



Ministry of Defence

Air Command Secretariat
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Ref. 2020/05939

[REDACTED]

18 June 2020

Dear [REDACTED],

Thank you for your e-mail of 21 May 2020 asking for Tornado GR4 documentation. Specifically, you requested:

".....a copy of the paragraph regarding the procedure used by Tornado GR4 pilot during BOLDFACE and Simulated flame out pattern the concerning OCU material about the procedures mentioned above of Tornado"

I am treating your correspondence as a request for information under the Freedom of Information Act 2000. A search for the information has now been completed within the Ministry of Defence and I can confirm that information within the scope of your request is held and I attach a copy of the relevant paragraphs together with a poster containing the complete Tornado GR4 BOLD FACE emergency actions encompassing all engine related emergencies.

If you have any queries regarding the content of this letter, please contact this office in the first instance.

If you wish to complain about the handling of your request, or the content of this response, you can request an independent internal review by contacting the Information Rights Compliance team, Ground Floor, MOD Main Building, Whitehall, SW1A 2HB (e-mail CIO-FOI-IR@mod.uk). Please note that any request for an internal review should be made within 40 working days of the date of this response.

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Yours sincerely



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Air Command

21. Single Engine (SE) GCA Procedures. The following procedures should be adhered to for single-engine GCAs, practice or real:

- a. Maintain a minimum of 300 kt in the GCA pattern. Inform ATC that the approach is simulated (or real) SE.
- b. Carry out limited pre-landing checks and call 'limited checks complete' to ATC. The 'limited checks' are all the normal pre-landing checks omitting the selection of flaps and undercarriage until as detailed below. For a real SE approach, the WSO will read the SE checks from the Emergency FCC.
- c. Calculate both Mid and Down Flap approach speeds. The mid flap speed is the minimum speed on final approach until the selection of down flap.
- d. On base leg, reduce speed to not below 280 kt and lower MVR flaps if required.
- e. When within 20° of the final approach heading **and** within 4 nm of descent point, reduce speed and once below 280 kt, select mid flap. At 250 kt select ERA and anticipate bringing the power up to stabilise less than 235 kt, but not less than 220 kt.
- f. As the GCA controller says, "Begin descent now," select gear down and complete the remaining pre-landing checks: gear down, brake test and LOW light on. Allow the speed to slowly reduce to achieve 8 AOA at DH.
- g. Down Flap selection is to be delayed until landing is assured and cleared to land. The point of down flap selection requires judgement and varies with aircraft speed, weight and headwind. Remember that Down Flap generates a large amount of drag so beware when heavy or in hot conditions as the ac may well be thrust limited and use of reheat may be necessary to avoid large speed loss. For this reason, do not select down flap above 300 ft and avoid selection of Down Flap in the flare due to the trim change on selection; if necessary, land with Mid Flap.
- h. Once continuing visually to land or touch and go, maintain the normal approach path and allow the speed to reduce towards 10 AOA by the threshold.

22. Precautionary SE Approach Procedures. The Tornado GR4 ACM states that certain emergency drills (**Engine VIB, Thrust Reverser Unlocked, Fuselage Fuel Leak**) call for a precautionary single-engine approach to cater for possible engine shutdown once the recovery has been started. In these cases, the appropriate **Single-engine Recovery-X-Drive OPEN or SHUT** drill should be completed, excluding IGNITION to OFF and TR to O'RIDE.

- a. A precautionary single-engine approach should also be flown in abnormal conditions where the integrity of the engine is suspected but the engine has not been shut down, e.g. a bird strike where it is unknown if the bird went down the intake. This might require a fixed-throttle approach.
- b. A precautionary single-engine profile is flown with all the speed gates and gear/flap selections as for a SE approach. For landing with one engine at idle, the two-engine crosswind limit applies and TR (both engines) should be used if and as required to slow the ac. If engine damage is a possibility, extreme caution should be exercised when using TR, especially above IDLE.
- c. If the integrity of the engine is suspected and a precautionary single-engine approach is flown, in the worst case, if the engine does fail the ac should be in a safe regime/configuration to action the **Engine Failure on Approach** drills.

23. SE Circuit. The practise SE visual circuit is flown as per the normal circuit except that ASM is selected to ERA, the X-Drive is confirmed SHUT and the selection of DOWN flap is delayed until landing is assured and clearance has been received. To avoid splitting up checks, complete Pre-Landing checks and then set the ac up SE. On Degraded CSAS and SE practice circuits only, pilots may complete the Pre-Landing checks earlier than normal (but not before levelling at 1000ft) to give them more time to configure the ac Deg CSAS or SE. AOA around the finals turn should be limited to no more than 10 AOA and as such the circuit may need to be widened if conditions dictate. NB the drag from a shutdown or seized engine will be greater than from an engine at idle for practice.

24. Practice SE Go Around. In all cases of Practice SE Go Around, carry out the following:

i. To go around, select COMBAT on the good engine, simultaneously apply rudder to centre the slip ball and raise the undercarriage without delay.

j. Confirm the reheat is lit as you pitch into the climb attitude using 10 AOA. If the 'good engine' reheat blows out, immediately select COMBAT on the 'dead' engine to compensate.

k. Aim to hold 1°-2° of climb angle in the HUD for the initial part of the departure to allow the speed to increase. If flying on HDD instruments scan the VSI to ensure a positive rate of climb is achieved and maintained throughout the climb away. The HDD scan at this stage is very demanding, with large trim changes to cater for whilst carrying out after t/o and departure checks. Fly the ac, break up the checks, and keep the VSI and CSI in the scan.

l. Two variations of the remainder of the procedure are possible:

i. **Realistic Technique.** Raise the flaps at 5 AOA as normal; crews may feel a sink as flaps travel up – MVR Flap selection will 'cushion' this effect but will also increase drag and make it harder to accelerate. Once the flaps have travelled up, power up the idling engine to Max Dry. Cancel reheat at 250 kt.

Note: This version is designed to be as much like a genuine SE go around as practicable, but is noisy.

ii. **Noise Abatement Technique.** Once the undercarriage is fully up, power up the idling engine to max dry. At 5 AOA, raise the flaps and cancel reheat at 250 kt.

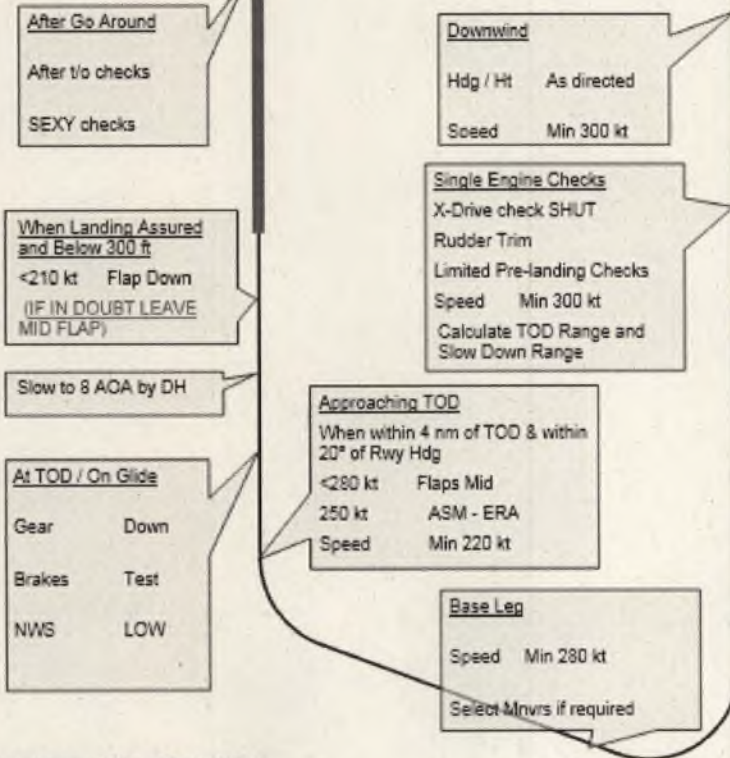
Note: This version significantly reduces noise pollution, but reduces trg value due to the very short time climbing away on one engine.

m. In all cases, once the above procedure is complete, carry out the After Take-off Checks and the **SEXY** checks (SPILS -ON, ERA -ASM ON, X-Drive push OPEN, Yaw Trim).

NB: If multiple, consecutive SE practices are to be carried out, do not push open the cross-drive until after the final practice has been completed

25. **Real SE Go Around.** To go around from a real SE approach, the procedure is as for the realistic practice technique, although acceleration will be significantly slower as no power is being produced from the shut down engine. In a clean aircraft the quoted best climb speed single-engine is 225 kt in 25° CR configuration. For other fits 10 alpha should be used as a maximum for climbing away single engine.

ANNEX B HEAVYWEIGHT SINGLE ENGINE GCA



NOTES FOR PRACTISE APPROACHES

LOW APPROACH TO GO AROUND	
"Good Engine"	COMBAT
Rudder	Ball In The Middle
Landing Gear Up ASAP	
5 AOA	Flaps Up
Failed Engine	Max Dry Power
>= 250 kt	
Reheat	Cancel
For noise abatement procedure see para 24. d. ii.	

TOUCH AND GO
Idle/Idle at Touchdown
Both Throttles to Max Dry
Check Engine Response and >150 kt - Rotate

GR4 BOLDFACE

ABORT (E-6)

1. Throttles..... IDLE, rock outboard

If REV/REV
2. Throttles..... Power as required

If no REV/REV
2. TR..... O RIDE (Within limits)

If REV
Throttle..... Power as required on associated throttle

3. Brakes..... Apply (as required)
4. Hook..... Down (if necessary)

NWS FAILURE/RUNAWAY DURING TAKE-OFF (E-7)

1. ICO..... Press and hold

TYRE FAILURE DURING TAKE-OFF (E-7)

If take off is continued:

1. Gear/Flaps..... Do not retract

FAILURE OF SEAT TO EJECT (E-10)

1. Command ejection lever BOTH
2. Firing handles..... Pull again

ENGINE FIRE ON GROUND (E-11)

L FIRE or **R FIRE**
FIRE Button

1. Throttles..... HP SHUT
2. LP cocks..... SHUT
3. Fire button..... Press
4. APU..... Off

ENGINE FIRE DURING TAKE-OFF ROLL (E-11)

L FIRE or **R FIRE**
L or R FIRE Button Lit

If decision to stop is made:

1. Abort

When stopped:

2. Throttles..... HP SHUT
3. LP Cocks..... SHUT
4. Fire Button..... Press

If take-off is continued:

1. Throttles..... COMBAT

When airborne:

2. Landing Gear..... UP
3. External Load..... Jettison (if necessary)
4. Complete ENGINE FIRE IN FLIGHT drill

ENGINE FIRE IN FLIGHT (E-12)

L FIRE or **R FIRE**
L or R FIRE Button Lit

1. Throttle..... HP SHUT
2. LP cock..... SHUT
3. Fire button..... Press

REAR FUSELAGE FIRE/HOT GAS LEAK (E-13)

FS FIRE

1. Air system master.... EMERG RAM AIR

DOUBLE ENGINE FLAMEOUT (E-25)

1. EPS..... ON
2. Left hydraulics..... OFF

If no auto relight:

3. Throttles..... HP SHUT
4. Either throttle (preferably the right).. IDLE, press relight

ENGINE OR REHEAT FAILURE DURING TAKE-OFF (E-28)

If decision to stop is made:

1. Abort

If take-off is continued:

1. Throttles..... COMBAT

When airborne:

2. Landing gear..... UP
3. External load..... Jettison (if necessary)

ENGINE FAILURE ON APPROACH (E-29)

1. Throttles..... Rock inboard, COMBAT

SURGE (E-30)

1. Throttles..... IDLE
2. AOA..... below 10 Units

ENGINE MECHANICAL FAILURE/TITANIUM FIRE (E-31)

1. Throttle..... HP SHUT
2. LP Cock..... SHUT
3. Both fire buttons..... Press simultaneously

ENGINE OIL PRESSURE LOW (E-33)

L OIL P or **R OIL P**

1. Throttle..... IDLE
2. Recover to 1g flight

If after 10 seconds, warning persists:

3. Throttle..... HP Shut

LOSS OF THROTTLE CONTROL (E-36)

1. Eng control..... Select other lane

THRUST REVERSER UNLOCKED (E-37)

L REV or **R REV**

and/or Magnetic Indicator REV or X-hatched

1. Throttle..... IDLE

TURBINE BEARING/BLADE OVERTEMPERATURE (E-32)

L TBT or **R TBT**

1. Throttle..... IDLE

If TBT and NH do not respond:

2. Engine Control..... Select Other Lane

If response is normal

a. Land as soon as practicable

If still no response:

a. Throttle..... HP SHUT
b. Land as soon as practicable

If NH Responds but TBT remains lit:

After 15 seconds but within 30 seconds of throttle IDLE:

2. Other Engine..... Max 90% NH
3. Left Lanes Switch.... Confirm LANE 1 selected
4. Left Lanes Test..... Press momentarily

If warning remains on:

a. Throttle..... HP SHUT

FUSELAGE FUEL LEAK (E-39)

FUEL in extreme cases.

1. Reheat..... Cancel
2. Fuel X-feed..... CLOSE

LOW COLLECTOR BOX CONTENTS (E-51)

FUEL with or without **FUEL**

1. Reheat..... Cancel
2. Recover to 1g level flight

DOUBLE GENERATOR FAILURE (E-59)

AC	DC	REHEAT	R ALT
		CSAS	PFCS
		GEN	TRU
		F PUMP	R PUMP

GENERATORS LEFT and RIGHT FAIL lights on

1. Reheat..... Cancel
2. Negative g..... Avoid

DOUBLE TRU FAILURE (E-68)

DC	R ALT	TRU
	CSAS	PFCS
	F PUMP	R PUMP

1. Reheat..... Cancel
2. Negative g..... Avoid

GEARBOX FAILURE (E-72)

L CONTR or **R CONTR** **GEN**

CSAS	PFCS
L UTIL	R UTIL

ENGINE control panel GENERATOR LEFT or RIGHT FAIL

1. Throttles (associated engine)... IDLE
(other engine)..... Minimum practicable

TF FAILURES (E-89)

Any combination of:

CSAS	AUTO P	CSAS	PFCS
TFR			

CRAM intrusion, yellow M and AP engaged or FD not satisfied, LHW. (Performance monitor warnings). OLP/U and/or flashing HUD breakaway X, ADI bars parked

1. Aircraft..... Ensure wings level, 3 to 4g pull-up to safe height
2. ICO..... Press before taking manual control

AFDS FAILURES (E-92)

AUTO P and/or **AP MON**

CPTR 1/2
ATTD FAIL

In case of an AP disconnect:

1. ICO..... Press

LOSS OF CONTROL/SPIN RECOVERY (E-93)

1. Controls..... Centralise and hold
2. Height..... Monitor
3. Airbrakes..... IN
4. Throttles..... IDLE
5. Speed/AOA..... Check

If spinning below 180kt with AOA off scale:
6. Stick..... Fully aft and into spin

When oscillatory motion stops:

7. Controls..... Centralise

When rotating above 180kt with AOA on scale:

8. Stick..... Ease aft

If rotating above 180kt with AOA on scale:

6. Stick..... Ease aft

If control not regained by 10,000ft AGL:

EJECT

SMOKE OR FUMES (E-95)

1. Oxygen..... 100%

OXYGEN FAILURE / CONTAMINATION (E-96)

OXY

and / or: MI Steady; Suspected hypoxia; Resistance to breathing in; Suspected contamination

1. Emergency oxygen... Pull
2. Mask seal, connections..... Check

DIRECTIONAL SWING ON RUNWAY / NWS FAILURE ON LANDING (E-99)

1. Throttles..... Cancel TR, IDLE

If directional swing caused by NWS failure/runaway:
2. ICO..... Press and hold