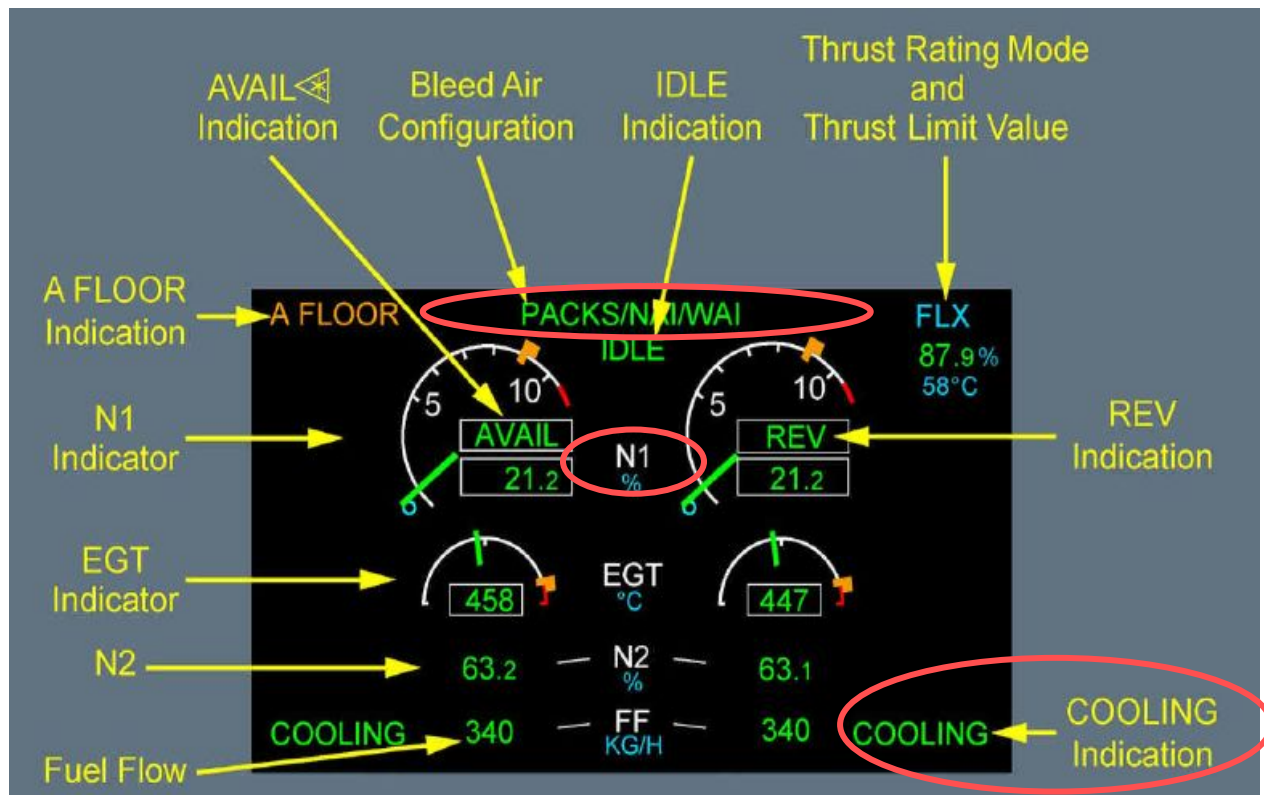


[PRO-Procedures](#)

[ABN 70-Power Plant](#)

ATA 70

Powerplant



DSC-Aircraft Systems

DSC 70-Power Plant

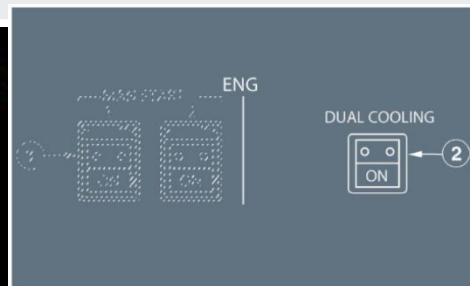
N1 instead of EPR

COOLING memo

Bleed Configuration

ATA 70

Powerplant



DSC-Aircraft Systems
DSC 70-Power Plant

ATA 70

Powerplant

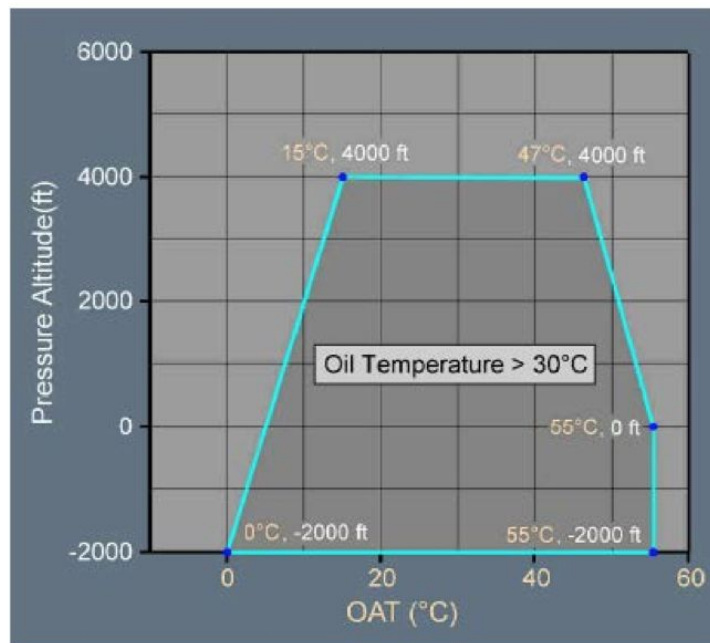
Dual Cooling function is armed when the DUAL COOLING pb-sw is ON.
When armed, Cooling will be performed on both engines simultaneously.

Dual Cooling function is available in a dedicated envelope of use depending on APU Performance and Oil temperature.

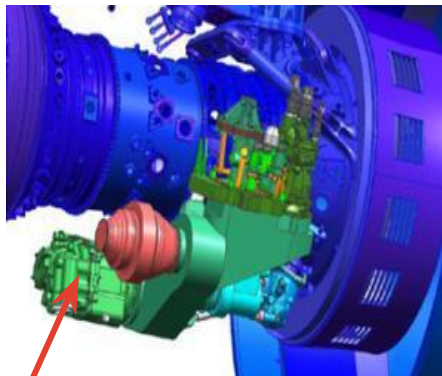


[DSC-Aircraft Systems](#)

[DSC 70-Power Plant](#)



ATA 70
—
Powerplant



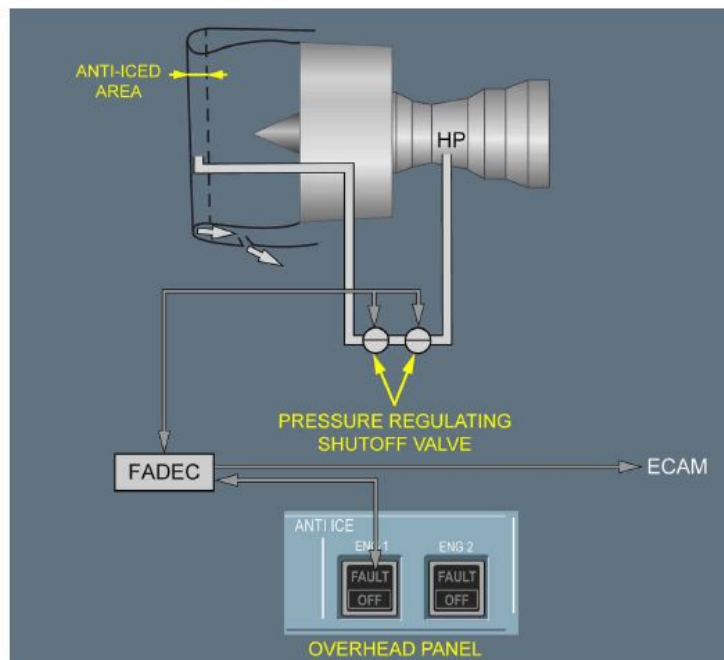
Derived from A340-500/600 for better reliability



PRO-Procedures
ABN 24-Electrical

ATA 24
—
Electrical Power

- **Two** Pressure Regulated & Shut off Valves (PRSOV) for better reliability and nacelle ice protection.
- Each valve is electrically controlled and pneumatically actuated to improve reliability and bleed control.

[DSC-Aircraft Systems](#)[30 30-Engine Anti-Ice](#)

ATA 30

Ice & Rain Protection

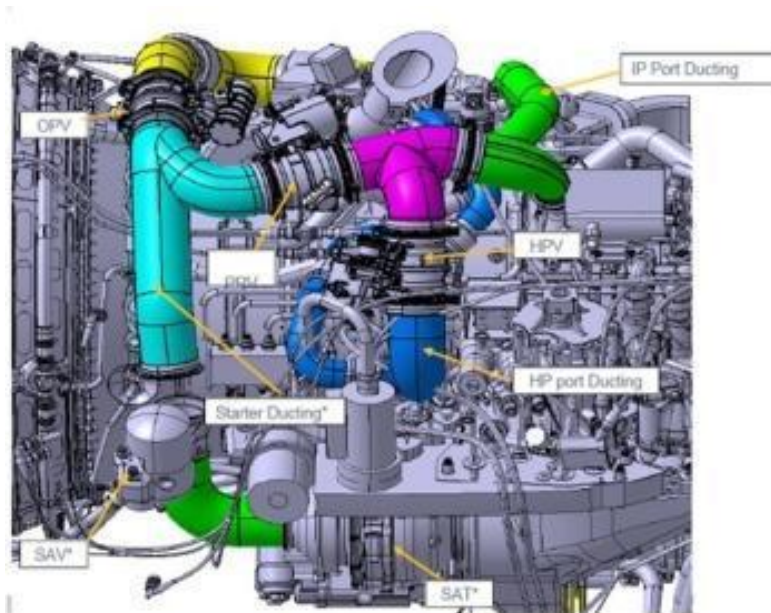
- New Engine Bleed Air System (EBAS) architecture.
- **Electro-pneumatically** valves (instead of fully pneumatically).



[DSC-Aircraft Systems](#)
[DSC 36-Pneumatic](#)



[PRO-Procedures](#)
[ABN 36-Pneumatic](#)



ATA 36

Pneumatic



**Limitations
(LIM)**

**Standard Operating
Procedures
(SOP)**

**Supplementary
Procedures
(SUP)**

**Abnormal
Procedures
(ABN)**

Wind and Autoland Limitations

- **Take-off crosswind limitation:**

- **35kt** (38kt on A320ceo)

NOTE

*The maximum certified crosswind value is an Airplane Flight Manual (AFM) limitation. **It is an engine limitation.***

Runway Surface Conditions	Maximum Crosswind for Takeoff (Gust included)	Maximum Crosswind for Landing (Gust included)
Damp Wet Up to 3 mm (1/8") of water	35kt	38kt

- **Autoland Limitations:**

- Maximum Headwind..... **20kt** (30kt on A320ceo)
- Maximum Crosswind..... **15kt** (20kt on A320ceo)
- Maximum Tailwind..... **5kt** (10kt on A320ceo)
- Airport elevation at or below **5750 feet**



Limitations (LIM)

Engine Limitations

- **Engine Limitations:** Updated to take into account PW1100G specification.

- RPM:
 - N1 max normal: 100% - N1 max permissible: 105%
 - N2 max normal: 100% - N2 max permissible: 105%
- EGT Limit:
 - TOGA: 1083 °C
 - MCT: 1043 °C
 - Starting: 1081°C
- Oil Limits:
 - Minimum Oil Temperature - prior to TO: 52 °C
 - Maximum Oil Temperature: 151°C
 - Minimum Oil Pressure: 65 PSI
 - Maximum Oil Pressure: 270 PSI

Note that red and amber oil pressure/temperature thresholds are not constant, and vary with the level of thrust.



Limitations (LIM)

Engine Limitations

- Starter Limits:
 - 3 consecutive start attempts
 - 35 sec between each cycle
 - after 3 cycles, a 15 min cooling period is necessary
 - No running engagement, when N2 is above 20%

NOTE

High Tailwinds (above 10kt) or crosswinds (above 35kt) may have an adverse effect on engine start. It may be necessary to reposition the aircraft into the wind.



Limitations (LIM)

Preliminary Cockpit Preparation



Standard Operating Procedures (SOP)

- **Preliminary Cockpit Preparation - Oil quantity check**
 - Minimum Oil quantity Value adapted to PW1100G:
Check that oil quantity is at or above 14 quarts. If OAT is colder than -30 °C check that oil quantity is at or above 16.5 quarts.
 - If the engine oil quantity indication does not appear on the ENG SD page, set the ENG 1 and 2 FADEC GND PWR pb-sw on the overhead maintenance panel to ON. After the check of the engine oil quantity, set the ENG 1 and 2 FADEC GND PWR pb-sw to off.
- **Exterior Walkaround**
 - Adapted to A320neo design

Engine Start



Standard Operating Procedures (SOP)

- **Automatic engine start:** Adaptation to PW1100G specificities:
 - **Dry cranking** information for flight crew awareness:

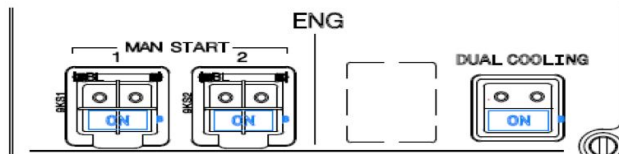
Memo **COOLING** displayed on the E/WD during automatic dry cranking commanded by FADEC depending on engine thermal state (see slide 10).

The dry cranking time is of approximately 2 min. During the dry cranking, the FADEC logic limits the maximum N2 around 10 %.
 - Due to possible leakage from the ecology tank, FCOM asks to **abort the start sequence if leak reported by ground crew during engine start**. Maintenance action is due before the flight.
- When the FADEC detects a stall, applies an automatic recovery sequence without ECAM message.

Engine Start – Dual Cooling

The goal of the dual cooling function is to reduce the overall time to start both engines. This is achieved with the following sequence:

- Make sure that COOLING information is displayed on both engines.
- Select DUAL COOLING push button.



- Launch an auto start of one Engine (rotary selector to IGN and Master Lever ON), both Engines launch the cooling sequence.
- When both Engines complete the cooling sequence, the engine with Master Lever ON undertakes the start sequence.
- The second engine with Master Lever OFF is waiting for the Master Lever ON request to achieve its start, keeping in memory the cooling benefit (provided start is launched within 20mn).

Only available in automatic engine start and, therefore, will be reflected in **FCOM NORMAL SOP procedure – Automatic Engine Start**.



Standard Operating Procedures (SOP)

Engine Start

- Engine start time longer than CEO

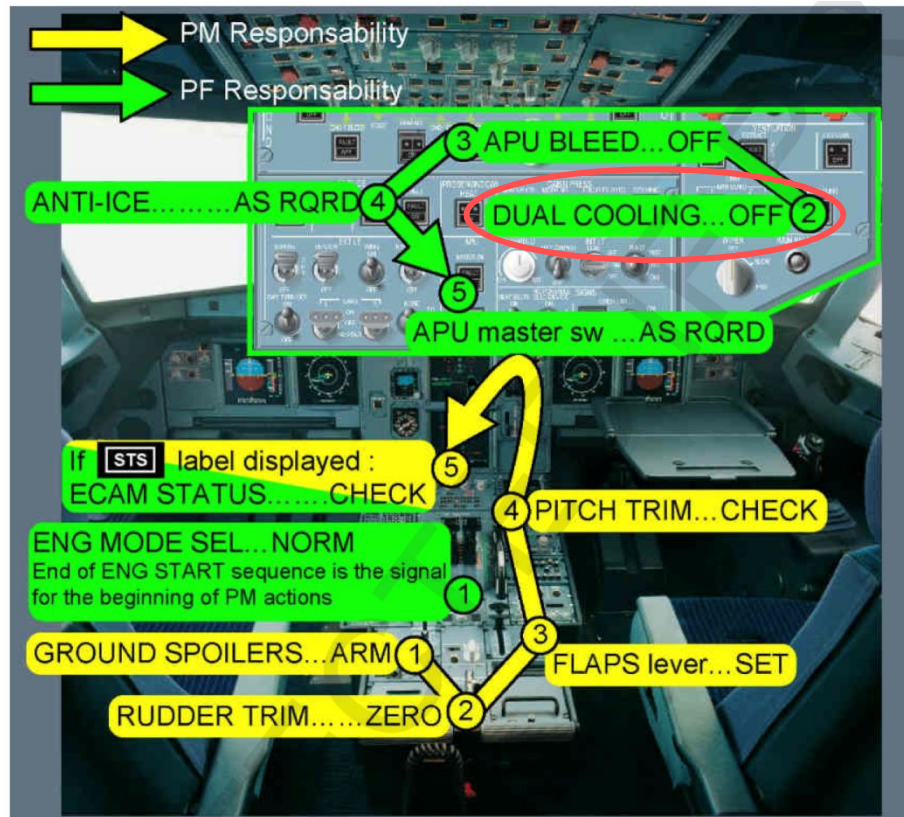
ON ECAM UPPER DISPLAY	ON ECAM LOWER DISPLAY
N2 increases	Corresponding start valve inline. Bleed pressure indication green. Oil pressure increases.
At approximately 18 % N2: - FF increases.	Indication of the active igniter (A or B).
20 s (maximum) after fuel is on - EGT increases - N1 increases prior to 48 % N2.	
At approximately 55 % N2	Start valve crossline. Igniter indication off.

- Engine Idle Parameters (ISA sea level):
 - N1 about 19%
 - N2 about 59%
 - EGT about 600 °C
 - FF about 270 kg/h



Standard Operating Procedures (SOP)

After Start



Standard Operating Procedures (SOP)

Ice Shedding

- **After Start – Ice shedding procedure**

- Engine acceleration at a minimum of **60 % of N1 at intervals not greater than 30 min.** There is no requirement to maintain the high thrust settings.
- If operating in conditions of **freezing rain, freezing drizzle, freezing fog or heavy snow**, the time intervals between engine accelerations shall not be greater than **10 min.**
- If the ground surface conditions or the environment do not permit the above engine acceleration procedures during the taxi, then the 60 % N1 engine acceleration just before takeoff must be maintained for at least 2 min.



Standard Operating Procedures (SOP)

Parking

Parking

- Caution note about **brake vibrations**

CAUTION	During parking, with brakes temperature above 200 °C, brakes vibrations may be experienced. In the case of severe vibrations, the flight crew should stop the aircraft and request towing. The flight crew must report any brakes vibrations phenomenon in the logbook.
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- The cooling period of 3 min before engine shutdown **is required for NEO** whereas it is recommended for CEO.
Due to their design characteristics, NEO engines are more subject to degradation when routine cooldown times shorter than 3 min are applied.
Therefore, flight crew **must** operate the engines at or near idle thrust for a cooling period of 3 min before shutdown to thermally stabilize the engines.



Standard Operating Procedures (SOP)

SUP-70 Power Plant



Supplementary Procedures

SUP-70 Power Plant

- Effect of the **dry cranking function** addressed in the following Supplementary Procedures (PRO-SUP):
 - **Manual Engine Start**
FADEC dry cranking even if manual engine start.
 - **Crossbleed Engine Start**
 - **Engine ventilation (Dry Cranking)**
- Removal of the **Start Valve Manual Operation** proc.
Associated MEL item NO GO
- **Air Conditioning during Automatic Engine Start:**
this procedure enables to recover air conditioning after automatic engine 2 start for passenger comfort.

SUP-93 GOP



Supplementary Procedures

SUP-93

Green Operating Procedures

—

- **Single Engine Taxi-Out :**
 - **XBLEED remains closed** to avoid the configuration of one Bleed supplying two Packs.
- **Removal of the One PACK procedure** because switching one PACK does NOT bring fuel economy benefit.

Abnormal Procedures

- New set of ECAM alerts due to enhanced monitoring of the engine (do **not** exist on A320ceo)

ENG 1(2) HIGH VIBRATION

ENG 1(2) FAN COWL NOT CLSD

- **ENG DUAL COOLING** (function armed but not available i.e. out of the Dual Cooling envelope)

- **Temporary Procedures** to cover possible spurious ECAM triggering:

ANTI ICE ENG 1(2) VALVE CLSD



Abnormal Procedures (ABN)

Dispatch

Update of A320 MEL

Start Valve is a now “NO GO” item

No Significant change in the way to dispatch
A320 NEO

Ground Ops unchanged



Minimum Equipment List

Performance

TOW around 3t more than CEO **when performance limited**.
Higher thrust (3% to 7% increase vs CEO depending on OAT).
Flexible temperature limited to ISA+50.

Landing performance improved.
Increased Thrust Reverser efficiency.

Lower Noise Levels and emissions.

New version of FlySmart,
with
new interface and improved functionality



ATA 70. Powerplant

ATA 30. Nacelle Anti-Ice (NAI)

ATA 36. Engine Bleed Air System (EBAS)



[GEN-General Information](#)



[DSC-Aircraft Systems](#)



[PRO-Procedures](#)



[LIM-Limitations](#)



[PER-Performance](#)

SOP & SUP □ No major changes

ABN □ New alerts

New FWC standard

ATA70, ATA24, ATA 36

No difference in Abnormal Maneuvers

 [GEN-General Information](#)

 [DSC-Aircraft Systems](#)

 [PRO-Procedures](#)

 [LIM-Limitations](#)

 [PER-Performance](#)

LIM 11. Weight & Center of Gravity limits
LIM 12. Environment Envelope – Wind Limitation
LIM 22. Auto Flight
LIM 70. Power Plant

 [GEN-General Information](#)

 [DSC-Aircraft Systems](#)

 [PRO-Procedures](#)

 [LIM-Limitations](#)

 [PER-Performance](#)

Updated Performance tables

 [GEN-General Information](#)

 [DSC-Aircraft Systems](#)

 [PRO-Procedures](#)

 [LIM-Limitations](#)

 [PER-Performance](#)

ATA 7x, 24, 30, 36

Update of Performance data

- MEL Entries
- MEL Items
- MEL Operational Procedures

AP/FD TCAS

The TCAS mode is an Auto Flight System mode which provides vertical guidance in case of a TCAS RA

- When a TA is triggered, the TCAS mode arms
- When a RA is triggered, the TCAS mode engages
- When “CLEAR OF CONFLICT”, the TCAS mode disengages



AP/FD TCAS mode



AP/FD TCAS

When the TCAS mode arms, the FMA displays **TCAS** in blue.

SPEED	ALT CRZ	NAV		AP1 1FD2 ATHR
	TCAS			

TCAS mode arms, even if both APs, and both FDs are disengaged.
In this case, the APs and FDs remain disengaged.

TCAS mode engaged

SPEED	TCAS	NAV		AP1 1FD2 ATHR

TCAS mode engages, even if both APs, and both FDs are disengaged.

- The AP engagement status does not change.
- If both FD bars are disengaged, the FD bars automatically engage.



AP/FD TCAS mode mode



AP/FD TCAS

Lateral mode

If the TCAS mode engages when a lateral mode is engaged, this lateral mode remains engaged.

Auto Thrust

When the TCAS mode engages, the A/THR SPEED/MACH mode engages.

Disengagement

When “CLEAR OF CONFLICT” sounds the TCAS mode disengages.
The AFS provides guidance toward the latest target altitude set on the FCU.
When the TCAS mode disengages one of the following modes engages:
V/S, ALT*, ALT, ALT CRZ* or ALT CRZ.



AP/FD TCAS mode



AP/FD TCAS

The TCAS mode is **not available**, when:

- The TCAS system is failed - **NAV TCAS FAULT**
- The TCAS mode is failed - **AUTO FLT TCAS MODE FAULT**
- The TCAS system is in TA mode
- FDs are inoperative.

The TCAS mode arming and engagement are **inhibited** when:

- The TA mode is manually selected
- The aircraft is below 900 ft radio height
- The EGPWS, WINDSHEAR or STALL warning is triggered.



AP/FD TCAS mode



AP/FD TCAS

(AP/FD) TCAS WARNINGS QRH procedure

This procedure is applicable **ONLY** to aircraft with AP/FD TCAS. Review QRH “Aircraft Configuration Summary” table to confirm AP/FD TCAS function on the specified aircraft.

If AP/FD TCAS mode is NOT installed or NOT available the “standard” TCAS Warnings procedure applies.

Only parts of the procedure are presented in the following slides.



AP/FD TCAS proc



AP/FD TCAS

■ Traffic Advisory (TA) alert:

TCAS mode..... CHECK ARMED

Check that the TCAS flight guidance mode arms (TCAS blue). If not, the flight crew must be prepared to manually follow the Resolution Advisory orders.

● If the A/THR is off:

A/THR ON

The flight crew should set the A/THR to ON to avoid the triggering of the AUTO FLT A/THR LIMITED alert at the A/THR activation, in the case of a RA.

Do not perform a maneuver based on a TA alone.



AP/FD TCAS proc (TA)



AP/FD TCAS

■ Resolution Advisory (RA) alert

■ If TCAS flight guidance mode is available

The flight crew applies this procedure, when a RA is triggered, and the TCAS mode engages. The TCAS mode follows the RA orders.

● If AP OFF

FD ORDERS..... FOLLOW

The AP can be engaged.

VERTICAL SPEED..... MONITOR

If a preventive RA was triggered: Check that the vertical speed remains out of the red area of the vertical speed scale.

If a corrective RA was triggered: Check that the vertical speed gets out of the red area, and remains in the green area of the vertical speed scale.

CAUTION

If for any reason during an RA, the aircraft vertical speed does not reach the green area of the vertical speed scale, the Pilot Flying (PF) should disconnect the AP, and override the FD orders, in order to lead the aircraft vertical speed out of the red area of the vertical speed scale. If necessary, the PF must use the full speed range between $V_{\alpha max}$ and V_{max}



AP/FD TCAS proc (RA)



AP/FD TCAS

● When “CLEAR OF CONFLICT” aural alert sounds

If engaged, the TCAS mode disengages

AP/FD.....MONITOR/FOLLOW

ATC.....NOTIFY

LATERAL AND VERTICAL GUIDANCE.....ADJUST

The flight crew should engage an appropriate vertical mode, or adjust the vertical speed target, in accordance with the latest ATC clearance.

SPEED.....ADJUST

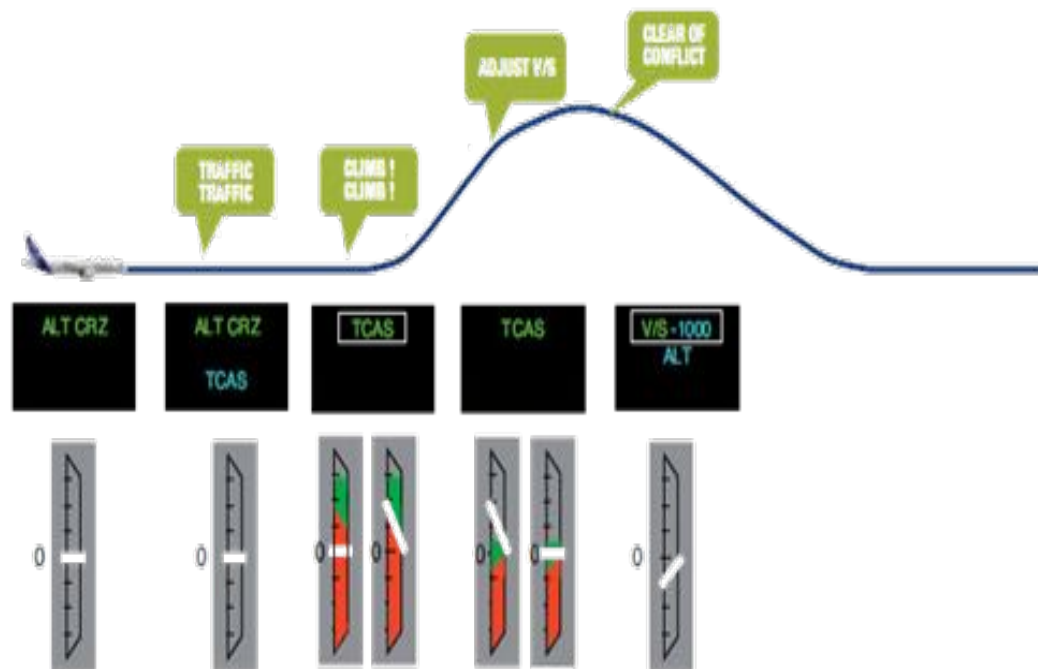
The flight crew should adjust the speed target, and revert to managed speed, as appropriate.



AP/FD TCAS proc (RA)



AP/FD TCAS



AP/FD TCAS proc



AP/FD TCAS

Refer to FCOM and review:



[DSC-Aircraft Systems](#)

C-22_30-70-85 TCAS mode



[PRO-Procedures](#)

-ABN-34 TCAS Warnings

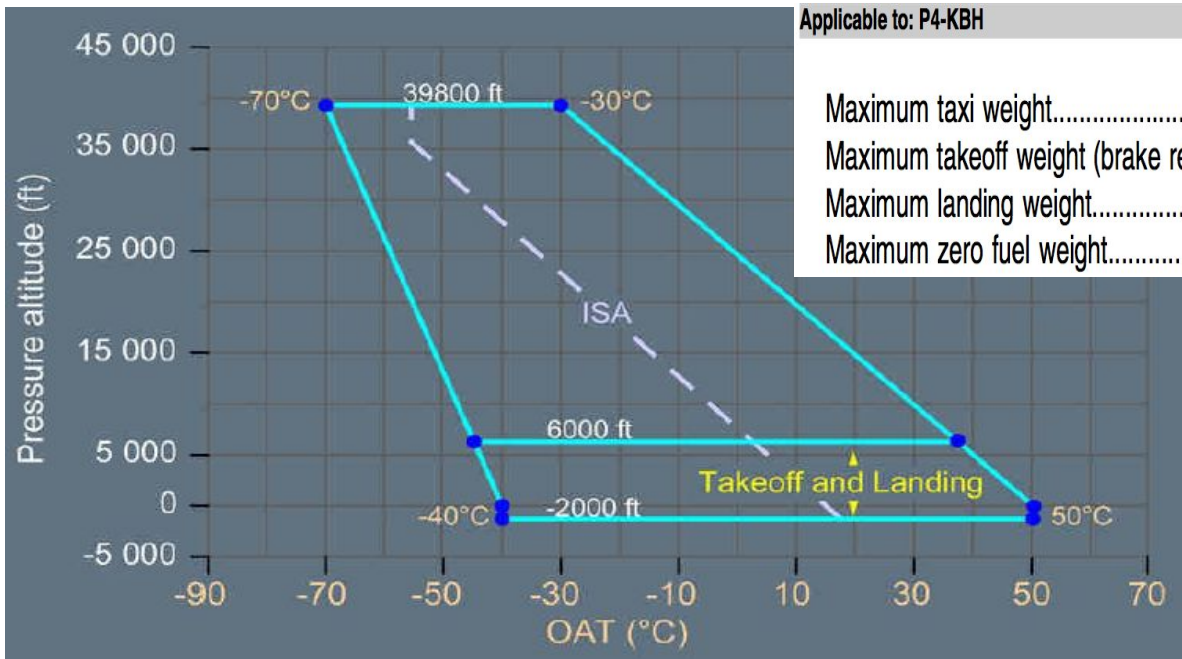
Refer to QRH and review: ABN-34 TCAS WARNINGS



AP/FD TCAS proc (RA)



Registration: P4-KBH
MSN: 7124 Model: 320-271N



Applicable to: P4-KBH

Maximum taxi weight.....	77 400 kg (170 637 lb)
Maximum takeoff weight (brake release).....	77 000 kg (169 755 lb)
Maximum landing weight.....	66 300 kg (146 166 lb)
Maximum zero fuel weight.....	62 800 kg (138 450 lb)