

MCDONNELL DOUGLAS MD-90EFD THRUST LIMITS AND FADEC

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Note: This guide is not an FCOM and does not describe every single behavior of the system.

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INTRODUCTION

The MD-90's two engines are controlled by Full Authority Digital Engine Control (FADEC). In order to maintain safe operation, thrust limits are computed and enforced by the FADEC and displayed on the Engine and Alert Display (EAD).

CONTROLS AND INDICATORS

Thrust limits are displayed with engine parameters on the Engine and Alert Display (EAD).



- 1) EPR Command (2)
Displays the EPR commanded by the thrust levers.
- 2) EPR Limit (2)
Displays the active EPR limit computed by the FADEC digitally and with the V bug.
- 3) Engine Thrust Rating
Displays the active thrust rating, 25K for 25,000lbs and 28K for 28,000lbs.

4) EPR Limit Mode

Displays the EPR limit mode.

- T/O: Takeoff Limit
- T/O FLEX: Takeoff Flex Limit
- G/A: Go Around Limit
- MCT: Maximum Continuous Thrust Limit
- CLB: Climb Limit
- CRZ: Cruise Limit

5) Total Air Temperature

Displays the Total Air Temperature (TAT) used for EPR limit calculations.

6) N1 Mode Switches (2)

Switches the respective engine into N1 Mode.

THRUST LIMITS

The International Aero Engines V2500 engine is controlled via Engine Pressure Ratio (EPR). EPR is an indicator of the thrust produced by the engine and is used to ensure the engine is operating within safe parameters. This is called the thrust limit.

There are many different thrust limits displayed on the Engine and Alert Display (EAD) that the engines can be controlled to. The Digital Flight Guidance System (DFGS) automatically selects the best thrust limit mode, but can be set manually using the THRUST LIMITS page of the Multifunction Control and Display Unit (MCDU). The Auto Thrust System (ATS) will respect the set thrust limit when engaged.

Takeoff Thrust

Available when T/O is displayed on the EAD. Normal thrust used for takeoff. Automatically selected when the DFGS enters TAKE OFF mode. Can be either 25K or 28K.

Takeoff Flex Thrust

Available when assumed temperature for flex computation is set on the THRUST LIMITS page of the MCDU. T/O FLEX will be displayed on the EAD. Only available in 25K mode. Allows flexible takeoff thrust using a derate based on an assumed temperature to reduce engine wear.

Go Around Thrust

Available when G/A is displayed on the EAD. Maximum thrust available for a go around. Automatically selected when the DFGS enters GO RND mode. Can be either 25K or 28K.

Maximum Continuous Thrust

Available when MCT is displayed on the EAD. Maximum thrust available for continuous operation without limitations. Automatically replaces the Climb and Cruise thrust limits during engine-out operations. Provides identical thrust regardless of thrust rating.

Climb Thrust

Available when CLB is displayed on the EAD. Maximum climb thrust for normal operations. This mode is automatically selected at the thrust reduction altitude (typically 1500 feet above the departure airport) if armed. Arming is accomplished by pulling the altitude knob on the Flight Guidance Control Panel when above 400 feet radio altitude. Provides identical thrust regardless of thrust rating.

Cruise Thrust

Available when CRZ is displayed on the EAD. Maximum cruise thrust for normal operations. Automatically selected when reaching the cruise altitude set in the MCDU. Provides identical thrust regardless of thrust rating.

AUTOMATIC THRUST RESTORATION

The Automatic Thrust Restoration (ATR) system is provided by the Digital Flight Guidance System (DFGS). The system provides restoration of thrust after takeoff.

ATR is armed if the pitch axis of the DFGS is in the TAKE OFF mode, the Auto Thrust System (ATS) is engaged, the airplane is above 350 feet radio altitude, and the EPRs on both engines are below the go around limit.

If one engine drops by at least 0.1 EPR or 14% N1, or the vertical speed is less than zero for 5 seconds, ATR will activate. The thrust limit will automatically switch to G/A and the ATS will switch to EPR G/A and control to the go around limit.

EPR LIMIT OVERRIDE

Normally, the EPR limit is set automatically. However, thrust limits can be overridden by the pilot manually during a malfunction or an unusual thrust setting is required.

The thrust limit mode or the thrust limit for each engine can be overridden on the THRUST LIMITS page of the Multifunction Control and Display Unit.

If the thrust limit is overridden, the Auto Thrust System may be used with the override set and will respect the overridden limit, but will not exceed the thrust limit commanded by the FADEC.

A white box around the limits on the EAD will be displayed when the limit is overridden.

N1 MODE

When N1 Mode is selected on the overhead panel, the ALTN light on the respective switch illuminates, the EPR Command T bug is removed from the Engine and Alert Display, and the engines revert to the alternate mode of thrust control. In this mode, thrust limits are no longer obeyed, and the Auto Thrust System will not function.

This mode should only be used if the engines cannot be controlled in EPR Mode due to FADEC failure or loss of EPR data. Should either of these occur, the SELECT light on the respective N1 Mode switch will illuminate and the engine will automatically revert to N1 Mode. N1 Mode should then be confirmed by pushing the respective N1 Mode switch, followed by switching the other engine into N1 Mode.

Never allow the engines to operate with only one engine in N1 Mode. Due to the alternate mode of control in N1 Mode, asymmetric thrust settings may occur. Thus, if an engine reverts to N1 Mode, immediately select N1 Mode for the other engine.

When thrust reversers are deployed, the engines always operate in N1 Mode. They will return to EPR Mode when the thrust reversers are stowed.