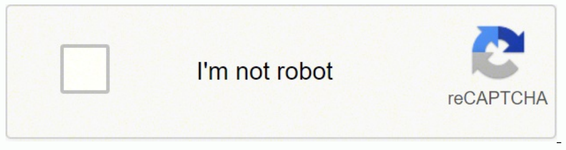


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# Jt8d engine maintenance manual diagram free pdf

DAC have 20 double tip fuel nozzles instead of the single tip and a dual annular shaped combustion chamber. The EEC will automatically switch on both ignition systems if a flameout is detected. The original choice of powerplant was the Pratt & Whitney JT8D-1, but before the first order had been finalised the JT8D-7 was used for commonality with the current 727. The name "CFM" comes from GE's commercial engine designation "CF" and SNECMA's "M" for Moteurs. NB on the 737-1/200 when the oil quantity gauge reads zero, there could still be up to 5 quarts present. This is done by pressing the primary EIS BITE button twice within 2 seconds, this will then alternately display the highest reading and the duration of the exceedance in seconds. The fleet of nearly 1,800 CFM56-3-powered 737s in service worldwide have logged more than 61 million hours and 44 million cycles while maintaining a 99.98 percent dispatch reliability rate (one flight delayed or cancelled for engine-caused reasons per 5,000 departures), a .070 shop visit rate (one unscheduled shop visit per 14,286 flight hours), and an in-flight shutdown rate of .003 (one incident per 333,333 hours)." In 2012 a CFM56-7B engine delivered in 1999, powering a 737-800 aircraft, became the first engine in the world to achieve 50,000 hours without a shop visit. This light will illuminate every time the reverser is commanded to stow, but extinguishes after the stow has completed, and will only bring up master caution ENG if a malfunction has occurred. The CFM56-7 tailpipe is slightly longer then the CFM56-3 and has a small tube protruding from the faring. The -7 was flat rated to develop the same thrust (14,000lb.st) at higher ambient temperatures than the -1 and became the standard powerplant for the -100. The CFM56-7 inlet has just one fan inlet temperature probe, which is for the EEC (because there is no PMC on the NG's).A subtle difference between the NG & classic temp probes is that the NG's only use inlet temp data on the ground and for 5 minutes after take-off. No oil pressure (by the time the engine is stable). From Boeing Flt Ops Review, Feb 2003: "On airplanes with AVM procedures, flight crews should also be made aware that AVM indications are not valid while at takeoff power settings, during power changes, or until after engine thermal stabilization. These thrust reversers are locked against inadvertent deployment by both deflector door locks and the four bar linkage being overcenter. Also the engine nacelles were extended by 1.14m as a drag reduction measure. The number of nozzles in use: 20/0, 20/10 or 20/20, varies depending upon thrust required. The one at the 2 o'clock position is used by the PMC and the one at the 11 o'clock position is used by the MEC. This is why QRH uses "ON" (eg in the One Engine Inop Landing checklist) to cover both LOW IGN & CONT for operators with mixed fleets consisting of old and new versions of the 737. The exhaust cone makes a divergent flow which slows down the exhaust and also protects the rear face of the last turbine stage. Net reverse thrust is defined as: fan reverser air, minus forward thrust from engine core, plus form drag from the blocker door. The EEC will automatically switch off both ignition systems if a hot or wet start is detected. CFM56-7B Exhaust nozzle/plug CFM56-7BE Exhaust nozzle/plug The -7BE will be able to be intermixed with regular SAC/DAC or Tech Insertion engines subject to updated FMC, MEDB and EEC. NG aircraft: for in-flight engine starts, GRD arms both igniters. The green unit forward (left) of the CSD is the generator cooling air collector shroud, the silver-gold thing forward of that (with the wire bundle visible) is the generator, and the green cap most forward is the generator cooling air inlet. This quote from CFMI in 1997: "Since entering service in 1984, the CFM56-3 has established itself as the standard against which all other engines are judged in terms of reliability, durability, and cost of ownership. During engine start or take-off & landing, GND & CONT use the selected igniters. Variable Stator Vanes The VSV actuation system controls primary airflow through the HP compressor by varying the angle of the inlet guide vanes and three stages of variable stator vanes. The CFM56-7 spinner has a unique conelliptical profile. This reduction should save reaching any engine limits. The view into the CFM56-3 jetpipe. The core is produced by General Electric and is virtually identical to the F101 as used in the Rockwell B-1. Engine Aircraft Series Max Static Thrust (lb.st.) Bypass Ratio EGT Margin (C) JT8D-7/7A/7B 1/200 14,000 1.10 JT8D-9/9A 1/200 14,500 1.04 JT8D-15/15A 200Adv 15,500 0.99 JT8D-17/17A 200Adv 16,000 1.02 JT8D-17R 200Adv 17,400 1.00 CFM56-3B4 500 18,500 5.0 90 CFM56-3B1 3/500 20,000 5.0 70 CFM56-3B2 3/400 22,000 5.0 50 CFM56-3C1 400 23,500 4.9 45 CFM56-7B18 600 19,500 5.5 145 CFM56-7B20 6/700 20,600 5.4 148 CFM56-7B22 6/700 22,700 5.3 150 CFM56-7B24 7/8/900 24,200 5.3 125 CFM56-7B26 7/8/900/BBJ 26,400 5.1 85 CFM56-7B27 8/900/BBJ 27,300 5.0 ? OFF: For ground start protection. There is also a second drain tube that does not protrude located on the inside of the fairing. JT8D Cutaway The sole powerplant for all 737's after the -200 is the CFM-56. The Nordam comes in HGW and LGW versions. This is also the thrust that you get when you firewall the thrust levers, regardless of the maximum rated thrust. Maximum limits are marked by a red line. 2mins on, 10secs off. Thank you for interesting in our services. The package includes improvements to the HP compressor, combustor and HP & LP turbines. The advantages of this include: minimised inter-stage bleeding, fewer stalls or surges and an increased compression ratio without decreasing efficiency. Oil Oil pressure is measured before the bearings, where you need it; oil temperature on return, at its hottest; and oil quantity at the tank, which drops after engine start. A higher than normal EGT should be expected, yet the same limits and procedures should apply. Fuel Thrust (fuel flow) is controlled primarily by a hydro-mechanical MEC in response to thrust lever movement, as fitted to the original 737-1/200's. The MEC uses the signal to establish parameters to control low and high idle power schedules.The temperature data is used for thrust management and variable bleed valves, variable stator vanes & high / low pressure turbine clearance control systems. After the engine start switch is moved to GND, the EEC performs Bowed Rotor Motoring (BRM). BRM will be active from 6 to 90 seconds and MOTORING will be displayed on the N2 gauge between 18-24%. Since 1997 with the introduction of the 737-700's CFM56-7B engines, the 75-decibel noise contour is now only 3.5 miles long. The core engine (N2) is governed by metering fuel (see below), whereas the fan (N1) is a free turbine. These were spring loaded and opened automatically whenever the pressure differential between inlet and external static pressures was high, ie slow speed, high thrust conditions (takeoff) to give additional engine air and closed again as airspeed increased causing inlet static pressure to rise. This is specified by the operator from the options in the table below. The package give a longer time on wing, about 5% lower maintenance costs, 15-20% lower oxides of nitrogen (NOx) emissions, and 1% lower fuel burn. Note that older 737-200s have ignition switch positions named GRD, OFF, L IGN, R IGN and FLT while newer 737s use GRD, OFF, CONT and FLT. The last exceedance is also put into volatile memory and can be read straight from the EIS before aircraft electrical power is removed. EIS Display The introduction of Engine Instrument System (EIS) in late 1988 gave many advantages over the electromechanical instruments present since 1967. Rotor redesigned. As hushkits use more fuel, the EU tried to ban all hushkitted aircraft flying into the EU from April 2002. This is to straighten the N1 and N2 shafts which may have bowed due to thermal buildup after the previous shutdown. Leap -1B The 737MAX has a new 69.4 in diameter CFM LEAP-1B (Leading Edge Aviation Propulsion). The REVERSER UNLOCKED light (EIS panel) is potentially much more serious and will illuminate in-flight if a sleeve has mechanically unlocked. The 737-1/200 thrust reverser panel has a LOW PRESSURE light which refers to the reverser accumulator pressure when insufficient pressure is available to deploy the reversers. In the –3/4/500 series, fuel flow is further refined electronically by the PMC, which acts without thrust lever movement. Several different Stage III hushkits have been available from manufacturers Nordam (shown right) and AvAero since 1992. We need your help to maintenance this website. There are two fan inlet temperature sensors in the CFM56-3 engine intake. The guarded NORMAL / OVERRIDE switches to enable the reverse thrust to be selected on the ground with the engines stopped (for maintenance purposes). 9.0 LEAP-1B23 -7 23,000? CFM is also defining potential upgrade kits that could be made available to operators by late 2007. The doors are set 35 degrees away from the vertical to allow the exhaust to be deflected inboard and over the wings and outboard and under the wings. By the end of the -200 production the JT8D-17R was up to 17,400lb.st. Some even had a high and low frequency filter selection switch. LEAP-1B21 -7 21,000? Normally, in-flight, no igniters are in use as the combustion is self-sustaining. CFM56-7BE "Evolution" The CFM56-7BE "Evolution" package was delivered from July 2011 with the following improvements: HPC outlet guide vane diffuser area ratio improved and pressure losses reduced. 737 classics may be fitted with hardwall forward acoustic panels which reduce noise by 1 EPNdB Additional References Limitations Series 1/200 3/4/500 6/7/8/900/BBJ MAX Engine JT8-17A CFM56-3 CFM56-7 LEAP-1B Max time limit for take-off or go-around thrust: 5 mins 5 /10 mins 5 /10 mins 5 /10 mins Max N1 102.4% 106% 104% 104.3% Max N2 100% 105% 105% 117.5% Max EGT's: Take-off (5 min limit) 650°C 930°C 950°C 1038°C Continuous 610°C 895°C 925°C 1013°C Ground Start 575°C 725°C 725°C 753°C Oil T's & P's Max temperature 165°C 165°C 155°C 155°C 15 minute limit 130-165°C 160-165°C 140-155°C (45mins) 155°C Max continuous 130°C 160°C 140°C 140°C Min oil press 40psi 13psi (warning light), 26psi (gauge) 13psi (warning light), 26psi (gauge) 17.4psi (warning light), 26psi (gauge) Min oil quantity (at dispatch) 2.25 USG 60% full (12 US Quarts) 60% full (12 US Quarts) 60% full (12 US Quarts) Starting pressures prior to starter engagement 30psi -1/2psi per 1000' amsl N/A N/A Starter duty cycle 1st attempt: 2min on, 20sec off 2nd & subsequent attempt: 2min on, 3min off 2mins on, 10secs off. They are fully open during rapid accelerations and reverse thrust operation. At low ambient temperatures, a temporary high oil pressure above the green band may be tolerated. The REVERSER light shows either control valve or sleeve position disagreement or that the auto-restow circuit is activated. By 1969 these had been changed by Boeing and Rohr to the much more successful hydraulically powered target type thrust reversers (shown right). 737-200 Ignition panel Engine Starting Min duct pressure for start (Classics only): 30psi at msl, -½psi per 1000ft pressure altitude. The CFM56-3 proved to be almost 20% more efficient than the JT8D. Do not re-engage engine start switch until N2 is below 20%. It has 18 woven carbon-fiber fan blades giving a bypass ratio of 9:1 versus 5.1:1 for the CFM56-7. This was strongly opposed and the directive has been changed to allow hushkitted aircraft to use airports which will accept them. As this is significantly greater at higher thrust, reverse thrust should be used immediately after landing or RTO and, if conditions allow, should be reduced to idle by 60kts to avoid debris ingestion damage. Ignition There are two independent AC ignition systems, L & R. If the oil pressure is ever at or below the red line, the LOW OIL PRESSURE light will illuminate and that engine should be shut down. High AVM indications can also be observed during operations in icing conditions." High Pressure Turbine Clearance Control The HPTCC system uses HP compressor bleed air to obtain maximum steady state HPT performance and to minimise EGT transient overshoot during rapid change of engine speed. To keep our site running, we need your help to cover our server cost (about $400/m), a small donation will help us a lot. At the recent Farnborough International Airshow, company officials said discussions are continuing with Airbus about a possible upgrade for the CFM56-5B for the A320 family based on the same technology suite. Variable Bleed Valves Control airflow quantity to the HP compressor. The heat shield above the nozzle has new titanium pans, inboard plume suppressors and side scoops to cope with the higher temperatures from the new short exhaust configuration. CFM provisionally scheduled engine certification by the end of the third quarter, but says development, including recently completed flight tests, have progressed faster than expected. The BITE check is accessed by pressing a small recessed button at the bottom of each eis panel, this is only possible when both engines N1 are below 10%. LPT blade & vane numbers reduced and profiles based on optimized loading distribution. One of the most significant improvements in the powerplant has been to the noise levels. Dual Annular Combustors (DAC) The CFM56-7B is available with an optional DAC system, known as the CFM56-7B/2, which considerably reduces NOx emissions. Rated thrust LEAP-1B28: 29,317lbs. This required a 48 inch extension to the tailpipe to accommodate the two cylindrical deflector doors which were mounted on a four bar linkage system and associated hydraulics. If any of the checks fail, the appropriate code will be shown in place of the affected parameters readout. When starting the engines in tailwind conditions, Boeing recommends making a normal start. Oil pressure is unregulated, therefore the yellow band (13-26psi) is only valid at take-off thrust whereas the lower red line (13psi) is valid at all times. When reverse was selected, 13th stage bleed air was ported to a pneumatic actuator that rotated the deflector doors and clamshell doors into position. This is the turbine exhaust area, no mixing is required as the bypass air is exhausted coaxially. Up to 10 minutes of data can be stored. Maximum Certified Thrust - This is the maximum thrust certified during testing for each series of 737. The following codes are used: Primary EIS BITE Codes Code Fault ROM Read Only Memory check RAM Random Access Memory check FDC Frequency to Digital Converter check ENG Engine Identity Inputs (not fuel flow) PWR Power Monitor MMF Maint Module Fault (fuel flow only) RTC Real Time Clock (fuel flow only) ERF Exceedance RAM Full (fuel flow only) A/D Analogue to Digital Converter (fuel flow only) ARF ARINC Receiver Fault (fuel flow only) uP Microprocessor Any exceedance of either N1, N2 or EGT is recorded at 1 sec intervals in a non-volatile memory along with the fuel flow at the time, this data can be downloaded by connecting an ARINC 429 bus reader. Although there were no in-flight shutdowns, boroscope inspections revealed that the LPT blades were starting to separate. ie a 10lb weight reduction, improved reliability, reduction in power consumption, detection of impending abnormal starts, storage of exceedances and a Built In Test Equipment (BITE) check facility. The first were installed on the 737-600 fleet of SAS but unfortunately were subject to resonance in the LPT-1 blades during operation in the 20/10 mode, which occurred in an N1 range usually used during descent and approach. Starting with R selected on the first flight of the day provides a check of the AC standby bus, which would be your only electrical source with the loss of thrust on both engines and no APU. If this occurs in-flight, reverse thrust will be available after landing. The 7BE engine can be identified by the exhaust configuration. They were later replaced with elliptical (round nosed) spinners which succeeded in deflecting the ice away from the core, but because of their larger stagnation point, were more prone to picking up ice in the first place. Unfortunately they were relatively ineffective and apparently tended to push the aircraft up off the runway when deployed. HushKits The first "hushkit" was not visible externally, in 1982 exhaust mixers were made available for the JT8D-15, -17 or -17R. Cautionary range is marked by an amber arc. Second and subsequent attempts: 2mins on, 3mins off. The sawtooth pattern or "chevrons" on the trailing edges of the fan nozzles were developed by NASA to smooth the mixing of the fan and core air flows. EGT rapidly approaching or exceeding 725˚C. The view into the JT8D jetpipe. This reduces turbulence giving a significant reduction in noise. Improvements include a new high-pressure compressor outlet guide vane diffuser, high-pressure turbine blades, disks and forward outer seal. This ensures that exhaust and debris is not blown into the wheel-well, nor is it blown directly downwards which would lift the weight off the wheels or be re-ingested. The -7BE gives a 1% fuel saving over the -7B. Fuel is heated to avoid icing by the returning oil in the MEC. Reverse Thrust The original 737-1/200 thrust reversers were pneumatically powered clamshell doors taken straight from the 727 (shown left). Tech Insertion "Tech Insertion" is an upgrade to the CFM56-5B & 7B available from early 2007. Caution: It is possible to deploy reverse thrust when either Rad Alt is below 10ft – this is not recommended. The first 737-3/400's had a conical (sharp pointed) spinner but these tended to shed ice into the core. The JT8D tailpipe fitted as standard from l/n 135 onwards. No increase, or very slow increase, in N1 or N2 (after EGT indication). Expect a longer cranking time to ensure N1 is rotating in the correct direction before moving the start lever. Secondary EIS BITE Codes Code Fault 0- Microprocessor 1- Program Memory 2- Random Access Memory check 3- Analogue to Digital Converter 4- Power Monitor 5- 400Hz Reference Voltage 6- ARINC Receiver Fault Airborne Vibration Monitors (AVM) All series of 737 have the facility for AVM although not all 737-200's have them fitted. The first full CFM56-7BE type design engine completed ground testing in January 2010, and overall completed 390 hours of ground testing, says the Franco-U.S. engine maker. The 3/4/500's may be flown with PMC's inoperative, but an RTOW penalty (ie N1 reduction) is imposed because the N1 section will increase by approximately 4% during take-off due to windmilling effects (FOTB 737-1, Jan 1985). The conelliptical spinner of the NG's neatly solves both problems. Minimum limits are marked by a red line. This was one of the reasons for the early limitation of minimum 45% N1 in icing conditions which made descent management quite difficult. Engine Instruments -200Adv Engine Instruments Round Dial -3/400 Engine Instruments 3/4/500 EIS NG EIS Upper DU Lower DU Upper DU in Compact Display mode The Compact Display mode can only be shown when the MFD ENG button is pressed for the first time after the aircraft has been completely shut down. The package also includes a new design of low-pressure turbine blades, vanes and disk. The early 737-1/200's had two vibration pickup points; One at the turbine section and one at the engine inlet there was a selector switch so that the crew could choose which to monitor. This along with advanced hot-section materials deliver an overall pressure ratio of 41:1, compared to 28:1 for the CFM56-7. The precise N1 ranges of the different modes varies with ambient conditions. In-flight after 5 minutes temp data is taken from the ADIRU's. 20/20 mode - High power (cruise N1 and above) 20/10 mode - Medium power 20/00 mode - Low power (Idle N1) This gives a lean fuel/air mixture, which reduces flame temperatures, and also gives higher throughput velocities which reduce the residence time available to form NOx. The net result is up to 40% less NOx emissions than a standard CFM56-7. Tech Insertion will become the new production configuration for both the CFM56-7B and CFM56-5B. Recycling the reverse thrust will often clear the fault. Starter cutout is approx 46% N2 -3/4/500; 56% N2 -NG's. The 737-NG's allow the EEC to switch the ignition ON or OFF under certain conditions: ON: For flameout protection. HPT blades numbers reduced, axial chord increased, tip geometry improved. This reduced the downforce on the main wheels thereby reducing the effectiveness of the wheel brakes. The NG's use the CFM56-7B which has a 61 inch diameter solid titanium wide-chord fan, new LP turbine turbomachinery, FADEC, and new single crystal material in the HP turbine. These were fitted behind the LP turbine to mix the hot gas core airflow with the cooler bypassed fan air. The blue caption between the switches is ISOLATION VALVE and illuminates when the three conditions for reverse thrust are satisfied: Engine running, Aircraft on ground & Fire switches in normal position. This increased mixing reduced noise levels by up to 3.6 EPNdB. One problem with such a high bypass engine was its physical size and ground clearance; this was overcome by mounting the accessories on the lower sides to flatten the nacelle bottom and intake lip to give the "hamster pouch" look. In conditions of moderate or severe precipitation, turbulence or icing, or for an in-flight relight, FLT should be selected to use both igniters. Auxiliary inlet doors were fitted to early JT8D's around the nose cowl. From the press 2 Aug 2010: CFM International has won certification for its upgraded CFM56-7BE engine from the FAA and the European Aviation Safety Agency (EASA), and is working with Boeing to prepare for flight tests on a Boeing 737 starting in the fourth quarter of this year. The thrust levers should not be re-adjusted during the take-off after thrust is set unless a red-line limit is likely to be exceeded, ie you should allow the N1's to windmill up. thrust. The LEAP-1B engine start sequence is slightly different to the old CFM-56. The large silver coloured pipe is the start air manifold with the starter located at its base. Fortunately the new longer nacelle improved cruise performance by improving internal airflow within the engine and also reduced cruise drag. The engine is 15% more fuel efficient than the CFM56-7B. A decision on whether or not an upgraded variant will be developed for Airbus will be finalized by year-end, adds the engine maker. The engines were moved forward and raised, level with the upper surface of the wing and tilted 5 degrees up which not only helped the ground clearance but also directed the exhaust downwards which reduced the effects of pylon overheating and gave some vectored thrust to assist take-off performance. It certainly takes longer to start the engine on a MAX than an NG. Starter duty cycle is: First attempt: 2mins on, 20sec off. An abnormal start advisory does not by itself mean that you have to abort the engine start. The temperature data is used for thrust management and variable bleed valves, variable stator vanes & high / low pressure turbine clearance control systems. The black unit below that is the CSD. The original thrust reversers were totally redesigned by Boeing and Rohr since the aircraft had inherited the same internal pneumatically powered clamshell thrust reversers as the 727 which were relatively ineffective and apparently tended to lift the aircraft off the runway when deployed! The redesign to external hydraulically powered target reversers cost Boeing $24 million but dramatically improved its short field performance which boosted sales to carriers proposing to use the aircraft as a regional jet from short runways. During cold weather starts, oil pressure may temporary exceed the green band or may not show any increase until oil temperature rises. 9.0 LEAP-1B25C -7 25,200 9.0 LEAP-1B25 -8 26,786 9.0 LEAP-1B27C -7 26,400 9.0 LEAP-1B27CB2 -7 27,900 9.0 LEAP-1B27 -8 -9 28,037 9.0 LEAP-1B28 -8 -9 29,317 9.0 LEAP-1B28B1 -8 -9 29,317 9.0 The left hand side of the CFM56-3. The original JT8D-9 engines in 1967 produced 75 decibel levels, enough to disrupt normal conversation indoors, within a noise contour that extended 12 miles along the take-off flight path. At 25% N2 or max motoring when you move the start lever to idle the EEC then performs a test of the Thrust Control Malfunction Accommodation (TCMA) and Electronic Overspeed System (EOS) functions. The corrugated ring is the mixer unit, this is designed to thoroughly mix the bypass air with the turbine exhaust. No indication of oil pressure by the time idle RPM is achieved requires an immediate engine shutdown. No EGT (within 10 secs of start lever being raised to idle). Max motoring is when N2 does not increase by more than 1% in 5 seconds. Aborted engine start criteria: No N1 (before start lever is raised to idle). To illustrate how poor the original clamshell system was, Boeings own data says target type thrust reversers at 1.5 EPR are twice as effective as clamshells at full thrust! The CFM56 uses blocker doors and cascade vanes to direct fan air forwards. LEAP56 incorporated. CFM quickly replaced all blades on all DAC engines with reinforced blades and have since replaced them again with a new redesigned blade. During start-up the EEC's receive electrical power from the AC transfer busses, but their normal source of power are their own alternators which cut-in when N2 is above 15%. This is the Aft Fairing Drain Tube for any hydraulic fluid, oil or fuel that may collect in there. This manifests itself as the fuel flow indicating zero, the engine fuel shut off valve opening and closing repeatedly and the ENG VALVE CLOSED light illuminating bright blue until the test has finished whereupon the start sequence continues. The photo shows this display with one engine started and nicely illustrates the blank parameters which are controlled by the EEC and hence are only displayed when the EEC powers up when the associated start switch is selected to GND. Normal operating range is marked by a white arc. The nozzle is 18" shorter and exhaust plug is 2.5" shorter, although it looks longer because of the much shorter nozzle. The 737-NG models go one stage further with FADEC (EEC). The outboard side of the JT8D-9A with the cowling open. In addition, the upgraded CFM completed a 60-hour certification flight test program in May on GE's modified 747 flying testbed in Victorville, Calif. We are a non-profit group that run this website to share documents. Max: 48psi. Min 25% N2 (or 20% N2 at max motoring) to introduce fuel; any sooner could result in a hot start. Please help us to share our service with your friends. SNECMA produce the fan, IP compressor, LP turbine, thrust reversers and all external accessories. On the 737NG, the EEC limits the maximum certified thrust gained from data in the engine strut according to the airplane model as follows: Aircraft Series Maximum Certified Thrust 737-600 CFM56-7B22 = 22,700lb.st 737-700 CFM56-7B24 = 24,200lb.st 737-800 CFM56-7B27 = 27,300lb.st 737-900 CFM56-7B27 = 27,300lb.st Maximum Rated Thrust - This is the maximum thrust for the installed engine that the autothrottle will command. Entry into service is planned for mid-2011 to coincide with 737 airframe improvements that, together with the engine upgrade, are designed to provide a 2% improvement in fuel consumption. Pressing these buttons will show an LED check during which the various checks are conducted. Primary nozzle, plug & strut faring all redesigned. All of which give an 8% fuel reduction, 15% maintenance cost reduction and greater EGT margin compared to the CFM56-3. The turbine has flexible blades manufactured by a resin transfer molding process, which are designed to untwist as the rotational speed increases. Follow the QRH drill, but only multiple failures will allow the engine to go into reverse thrust.

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