

0. MODIFICATION STANDARD.

The systems described in chapters 17.1 and 17.2 assume a certain modification standard of the aircraft. If a modification is not installed the following apply as a complement to what is stated.

0. 1. PROPELLER

Hamilton Standard propeller system (Optional).

Description/Limitations/Operation:
See Section 37, Supplement No. 2

0. 2. PROPELLER GEAR BOX (PGB) OIL SYSTEM.

Applicable to a/c 160-173, 175,176,178 and 179
(without Mod No. 1492 , addition of separate PGB Oil
Press Switch).

A single transducer provides signals to the warning system via the cockpit indicator. The warning comes on at 25 psi airborne and at 7 psi on ground (WoW switch function).

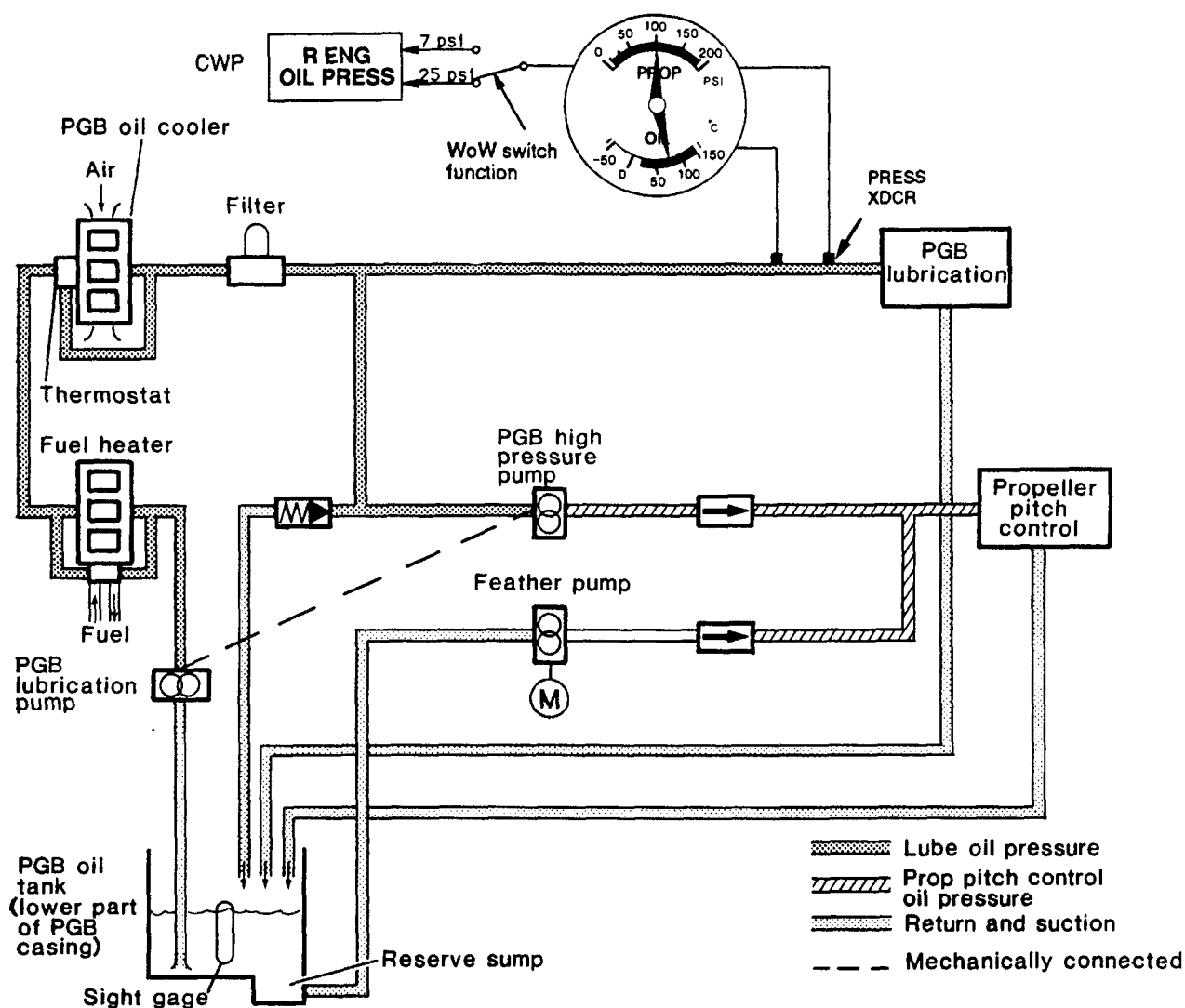
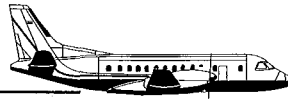


Fig. 1. Propeller gear box oil system – schematic.

**0.3. STARTING SYSTEM.**

Applicable to a/c without Mod 2417, SB 24-021 (Electrical power change to parallel motoring).

The aircraft electrical system DC generator operates as a motor during engine start (combined starter/generator). See also AOM 1.5. ELECTRICAL.

The starter/generator may be powered from:

- aircraft batteries (battery start);
- GPU;
- the generator of an operating engine, together with the aircraft batteries. (Generator cross-over start.)

During battery start, the batteries are connected in series by the series/parallel relay. This switching is accomplished automatically when the start cycle is initiated and there is no external or generator power available.

If the battery temperature is too high (57.5°C or above), a NO BAT START light in the cockpit overhead panel will illuminate.

The start function of the starter/generator is controlled by the start relay. During an engine start this relay is closed when the following conditions are met (for the engine being started):

- CL in START position;
- Ignition switch in NORM or CONT position;
- Start switch L or R position respectively;
- Ng below 55% (as sensed by the starter/generator).

This means that the starter/generator will drive the engine up to approximately 55% Ng, then automatically cut out and revert to its role as generator.

Dry motoring of the engine without ignition is possible with the concerned ignition switch in the OFF position and the CL in FUEL OFF. For this operation the start switch must be held in the L or R position for as long as motoring is required.

Power supply for engine start control is L/R BAT BUS respectively.

0.4. STARTING SYSTEM.

Applicable to a/c without Mod No 2617, SB 24-025 (Additional changes to engine start control power supply).

EXT PWR disconnects automatically, EXT PWR ON light goes out and EXT PWR switch automatically flips to OFF if:

- With START switch engaged and if GPU voltage drops to below approx. 7V the starter/generator will automatically be powered from the batteries. i.e. a start sequence will continue as a battery start and in case of motoring the motoring will continue on battery power.
- With START switch released and if GPU voltage drops to below approx. 10V the batteries connect automatically, however, the starter/generator will be disengaged. Reactivating the START switch will re-engage the starter/generator.

0.5. BETA STOP.

Applicable to a/c without FI STOP Mod No 2558, SB 76-032.

A manually operated BETA STOP is available (Mod No 2609, SB 76-034). Description and Operation, see Operations Bulletin No 23, Rev A.



1. GENERAL

The aircraft is equipped with two General Electric CT7-9B turboprop engines, each developing a maximum takeoff power of 1870 SHP/1935 ESHP at sea level up to a temperature of 35°C. Each engine drives a 132 inch diameter four-bladed Dowty Rotol propeller.

1.1. Engine

The engine consists of a gas generator powering a free power turbine which is directly coupled to the propeller gear box.

The air inlet duct is equipped with a "bird catcher" which will trap ingested birds before they reach the engine air inlet.

The gas generator has an axial-centrifugal compressor with 5 axial stages and one centrifugal stage. The compression ratio is 17:1. The compressor inlet guide vanes and the stator vanes for the 1st and 2nd stage are variable. The air inlet to the compressor is designed to reduce ingestion of foreign objects by iner-

tial action. The combustor, where the fuel is injected and burned is of the annular type. A two-stage turbine with air-cooled blades drives the compressor.

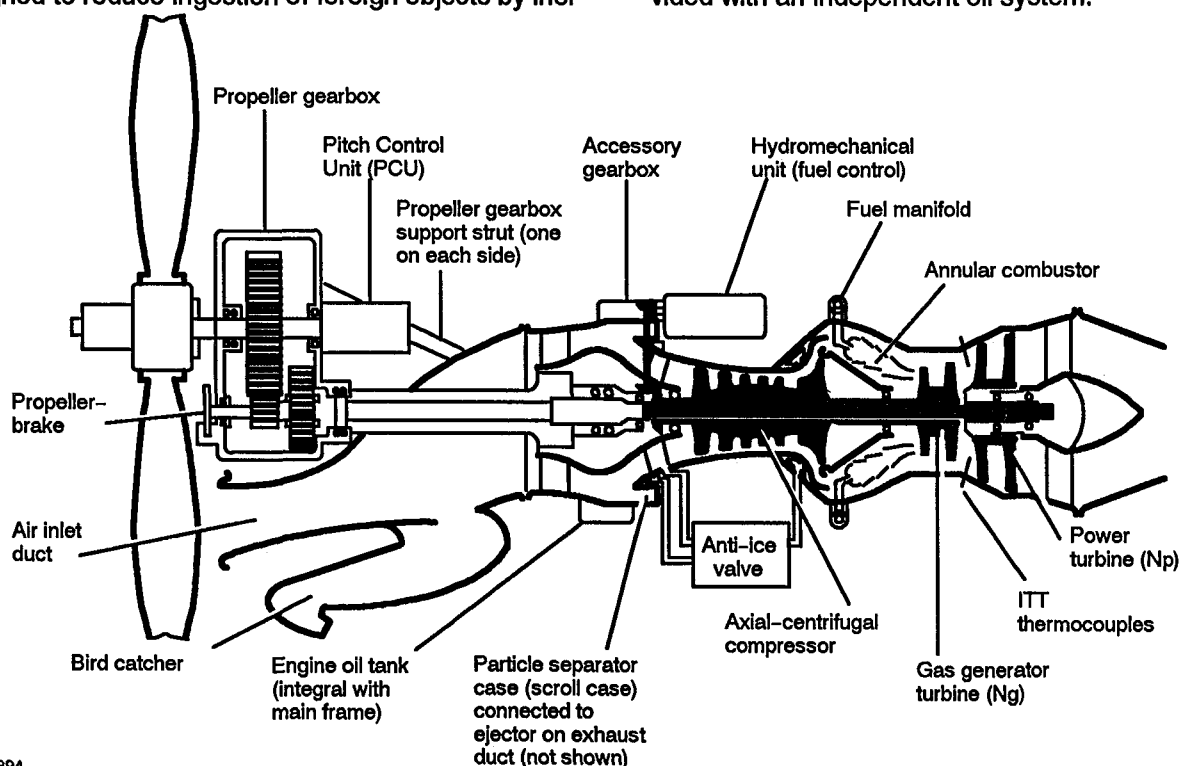
An accessory gear box, located on top of the engine, is driven by the gas generator through a radial drive shaft. The accessory gear box has drive pads for various engine and aircraft accessories.

A two-stage power turbine has an output shaft running through the entire gas generator to the propeller gear box (PGB) which is a separate unit located in front of the engine. There is no mechanical connection between the power turbine and the gas generator rotating parts.

The propeller gear box drives the propeller with a gear ratio of 15.9:1. It is equipped with drive pads for various engine and aircraft accessories.

The engine fuel system provides the engine with fuel to satisfy the various operating conditions.

The engine and the propeller gear box are each provided with an independent oil system.



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FIG 1. CT7 engine – general arrangement.



The engine system provides lubrication and cooling of the bearings and accessory gear box. The propeller gear box oil system lubricates the gear box and is also used for the propeller pitch control and fuel heating. The engine is equipped with a self-contained electrical system supplying power to various engine functions. The power source is an alternator driven by the accessory gear box.

The engine splitter lip and inlet guide vanes are anti-iced by hot air tapped from the compressor and the engine inlet by hot engine scavenge oil. The nacelle air intake and the birdcatcher are electrically anti-iced. For description of these systems, see AOM 11.1. ICE AND RAIN PROTECTION.

1. 2. Propeller.

The propeller is a four-bladed Dowty Rotol, constant speed, fully feathering and reversible pitch unit. The blades are constructed of composite material (carbon fibre and fiberglass reinforced plastic). Propeller gear box oil and counterweights on the propeller blades are utilized to power the pitch change mechanism. The propeller pitch is controlled by a Pitch Control Unit (PCU) driven by the propeller gear box. To prevent overspeed, should the governor in the PCU fail, an independent overspeed governor is provided.

The propeller blades are electrically de-iced. For description of this system, see AOM 11.1. ICE AND RAIN PROTECTION.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Engine fuel system. (Fig. 2.)

The engine fuel system pumps, heats, filters and meters the fuel in the engine to satisfy all operating conditions. In addition it is used to cool the engine oil.

Main pump.

The main pump is driven from the accessory gear box. The pump provides both fuel suction from the fuel tank and fuel pressure to the high pressure pump within the hydromechanical unit (HMU).

In case of failure of the main pump, as sensed by a differential pressure switch across the pump, the standby pump in the aircraft fuel tank is automatically started. Lights in the cockpit will indicate the main pump failure and standby pump on.

Fuel heater.

To prevent fuel icing in the fuel filter, a fuel heater is installed. The heater utilizes PGB oil to heat the fuel. A thermostat valve sensing the fuel temperature controls the oil flow through the heater. A thermal switch in the fuel out port of the fuel heater will cause a light in the cockpit to illuminate when the fuel temperature becomes too low, 0 – 3°C (32 – 38°F). This can occur if the heater fails or during engine start with fuel temperatures near 0°C (32°F).

Fuel filter.

A fuel filter is installed to ensure that no debris will block the HMU and the fuel nozzles.

The filter is provided with an impending bypass sensor which will cause an indicating light in the cockpit to illuminate should the differential pressure across the filter rise above a predetermined value, which is approximately half the bypass pressure. In case of further increased differential pressure, a bypass valve will open, allowing unfiltered fuel into the HMU. A small filter in the HMU would then filter the fuel.

Hydromechanical unit (HMU).

The HMU provides high pressure metered fuel for combustion. It contains a high pressure vane pump and a pressure regulator and metering valve that schedules fuel to meet the various engine operating conditions and demands. The HMU also controls the variable geometry system (inlet guide vanes and stage 1 and 2 stator vanes) and the start and anti-ice bleed valve to provide for efficient and smooth engine operation throughout the entire speed range. A mechanical Ng overspeed protection in the HMU shuts off fuel and flames out the engine at 110% Ng. This system is an internal part of the HMU and can not be tested from the cockpit.

The HMU responds to:

- power lever (PL) inputs (power demand);
- condition lever (CL) input (fuel shutoff);
- gas generator speed (Ng);
- compressor inlet temperature;
- compressor discharge pressure;
- DECU command signals to the torque motor.



In the HMU there is a torque motor which can only increase fuel beyond PL position and which has two functions:

- to meter engine fuel, by signals from the DECU bottoming governor circuit, in order to achieve a pre-set variable minimum PROP RPM on ground (1040/1200) ;
- to meter engine fuel, by signals from the DECU constant torque and APR circuit, in order to achieve a selected torque (CTOT-function) or a torque push (APR-function).

The metered fuel output from the HMU is indicated on the fuel flow indicator in cockpit.

Fuel Used Indicator.

An optional, digital readout, Fuel Used Indicator is tied into both fuel flow indicators and displays total fuel used.

The indicator resets automatically to zero during an internal battery start and also during a GPU-start if GPU voltage drops below approximately 20 V.

NOTE

If a fuel flow needle momentarily drops to zero, the Fuel Used Indicator notches up ten units (10 lb or 10 kg) each time this happens.

With the lamp test switch in LWR, the indicator should read 8880.

Overspeed and drain valve.

During normal operation the overspeed and drain valve allows metered fuel to pass from the HMU to the fuel injectors. In case an Np overspeed is sensed by the DECU, the fuel flow is shut off to the fuel injectors and bypassed back to the inlet of the HMU high pressure pump, causing a momentary engine flameout. At engine shutdown, the overspeed and drain valve allows fuel upstream of the valve to be purged back through the fuel injector manifold and lines to an environmental container located just forward of the wheel well.

2. 2. Torque and RPM.

- Engine RPM (Ng); is the speed of the gas generator speed. The signal is taken from the engine electrical power alternator, which is driven by the accessory gear box. The signals are used for:

- ° ENG rpm indication;
- ° DECU flame out protection system (autoignition)
- ° Autocoarsen system.

- Forward Np sensor; This sensor is located at the forward end of the propeller drive shaft housing between the gas generator and the PGB. This sensor is used to measure power turbine speed (Np). The sensor contains a permanent magnet and wire coil and produces a pulse of current each time a timing notch on the shaft passes. The signals are used for:
 - ° PRPM indication (via the DECU);
 - ° BG function.
- Aft TRQ/Np sensor; This dual function sensor is located in the exhaust frame. Np is picked up the same way as for the forward Np sensor.

The torque signals are picked up as follows;

Engine power output of the propeller is an electronic measurement of twist applied to the Np rotor shaft.

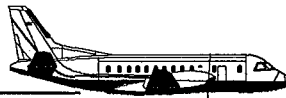
The rotor shaft is hollow and a coaxial reference shaft is pinned to the rotor shaft at the forward end and is free at the aft end.

The rotor shaft and the reference shaft have four teeth at the aft end. The reference shaft teeth are 180° apart and offset 90° from the teeth on the rotor shaft.

A dual-function monopole sensor is installed and senses the rotary motion and relative position of the teeth. In a no-load condition, the teeth pulses are equal to the reference shaft teeth pulses. When power is applied, a measurable twist occurs on the rotor shaft which is directly proportionate to the applied power. The reference shaft will not twist since it is free at its aft end; therefore, the phase relationship of the torque shaft and reference shaft teeth changes, and the phase shift between the induced pulses is a measurement of twist (torque) applied to the propeller through the reduction gear.

The signals are used by the DECU for:

- ° TRQ indication;
- ° Autocoarsen system;
- ° CTOT/APR system;
- ° Np overspeed protection;
- ° Back up Np signals to the BG function should forward Np sensor fail.



2. 3. Digital Electronic Control Unit (DECU).

The DECU is a digital electronic supervisory control device mounted below the compressor casing. The forward face of the DECU extends into the scroll case and is cooled by airflow through the scroll case.

The DECU is powered by the engine electrical power alternator. See 2.4.

The DECU accepts signals and provides functions as below:

- Np overspeed protection;
- Flameout protection (autoignition);
- Bottoming governor (BG) function (variable);
- CTOT system with APR function;
- TRQ/PROP RPM indication (processed);
- ITT indication (adjusted and passed through).

Power turbine (Np) overspeed protection.

Should the power turbine speed (Np) exceed 25,000 RPM (1573 PROP RPM), the DECU activates the overspeed solenoid on the Overspeed and Drain Valve (ODV). This shuts off fuel and turns on ignition. When the rpm has dropped below 1573, the DECU signal is removed, causing the fuel flow to return. The ignition is on for at least 7 seconds after the overspeed has passed. The Np overspeed protection system can be tested with the ENG OVSP A and B test switches on the cockpit overhead panel.

Flameout protection (Autoignition).

The DECU compares actual gas generator speed (Ng) rate of change to a predetermined flameout schedule to detect an engine flameout. When such a condition is detected, the auto-ignition system will be triggered for at least 7 seconds. Should Ng decrease below 62% ignition will be shut off to prevent sub-idle relight.

Bottoming governor (BG) function (Variable minimum PROP RPM.)

The purpose of the BG-function is to automatically provide a minimum PROP RPM during ground operation only.

- 1040 during normal ground operation;
- 1200 during full reverse thrust operation.

This is achieved by increasing fuel flow thereby increasing engine speed (Ng).

Basically the BG-function consists of a BG-circuit in the DECU and a torque motor in the HMU.

The forward Np sensor sends PROP RPM reference signals to the BG-circuit which in turn signals the torque motor to increase fuel flow to maintain Np at the reference speed.

The BG is manually enabled by moving CL into MIN-MAX range.

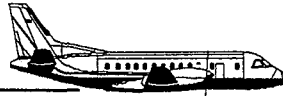
Should the Forward Np Sensor fail, the Aft TRQ/Np Sensor functions as back-up.

There are several functions which affect BG enabling/disabling and thereby the torque motor operation:

- CL quadrant switch. Provides BG enabling with CL in MIN-MAX range.
- DECU function which enables the BG above 830 PRPM and disables the BG below 280 PRPM. The upper limit is to avoid overswing and the lower limit is to prevent Ng acceleration in the event of Np sensing signal system failure.
- PL quadrant switches which together with a WoW switch function will disable the BG with PL in the range FLT IDLE to 64 PLA, when airborne. This is to prevent asymmetric power should one torque motor inadvertently be activated during the approach/landing phase of flight. On ground the BG is enabled regardless of PL position, provided CL is in MIN-MAX range.

When PL is advanced between GND IDLE and FLT IDLE with CL in MIN-MAX range, gas generator speed and propeller blade angle are increased. If the PRPM is less than 1040, the torque motor will be signalled by the DECU to increase fuel flow and thus gas generator speed and therefore PRPM. Further PL advancement increases gas generator and propeller speeds.

During reverse thrust operation PRPM is maintained at 1040 by increasing gas generator speed as the propeller blade angle goes negative. When the propeller blade angle exceeds -10 degrees, the BG function increases fuel flow to maintain above 1200 PRPM.



Although the BG is also enabled during flight (except when PL is between FLT IDLE to 64° PLA range) there is no BG function, due to the fact that during flight PRPM is above 1040.

CTOT/APR system. (See also 2.10)

A constant-torque circuit located in the DECU, a common variable resistance circuit in the CTOT panel and a torque motor in the HMU (same torque motor as for BG function) are used to adjust fuel flow (Ng) beyond PL position and thereby torque, to a preselected value.

In the CTOT system is an integrated Automatic Power Reserve (APR)-function to provide an extra 7% delta torque push on the good engine, should a power loss occur on one engine. A resistance circuit in the CTOT panel is automatically reconfigured to increase the torque reference signal activated by an autocoarsen signal.

Torque (TRQ) /Propeller rpm (PROP RPM) indications. (See also 2.2.)

The TRQ indication is inhibited below 470 PRPM.

The propeller speed is actually measured as power turbine speed (Np) but is displayed in cockpit as PROP RPM (i.e. Np divided by 15.9)

NOTE

As regards torque indication characteristics, minor fluctuations ($\pm 1\%$) on the gauge are acceptable. When the gas generator rotates at exactly twice the power turbine speed ($Ng = 2 Np$), the torque sensor may vibrate and thereby produce a slightly higher torque fluctuation. In this case $\pm 3\%$ on the gauge is acceptable. A small change in PL or CL position (Ng or PROP RPM) should eliminate the fluctuation. Two commonly used power settings where the phenomena may occur are PROP RPM 1330, Ng 92% and PROP RPM 1270, Ng 90%. This is based on 100% Ng = 44720 and 100 Np = 22000 (1384 PROP RPM).

CAUTION

Should torque fluctuations exceed these values, or if PL/CL changes do not eliminate them, the indication should be considered as erratic indication, and the torque motor should be locked out.

NOTE

Failure of the TRQ and/or Np signals to the DECU or a failure inside the DECU may cause the BG and CTOT functions to give erroneous signals to the torque motor. This may cause engine rpm (Ng) to increase uncontrolled, followed by a possible overtorque or power turbine overspeed. In both cases, the failure can be corrected by locking out the torque motor from the DECU.

Erratic TRQ and/or PROP RPM cockpit indications (large needle movements; needle hesitations followed by abrupt step change to another value) can be the first indication to the crew of a sensor system failure. Prompt crew action must be taken to lock out the torque motor. Locking out the torque motor will not correct the erratic cockpit indications; however, it will prevent the engine from causing propeller overspeed or overtorque.

To lockout the torque motor; Push CL to MAX then lift up and momentarily push hard into T/M, then pull back to approx. half between MAX-MIN, then set desired PRPM.

NOTE

With the CL in the T/M position, fuel is vented overboard; therefore, CL should be moved only momentarily into this position. Pulling back to approx. half between MAX-MIN will ensure closing of the vapor vent valve.

If the torque motor has been locked out it can only be reset by positioning the CL to FUEL OFF.

Torque motor lock-out does not affect propeller rpm when airborne; on ground, however, minimum PROP RPM must be manually controlled by the PL. See also ABNORMAL PROCEDURES.



ITT indication.

The interstage turbine temperature (ITT) is measured by a thermocouple assembly located in the gas-stream between the gas generator turbine and the power turbine. The assembly consists of seven thermocouples that average temperature input to the cockpit ITT gauge. A loss of a thermocouple will therefore not significantly affect the indicated temperature. The output of the thermocouples is transmitted to the DECU where it may be slightly adjusted by a factory calibrated timer and then transmitted for cockpit indication. In the event of a DECU failure, the ITT signal to the cockpit will not be adjusted by the timer. The indicator has both analog and digital presentations; the digital presentation being derived from the same incoming signal, however processed by a separate amplifier.

2.4. Engine electrical system.

Each engine has its own electrical system, powering the basic electrically powered engine systems.

The sole source of power is an alternator driven from the accessory gear box. The alternator contains three separate sets of windings for its three functions:

- Ignition power;
- DECU power;
- Ng RPM signal.

2.5. Oil system.

Engine oil system. (Fig. 3.)

The engine oil system is a self-contained, recirculating, dry sump system providing pressurized oil for lubrication and cooling.

The oil tank is integral with the engine main frame. The capacity is 7.3 US quarts (approx 7 liters) and a sight gauge showing tank quantity is located on the right side of the tank.

Two quarts may be added to an engine which is at the "ADD" level to bring it to full. It is not possible to over-service the engine. As an extra precaution the oil tank inlet has a flapper valve which seals the inlet if the oil cap is not on properly.

The oil pump is a multi-element (six scavenge and one lube) pump with gear rotors on a common shaft. The lube pump draws oil from the tank and provides high pressure oil through a fine mesh filter to the engine bearings and the accessory gear box.

The other six pump elements scavenge oil from the various sumps (A, B and C) and return the oil to the tank via an oil cooler where fuel cools the oil.

Before reaching the oil tank, the return oil passes through the engine inlet frame vanes where it aids in anti-icing the inlet (not controllable).

There is an engine oil differential pressure transducer and a differential pressure switch. The pressure switch provides signals to the warning system, and the transducer provides signals to the cockpit indicator. Master warning and L/R ENG OIL PRESS CWP light come on when oil pressure is below 30 psi.

The transducer and pressure switch measure the differential pressure between tube pump output and the B-sump which houses the number 4 bearing. (See fig 3.) This system provides the earliest warning of low oil pressure or low oil level at any of the sumps.

Characteristics of a pressure transducer failure are that the oil pressure indication will rapidly go to zero or to the upper limit of the gauge.

NOTE

The warning consists of the master warning and L/R ENG OIL PRESS CWP light. The same master warning and CWP light will come on in the case of low PGB oil pressure.

With the aircraft on ground, the PGB warning is delayed by 15 seconds to allow for propeller acceleration transients. There is no delay on the engine oil pressure warning. This means that at aircraft electrical power-up, the master warnings L and R ENG OIL PRESS shall be generated immediately. Should the warning not be displayed until some 15 seconds after the electrical power-up, then there is a failure in the engine oil pressure circuit.

Loss of oil usually is characterized by fluctuating oil pressure and then a drop in oil pressure. The oil temperature indication is taken downstream of the lube pump and prior to the oil being delivered to the bearings. If the oil quantity should start to decrease (i.e. leakage), air will begin to mix in the supply line and



due to aeration, the oil temperature will hold steady or start to decrease slightly. This phenomenon is opposite to what pilots generally expect which is a rise in oil temperature. The oil filter is equipped with an impending bypass sensor which will cause a MASTER CAUTION if the pressure drop across the filter exceeds a predetermined value. If the pressure differential increases further, a bypass valve will open, allowing unfiltered oil into the lubrication system.

A magnetic chip detector is installed in the return oil system. The chip detector will cause a MASTER CAUTION if metal particles are present in the oil system. See Fig. 3, 7 and 9.

Propeller Gear Box (PGB) oil system. (Fig. 4)

The PGB is lubricated by an integral oil system where the PGB housing itself is used as the oil reservoir. A sight gauge on the lower right side of the PGB indicates oil quantity. The capacity of the reservoir is 5 US quarts (approx 4.7 l) of which approximately 1 qt constitutes a reserve for emergency propeller feathering.

One quart can be added to a PGB which is at the "ADD" level to bring it to full. The PGB reading should be taken at least ten minutes after shut down. It is possible to over-service the PGB. An over-serviced PGB will cause fluctuating PGB oil pressure indication. The PGB lube pump provides pressurized oil for gear and bearing lubrication and propeller control. The low pressure oil is passed through an oil cooler and fine mesh filter after being discharged from the pump. Approximately 50% of the pressurized oil flow is utilized for lubrication. The other 50% is routed to the high pressure side of pump where the pressure is further increased for use in the propeller pitch control system. An electrically powered propeller (feathering) pump, has access to the emergency reserve oil for propeller feathering, should the normal oil supply be lost.

PGB oil is also used for fuel heating to prevent icing in the fuel filter.

There is a PGB differential oil pressure transducer and a PGB differential oil pressure switch. The transducer provides signals to the cockpit indicator and low power (PL < FLT IDLE) oil pressure warning. The pressure switch provides signals to the high power (PL > FLT IDLE) oil pressure warning.

Characteristics of a pressure transducer failure are that the oil pressure indication will rapidly go to zero or to the upper limit of the gauge

NOTE

The warning consists of the master warning and the same L/R ENG OIL PRESS CWP light as for the engine oil pressure warning. The warning comes below 25 psi (PL > FLT IDLE) and below 7 psi (PL < FLT IDLE).

2.6. Propeller control system. (Fig. 5.)

The propeller pitch control system utilizes PGB oil pressure boosted by the high pressure section of the PGB pump to control the propeller blade angle. The pitch change mechanism is contained in the propeller hub while the pitch control unit is located on, and driven by, the PGB. The propeller pitch control range is from the fully feathered position (+ 83°) to max reverse blade angle (- 16°).

Propeller pitch change mechanism.

Propeller pitch angle is controlled by a piston in the propeller dome. The piston shaft engages pins on the root end of each propeller blade. The extension of the piston shaft (the beta tube) runs through the propeller shaft to the propeller pitch control unit on the rear side of the PGB. The beta tube contains the oil passages for directing the pitch control oil to either side of the piston. Forward movement of the piston will cause a change towards fine pitch (ultimately reverse) while rearward movement will cause a change towards coarse pitch (ultimately feather).

In addition to oil pressure, counter weights on the propeller blades are utilized for pitch control. They are sized and phased so that the centrifugal force of the weights tends to move the blades towards coarse pitch.

The counterweight arrangement makes the propeller "fail-safe towards coarse" (low RPM) in case of loss of control oil pressure.

Pitch Control Unit (PCU).

The PCU contains the principal elements of the pitch change control systems: the constant speed governor, the feathering valve and associated feather solenoid valve and the beta tube assembly.

The constant speed governor is a fly-weight operated unit driven by the PGB. The flyweights position a hydraulic valve to direct oil pressure as required to maintain a set RPM.



Input to set the desired PRPM is made with the CL. During normal constant speed operation, the pitch control system operates as a single oil line system with the governor directing pressure oil to the fine pitch side of the piston to decrease pitch (increase PRPM) or connecting the fine pitch side to return so that counterweight action will increase pitch to decrease PRPM. The governor speed control range is from 1150 to 1396 PRPM.

The feathering valve controls the feathering action of the propeller. The valve is controlled either mechanically by the CL or electrically / hydraulically through the feather solenoid valve. When the feathering valve is actuated, it isolates the propeller from the governor and directs pressure oil to the coarse pitch side of the piston thereby aiding counterweights on the propeller in driving the propeller blades to the feather position.

The beta tube assembly consists of the beta tube and the beta sleeve. The beta tube actually consists of two concentric tubes, the inner one carrying control oil to the coarse pitch side of the piston and the outer one carrying oil to the fine pitch side. The beta tube is attached to the pitch change piston and serves as a feedback of propeller blade position to the PCU. It rotates with the propeller shaft. The beta sleeve, through which the beta tube runs, serves as an oil transfer for the pitch control oil. The sleeve has an axial travel controlled by the PL.

During constant speed operation (CL in constant speed range and PL above flight idle) the beta sleeve is positioned so that oil is admitted to/ from the piston as directed by the governor. In this mode of operation the beta sleeve also serves as a minimum pitch stop controlled by the PL. At low power settings when the engine cannot maintain the propeller speed set by the governor, the pitch is controlled by the PL moving the minimum pitch stop. (+ 10° to + 17° blade angle).

When the PL is moved below the FLT IDLE position, the system goes into the beta control mode. Propeller pitch is then directly controlled by the PL between + 10° at FLT IDLE through 0° (ground idle) to full reverse (stop at -16°). On the ground with PL and CL in the enabling positions propeller RPM is maintained at 1040 (max reverse above 1200 PRPM) by the bottoming governor function of the DECU. When the propeller

is in the beta mode the BETA light will illuminate at pitch + 8° or less.

It is prohibited to move PL below the FLT IDLE position when airborne.

Propeller Overspeed Governor.

The overspeed governor is a separate unit driven by the PGB. It is a flyweight-operated unit similar to the constant speed governor. With the propeller RPM in the normal operating range the overspeed governor merely directs propeller control oil to the constant speed governor.

In case of propeller overspeed (1453 RPM or more) when in governing mode (PL at FLT IDLE or above), the overspeed governor shuts off the oil supply to the constant speed governor. Deprived of control oil pressure, the propeller blades will move towards coarse pitch by counterweight action, thereby reducing the rpm.

The overspeed governor can be tested on ground with the PROP OVSP test switch on the cockpit overhead panel.

NOTE

Should propeller overspeed occur it is essential not to move the affected PL until the propeller has been feathered by the CL. Retarding PL to FLT IDLE will fine off the propeller pitch and might aggravate the overspeed. See also Abnormal Checklist.

Propeller (feathering) pump.

The propeller pump is an electrically powered auxiliary pump which provides propeller control oil pressure for feathering should the PGB high pressure section of the pump fail. As the propeller feathering pump has access to the reserve sump oil in the PGB it is possible to feather the propeller if PGB oil is lost through leakage. The pump may also be utilized for propeller checks on ground by maintenance.

The pump is controlled by the propeller PUMP switch on the cockpit overhead panel.

**AUTOCOARSEN SYSTEM**

The autocoarsen system is installed to achieve a fast reduction in windmilling drag during takeoff, approach and go-around in case of engine failure. The system also responds to temporary engine malfunctions such as momentary fuel or air flow interruption.

The system continues to monitor engine parameters after an autocoarsen, and it uncoarsens the propeller if both TRQ and P3 return above threshold values.

Among the hardware/software components in the system are an autocoarsen computer and an auto-coarsen switcher.

Cockpit indications and switches:

- AUTOCOARSEN ON/OFF switch;
- AUTOCOARS LOW/HIGH status lights;
- AUTOCOARSEN CWP light;
- AUTOCOARS/RST test switch;
- AUTO COARS LOW TEST switch.

The AUTO COARSEN ON/OFF switch must be set to ON position to achieve any indication or autocoarsen function.

The system has two distinct modes of operation: LOW POWER and HIGH POWER, modes.

The system monitors power lever positions and engine parameters as below:

- PLA – Power Lever Angle quadrant position.
PLA 64 degrees is the minimum takeoff power PL position;
- Ng – Gas generator speed (%);
- Ne – Starter/generator speed (%);
- TRQ – Torque (%);
- P3 – Compressor discharge pressure (psi).

System status indications:

- AUTOCOARS LOW and AUTOCOARS HIGH arm lights (green flight status panel lights) indicating that the system is armed in LOW or HIGH power mode;
- AUTOCOARSEN (CWP light) indicating a system malfunction.

All parameters are supplied to the autocoarsen switcher. Depending upon power mode, the respective parameters are either modified by the switcher or passed directly through to the computer. During low power mode the switcher modifies low power mode in-

puts to emulate high power parameters as either a high (=good) value, or low (=failed) value for computer processing.

To command an autocoarsen, two input parameters from the same engine must be below their respective threshold values (a low input) for that mode of operation.

NOTE

Numbers below are rounded to nearest 5 except for the PLA.

LOW POWER mode

This status is indicated by an AUTOCOARS LOW "armed" light if:

- PLA < 64 degrees (one or both PL's); and
- Ng > 55% (both engines); and
- Ne > 60% (both engines).

Autocoarsen occurs if (AUTOCOARS LOW light does not need to be on):

- Ng < 55% (failed engine); and
 - Ne < 60% (failed engine); and
 - Ng > 55 (good engine).
- (PLA is irrelevant).

NOTE

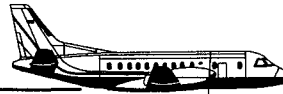
With a DC generator inoperative and the fault is caused by a sheared generator shaft, the AUTO COARS LOW "armed" light will not illuminate due to loss of Ne Signal. However, auto-coarsen occurs if the required parameters are fulfilled.

Uncoarsen occurs if:

- Torque increases > 50% (failed engine); and
- P3 increases > 120 psi (failed engine).

Uncoarsening will also occur if the AUTOCOARSEN switch is set to OFF.

Provided the engine parameter inputs are correct, the AUTOCOARS LOW light is on if one or both PL's are below 64 PLA and goes out when both PL's are above 64 PLA.



HIGH POWER mode

This status is indicated by an AUTOCOARS HIGH "armed" light if:

- PLA > 64 degrees (both PL's); and
- TRQ > 50 % (both engines); and
- P3 > 120psi (both engines).

Autocoarsen occurs if (AUTOCOARS HIGH light does not need to be on):

- PLA > 64 degrees (both PL's); and
- TRQ > 50 % (good engine); and
- TRQ < 50 % (failed engine); and
- TRQ differential > 25% (between engines); and
- P3 < 120 psi (failed engine).

The system has a back-up feature: in the event a high power mode autocoarsen does not occur due to a system malfunction, an autocoarsen occurs if:

- Ng < 55 % (failed engine); and
- Ne < 60 % (failed engine); and
- Ng > 55 % (good engine).

Uncoarsen occurs if:

- Torque increases > 50% (failed engine); and
- P3 increases > 120 psi (failed engine).

Uncoarsening will also occur if the AUTOCOARSEN switch is set to OFF.

Provided the engine parameter inputs are correct the AUTOCOARS HIGH light comes on with both PL's above 64 PLA and goes out if one or both PL's are retarded to below 64 PLA.

Normal computer function prevents the autocoarsening of both propellers simultaneously, and a lightning protection/lock-out relay will protect against the inadvertent autocoarsening of both propellers due to lightning strike or internal computer failure.

A failure of the autocoarsen system may result in lights illuminating as below:

- AUTOCOARSEN (CWP) light;
- AUTOCOARS LOW at high power;
- AUTOCOARS HIGH at low power;
- AUTOCOARS LOW and HIGH simultaneously;
- all lights above simultaneously.

Two system test switches are installed: AUTOCOARS/RST for computer testing and L/R for LOW mode testing.

Propeller synchro-phasing.

The synchro-phasing system reduces propeller noise and vibration.

The sensors for the synchro-phaser are located on the propeller slip-ring assembly for each propeller. To be able to synchro-phase, the propeller RPM must be within 10 RPM of each other. The synchro-phaser will then sense the position of the propeller and adjust the PCU governors so that the propellers will keep the same relative position and thereby also the same RPM. Any manual propeller speed setting difference (CL manipulation) exceeding 10 RPM will cause loss of synchro-phasing and result in split propeller RPM. The synchro-phaser drives the slower RPM up to the higher RPM. There is no slave propeller with the system.

2.7. Propeller brake. (OPTIONAL)

The right propeller gear box is equipped with a Propeller Brake which permits the right engine to be operated as an auxiliary power unit. DC power for the electrical system and bleed air for the air conditioning system is available during ground operation. The brake is powered from the aircraft hydraulic system (main gear down line) via a control unit. With the HYDR PUMP switch in AUTO, engagement of the propeller brake starts the hydraulic pump, which will run continuously. To prevent unintentional propeller rotation due to a failure when the propeller brake is set ON, the following safety features are built into the system:

- Two hydraulic brake cylinders supplied by separate channels, each capable of holding the propeller stationary;
- Two hydraulic lock valves that will trap hydraulic pressure in the brake cylinders should the supply pressure drop while the brake is on;
- The system will retain the last commanded setting in case of hydraulic or electrical failure.

Two ON-OFF solenoid operated control valves in the control unit direct hydraulic pressure for ON and OFF functions. With the Landing Gear Handle DOWN there is a positive actuation of the OFF function, as a back up safety feature, for unintentional propeller brake engagement when airborne and the landing gear is down.

To engage the propeller brake the following conditions must be met:

- Gust Lock ENGAGED;
- Right PL in GND IDLE;
- Right CL in START or FUEL OFF;
- Right Fire Handle IN;
- PROP BRK switch ON.



Except for emergency or abnormal conditions, the Gust Lock, Fire Handle and CL must remain in these positions.

If the Gust Lock is disengaged or the CL moved forward out of START position, or the right Fire Handle is pulled, the hydraulic pressure supply will be turned off. The lock valves will keep the brake engaged. However, there might be a decrease in pressure which will cause the propeller to start to rotate with subsequent brake damage.

A PROP BRAKE status light in the overhead ground status panel will come on when the R PROP BRK switch is actuated to ON and power is applied to the brake ON-solenoid. The light will go out if power is interrupted.

NOTE

On ground if PROP BRAKE warning comes on with the PROP BRK switch in either ON or OFF position the engine must be shut down immediately, followed by maintenance action.

A PROP BRAKE warning light in the CWP will come on together with MASTER WARNING and triple chime for the following conditions:

- PROP BRK switch ON
 - ° Power interrupted to the ON solenoid (e.g. due to failure, power loss, Gust lock or CL moved out of position, or Fire Handle pulled);
 - ° Hydraulic pressure (one or both channels) too low.
- PROP BRK switch OFF
 - ° Hydraulic pressure (one or both channels) too high;
 - ° May come on for 5 seconds during disengagement (nuisance warning). However, the engine must be shut down immediately followed by maintenance action. It is impossible to determine this nuisance from a real warning.

2.8. Starting system.

The aircraft electrical system DC generator operates as a motor during engine start and engine motoring (combined starter/generator). See also AOM 5. ELECTRICAL.

The starter generator may be powered from:

- Aircraft batteries (external power must be off).
- External power.
- Generator of an operating engine, together with the aircraft batteries.

During "battery start" the batteries are connected in series.

During "motoring" the batteries are connected in parallel.

The series/parallel logic is controlled by the series/parallel relay via the position of the IGN switch. With the switch in OFF position the batteries are connected in parallel and with the switch in NORMAL or CONT position in series, hence "motoring" is accomplished in parallel and "battery start" in series. When performing a "motoring start" (start initiated by dry motoring) the motoring sequence is accomplished with the batteries in parallel and the start sequence in series.

The reason for the switching logic is to keep low battery temperature. If the battery temperature is too high (57°C or above), a NO BAT START light on the overhead panel will illuminate.

The function of the starter/generator is controlled by the start relay. The relay is closed during the following conditions.

Engine start:

- CL in START position.
- Ignitions switch in NORM or CONT position.
- Start switch L or R respectively.
- Ng below 55% (as sensed by starter/generator).

Motoring:

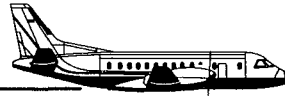
- CL in FUEL OFF position.
- Ignition switch in OFF position.
- Start switch in L or R position.

During engine start the starter/generator will drive the engine up to approximately 55% Ng, then automatically cut out and revert to its role as generator.

NOTE

If EXT PWR should drop off line while the Start Switch is being held in the START position or anytime during a start-up, there will be loss of electrical power. The only busses that will be powered are LH and RH Hot Battery Busses and Emergency Battery Bus until the Start Switch is released (during motoring or motoring start) or the Condition Lever is moved to Fuel Off (during a start-up).

The loss of power will effect most systems in the cockpit as well as the cabin lighting. The EXT PWR switch is powered by the Emergency Bus during the start, and will not automatically move to OFF position. Electrical power will be restored (Main battery power) and EXT PWR switch will drop to OFF once the Start Switch is released (during motoring) or the Condition Lever is moved to Fuel OFF (during start).



2.9. Ignition System

The ignition system is an AC powered capacitor discharge low voltage system. It includes a dual exciter unit and two igniter plugs.

The exciter is powered by one winding of the engine electrical system alternator. The spark rate of each ignition circuit is a minimum of two sparks per second.

The ignition system is controlled by two switches (L IGN/R IGN). The switches have three positions: OFF-NORM-CONT.

With the switch in NORM an auto-ignition system is triggered for 7 seconds by the DECU flameout protection system. (See 2.3.)

Two lights in the flight status panel (L IGN/R IGN) will come on:

- With the switch in NORM:
 - ° during engine start;
 - ° during engine shut down (momentarily);
 - ° if autoignition triggered due to flameout or a fast retardation of PL;
 - ° If electrical control power is lost (engine autoignition CB tripped);
 - ° if ignition is applied automatically by the DECU in case of power turbine overspeed;
 - ° during engine overspeed test.
- With the switch in CONT.

The lights can be tested by the LAMPS test switch when held to the LWR position. The ignition system control power is supplied via two circuit breakers for each engine, one for each normal ignition system and one for each auto-ignition system which also is common to the anti-skid system, the BG system and PGB oil pressure system (FLT IDLE switch).

In case of loss of control power (engine autoignition CB tripped):

- the ignition light will come on;
- the auto-ignition is activated (fail safe design);
- the anti-skid touch down protection is deactivated on one circuit;
- BG will not be disabled ($PL > FLT IDLE < 64 PLA$) for affected side;
- PGB oil pressure warning will not be activated until pressure below 7 psi during flight ($PL > FLT IDLE$).

In case of a power turbine overspeed and the resulting flame-out relight, the ignition is applied automatically by the overspeed circuit and remains on for 7 seconds after the overspeed has ceased. This permits an instant relight as fuel flow is reinstated when the PRPM has decreased below the overspeed threshold.

2.10. CTOT/APR system.

The CTOT/APR system is designed to be used during takeoff and go-around only. It may be used solely as CTOT system or as a CTOT/APR system.

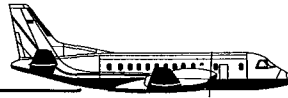
- The CTOT trims the engine power to a selected torque value above the PL position thereby eliminating the need for the pilot to adjust the power setting.
- The APR provides an extra 7% delta-torque increase on the good engine in case of one engine power loss. The APR system is triggered by an auto-coarsen signal, therefore to be able to achieve APR function the autocoarsen system must be ON.

The CTOT system limits the ITT. There will be fuel cut-back at ITT 955°C. However, the limitation may always be overridden by advancing the PL's.

The system is manually controlled by a CTOT switch, a CTOT-knob and PL position. The CTOT switch has three positions (OFF-ON-APR).

The CTOT-knob is used to select or set a desired torque value. The knob controls a potentiometer which controls a signal used by a constant torque circuit in the DECU. The DECU sends a signal to the torque motor in the HMU to control fuel flow beyond that set by the PL.

The system requires that the PL's are positioned above 64 PLA. However, operational requirements call for the PL's to be advanced 15–20% delta torque below the selected CTOT value before setting the CTOT switch to either ON or APR position. The switch is guarded in APR position and controls both sides.



Engine torque will increase automatically. PL setting the torque within 15–20% below selected torque is required in order to avoid overriding the CTOT system with PL position, due to torque blooming during acceleration. If PL setting is too high (less 15–20% below CTOT value), the final torque will exceed the selected torque, because of "the built in" torque blooming caused by increased airspeed. If the CTOT switch is set to ON or APR while PL is above 64 PLA but below the selected value, or if PL is advanced through the 64 PLA position while the CTOT switch is in ON or APR position, the torque will immediately increase. The torque can be changed at any time by turning the CTOT knob, however, the torque can never be changed to below the torque determined by the actual PL position. When the selected value is attained, the desired torque will be maintained unless ITT increases to 955°C. The torque will not increase once the ITT limit has been reached.

Right and left engines are serviced by independent CTOT systems with the exception of a common CTOT knob and CTOT switch.

The CTOT system is disengaged by selecting the CTOT switch OFF. Retarding the PL below the 64 PLA will also disengage the system. Readvancement of the PL will cause a rapid acceleration to dialed torque if the system has not been turned OFF. It is possible to override the system by advancing the PL to command a higher torque than is selected. This action cancels the torque limit and ITT limit features. In an aborted takeoff the CTOT will be disengaged when PL is retarded below 64 PLA.

PL position to within 15–20% of the selected torque is also desirable in the unlikely event of failure of both CTOT systems. Torque drop between the CTOT setting and PL position setting is then minimized. Similarly, torque differential between right and left engine will be minimal should one CTOT system fail.

The APR function is an integrated part of the CTOT system.

The APR system will provide an extra 7% delta torque (120 shp) on the good engine should power loss occur on one engine.

The APR system, when armed, is activated by an autocoarsen signal. The resistance circuit in the CTOT panel is then automatically reconfigured to increase the torque reference signal to the DECU by 7% delta.

To achieve the APR function, the system must be armed and activated by an autocoarsen signal (from either HIGH or LOW mode).

The system is armed (individually) when;

- AUTOCOARSEN switch ON;
- PL (individual function) above 64 PLA;
- CTOT switch set to APR position.

There are two (L APR/R APR) lights in the flight status panel which will come on if the respectively PL is advanced above 64 PLA and the CTOT switch is set to APR.

AUTOCOARS HIGH or AUTOCOARS LOW light together with an APR light indicates that the particular APR system is armed.

An autocoarsen signal from either HIGH or LOW mode will activate the APR system. However, only an engine whose corresponding PL is set above 64 PLA can be affected by the APR.

There is no sequence logic built into the system. That means that there will be an APR activation irrespective of in which sequence the system receives the required inputs (autocoarsen signal, PL advancement and CTOT switch positioning).

The signal is latched in the CTOT panel and the APR function can only be deactivated by selecting the CTOT switch from APR to ON or OFF positions. Selecting the AUTOCOARSEN switch to OFF will not deactivate the system.

Manipulating a PL after an APR activation will in principle have the same influence on the CTOT/APR system as if CTOT only was in use. The system will be disengaged if PL is retarded below 64 PLA and will be reengaged if PL is readvanced to above 64 PLA, provided an autocoarsen command still exists.

If the CTOT knob is set to below 100% and with the CTOT switch set to ON or APR, additional power may be achieved quickly and accurately by rotating the CTOT knob clockwise to a higher value;

- with the CTOT switch in ON position the power is limited to 100% TRQ;
- with the CTOT switch in APR position, and should the APR be triggered, the APR torque increase will be added to the new CTOT value, however, it will be limited to 107% TRQ.

If the situation warrants, power may always be added by advancing the PL. Advancing the PL cancels the ITT limit feature.



2.11. Engine Bleed Air system.

See AOM 16. PNEUMATICS.

2.12. FI STOP (Flight Idle Stop) system.

The purpose of the FI STOP is to prevent any PL from being moved into beta range during flight.

The system consists of an automatically operated mechanical stop arm located within the control quadrant which physically blocks power lever movement below flight idle when the aircraft is in flight (stop is closed), and is removed to give free passage, forward and aft, when the aircraft is on ground (stop is open). The automatic function of the stop arm is controlled by a solenoid which is controlled by signals from the following:

- L or R landing gear locked down switches.
- L or R (inboard or outboard) wheel spin-up (anti-skid computer).
- L or R weight-on-wheel switches.

An emergency override function, to be used on ground only, is also provided.

When the solenoid is depowered the stop will be in flight position (stop is closed).

The normal function as well as the override function have their dedicated cockpit indications.

Stop logic.

Stop Open – aircraft on ground

(L or R LDG extended) **AND** ((L or R inboard or outboard wheel speed >25 kts) **or** (L or R weight-on-wheels)).

Stop Closed – aircraft in flight

(L and R LDG retracted) **OR** ((L and R LDG extended) **and** (L and R not weight-on wheels) **and** (L and R inboard and outboard wheel speed <9 kts)).

Indications.

The position of the stop is indicated on the top of the Flight Status Panel as follows:

FI STOP (blue) is on:

- Stop is open and landing gear down and locked. This is the normal indication when aircraft is electrically powered on ground. The light should remain on until the landing gear is retracted after take-off. If the landing gear is not retracted the light will stay on until all wheels have spun down to <9 kts which may take

up to 90 seconds, during which period the stop will remain open.

During the remainder of the flight the blue light should be out (stop closed) until after touch down when it should come on again (stop automatically open).

FI STOP OPEN (amber) is on:

- Flight Idle Stop is open and landing gear not down and locked. This indicates an abnormal situation. The indication is latched even after the gear is down and locked and is reset only after the aircraft has been electrically powered down.

This light will come on:

- In case of failure of the stop to close after take off when the gear is retracted (electrical or mechanical failure).
- In case of activation of the emergency override function, before the landing gear is extended.

NOTE

Both the FI STOP (blue) light and the FI STOP OPEN (amber) light will come on after gear is down and locked, should the override function be activated when airborne.

Emergency override function.

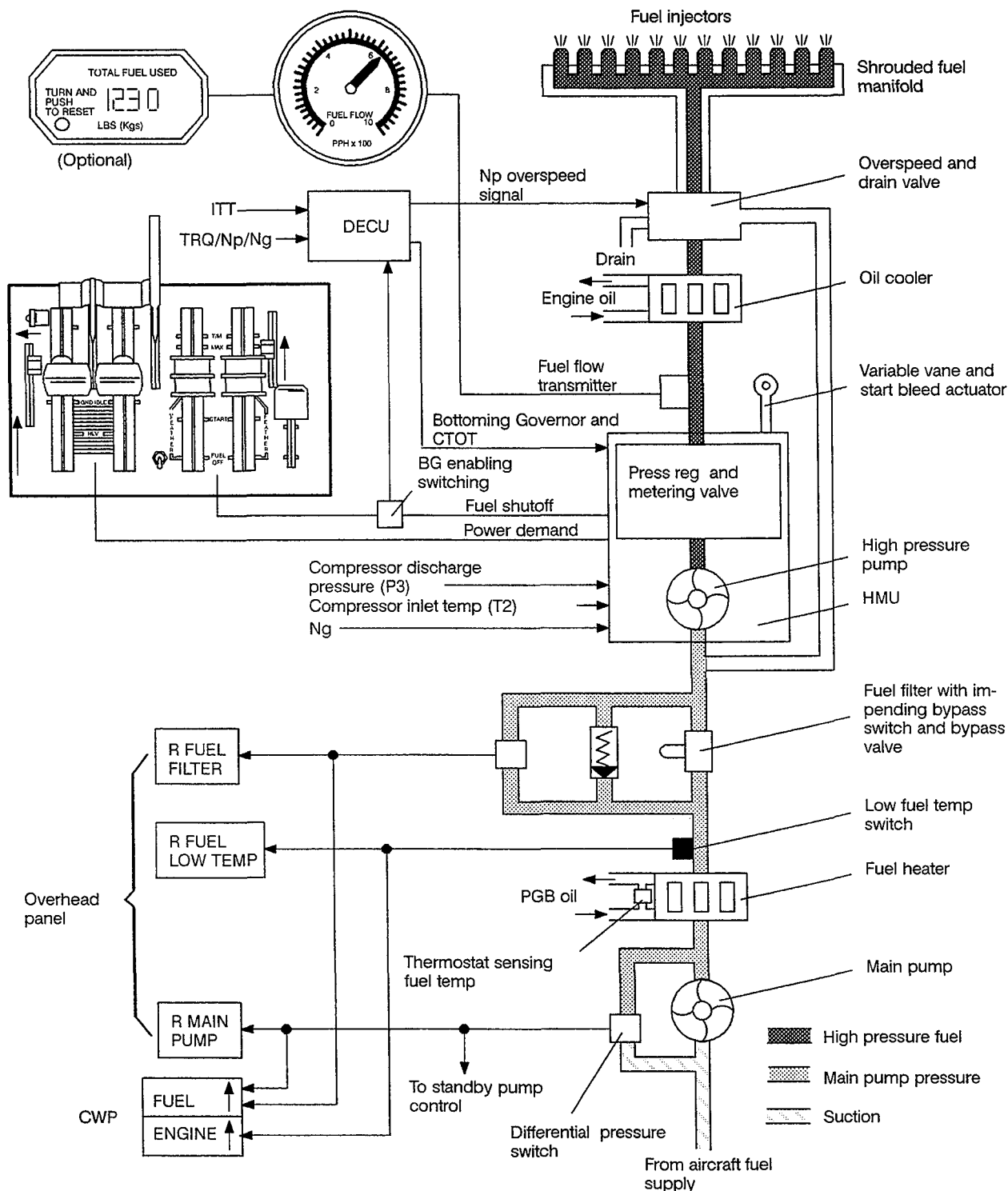
The override function is activated with the FI STOP OVRD pull knob, located on the control quadrant between the PLs and the CLs. The knob is connected to the stop arm by a mechanical cable. When the knob is pulled the stop will be mechanically forced to its open position, irrespective of the electrical solenoid and its logic.

After the knob is pulled it is locked in up position (a red colored area is exposed under the knob), and must be reset by maintenance action.

When the knob is pulled, the aircraft takeoff CONFIG (warning) (non-resettable) will be triggered at a left engine start attempt (CL in START and the START switch activated). The warning can be inhibited only by retarding the L CL to FUEL OFF position. This specific warning can only be triggered with aircraft on ground (weight-on-wheels and landing gear down and locked).

Procedures.

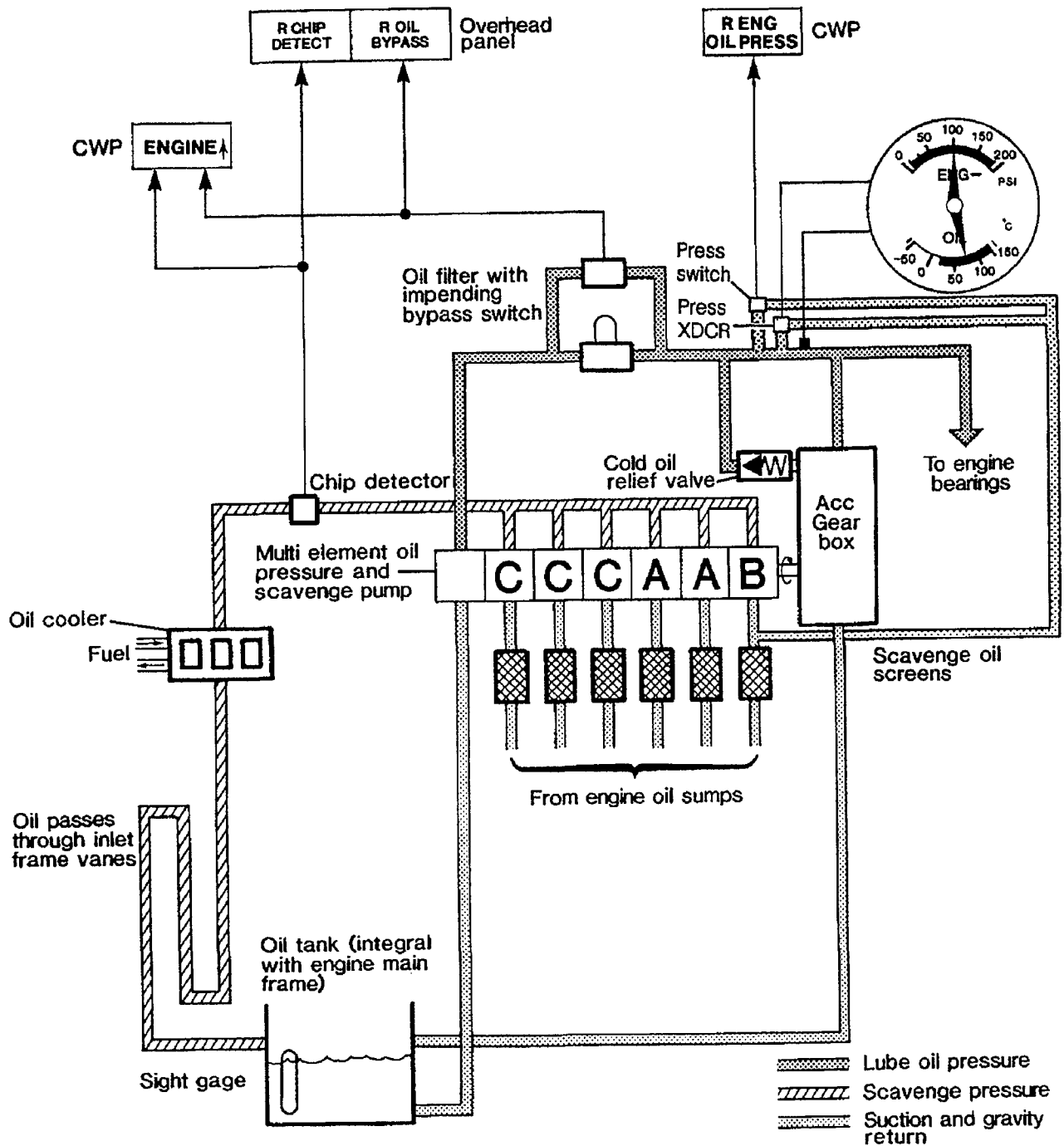
- See – NORMAL PROCEDURES 17.2
– ABNORMAL PROCEDURES 17.2
– NORMAL PROCEDURES 22



A11651

FIG. 2. Engine fuel control system – schematic.

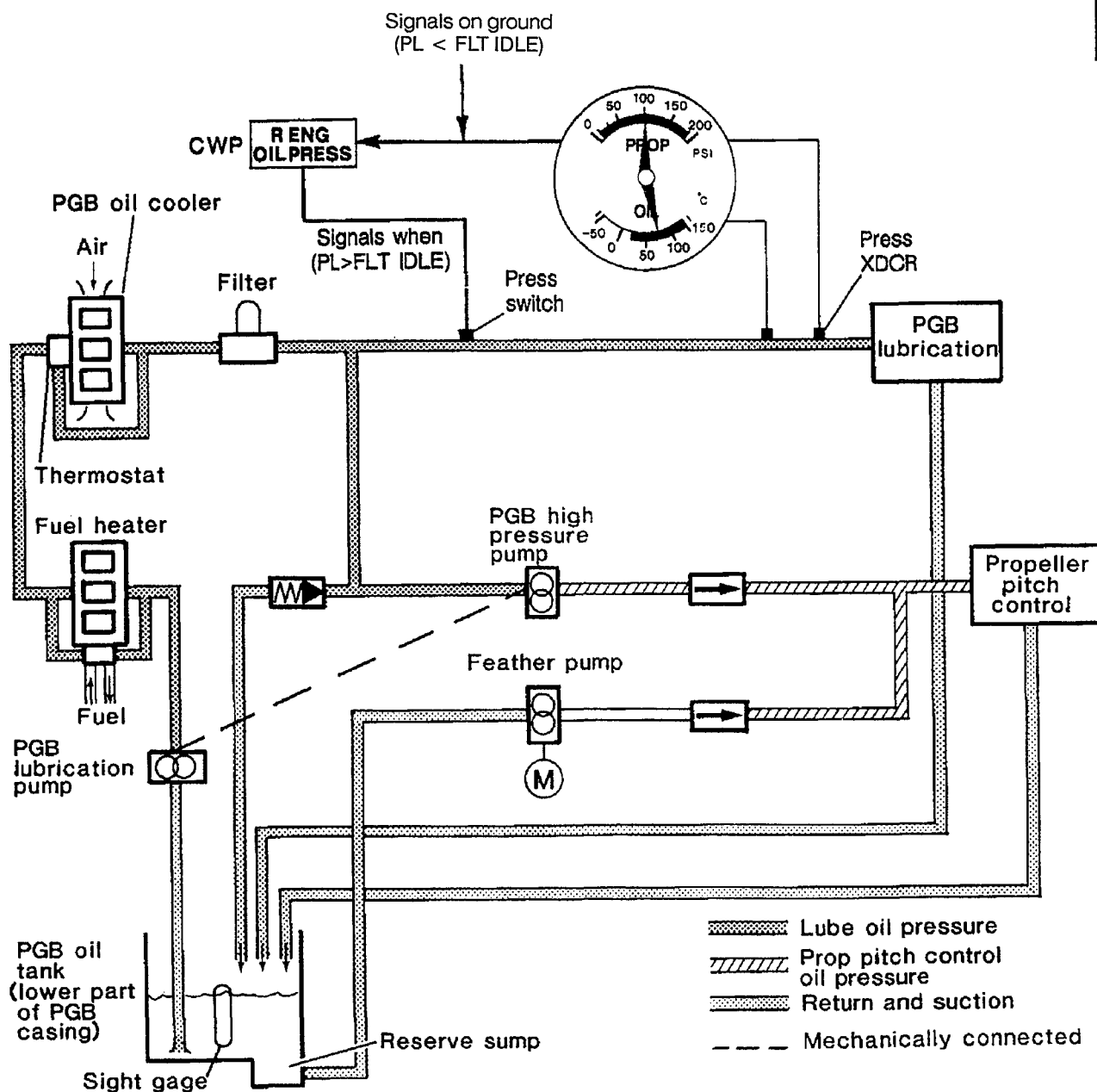
17.1



A9899

FIG. 3. Engine oil system – schematic.

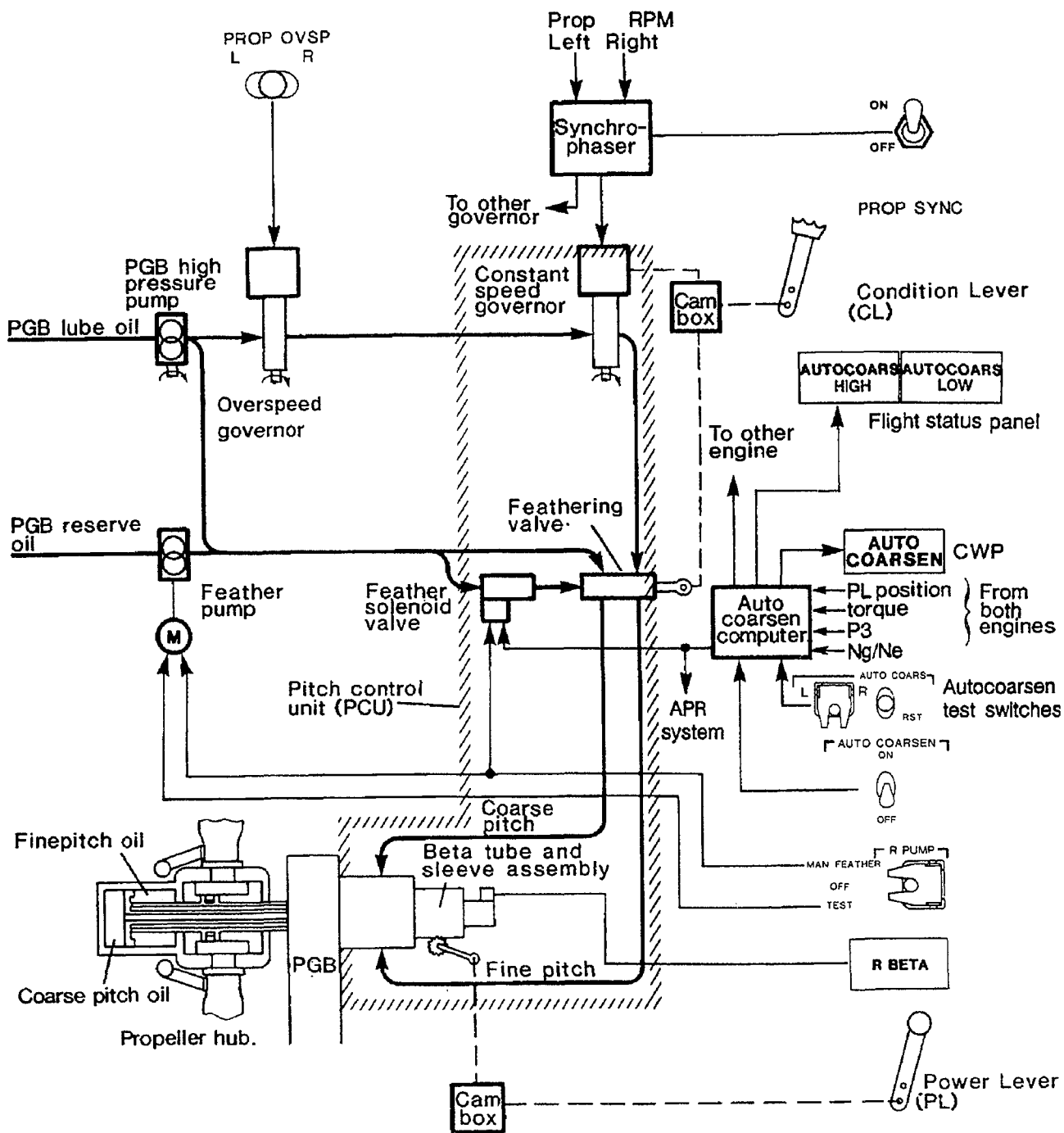
17.1



A9900

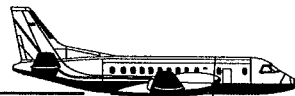
FIG. 4. Propeller gear box oil system – schematic.

17.1



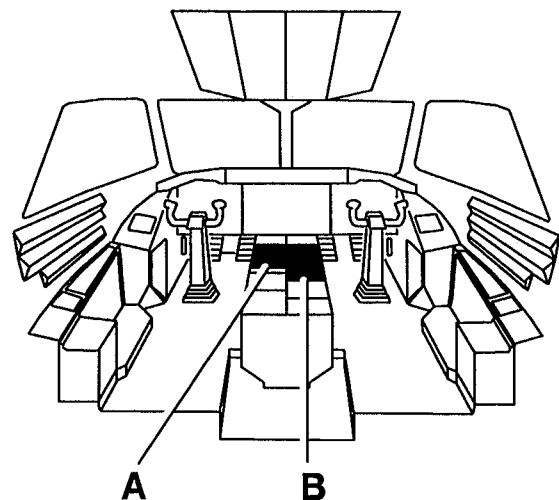
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FIG. 5. Propeller control system – schematic.



3. CONTROLS AND INDICATORS.

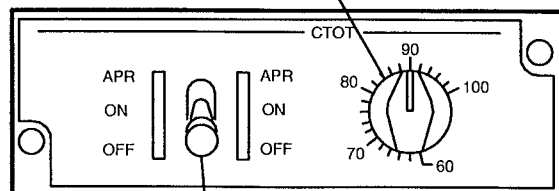
A CONTROL PEDESTAL



CTOT knob (both engines).

- Selector for the desired torque to be set prior to takeoff or go-around;
- If APR triggered, TRQ will automatically increase 7% delta TRQ;
- May be used to adjust power up or down as required when CTOT or APR is engaged.

B CTOT PANEL



CTOT switch (both engines)
With PL > 64 PLA:

- APR: Activates CTOT and arms the APR (guarded position).
ON: Activates CTOT only.
OFF: Deactivates CTOT/APR.

GUST LOCK lever.

Prevents PL's advancement. Must be engaged to enable the propeller brake to be actuated.

Power Lever (PL) (2).

The PL serves as power demand input to the HMU.

In the range aft of the FLT IDLE position, the PL also directly controls the propeller pitch for ground operation (beta control) including reverse.

A feel detent identifies the GND IDLE position.

A stop prevents the PL from being retarded below FLT IDLE when pulling on the PL knob only. Lifting a PL latch below the knob allows the PL to be moved below the stop into the beta range. The latch should be lifted:

- only on the ground and after that the PL has been retarded fully to FLT IDLE.

Serration on the cam prevent retarding the PL towards FLT IDLE should the PL latch be lifted with PL above FLT IDLE from an intermediate position, approximate half between maximum PLA and Flight Idle position.

WARNING

It is prohibited to move the Power Lever(s) below FLT IDLE when airborne. If the Power Lever(s) are moved below FLT IDLE when airborne, the propeller(s) will go into low pitch angle, the propeller speed will increase uncontrolled with extremely high drag, uncontrolled flight, engine shut down, potential engine damage and total loss of engine power.

WARNING

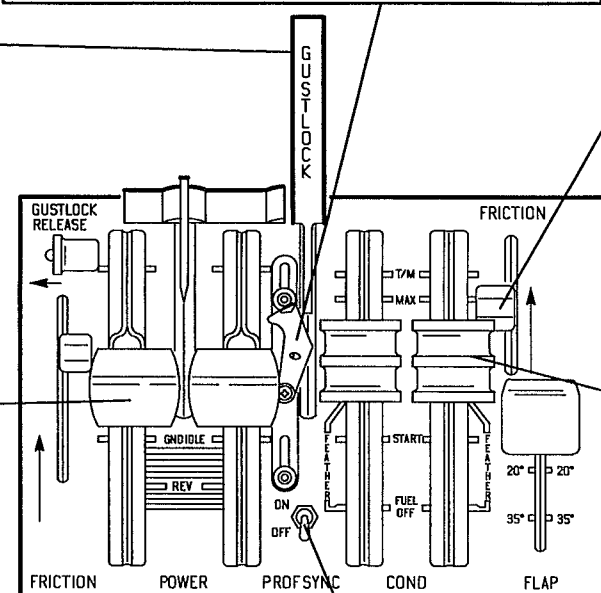
During an aborted takeoff PL must be retarded fully to the FLT IDLE position prior lifting the latch allowing PL to be moved below FLT IDLE. If the latch is lifted with PL above FLT IDLE the PL will be stuck with consequential increased stopping distance.

Friction lock lever (2).

One for PL (left) and one for CL (right). Allows the friction lock for the respective controls to be adjusted to a suitable level.

Power lever stop (only if prop brake installed).

When gust lock is engaged, prevents right PL advancement. The stop is adjustable to meet different propeller brake operation requirements.



PROP SYNC switch.

Controls the propeller synchro-phaser.

- ON:** The propeller will maintain equal RPM and keep the same relative blade position (be phased). Only possible if the RPM of the two propellers is set within 10–15 RPM of each other.
- OFF:** The synchro-phaser is off.

Condition lever (CL) (2):

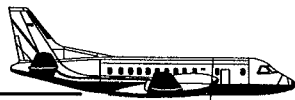
Controls propeller operation and serves as fuel shutoff control.

The following positions are identified on the quadrant

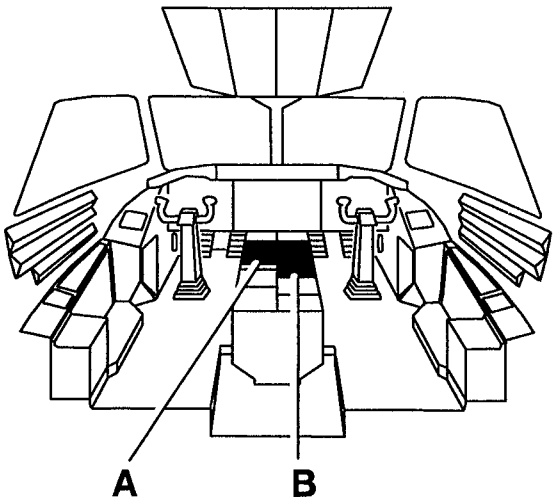
- | | |
|-----------|--|
| FUEL OFF: | Fuel and ignition to the engine is shut off. |
| FEATHER: | With CL in this range the propeller is feathered. |
| START: | Opens the fuel shutoff valve in the HMU and allows ignition to come on when starter is activated. CL must be in START-FUEL OFF range to enable propeller brake to be actuated. |
| UNF: | Propeller is unfeathered. Propeller speed is controlled by PL. GND IDLE gives approx. 950 PROP RPM. |
| MIN-MAX: | Range for propeller constant speed operation. MIN = 1150 – RPM; MAX = 1396 RPM. With CL in this range and at low power where governor speed can not be maintained, bottoming governor function will maintain the minimum propeller RPM for normal operation (1040 and above 1200 at max. reverse). |
| T/M: | Momentarily moving CL into T/M causes the torque motor to be mechanically locked out. On ground the propeller speed must then be manually controlled by the PL. To reset the torque motor, CL must be moved to FUEL OFF.

In T/M position, the fuel vapor vent opens allowing purging of the engine fuel system. |

FIG. 6. Power plant – controls and indicators.



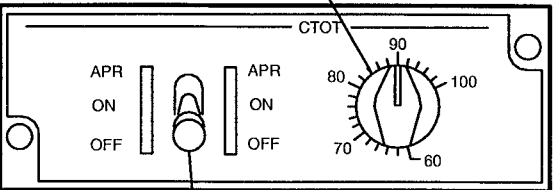
3. CONTROLS AND INDICATORS.



CTOT knob (both engines).

- Selector for the desired torque to be set prior to takeoff or go-around;
- If APR triggered, TRQ will automatically increase 7% delta TRQ;
- May be used to adjust power up or down as required when CTOT or APR is engaged.

B CTOT PANEL



CTOT switch (both engines)
With PL > 64 PLA:

- APR: Activates CTOT and arms the APR (guarded position).
- ON: Activates CTOT only.
- OFF: Deactivates CTOT/APR.

A CONTROL PEDESTAL

GUST LOCK lever.

Prevents PL's advancement. Must be engaged to enable the propeller brake to be actuated.

Power Lever (PL) (2).

The PL serves as power demand input to the HMU.

In the range aft of the FLT IDLE position, the PL also directly controls the propeller pitch for ground operation (beta control) including reverse.

A feel detent identifies the GND IDLE position.

A stop prevents the PL from being retarded below FLT IDLE when pulling on the PL knob only. Lifting a PL latch below the knob allows the PL to be moved below the stop into the beta range. The latch should be lifted;

- only on the ground and after that the PL has been retarded fully to FLT IDLE.

There are no serration on the cam preventing PL movements with lifted PL latches therefore it is possible to retard PL direct from above to below FLT IDLE even if the PL latch is lifted. However, see CAUTION below.

WARNING

It is prohibited to move the Power Lever(s) below FLT IDLE when airborne. If the Power Lever(s) are moved below FLT IDLE when airborne, the propeller(s) will go into low pitch angle, the propeller speed will increase uncontrolled with extremely high drag, uncontrolled flight, engine shut down, potential engine damage and total loss of engine power.

CAUTION

During an aborted takeoff PL should be retarded fully to the FLT IDLE position prior lifting the latch allowing PL to be moved below FLT IDLE.

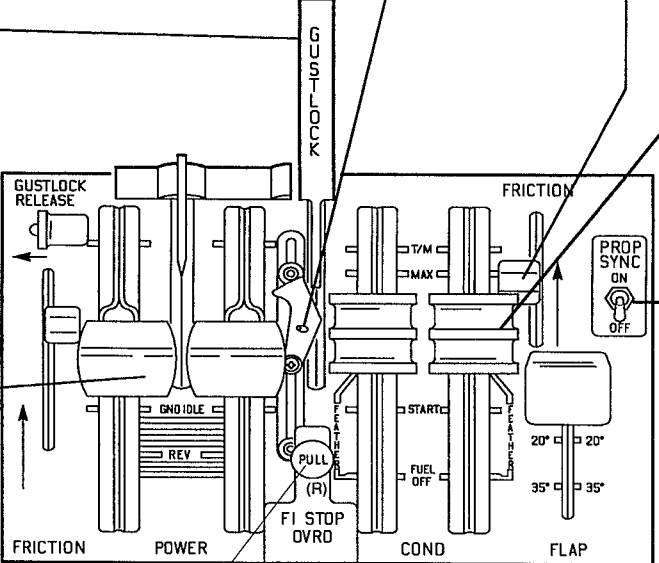
If the latch is lifted and pressed fully up at approximate takeoff power PLA the PL retardation might be hindered by a bracket corner in FI STOP feature.

Friction lock lever (2).

One for PL (left) and one for CL (right). Allows the friction lock for the respective controls to be adjusted to a suitable level.

Power lever stop (only if prop brake installed).

When gust lock is engaged, prevents right PL advancement. The stop is adjustable to meet different propeller brake operation requirements.



FI STOP OVRD Pull knob.

Mechanically overrides the FI STOP.

- DOWN: The FI STOP operates automatically.
- PULLED: The FI STOP is open.

PROP SYNC switch.

Controls the propeller synchro-phaser.

- ON: The propeller will maintain equal RPM and keep the same relative blade position (be phased). Only possible if the RPM of the two propellers is set within 10-15 RPM of each other.
- OFF: The synchro-phaser is off.

Condition lever (CL) (2):

Controls propeller operation and serves as fuel shutoff control.

The following positions are identified on the quadrant

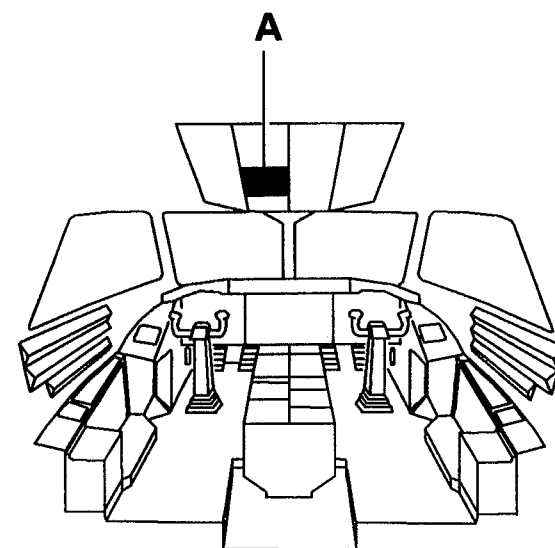
- FUEL OFF: Fuel and ignition to the engine is shut off.
- FEATHER: With CL in this range the propeller is feathered.
- START: Opens the fuel shutoff valve in the HMU and allows ignition to come on when starter is activated. CL must be in START-FUEL OFF range to enable propeller brake to be actuated.
- UNF: Propeller is unfeathered. Propeller speed is controlled by PL. GND IDLE gives approx. 950 PROP RPM.
- MIN-MAX: Range for propeller constant speed operation. MIN = 1150 – RPM; MAX = 1396 RPM. With CL in this range and at low power where governor speed can not be maintained, bottoming governor function will maintain the minimum propeller RPM for normal operation (1040 and above 1200 at max. reverse).
- T/M: Momentarily moving CL into T/M causes the torque motor to be mechanically locked out. On ground the propeller speed must then be manually controlled by the PL. To reset the torque motor, CL must be moved to FUEL OFF.

In T/M position, the fuel vapor vent opens allowing purging of the engine fuel system.

A15898

FIG. 6. Power plant – controls and indicators.

Applicable to a/c with FI STOP (Mod 2558, SB 76-032).



A PROPELLER CONTROL AND ENGINE START PANELS

AUTO COARSEN switch.

Controls power to the auto coarsen computer.

CHIP DETECT caution light (amber) (2).

Comes on to indicate the presence of magnetic particles in the engine oil system. ENGINE (CWP) light and MASTER CAUTION will also come on.

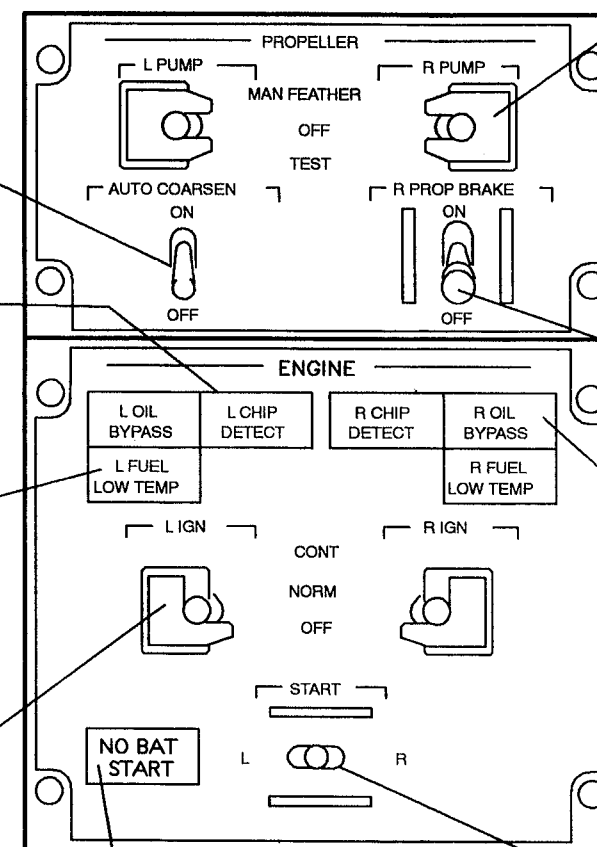
FUEL LOW TEMP caution light (amber) (2).

Comes on if engine fuel temperature becomes too low, indicating a failure of the fuel heater or insufficient PGB oil heat available. ENGINE (CWP) light and MASTER CAUTION will also come on.

Ignition switch (2).

CONT: Continuous ignition is on.
NORM: Power to the ignition system is controlled by engine starting system and the autoignition system. During engine start ignition is on as long as the starter/generator is energized. The autoignition comes on in case of flameout (Ng rate of change schedule) for 7 seconds.

OFF: Ignition if off, allowing dry motor-ing of the engine.



Propeller pump switch (2).

Controls the operation of the feather pump and feather solenoid valve.

MAN FEATHER:

The feather pump will run and the feather solenoid valve will open allowing complete feathering of the propeller.

OFF: The pump is off.

TEST: The feather pump will run but the feather solenoid valve will not open. This function is used for maintenance tests of the propeller pitch control system.

The switch is spring loaded to OFF.

R PROP BRAKE switch.

Controls command power to the right propeller brake.

OIL BYPASS caution light (amber) (2).

Comes on to indicate an impending bypass of the engine oil filter. ENGINE (CWP) light and MASTER CAUTION will also come on.

NO BAT START caution light (amber).

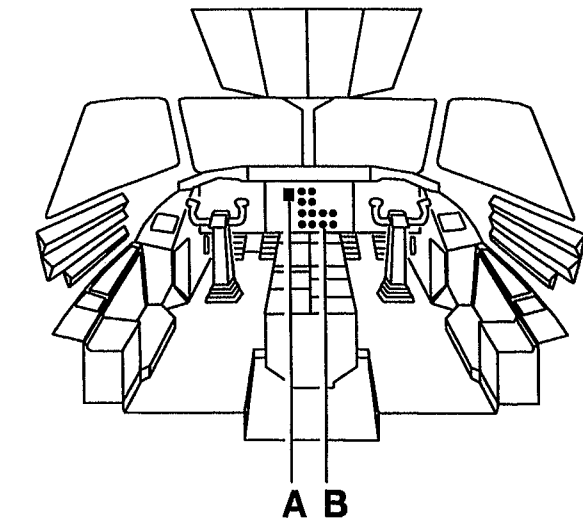
Comes on at battery temp 57°. Observe battery temperature limits.

START switch.

Controls the operation of the starter/generator in its function as starter. The switch is spring-loaded to mid position.

A9903

FIG. 7. Power plant – controls and indicators.



AUTOCOARSEN HIGH light (green).

Comes on when:

- AUTOCOARSEN switch is ON;
- Both PL's > 64 PLA; and
- TRQ on both engines above 50%; and
- P3 pressure on both engines above 120 psi.

Ignition light (white) (2).

Comes on:

- With IGN switch in NORM
 - during engine start;
 - if autoignition is triggered due to flame-out or fast retardation of PL;
 - if electrical control power is lost;
 - if ignition is applied automatically by the DECU in case of power turbine over-speed;
 - during engine overspeed test.

A FLIGHT STATUS PANEL

L BETA	R BETA
L PROP DE-ICE	R PROP DE-ICE
L ENG ANTI-ICE	R ENG ANTI-ICE
L APR	R APR
AUTO COARS HIGH	AUTO COARS LOW
L IGN	R IGN

BETA light (green) (2).

Indicates that the propeller is in the beta mode.

L/R APR light (green).

Comes on:

- PL > 64 PLA.
- CTOT switch set to APR.

AUTOCOARSEN LOW light (green).

Comes on when:

- AUTOCOARSEN switch is ON.
- One or both PL's below 64 degrees PLA; and
- Both Ng above 55%; and
- Both Ne above 60%.

B ENGINE INSTRUMENT PANEL

Engine overtemperature light (red) (2).

Comes on if ITT exceeds 962 +3 °C. -2

Torque indicator (2).

Indicates the torque delivered by the power turbine to the PGB.

Engine RPM indicator (Ng) (2).

Indicates gas generator RPM in percent of max. rated RPM.

Engine oil pressure and temperature indicator (2).

Indicates engine lubrication oil pressure and temperature.

Fuel flow indicator (2).

Indicates fuel flow delivered by the HMU to the engine.

Interstage Turbine Temperature (ITT) Indicator (2).

Indicates the gas temperature between the gas generator turbine and the power turbine. Contains both analog and digital indication. The digital display will show 888 when the LAMP TEST switch is hold to LWR. Above 1000°C the digital start to indicate from zero and up, e.g. 1080 will indicate 080.

Propeller RPM indicator (2).

Indicates power turbine RPM reduced to propeller RPM.

PGB oil pressure and temperature indicator (2).

Indicates PGB lubrication oil pressure and temperature.

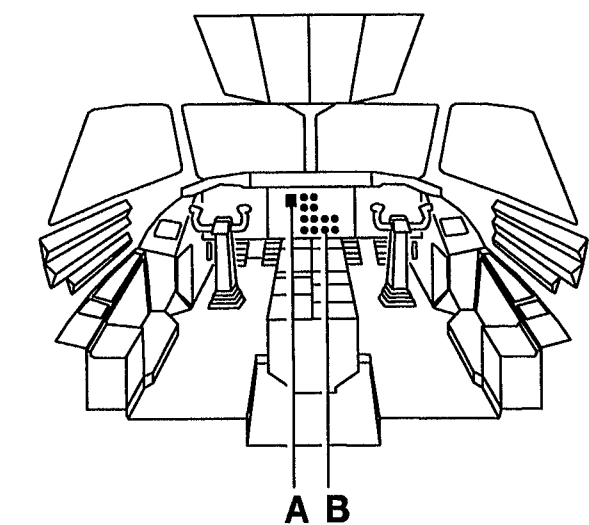
NOTE:

Optional engine instrument panel;
Propeller RPM indicators and Engine oil pressure and temperature indicators swap position.

A9906

FIG. 8. Power plant – controls and indicators.

Applicable to a/c without FI STOP (Mod 2558, SB 76-032).



AUTOCOARSEN HIGH light (green).
Comes on when:
– AUTOCOARSEN switch is ON;
– Both PL's > 64 PLA; and
– TRQ on both engines above 50%; and
– P3 pressure on both engines above 120 psi.

Ignition light (white) (2).
Comes on:
– With IGN switch in NORM
° during engine start;
° if autoignition is triggered due to flame-out or fast retardation of PL;
° if electrical control power is lost;
° if ignition is applied automatically by the DECU in case of power turbine over-speed;
° during engine overspeed test.

A FLIGHT STATUS PANEL

(A) FI STOP OPEN	FI STOP (B)
L BETA	R BETA
L PROP DE-ICE	R PROP DE-ICE
L ENG ANTI-ICE	R ENG ANTI-ICE
L APR	R APR
AUTO COARS HIGH	AUTO COARS LOW
L IGN	R IGN

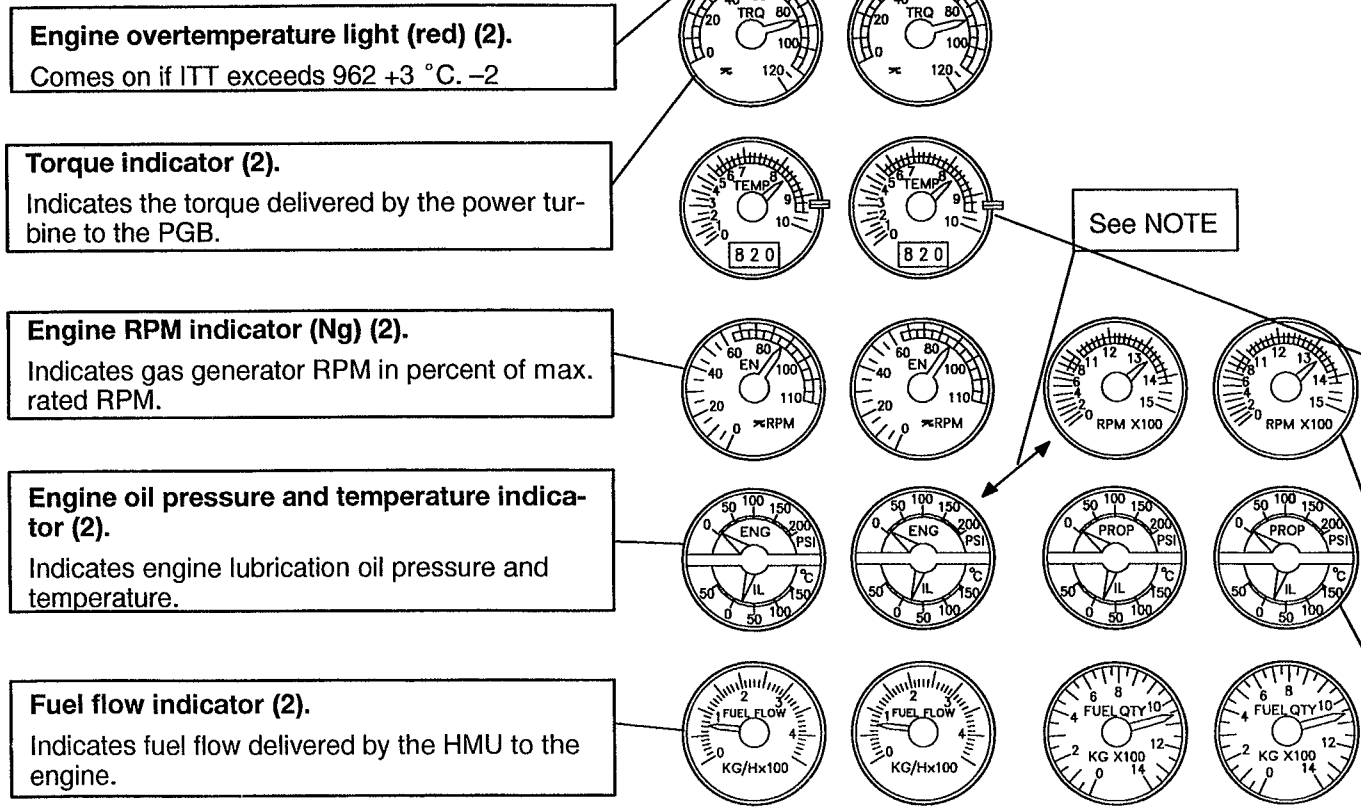
BETA light (green) (2).
Indicates that the propeller is in the beta mode.

L/R APR light (green).
Comes on:
– PL > 64 PLA.
– CTOT switch set to APR.

AUTOCOARSEN LOW light (green).
Comes on when:
– AUTOCOARSEN switch is ON.
– One or both PL's below 64 degrees PLA; and
– Both Ng above 55%; and
– Both Ne above 60%.

FI STOP (B) light.
On – Stop is open.
– Normal indication on ground with electrical power on.
– Airborne with landing gear down if wheel spin >9 kts.
Out – Stop is closed.
– Normal indication airborne with gear retracted.

B ENGINE INSTRUMENT PANEL



FI STOP OPEN (A) and gear not down.
On – Stop is open and locked. This indicates an abnormal situation. The light will remain on even after the gear is down and locked and goes out only after a/c is electrically powered down.
– Will come on in case of failure of the stop to close after takeoff when the gear is retracted or in case of activation of the emergency override pull knob before the landing gear is extended.

Interstage Turbine Temperature (ITT) Indicator (2).
Indicates the gas temperature between the gas generator turbine and the power turbine. Contains both analog and digital indication. The digital display will show 888 when the LAMP TEST switch is hold to LWR. Above 1000°C the digital start to indicate from zero and up, e.g. 1080 will indicate 080.

Propeller RPM indicator (2).
Indicates power turbine RPM reduced to propeller RPM.

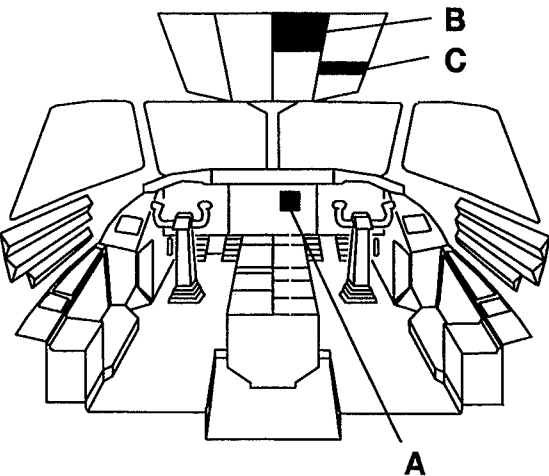
PGB oil pressure and temperature indicator (2).
Indicates PGB lubrication oil pressure and temperature.

NOTE: — — — — —
Optional engine instrument panel;
Propeller RPM indicators and Engine oil pressure and temperature indicators swap position.

A15991

FIG. 8. Power plant – controls and indicators.

Applicable to a/c with FI STOP (Mod 2558, SB 76-032).



A CENTRAL WARNING PANEL

PROP BRAKE warning light (red).

Will come on to indicate a failure in the propeller brake system.

AUTO COARSEN caution light (amber).

Comes on to indicate a failure in the auto-coarsen computer.

FUEL caution light (amber).

Comes on if an amber fuel caution light comes on in overhead fuel panel, except for XFEED,ON and CONN VLV OPEN lights.

ENGINE caution light (amber).

Comes on together with L or R FUEL LOW TEMP, L or R OIL BYPASS and L or R CHIP DETECT lights.

ENG OIL PRESS warning light (red) (2).

Comes on if:

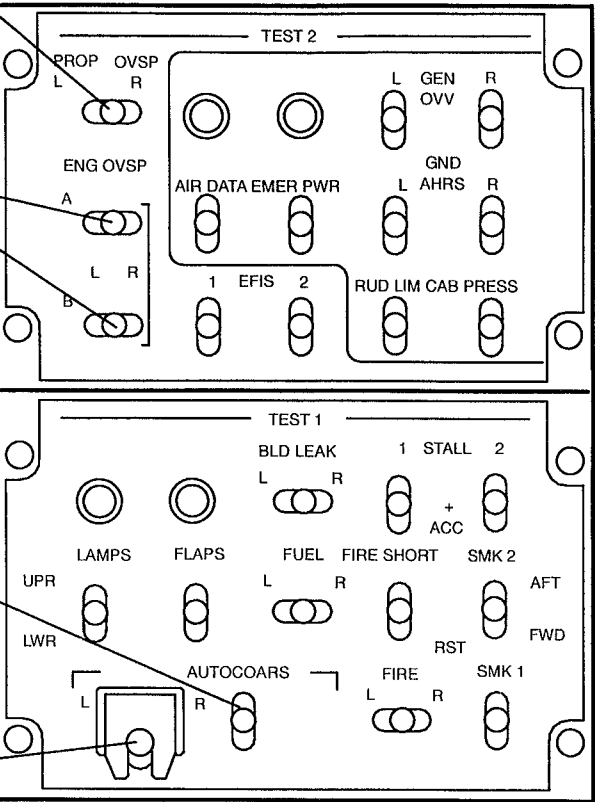
- Engine oil pressure is below 30 psi;
- PGB oil pressure is below 25 psi (PL > FLT IDLE);
- PGB oil pressure is below 7 psi on ground (PL < FLT IDLE).

	A	B	C	D	
1	L ENG FIRE	AVIONIC SMOKE	LAV SMOKE	R ENG FIRE	1
2	L ENG OILPRESS	CARGO SMOKE	CABIN PRESS	R ENG OILPRESS	2
3	L TAIL P HOT	PROP BRAKE		R TAIL P HOT	3
4		AUTO TRIM	CONFIG		4
5	AUTO COARSEN		PITCH TRIM	RUDDER LIMIT	5
6	L FIRE DET FAIL	FUEL	ELEC	R FIRE DET FAIL	6
7	ICE PROT	ENGINE	FLAPS	AIR COND	7
8	PARK BRK ON	HYDR	EMER LTS UN ARMED	OXYGEN	8
9	A-SKID INOP	AVIONICS	AVIONICS VENT	DOORS	9
10	L STALL FAIL	GUST LOCK	PUSHER SYSTEM	R STALL FAIL	10

PROP OVSP test switch.

For test procedure see AMM.

B TEST PANELS



ENG OVSPD test switches (A and B).

For test procedure see AMM.

AUTO COARS test switch.

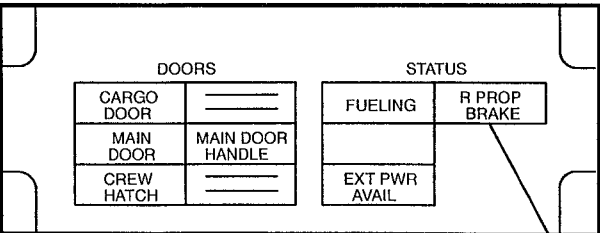
Tests the auto coarsen computer circuits. The system must be on to allow a test. For test procedure see AMM.

For test procedure see AMM.

AUTOCOARS LOW test switch.

Tests the autocoarsen LOW MODE. For test procedure see AMM.

C GROUND STATUS PANEL



R Prop brake light (green).

Indicates that the propeller brake is engaged.

The light comes on when the R PROP BRK switch is selected to ON and Power is applied to the brake ON – solenoid.

FIG. 9. Power plant – controls and indicators.

Pull back to MIN, then lift and pull back into FUEL OFF detent.



Nov 30/96



There are two versions of CL-quadrant, easiest recognized by one version having the upper gate at MAX position removed.

CL manipulations:

FUEL OFF to START

Lift up—forward, then push down—forward into START detent.

START to MIN:

Lift up—forward to upper gate, then release into MIN position.

MIN-MAX range:

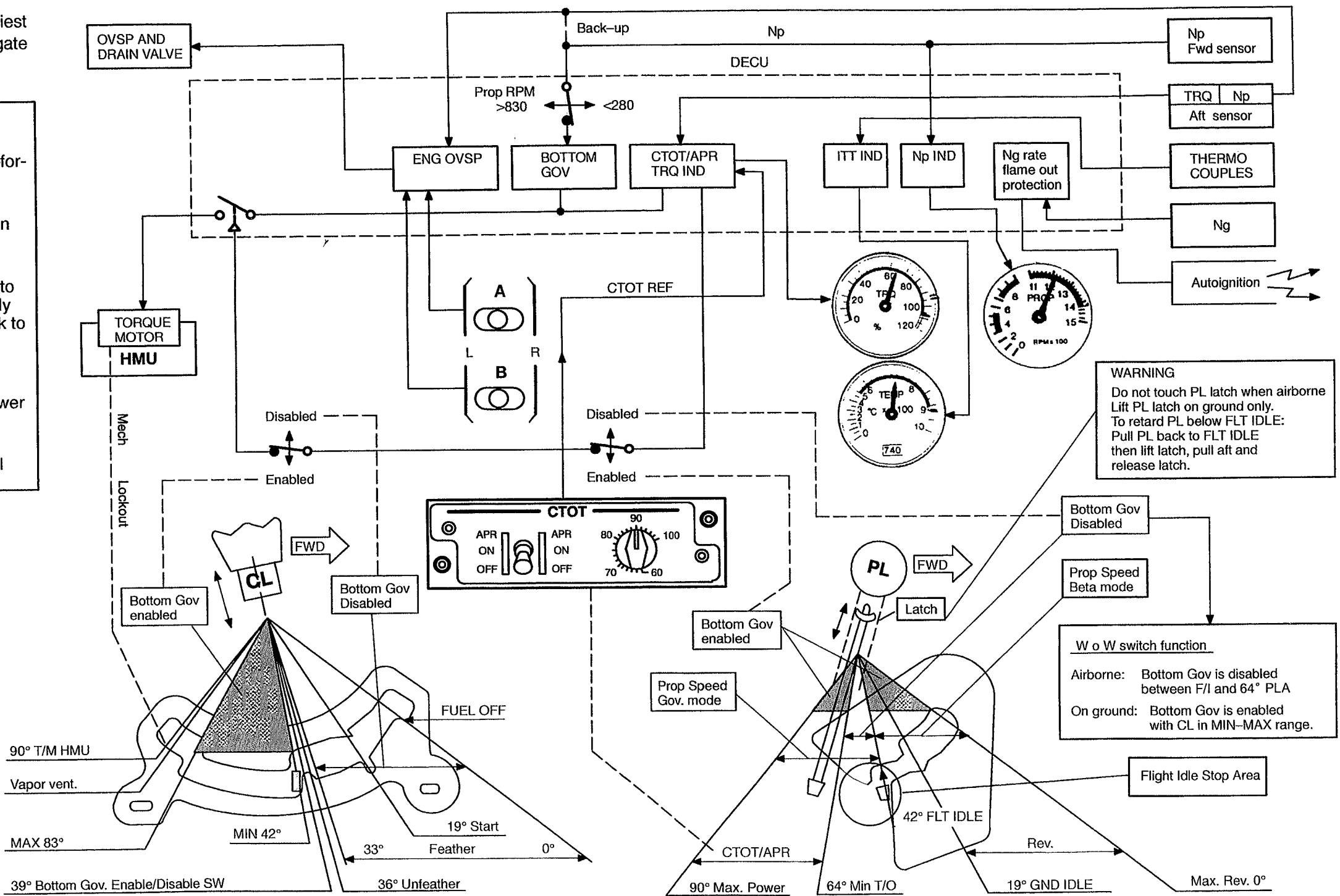
Push and Pull. T/M lockout: Push to MAX. Then lift up and momentarily push hard into T/M, then pull back to approx. half between MAX-MIN, then set desired PRPM.

START to UNF:

Lift and push down–forward to lower gate at UNF.

MIN-MAX to FUEL OFF:

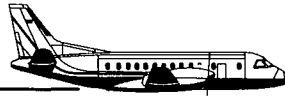
Pull back to MIN, then lift and pull back into FUEL OFF detent.



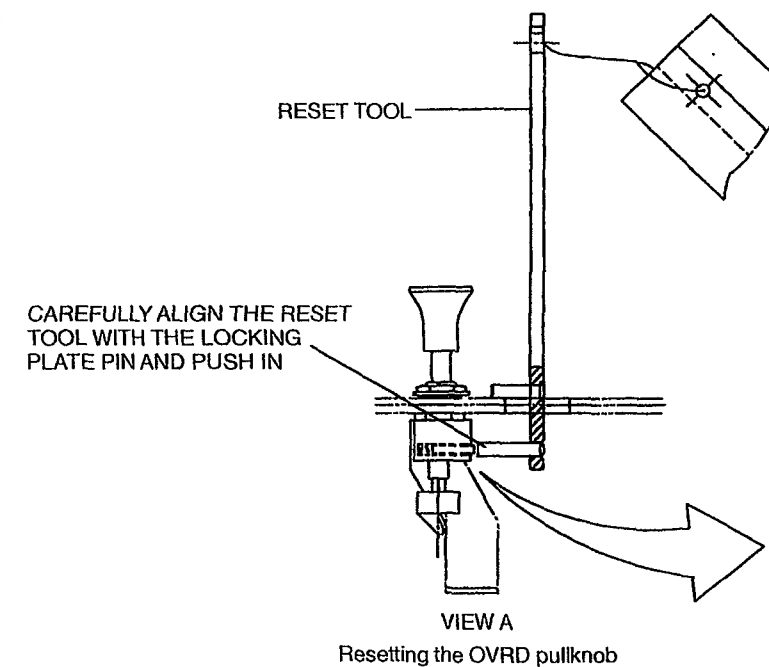
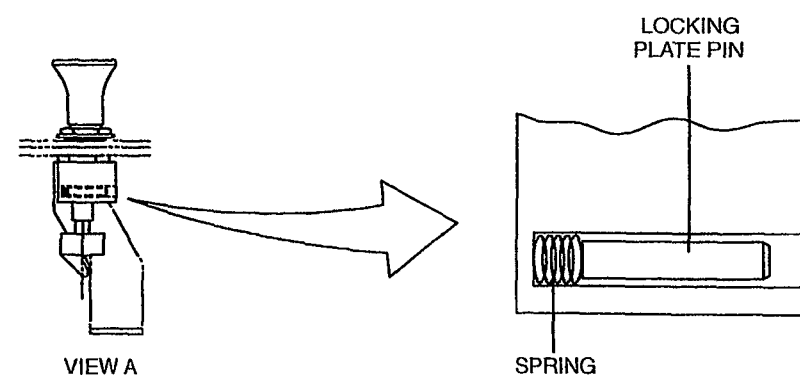
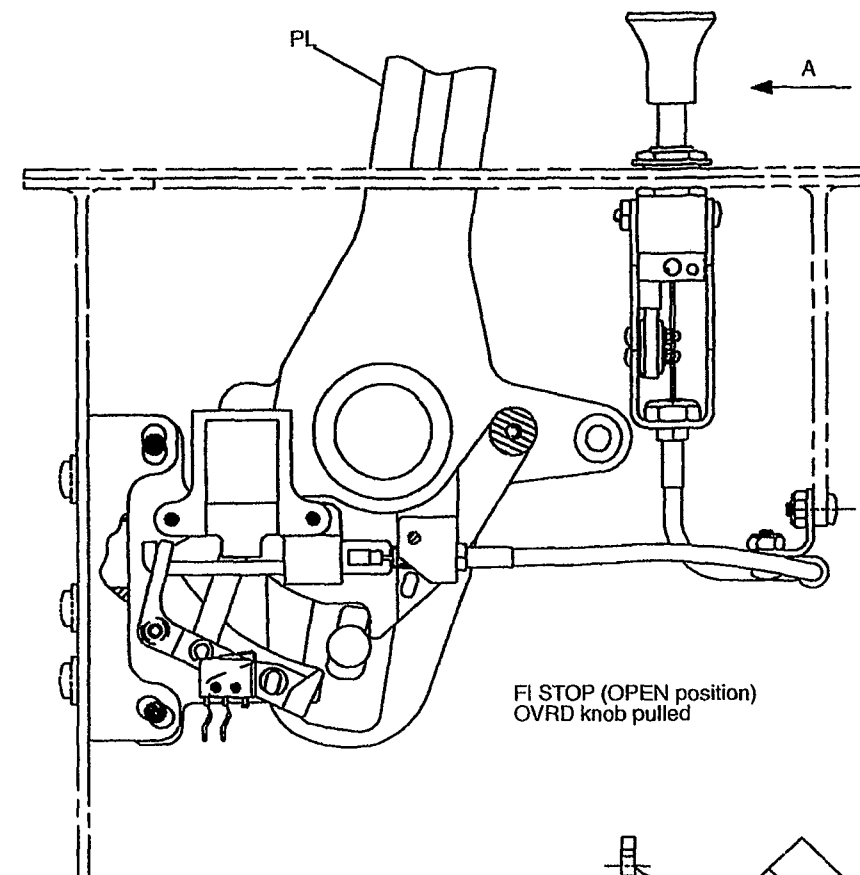
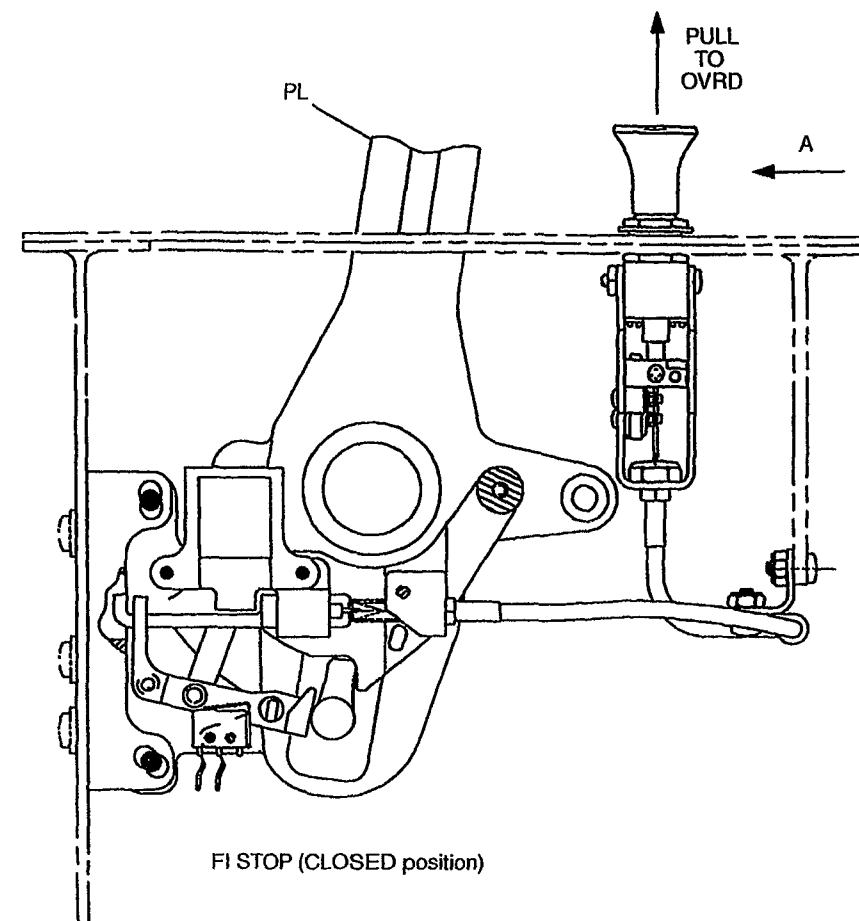
SHOWN: CL at MIN, PL above min T/O power position, Bottom. Gov. enabled, CTOT OFF.

FIG. 10. Power plant – controls and indicators.

Applicable to a/c with FI STOP (Mod 2558, SB 76-032).



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A15880

FIG. 11. Power plant – controls and indicators.

Applicable to a/c with FI STOP (Mod 2558, SB 76-032).



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4. ELECTRICAL POWER SUPPLY.

Engine starting.

GCU L eng	L BAT BUS	J-4	L GCU
GCU R eng	R BAT BUS	R-2	R GCU
Control L eng (NORM ignition)	L EMG BUS	J-3	CTL L
Control R eng (NORM ignition)	R EMG BUS	R-1	CTL R
Auto ignition L eng	L BAT BUS	J-19	AUTO-IGN L CTL
Auto ignition R eng	R BAT BUS	R-18	AUTO-IGN R CTL

Indications.

Engine speed (Ng) L eng	L BAT BUS	J-9	L ENG SPEED
Engine speed (Ng) R eng	R BAT BUS	R-7	R ENG SPEED
Engine temp (ITT) L eng	L BAT BUS	J-6	L TEMP
Engine temp (ITT) R eng	R BAT BUS	R-4	R TEMP
Engine torque L eng	L BAT BUS	J-7	L TRQ
Engine torque R eng	R BAT BUS	R-5	R TRQ
Engine oil temp & press L eng	L BAT BUS	J-12	L ENG OIL T&P
Engine oil temp & press R eng	R BAT BUS	R-11	R ENG OIL T&P
Fuel flow L eng	L BAT BUS	J-10	L FUEL FLOW
Fuel flow R eng	R BAT BUS	R-8	R FUEL FLOW
Fuel used L & R	R BAT BUS	R-9	L + R F-USED
Prop speed L eng	L ESS BUS	J-8	L PROP SPEED
Prop speed R eng	R ESS BUS	R-6	R PROP SPEED
Prop oil temp & press L eng	L BAT BUS	J-11	L PROP OIL T&P
Prop oil temp & press R eng	R BAT BUS	R-10	R PROP OIL T&P
BETA L eng	L ESS BUS	K-17	L BETA
BETA R eng	R ESS BUS	S-16	R BETA
Ignition	R BAT BUS	R-19	AUTO-IGN L+R IND
APR light L	L BAT BUS	J-20	L PL MIN T/O
APR light R	R BAT BUS	R-20	R PL MIN T/O
FI STOP	R BAT BUS	-	ENG-PWR LVR-FI STOP
FI STOP OPEN	R BAT BUS	-	ENG-PWR LVR-FI STOP

Engine control.

DECU L eng	L eng elec sys.	No CB	
DECU R eng	R eng elec sys.	No CB	
Constant torque L eng	L BAT BUS	J-20	L PL MIN T/O
Constant torque R eng	R BAT BUS	R-20	R PL MIN T/O

Propeller control.

Feather pump L eng	L ESS BUS	K-18	L PUMP
Feather pump R eng	R ESS BUS	S-17	R PUMP
Feather solenoid L eng	L ESS BUS	K-19	L COARS
Feather solenoid R eng	R ESS BUS	S-18	R COARS

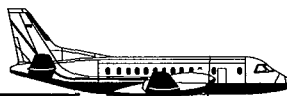
SAAB 340 B

Aircraft Operations Manual



CT7-9B
POWER PLANT
Description

Auto coarsen computer	L ESS BUS	K-20	AUTO COARSEN
Prop overspeed test	L ESS BUS	K-15	PROP OVSP TEST
Propeller synchrophasing	L MAIN BUS	K-16	PROP SYNC
R propeller brake	R BAT BUS	S-19	R P-BRK
Autocoarsen HIGH/LOW ind	L ESS BUS	K-20	AUTO COARSEN
FI STOP solenoid	R BAT BUS	-	ENG-PWR LVR-FI STOP



NOTE

MAX Continuous Power.

Is provided for one engine operation and if required, for two engine operation in extreme icing conditions. It is NOT intended for use during normal icing conditions, climb expedites from ATC etc.

However, the statement above should not prevent the pilot from using the power deemed required in an emergency or abnormal situation or from using the power required to prevent such a situation from developing. The AOM power setting charts for Max. Takeoff/Climb/Cruise contain the maximum torque to be used for normal operations.

1. 1. POWER RATINGS.

	Unit	Min	Normal	Max
– T/O power (flat rated to +35°C)	SHP	–	1750	–
° Incl. exhaust thrust	ESHP	–	1815	–
– T/O power + APR (flat rated to +35°C)	SHP	–	1870	–
° Incl. exhaust thrust	ESHP	–	1935	–
– Max continuous (flat rated to +34°C)	SHP	–	1750	–
° Incl. exhaust thrust	ESHP	–	1810	–

1. 2. POWER PLANT OPERATING LIMITS.

Power rating time limits.

– Takeoff	min	–	–	5
– Max continuous	min	–	–	No limit

RPM.

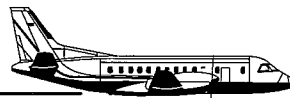
– Overspeed.				
° Ng (max 12 sec)	%	–	–	105
° Ng overspeed (HMU fuel shutoff)	%	–	110	–
° Np (max 12 sec)	Prop RPM	–	–	1572
° Np overspeed protection	Prop RPM	1558	1573	1588

NOTE

- Prop RPM up to 1396 is allowed with CL in MAX. However, the Prop RPM shall be reduced to max 1384 by CL adjustment.
- Prop RPM above 1396 indicates a propeller control system anomaly, although Prop RPM up to 1456 is allowed up to one hour at up to Max Continuous Power.

° Prop overspeed governor	Prop RPM	1450	1453	1456
– Takeoff.				
° Ng	%	–	–	101.3 (+APR 102)
° Np	Prop RPM	–	1384	1396

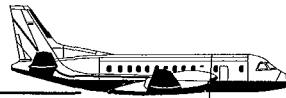
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(Cont'd)

	<u>Unit</u>	<u>Min</u>	<u>Normal</u>	<u>Max</u>
– Max continuous.				
° Ng	%	–	–	102
° Np	Prop RPM	–	1384	1396
– Min Np normal ground operation				
° Bottoming governor	Prop RPM	–	1040	–
° Bottoming governor during max reverse	Prop RPM	–	1205	–
– Avoid steady state PROP RPM in the ranges (except for required checks):				
° 350 – 500				
° 625 – 950				
° 1070 – 1220 (<i>Applicable for Dowty Propeller only</i>)				
– Continuous operation of the propeller on the ground between 1070 and 1220 PRPM more than needed for normal taxiing is to be avoided.				
– Ground idle Ng	%	65	70	75
– Motoring Ng	%	20	–	–
Temperature (ITT).				
– Starting transient if Ng accelerates normally to ground idle	°C	–	–	965
– Acceleration above ground idle (except takeoff) (max 12 sec)	°C	–	–	965
– Takeoff (max 5 min)	°C	–	–	917 (+APR 940)
– Takeoff (max 2 min)	°C	–	–	927 (+APR 950)
– Max continuous	°C	–	–	940
– Propeller brake operation	°C	–	–	895
Torque.				
– Takeoff (max 5 min)	%	–	–	100 (+APR107)
– Transient overshoot, except takeoff (max 12 sec)	%	–	–	112
– Max continuous (OEI)	%	–	–	100
– Tolerance to selected CTOT value	%	–	–	±2
– Max. diff. between indications with CTOT selected ON	%	–	–	3

(Cont'd)



(Cont'd)

	Unit	Min	Normal	Max
– Fluctuations (Delta torque)	%	–	–	± 1
– Fluctuations at Ng = 2 Np (Delta torque)	%	–	–	± 3

FUEL SYSTEM.

Fuel temperature – – 40°C – +43°C

NOTE

For Jet-B and JP4, max fuel temperature is + 18°C.

Fuel unbalance lbs – – 200

NOTE

XFEED/CONN VALVE switches shall be OFF resp. CLOSED during take-off and landing in normal operation.

OIL SYSTEM.

NOTE

For operators where flight crew members are also responsible for checking engine and propeller gear box oil fluid levels, there should be an established procedure which allows both technicians and flight crews to monitor oil CONSUMPTION RATES.

Engine oil consumption limit (Maximum).

133 cc/hr (1 quart/7 hrs; 1 liter/7.5 hrs)

(hrs = blocktime)

Two (2) quarts may be added to bring the oil quantity level on the sight gauge from ADD to FULL. Wait a minimum of 10 minutes after engine shutdown to allow oil to drain back into the tank before checking the oil tank level indicator.

PGB Oil consumption limit (Maximum).

35 cc/hr (1 quart/27 hrs; 1 liter/29 hrs)

(hrs = blocktime)

One (1) quart may be added to bring the oil quantity level on the sight gauge from ADD to FULL. Wait a minimum of 3 minutes after engine shutdown to allow oil to drain from the lines before checking the oil tank level indicator.

(Cont'd)



(Cont'd)

CAUTION

Do not operate the engine if any of the oil consumption limits are exceeded.

	Unit	Min	Normal	Max
Engine oil pressure				
On ground with PL above GND IDLE	psi	30	—	100
On ground at GND IDLE	psi	20	—	100
Airborne	psi	30	—	100
Restricted to engine starting and initial ground idle operation with extremely cold oil	psi	—	—	200
— Oil pressure warning	psi	28	30	32
— Oil pressure fluctuations	psi	—	—	± 5
Engine oil temperature (excl. starting)				
° Normal operation	°C	35	—	122
° Max 15 minutes	°C	—	—	132

PGB Oil Pressure

Operation Allowed

0 — 5 psi	— No steady-state operation
5 — 25 psi	— No operation above ground idle
25 — 140 psi	— All operations (normal pressure).
140 — 225 psi	— No operation above ground idle.

NOTE

Oil pressure warning can be triggered after start with the propeller in feather due to tolerances in warning pressure level. If the warning goes out when the CL is moved to UNF, the warning can be disregarded. Do not operate prolonged time with the propeller in feather and the warning displayed.

Oil pressure warning

° (PL < FLT IDLE)	psi	5	7	9
° (PL > FLT IDLE)	psi	23	25	27
— Oil pressure fluctuation (25 — 45 psi)	psi	—	—	± 5
(46 — 140 psi)	psi	—	—	± 10
PGB Oil temperature	°C	45	—	77

- Minimum oil temp. 25°C for ground operations, and after take off for maximum 5 minutes.
- Maximum oil temp. 93°C for maximum 15 minutes.

(Cont'd)



(Cont'd)

APPROVED TYPE OF OIL (ENGINE AND PGB).

- Type I oil
 - ° BP Turbo oil 2389
 - ° Exxon Turbo oil 2389
 - ° Castrol 325
- Type II oil
 - ° Aero Shell Turbine oil 500
 - ° BP Turbo oil 2380
 - ° Exxon Turbo oil 2380
 - ° Castrol 205
 - ° Mobil Jet II
 - ° Stauffer Jet II

CAUTION

Minimum oil temperature for engine start with type I oil is -54°C and type II oil is -40°C.

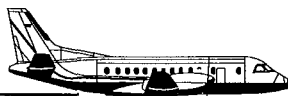
NOTE

Mixing of type I and II oils is allowed but not recommended.

STARTER/GENERATOR (S/G) DUTY CYCLE LIMITS.

- Two start attempts (including dry motoring) with 3 minutes cooling in between, then a 25 minute cooling period. Maximum time with engaged starter is 70 seconds of which max 30 seconds dry motoring.
- The S/G is heat sensitive to repeated and prolonged engagements.
- If there are repeated engagements, there should be a cool down period in between.
As an example, a cross-over start (also called cross-generator start) requires a one minute cooling time after completing the first engine start (first engine generator on-line) prior to performing a cross-over start of the second engine.

(Cont'd)



(Cont'd)

MISCELLANEOUS LIMITATIONS.**WARNING**

Moving PL below FLT IDLE position is prohibited when airborne.

See also 17.1 page 19/20

- When airborne, grip the PL knobs only, thereby eliminating PL movement to below FLT IDLE.

1. 3. PROPELLER BRAKE LIMITATIONS.

- Minimum OAT when visible moisture is present is +3° C.
 - Max. tailwind component with propeller brake engaged is 18 kts.
 - Minimum time between brake actuations is 10 minutes.
 - Max steady-state ITT 895°
 - Engine operation with propeller braked requires a qualified person in the co-pilot seat.
 - Do not exceed max. allowable ENG RPM, as per TABLE 1 during propeller brake operation.
 - First brake application of the day must be with the engine running. The propeller must stop rotating within 5 seconds. This is to check the conditions of the brake.
- Applicable to a/c without SB 61-028, Mod 2066 (Propeller-Prop Brake slippage due to PGB oil leakage).

CAUTION

Assure all personnel remain clear of the exhaust and propeller areas.

(Cont'd)



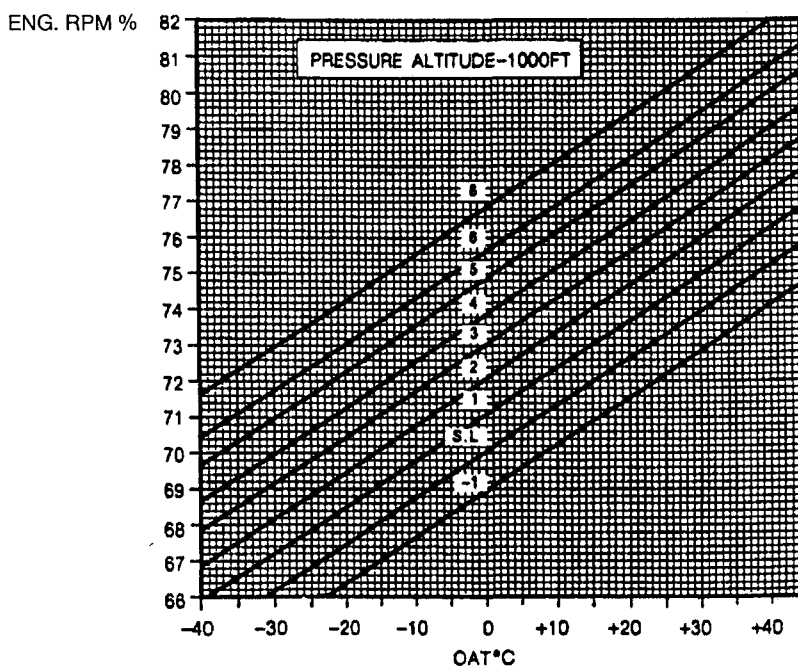
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NOTE

Use the official reported temperature to below table.

TABLE 1.

Max. allowable N_g during propeller
brake operation.



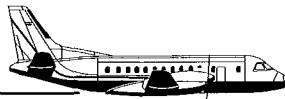
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2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 0. GENERAL.	<div style="border: 1px dashed black; padding: 10px;"> <p>"Hints for longer engine life" and "FOD-prevention" are procedures to minimize maintenance expenditures. The procedures are recommended to reduce engine temperature and to avoid FOD (Foreign Object Damage) to engines and propellers during ground operations. However, the procedures must be adopted with full safety consideration. Nothing herein should prevent the pilot from applying maximum forward and reverse thrust for safety reason. Nothing herein should prevent the pilot from taxiing at a safe speed. The procedures might deviate from operators standard operating procedures and must therefore be adapted in a way that required test- and checkitems before takeoff and after landing are performed.</p> </div> <p>Operation in gravel areas and on FOD surfaces is not recommended. Request through appropriate authorities that the ramp, taxiway and runway be cleared. Get rid of stones, pebbles and dirt. Remain on clean surfaces for all ground operations. However, if operation on FOD surfaces can not be avoided, following the "FOD-prevention" procedures will minimize possible damage.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>CAUTION</p> <p>Do not taxi using reverse power rather than aircraft brakes. FOD engine ingestion may result.</p> </div> <p>Although mentioned in section ICE AND RAIN PROTECTION, the extreme importance of switching on engine anti-ice well in advance of entering icing conditions to prevent FOD, can not be over-emphasized.</p> <p>To emphasize the importance of keeping a low ITT, some of the normal procedures are also highlighted in "Hints for longer engine life".</p>
2. 1. ENGINE START-ING PROCEDURE. (See also 3.2. MOTORING/ COMBINED MOTORING AND START PROCEDURE).	<p>Hints for longer engine life.</p> <ul style="list-style-type: none"> - If possible, avoid tailwind starts. Starting engine in a strong tailwind may cause a HOT start. If strong tailwind and it is operationally feasible, perform motoring start on one engine, then taxi into the wind and then start the other engine. - Operate the engines with as low ITT as feasible with due consideration to safety and passenger comfort. - Start engines with HP-bleed switches in off position. - Bleed air, especially HP-bleed will have considerable impact on ITT. HP-bleed may be necessary to operate boot de-ice system or for cabin comfort in hot or cold climate. Use HP-bleed only when required. Turn HP-bleed off when requirements have been satisfied. When using HP-bleed use TABLE 1 (17.2 page 7) as a guide for initial setting of Ng to obtain a low ITT. Minor Ng adjustments may decrease ITT further. For propeller brake operation, TABLE 1 gives the maximum allowable Ng.

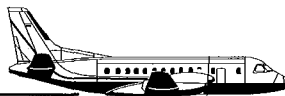
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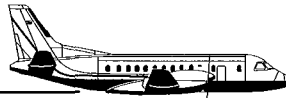
CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<p>FOD-prevention.</p> <ul style="list-style-type: none"> – Pick up loose objects on the ramp. – Keep running propellers over hard, clean surfaces. If this is not possible, consider either: <ul style="list-style-type: none"> a) Start-up and taxi out on one (most suitable) engine; b) Start-up both engines. Leave one CL in START (feathered) position and taxi out on one (most suitable) engine. <p>Prevention of sub-idle overtemperature.</p> <p>There is a potential possibility for sub-idle overtemperature when placing electrical or bleed air loads on an engine running at ground idle speed.</p> <p>After engine start the Ng must always be maintained at or above the idle speed observed when the engine was initially started.</p> <p>Increasing the Ng 2–3%, whenever possible, especially during tailwind conditions, prior to placing electrical or bleed air loads on the engine will greatly reduce the potential of a sub-idle event.</p> <p>Low compressor efficiency, bleed air extraction (LP/HP), and electrical loads on the accessory drive, in combination, may cause Ng to be reduced to a speed where the gas generator is no longer able to sustain operation.</p> <p>This situation may result in a rapid decay of Ng and Np, a rapid rise in ITT, and can cause extension damage to the engine, if the crew fails to immediately shut down the engine by placing the condition lever to FUEL OFF.</p> <p>Electrical system damage prevention.</p> <p>If during a "Motoring" start the IGN switch is set to NORM and the CL is advanced to START at about the same time with the IGN switch leading the CL movement, the start signal to the start relay will be interrupted momentarily similar to a poor ground power unit. The flight crew will not see the interruption in the cockpit displays. This causes the start relay to begin coming open and then go closed again resulting in nothing more than loss of contact pressure causing burning of the contacts (damage of the PDUs). To prevent this from happening, the flight crew should verify that the CL is in the START position before setting the IGN switch to NORM. At no time should the CL be moved below the START detent unless the start is being terminated or the engine is being shut down using published procedures.</p> <p>Preparations.</p> <ul style="list-style-type: none"> – Electrical power CHKD AND ON <ul style="list-style-type: none"> ° L/R BAT sws ON. BAT requirement Min 24V. ° EXT PWR sw ON or OFF as applicable. – BUS TIE CONN green light CHKD ON <ul style="list-style-type: none"> ° It is essential to check the BUS TIE-function. BUS TIE light must be on before all engine starts. – HP VALVE sws CLOSED
(Cont'd)	



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<ul style="list-style-type: none"> – BLD VALVE sws RESET/AUTO <ul style="list-style-type: none"> ° To facilitate engine acceleration. – Engine instruments CHECK NORMAL <ul style="list-style-type: none"> ° If ITT is above 175, motor engine to below 175. – Propeller area CHECK CLEAR – L/R AVION sws OFF – Must be in OFF position during engine start, on ground only. <p>Starting. Starting methods and designations:</p> <ul style="list-style-type: none"> – "Motoring Start": Start initiated by dry motoring of engine. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>Motoring Start is the recommended procedure for all engine starts on ground due to;</p> <ul style="list-style-type: none"> – High airflow during initial start and thereby leaner fuel to air ratio and improved fuel burn. </div> <ul style="list-style-type: none"> – "Direct Start": Start without motoring. <p>Both starting methods can be performed by use of different power sources – hence:</p> <ul style="list-style-type: none"> – "Battery Start": Start on batteries only. – "Cross-over Start": Start on batteries and one generator – "EXT PWR Start": Start on external power. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>EXT PWR requirement is 1400 Amp minimum and 1600 Amp maximum. If EXT PWR <1400 Amp it is recommended to perform Battery and Cross-over starts to facilitate engine acceleration.</p> <p>Repeated Battery Starts may bring the Battery Temperature above limits. This is especially pronounced in hot weather operation if short times between starts. (The Battery Temperature increases approx. 10–15 degrees every Battery Start). Therefore, check Battery Temperature now and then, and when required, perform an EXT PWR Start.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>During battery start there might be nuisance Fuel Flow fluctuations due to voltage variations. To avoid these fluctuations, for the engine being started, it is recommended to perform a Battery Start on the RH engine and thereafter a Crossover Start on the LH engine.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>During starting at sub-idle engine speeds and after shutdown, nuisance fuel flow indications up to 900 lb/h (400 kg/h) may be observed with the CL at FUEL OFF. Since there is no evidence of actual fuel flow (ITT indication) this situation is considered to an indication error only and does not affect the operability of the engine.</p> </div>
(Cont'd)	



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<p>The engine start shall be aborted for any of the following conditions:</p> <ul style="list-style-type: none"> – Ng does not start to increase at starter activation – If Ng ceases to accelerate before reaching ground idle – No light-up (ITT rise) indication within 20 seconds from initial Ng indication – If ITT rapidly approaches or exceeds 965°C – No positive ENG OIL or PROP OIL pressure indication after ground idle – No PROP OIL pressure indication at stable ground idle PROP RPM <p>Abort start by returning the CL to FUEL OFF, turn OFF ignition and motor engine to below ITT 175°C. If start is aborted before light-up (no ITT rise), motor for at least 10 seconds to purge fuel from combustor and turbine.</p> <ul style="list-style-type: none"> – NO BAT START light; <ul style="list-style-type: none"> ° Battery Start – light must be off; ° Cross-over Start – light might be on. Check L/R BAT temp max 60°C; ° If light comes on during start, continue the start; ° If light is on after engine start, check L/R BAT temp max. 64°C before takeoff. – PL to GND IDLE – CL in FUEL OFF and Check: <ul style="list-style-type: none"> Bus Tie green light ON L/R Avion switches OFF Stby Press Light (ON or OFF) IGN switches OFF NO BAT START light <p>Motoring Start.</p> <ul style="list-style-type: none"> – START sw (L/R). Check Ng to stabilize (approx. Ng 20%) and ITT below 175°C, then; <ul style="list-style-type: none"> ° Move CL to START, then after 1 sec (but within 2 secs.); ° IGN switch to NORM while holding START switch; ° Hold the START switch until light up which should occur a few seconds after IGN sw is set to NORM. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>NOTE</p> <p>It is essential that CL is moved to START before IGN sw is set to NORM. This is to prevent damage to the PDU starter relay.</p> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>NOTE</p> <p>Turn IGN switch to NORM not earlier than 1 seconds but within 2 seconds after CL is moved to START. If not, retard CL to FUEL OFF.</p> </div> <p>Direct Start.</p> <p>A direct start is accomplished by advancing the CL to START and then activating the START sw (L/R) for 2 seconds.</p> <p>Check of power plant parameters during acceleration to ground idle.</p> <ul style="list-style-type: none"> – Ng, Light-up, ITT, Oil press, propeller rotation and S/G cut-out. <p>There might not be PROP RPM instrument indication at low propeller speed (CL in START). The uncertainty is due to low Np sensor output signals.</p>
(Cont'd)	



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<p>Fuel Flow indication may be delayed during start sequence due to transmitter tolerances at low fuel flow rates.</p> <p>The increase in Ng might be slow. However, as long as Ng increases and ITT does not exceed 965°C the start attempt can continue. Watch Ng carefully. If any tendency of Ng to stop accelerating, abort the start immediately.</p> <p>NOTE</p> <div style="border: 1px solid black; padding: 5px;"> <p>Cold weather operation.</p> <p>Engine OIL BYPASS light may be on due to high oil viscosity if oil temperature increases. The FUEL LOW TEMP light may be on if the fuel is cold. Light shall go off as temperature is below 0°C. The light will remain on until the PROP OIL temperature has increased enough to heat the fuel. It is normal with high engine oil pressure during initial start when oil is cold. Run engine at Ground Idle until oil pressure is within limits. Engine oil pressure should return to 30–100 psi after approx. 5 minutes but longer time may be required depending on engine and oil temperature before start.</p> <p>The propeller oil pressure will take longer time to attain normal operating range. As soon as both engine and prop oil pressure are within limits the PL can be advanced as long as prop oil pressure remains within normal operating range. Setting higher power thereby shortens the time to get engine and propeller oil temperatures within limits.</p> </div> <ul style="list-style-type: none"> – Check Ng to stabilize at ground idle, then: – Check BUS TIE CONN light is on. <ul style="list-style-type: none"> ° It is essential to check BUS TIE and S/G cut-out functions. ° After an engine start (irrespective of starting method). ° Check light to come on before turning on the generator or if EXT PWR start before EXT PWR switch is set to OFF. ° If light does not come on, check L/R BAT voltage. If voltage below 20 V, immediately turn BAT switches to OFF and shut down engine(s). If voltage above 20 V, press release button K-1. If light then does not come on, call maintenance. <p>NOTE</p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> – Voltage below 20 V indicates a short circuit. – If voltage above 20 V and BUS TIE light not coming on after a reset attempt (K-1) indicates either a BUS TIE relay, PDU or a S/G cut-out failure </div> <ul style="list-style-type: none"> – Turn on the generator. <ul style="list-style-type: none"> ° It may take 15 seconds before the generator is on line. Check voltage to be minimum 27,5 V before flight. – Turn on L/R AVION. <ul style="list-style-type: none"> ° Normally, during EXT PWR start, AHRS initialization is completed before first engine start, then leave switches in OFF until second engine has been started.
(Cont'd)	



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<ul style="list-style-type: none"> ° If battery start followed by cross-over start, turn switches ON after first generator is on line, wait for initialization (approx. 70 secs) then turn OFF before second engine start. – Check ENGINE and FUEL panels. ° Check all indicating lights in ENGINE and FUEL overhead panels to be out. – If required, turn engine anti-ice on.
2. 2. PROPELLER BRAKE OPERATION.	<p>Hints for longer engine life.</p> <ul style="list-style-type: none"> – Bleed air, especially HP-bleed, will have considerable impact on ITT. Use HP-bleed only when required. Turn HP-bleed off when requirements have been satisfied. When using HP-bleed, set Ng according to TABLE 1, 17.2 page 6 or PL stop, whichever is lowest. – Open the X VALVE only when required. <div style="border: 1px solid black; padding: 5px;"> <p>CAUTION</p> <p>After the propeller brake has been released, operate the engine for two minutes with CL in START and PL in GND IDLE prior to increasing PROP RPM or engine shut down. This is required in order to stabilize the power turbine temperature. The temperature profile across the disks with the turbine stopped are different compared with a rotating turbine. With this procedure the temperature is returned to the normal operating profile. After two minutes, the mechanical stresses (blades pulling on disks at higher speed) can be increased. Not following this procedure will shorten the life of the disks.</p> </div> <p>General.</p> <p>The right propeller may be braked, allowing the engine to be used as an auxiliary power unit supplying electrical and pneumatic power for operation of the aircraft systems without the need for a ground power unit.</p> <div style="border: 1px solid black; padding: 5px;"> <p>CAUTION</p> <p>If a malfunction occurs during operation of the propeller brake or any motion of the propeller occurs after application of the brake, the engine must be shut down immediately.</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p>NOTE</p> <p>Check nose wheel in centered position: More than 20° deflection will drain the MAIN accumulator pressure faster.</p> </div> <p>To apply propeller brake with engine running.</p> <ol style="list-style-type: none"> 1. HYDR PUMP switch OVRD then AUTO <ul style="list-style-type: none"> – Check MAIN pressure to be approx. 3000 psi. 2. R Power lever GND IDLE
(Cont'd)	



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<ol style="list-style-type: none"> 3. R Condition lever START <ul style="list-style-type: none"> – Check right propeller to be feathered. 4. Gust lock ON 5. R PROP BRK switch ON <ul style="list-style-type: none"> – Check PROP BRAKE Status Light to come on. – Check right propeller to stop rotating and remain motionless within 5 seconds. – If PROP BRAKE Status Light does not illuminate or propeller does not stop within 5 seconds return R PROP BRK switch to OFF. Do not try another attempt. Consider the propeller brake as unserviceable. Request maintenance check with regard to heat damage and oil contamination prior to takeoff. 6. End of procedure. <p>To perform an engine start with propeller brake on.</p> <ol style="list-style-type: none"> 1. Perform the BEFORE ENGINE START checklist. 2. HYDR PUMP switch OVRD then AUTO <ul style="list-style-type: none"> – Check MAIN pressure to be approx. 3000 psi. 3. R PROP BRK switch ON <ul style="list-style-type: none"> – Check that PROP BRAKE status light is on. 4. Start engine, check propeller remains motionless and perform AFTER ENGINE START checklist. 5. End of procedure. <p>Engine operation with propeller brake applied.</p> <ol style="list-style-type: none"> 1. R Power lever SET <ul style="list-style-type: none"> – If only LP-bleed and generator is on remain at GND IDLE. If using HP-bleed set PL to value of TABLE 1 (17.2 page 7) or PL stop, whichever is lowest. 2. Electrical power AS REQUIRED 3. R BLD VALVE switch AS REQUIRED 4. R HP VALVE switch AS REQUIRED 5. R POWER lever RESET <ul style="list-style-type: none"> – Reset acc. to 1. above 6. L BLD VALVE switch AS REQUIRED <ul style="list-style-type: none"> – The L BLD VALVE must be closed to be able to open the X VALVE.
(Cont'd)	



CONDITONS	NORMAL PROCEDURES
(Cont'd)	<p>7. Air Condition X VALVE switch AS REQUIRED</p> <p>8. R AND L RECIRC switch AS REQUIRED</p> <p>9. R Power lever RESET</p> <p>– Reset acc. to 1. above</p> <p>– Apply Power Lever friction lock.</p> <div style="border: 1px dashed black; padding: 5px;"> <p>CAUTION</p> <p>On a hot day, engine temp can be limiting when operating with air condition X VALVE open.</p> </div> <p>10. HYDR PUMP switch OFF/AUTO AS REQUIRED</p> <p>– Maintain HYDR MAIN pressure between 2700 and 3000 psi by switching HYDR PUMP between OFF and AUTO.</p> <div style="border: 1px dashed black; padding: 5px;"> <p>CAUTION</p> <p>HYDR PUMP operation must be followed by at least an equal length of time with HYDR PUMP OFF. Do not operate hydraulic pump continuously for more than 30 minutes.</p> </div> <p>11. End of procedure.</p> <p>Engine shut down with propeller brake applied:</p> <p>1. Stabilize engine at GND IDLE for two minutes with HP BLD OFF.</p> <p>2. Shut down engine.</p> <p>3. When engine has spooled down, set prop brake switch to OFF before switching off battery power.</p> <p>To release propeller brake:</p> <p>1. Prop Area Clear CHECK</p> <p>2. Air Condition X VALVE switch CLOSED</p> <p>3. HP VALVE switch CLOSED</p> <p>4. R Power Lever GND IDLE</p> <p>5. R BLD VALVE switch CLOSED</p> <p>6. R PROP BRK switch OFF</p> <p>– Check that right propeller rotates and PROP BRAKE warning light is off.</p> <p>– After the propeller brake has been released, operate the engine for two minutes with CL in START and PL in GND IDLE prior to increasing PROP RPM or engine shut down.</p> <p>7. HYDR PUMP switch AUTO</p> <p>8. End of procedure.</p>



CONDITIONS	NORMAL PROCEDURES
<p>2. 3. GROUND OPERATION.</p> <p>(Cont'd)</p>	<p>BOTTOMING GOVERNOR OPERATION.</p> <p>On ground the BG is disabled with CL out of MIN-MAX range. CL in UNF position and PL in GND IDLE gives approx. 950 PROP RPM.</p> <p>NOTE — — — — — The UNF CL position should normally be transit only. Exceptions are some engine checks on ground.</p> <p>After engine start, advance CL to MIN. and simultaneously check Ng and PRPM. The propeller starts to unfeather and PROP RPM increases. Ng should accelerate slightly as PRPM passes 830 and stabilizes at 1040.</p> <p>CAUTION — — — — — If Ng immediately starts accelerating when moving CL into MIN-MAX range, retard CL immediately to FUEL OFF.</p> <p>Hints for longer engine life.</p> <ul style="list-style-type: none"> – When possible avoid strong tailwinds during taxi delays. <p>FOD-prevention.</p> <p>If suspect FOD surfaces:</p> <ul style="list-style-type: none"> – Do engine run up checks (i.e. engine and propeller overspeed tests) over clean and hard surfaces only; – Taxi slightly faster than normal with as little power as possible over suspect FOD surfaces. This may be done by adding power when passing a clean surface and then transit the FOD surface with min. power. If this is not suitable taxi at slow speed with low power; – Use brakes, not reverse thrust, to decrease taxispeed; – Behind other aircraft, taxi with greater spacing than normal. <p>Before taxiing.</p> <ol style="list-style-type: none"> 1. PL GND IDLE <ul style="list-style-type: none"> – Check Ng/Np are stable. If indication is abnormal, shut down engine and request maintenance check. 2. CL MIN then MAX <ul style="list-style-type: none"> – This will enable the BG function. – Lift CL out of START and move to MIN position. When Ng starts to accelerate at 830 PRPM, move CL to MAX.

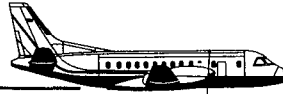


CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<p>3. BETA lights CHECK ON</p> <p>4. Ice protection AS REQUIRED</p> <p>– Modulation of PL between GND IDLE and FLT IDLE will directly control propeller pitch between 0 and 10 degrees. The bottoming governor function will maintain 1040 propeller RPM as long as PL is below FLT IDLE.</p> <p>Taxiing.</p> <p>5. PL AS NEEDED</p> <p>– Modulation of PL between GND IDLE and FLT IDLE will directly control propeller pitch between 0 and 10 degrees. The bottoming governor function will maintain 1040 propeller RPM as long as PL is below FLT IDLE.</p> <p>– If reverse thrust is required the PL's may be moved aft of GND IDLE into reverse. When a propeller blade is below -10° pitch the BG-function will maintain above 1200 RPM on that engine.</p> <p>– Operating with PL above FLT IDLE is only required to start taxiing in snow, uphill etc.</p>



CONDITIONS	NORMAL PROCEDURES
<p>2. 4. TAKEOFF.</p>	<p>Hints for longer engine life.</p> <ul style="list-style-type: none"> - Bleed valve closed takeoffs means lower ITT which increases engine reliability and life. - "Reduced power takeoffs" will significantly increase engine reliability and life and reduce maintenance expenditures. When possible and operationally feasible, select runways which will allow reduced power for takeoff. <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>NOTE</p> <p>For "Reduced power takeoff" limitations procedures and performance see AFM and Sect. 28</p> <p>In addition to the limitations, consider possibly downdrafts and windshears if obstacle limited and/or windy conditions. Full use of reduced power will result in the aircraft operating near the performance limits. Although there are extra margins built into the reduced power takeoff concept, these extra margins might be easily consumed during unfavorable conditions.</p> </div> <ul style="list-style-type: none"> - When max. takeoff power is set (e.g. takeoff or go-around) with engine anti-ice ON and/or ECS OFF, set climb power prior switching off anti-ice or switching on ECS. This is to avoid the possibility of exceeding maximum rated takeoff power. <p>FOD-prevention.</p> <ul style="list-style-type: none"> - Make rolling takeoffs if possible. - Apply power smoothly. An abrupt power application greatly increases possibility for FOD. <p>General.</p> <ul style="list-style-type: none"> - CL must be in MAX position. - To meet different performance criteria there are different "methods" for takeoff power application and aircraft handling. The "methods" and corresponding performance data are described in the AFM and AOM Sect. 28. - The AUTO COARS LOW light will be on at low power and will go out when the PL's are advanced to high power. The AUTOCOARS HIGH light should come on when both PL's are advanced to above PLA 64°. <p>Power setting with CTOT.</p> <ul style="list-style-type: none"> - Advance PL and STOP PL MOVEMENT at 15-20% TRQ below selected TRQ, then select CTOT switch to ON or APR as required.

(Cont'd)



CONDI- TIONS	NORMAL PROCEDURES
(Cont'd)	<div data-bbox="565 415 1477 569" style="border: 1px dashed black; padding: 10px;"> <p>NOTE</p> <p>It is essential to stop PL forward movement at 15–20% below selected TRQ. If not, the selected TRQ might be exceeded due to torque blooming during acceleration.</p> </div> <p>Should a change in power be required, this is achieved by turning the CTOT knob.</p> <p>For power plant indications and procedures in case of power loss, see AB-NORMAL PROCEDURES 3.3 and 3.4.</p> <p>Power setting without CTOT.</p> <ul style="list-style-type: none"> – Advance PL and set torque according to power setting chart. Do not adjust power above 60 KIAS. The torque blooming will increase the torque by approx 5%. <div data-bbox="565 911 1477 1064" style="border: 1px dashed black; padding: 10px;"> <p>NOTE</p> <p>During Autocoarsen inoperative procedures the CTOT switch should be selected to ON or OFF positions (not APR). This is to avoid a possible un-commanded APR boost, should a failure exist in the autocoarsen/APR activation circuit.</p> </div> <div data-bbox="565 1106 1477 1287" style="border: 1px solid black; padding: 10px;"> <p>WARNING</p> <p>During an aborted takeoff the PL must be retarded fully to the FLT IDLE position prior lifting the latch allowing PL to be moved below FLT IDLE. If the latch is lifted with PL above FLT IDLE the PL will be stuck with consequential increased stopping distance.</p> </div>
<p>2. 5. CLIMB.</p> <p>(Cont'd)</p>	<p>Climb power setting.</p> <p>REDUCE TORQUE PRIOR TO REDUCING PROP RPM.</p> <p>ADJUST TORQUE ACCORDING TO AOM POWER SETTING CHARTS.</p> <p><u>Without CTOT.</u></p> <p>Adjust PL to climb power, then set CL to desired PROP RPM. Readjust PL as necessary.</p> <p><u>With CTOT.</u></p> <ul style="list-style-type: none"> – Gently rotate CTOT knob counter clockwise to decrease torque, then select the CTOT switch to OFF. This method will give a smooth power reduction and is recommended during normal operations.



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<p>NOTE — — — — —</p> <p>The design of the CTOT system does not prevent rapid power reductions. Rotating the knob too fast or selecting the switches to OFF prior using the knob can have an adverse impact on the engine operation.</p> <p>It is therefore essential to gradually reduce the TRQ by the CTOT knob to a value below that of the PL's and then select the switches to OFF. Power reduction rate using the knob should be no greater than that which would be considered a good power setting technique using the PL's.</p> <p>— After CTOT is disengaged, adjust PL to climb power, then set CL to desired PROP RPM and readjust PL.</p> <p>— PROP SYNC should be turned ON to reduce vibration and cabin noise. Adjust CL to within 10 PROP RPM before turning on. The PROP SYNC switch may remain in ON position during PROP RPM changes and propellers will be synchronized when within 10 PROP RPM diff. However, the best result for synchrophasing is to turn the system OFF before and ON after PROP RPM adjustments.</p> <p>NOTE — — — — —</p> <p>During normal operation it is important that the CTOT switch is set to OFF during the initial climb after takeoff or go-around. If the switch is not set to OFF, the torque will be constant and the ITT will gradually rise to above limits as the aircraft climbs. To avoid this, always verify the switch is OFF physically by the hand.</p> <p>— Check that FI STOP light is out after gear retraction.</p> <p>— During climb now and then adjust PL to required TRQ.</p>
2. 6. CRUISE.	<p>Hints for longer engine life.</p> <p>— Maintain an effective engine power monitoring system. (See General Electric Operating Instructions)</p> <p>1. CL SET CRUISE RPM</p> <p>2. PL ADJUST CRUISE POWER</p> <p>For a fixed PL position and constant PROP RPM, the TRQ increases with speed.</p> <p>Negative G-load.</p> <p>ENGINE OIL (CWP) light + MASTER WARNING will come on during negative G-load.</p>



CONDITIONS	NORMAL PROCEDURES
2. 7. DESCENT APPROACH.	<p>Hints for longer engine life.</p> <ul style="list-style-type: none"> - If required, turn engine anti-ice on well in advance. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>WARNING</p> <p>Do not move the PL below FLT IDLE when airborne. See also 17.1 page 19/20.</p> </div> <ul style="list-style-type: none"> - High PROP RPM will increase the drag and the rate of descent. - Move CLs gently to avoid unnecessary stress on propeller and PGB.
2. 8. BEFORE LANDING.	<p>Hints for longer engine life.</p> <ul style="list-style-type: none"> - Check HP VALVES are closed, if not required for boot de-ice operation. <ol style="list-style-type: none"> 1. PROP SYNC switch OFF 2. CL MAX
2. 9. LANDING AND REVERSE OPERATION.	<p>FOD-prevention.</p> <ul style="list-style-type: none"> - If operationally feasible avoid reverse thrust especially on contaminated or suspected FOD runways. Use ground idle and brakes to stop the aircraft. - If operationally feasible avoid reverse thrust below 50 KIAS after flight in icing conditions. <p>After touchdown.</p> <ol style="list-style-type: none"> 1. With the PL's at FLT IDLE stop, lift the latches and retard the PL's to GND IDLE. Check both BETA lights on before moving the PL's into REV as required. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>NOTE</p> <p>It is important to retard the PL's fully to the FLT IDLE before the latches are lifted in order to be able to move the PL's further into the BETA range.</p> </div> <p>PL's in GND IDLE will schedule the propeller to zero pitch.</p> <p>Modulation of the PL's below GND IDLE will schedule propeller pitch between zero pitch and max reverse (-16° pitch). PROP RPM will increase automatically and be kept above 1200 RPM (may vary slightly during transition). The PROP RPM increase is independent for each propeller and starts when the propeller is below -10° pitch.</p>

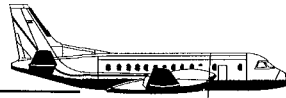


CONDITIONS	NORMAL PROCEDURES
2. 10. ENGINE SHUT DOWN ON GROUND.	<p>NOTE</p> <ul style="list-style-type: none"> – There is a 2-minute cool-down period requirement with HP bleed OFF, before shutdown. This is to cool internal engine parts from high operating temperatures and to prevent seal rubs during restart. – The cool-down period may commence upon landing if HP-bleed is OFF and PL remains between FLT IDLE and GND IDLE (no reverse) after landing. – Otherwise operate engine with PL in GND IDLE and HP-bleed OFF for 2 minutes before shutdown. <p>CAUTION</p> <p>When CL is moved to START, the propeller should feather and PROP RPM decrease. If PROP RPM does not decrease, move CL to FUEL OFF immediately, otherwise engine will accelerate to over-torque and over-temp condition.</p> <p>CAUTION</p> <p>If left engine is shut down or left generator is turned off during intaxiing, check BUS TIE light to come on. This is to ensure proper nosewheel steering and anti-skid function.</p> <p>1. PL GND IDLE</p> <p>NOTE</p> <p>When icing conditions, ice accumulation is minimized by keeping the CL in MIN-MAX as long as practical.</p> <p>2. CL START</p> <ul style="list-style-type: none"> – A smooth feathering will be accomplished by noticing the PROP OIL pressure which initially rises then drops when CL is about half way between MIN and START. At pressure rise hold the CL for a few seconds then move it slowly into START. <p>3. BLD VALVE switch CLOSED</p> <ul style="list-style-type: none"> – This will further reduce ITT. <p>4. GEN switch OFF</p> <p>5. CL FUEL OFF</p>

(Cont'd)



CONDITIONS	NORMAL PROCEDURES
(Cont'd)	<p>– If there is evidence of combustion after shutdown, indicated by a immediate rise in ITT, motor the engine.</p> <div data-bbox="535 426 1458 600" style="border: 1px dashed black; padding: 10px;"> <p>NOTE</p> <p>During ground operation, if an immediate shut down is required from high power (Ng above 90 %) the PL should be retarded to GND IDLE and CL to FUEL OFF, then motor to below 175°C. If unable to reduce to 175°C within 5 minutes, wait 2 hrs to restart engine.</p> </div> <p>For engine shut down with propeller brake applied see, PROPELLER BRAKE OPERATION.</p>
2. 11.P3 SWITCH TEST.	<div data-bbox="535 751 1458 919" style="border: 1px dashed black; padding: 10px;"> <p>CAUTION</p> <p>Do not activate PROPELLER PUMP switches with CL's in MIN-MAX range. The CL's must be in the UNF position. With CL's unintentionally moved into MIN-MAX range the bottoming governor will try to maintain 1040 PROP RPM and an overtorque will occur.</p> </div> <ol style="list-style-type: none"> 1. Set AUTO COARSEN switch to ON position. 2. Move CL's to UNF position. <ul style="list-style-type: none"> – Check PROP RPM to increase. 3. Advance PL's until TRQ is 10–15%. 4. Hold L PROPELLER PUMP switch momentarily to MAN FEATHER position. <ul style="list-style-type: none"> – Check PROP RPM starts to decrease. 5. Set AUTO COARSEN switch to OFF during at least 2 seconds, then ON. <ul style="list-style-type: none"> – Check PROP RPM starts to increase. 6. Repeat items 4 and 5 for R engine. <div data-bbox="535 1360 1458 1507" style="border: 1px dashed black; padding: 10px;"> <p>NOTE</p> <p>For a/c without Mod No 2198, SB 61-026 (Introduction of new autocoarsen computer) the PROP RPM should start to increase when PROPELLER PUMP switch is released. Item 5 could then be deleted.</p> </div>



CONDITIONS	NORMAL PROCEDURES
2.12. POWER FLUCTUATIONS.	<p>Even if the procedures for activation of the engine anti-ice system has been followed, power fluctuation(s) may occur during the time the system is activated. This is caused by snow accumulated in the birdcatcher and ingested into the engine causing a momentary power drop.</p> <p>Power fluctuation occurs primarily at altitude >10 000 feet and at temperatures between ISA and ISA+20. Repeated fluctuations may occur. A power fluctuation is recognized as a momentary drop in engine indications, with consequently slight yaw. In some cases flames might be seen in the exhaust pipe followed by a bang. All parameters recover in 1–4 seconds. If the autoignition is activated, a L(R) IGN light will come on for approx. 7 seconds.</p> <p>Power fluctuation(s) should not be considered as abnormal engine behavior, and no action is required by the crew. Should a bang and/or a flame be noticed, it is recommended to inform the passengers about this “normal engine characteristics”.</p> <div style="border: 1px dashed black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">NOTE</p> <p>Experience reveals that in most cases the autoignition system is an active part in the power drop recovery process. Therefore, it is essential to test the autoignition system.</p> </div>
2.13. AUTO IGNITION TEST (CIRCUIT TEST).	<ul style="list-style-type: none"> – During engine shut down verify IGN lights in the Flight Status Panel to illuminate momentarily. IGN lights will illuminate until Ng drops below approx. 62%. – In bright sunlight, shade the Flight Status Panel to ensure that the lights are visible when illuminated. – If an ignition light fails to illuminate the auto-ignition system is to be considered inoperative. <ol style="list-style-type: none"> 1. Adjust Ng to approx. 75 – 77% (minimum 75%). 2. Shut down the engines (CL to FUEL OFF). 3. Check IGN lights to illuminate momentarily. 4. Retard PLs to GND IDLE. 5. End of procedure. <div style="border: 1px dashed black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">NOTE</p> <p>The functions of the igniter plugs, ignition exciters and alternator are automatically checked during engine start. When combined with the circuit test above this will provide a full function check of the auto-ignition system.</p> </div>



3. ABNORMAL OPERATION.

For Abnormal Operation, see also sections 23 ABNORMAL PROCEDURES and 24 EMERGENCY PROCEDURES.

CONDITIONS	NORMAL PROCEDURES
3. 0. GENERAL.	<p>In all cases when a power plant behavior and/or cockpit indication differ from normal, when practical:</p> <ul style="list-style-type: none"> – Push FDR EVENT button; – Record indicated parameters and duration above or below limit; – Notify maintenance; – Consider FDR securing and removal. <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>CAUTION</p> <p>PRIOR TO SHUTTING DOWN OR SWITCHING OFF VITAL ITEMS LIKE ENGINE, FUEL, GENERATORS ETC THE APPROPRIATE LEVER, HANDLE OR SWITCH SHALL BE VERIFIED BY BOTH PILOTS.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>NOTE</p> <p>UNLESS OTHERWISE INDICATED IN THE PROCEDURES, MANIPULATION OF LEVERS, SWITCHES ETC REFERS TO THE AFFECTED ENGINE AND/OR SYSTEM.</p> </div> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>NOTE</p> <p>It is recommended that training includes at least the two below mentioned essential engine securing procedures to be performed as memory items:</p> <ol style="list-style-type: none"> 1. <u>Engine shut down</u> 2. <u>Torque motor lockout.</u> </div>
3. 1. DISCONTINUED ENGINE START. (Cont'd)	<p>If an abnormal condition develops during engine start, necessitating aborting the start, the following procedure applies.</p> <p>If the specific malfunction requires a different abort procedure, this will be covered in Section 23.</p> <ol style="list-style-type: none"> 1. CL FUEL OFF <p>– This action will shut off the fuel to the engine and cut out the starter and ignition.</p>



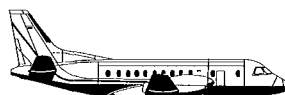
CONDI- TIONS	ABNORMAL PROCEDURES
(Cont'd)	<p>2. Check engine deceleration.</p> <p>◆ If no fuel was indicated.</p> <p>3. End of procedure.</p> <p>◆ If fuel was admitted to the engine.</p> <p>3. Motor the engine.</p>
<p>3.2 MOTORING/ MOTORING START. (A Motoring Start procedure is to be consid- ered as a NOR- MAL PROCE- DURE and is used frequently at short-turn around).</p>	<p>GENERAL.</p> <p>The reason for motoring might be:</p> <ul style="list-style-type: none"> ° High ITT indications before start; <ul style="list-style-type: none"> – motor to below 175° C. ° Engine start in tailwind; <ul style="list-style-type: none"> – motor to above 20% ng. ° External power source is suspect; <ul style="list-style-type: none"> – motor to above 20% ng. ° High ITT after discontinued start; <ul style="list-style-type: none"> – motor to below 175° C. ° Engine is wet (Ng above 8%) after discontinued start; <ul style="list-style-type: none"> – motor at least 10 seconds. ° Engine shut down on ground from high power (Ng above 90%); <ul style="list-style-type: none"> – motor to below 175° C. ° Evidence of combustion after shut down (in flight or on ground) i.e. ITT does not decrease or rises above 540° C; <ul style="list-style-type: none"> – motor to below 175° C. <p>1. CL FUEL OFF</p> <p>2. IGN switch OFF</p> <p>– Engine will not motor without IGN switched OFF.</p> <p>3. START switch TURN TO AFFECTED ENGINE AND HOLD</p> <p>– Check ENG RPM for proper engine rotation (min 20% Ng).</p> <div style="border: 1px dashed black; padding: 5px; margin-top: 10px;"> <p>NOTE</p> <p>If motoring on external power and the GPU voltage drops off line, the EXT PWR switch will not flip to OFF as long as the start switch is held. The motoring will not continue on battery power. The batteries will be connected once the start switch is released.</p> </div>
(Cont'd)	



CONDI- TIONS	ABNORMAL PROCEDURES
(Cont'd)	<p>When motoring completed.</p> <p>4. IGN switch NORM</p> <p>5. End of procedure.</p> <p>Motoring Start procedure</p> <p>1. Perform items 1 – 3 above. – Check ITT below 175° C and Ng above 20%.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>CAUTION</p> <p>Turn IGN switch to NORM within 2 seconds after CL is moved to START. If not, retard CL to FUEL OFF and motor engine.</p> </div> <p>2. CL START</p> <p>3. IGN switch NORM</p> <p>4. START switch RELEASE – Release after a positive rise in Ng.</p> <p>5. Check engine parameters.</p> <p>6. End of procedure.</p>
<p>3. 3. POWER LOSS INDICATIONS, AUTO COARSEN AND CTOT SYSTEM INDICATIONS, PROPELLER CHARACTERISTICS, PROPELLER DRAG.</p> <p>(Cont'd)</p>	<p>INDICATIONS GENERAL.</p> <ul style="list-style-type: none"> – TRQ is the primary indication for the entire power plant (gas generator turbine and propeller) operation. – ITT and Ng indicate the condition of the gas generator turbine where ITT is the most critical of the variables and should be closely observed. – PROP RPM is the primary indication of the propeller. <p>1. Cockpit indications in case of power loss.</p> <ul style="list-style-type: none"> – TRQ will decrease. – ITT and Ng will decrease if flameout. Other failures may create different indications. – IGN light may come on. – PROP RPM will decrease if autocoarsen occurs, otherwise PROP RPM remains about 1200–1384 depending on aircraft speed. – When a propeller autocoarsens the Flight Status Panel AUTO COARS HIGH or LOW "arm" light goes out and the ICE PROTECT (CWP) and AC GEN caution lights will come on (provided the AC GEN switch is ON). – When engine (Ng) has spooled down to about 25% the DECU is no longer powered and all signals from the DECU for TRQ – and PROP RPM – indications will be zero.



CONDITIONS	ABNORMAL PROCEDURES																																
(Cont'd)	<p>2. Typical autocoarsen and APR indications on the Flight Status Panel.</p> <p>— <u>Taxiing:</u></p> <table border="1"> <tr> <td></td><td></td></tr> <tr> <td></td><td>AUTO COARS LOW</td></tr> </table> <p>— <u>Takeoff or go-around with CTOT switch set to OFF or ON</u></p> <table border="1"> <tr> <td></td><td></td></tr> <tr> <td>AUTO COARS HIGH</td><td></td></tr> </table> <p>° Left or right eng. power loss:</p> <table border="1"> <tr> <td></td><td></td></tr> <tr> <td></td><td></td></tr> </table> <p>— <u>Takeoff or go-around with CTOT set to APR</u></p> <table border="1"> <tr> <td>L APR</td><td>R APR</td></tr> <tr> <td>AUTO COARS HIGH</td><td></td></tr> </table> <p>° Left engine power loss:</p> <table border="1"> <tr> <td>L APR</td><td>R APR</td></tr> <tr> <td></td><td></td></tr> </table> <p>° Right engine power loss:</p> <table border="1"> <tr> <td>L APR</td><td>R APR</td></tr> <tr> <td></td><td></td></tr> </table> <p>– Left PL retarded below 64 PLA E.g. simulated eng. failure:</p> <table border="1"> <tr> <td></td><td>R APR</td></tr> <tr> <td></td><td>AUTO COARS LOW</td></tr> </table> <p>° Left engine real power loss:</p> <table border="1"> <tr> <td></td><td>R APR</td></tr> <tr> <td></td><td></td></tr> </table>				AUTO COARS LOW			AUTO COARS HIGH						L APR	R APR	AUTO COARS HIGH		L APR	R APR			L APR	R APR				R APR		AUTO COARS LOW		R APR		
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CONDITIONS	ABNORMAL PROCEDURES																
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CONDITIONS	ABNORMAL PROCEDURES																
(Cont'd)	<div>4. Propeller drag.</div> <div>Influence on performance of a feathered or wind-milling propeller versus a coarsened propeller. Numbers are approximative at normal takeoff and landing speeds and are given as increase of grossweight and decrease in rate of climb versus a coarsened propeller.</div> <div><table><tr><td>Propeller</td><td>lb</td><td>(kg)</td><td>(ft/min)</td></tr><tr><td>Coarsened</td><td>0</td><td>0</td><td>0</td></tr><tr><td>Feathered</td><td>+ 300</td><td>(140)</td><td>- 20</td></tr><tr><td>Windmilling</td><td>+ 6000</td><td>(2700)</td><td>- 500</td></tr></table></div> <div><div>NOTE</div><div>The above referenced performance penalties are <u>not</u> intended to be used for dispatch with an inoperative autocoarsen system. Refer to applicable AFM supplement for operation with autocoarsen inoperative.</div></div> <div><div>WARNING</div><div>An unfeathered propeller of an engine with the PL at FLT IDLE and CL in MAX will produce more drag than a feathered propeller with the CL in FUEL OFF. The drag difference is considerable and varies with speed, increasing with speed reduction down to approx. 100 KIAS. Further speed reduction will decrease the drag difference.</div></div> <div><div>NOTE</div><div>OEI performance is based on a feathered propeller with CL in FUEL OFF.</div></div> <div><div>NOTE</div><div>A windmilling uncoarsened propeller rotates at a "steady" RPM (1200-1384) depending on aircraft speed and results in a substantial yawing moment.</div></div>	Propeller	lb	(kg)	(ft/min)	Coarsened	0	0	0	Feathered	+ 300	(140)	- 20	Windmilling	+ 6000	(2700)	- 500
Propeller	lb	(kg)	(ft/min)														
Coarsened	0	0	0														
Feathered	+ 300	(140)	- 20														
Windmilling	+ 6000	(2700)	- 500														
3. 4. POWER PLANT FAILURE, SEVERE DAMAGE OR SEPARATION, ENGINE FLAME OUT. <																	

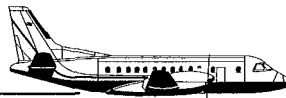


CONDITIONS	ABNORMAL PROCEDURES
(For ENGINE and TAILPIPE HOT, see 2.7. Fire protection).	<p>NOTE</p> <p>In case of power loss in go-around or during takeoff when the decision is to continue the takeoff, it is recommended to shut down engine (thereby feathering the prop) after the 3rd (acceleration) segment. However, there may be circumstances where an engine shutdown at an earlier stage could prevent increased drag or further damage e.g. propeller overspeed failure to autocarsen, engine fire, power plant severe damage or separation etc.</p> <p>CAUTION</p> <p>Following an engine failure, if an autocarsen has not occurred, an abrupt PL retardation may cause severe yaw due to propeller windmilling drag. Be prepared to move CL of the failed engine to FUEL OFF immediately.</p> <p>NOTE</p> <p>If an immediate shut down is required, CL may be moved directly to FUEL OFF prior to retarding PL. Moving CL directly to FUEL OFF is essential especially if engine is still producing power. Any pause in the FEATHER range may cause an overtorque.</p> <p>NOTE</p> <p>A feathered Dowty propeller may rotate slowly. A Hamilton Standard propeller does rotate after a feathering. For both types of propellers, rotation speeds vary with IAS and sideslip.</p>
3. 5. ENGINE FLAMEOUT.	<p>INDICATIONS.</p> <ul style="list-style-type: none"> – Loss of torque. – Rapid decrease of ITT. – Ignition light on. <p>ACTIONS.</p> <ol style="list-style-type: none"> 1. If the engine does not relight automatically, shut down engine. Check that the fuel system is correctly set and that fuel is available to the engine. <p>CAUTION</p> <p>Do not attempt a restart if engine damage is suspected.</p> <p>If no malfunction or no abnormal operation was observed before the flameout, the engine may be restarted.</p>

(Cont'd)



CONDITIONS	ABNORMAL PROCEDURES
(Cont'd)	<p>PROBABLE CAUSE</p> <ul style="list-style-type: none"> – Interrupted fuel supply. – Engine fuel system problem,. – Excessive ice/slush ingestion into the engine without autoignition available. <p>AUTOMATIC RELIGHT.</p> <ul style="list-style-type: none"> – Should an engine flameout occur and then automatically relight; the engine parameters will return to normal or approximately normal indications within 1–4 seconds depending on the flameout characteristics.
3.6. UNUSUAL ENGINE NOISE.	<p>High pitched, whining sound from an engine, sound changes (level and frequency) with engine power changes may be caused by a damaged compressor.</p> <p>ACTIONS.</p> <ul style="list-style-type: none"> – Reduce power and monitor engine instruments.



CONDITIONS	ABNORMAL PROCEDURES
<p>3.7. OPERATION IN TORQUE MOTOR LOCK-OUT.</p>	<p>GENERAL.</p> <ul style="list-style-type: none"> – Except for CTOT/APR operation during takeoff and go-around, the torque motor affects operation on ground only. – Some abnormal procedures call for the torque motor to be locked out. The purpose is to prevent engine electrical control failures from causing actual uncommanded power plant response. – When procedures call for torque motor to be locked out, prompt action should be taken. – After the torque motor has been locked out: <ul style="list-style-type: none"> ◦ the bottoming governor function is disabled; ◦ the CTOT/APR function is not available; ◦ the reverse power is poor; ◦ the torque motor can not be reset without shutting down the engine by moving CL to FUEL OFF. – Subsequently also some other systems are affected and special considerations have to be taken: <ul style="list-style-type: none"> ◦ the AC generators will go off line during ground operation, thereby affecting the ice protection system, however, when on ground only; ◦ if the a/c has to be dispatched with torque motor locked out, both torque motors must be locked out and the a/c must be operated according to CTOT inoperative procedures/performance; ◦ if only one engine has the torque motor locked out, asymmetric and reduced reverse power will be obtained with PL's at the same position. Locking out both torque motors restores the ability to obtain symmetric reverse although the reverse thrust is poor. If one torque motor has to be locked out when airborne consider also to lock out the other torque motor. <div style="border: 1px dashed black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">NOTE</p> <p>With torque motors locked out, positioning PL's at GND IDLE after touch down gives a retardation equal to 50% of max. reverse thrust during landing roll and gives more retardation than positioning PL's into REV. At low speed (taxiing) the situation is the opposite, however, to slow down from taxi speed to a stop, by use of reverse only, will take a long distance.</p> </div> <p style="text-align: center; margin-top: 20px;">– To lock out the torque motor:</p> <div style="border: 1px dashed black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">CAUTION</p> <p>Keeping Condition Lever in T/M position will cause fuel to be vented overboard.</p> </div>

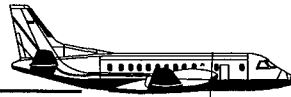
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CONDITIONS	ABNORMAL PROCEDURES
	<p>1. Condition Lever T/M then SET</p> <ul style="list-style-type: none"> – Move CL to MAX, then lift up and push hard into T/M, then pull back to approx. half between MAX–MIN, then set desired PRPM. – This will mechanically lock out the torque motor. Pulling CL to approx. half between MAX–MIN will ensure closing of the vapor vent valve. <p>2. End of procedure.</p>
<p>3.8. STARTER/GENERATOR (S/G) SPEED SENSOR SIGNAL FAILURE.</p>	<p>INDICATIONS.</p> <p>Abnormal indications after engine start:</p> <ul style="list-style-type: none"> – No BUS TIE CONN light; – No overhead caution lights and no CWP amber lights. <p>During the starting cycle non–essential cautions (overhead and CWP amber alerts) are inhibited. The Warning Annunciator System (WAS) reverts to the T/O INH mode due to loss of power on L/R ESS Busses caused by the Starter Relay being energized until a 55% Ng speed sensor signal de–energizes the Starter Relay and the WAS reverts back to the GNC OP mode.</p> <p>If for any reason the speed sensor signal fails the S/G will remain in the starter mode and after the start–up no BUS TIE CONN light and no overhead and CWP cautions will come on.</p> <p>The following busses are the only busses available during engine start (on ground and airborne):</p> <ul style="list-style-type: none"> – L/R Battery Busses; – Emergency Bus; – Emergency Avionic Bus; – L/R AVION Start Busses (only at GPU or generator cross–over start); – L/R Main Start Busses (only at GPU or generator cross–over start). <p>ACTIONS.</p> <p>On ground:</p> <ul style="list-style-type: none"> – Refer to MEL. <p>Airborne:</p> <ul style="list-style-type: none"> – Apply STARTER DOES NOT DISENGAGE procedure A44



CONDITIONS	ABNORMAL PROCEDURES
3.9. ENGINE RESTART IN FLIGHT.	<p>During engine restart in flight PL should be placed in FLT IDLE position.</p> <div> <p>WARNING</p> <p>It is prohibited to move PL below FLT IDLE when airborne.</p> <p>During engine start on ground, PL is placed into GND IDLE position. Due to the fact that this is the "normal start position", there is a possibility, by habit, to move PL to this wrong position also during an engine restart in flight.</p> <p>If PL is moved below FLT IDLE there will be no control of the propeller speed with consequential extremely high drag and uncontrolled flight.</p> </div>
3.10. TORQUE STICKING.	<p>INDICATIONS.</p> <ul style="list-style-type: none"> – Torque indication remains at the last power setting when Power Lever is moved. – Engine responds normally as indicated by change in ITT, Ng and Fuel Flow. – Usually this occurs after a prolonged period of time at constant power setting. <p>PROBABLE CAUSE.</p> <ul style="list-style-type: none"> – "Cocked" oil build-up between the power turbine and the internal torque reference shaft in the area of the torque reference shaft's rear snubbers. <p>ACTIONS.</p> <p>If "torque stiction" occurs while retarding power levers, to minimize the duration of the stiction, retard the affected power lever toward FLIGHT IDLE and pause. Experience indicates that the torque indication will unstick and will indicate the actual torque after a few minutes of operation at the new lower power setting. When the actual torque is indicated, or as conditions dictate, return the power lever to match the other engine.</p> <p>If "torque stiction" occurs on a forward movement of the power levers, match the power levers and maintain the expected ITT difference between the two engines. Experience has shown that the indication will return to the actual reading within a few minutes.</p>
3.11. FI STOP. FI STOP and/ or FI OPEN light illuminate in flight.	<p>CAUSE.</p> <ul style="list-style-type: none"> – FI STOP (blue) light will illuminate until wheel spin down <9 kts, should the landing gear not be retracted. The spin down may take up to 90 seconds. – FI STOP OPEN (amber) light indicates an electrical or mechanical failure or the override function has been activated. <p>ACTIONS.</p> <ul style="list-style-type: none"> – Crew awareness. Stop is open.



CONDITIONS	ABNORMAL PROCEDURES
3.12. FI STOP. Emergency Override Function.	INDICATION. – Unable to move PLs below Flight Idle after touch down. ACTIONS. – Pull FI STOP OVRD knob.
3.13. FI STOP. Electrical failures.	– In case of RH BAT BUS power loss, pull FI STOP OVRD knob after touch down. – In case of any other RH MAIN or ESS BUS failure, be prepared to pull FI STOP OVRD knob after touch down.