

A320 Alerting Issues – Single engine failure/fire

1. Initiating Condition: Engine failure after V1 and prior to V2

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution lights on glareshield	Engine failure detected by engine core speed below idle with engine master switch on and fire pushbutton not pushed				Cancelled by pressing the light
	ECAM amber caution ENG 1 or 2 FAIL	Engine failure detected by engine core speed below idle with engine master switch on and fire pushbutton not pushed				
	Oil pressure needle and digital indication on the Engine/Warning Display turn red	Oil pressure below 60 psi (amber below 80 psi)		Not immediately salient-- engine page must be manually selected to display, or it is automatically displayed during subsequent ECAM procedure during affected systems review		
	Generator FAULT light on overhead panel (subsequently also Hydraulic and Pack lights)	System sources drop off line due to engine failure	These are secondary events that conceivably could distract from the primary event of engine failure; however, they are only displayed on the overhead panel and the relevant ECAM and other warnings are inhibited			

A320 Alerting Issues – Single engine failure/fire

1. Initiating Condition: Engine failure after V1 and prior to V2 – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Aural Alerts	Single chime	Engine failure detected by engine core speed below idle with engine master switch on and fire pushbutton not pushed				
Tactile Alerts	None					
Visual Cues	Low or zero values on E/WD indicators for N1, N2, Fuel Flow, etc.					
	Nose yawing off runway centerline					
Aural Cues	Possible loud noise		These sounds may be similar to those from engine surge and tire failure			
Tactile/ Somatic Cues	Possible vibration/buffet		Cue not definitive as to cause			
	Lateral g		Cue not definitive as to cause			
	Rudder pressure required to stay on runway					
	Reduced longitudinal acceleration					

Expected Pilot Response(s)

- Control the aircraft.
- Execute single engine takeoff/climb profile.
- Execute appropriate ECAM procedure (ENG 1 OR 2 FAIL).
- Perform single engine approach and landing, considering operational limitations as suggested by the ECAM status.

A320 Alerting Issues – Single engine failure/fire

1. Initiating Condition: Engine failure after V1 and prior to V2 – Cont.

Possible sources of confusion with regard to pilot response(s)

- Stress, time pressure, startle.
- Confusion among engine surge, engine failure, tire blowout.
- Partial engine failure may present difficult diagnosis and decision as to whether to shut down.

Issues with regard to multiple concurrent non-normal conditions

- Engine failure presents concurrent electrical, hydraulic, and/or fuel system alerts, cues that may require additional action.
- Uncontained engine failure may present additional multiple alerts and failures.

A320 Alerting Issues – Single engine failure/fire

2. Initiating Condition: Engine failure in cruise flight with autopilot engaged

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution lights on glareshield	Engine failure detected by engine core speed below idle with engine master switch on and fire pushbutton not pushed				Cancelled by pressing the light
	ECAM amber caution ENG 1 or 2 FAIL	Engine failure detected by engine core speed below idle with engine master switch on and fire pushbutton not pushed				
	Oil pressure needle and digital indication on the Engine/Warning Display turn red	Oil pressure below 60 psi (amber below 80 psi)		Not immediately salient- -engine page must be manually selected to display, or it is automatically displayed during subsequent ECAM procedure during affected systems review		
	Generator FAULT light on overhead panel (subsequently also Hydraulic and Pack lights)	System sources drop off line due to engine failure	These are secondary events that conceivably could distract from the primary event of engine failure; however, they are only displayed on the overhead panel and the relevant ECAM and other warnings are inhibited			

A320 Alerting Issues – Single engine failure/fire

2. Initiating Condition: Engine failure in cruise flight with autopilot engaged – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Aural Alerts	Single chime	Engine failure detected by engine core speed below idle with engine master switch on and fire pushbutton not pushed				
Tactile Alerts	None					
Visual Cues	Low or zero values on E/WD indicators for N1, N2, Fuel Flow, etc.					
Aural Cues	Possible loud noise		These sounds may be similar to those from engine surge and tire failure			
Tactile/Somatic Cues	Possible vibration/buffet		Cue not definitive as to cause			

Expected Pilot Response(s)

- Control the aircraft.
- Execute single engine takeoff/climb profile.
- Execute appropriate ECAM procedure (ENG 1 OR 2 FAIL).
- Perform single engine approach and landing, considering operational limitations as suggested by the ECAM.

Possible sources of confusion with regard to pilot response(s)

- Stress, time pressure, startle.
- Confusion among engine surge, engine failure, tire blowout.
- Partial engine failure may present difficult diagnosis and decision as to whether to shut down.
- Note: there are no cues to the asymmetric thrust from lateral or directional controls (sidestick/rudder) either through movement (autopilot engaged) or pressure (autopilot disengaged).

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2. Initiating Condition: Engine failure in cruise flight with autopilot engaged – Cont.

Issues with regard to multiple concurrent non-normal conditions

- Engine failure presents concurrent electrical, hydraulic, and/or fuel system alerts, cues that may require additional action.
- Uncontained engine failure may present additional multiple alerts and failures.

A320 Alerting Issues – Single engine failure/fire

3. Initiating Condition: Engine fire after V1 and prior to V2

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
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Visual Alerts	ECAM red warning ENG 1 or 2 FIRE	Engine fire loop(s) exceed temperature threshold (Dual loop FIRE/FIRE, FIRE/FAIL, or FAIL/FAIL within 5 sec)				Fire is extinguished to the extent that sensed temperature on loop(s) decreases below threshold, with at least one loop still functional
	Master warning lights (flashing red) on glareshield	Engine fire loop(s) exceed temperature threshold (Dual loop FIRE/FIRE, FIRE/FAIL, or FAIL/FAIL within 5 sec)				Cancelled by pressing the light
	FIRE light in respective engine's fire pushbutton on overhead fire panel	Engine fire loop(s) exceed temperature threshold (Dual loop FIRE/FIRE, FIRE/FAIL, or FAIL/FAIL within 5 sec)				
	FIRE light for respective engine on pedestal	Engine fire loop(s) exceed temperature threshold (Dual loop FIRE/FIRE, FIRE/FAIL, or FAIL/FAIL within 5 sec)				
	ENGINE page appears on ECAM System/Status Display	Engine fire loop(s) exceed temperature threshold (Dual loop FIRE/FIRE, FIRE/FAIL, or FAIL/FAIL within 5 sec)				

A320 Alerting Issues – Single engine failure/fire

3. Initiating Condition: Engine fire after V1 and prior to V2 – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Generator FAULT light on overhead panel (subsequently also Hydraulic and Pack lights)	Only after engine is shut down during ECAM procedure, system sources drop off line due to engine shutdown	These are secondary events that conceivably could distract from the primary event of engine fire/failure; however, they are only displayed on the overhead panel and the relevant ECAM and other warnings are inhibited			
Aural Alerts	Continuous repetitive chime	Engine fire loop(s) exceed temperature threshold				Cancelled by pressing the master warning light
Tactile Alerts	None					
Visual Cues	None					
Aural Cues	None					
Tactile/Somatic Cues	None					

Expected Pilot Response(s)

- Control the aircraft.
- Execute V1 engine failure/fire flight profile.
- Execute engine fire ECAM.
- Perform single engine approach/landing procedures.
- If fire indication continues despite attempts to extinguish, expedite landing.

A320 Alerting Issues – Single engine failure/fire

3. Initiating Condition: Engine fire after V1 and prior to V2 – Cont.

Possible sources of confusion with regard to pilot response(s)

- False fire warning cannot readily be distinguished from valid fire warning (see condition 4 below).
- False indication of fire extinguishment can occur due to burnthrough of both detection loops, at least until 5 seconds after dual loop break generates detection failure signal, which re-establishes the ENG FIRE alerts. (Burnthrough also provides ENG FIRE DET and/or ENG 1 or @ LOOP AB FAULT ECAMs--but only once the aircraft reaches 1,500 feet in the climbout)

How does pilot know condition is resolved/recovered?

- Fire warning indication that fire is extinguished

Issues with regard to multiple concurrent non-normal conditions

- Possible confusion between fire with and without engine failure.
- Engine fire will devolve to an engine failure, either as a direct result of and simultaneous with the fire onset or as part of the engine fire procedure.
- Engine fire presents concurrent electrical, hydraulic, and/or fuel system alerts, cues that may require additional action.
- Engine fire may present cascading emergency (e.g., hydraulic failures, smoke in cabin, etc.)
- Uncontrollable fire may present additional, cascading conditions (e.g., structural failure, fuel loss, need to expedite landing or even land off-airport).

A320 Alerting Issues – Single engine failure/fire

4. Initiating Condition: False fire warning from engine bleed leak, during takeoff after V1 and before V2

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
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Visual Alerts	ECAM red warning ENG 1 or 2 FIRE	Engine fire loop(s) falsely indicate exceeding temperature threshold	Warning is false, there is no fire. There are no salient cues to the fact that there is no fire; absence of engine failure is not, in itself, diagnostic of a false fire warning.	False fire warning can lead to unneeded RTO, engine shutdown, etc.		Lower temperature sensed by engine fire loop
	Master warning lights (flashing red) on glareshield	Engine fire loop(s) falsely indicate exceeding temperature threshold	Warning is false, there is no fire. There are no salient cues to the fact that there is no fire; absence of engine failure is not, in itself, diagnostic of a false fire warning.	False fire warning can lead to unneeded RTO, engine shutdown, etc.		Cancelled by pressing the master warning light
	FIRE light in respective engine's fire pushbutton on overhead fire panel	Engine fire loop(s) falsely indicate exceeding temperature threshold	Warning is false, there is no fire. There are no salient cues to the fact that there is no fire; absence of engine failure is not, in itself, diagnostic of a false fire warning.	False fire warning can lead to unneeded RTO, engine shutdown, etc.		Lower temperature sensed by engine fire loop
	FIRE light for respective engine on pedestal	Engine fire loop(s) falsely indicate exceeding temperature threshold	Warning is false, there is no fire. There are no salient cues to the fact that there is no fire; absence of engine failure is not, in itself, diagnostic of a false fire warning.	False fire warning can lead to unneeded RTO, engine shutdown, etc.		Lower temperature sensed by engine fire loop
	ENGINE page appears on ECAM System/Status Display	Engine fire loop(s) falsely indicate exceeding temperature threshold	Warning is false, there is no fire. There are no salient cues to the fact that there is no fire; absence of engine failure is not, in itself, diagnostic of a false fire warning.	False fire warning can lead to unneeded RTO, engine shutdown, etc.		Lower temperature sensed by engine fire loop

A320 Alerting Issues – Single engine failure/fire

4. Initiating Condition: False fire warning from engine bleed leak, during takeoff after V1 and before V2 – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
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Aural Alerts	Continuous repetitive chime	Engine fire loop(s) falsely indicate exceeding temperature threshold	Warning is false, there is no fire. There are no salient cues to the fact that there is no fire; absence of engine failure is not, in itself, diagnostic of a false fire warning.	False fire warning can lead to unneeded RTO, engine shutdown, etc.		Cancelled by pressing the master warning light
Tactile Alerts	None					
Visual Cues	None					
Aural Cues	None					
Tactile/ Somatic Cues	None					

Expected Pilot Response(s)

- Control the aircraft
- Execute V1 engine failure/fire flight profile
- Execute engine fire ECAM
- Perform single engine approach/landing procedures

Possible sources of confusion with regard to pilot response(s)

- False fire warning cannot readily be distinguished from valid fire warning (see condition3 above).

Issues with regard to multiple concurrent non-normal conditions

- False indication of engine fire will likely devolve to an engine failure as part of the engine fire procedure.
- If false indication of fire continues after engine fire NNPs are performed, pilot concerns about inextinguishable fire may prompt risky alternative actions (e.g., rushing, off-airport landing, etc.).