CT7-2E Maintenance INCREMENTAL CHANGE
MM 72-00-00, FAULT ISOLATION 002
NON-FADEC FAULT ISOLATION (CT7-2E1)

Release Notification Date: 08/08/2024

DISCLAIMER

The Incremental Changes published by GE Aerospace are considered Instructions for Continued Airworthiness. These Incremental Changes, along with the current Manual revision and published Temporary Revisions, constitute the latest Instructions for Continued Airworthiness.

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HIGHLIGHTS

HIGHLIGHT REFERENCE	DESCRIPTION OF CHANGE
tk72-00-00-810-810	Technical Change: Changed the chip detector inspection criteria in Figure 116, Sheet 5.

* * * FOR CT7-2E1

TASK 72-00-00-810-810

1. General Information.

A. Purpose.

The fault isolation procedures provided in this section are to be used as a guide for locating and correcting faults. Use of these procedures will reduce delays and maintenance downtime. It will also reduce unnecessary replacement of engine parts.

B. Procedures.

NOTE: Two basic things are assumed in these procedures:

* The correct operating procedures have been followed.

* The fault isolation is caused by a single failure or malfunction.

(1) Get as much information as possible from the flight crew that reports the problem. In many cases, this information will describe the fault completely. If possible, the fault should be confirmed by a ground test run, if there is no danger of causing engine damage.

(2) The fault isolation procedures are given in logic diagram format. The logic diagrams are organized by specific symptoms and ask a question which is answered by either a yes or a no. The answer will lead either to another question or to a final solution.

(a) See DESCRIPTION AND OPERATION for a schematic diagram of the engine electrical system.

(b) See system and component checks (TEST) for electrical checks, circuit checks at S39 connector, etc. whenever such checks are called for by the logic diagrams.

(c) Many faults, particularly if intermittent and not corrected by paragraph C., are best isolated by swapping with known good parts from other engine with suspect parts, one at a time. When fault follows suspect part onto known good engine, isolation is assured.

(3) Use the following procedural guidelines when doing fault isolation:

(a) If possible, confirm the reported fault with a ground test run.

(b) Troubleshoot according to the symptoms.

(c) Complete the checks required (TEST).

(d) Confirm fault has been fixed with a ground test run.

C. Any fluctuation of engine related parameters, such as Ng speed, Np speed, torque, or TGT, may be due to dirty or inadequately secured electrical connectors. Contamination, moisture or looseness is particularly suspect when fault is intermittent. Such engine and airframe electrical connectors will be disconnected, inspected (74-00-00, INSPECTION), and cleaned (74-00-00, CLEANING) prior to the next engine test and prior to any line replaceable unit (LRU) component removal.

D. Unusual Engine Noise.

(1) If an unusual high-pitched whining sound is heard, do the following:

NOTE: * Certain compressor damage can cause a high-pitched whining sound. The noise will vary with gas generator speed and should be much higher than usual engine noise level.

* Compressor rotors with repaired stage 1 blades produce a higher pitched noise than is present on undamaged compressor rotors. This higher pitch is not harmful to personnel or material, and should not be cause for engine removal from an aircraft.

(a) Reduce power and stop running the engine as soon as practical to avoid damaging compressor.

(b) Review engine records to determine if stage 1 compressor rotor blades have been repaired.

(c) If stage 1 blades have not been repaired, borescope the compressor (INSPECTION).

(2) Before break-in, a new gas generator rotor and stator could emit a rubbing sound from the outer balance piston seal, this is normal.

2. Symptom Index.

A. See Table 101 for a list of fault isolation symptoms.

TABLE 101. SYMPTOM INDEX

Symptom	Figure
Engine Flames Out (Combustion Stops Indicated by a Drop in TGT)	Figure 101
Np Does Not Accelerate to Flight Idle Speed (EECU Will Not Allow the Engine to Go to 70% Ng Speed)	Figure 102
Np Low at Ground Idle Speed (Idle Speed is below Limits in TEST)	Figure 103
Uncontrolled Deceleration (Ng) (Ng and TGT Decrease Without Switching SIF Switch or Collective Pitch)	Figure 104
Stall Above Ground Idle Speed (Acceleration or Deceleration Above Ground Idle Speed)	Figure 105
Starting Stalls (Audible Popping or Whining During Ng Acceleration to Ground Idle Speed)	Figure 106
Abnormally High TGT During Start	Figure 107
Combustor Rumble During Start	Figure 108
No Start (Fuel Mist Seen Coming From Tailpipe; No Rise in TGT)	Figure 109
No Start (No Compressor Rotor Rotation)	Figure 110
No Start (No Fuel Mist Seen Coming From Tailpipe; No Rise)	Figure 111
Slow or Hung Start (TGT Increases But Hangs) (On a Hung Start, Engine Lights Off But Does Not Accelerate To Idle Speed. Speed Hangs Up Between Lightoff and Idle)	Figure 112
Engine Exceeds TGT Operating Limits	Figure 113
Excessive Fuel Leaking from Overboard Drain While Engine is Operating at Ground Idle Speed	Figure 114
Fuel Filter Bypass Light On	Figure 115
Electrical Chip Detector Light On During Engine Operation	Figure 116

Excessive Oil Leakage at Overboard Drain	Figure 117
Excessive Leakage at Service Port Scupper	Figure 118
High Oil Consumption	Figure 119
High Oil Level	Figure 120
High Oil Pressure	Figure 121
No Oil Pressure	Figure 122
Oil Filter Impending Bypass Light Comes On Without a Fault Code	Figure 123
Oil Pressure Below Limits	Figure 124
Oil Pressure Fluctuates	Figure 125
Oil Temperature Exceeds Limits (Exceeds Normal Operating Temperatures for Affected Engine)	Figure 126
Smoke in Exhaust	Figure 127
Low Engine Performance (Indication of Low Margin by Power Assurance Check) (Torque Indicator is Low for a Given Ng and TGT, with Possible Torque Split at High Power)	Figure 128
Torque Split	Figure 129
Unstable Operation at Flight on Ground (Ng, TGT, Torque and Np Fluctuate Greater Than 5% With Engine at Flight)	Figure 130
No Ng Signal from Engine to Aircraft AMMC	Figure 131

* Refer to para 1.C. before you start troubleshooting procedures.

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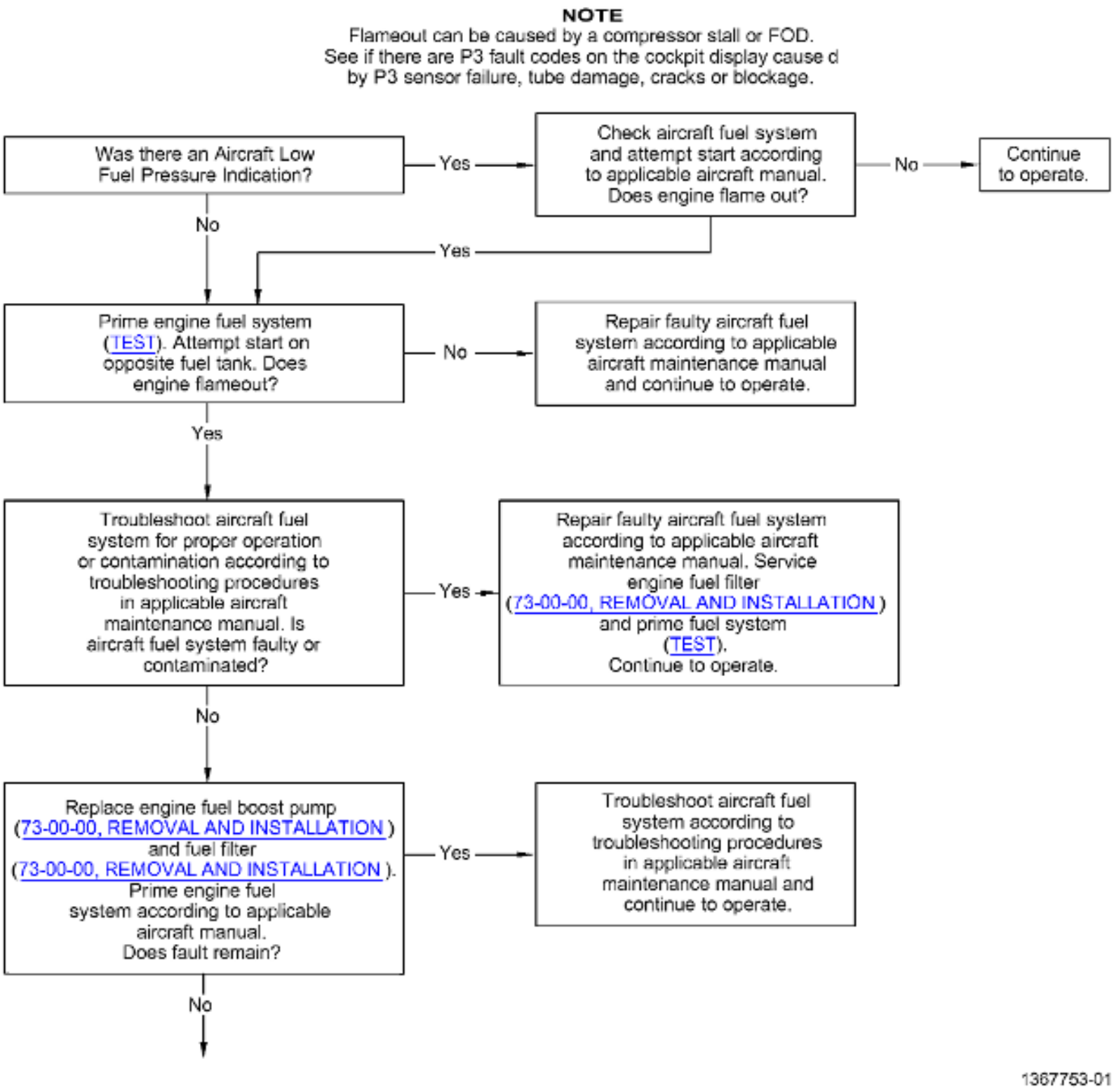

Figure 101 (Sheet 1) Engine Flames Out (Combustion Stops Indicated by a Drop in TGT)

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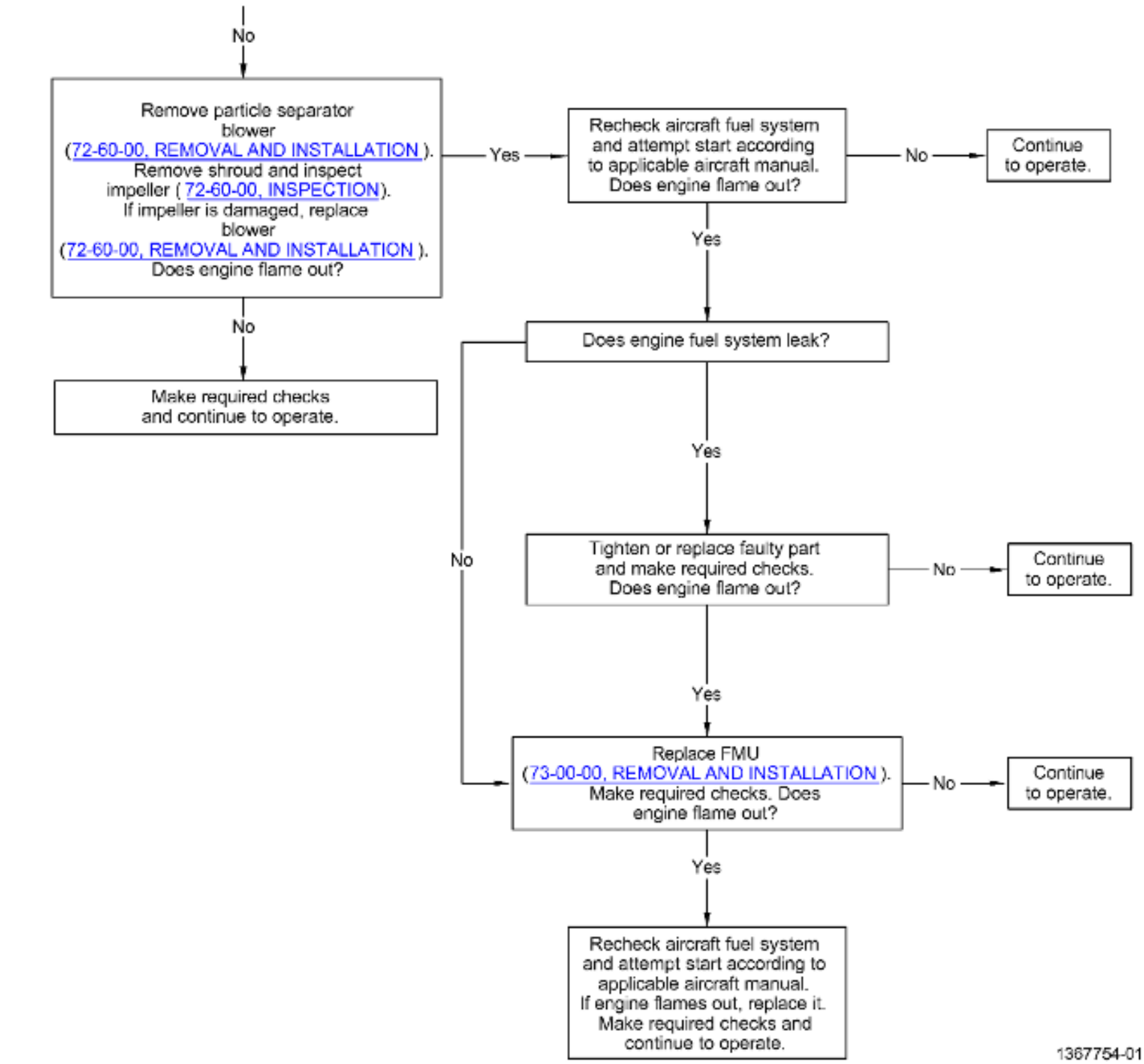

Figure 101 (Sheet 2) Engine Flames Out (Combustion Stops Indicated by a Drop in TGT)

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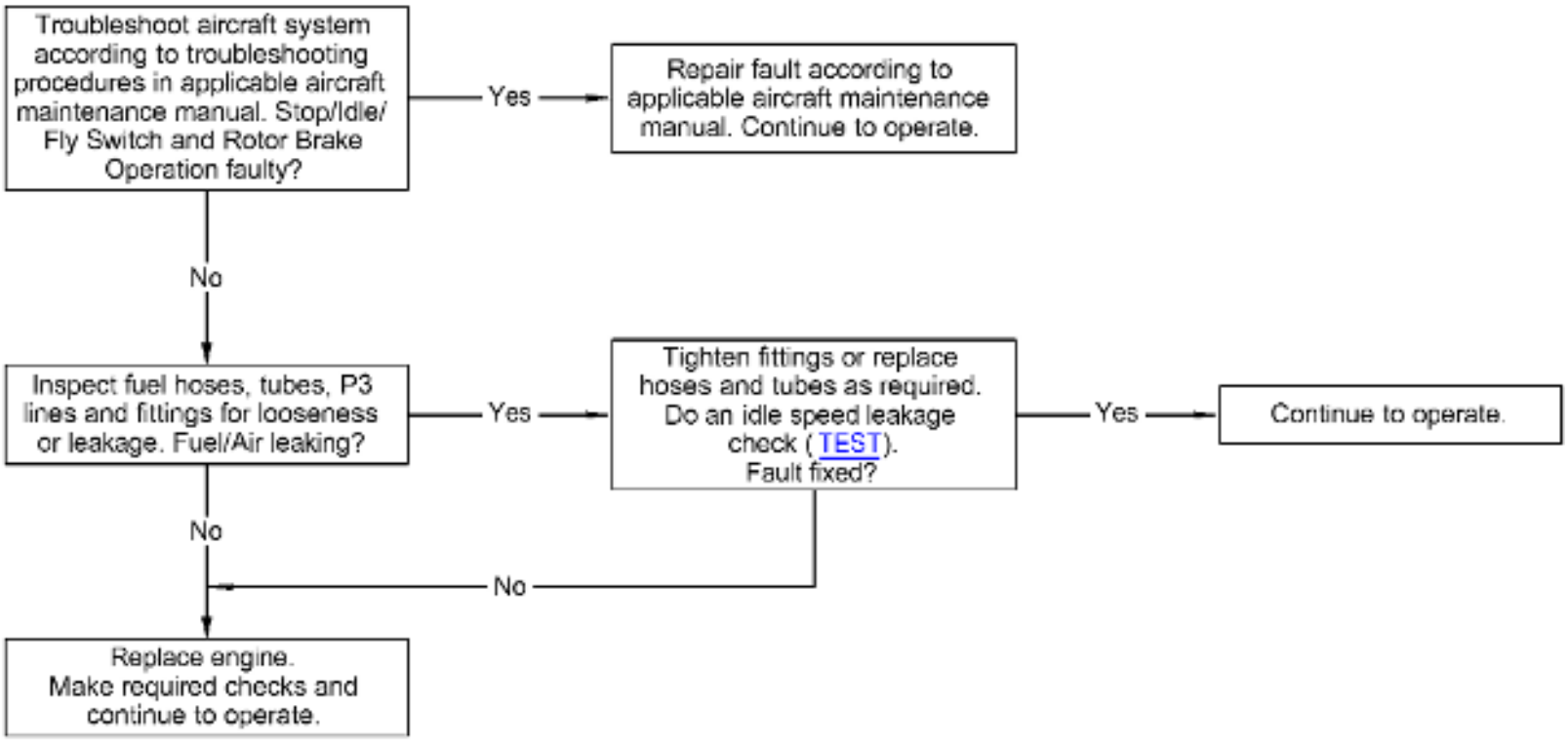

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Figure 102 Np Does Not Accelerate to Flight Idle Speed (EECU Will Not Allow the Engine to Go to 70% Ng Speed)

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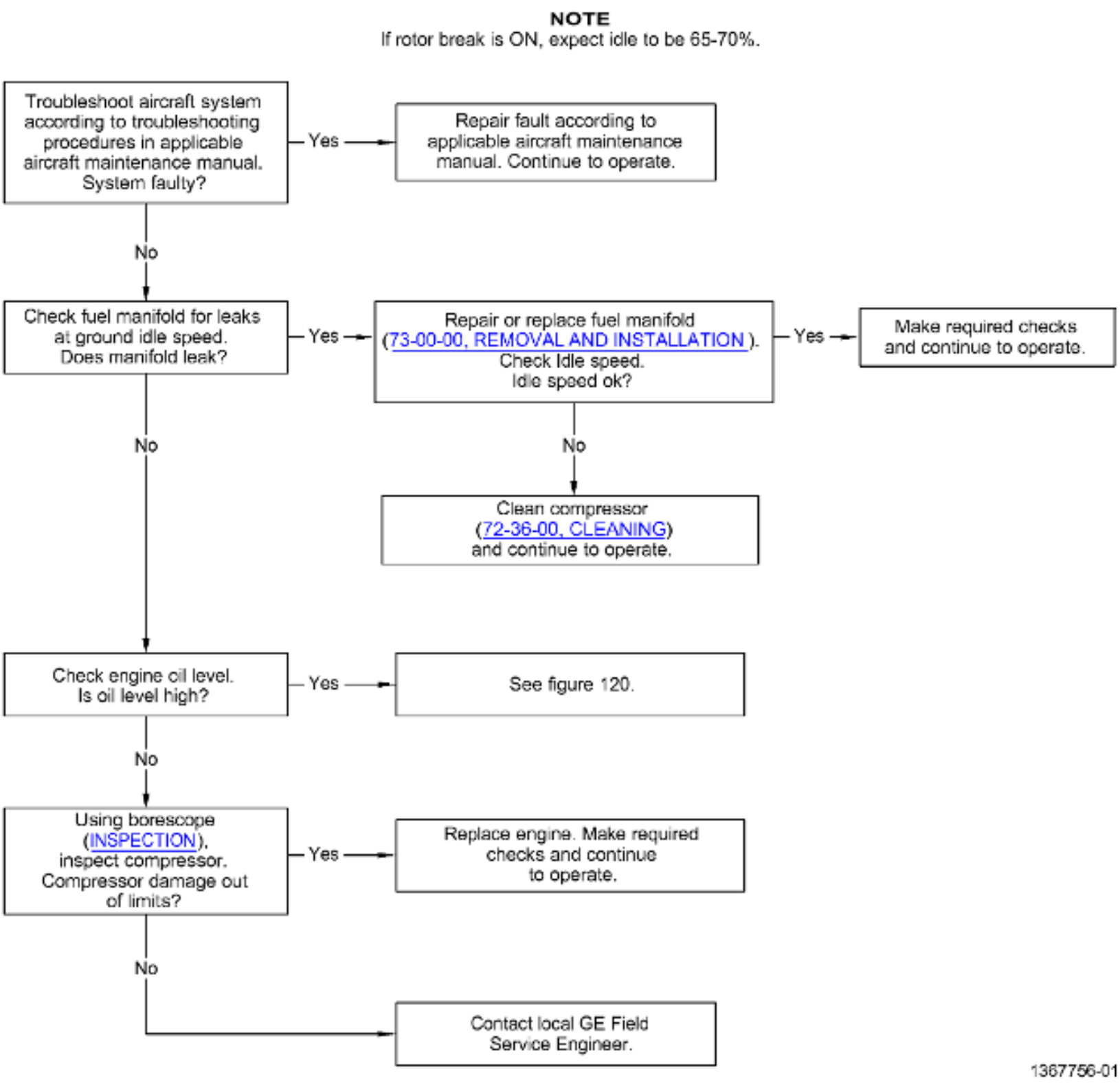

Figure 103 Np Low at Ground Idle Speed (Idle Speed is below Limits in TEST)

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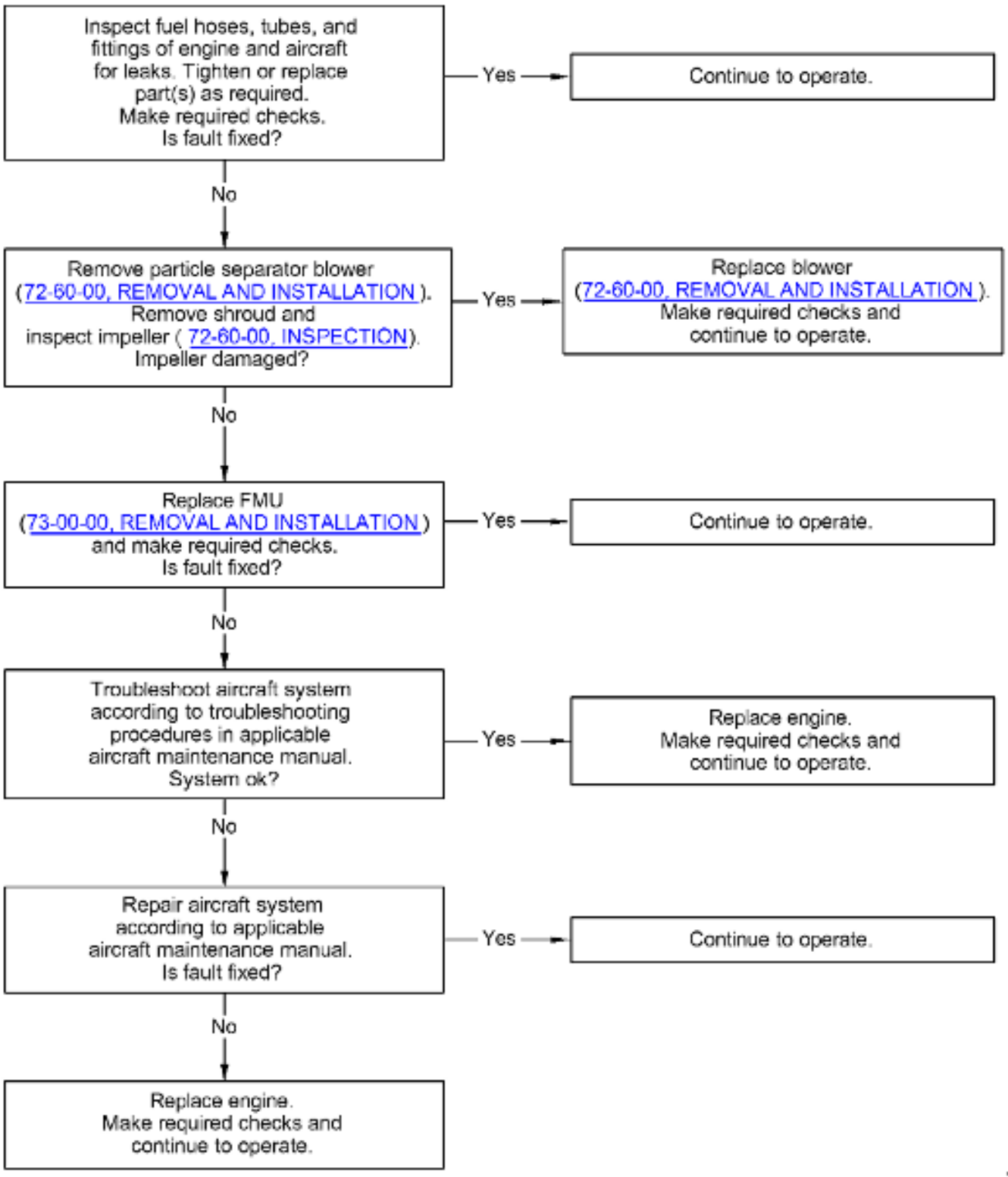

Figure 104 Uncontrolled Deceleration (Ng) (Ng and TGT Decrease Without Switching SIF Switch or Collective Pitch)

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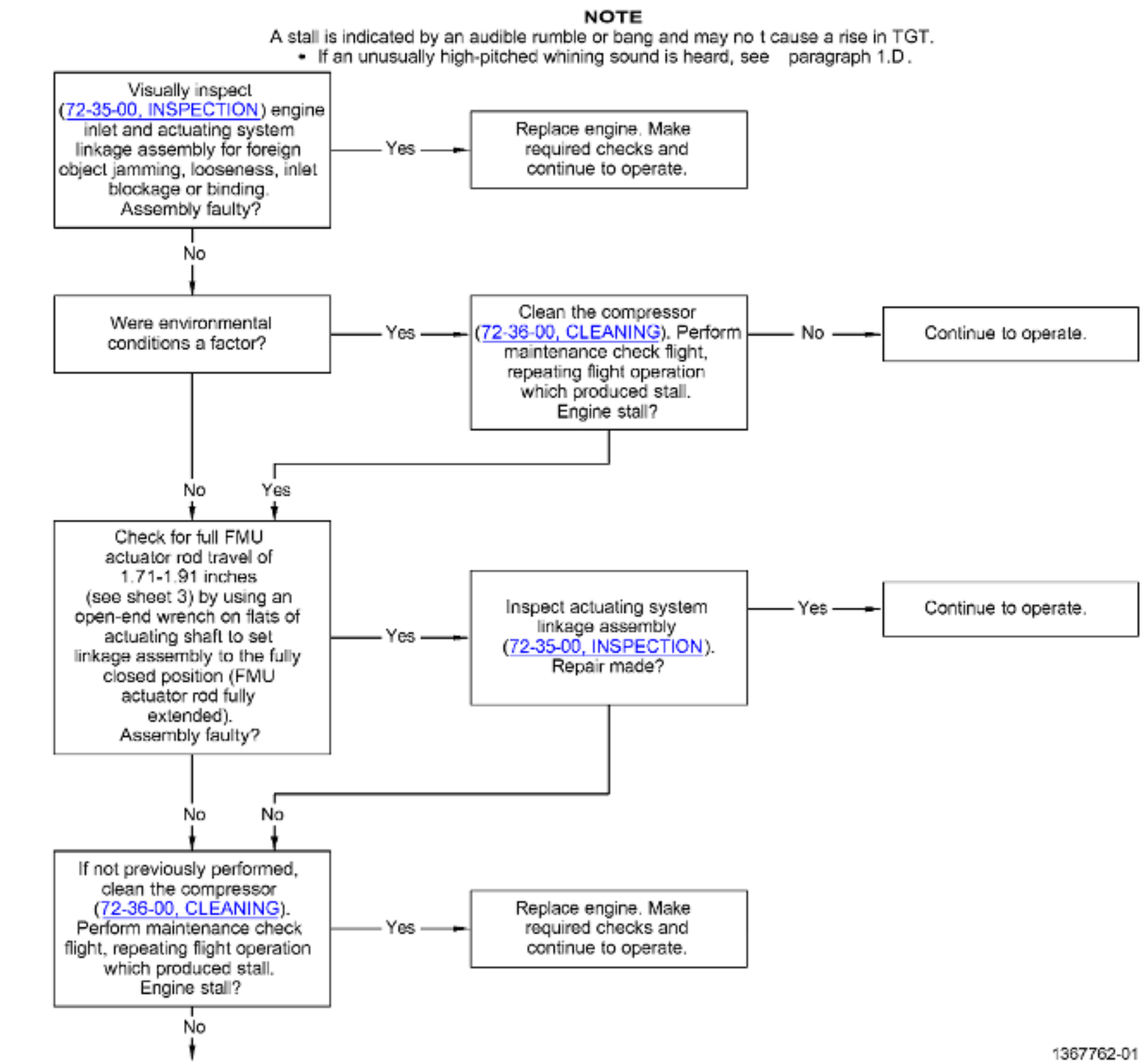

Figure 105 (Sheet 1) Stall Above Ground Idle Speed (Acceleration or Deceleration Above Ground Idle Speed)

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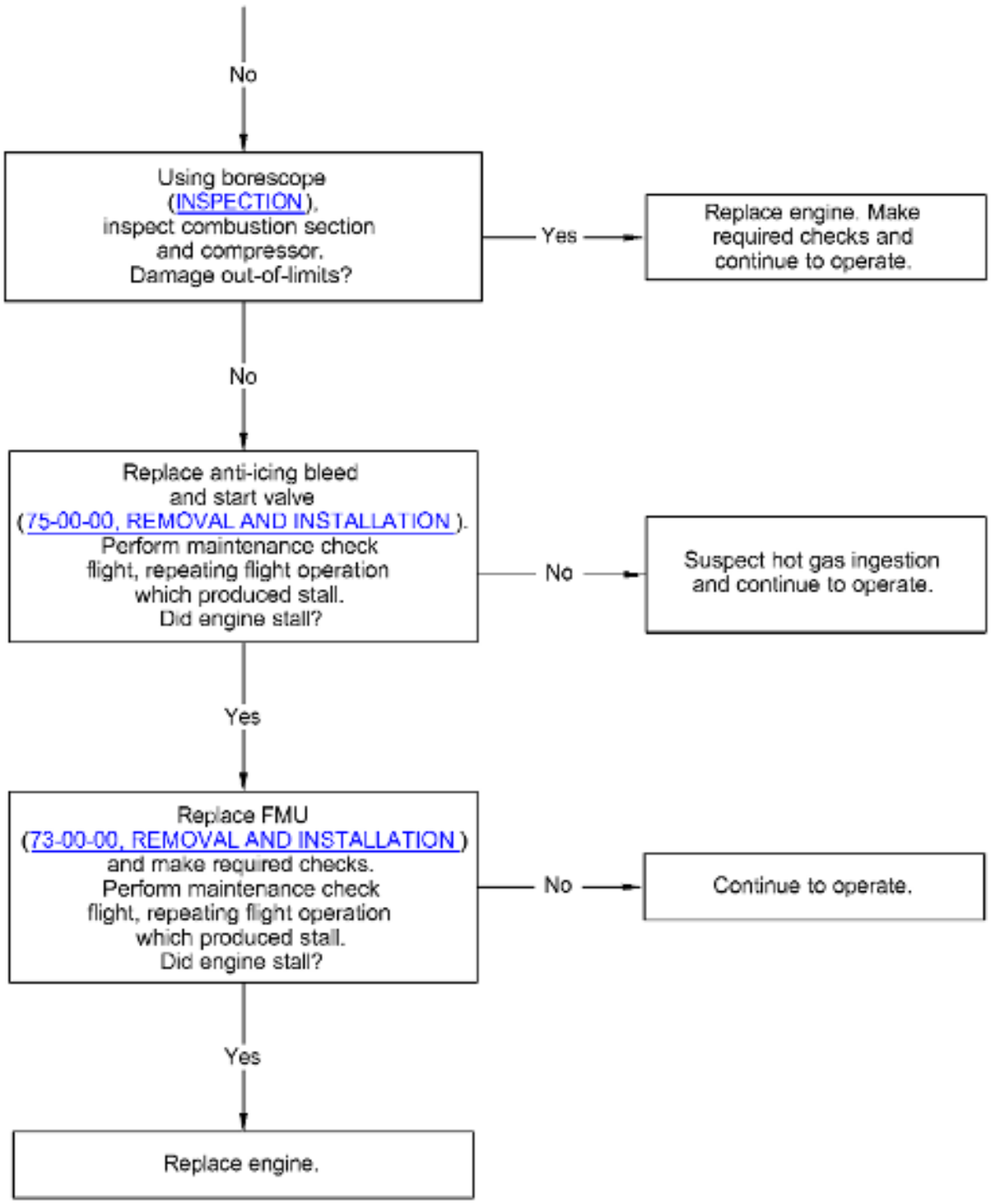

Figure 105 (Sheet 2) Stall Above Ground Idle Speed (Acceleration or Deceleration Above Ground Idle Speed)

* * * FOR CT7-2E1

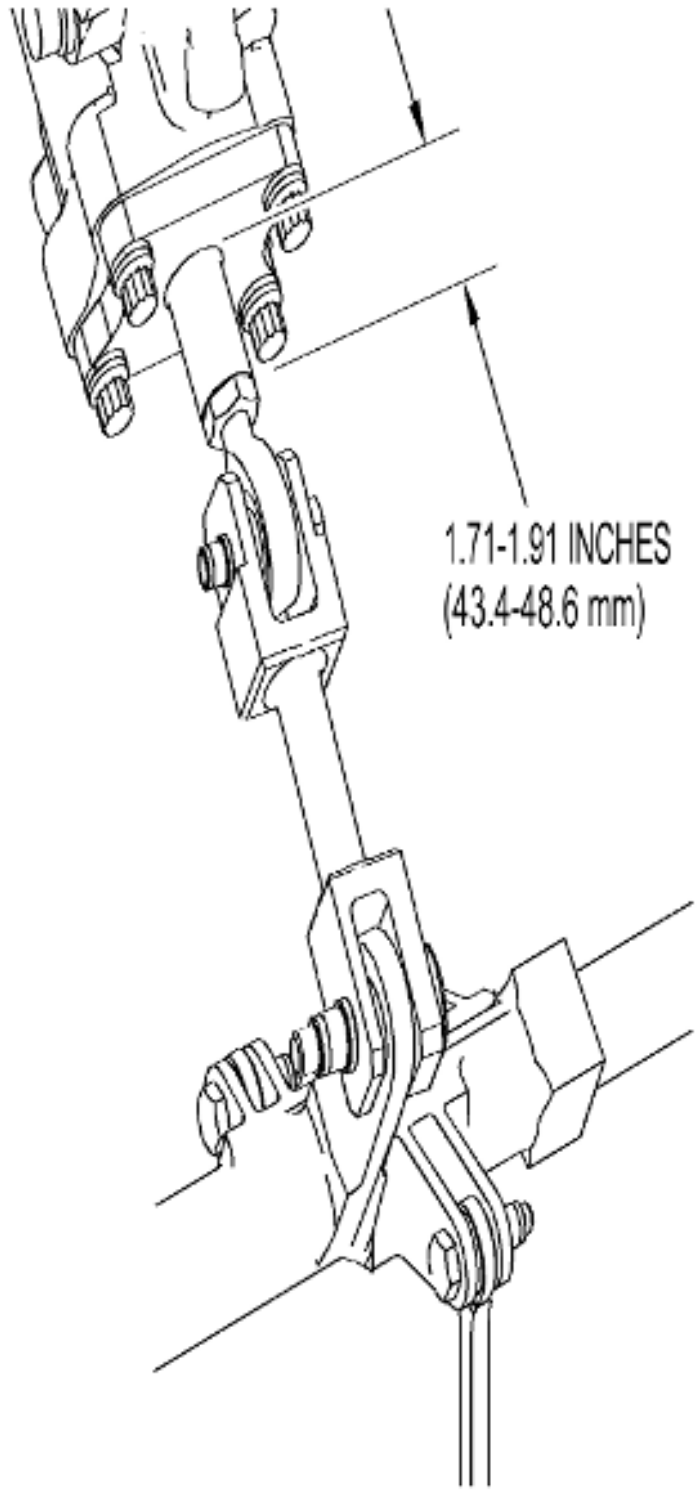

Figure 105 (Sheet 3) Stall Above Ground Idle Speed (Acceleration or Deceleration Above Ground Idle Speed)

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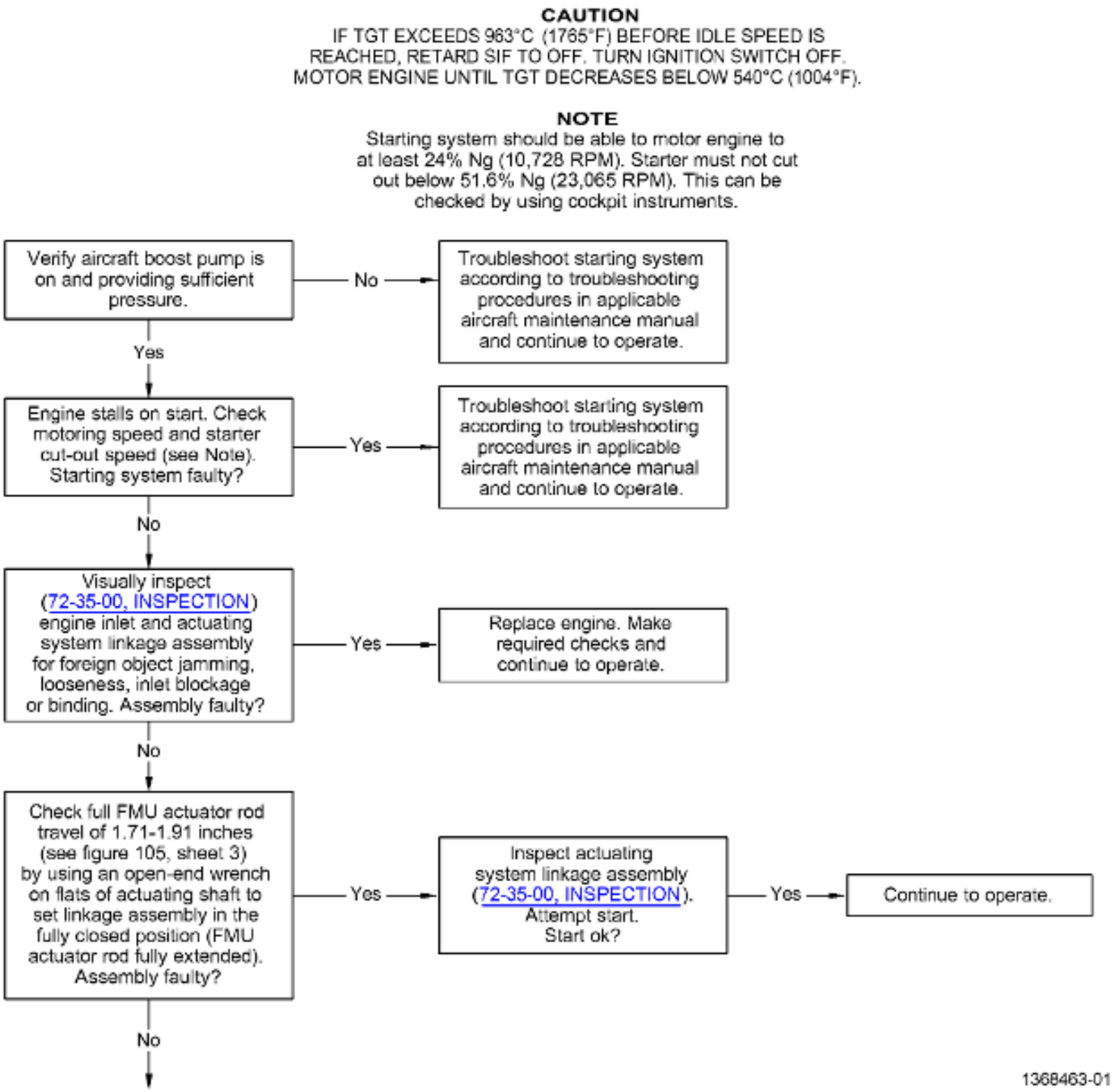

Figure 106 (Sheet 1) Starting Stalls (Audible Popping or Whining During Ng Acceleration to Ground Idle Speed)

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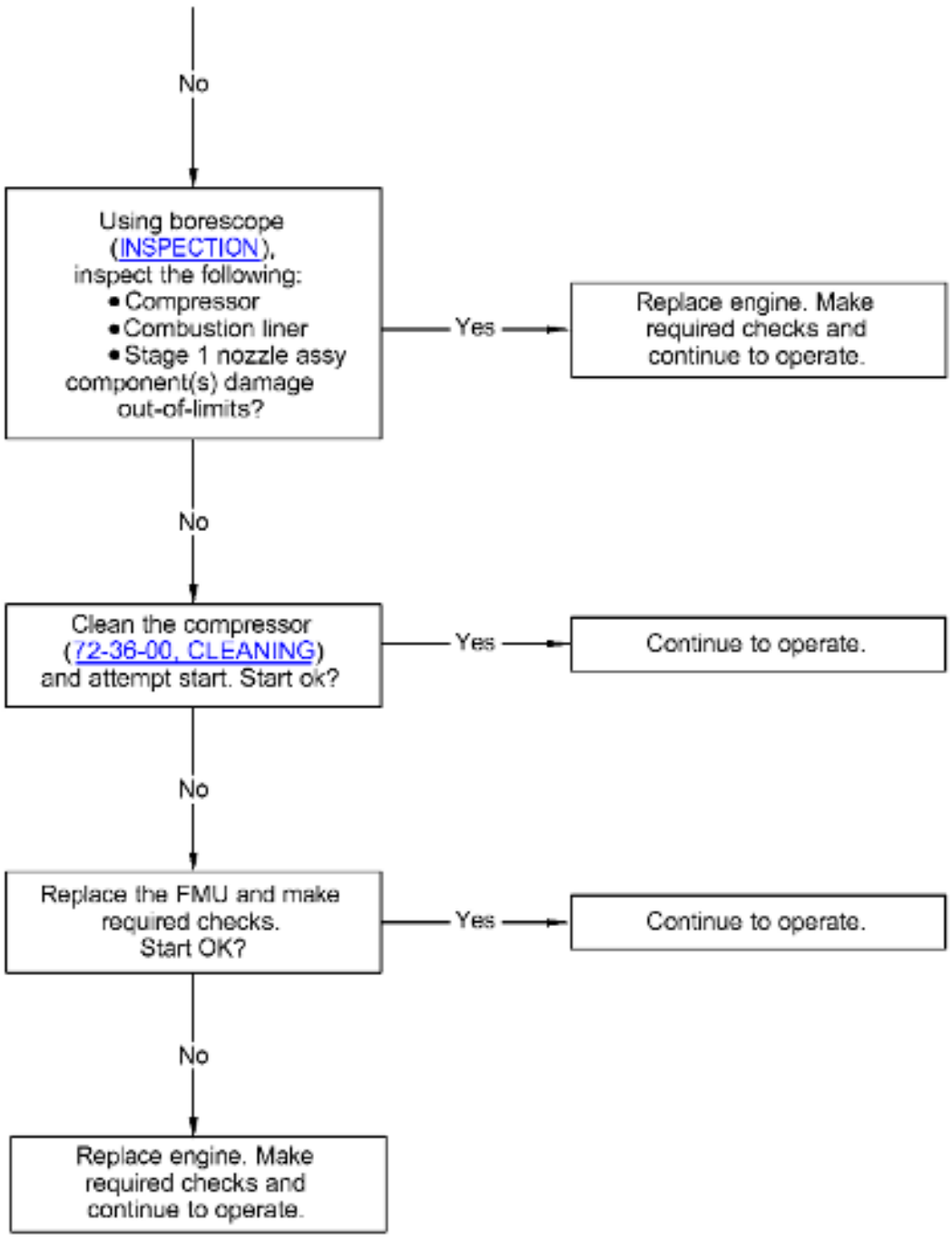

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Figure 106 (Sheet 2) Starting Stalls (Audible Popping or Whining During Ng Acceleration to Ground Idle Speed)

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CAUTION

IF TGT EXCEEDS 963°C (1765°F) BEFORE IDLE SPEED IS REACHED, RETARD SIF TO OFF. TURN IGNITION SWITCH OFF. MOTOR ENGINE UNTIL TGT DECREASES BELOW 540°C (1004°F).

NOTE

- Starting system should be able to motor engine to at least 2 4% Ng (10,728 RPM). Starter must not cut out below 51.6% Ng (23,065 RPM). This can be checked by usin g cockpit instruments.
- Check for environmental factors and TGT less than 150°C when start was initiated.

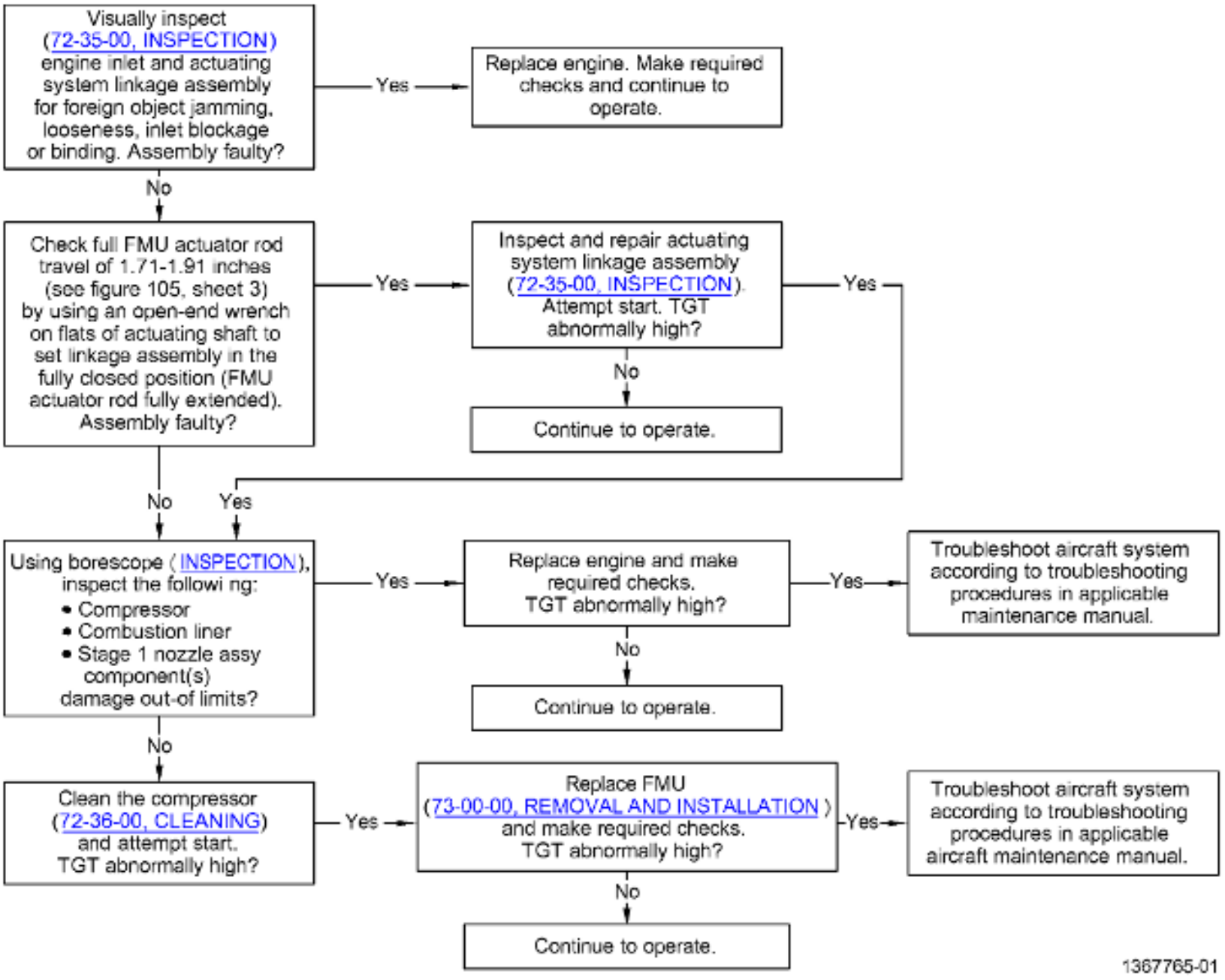

Figure 107 Abnormally High TGT During Start

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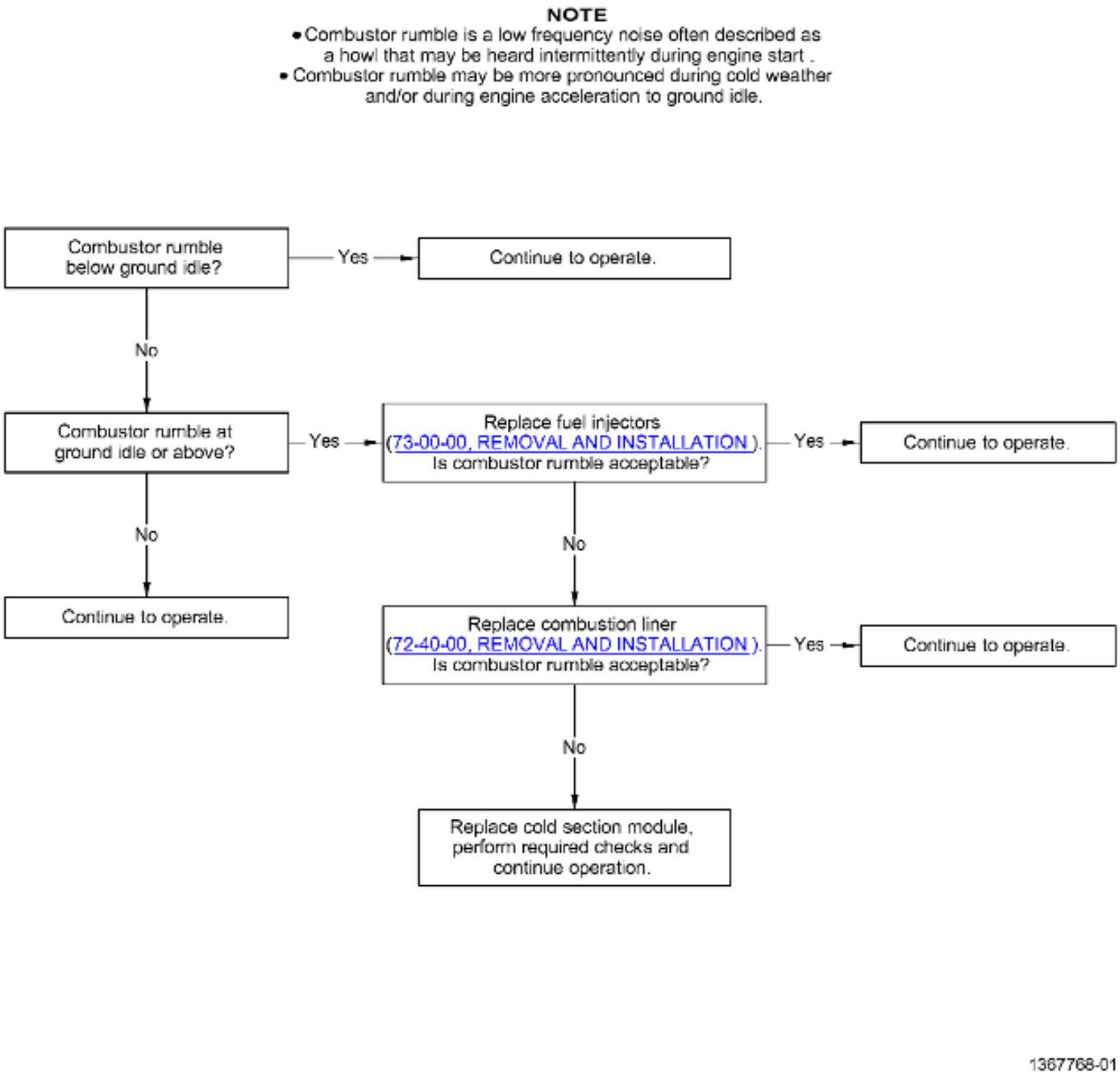

Figure 108 Combustor Rumble During Start

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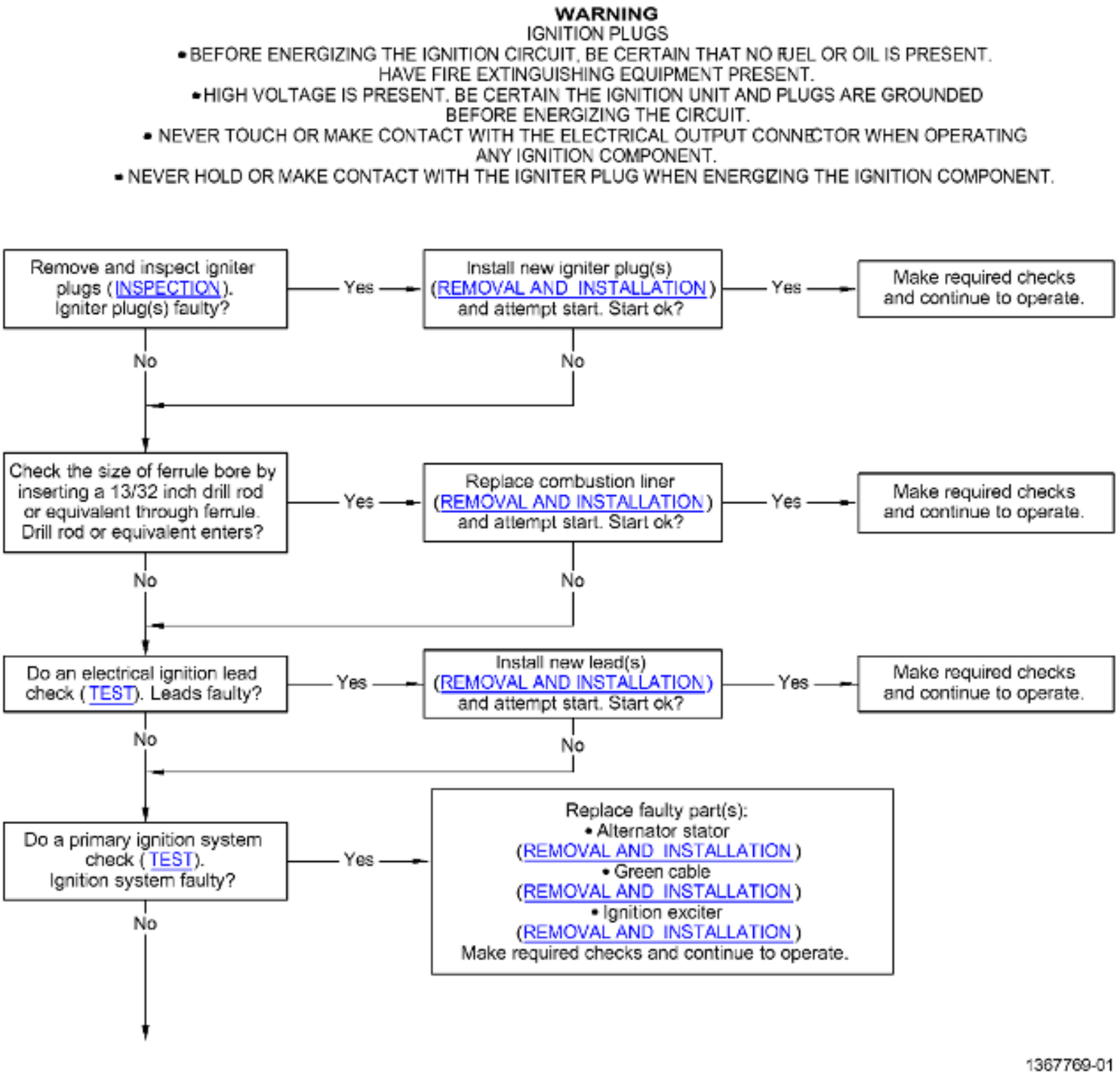

Figure 109 (Sheet 1) No Start (Fuel Mist Seen Coming From Tailpipe; No Rise in TGT)

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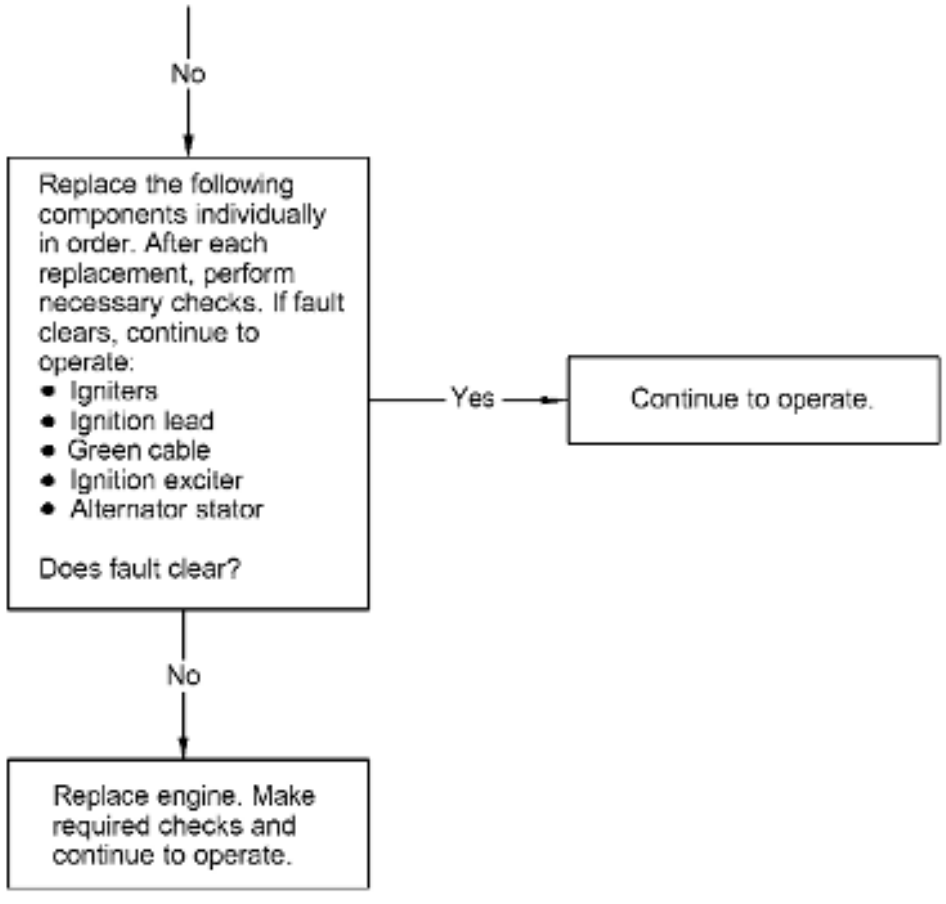

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Figure 109 (Sheet 2) No Start (Fuel Mist Seen Coming From Tailpipe; No Rise in TGT)

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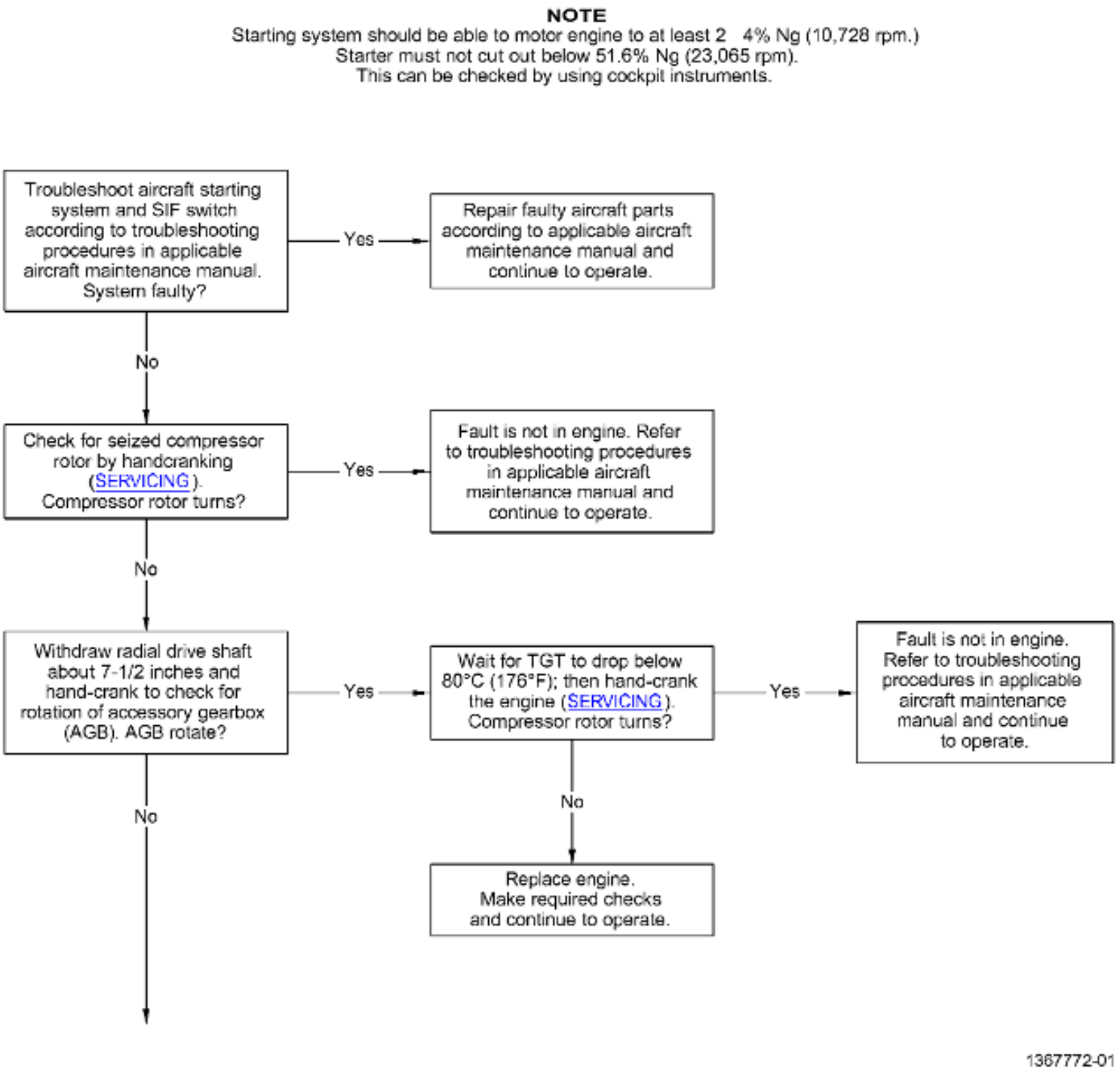

Figure 110 (Sheet 1) No Start (No Compressor Rotor Rotation)

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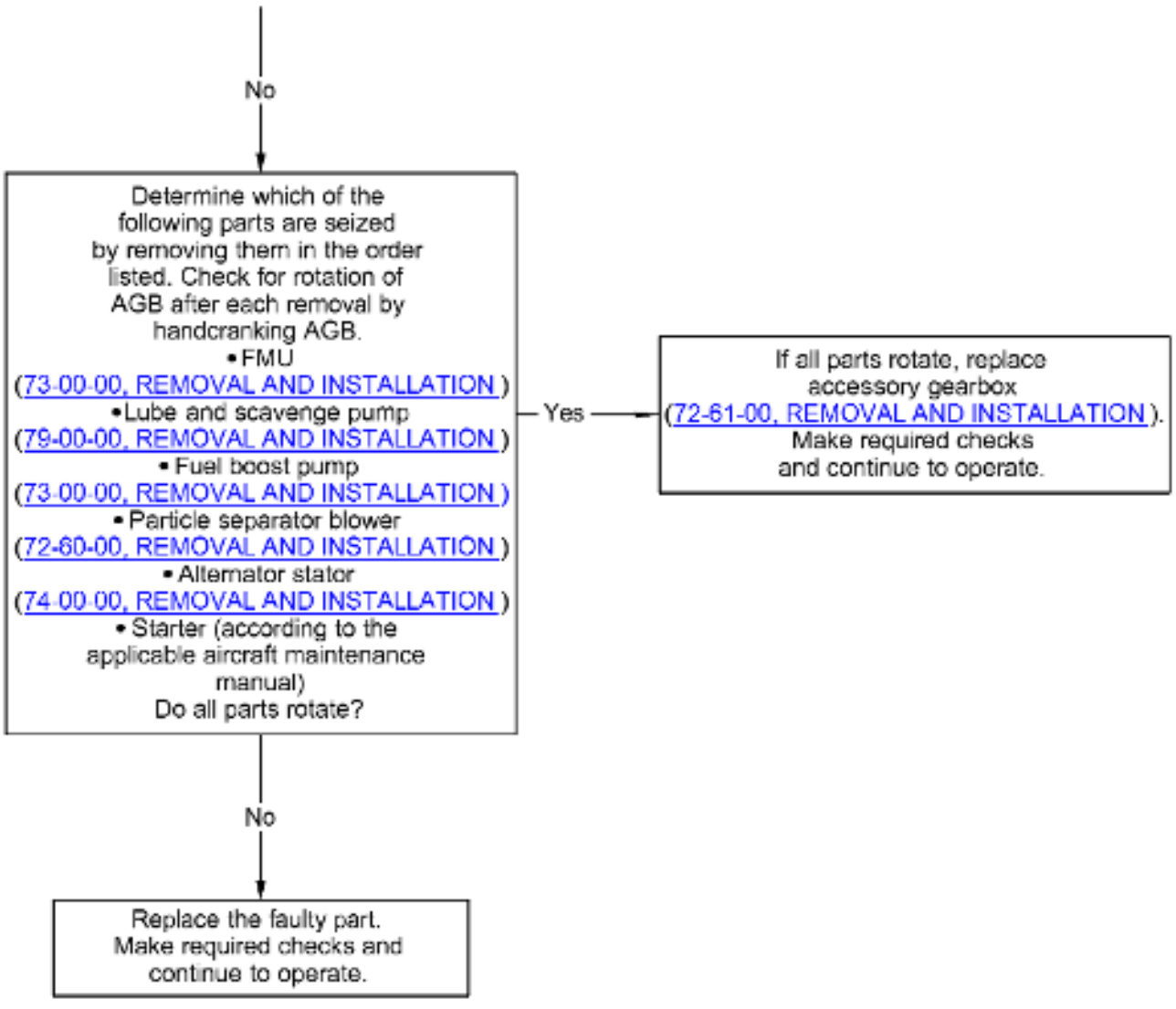

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Figure 110 (Sheet 2) No Start (No Compressor Rotor Rotation)

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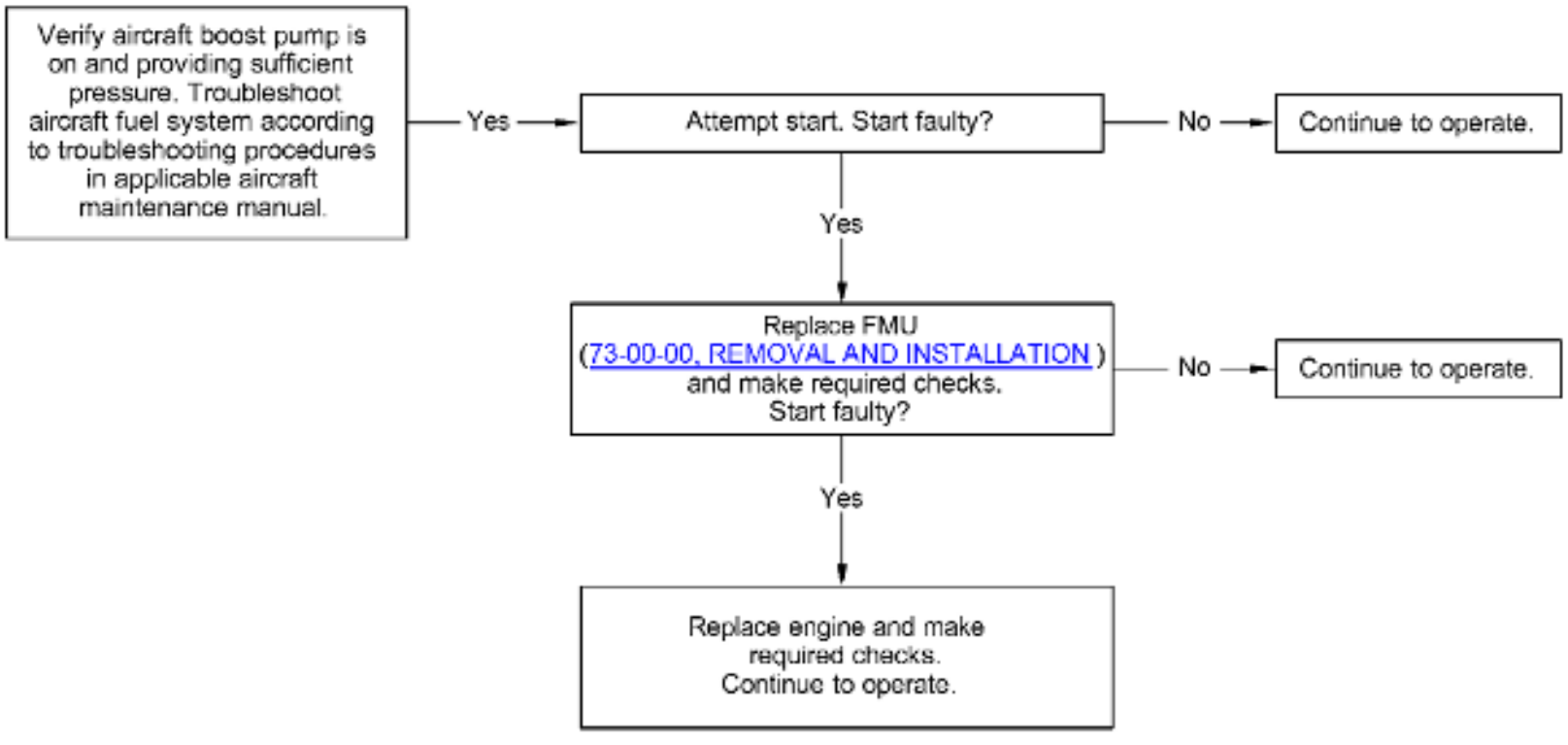

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Figure 111 No Start (No Fuel Mist Seen Coming From Tailpipe; No Rise)

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WARNING

- IF ANTI-ICING BLEED AND START VALVE DOES NOT OPEN, COMPRESSO R WILL PROBABLY STALL AT ABOUT 40% NG (17,880 RPM). WHEN COMPRESSOR STALLS, A RUMBLE OR BANG WILL BE HEARD, BUT TGT MAY NOT RISE.
- IF AN UNUSUALLY HIGH-PITCHED WHINING SOUND IS HEARD SEE PARAGRAPH 1.D. FOR POSSIBLE BENT BLADE.

NOTE

See if there are P3 fault codes on the cockpit display cause d by P3 sensor failure, tube damage, cracks or blockage.

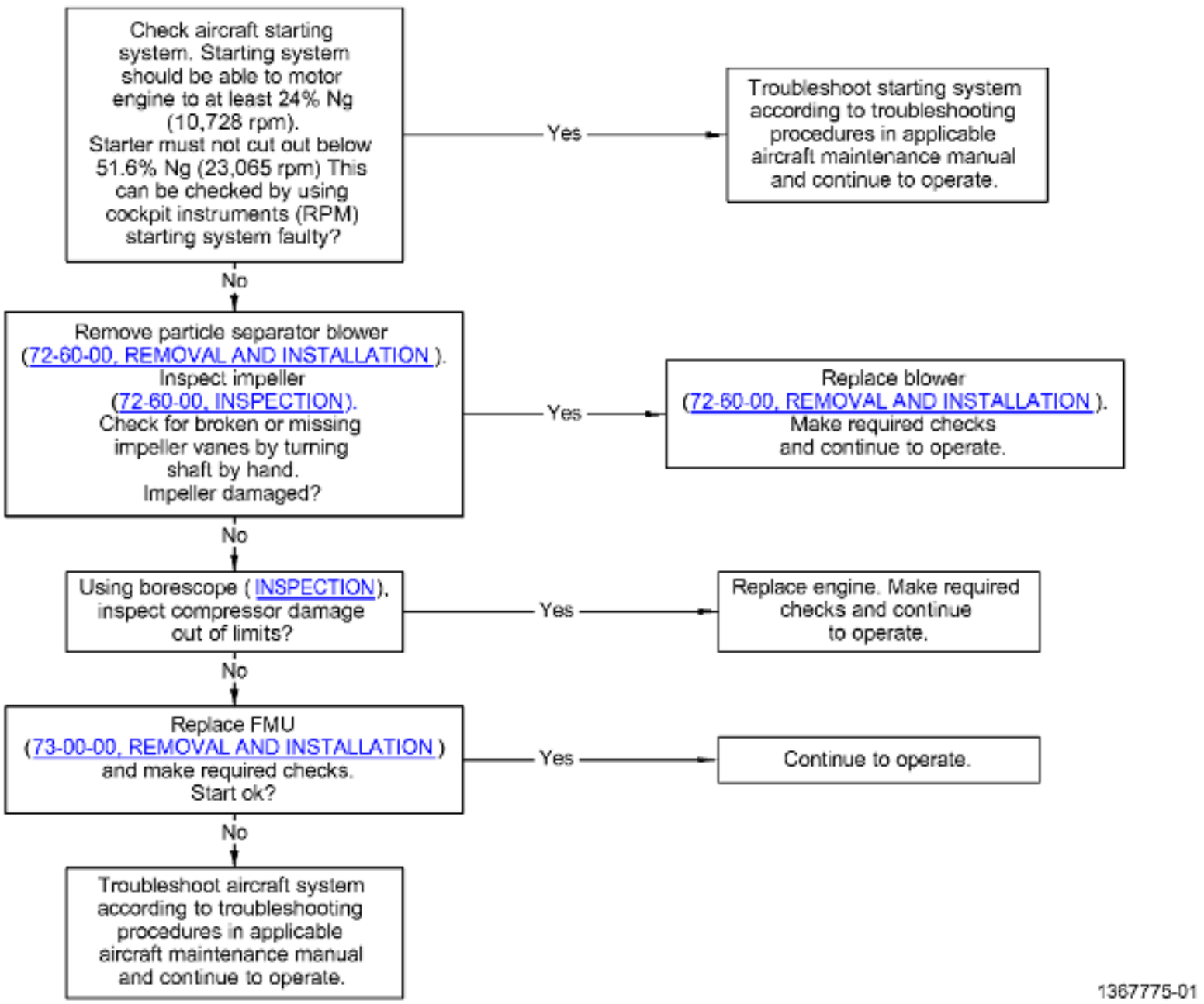

Figure 112 Slow or Hung Start (TGT Increases But Hangs) (On a Hung Start, Engine Lights Off But Does Not Accelerate To Idle Speed. Speed Hangs Up Between Lightoff and Idle)

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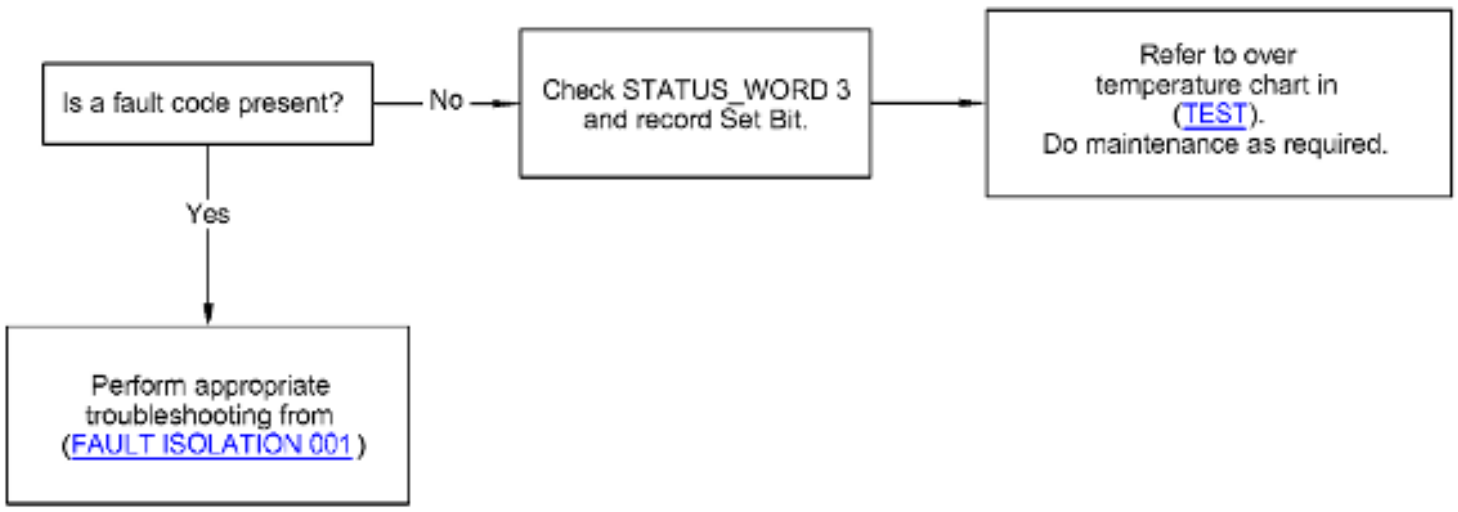

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Figure 113 Engine Exceeds TGT Operating Limits

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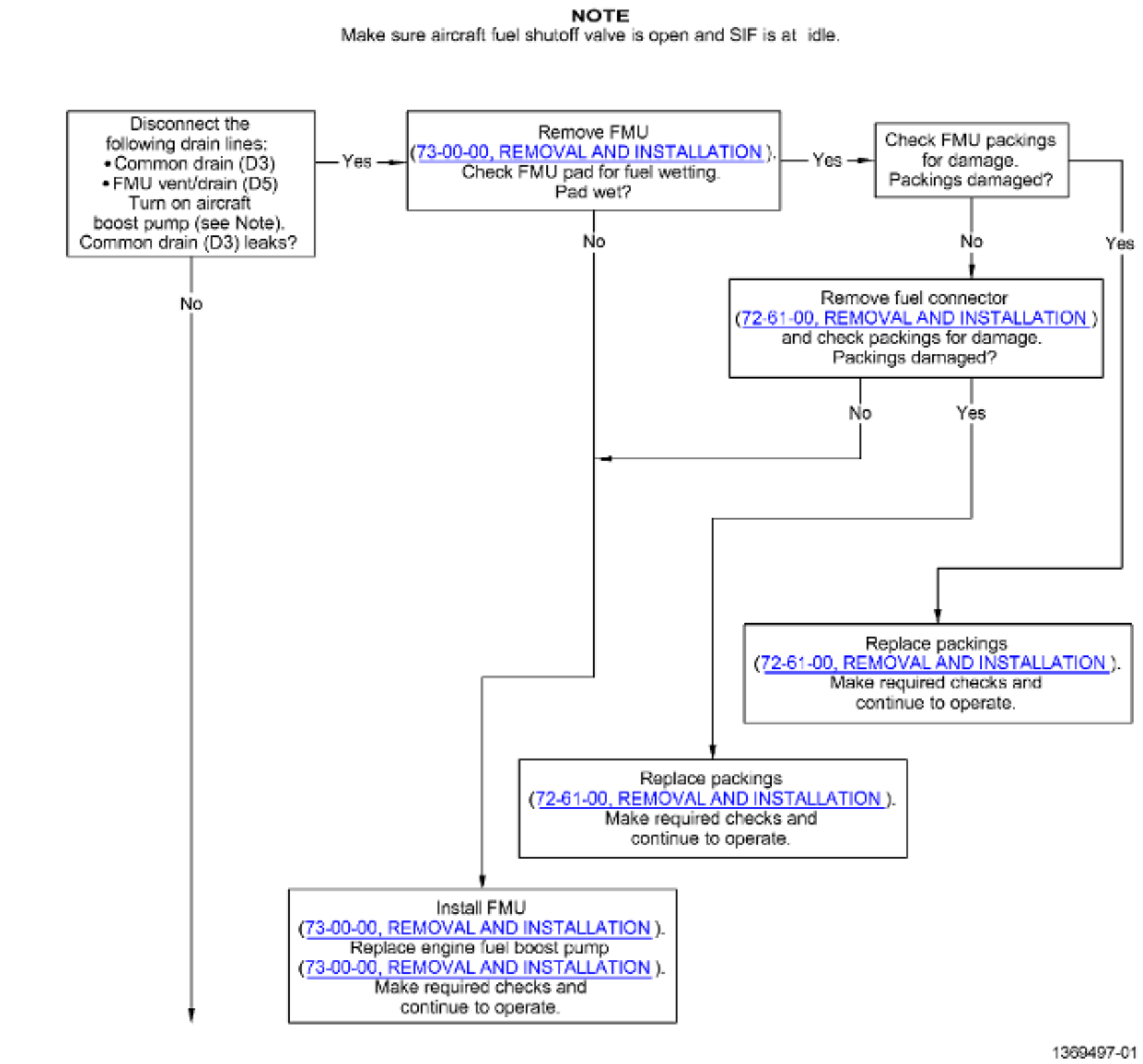

Figure 114 (Sheet 1) Excessive Fuel Leaking from Overboard Drain While Engine is Operating at Ground Idle Speed

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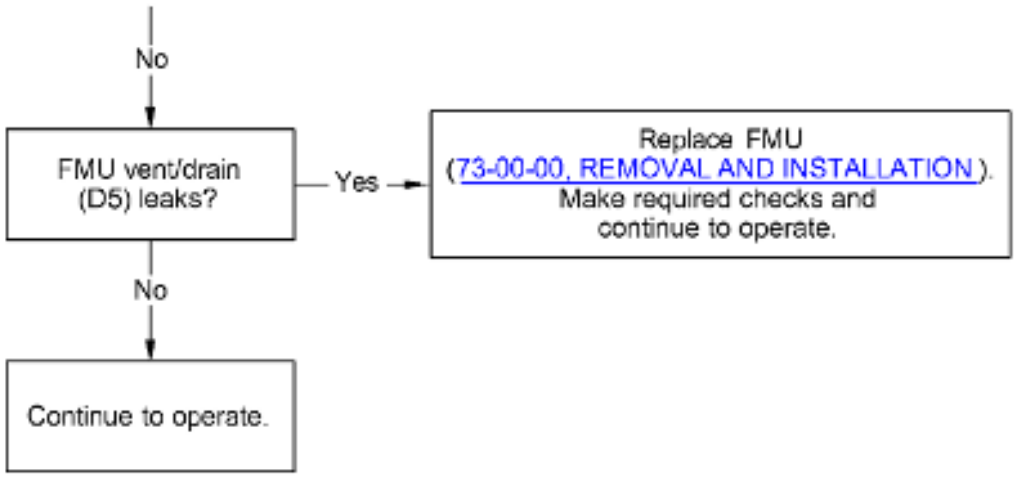

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Figure 114 (Sheet 2) Excessive Fuel Leaking from Overboard Drain While Engine is Operating at Ground Idle Speed
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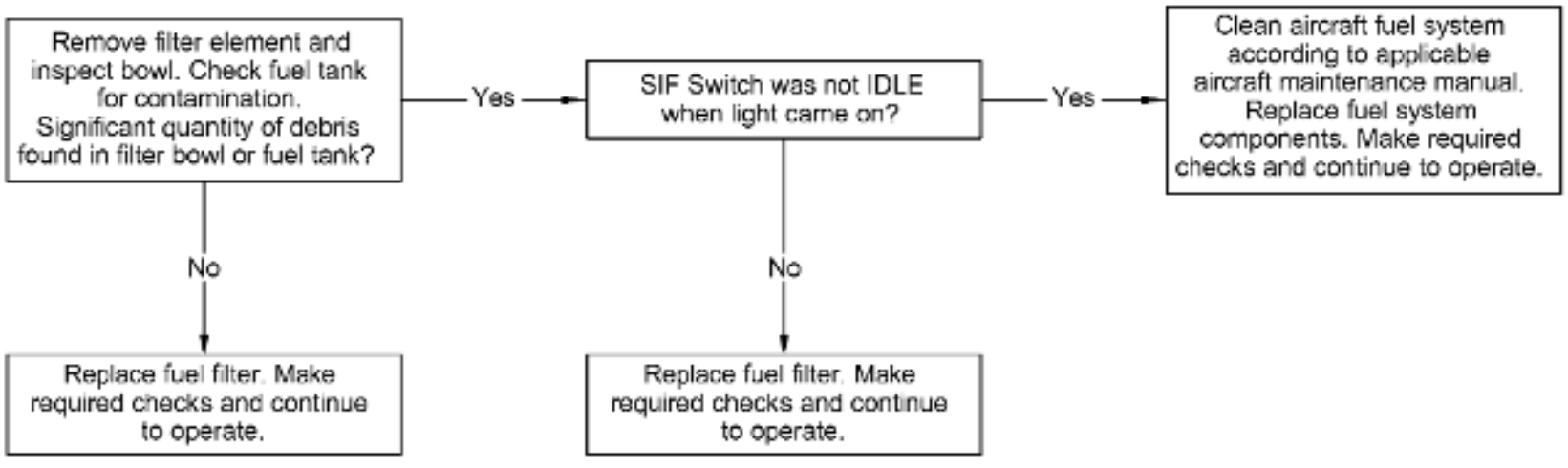

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Figure 115 Fuel Filter Bypass Light On

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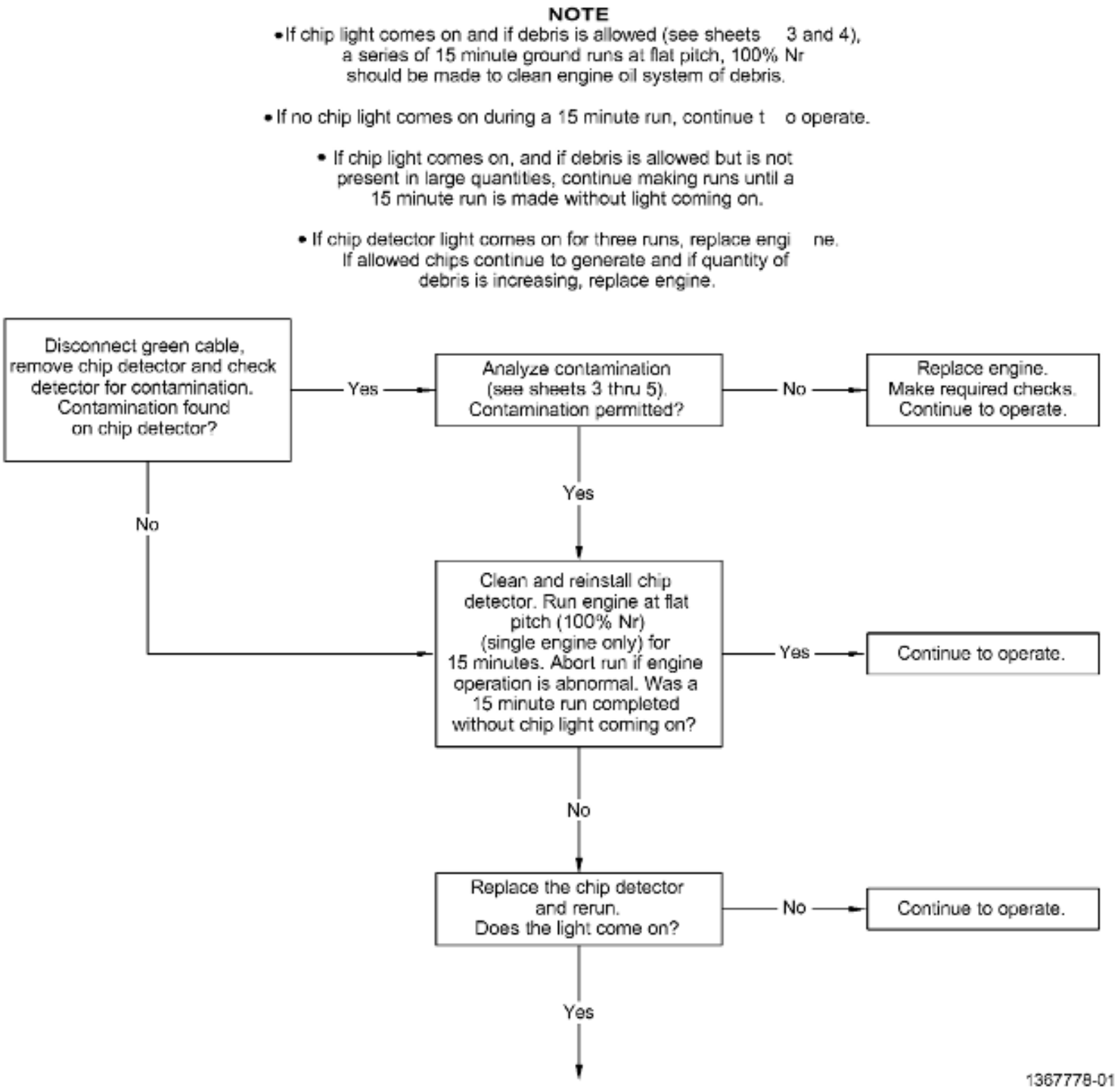

Figure 116 (Sheet 1) Electrical Chip Detector Light On During Engine Operation

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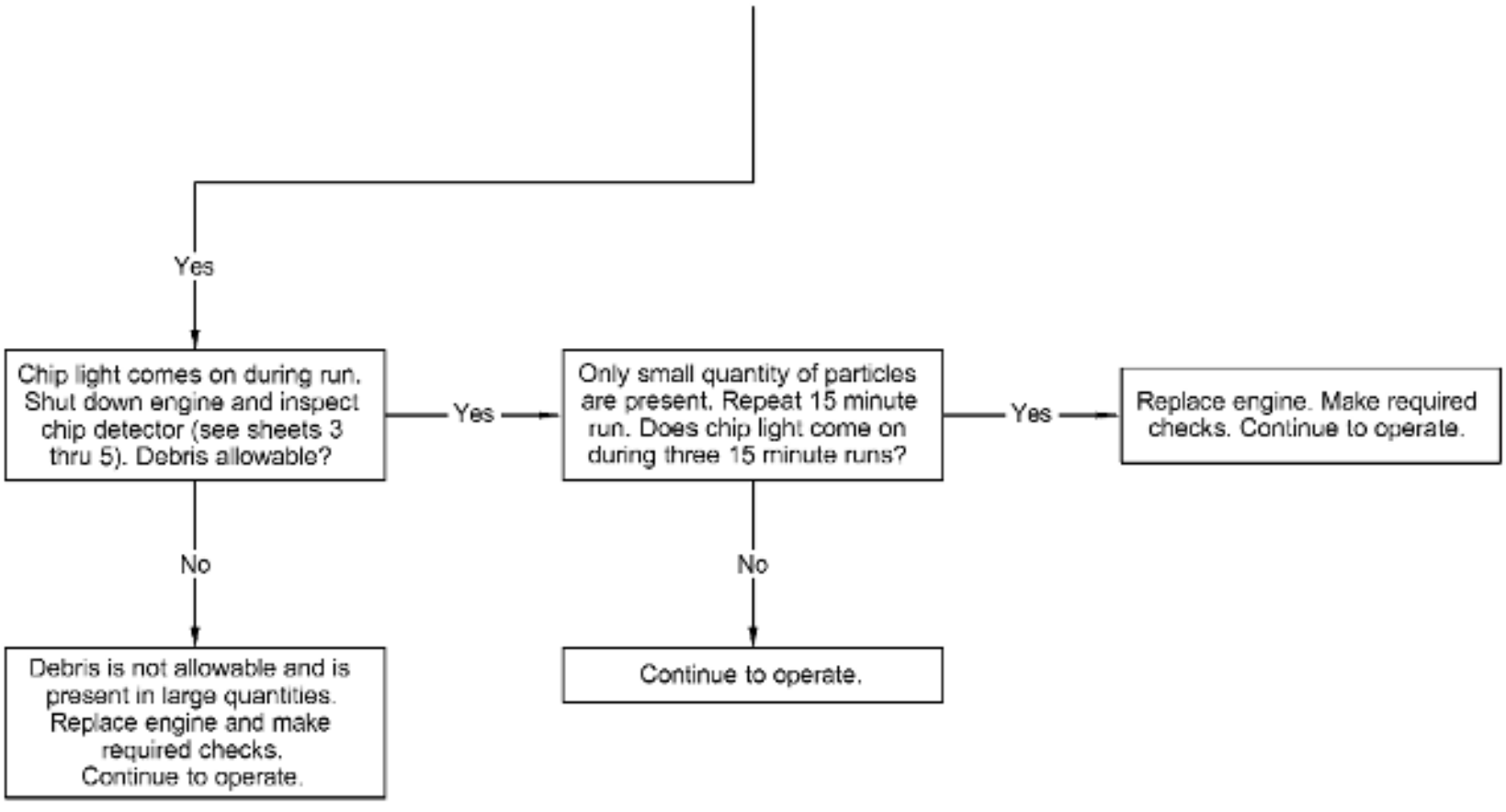

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Figure 116 (Sheet 2) Electrical Chip Detector Light On During Engine Operation

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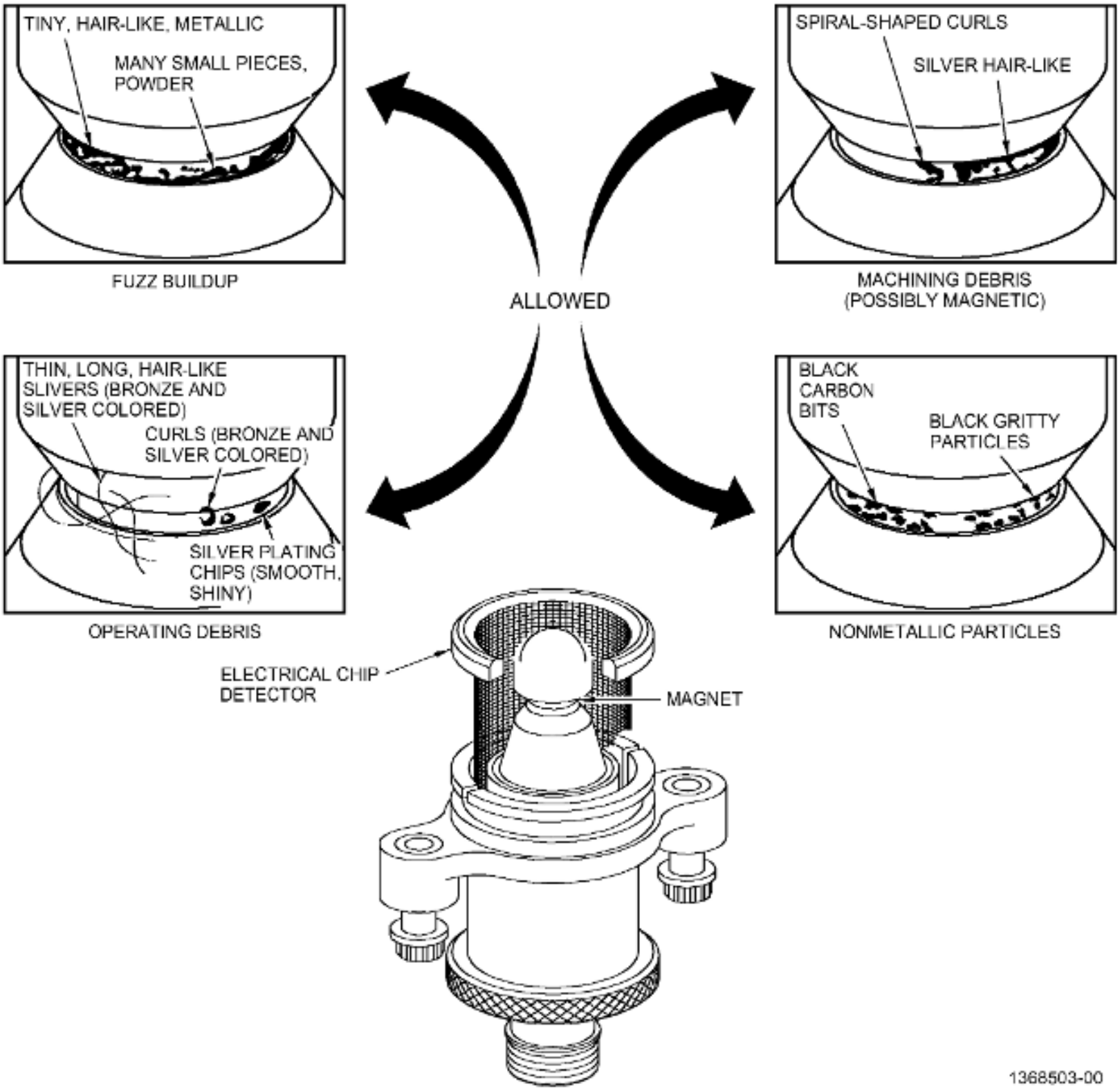

Figure 116 (Sheet 3) Electrical Chip Detector Light On During Engine Operation

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NOTE

- All debris must be examined with a 10x magnifying glass.
- Characteristics of chips of the allowable category are as fo llows:
  - Machining debris. This type of material is left over from the manufacturing operations used to make the engine parts. Typical characteristics include spiral shaped curls, semi-circular curls, or section of curls. Section of curls will appear as tiny rectangular shapes. One side of the chip may be stained or blued more than the other. Usually non-magnetic, as with nickel based steels such as the INCO series, aluminum, etc. But can also be magneti c.
  - Non-magnetic metal chips. Except relatively large pieces of non-magnetic material (chunks) which appear to have fractured away from larger structure as evidenced by a machined surface on one side, irregular and jagged on the other surfaces.
  - Non-metals, such as preformed packing and carbon seal mate rial.
  - Long, hair-like, bronze colored slivers, non-magnetic, typical of sump labyrinth seal material.
  - Long, hair-like, slivers, magnetic, typical of driveshaft bearing locknut threads.
  - Wire shaped pieces.
  - Soft, ductile, silvery colored material, typical of silver plating. Can be deformed by hand. May have copper tint on one side.
  - Fuzz-like accumulation on chip detector, particularly on a new or recently overhauled engine. Under magnification fuzz will appear as tiny slivers or a fine powder.
  - Non-metallic, black, gritty particles, carbon-like in appe arance, typical of coked oil.
  - Chunks of carbon seal, or chunks of hard black plastic are allowable as long as oil consumption is within limits and oil temperatures and pressures are normal.
- Machining chips or debris are typically found during the fir st few hours of operation on a new engine, but experience has s hown that it is possible for them to be dislodged hundreds of ope rating hours later. Typically this is a one time occurrence, with n o subsequent relights of the chip detector after being cleaned .
- Chips less than 0.010 inch (0.25 mm) are considered too smal l to be interpreted by visual means; however, if the chip dete ctor repeatedly accumulates large quantities of extremely small c hips, this is to be considered an unacceptable condition.

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Figure 116 (Sheet 4) Electrical Chip Detector Light On During Engine Operation

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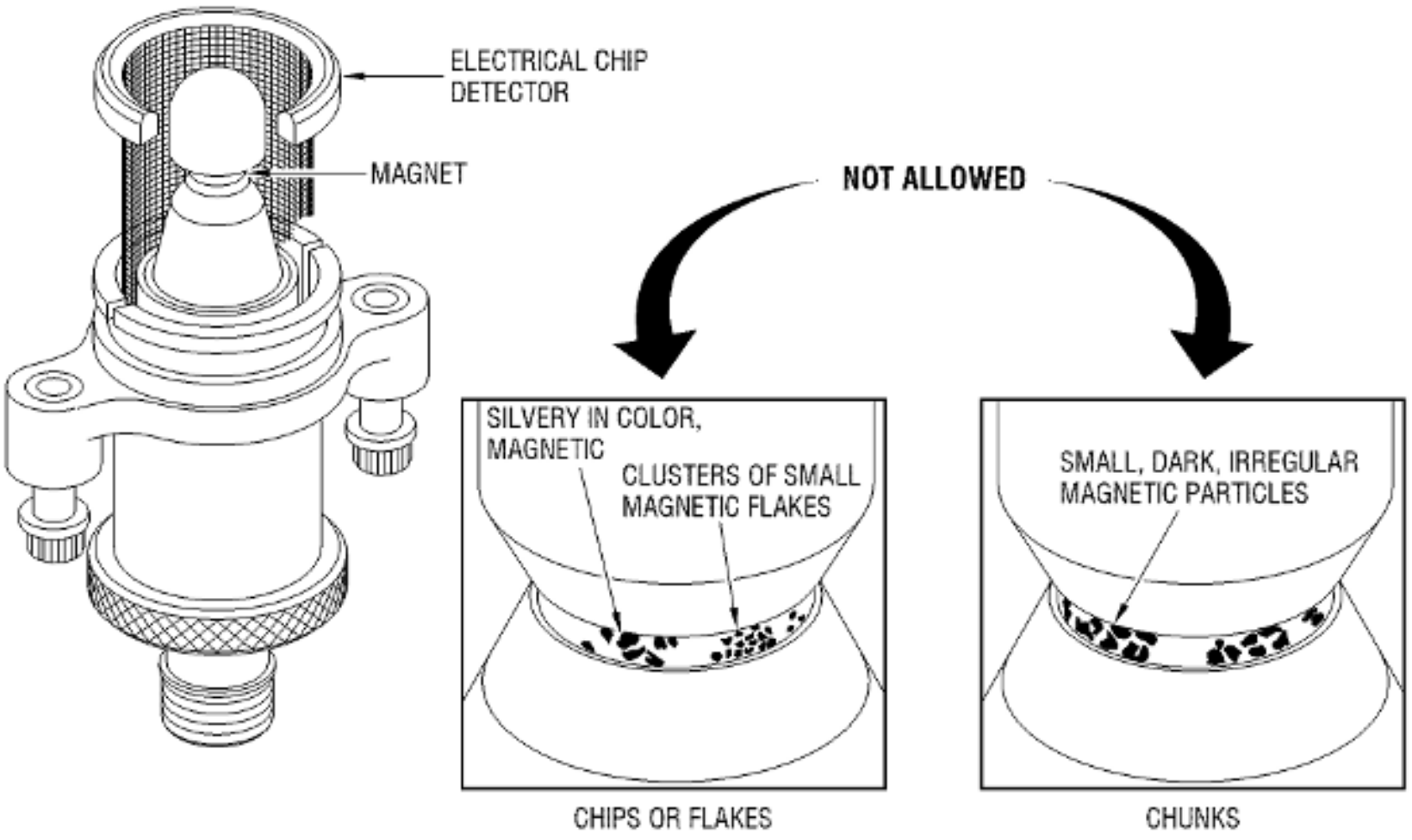

NOTE

- All debris must be examined with a 10x magnifying glass.
- Unallowable chips are from power unit bearings, including driveshaft, power takeoff, and accessory gearbox bearings. The inner and outer races, balls, and rollers are made from M50, M50 NIL, or 52100 steel. Unallowable chips can also be from the accessory/PTO gears which are manufactured from AISI 9310. Any chip identified as unallowable debris, either visually or by laboratory analysis, is cause for immediate engine disassembly.
- The following visual characteristics can be used to distinguish these types of chips:
  - Many chips of similar size and shape.
  - Magnetic material is an indication that the chips are unallowable. (Some types of allowable chips are also magnetic).
  - Smooth and reflective (silvery) on one side, rough on the other, typical of M50 material.
  - Roughly circular or elliptical flakes, thinner around edges, typical of a spalling-type bearing distress.
  - Material that is hard and brittle, rather than soft and ductile. Chunks of metal, as small dark irregular particles, or individual larger chunks.
  - Pieces of bearing cage material, which appear as chunks of silver plated steel.
- The types of material that are considered unallowable, as determined by laboratory analysis, are as follows:
  - M50 (AMS 6491) and M50 NIL (AMS 6278) steel, the main material in all bearings.
  - SAE 52100 (AMS 6444), accessory bearing material.
  - AISI 4340 steel (AMS 6414) with silver plating (AMS 2412), bearing cage material.
  - AISI 9310 (AMS 6265), gear material.
- **NOTE:** GEK 113993 (Field Guide for Lubrication System Debris) and T700/CT7 Lube System Debris Analysis Handbook can help to identify the source of material and/or the contamination.

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Figure 116 (Sheet 5) Electrical Chip Detector Light On During Engine Operation

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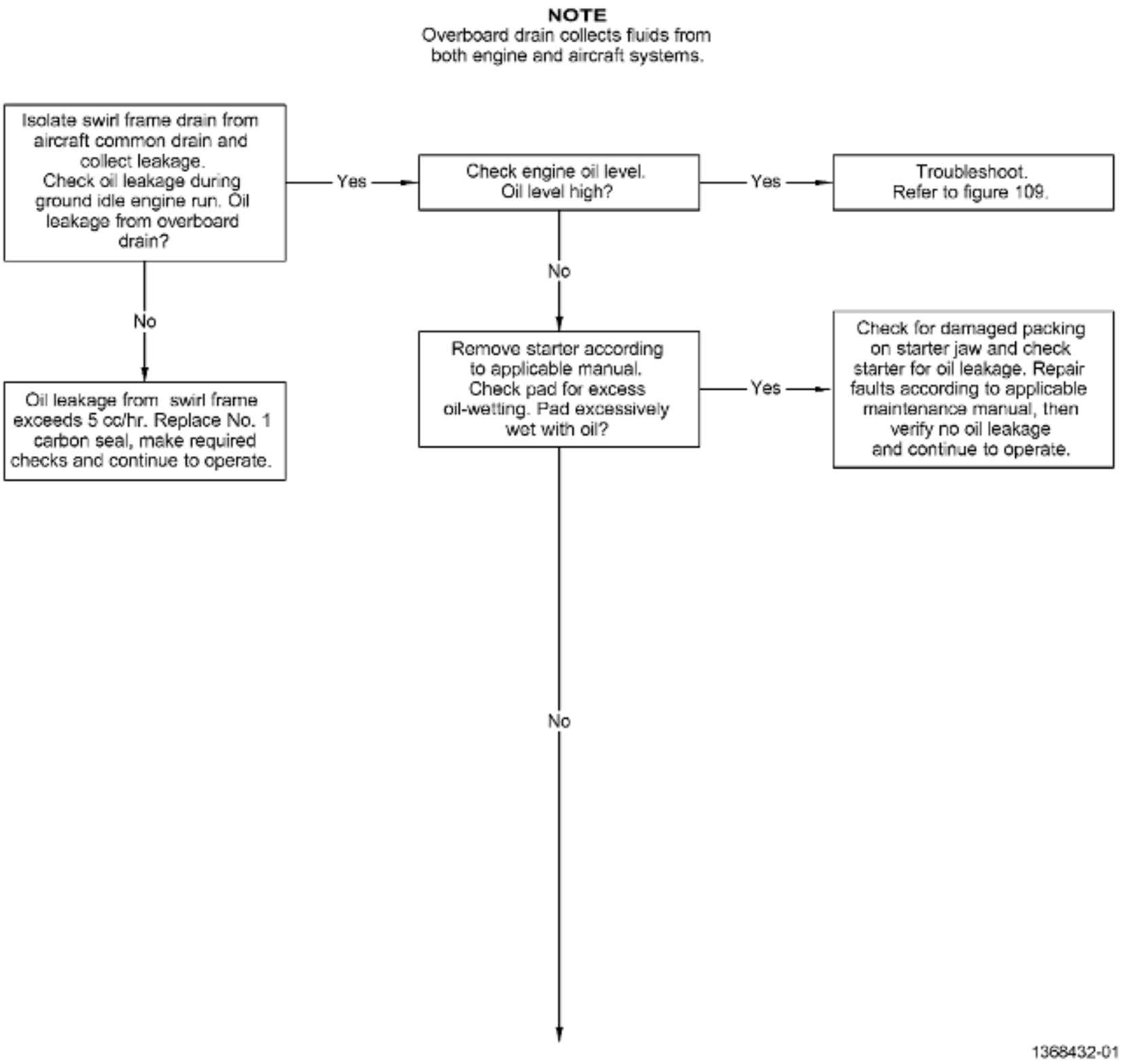

Figure 117 (Sheet 1) Excessive Oil Leakage at Overboard Drain

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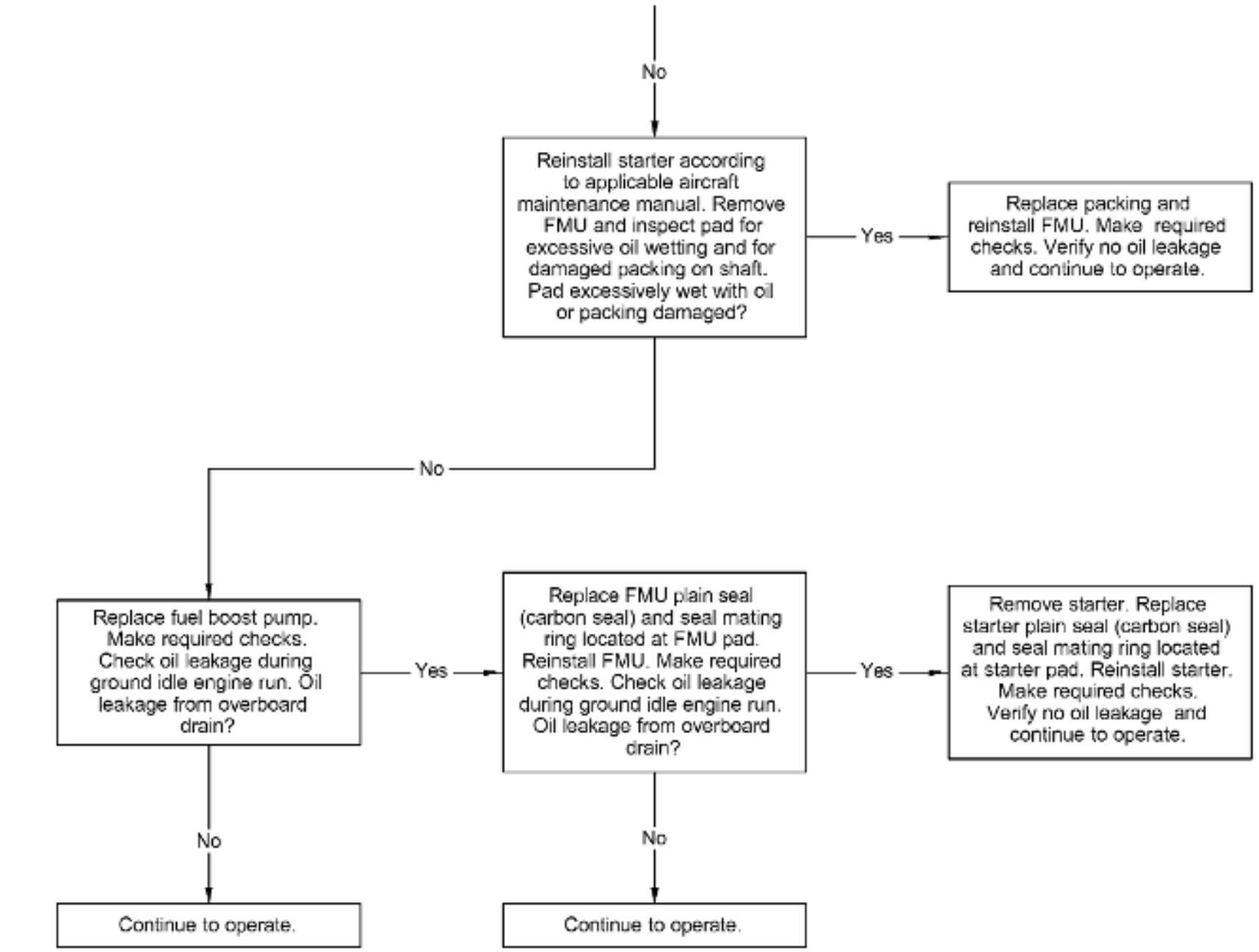

Figure 117 (Sheet 2) Excessive Oil Leakage at Overboard Drain

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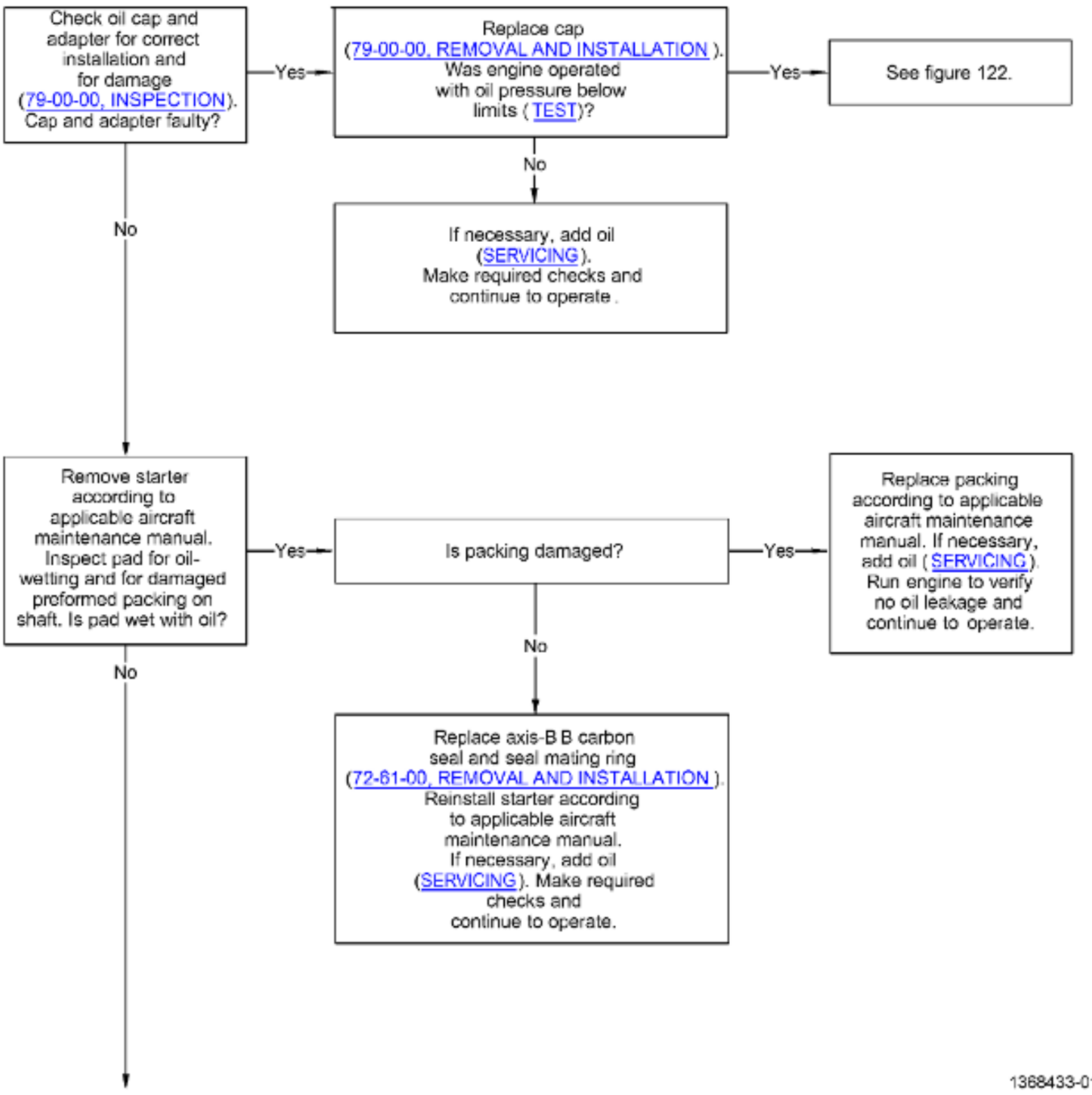

Figure 118 (Sheet 1) Excessive Leakage at Service Port Scupper

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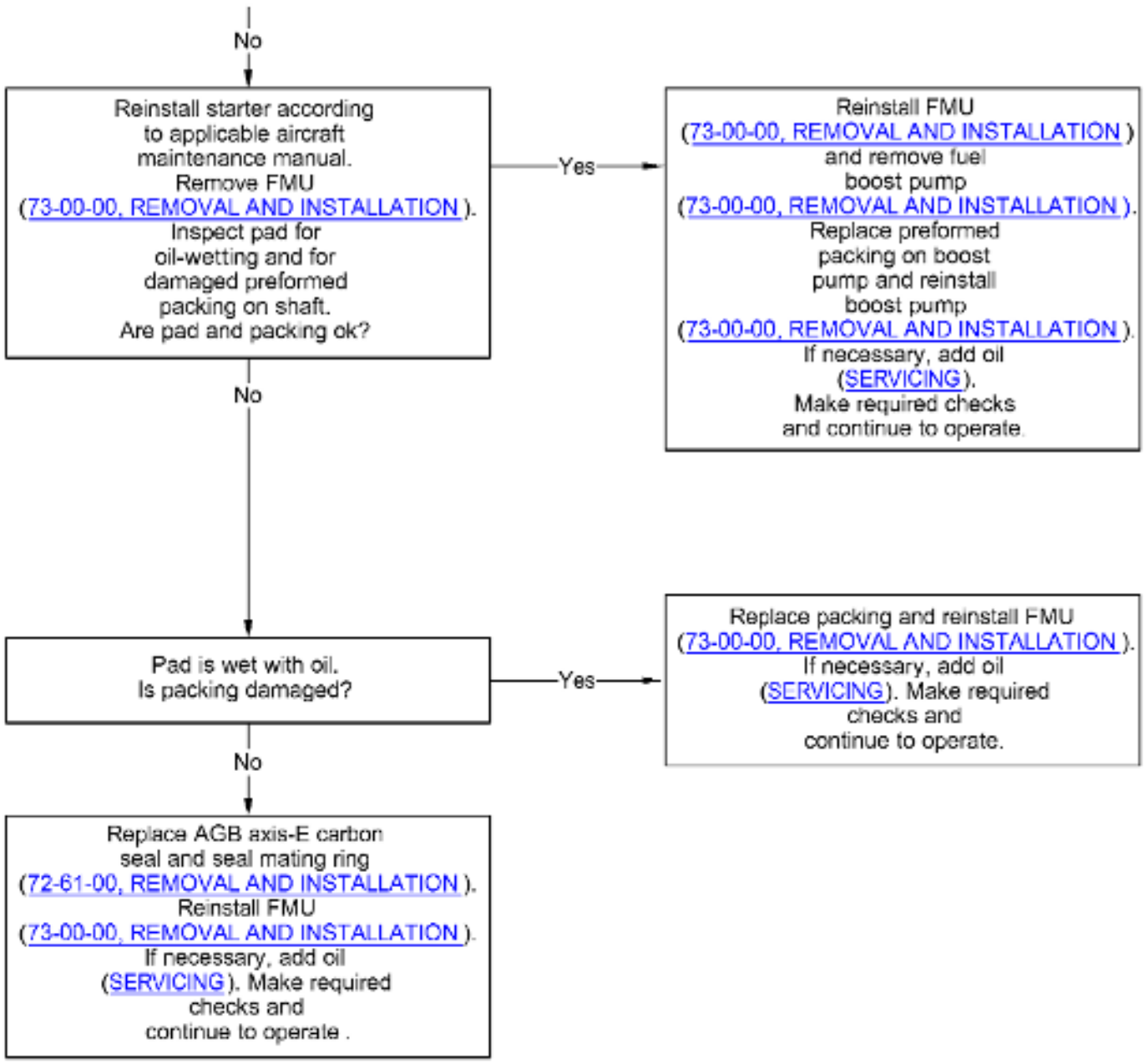

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Figure 118 (Sheet 2) Excessive Leakage at Service Port Scupper

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WARNING

THE MAXIMUM OIL CONSUMPTION, INCLUDING ALL FORMS OF OIL LOSS , SHALL NOT BE GREATER THAN 0.3 POUNDS PER HOUR (MIL-PRF-23699) OR 0.5 POUNDS PER HOUR (MIL-PRF-7808), EXCEPT FOR THE FOLLOWING CONDITIONS:

(A) DURING CONTINUOUS WINDMILLING AT GAS GENERATOR ROTOR SPEED OF 2500 RPM AND OUTPUT SHAFT SPEED OF 4000 RPM.

(B) DURING OPERATION AT AN ATTITUDE OF 40 DEGREES (0.7 RADIANS) ABOVE HORIZONTAL (INLET END UP).

(C) DURING QUALIFICATION ENDURANCE TEST CYCLES WITH AUXILIARY OIL HEATING REQUIRED TO MAINTAIN MAXIMUM OIL TEMPERATURE.

THE MAXIMUM OIL CONSUMPTION FOR CONDITIONS (A), (B), AND (C)SHALL NOT BE GREATER THAN 1.0 POUNDS PER HOUR. IF THE AVERAGE OIL CONSUMPTION RATE DURING THE QUALIFICATION TESTS IS LESS THAN ONE-THIRD OF THE SPECIFIED VALUE, THE SPECIFICATION OIL CONSUMPTION RATE SHALL BE ADJUSTED TO A VALUE NO GREATER THAN THREE TIMES THE QUALIFICATION TEST AVERAGE.

ENGINE OPERATION IS NOT PERMITTED UNLESS OVER SERVICEABLE LIMIT EXTENSIONS REQUIREMENTS ARE MET, OR OIL CONSUMPTION IS REDUCED BELOW CONSUMPTION LIMITS.

ENGINES THAT ARE BEING MONITORED FOR HIGH ENGINE OIL CONSUMPTION OR FOR KNOWN OIL LEAKAGE MUST HAVE OIL LEVEL CHECKED AT LEAST DAILY UNTIL THE PROBLEM IS CORRECTED.

IF THE ENGINE REQUIRES MORE THAN 3.8 QUARTS (3.6 LITERS) OF OIL DURING ANY SINGLE OIL SERVICING EVENT, AND THE ENGINE HAS BEEN OPERATED ABOVE FLIGHT IDLE, IT MUST BE REPLACED (REFER TO APPLICABLE AIRCRAFT MAINTENANCE MANUAL) DUE TO THE POSSIBILITY OF OIL FROTHING/STARVATION RESULTING IN BEARING DISTRESS.

IF THE ENGINE REQUIRES 3.0-3.8 QUARTS (2.8-3.6 LITERS) DURING ANY SINGLE OIL SERVICING EVENT, AND THE ENGINE HAS BEEN OPERATED ABOVE FLIGHT IDLE, THEN AN "ENGINE LOW OIL LEVEL CLEARING PROCEDURE" (REFER TO SPECIAL PROCEDURES) MUST BE DONE.

NOTE

ACCORDING TO STANDARD PROCEDURE, ADDITION OF OIL IN WHOLE QUART QUANTITIES MAY RESULT IN APPARENT HIGH OIL CONSUMPTION. IF EXCESSIVE OIL CONSUMPTION IS SUSPECTED, MAINTAIN A LOG OF QUARTS OF OIL USED AND OF ENGINE OPERATING TIME.

IF ENGINE OIL SYSTEM IS SERVICED AND ENGINE IS TIPPED DURING REMOVAL OR INSTALLATION, OIL WILL SEEP (OIL FORMING DROPS, PUDDLES OR STREAKS) FROM A-SUMP, DOWN STAGE 1 BLADES, AND INTO BOTTOM OF THE MAIN FRAME. THIS IS NO CAUSE TO REJECT THE ENGINE.

5001572-01

Figure 119 (Sheet 1) High Oil Consumption

* * * FOR CT7-2E1

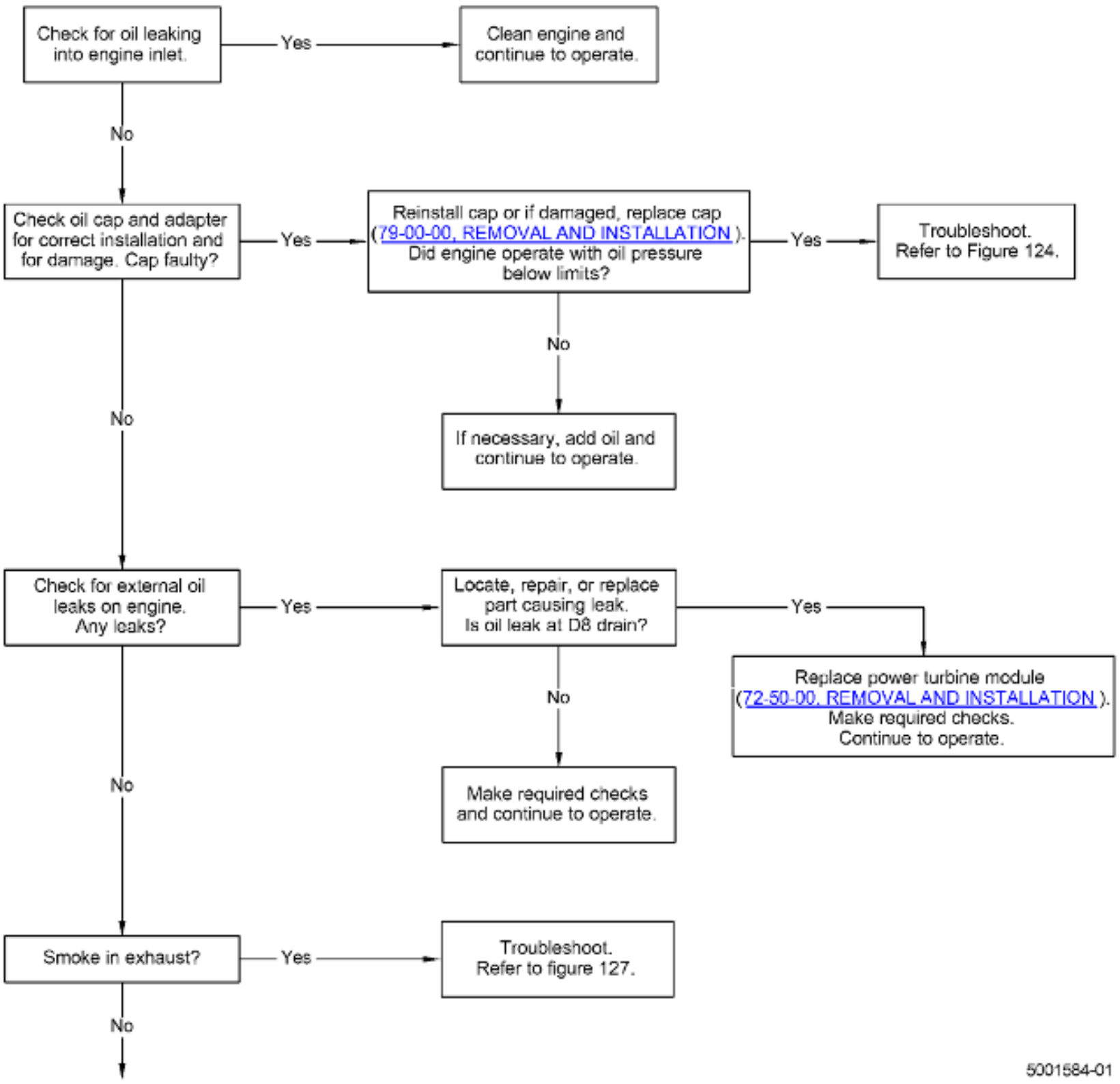


Figure 119 (Sheet 2) High Oil Consumption

* * * FOR CT7-2E1

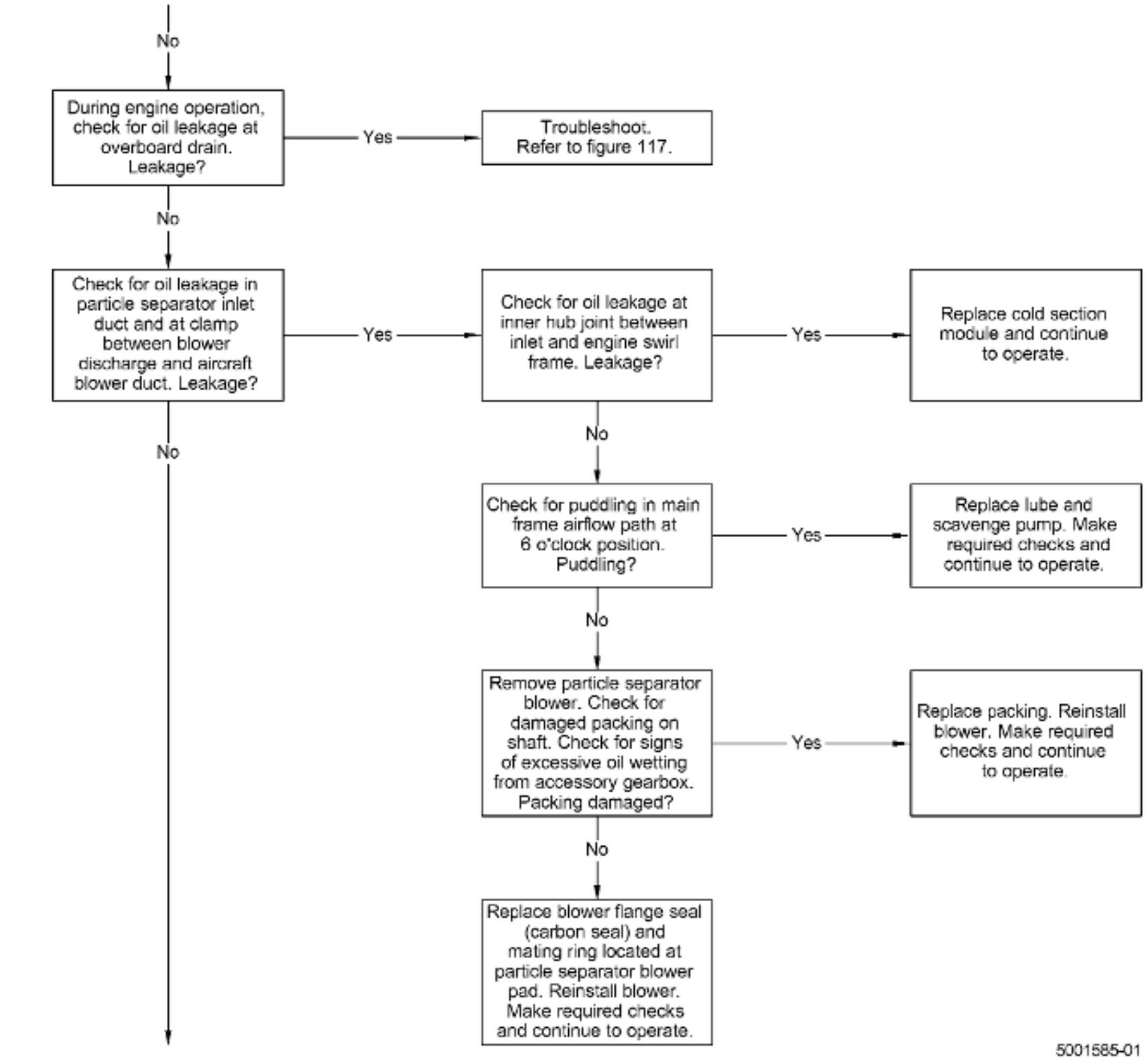
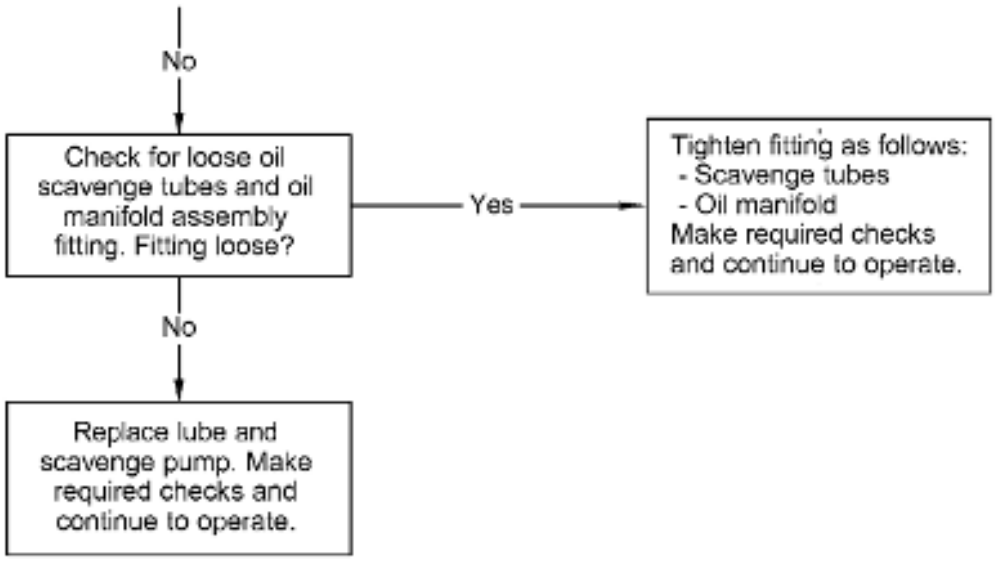


Figure 119 (Sheet 3) High Oil Consumption

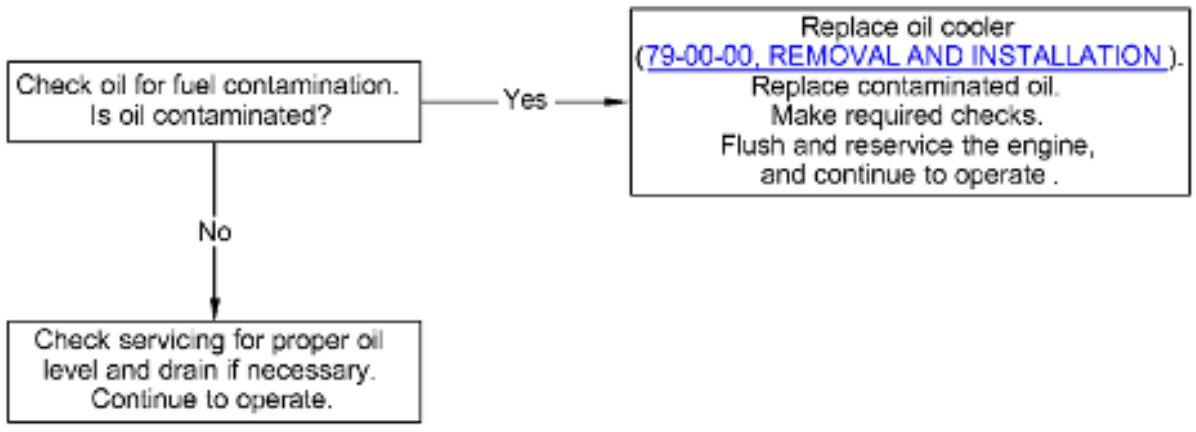
* * * FOR CT7-2E1



5001586-00

Figure 119 (Sheet 4) High Oil Consumption

* * * FOR CT7-2E1



1368438-01

Figure 120 High Oil Level

* * * FOR CT7-2E1

NOTE

- A sudden increase in oil pressure of 10 psig (69kPa) over pr essure that is normal for the engine is cause for investigation. It is expected to have an oil spike during cold start. It should return to normal after 5 minutes at idle speed.

- Engine high oil pressure is displayed in the cockpit CWP wit h X ENG OIL P and MFD with POIL_HIGH_MSG when X engine oil pressure is higher 200 psid.

- The oil pressure transducer produces a voltage output propor tional to the differential between engine lube pump discharge and B-sump reference pressure. The senso r is mounted on the lube pump drive pad. It is a low-level output device: (100 mV) full sc ale. The excitation is conditioned 10Vdc provided by the EECU. Continuous remote indications of oil p ressure are provided to the aircraft on the Data bus.

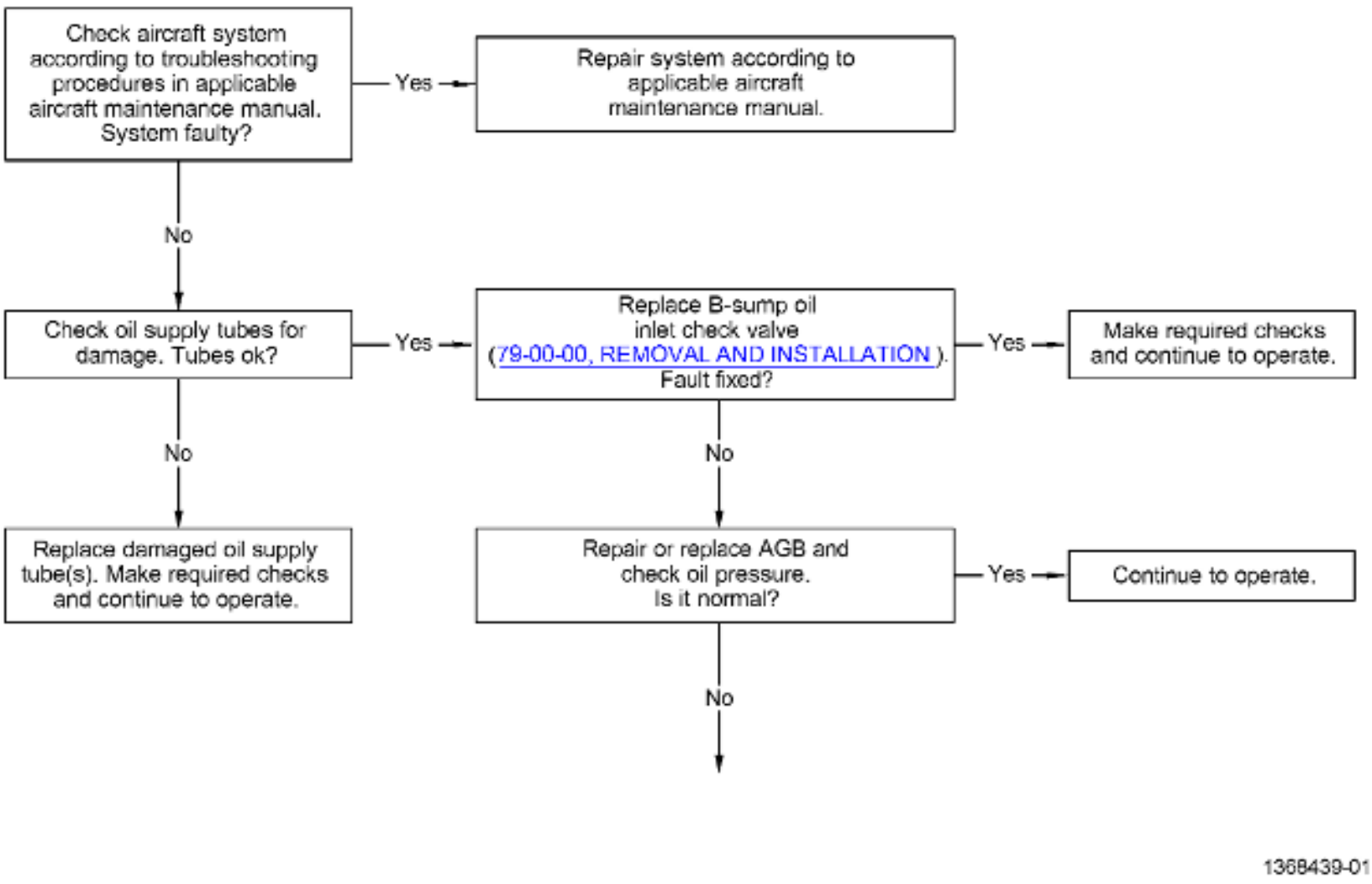
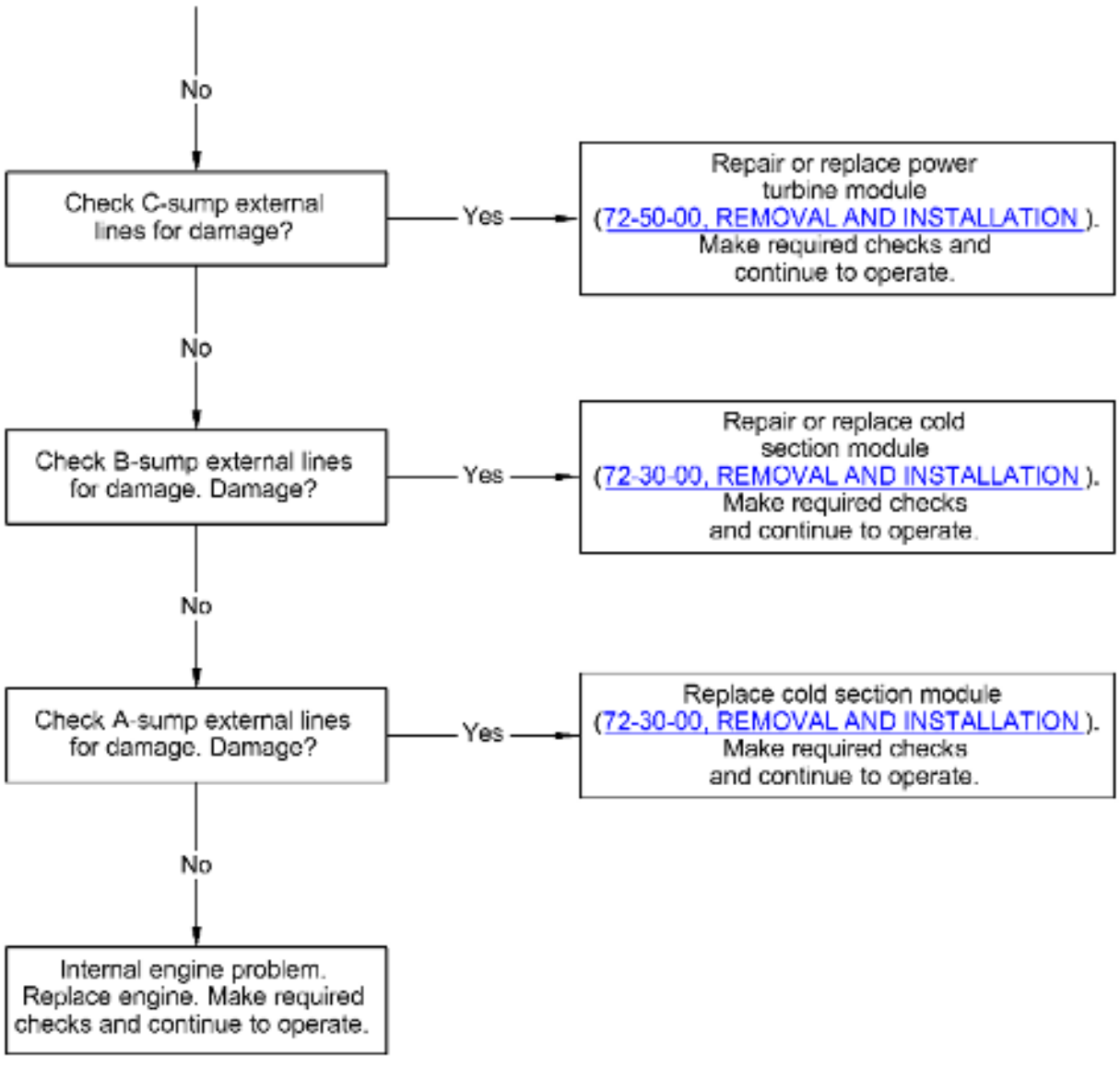


Figure 121 (Sheet 1) High Oil Pressure

* * * FOR CT7-2E1



1368440-01

Figure 121 (Sheet 2) High Oil Pressure

* * * FOR CT7-2E1

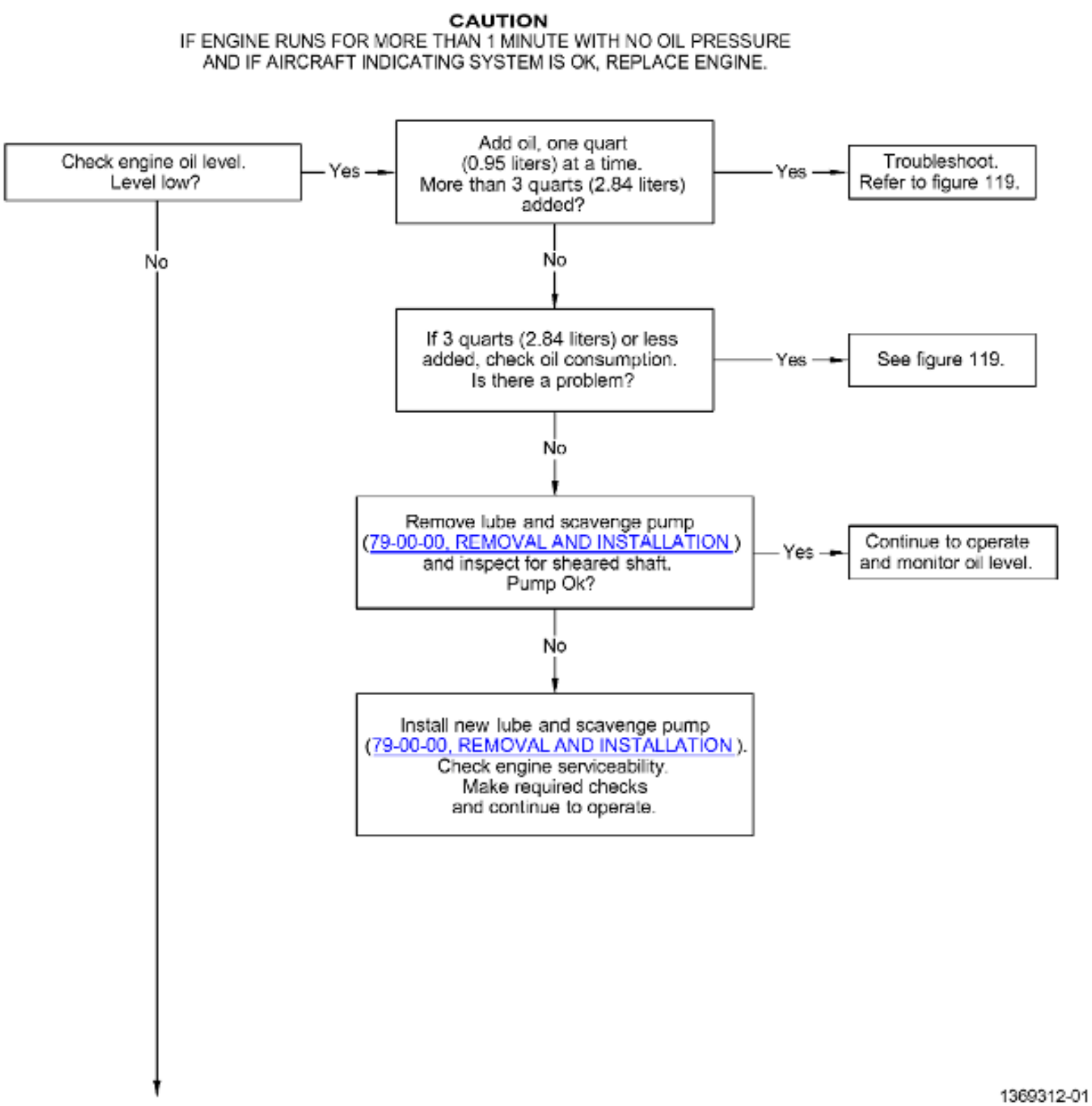
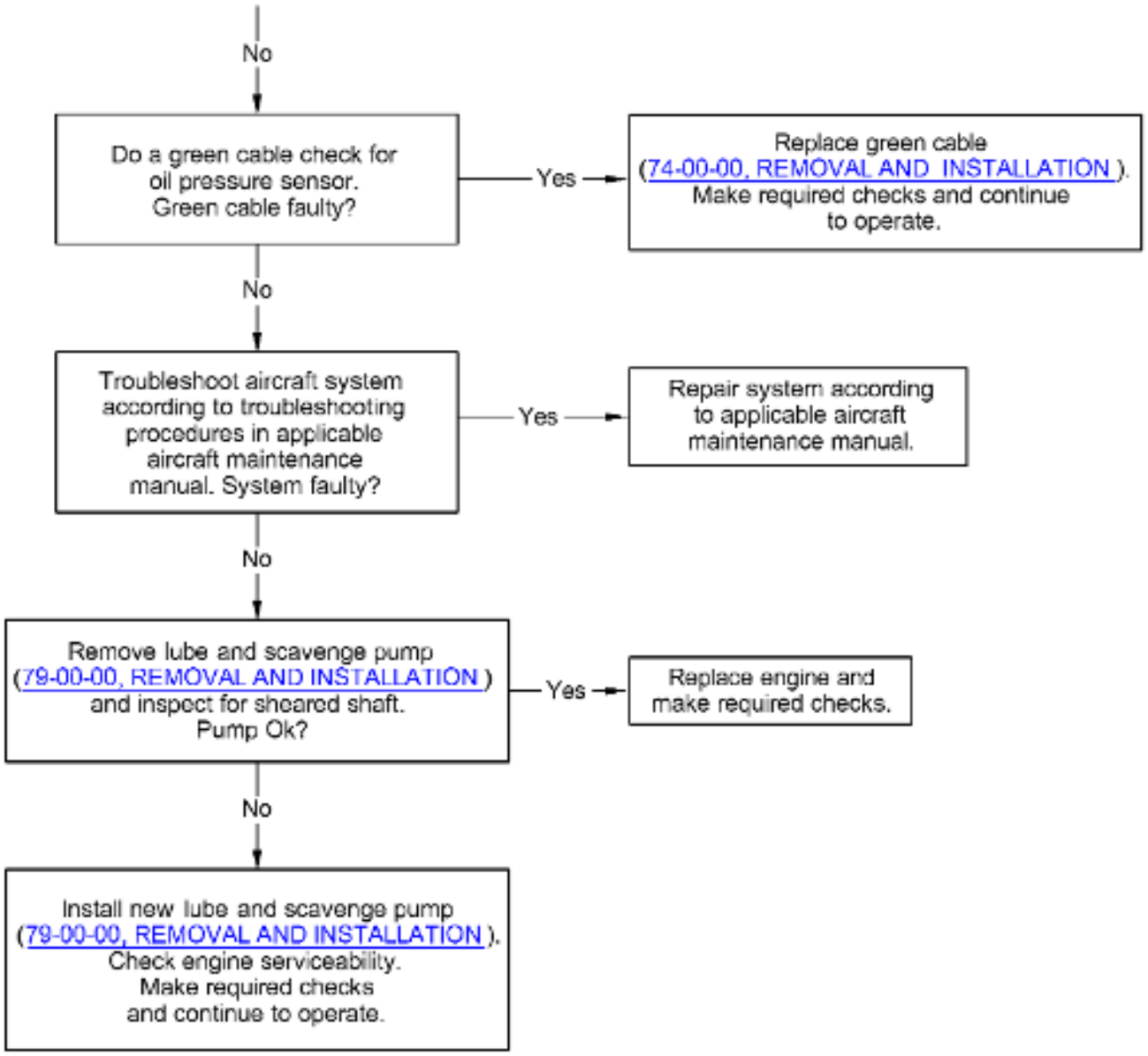


Figure 122 (Sheet 1) No Oil Pressure

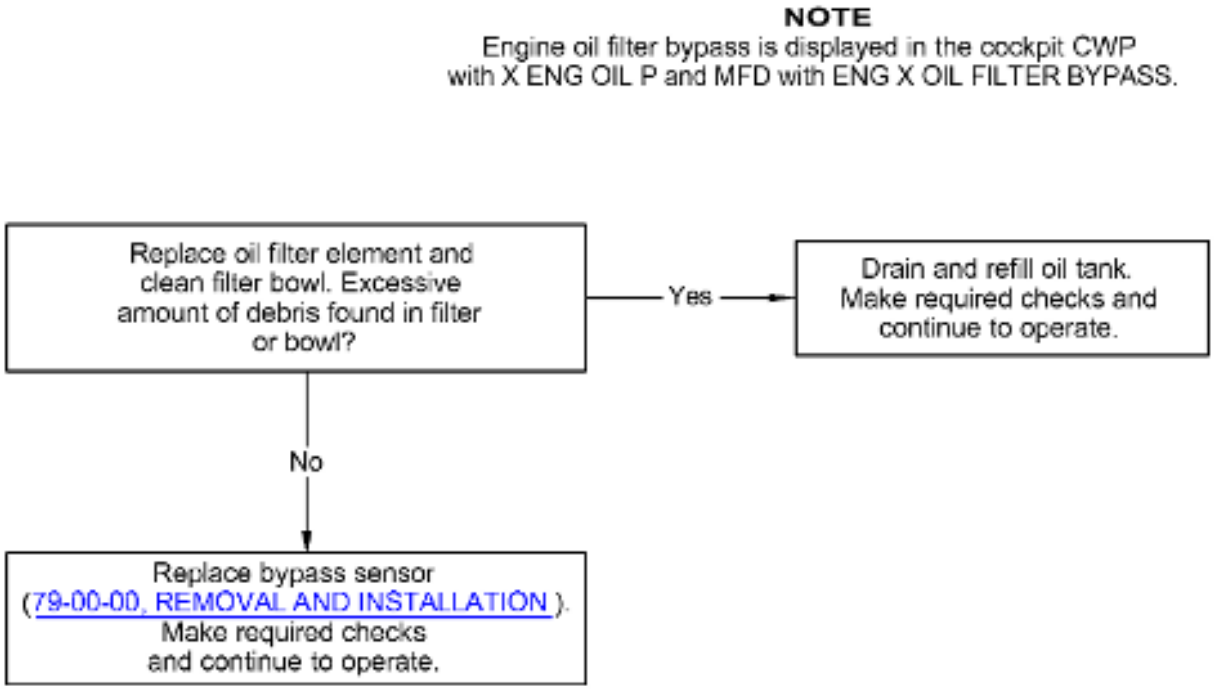
* * * FOR CT7-2E1



1369313-01

Figure 122 (Sheet 2) No Oil Pressure

* * * FOR CT7-2E1



1367793-01

Figure 123 Oil Filter Impending Bypass Light Comes On Without a Fault Code

* * * FOR CT7-2E1

CAUTION

IF ENGINE RUNS MORE THAN 1 MINUTE WITH OIL PRESSURE BELOW MINIMUM, REFER TO (TEST), AND IF AIRCRAFT INDICATING SYSTEM IS OK, REPLACE ENGINE.

NOTE

Engine oil low pressure is displayed in the cockpit CWP with X ENG OIL P and MFD with ENGX LOW OIL PRESSURE when low oil pressure switch indicating low pressure, including engine shutdown.

The low oil pressure switch is a gearbox-mounted component that senses the differential between engine lube pump discharge and B-sump reference pressure and is activated at 21+/-1 psid. The switch assembly incorporates an integral relief valve, which actuates under cold oil conditions to limit maximum positive oil pressure. The oil pressure transducer produces a voltage output proportional to the differential between engine lube pump discharge and B-sump reference pressure. The sensor is mounted on the lube pump drive pad. It is a low-level output device: (100 mV) full scale. The excitation is conditioned 10Vdc provided by the EECU. Continuous remote indications of oil pressure are provided to the aircraft on the Data bus. Cross checking between the oil pressure switch and the oil pressure transducer serves to distinguish transducer failure from actual low-pressure events. The oil pressure switch and transducer are wired to different EECU channels and therefore can continue to provide a low lube pressure signal after any single failure.

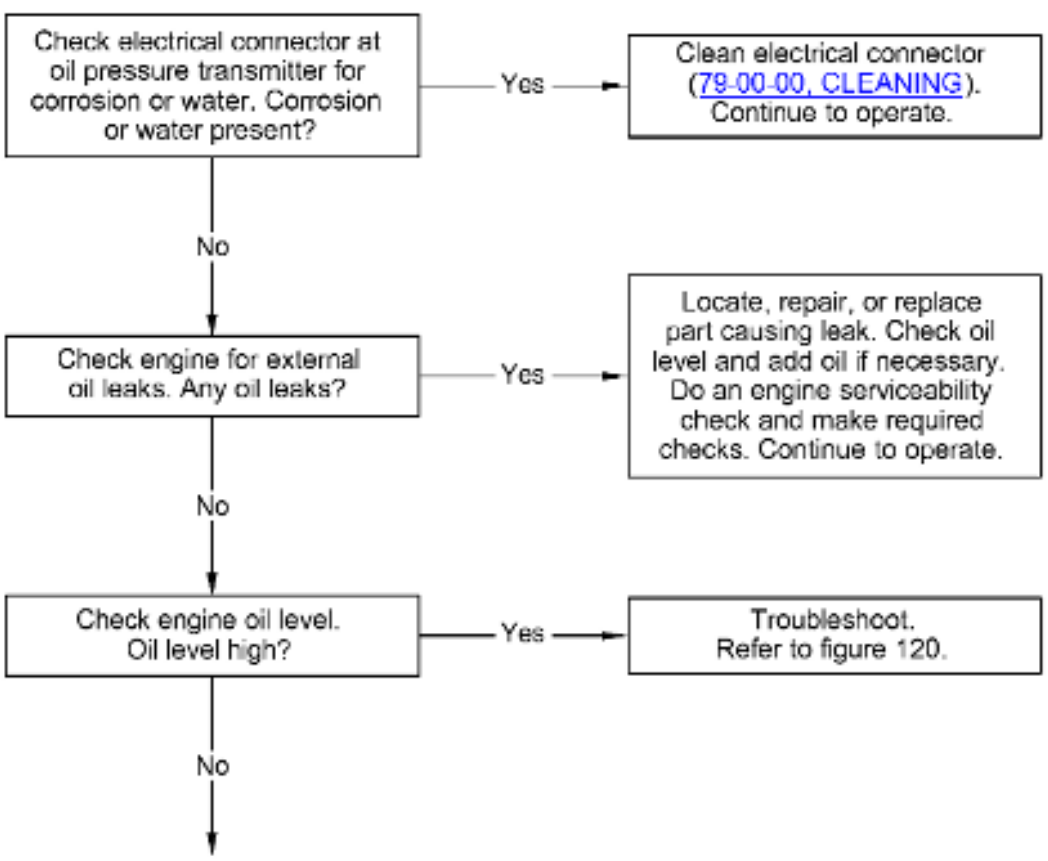


Figure 124 (Sheet 1) Oil Pressure Below Limits

* * * FOR CT7-2E1

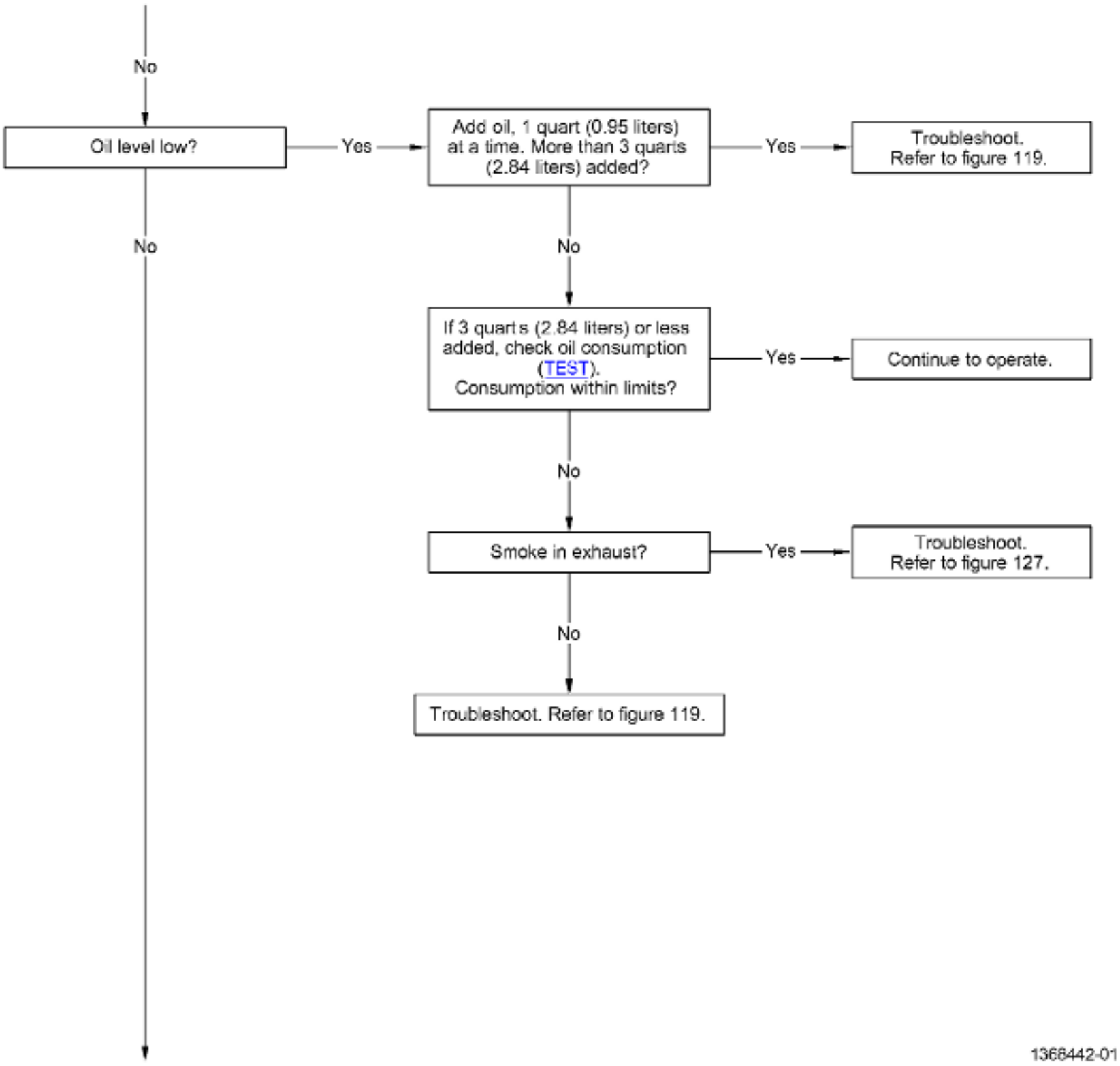


Figure 124 (Sheet 2) Oil Pressure Below Limits

* * * FOR CT7-2E1

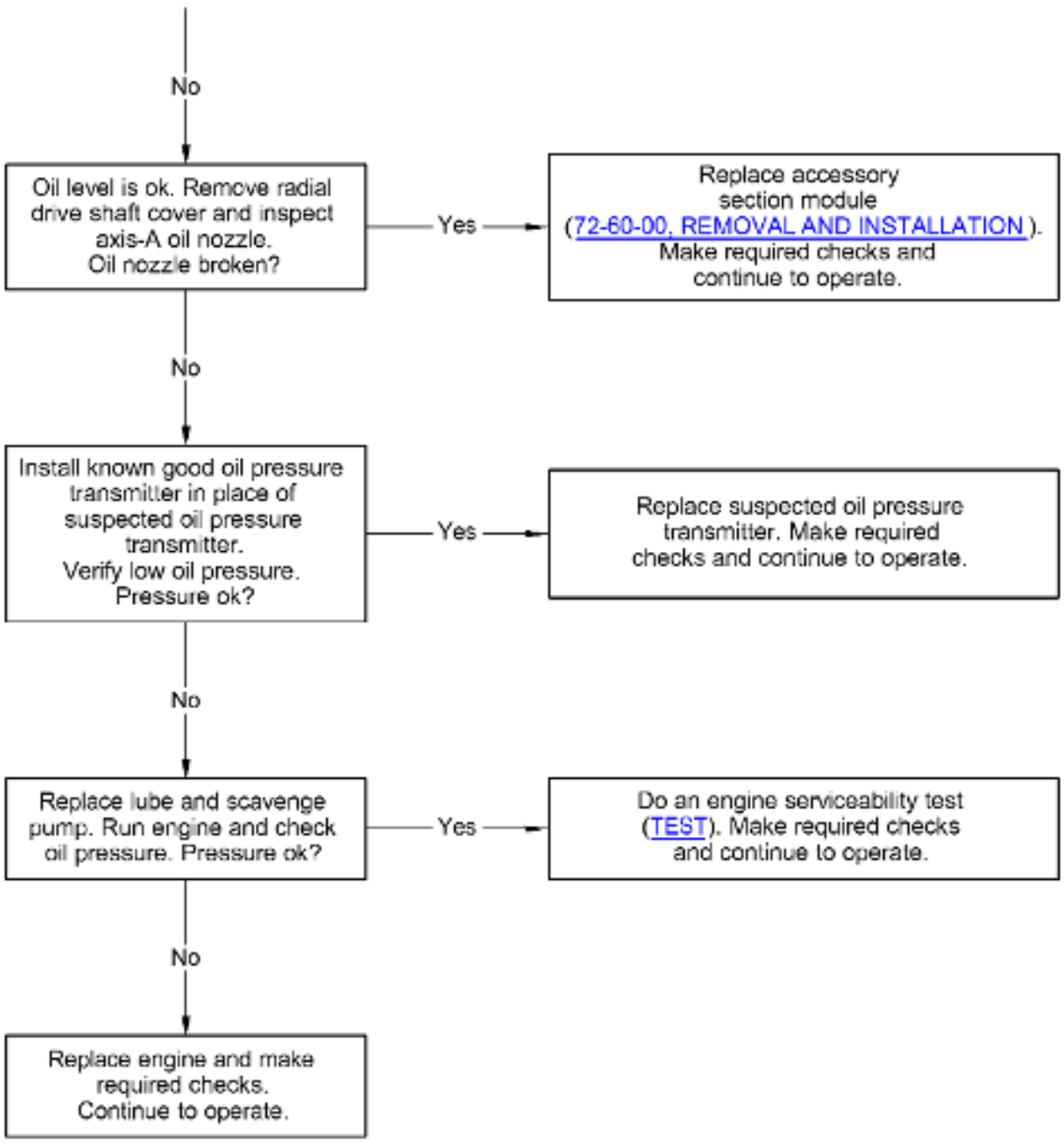


Figure 124 (Sheet 3) Oil Pressure Below Limits

* * * FOR CT7-2E1

NOTE

A change of ±5 psig (±34kPa) is cause for investigation. Oil pressure will change during transient conditions. These changes should stop about 1 minute after to return to steady state Ng conditions.

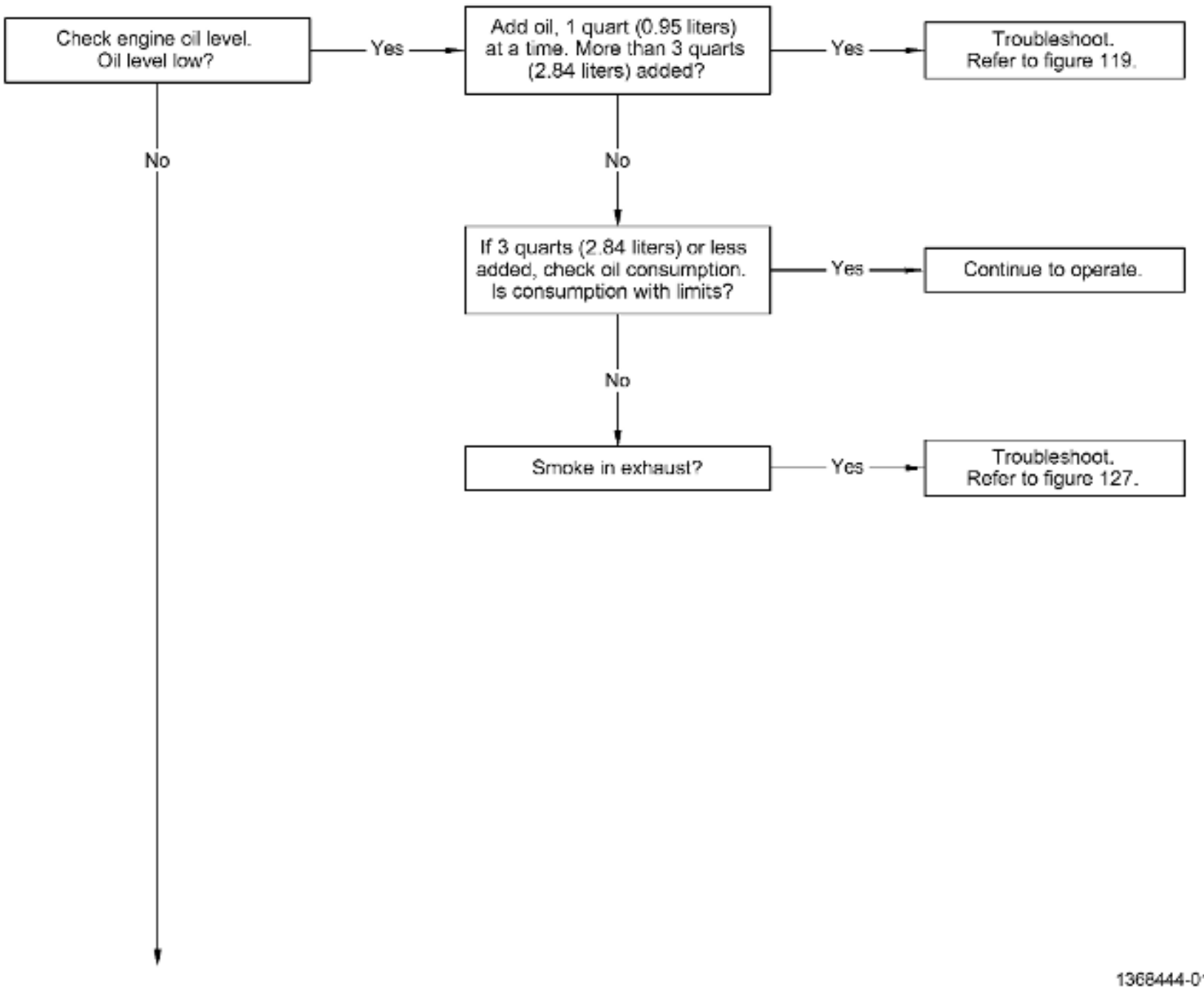
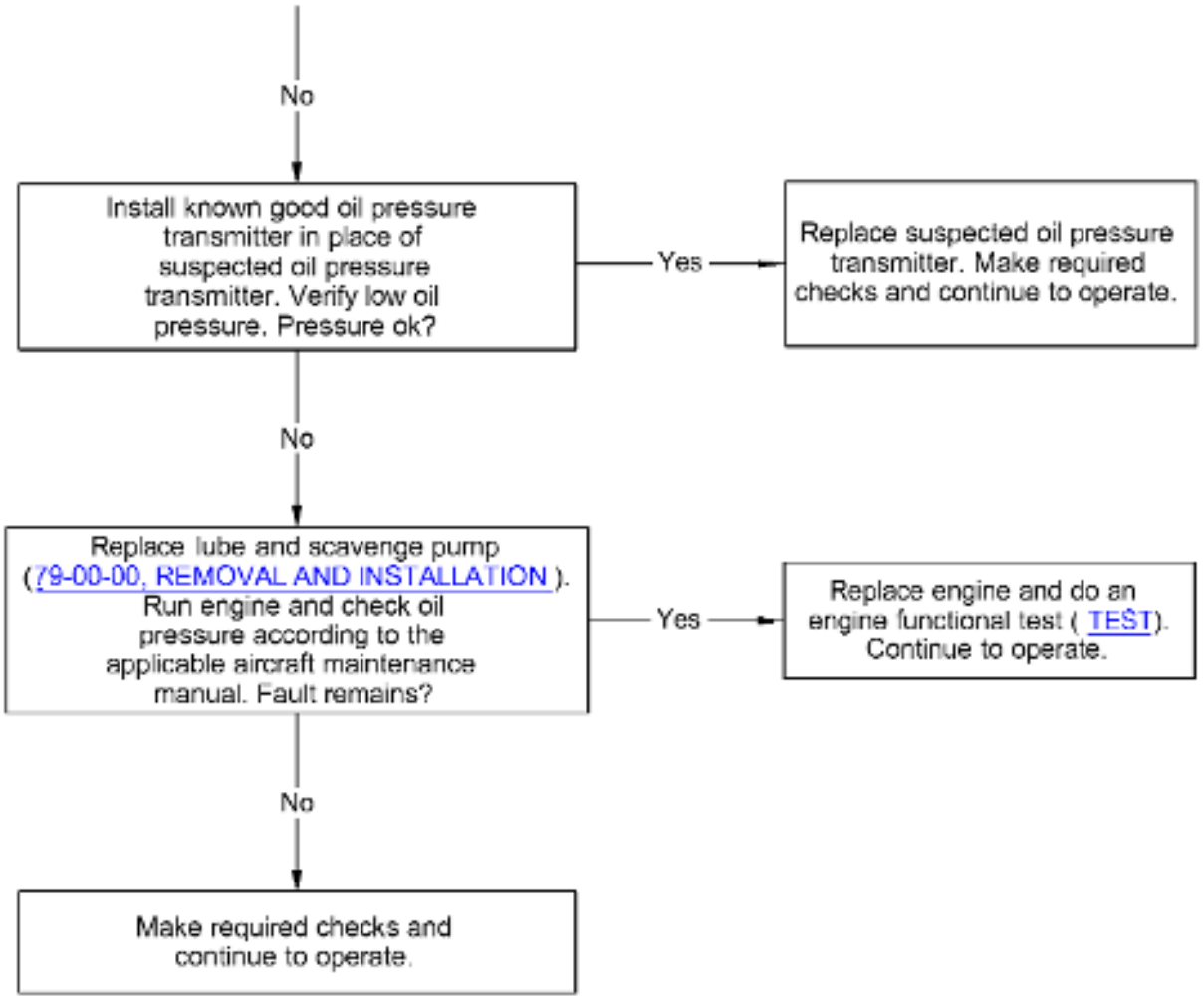


Figure 125 (Sheet 1) Oil Pressure Fluctuates

* * * FOR CT7-2E1



1368445-01

Figure 125 (Sheet 2) Oil Pressure Fluctuates

* * * FOR CT7-2E1

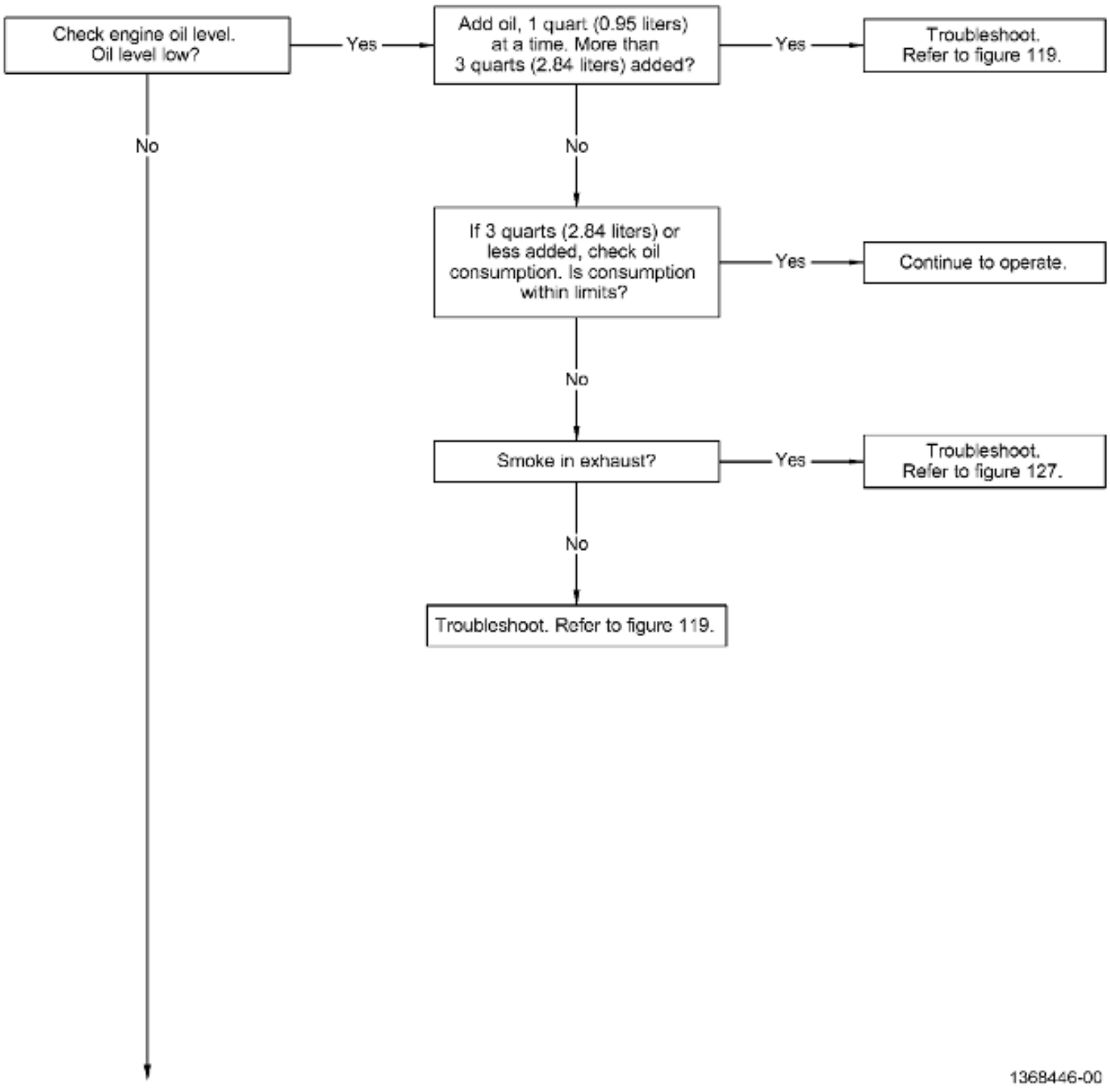


Figure 126 (Sheet 1) Oil Temperature Exceeds Limits (Exceeds Normal Operating Temperatures for Affected Engine)

* * * FOR CT7-2E1

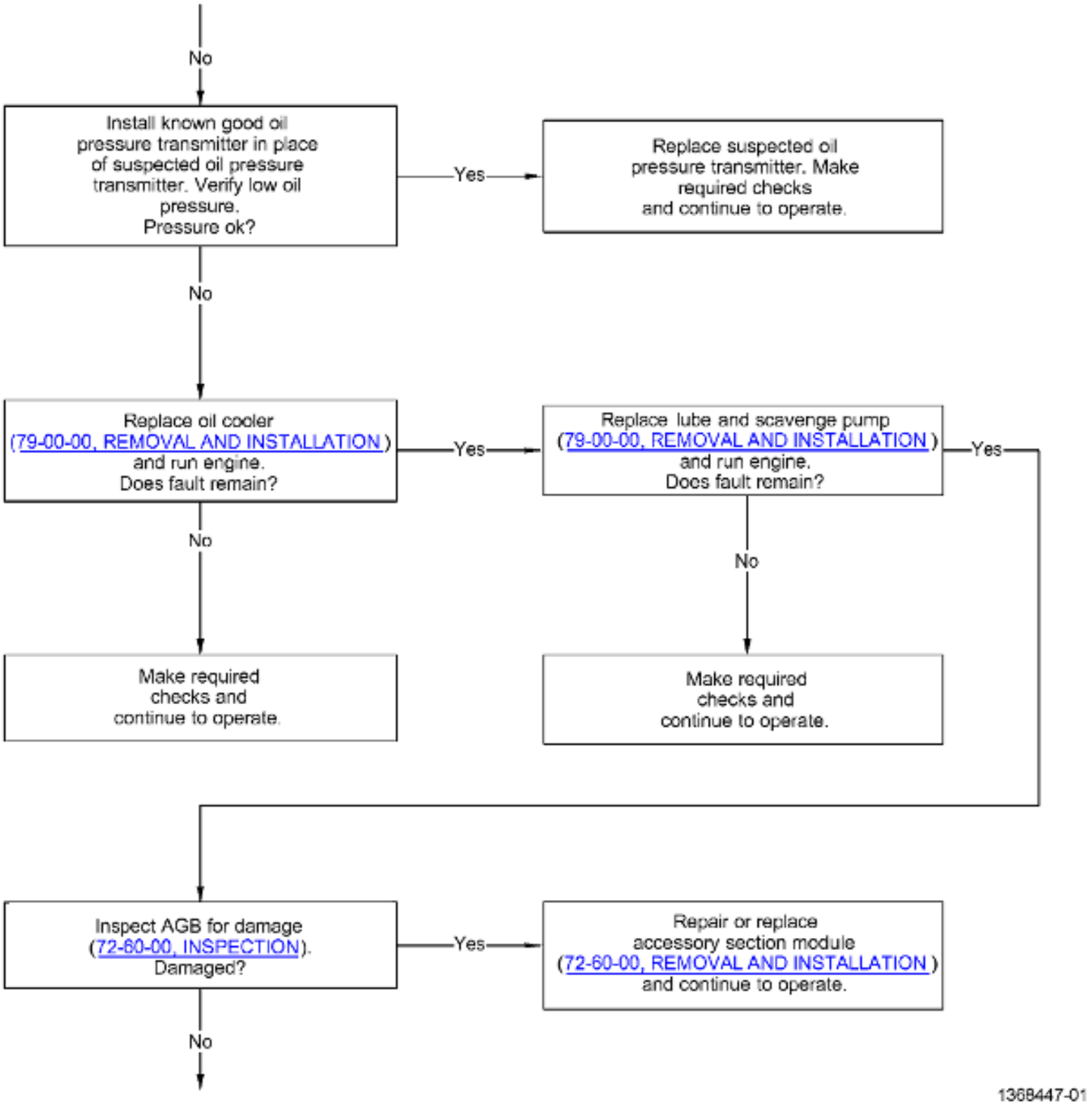


Figure 126 (Sheet 2) Oil Temperature Exceeds Limits (Exceeds Normal Operating Temperatures for Affected Engine)

* * * FOR CT7-2E1

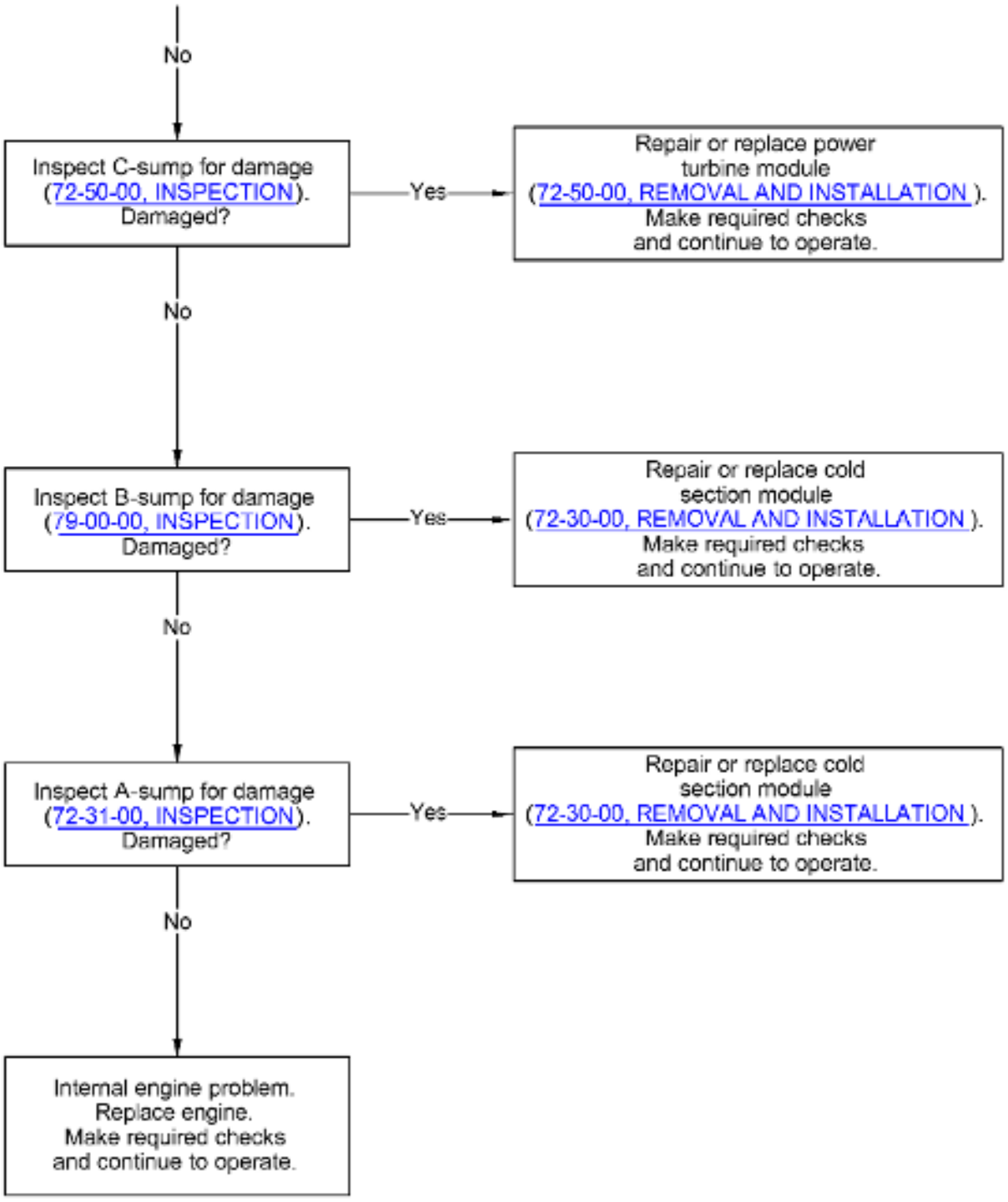
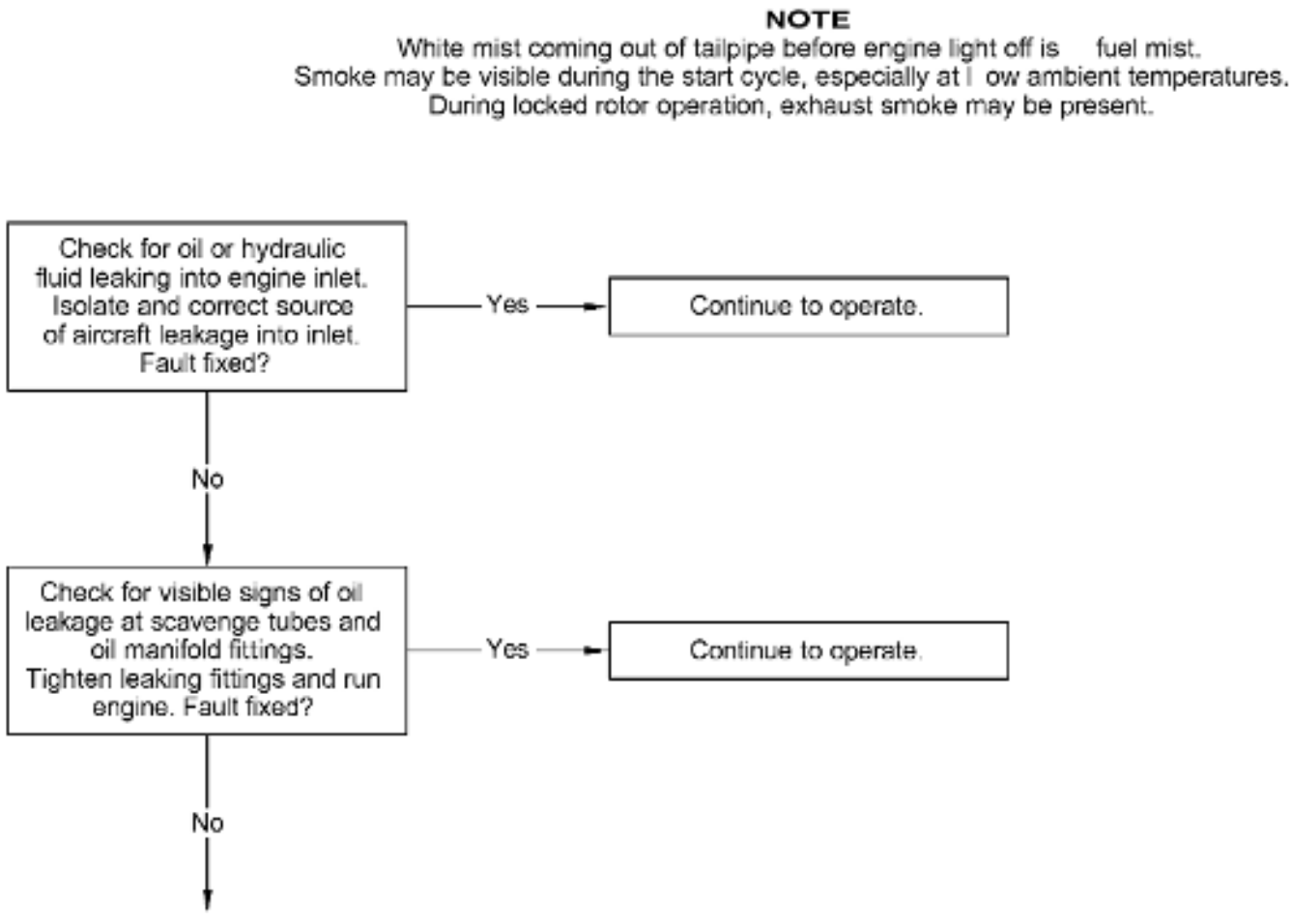


Figure 126 (Sheet 3) Oil Temperature Exceeds Limits (Exceeds Normal Operating Temperatures for Affected Engine)

* * * FOR CT7-2E1



1367794-01

Figure 127 (Sheet 1) Smoke in Exhaust

* * * FOR CT7-2E1

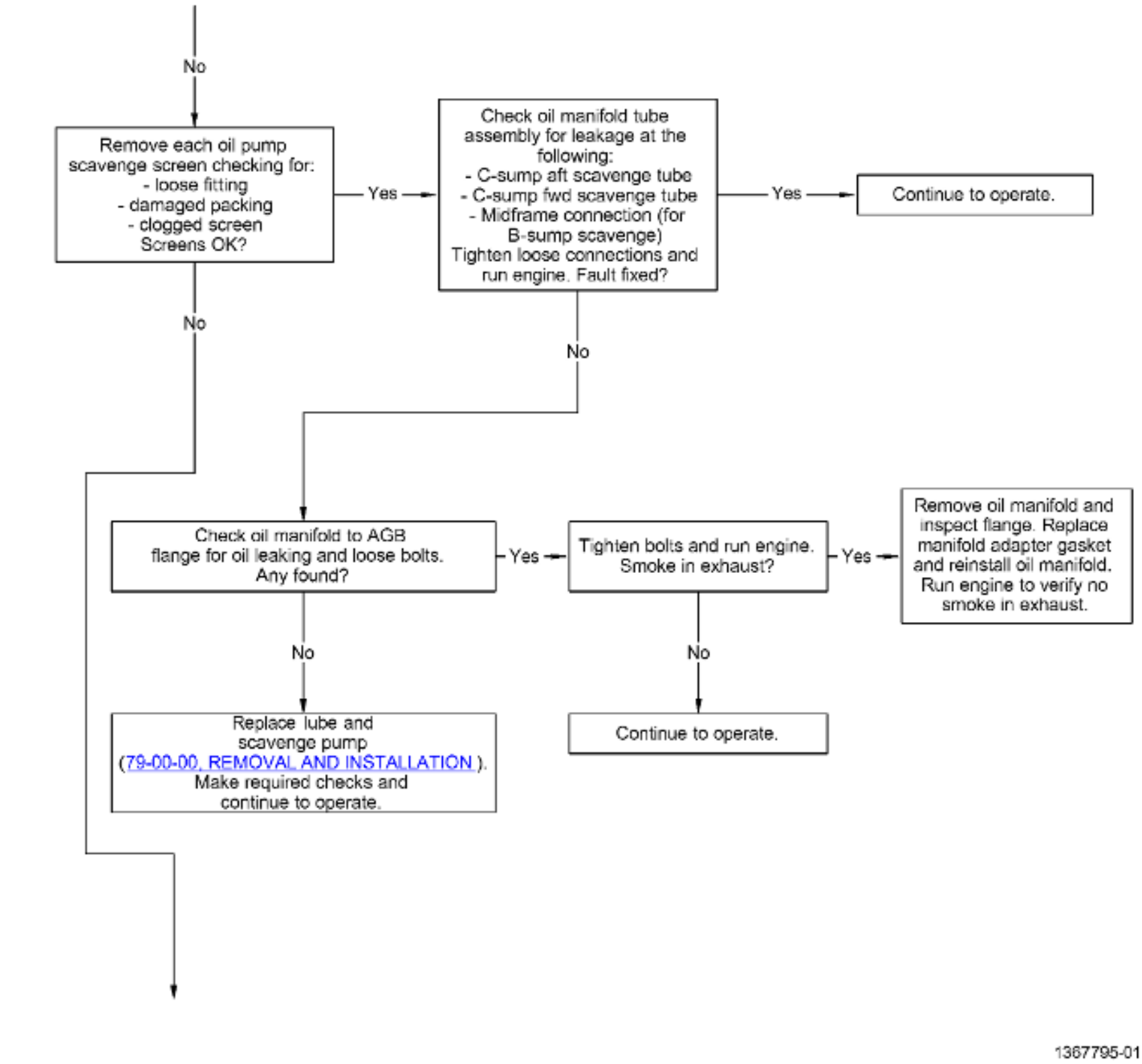


Figure 127 (Sheet 2) Smoke in Exhaust

* * * FOR CT7-2E1

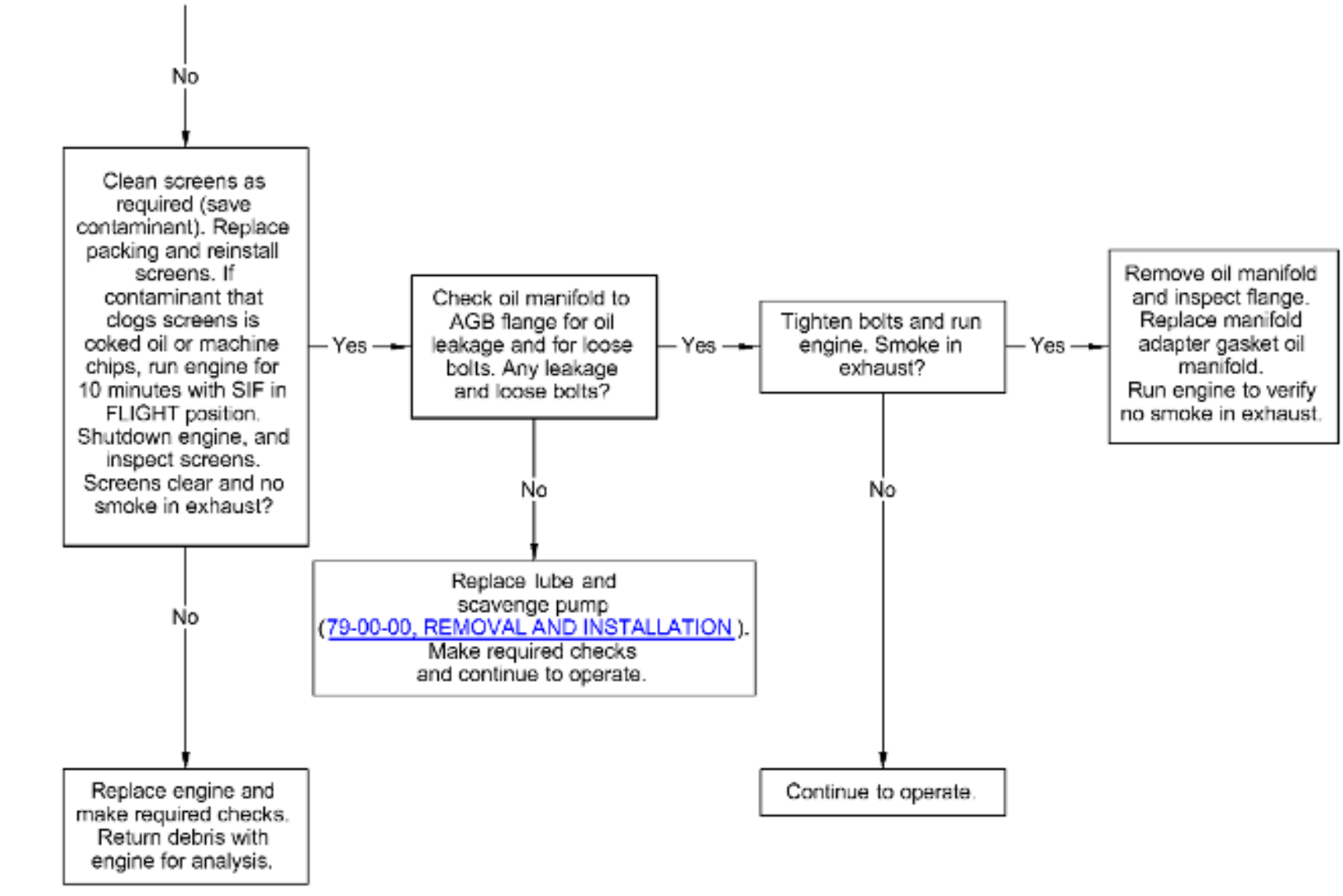


Figure 127 (Sheet 3) Smoke in Exhaust

* * * FOR CT7-2E1

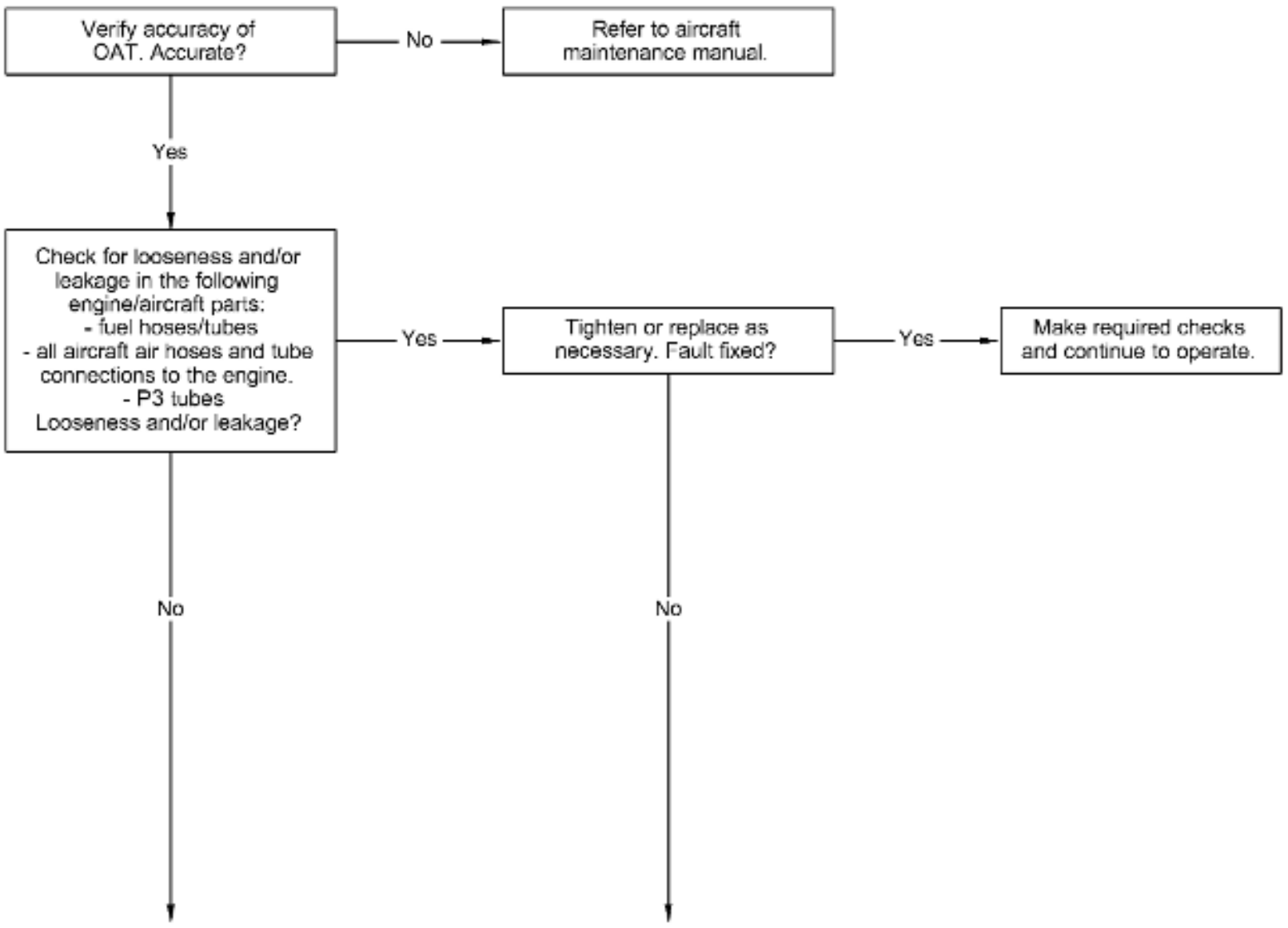


Figure 128 (Sheet 1) Low Engine Performance (Indication of Low Margin by Power Assurance Check) (Torque Indicator is Low for a Given Ng and TGT, with Possible Torque Split at High Power)

* * * FOR CT7-2E1

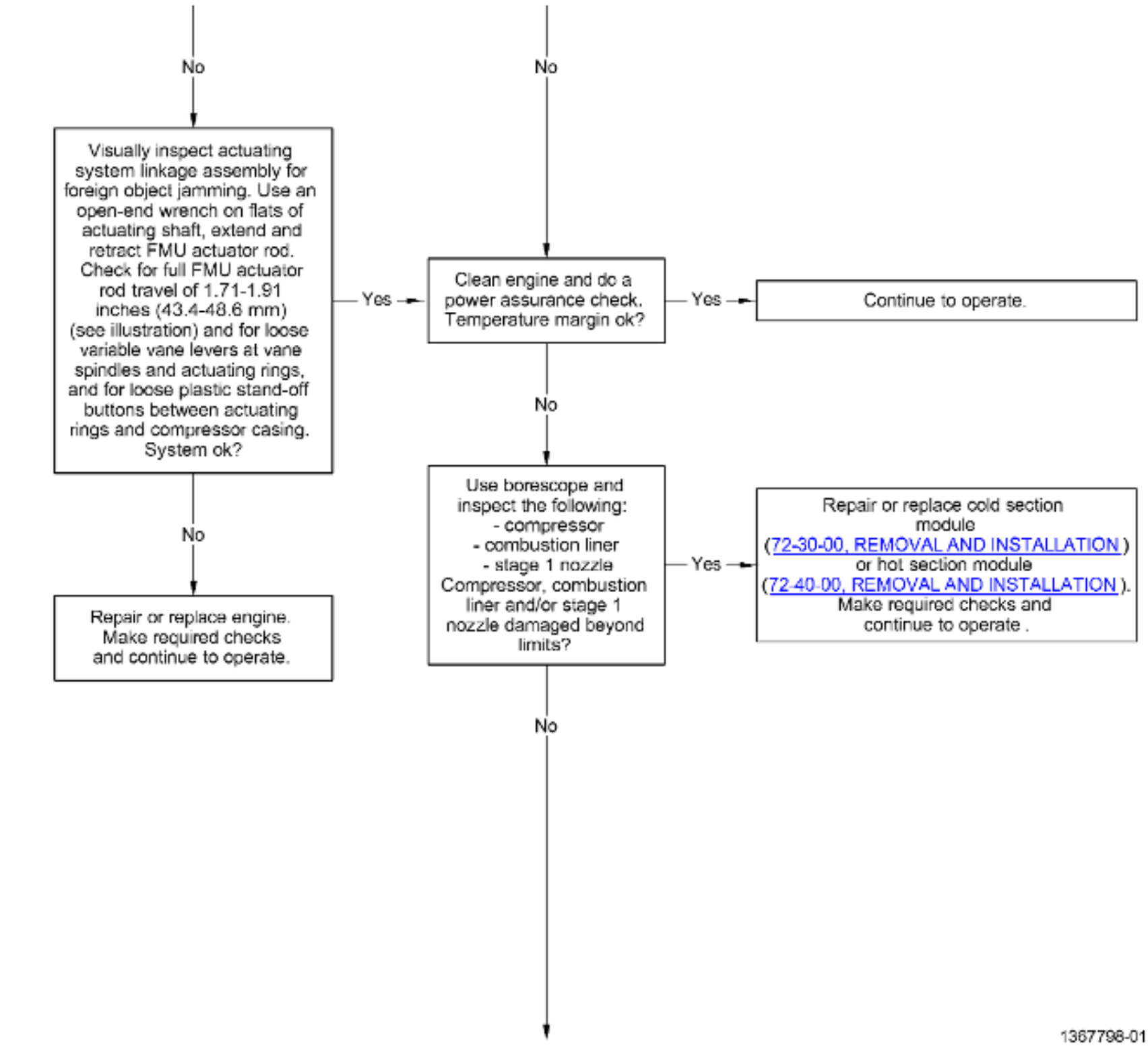
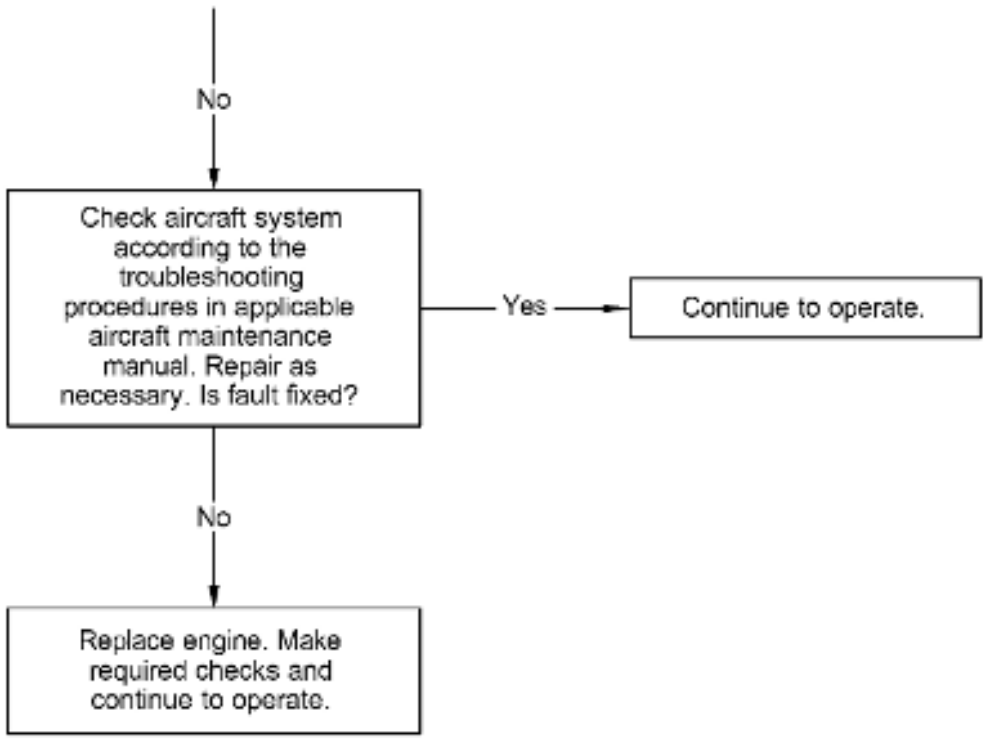


Figure 128 (Sheet 2) Low Engine Performance (Indication of Low Margin by Power Assurance Check) (Torque Indicator is Low for a Given Ng and TGT, with Possible Torque Split at High Power)

* * * FOR CT7-2E1

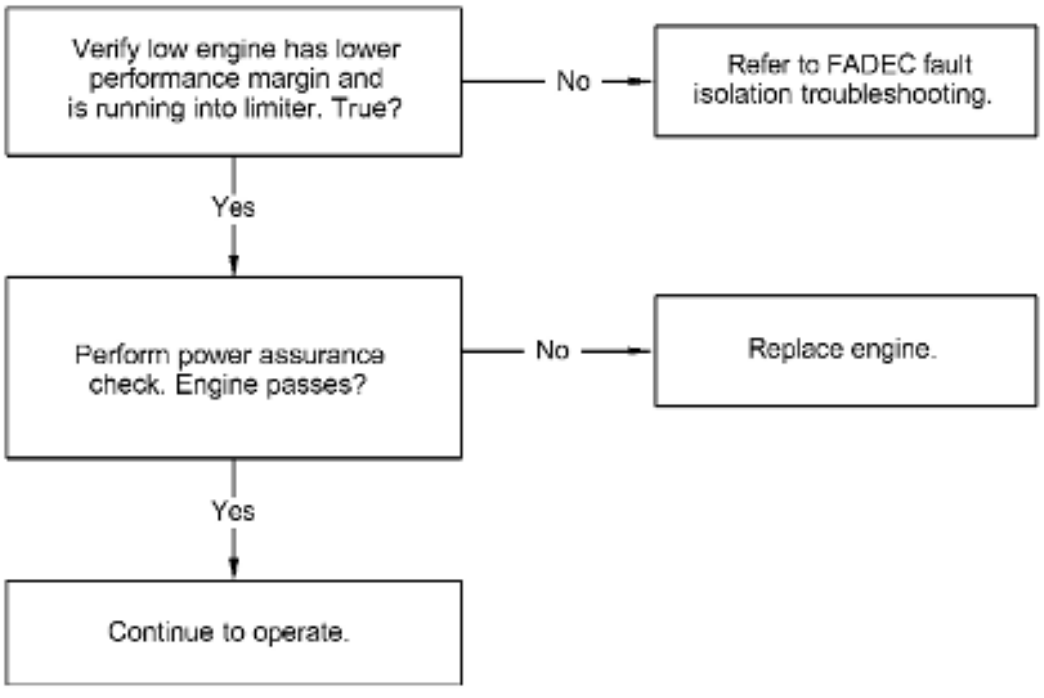


1367799-00

Figure 128 (Sheet 3) Low Engine Performance (Indication of Low Margin by Power Assurance Check) (Torque Indicator is Low for a Given Ng and TGT, with Possible Torque Split at High Power)

* * * FOR CT7-2E1

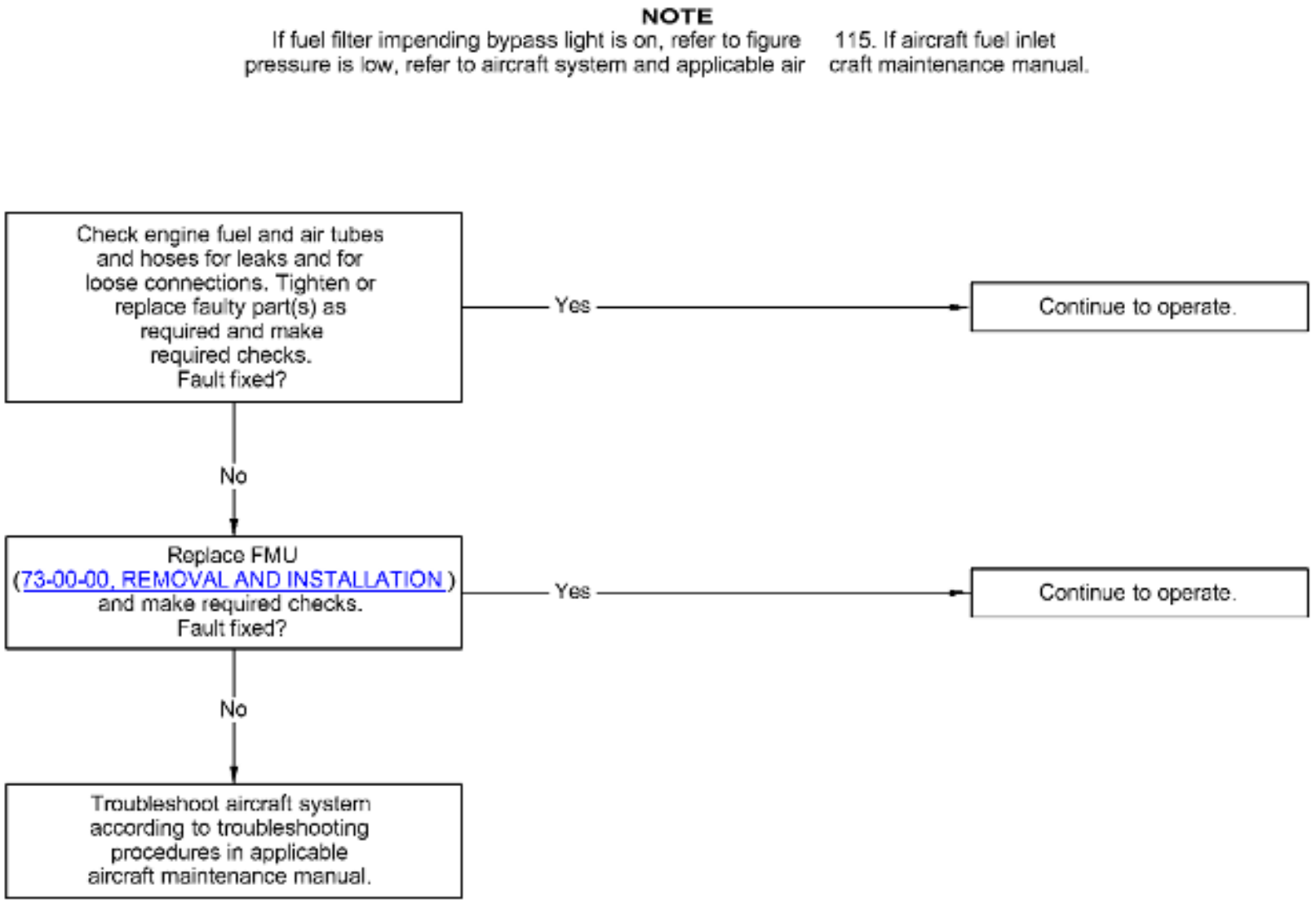
NOTE
For engines that show >5% torque difference while running on torque load share.



1369314-01

Figure 129 Torque Split

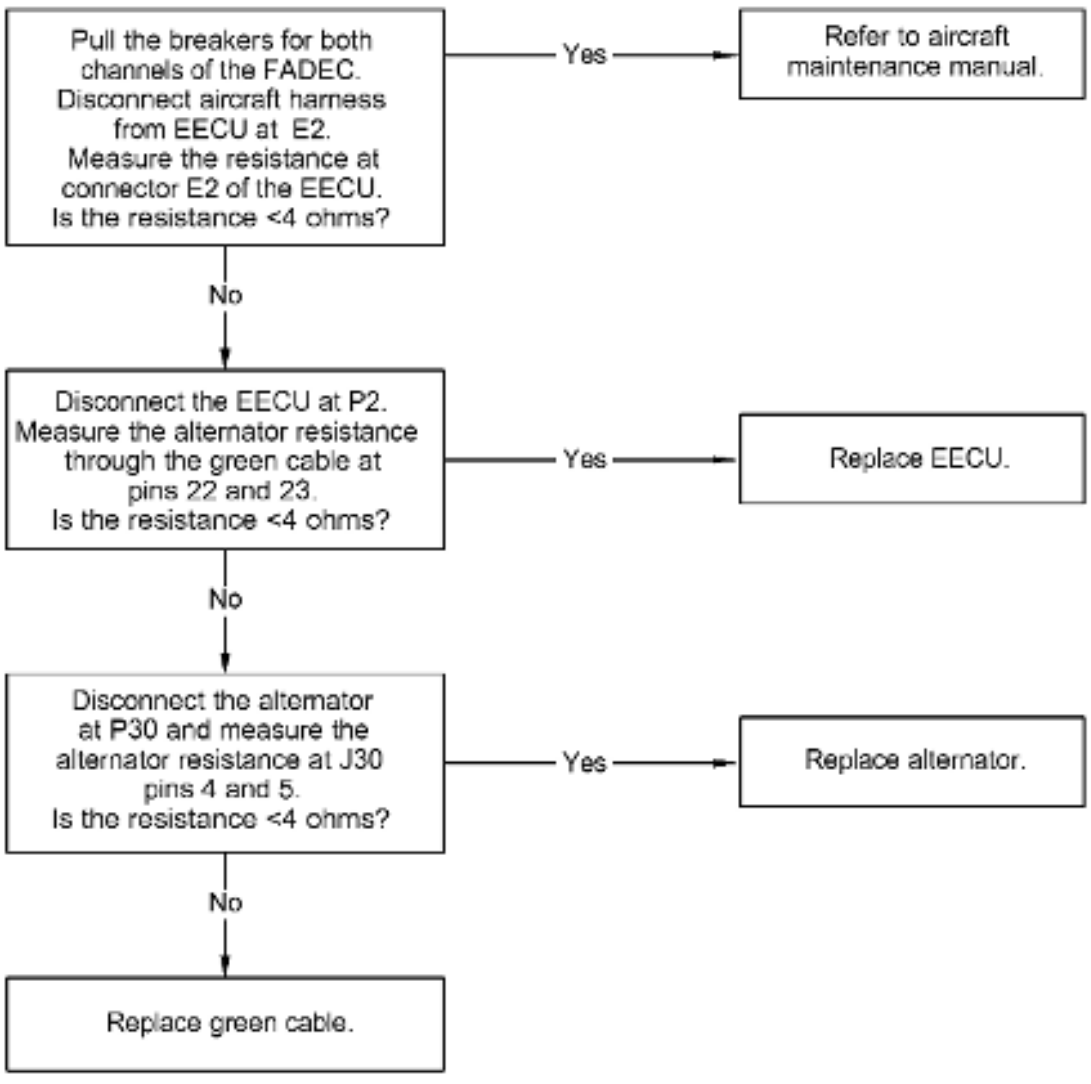
* * * FOR CT7-2E1



1367804-01

Figure 130 Unstable Operation at Flight on Ground (Ng, TGT, Torque and Np Fluctuate Greater Than 5% With Engine at Flight)

* * * FOR CT7-2E1



5001655-01

Figure 131 No Ng Signal from Engine to Aircraft AMMC

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