DeHavilland DHC-3 Otter

Airplane Flight Manual Supplement

TTC-FMS-1
for
Turbine Engine Conversion
and
Optional Bleed-air Heater

Applicable to:

Aircraft Registration No: _____

Aircraft Serial No. _____

This supplement is FAA approved and must be attached to the FAA-approved Airplane Flight Manual when the aircraft has been modified by the installation of a Honeywell TPE-331 engine in accordance with STC **SA09866SC**. The information contained in this document supplements or supersedes the Airplane Flight Manual only in those areas listed herein. For limitations, procedures, and performance not contained in this supplement, consult the Airplane Flight Manual.

Approved By: _____

S. Frances Cox, Manager
Special Certification Office
Federal Aviation Administration
Fort Worth, Texas 76137-4298

Original Issue: May 5, 2001
Revision Date: May 23, 2011 **Revision D**

Table of Revisions

Rev	Description	Pages	Approved By	Date
IR	Initial Release	----	*Mark Flora for S. Frances Cox*	May 5, 2001
A	Added Seaplane Compatibility List	1-1, 1-4	*S. Frances Cox*	Jan 31, 2002
B	Added optional bleed-air heater, Revised fuel system	i,1-2,2-1,2-4,2-6,3-1,3-4,3-5,3-7,3-8,3-9,4-2,4-3,4-5,4-6,4-7,4-8,4-9,4-10,5-1,5-2,5-3,6-2,7-1,7-2,7-4,7-7,7-8,7-10,7-11,7-13,7-14,7-15	*S. Frances Cox*	Sep 22, 2003
C	Added optional parallel/series start system descriptions, revised float weights, revised engine temp limits, revised propeller start-lock angle	i, ii,1-2,1-4,2-2,2-5,3-2,4-2,4-3, 4-10,7-5,7-12	*S. Frances Cox*	Mar 10, 2006
D	Added clarification notes on the various floats installations and compatibility Add new airspeed, propeller and weight limitations Removed references to the TPE331-12JR engine	i, ii, 1-4 2-1,2-2,2-5 1-2, 2-2	S. Frances Cox, Manager Special Certification Office Federal Aviation Administration Fort Worth, Texas 76137-4298	May 23, 2011

Table of Contents

Section		Page
1	General	1-1
2	Limitations	2-1
3	Emergency Procedures	3-1
4	Normal Procedures	4-1
5	Performance	5-1
6	Weight & Balance	6-1
7	Systems Description	7-1

SECTION 1
GENERAL

TABLE OF CONTENTS

Page

Description 1-2

Dimensions 1-2

Gross Weight 1-2

Engine 1-2

Propeller 1-2

Fuel 1-2

Engine Oil 1-2

Three-view Drawing 1-3

Seaplane Compatibility 1-4

DESCRIPTION

The DHC "Otter" airplane is an all-metal, high wing monoplane powered by a single Honeywell (Garrett) TPE331-10 engine driving a Hartzell constant speed, full-feathering, reversing propeller. The aircraft has been designed to carry a pilot and from six to fifteen passengers. It may also be used for liaison duties, ambulance and rescue operations, forestry, border and coastal patrols, spraying, dusting, skydiving, aerial surveying, photographic operations, or cargo transportation. The aircraft is divided through partitions into a cockpit, a cabin and a baggage compartment. An optional bleed-air heater and parallel/series start system may be installed.

DIMENSIONS

General overall dimensions of the airplane are:

Length.....	46 feet, 11 inches
Wing Span.....	58 feet, 0 inches
Height.....	12 feet, 6.6 inches

MAXIMUM WEIGHT

Maximum takeoff weight.....	8000 pounds.
Maximum landing weight.....	8000 pounds.

ENGINE

Manufacturer:.....	Honeywell (Garrett)
Model:.....	TPE331-10
Horsepower:.....	Flat rated to 900 shp at 1591 rpm.

PROPELLER

Manufacturer:	Hartzell Propeller
Model:	HC-B4TN-5NL/LT10890N
Blades:	4
Diameter:	109.5"
Type:	Constant-speed, Full-feathering, Reversing, Counter-weighted, and Hydraulically actuated.
Pitch Range:	measured at the 42" blade station
Feathered…….	+81.2°
Reverse……	-12°

FUEL

Recommended Fuel:	Jet A
Emergency Fuels:	See LIMITATIONS Section.

ENGINE OIL

Recommended Engine Oil:	See LIMITATIONS Section.
Total Oil Capacity:	8 U.S. quarts

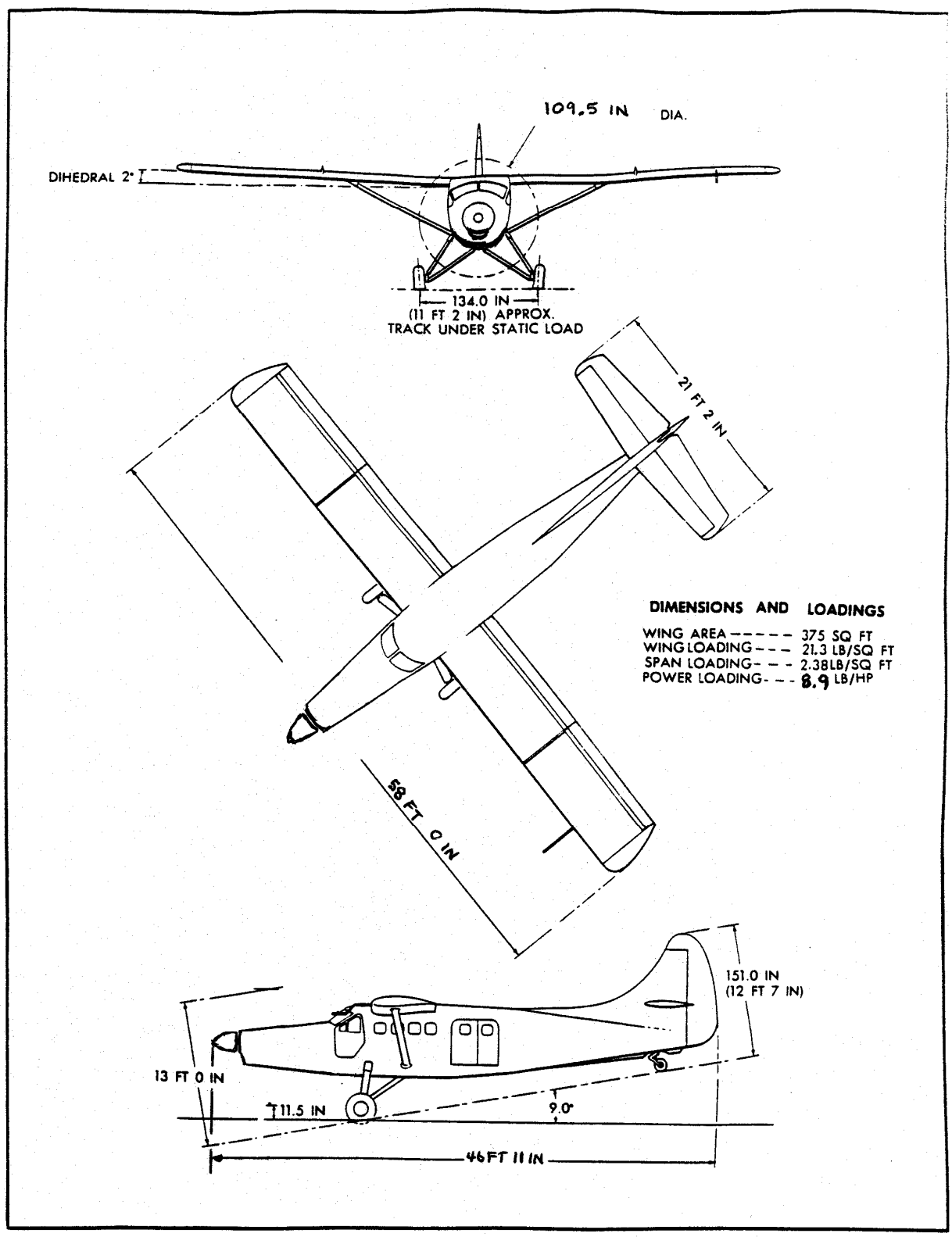


Figure 1-1, Three-view dimensional diagram: Landplane

SEAPLANE COMPATIBILITY

This conversion is compatible with the following approved float installations:

STRAIGHT FLOATS

Model	Length	Width	Installed Weight	Float Displacement	Otter Max Allowable Weight	Approval
EDO 7170	24'8"	10'6"	800 lbs.	7170 lbs.	7967-8367 lbs. (see notes 1 & 2)	TC A-815
EDO 7490	25'4.5"	11'0"	850 lbs.	7490 lbs.	8000-8367 lbs. (see note 1)	TC A-815
EDO 7850	26'2"	12'0"	900 lbs.	7850 lbs.	8000-8367 lbs. (see note 1)	U.S. STC SA678NW or CDN STC SA01-127 (see note 5)
Intaero 8100	26'6"	12'0"	1204 lbs.	8100 lbs.	8000-8367 lbs. (see note 1)	LSTC O-LSA01-475/D (see note 4)
Wipline 8000	27'6"	12'0"	1211 lbs.	7842 lbs.	8000-8367 lbs. (see note 1)	U.S. STC SA331CH (see note 3)

AMPHIBIOUS FLOATS

Model	Length	Width	Installed Weight	Displacement	Otter Max Allowable Weight	Approval
EDO 7490	25'4.5"	10'6"	1369 lbs.	7200 lbs.	8000-8367 lbs. (see note 1)	TC A-815
Wipline 8000	27'6"	12'0"	1504 lbs.	7570 lbs.	8000-8367 lbs. (see note 1)	U.S. STC SA331CH (see note 3

Note 1: This turbine engine conversion has been shown to be compatible with the AOG Air Support gross weight increase U.S. STC SA00438NY or Canadian STC SA95-32 to a maximum gross weight of 8367lbs. Without the installation of the AOG Air Support kit, the gross weight is limited to 7967 (for 7170's) or 8000 lbs (for all others).

Note 2: Aircraft utilizing 7170 floats must have an approved buoyancy modification to allow operation at the higher gross weight.

Note 3: This turbine engine conversion has been shown to be compatible with the Wipaire STC SA331CH to install the Wipline Model 8100 straight and amphibious floats.

Note 4: This turbine engine conversion has been shown to be compatible with the International Aeroproducts LSTC O-LSA01-475/D to install the Intaero 8100 straight floats.

Note 5: This turbine engine conversion has been shown to be compatible with the Jobmaster Company STC SA678NW or Canadian STC SA01-127 to install the EDO 7850 straight floats.

SECTION 2
LIMITATIONS

TABLE OF CONTENTS

Page

General Remarks....2-2

Airspeed Limitations....2-2

Airspeed Indicator Markings....2-2

Powerplant Limitations for TPE331-10....2-2

Powerplant Instrument Markings....2-3

Electrical System and Ignition Duty Cycle Limitations....2-3

Fuel Limitations....2-4

Oil Specifications....2-5

Propeller Limitations for Hartzell HC-B4TN-5NL/LT10890N....2-5

Weight Limits....2-5

Maneuver Limit....2-6

Bleed-air Heater Limits (if installed)....2-6

Other Limitations....2-6

GENERAL

The following limitations have been written with regard to the TPE331-10 engine only. For operation of the aircraft with the TPE331-12JR engine installed, refer to the TTC-FMS-12JR aircraft flight manual supplement.

AIRCRAFT CLASSIFICATION

No changes to the aircraft classification

ALL ACROBATIC MANEUVERS, INCLUDING SPINS, ARE PROHIBITED

Stalls are permitted for demonstration purposes only.

AIRSPEED LIMITATIONS

Maximum operating airspeed (Vmo)	144 mph (landplane) 134 mph (seaplane)

AIRSPEED INDICATOR MARKINGS

		Landplane	Seaplane
Red Line	Vmo	144 mph	134 mph
Green Arc	Normal operating range	77-144 mph	77-134 mph
White Arc	Full flap operating range	52-94 mph	52-94 mph

POWERPLANT LIMITATIONS (TPE331-10 engine)

Operating Condition	SHP	Torque (%)	Max EGT (degrees C)	RPM (%)	Oil Press. (psig)	Oil Temp. (degrees C)
Starting	---	---	770 (1 sec)	---	---	-40 (min)
Ground Idle	---	---	770	68 (min)	40 (min)	127
Takeoff	900	100	565 (1)	101.0	70-120 (3)	55-110 (4)
Maximum Continuous	900	100	565 (1)	101.0	70-120 (3)	55-110 (4)
Climb	900	100	565 (1)	101.0	70-120 (3)	55-110 (4)
Cruise (96%)	900	100	567 (1)	96 to 101.0	70-120 (3)	55-110 (4)
Landing	---	---	---	93.0 (min)	70-120 (3)	55-110 (4)
Maximum Reverse	---	---	565 (1)	101.0	70-120 (3)	55-110 (4)
Transient	---	104 (5 min)	770 (1 sec)	104 (2)	(6)	127 (5)

Note 1: The maximum permissible temperatures vary as a function of ambient temperature, altitude, and other operating conditions. Takeoff and maximum continuous EGT temperatures are for the ISA standard of 15 C at sea level.

Note 2: Transient operation of propeller output shaft speed above 104 percent, to a maximum of 106 percent is allowable for fuel control overspeed governor test when propeller is on the start locks. DO NOT allow the engine to windmill between 18% and 28 %.

Note 3: Normal operating range above 23,000 ft.: 50-120 psig.

Note 4: Oil temperature limits are for Type II oil. For Type I use: 55-79 C above 776 shp.
55-93 C below 776 shp.

Note 5: The TPE331-10 has an oil temperature limit at 776 shp or less of 127 C for five minutes. If the limit is exceeded, a SOAP sample is required within 25 flight hours.

Note 6: Transients above 120 psig can occur during cold weather starting

EGT LIMITS vs. INDICATED OAT:

Cond./Temp	-50 C	-40 C	-30 C	-20 C	-10 C	0 C	+10 C	+20 C	+30 C	+40 C	+50C
Takeoff/Max Cont. (100%)	528	533	537	541	546	554	561	569	578	588	598
Max Cruise (98%)	513	517	521	527	534	542	550	560	571	581	591
Normal Cruise (96%)	516	520	526	534	543	552	562	572	583	594	604

POWERPLANT INSTRUMENT MARKINGS

Engine Parameter	Green Band		Amber Band		Red Line
	low	high	low	high	
Speed- %	96	100	100	101	101
Torque- %	0	100	----	----	101
EGT- C	See Note 1				620
Oil Pressure- psi	70	120	40	70	40 min/ 120 max
Oil Temperature- C (Type II oil)	55	110	110	127	127
(Type I oil)	55	79	79	93	93
Fuel Pressure- psi	20	80	80	90	8 min/ 90 max

Note 1: The maximum permissible EGT limits vary as a function of ambient temperature. See the **EGT LIMITS vs. INDICATED OAT** table for the applicable limit.

ELECTRICAL SYSTEM and IGNITION DUTY CYCLE LIMITATIONS

Maximum continuous generator load is limited to 100 amps.

Ignition Unit Duty Cycle: One Hour (Total) ON in any Two Hour Period

Above 50°F (10°C): The ignition unit may be run up to one hour at a time. Total time "on" shall not exceed one hour without one hour "off". The one hour "on" may be either continuous or intermittent.

Below 50°F (10°C): The ignition unit may be run as needed without stopping.

FUEL LIMITATIONS

Recommended Fuel: JET-A

Emergency Fuels:

Fuel Type	Garrett** Specification	Class	Freeze Point, C	Equivalent Specification	Grade/Type	Freeze Point, C	Additives*** Anti-Icing	Additives*** Anti-Static	NATO Code
Kerosene Aviation Turbine Fuel	EMS53111	A	-40	ASTM D1655	A	-40	Conditional	Conditional	—
	EMS 51112	A-1	-46	ASTM D1655	A-1	-46	Conditional	Conditional	—
		JP-8	-50	U.S. MIL-T-83133A	JP-8	-50	Mandatory	Mandatory	F-14
				French Air 34050	—	-50	Optional	Optional	F-14
				British DERD 2494	AVTUR	-50	Without	Agreement	F-15
				British DERD 2451	AVTUR/FS11	-50	Mandatory	Agreement	F-34
Wide-Cut, Aviation Turbine Fuel	EMS 53113	A	-58	U.S. MIL-T-5624K	JP-4	-58	Mandatory	Mandatory	F-40
				French Air 34078	—	-58	Optional	Optional	F-40
				British DERD 2486	AVTAG	-58	Without	Agreement	—
				British DERD 2454	AVTAG/FS11	-58	Mandatory	Without	F-40
		B	-49	ASTM D1655	B	-49	Conditional	Conditional	—
High Flash Kerosene, Aviation Turbine Fuel	EMS 53116	JP-5	-46	U.S. MIL-T-5624K	JP-5	-46	Mandatory	Without	F-44
				French Air 34048	—	-46	Optional	Optional	F-42
				British DFRD 2498	AVCAT	-46	Without	Without	F-44
				British DERD 2452	AVCAT/FS11	-46	Mandatory	Without	F-44
Gasoline Aviation Type	EMS 53122 (Grade 100LL)			U.S. MIL-G-5572F	80/87	-60	Without	Without	F-12
				U.S. MIL-G-5572F	100/130	-60	Without	Without	F-18

*Gasoline may be used for emergency fuel operation. The consumption must to exceed 1000 U.S. gallons of Grade 80/87 on 250 U.S. gallons of Grade 100/130 per 100 hours of operation.

**The use of anti-icing and anti-static additives is approved for TPE331 turboprop engines as follows.

Anti-icing additive - Fuel system icing inhibitor conforming to MIL-I-27686E, or equivalent, is approved for use in homogenous mixtures not to exceed a volumetric concentration of 0.15 percent, except for JP-5 per MIL-T-5624L, which has a 0.20-percent limitation.

Anti-static additive - Electrical conductivity additive conforming to Shell ASA-3 or equivalent is approved for use to increase the conductivity of the fuel up to 300 picosiemens per meter for 300 picoohm/meter where 1 picoohm = $10^{-12}ohm^{-1}$ at 25C) providing the concentration does not exceed 1 milligram per liter.

***ADDITIVE TERMINOLOGY:

Conditional - Permitted, under conditions that the quantities and types of additives are declared by mandatory manufacturer and agreed to by purchaser.
Mandatory - Approved additive is required by specification within prescribed concentration limits.
Optional - Approved additives may be added within specified concentration.
Agreement - Approved additive may be added within specified concentration upon agreement beteween purchasing authority and the supplier.
Without - Not included among approved additives.

Fuel Management

- Do not takeoff with less than 134 lbs (20 U.S. gal.) of fuel in all three tanks.
- Burn from the front tank for takeoff and landing.
- After takeoff, burn fuel from the aft tank forward. Retain as much as possible in the front for landing.
- The electric boost pump must be used for takeoff, landing, fuel tank selection, and operations above 10,000 feet.

NOTE

A placard must be installed above the pilot stating, "**For starting, takeoff, landing, flight above 10,000 ft., and when selecting fuel tanks, the boost pump must be turned ON**".

OIL SPECIFICATIONS

Recommended Oil: -Type II Oil

Approved Oils:

Type	MIL Spec.	Brand Name
I	*MIL-L-7808D	Texaco SATO 15 Sinclair Turbo S Oil 15 Caltex SATO 15 British Petroleum Aero Turbine Oil 15 Brayco 880 Conojet Continental Conojet Regent SATO 15 Castrol 399
	*MIL-L-7808F	Stauffer Jet I Brayco 880H Hancock Airturb Syn Lube
	MIL-L-7808G	Stauffer Jet I Mobil Avrex-S Turbo 256 Exxon 2389 Brayco 880H
II	MIl-L-23699	Mobil Jet Oil II Exxon (Enco/Esso) 2380 Turbo Oil Chevron Jet Engine Oil No. 5 Stauffer Jet II Cal Tech RPM Jet Engine Oil No. 5 Castrol 205 Castrol 5000 Aeroshell/Royco Turbine Oil 500** Aeroshell/Royco Turbine Oil 560 Mobil 254

*MIL-L-7808D and F oils were qualified at 175F oil inlet temperature. All other listed oils were qualified at 230F oil inlet temperature.
**Approved for all engines certified to 776 shp or less.

PROPELLER LIMITATIONS for HARTZELL HC-B4TN-5NL/LT10890N

Feathered:	+81.2° ±0.5°	Measured at 42” station
Start Locks:	-1.4 to -5.5° ±0.1°	
Flight Idle Blade Angle:	+5.0° ±0.5°	
Max Reverse:	-12° ±0.5°	
Diameter:	109.5” to 107.5”	
Max Takeoff RPM:	100% (1591) rpm	
Max Cont. RPM:	100% (1591) rpm	
Transient RPM:	106% (1686) rpm	
Avoid Stabilized RPM:	Below 68% and between 85% to 92%	

CAUTION:

Stabilized ground operation is prohibited **below 68%** and **between 85% and 92%** .

WEIGHT LIMITS

Minimum gross weight is 4100 lbs. No change to maximum weights.

MANEUVER LIMITS

1. Do not intentionally sideslip the aircraft with flaps extended.

2. Do not intentionally sideslip the aircraft below 80 mph with flaps retracted.

BLEED-AIR HEATER LIMITS (if installed)

Bleed-air heater valve must be closed under the following conditions:

1. Before starting the engine
2. In-flight air start

OTHER LIMITATIONS

This aircraft is not approved for flight at night unless an anti-collision lighting system that meets the requirements of FAR 23.1401 has been installed.

SECTION 3
EMERGENCY PROCEDURES

TABLE OF CONTENTS

Page

Operating Instructions 3-2

Engine Failure 3-3
Engine Failure During Takeoff Run 3-3
Engine Failure In-flight 3-3
Air-start 3-3
Air-start from Feather 3-4
Aborted Air-start 3-5
Precautionary & Intentional Engine Shutdown 3-5
Aborted Ground Start 3-6

Propeller Failure 3-6
Propeller Control Malfunction 3-6
Propeller Failure During Takeoff 3-6
Propeller Failure After Takeoff 3-6

Engine Fire 3-7
Engine Fire on the Ground 3-7
Engine Fire In-flight 3-7

Fuel Control Malfunction 3-8

Engine Inlet Anti-ice and Continuous Ignition 3-8

Non-responsive Power Lever 3-8

Main Power Electrical Failure 3-8

Bleed-air Heater Duct Overheat (if installed) 3-8

Sudden Rise in EGT 3-9

OPERATING INSTRUCTIONS

The following operating procedures are presented in a form suitable for use by flight crews in the DeHavilland DHC-3ST Turbine Otter only. Procedures contained in this section will show the basic principles of aircraft and powerplant operation. During all operations, observe the operating limitations of the aircraft, propeller, and powerplant.

If the optional parallel/series start system is installed, all emergency procedures are the same except that there is only one master switch installed instead of two. In those procedures referring to the master switches, substitute MASTER SWITCH in place of BOTH MASTER SWITCHES.

The following definitions apply to warnings, cautions, and notes:

(a) **WARNING**: Operating procedures, techniques, etc., which could result in personal injury or loss of life if not carefully followed.

(b) **CAUTION**: Operating procedures, techniques, etc., which could result in damage to equipment if not carefully followed.

(c) **NOTE**: An operating procedure, techniques, etc., which is considered essential to emphasize.

All boxed items included in the following emergency checklist are considered critical to aircraft and personnel safety and should be committed to memory.

ENGINE FAILURE.

CAUTION

WINDMILLING IN THE SPEED RANGE BETWEEN 18 AND 28 PERCENT MAY RESULT IN ENGINE DAMAGE.

CAUTION

ACTIVATION OF THE STOP CIRCUIT FOLLOWING MANUAL SHUT DOWN OF AN ENGINE EQUIPPED WITH A FUEL PURGE SYSTEM WILL RESULT IN FUEL ACCUMULATION IN THE PLENUM. DO NOT ACTIVATE THE ELECTRICAL SHUT DOWN CIRCUITS UNTIL ENGINE COOLING PRECLUDES COMBUSTION.

NOTE

The engines are equipped with a negative torque sensor system, which, in the event of an engine failure, automatically moves the propeller blades toward the feather position and thus reduces propeller drag.

ENGINE FAILURE DURING TAKEOFF RUN

Remaining runway is sufficient for rollout:

1.	Brakes	-APPLY with control column fully back
2.	Emergency Fuel Shutoff/Feather Lever	-MOVE TO AFT AND LOCKED POSITION
3.	Firewall Emergency Fuel Shutoff	-PULL
4.	Fuel Selector Valve	-OFF
5.	AUTO/CONT. Ignition Switch	-OFF
6.	Both Master Switches	-OFF

ENGINE FAILURE IN-FLIGHT (no re-start will be attempted)

1.	Power Lever	-FULL FORWARD
2.	Emergency Fuel Shutoff/Feather Lever	-MOVE TO AFT AND LOCKED POSITION
3.	Firewall Emergency Fuel Shutoff	-PULL
5.	Fuel Selector Valve	-OFF
6.	AUTO/CONT. Ignition Switch	-OFF
7.	Both Master Switches	-OFF

AIRSTART (propeller unfeathered and wind-milling)

CAUTION

DO NOT ENGAGE THE STARTER DURING AN AIR START BECAUSE THE HIGH TORQUE REQUIREMENTS OF A FEATHERED PROPELLER MAY DAMAGE THE STARTER.

ABORT AIR START IMMEDIATELY WHEN:

1. PROPELLER FAILS TO ROTATE
2. RPM DOES NOT REACH 10 PERCENT IN 10 SECONDS
3. EGT IS NOT RISING 10 SECONDS AFTER 10-PERCENT RPM
4. EGT RISES RAPIDLY TOWARD START LIMITS

5. EGT APPROACHES START LIMIT
6. OIL PRESSURE FAILS TO RISE BY 65-PERCENT RPM
7. RPM STOPS INCREASING PRIOR TO PROPELLER GOVERNOR SETTING
8. ANY UNUSUAL NOISE OR VIBRATION OCCURS
9. ENGINE INSTRUMENTS INDICATE ABNORMAL CONDITIONS

If sufficient altitude is available attempt air start as follows:

1.	Altitude	-Below 20,000 feet
2.	Bleed-air heat valve (if installed)	-CLOSED
3.	Airspeed	-90 TO 144 MPH
4.	STOP Switch	-STOP
5.	Emergency Fuel Shutoff/Feather Lever	-FULL FORWARD AND LOCKED POSITION
6.	Fuel selector	-FULLEST TANK
7.	Boost Pump Switch	-ON with POSITIVE pressure
8.	Power Lever	-1" FORWARD OF FLIGHT IDLE. This position will reduce drag associated with the propeller.
9.	Condition Lever	-LOW RPM. This position will reduce overshoot when the engine speed reaches the propeller governor setting. The engine speed will stabilize between the propeller governor stops (94 to 100 percent rpm)
10.	AUTO/CONT. Ignition Switch	-CONT. POSITION
11.	FUEL ON/SPR Switch	-ON (watch for EGT to rise)
12.	FUEL ON/SPR Switch	-TOGGLE as necessary to accelerate

If air start fails:

1.	STOP Switch	-STOP
2.	Maintain maximum glide speed of 90 mph with flaps UP	
3.	Proceed with ENGINE FAILURE IN-FLIGHT CHECKLIST	

AIR START FROM FEATHER (requires approximately 1500 ft. min)

CAUTION

DO NOT OPERATE UNFEATHER PUMP WITH THE FEATHER LEVER IN THE FEATHER POSITION AS ALL THE OIL WILL BE PUMPED INTO THE ENGINE SUMP.

1.	Altitude	-BELOW 20,000 FEET
2.	Bleed-air heat valve (if installed)	-CLOSED
3.	Airspeed	-90 to 120 MPH
4.	Emergency Fuel Shutoff/Feather Lever	-FULL FORWARD AND LOCKED POSITION
5.	Power Lever	-Approx. 1 inch forward of FLIGHT IDLE
6.	Condition Lever	-LOW RPM to reduce overshoot
7.	Boost Pump	-ON with a POSITIVE fuel pressure
8.	AUTO/CONT. IGNTION Switch	-CONT. positions
9.	Unfeathering Pump	-ON When the unfeathering pump switch is held on manually, the switch can be released anywhere between 30 and 60 percent rpm

		because the pressure from the propeller pump is higher than the unfeather pump.
10.	Propeller	-ROTATING. As soon as the blades begin to unfeather the propeller should start to rotate. If not, release the unfeathering pump switch and recheck "prior to start" instructions. When all oil has been pumped out of the oil tank, unfeathering is not possible. Slow propeller rotation at high airspeeds might replenish the oil supply for unfeathering.
11.	FUEL ON/SPR Switch	-ON at 12-15%
12.	EGT	-RISING, OBSERVE LIMITS.
13.	RPM	-INCREASING. The engine rpm should continue to increase until reaching the propeller governor setting. If the engine speed dwells (stops increasing) abort the start and investigate the cause.
14.	Oil pressure	-RISING BY 65-PERCENT RPM. Do not operate the engine without oil pressure.

Once engine has stabilized:

1.	Condition lever	-AS NECESSARY
2.	Boost Pump	-OFF
3.	AUTO/CONT. Switch	-AUTO

ABORTED AIR START

1.	Fuel Shutoff and Feather Lever	-FULL AFT AND LOCKED POSITION
2.	AUTO/CONT. Switch	-OFF
3.	Boost Pump	-OFF

PRECAUTIONARY SHUTDOWN AND INTENTIONAL ENGINE SHUTDOWN WHEN AIR STARTS ARE ANTICIPATED

CAUTION
DO NOT EXCEED WINDMILLING LIMITS.

A normal shutdown should be accomplished when a precautionary or intentional shutdown is to be made, and an air start is desired soon after shutdown. The engine should be shut down with the stop switch and allowed to NTS down to approximately 35 percent rpm and then feathered. This allows the engine to be cooled during the shutdown so that an air start can be made after feathering the propeller.

1.	STOP Switch	-STOP
2.	NTS Action	-Check to approximately 35 percent rpm
3.	Fuel shutoff and feather lever	- FULL AFT AND LOCKED POSITION

If additional engine cooling is desired, restore the feather lever to normal and cause the engine to rotate slowly (about 10 percent rpm) by momentarily actuating the unfeathering pump. Observe wind milling limits.

ABORTED GROUND START

1.	Engine STOP Switch	-STOP
2.	Fuel Shutoff and Feather Lever	-PULL **for an electrical failure**

PROPELLER FAILURE.

PROPELLER CONTROL MALFUNCTION IN FLIGHT

Indications of a propeller control malfunction may be an inability to govern at the selected speed. If the beta light comes on at low power settings at approach airspeeds, when possible, check the handling of the aircraft by a simulated landing flare at a safe altitude. If power increases, the pilot should be prepared to shut down the engine on landing, as the pilot may not be able to reduce thrust on the engine during flare and after touchdown.

At first evidence of a runaway propeller:

1.	Power Lever	-FLIGHT IDLE
2.	Condition Lever	-MANIPULATE TO REGAIN CONTROL

CAUTION:

The engine can quickly exceed the rotor speeds and propeller speeds in a matter of seconds. Do not let the propeller or engine exceed the limits in Section 2.

If unsuccessful:

1.	STOP Switch	-STOP
2.	Proceed with ENGINE FAILURE IN-FLIGHT CHECKLIST	

PROPELLER FAILURE DURING TAKEOFF RUN

Abandon take-off as follows:

1.	Power Lever	-FLIGHT IDLE
2.	Brakes	-APPLY
3.	STOP Switch	-STOP

If necessary:

4.	Emergency Fuel Shutoff/Feather Lever	-FULL AFT AND LOCKED POSITION
5.	AUTO/CONT. Ignition Switch	-OFF
6.	Both Master Switches	-OFF

PROPELLER FAILURE AFTER TAKE-OFF

1.	Power Lever	-REDUCE
2.	Condition Lever	-MANIPULATE TO REGAIN CONTROL

3. If unsuccessful, decide whether to return to field, climb to decrease engine speed, or shut engine down.

ENGINE FIRE.

ENGINE FIRE ON THE GROUND

1.	STOP Switch	-STOP
2.	Boost Pump	-OFF
3.	Emergency Fuel Shutoff/Feather Lever	-FULL AFT AND LOCKED POSITION
4.	Firewall Emergency Fuel Shutoff	-PULL
5.	Fuel Selector Valve	-OFF
6.	AUTO/CONT. Ignition Switch	-OFF

If fire persists after the engine has stopped:

1. Have portable fire extinguisher discharged through augmentor tube opening

NOTE

After an engine has been on fire, no attempt should be made at re-starting until the engine has been examined.

ENGINE FIRE IN-FLIGHT

1.	STOP Switch	-STOP
3.	Boost Pump	-OFF
4.	Emergency Fuel Shutoff/Feather Lever	-FULL AFT AND LOCKED POSITION
5.	Firewall Emergency Fuel Shutoff	-PULL
6.	Fuel Selector Valve	-OFF
7.	AUTO/CONT. Ignition Switch	-OFF
8.	Bleed-air heat valve (if installed)	-CLOSE

If the fire persists:

1. Maintain maximum glide speed of 90 mph with flaps UP
2. Radio state of emergency and position
3. Instruct other occupants of aircraft for crash landing
4. Conduct ENGINE FAILURE IN-FLIGHT CHECKLIST

FUEL CONTROL MALFUNCTION.

If there is an indication of improper operation of the fuel control, when possible, check the handling of the aircraft by a simulated landing flare at a safe altitude before trying to land. If unusual drag is noted that cannot be eliminated by increasing the power, it may be necessary to feather the engine when the pilot has the runway made.

ENGINE INLET ANTI-ICE AND CONTINUOUS IGNITION.

Engine inlet anti-ice (inlet heat) should be used during all flight in potential icing conditions. These conditions exist when flying in precipitation or visible moisture (including clouds or fog), with OAT of +1OC (+50F) or colder.

Select AUTO/CONT Ignition Switch -TO AUTO or CONT as below:

1. During takeoff or approach, during or shortly after operation in icing conditions.
2. When ice is observed shedding from the propeller and/or spinner.
3. Before applying inlet heat, when ice has accumulated.
4. Immediately, any time engine flameout occurs as a possible result of ice ingestion.

NON-RESPONSIVE POWER LEVER.

If a lack of response to the power lever is observed, turn the AUTO/CONT. Ignition switch to CONT. and the ANTI-ICE switch ON. After the engine has cleared and normal operation is observed, which occurs in approximately three minutes, anti-ice and ignition can be turned OFF.

MAIN POWER ELECTRICAL FAILURE

1. Engine Instruments Back-up Switch -BACK-UP
2. Land at nearest suitable airport

BLEED-AIR HEATER DUCT OVERHEAT (if installed)

If the bleed-air heater duct-overheat light is illuminated (red light):

Verify that the bleed-air heat valve has been closed by the automatic duct overheat relay. If the valve is still indicating that it is open after 15 seconds, close the bleed valve manually with the toggle switch located on the bleed-air heater panel.

CAUTION

If there is a main power failure during use of the bleed-air heat system, the valve will remain in the last position selected and cannot be closed until the engine instruments back-up switch is turned ON. The valve will then be powered by the hot battery bus.

NOTE

The toggle switch that controls the bleed-air heat valve is disabled when the automatic duct overheat relay senses a duct overheat. If the automatic system fails, the toggle switch should still be operational.

SUDDEN RISE IN EGT

1.	Power Lever	-REDUCE
2.	Bleed-air Heat Valve (if installed)	-CLOSE

SECTION 4
NORMAL PROCEDURES

TABLE OF CONTENTS

Page

Exterior Inspection **4-2**

On Entering the Aircraft **4-2**

Before Engine Start **4-3**

Normal Engine Start **4-4**

Quick Turn-Around Engine Start **4-5**

Clearing Engines **4-5**

Before Taxi **4-5**

Taxi **4-6**

Before Takeoff **4-6**

Takeoff **4-7**

Climb **4-7**

Cruise **4-8**

Stalls **4-8**

Before Landing **4-8**
Steep Approach 4-8
Flat Approach 4-8
SideSlips 4-9

Landing **4-9**
Normal Landing 4-9
Crosswind Landing 4-9

Go-Around and Balked Landing **4-9**

After Landing **4-9**

Normal Engine Shutdown on Ground **4-10**

Before Leaving Airplane **4-11**

EXTERIOR INSPECTION.

1.	Wings and fuselage	-FOR DAMAGE
2.	Control surfaces and hinges	-CLEAR
3.	Tires	-FOR PRESS., SLIPPAGE MARKS & CUTS
4.	Hydraulic brake lines	-FOR LEAKS
5.	Pitot head cover	-REMOVED
6.	Chocks	-SET
7.	Fuel tank caps	-SECURE
8.	Stowage of cargo and luggage	-SECURE
9.	Load distribution and CG position	-WITHIN LIMITS
10.	Engine Air Inlet	-CLEAR and CLEAN.
11.	Engine Inlet Pres and Temp Sensor	-GENERAL CONDITION.
12.	Engine Exhaust	-CLEAR.
13.	Engine Oil Quantity	-PROPER LEVEL.
14.	Propeller	-ROTATION AND CONDITION, NO UNUSUAL ENGINE NOISE.
15.	Engine Cowling	-SECURE.
16.	Engine Fuel Drains	-CLEAR.
17.	Oil Filter Bypass Indicator	-CHECK.

NOTE: USE OF EXTERNAL POWER

Engine starts can be made with aircraft battery power or with auxiliary dc electrical power. Use an auxiliary power unit (GPU), if available, when ambient air temperature is 12C (54F) or below. Ensure that the GPU is regulated to 28 V dc and can provide at least 16 V dc, 1000 amperes during the starting cycle.

ON ENTERING AIRCRAFT.

NOTE: If the optional parallel/series start system is installed, all normal procedures are the same except that there is only one master switch installed instead of two. In those procedures referring to the master switches, substitute MASTER SWITCH in place of MASTER SWITCHES.

1.	Controls	-UNLOCKED
2.	Parking brake	-SET
3.	Flight controls	-CORRECT, FREE AND FULL MOVEMENT
4.	Trim tabs	-AS REQUIRED
5.	Control column throw-over lock	-SECURELY ENGAGED
6.	All switches	-OFF
7.	Battery Master Switches	-OFF (ON if, in an emergency, or external power is not used)
8.	External power	-CONNECTED

WARNING

WHEN EXTERNAL POWER IS CONNECTED, THE ELECTRIC SYSTEM OF THE AIRCRAFT IS ALIVE, IRRESPECTIVE OF THE POSITION OF THE MASTER OR ANY OTHER SWITCHES. HENCE, OPERATION OF THE STARTER SWITCH WILL TURN OVER ENGINE AND PROPELLER.

9.	Fuel quantities	-CHECK

10.	Fuel selector control	-FULLEST TANK
11.	Altimeter	-SET
12.	Clock	-SET
13.	Stowage of hand operated fire ext.	-CHECK
14.	Pilot's seat, if necessary	-ADJUST
15	Safety belt and shoulder harness, if provided	-FASTEN
16.	Flash light	-CHECK
17.	Communication equipment	-TEST

When night flying is anticipated, make the following checks with the help of an outside observer:

1. Landing light.
2. Navigation lights, identification lights if fitted.
3. Check panel lights, interior lights
4. Flashlight on board

CAUTION

Do not leave landing light on for more than 10 seconds in any two-minute period when aircraft is on the ground, or else heat may fuse the landing light in the ON position.

BEFORE ENGINE START.

1.	Bleed-air Heat Valve (if installed)	-CLOSED
2.	Condition Lever	-LOW RPM
3.	Power Lever	-FLIGHT IDLE
4.	Fuel Shutoff and Feather Lever	-FORWARD AND LOCKED
5.	Aircraft Power	-EXT. POWER or MASTER SW. ON (or both)
6.	Bus Voltage	-24V (Battery) 28V(GPU)
7.	Propeller	-CLEAR and ON start locks

If feathered:

a.	Power Lever	-REVERSE.
b.	Unfeather Pump	-ON.
	-Observe propeller blade angle until the propeller blades have moved to the locked position.	
c.	Unfeather Pump	-OFF.
d.	Power Lever	-FLIGHT IDLE.

8.	Auto/Cont. Ignition switch	-TEST BOTH POSITIONS, THEN OFF
9.	Fuel Boost Pump	-ON
10.	Stop switch	-STOP POSITION

NOTE

If indicated EGT is in excess of 200 C, the engine may be cranked without fuel until 15 percent rpm is attained to lower internal temperatures. Add fuel after 15 percent and EGT temperature below 200 C.

ENGINE START SHOULD BE ABORTED WHEN

1. **PROPELLER FAILS TO ROTATE**
2. **RPM DOES NOT REACH 10 PERCENT WITHIN APPROXIMATELY 10 SECONDS**
3. **EGT IS NOT RISING APPROXIMATELY 5 SECONDS AFTER 10-PEPCENT RPM OR APPROXIMATELY 10 SECONDS WHEN COLD SOAKED**
4. **EGT/ITT RISES RAPIDLY TOWARDS START LIMIT**
5. **EGT/ITT APPROACHES START LIMIT**
6. **OIL PRESSURE FAILS TO RISE BY IDLE RPM**
7. **RPM STOPS INCREASING PRIOR TO IDLE RPM**
8. **ANY UNUSUAL NOISE OR VIBRATION OCCURS**
9. **ENGINE INSTRUMENTS INDICATE ABNORMAL CONDITIONS**

NOTE

The intervals of time and rpm given for abort are not limits, but are mentioned to provide a relative guide for starting with conditions of the batteries/auxiliary power, starter, ambient temperature, and altitude taken into consideration. These conditions and temperatures of below ISA will have an effect on engine acceleration to 10 percent rpm during the starting cycle. A minimum acceleration rate of **one percent per second** should be obtained to achieve normal starts.

NOTE

Following an aborted start, a second start can be made. Use the start procedure with fuel entered at 15-percent rpm. When EGT rises initially, release fuel enrichment immediately if abort is for excessive turbine temperature.

NORMAL ENGINE START.

1.	START/GEN Switch	-START (check propeller rotation).
2.	12-15% engine rpm.	-FUEL/SPR SWITCH TO ON (hold on until light-off or three seconds, whichever comes first)
3.	FUEL ON/SPR Switch	-TOGGLE TO HELP ENGINE ACCELERATE

CAUTION

DO NOT USE SPR (or FUEL ENRICHMENT) IF EGT APPROACHES THE START TEMPERATURE LIMIT.

NOTE

Use the fuel enrichment switch as follows:

ON- at 12-15% and hold three seconds or until light-off, whichever comes first
OFF- When EGT rises
ON- To assist acceleration
OFF- When EGT rises rapidly or approaches the start temperature limit or at 60-percent rpm

4.	EGT Rising. **Limit 770C**	-CHECK.
5.	Tachometer	-RPM INCREASING.
6.	Oil Pressure	-RISING.
7.	START/GEN switch	-OFF at 55 percent rpm
8.	Starter/Ignition Light	-VERIFY OFF

QUICK TURNAROUND ENGINE START.

NOTE

A normal engine start can be made at any time after a normal shutdown as long as the electrical power source and wind direction and velocity are satisfactory.

If an engine start is to be made 10 to 45 minutes from the last shutdown, it is recommended that the propeller be turned to both ventilate the engine and reorient the rotating group.

A cooler start can be made by motoring the engine to 15 percent rpm prior to adding fuel.

CLEARING ENGINES.

Clearing an engine of fuel or vapors is accomplished either by motoring the engine with the starter, with the fuel off, or by allowing 3 minutes for fuel to drain from the engine before attempting another start.

BEFORE TAXI.

1.	START/GEN Switch	-GEN
2.	Engine Instruments	-CHECK
3.	WARNING Lights	-CHECK
4.	AUTO/CONT. Ignition Switch	-AUTO
5.	Fuel System	-CHECK ALL FILLED TANKS FEED
6.	Electrical System	-CHECK VOLT/AMMETER
7.	Heater Recirculation Fan (if installed)	-AS NECESSARY
8.	Bleed-air Heat Valve (if installed)	-AS NECESSARY

CAUTION

As the bleed-air heat valve is opened, the engine EGT at ground idle may rise as much as 30 degrees C. Observe EGT limits. Care must be taken when trying to rapidly heat the cabin, because the duct temperatures can easily reach the 250°F ±5°F duct temperature limit.

9.	Test Flaps and Hand-pump Operation	-TEST
10..	Seat Belts	-FASTEN
11.	Radios- COMM and NAV	-SET
12.	Overspeed Fuel Governor Check	-(PROPELLER START LOCKS WILL REMAIN ENGAGED FOR THIS CHECK.) This check should be made every 300 flight hours for the Woodward and Bendix Fuel Control Systems), prior to each flight when air starts are to be intentionally made, if there is any

indication of malfunction, or when any maintenance or adjustments involving the engine control system have been performed. Ensure that brakes are locked and the area ahead of the aircraft is clear.

CAUTION
DO NOT ALLOW RPM TO EXCEED LIMITS OF SECTION 2

	Condition Lever	-HIGH RPM
	Power Lever	-Advanced to maximum stabilized rpm of 103-105 percent rpm. If the rpm is not within limits, see engine maintenance manual.
	Power Lever	-RETARD TO GROUND IDLE
	Condition Lever	-LOW RPM
13.	Unlock Propeller Start Locks	-Set COND. lever to "High." Move power lever slowly towards reverse until a positive indication of reverse thrust is observed as a rise in torque. Reset power lever to ground idle.
14.	Check Propeller Start Locks	-Move power lever slowly towards flight idle until a positive indication of forward thrust is observed as a rise in torque. Reset power lever to ground idle.

TAXI.

CAUTION
IF ENGINE SPEED DECREASES BELOW 64 PERCENT RPM, UNLOAD THE ENGINE BY MOVING THE POWER LEVER TO THE GROUND IDLE POSITION.

CAUTION
IF THE RPM DECAYS TO 55 PERCENT DURING STATIC OR TAXI OPERATION, SHUT DOWN THE ENGINE IMMEDIATELY.

NOTE
If power above flight idle is needed during taxi with the engine speed control in the low position, advance the engine speed control as necessary.

1.	Wing flaps	-CRUISE to improve directional control
2.	Chocks	-REMOVE
3.	Parking Brake	-RELEASE
4.	As soon as airplane is rolling	-APPLY BRAKES TO TEST

BEFORE TAKEOFF.

1.	Doors	-CHECKED FOR CLOSED
2.	Elevator trim	-TAKE OFF SETTING

3.	Wing flaps	-TAKE-OFF POSITION
4.	Directional gyro and artificial horizon	-SET AND UNCAGED
5.	Pitot Heat	-AS NECESSARY
6.	Stall Warning Light	-PUSH TO CHECK LIGHTING
7.	Anti-ice Switch	- OFF
8.	Bleed-air Heat Valve (if installed)	-AS NECESSARY
9.	Boost Pump	- ON
10.	Fuel Selector	-FRONT TANK
11.	Power Lever	-GROUND IDLE
12.	Engine Instruments	-CHECK
13.	Annunciator Lights	-CHECK

TAKEOFF.

CAUTION

ENGINE SPEED CONTROL LEVER MUST BE IN THE HIGH POSITION OR TORQUE FLUCTUATIONS MAY OCCUR.

1.	Friction controls	-ADJUST to prevent creep
2.	Condition Lever	-HIGH (should see 96-97 percent RPM)
3.	Power Lever	-ADVANCE (should see 100-101 percent RPM)

NOTE

Move power lever forward until 100% torque or the maximum EGT for the conditions is reached, whichever comes first**.** Do not exceed limits in Section 2.

4.	Aircraft Yaw	-COUNTERACT ANY TENDENCY OF AIRCRAFT TO SWING (usually to the right)
5.	Rotation	-Allow airplane to fly itself off in a tail-down attitude at approximately 55 mph IAS

CLIMB.

For maximum rate of climb:

1.	Condition Lever	-HIGH
2.	Power Lever	-MAXIMUM CONTINUOUS

NOTE

Do not exceed limits in Section 2.

INITIAL CLIMB:

-To achieve the maximum angle of climb on take-off climb at 64 mph using take-off power and TAKE-OFF flaps.

CONTINUOUS CLIMB:

-At approximately 500 feet above the airfield, reduce power if desired.

For reduced power or en-route climb:

1.	Power Lever	-REDUCE AS REQUIRED
2.	Engine Speed Control	-96 to 98 PERCENT RPM

CRUISE.

1.	Flaps	-UP
2.	Engine Speed Control	-96 to 98 PERCENT RPM
3.	Power Lever	-AS REQUIRED
4.	Boost Pump	-OFF
5.	Heater Recirculation Fan (if installed)	-AS NECESSARY
6.	Bleed-air Heat Valve (if installed)	-AS NECESSARY

CAUTION

As the bleed-air heat valve is opened, the engine EGT may rise as much as 20 degrees C, depending on flight condition. Observe EGT limits. Care must be taken when trying to rapidly heat the cabin, because the duct temperatures can easily reach the 250°F ±5°F duct temperature limit.

STALLS

CAUTION

When demonstrating stalls with power on and flaps extended, full rudder deflection may be reached before aircraft stalls. Recovery must be initiated prior to full rudder deflection.

BEFORE LANDING.

1.	Condition Lever	-HIGH
2.	Power Lever	-Retard toward FLIGHT IDLE as required for the proper rate of descent.
3.	Boost Pump	-ON
4.	Fuel Selector	-TO FORWARD TANK
5.	Bleed-air Heat Valve (if installed)	-AS NECESSARY
6.	Instruments	-CHECK
7.	Flaps	-LANDING or as desired
8.	Brakes	-CHECK

STEEP APPROACH

1.	Wing Flaps	-LANDING
2.	Power Lever	-FLIGHT IDLE
3.	Airspeed	-SLOW UNTIL BETA LIGHT ILLUMINATES
4.	Airspeed	-MAINTAIN 68 MPH

The rate of descent will be approximately 3000 feet per minute.

FLAT APPROACH (with a dead engine or under forced landing conditions)

1.	Propeller	-FEATHERED
2.	Flaps	-UP
3.	Airspeed	-85 MPH

Gliding without power at that speed will result in a gradient of 10%, which corresponds with an angle of 5.7 degrees.

CAUTION

IF IT IS NECESSARY TO DO A LANDING APPROACH ON THE CENTER TANK AFTER THE LOW LEVEL WARNING LIGHT HAS COME ON, THE AIRCRAFT SHOULD BE FLOWN LEVEL OR NOSE HIGH WITH THE BOOST PUMP ON.

SIDESLIPS

The aircraft may be sideslipped although the recommended method is with the use of drag through a reduction in the power lever setting. The airspeed must not drop below 80 mph in an intentional sideslipping. Recovery should be initiated above 250 feet from the ground. Side slipping with flaps extended is prohibited.

LANDING.

NORMAL LANDING

No change

CROSS WIND LANDING

Because of the low landing speed of the aircraft with full flaps, crosswind landings should be made by experienced pilots only and not be attempted if the lateral component of the wind velocity is more than 17 mph (landplane). In gusty air, reduced flap settings may be preferred by the pilot.

GO-AROUND AND BALKED LANDING.

Decide early in approach whether it is necessary to go around.

1.	Power Lever	-100% TORQUE or MAX EGT
2.	Elevator trim	-ADJUST TO KEEP NOSE DOWN
3.	At Safe Altitude & Airspeed	-RETRACT FLAPS IN TWO STEP WHILE TRIMMING IN BETWEEN

AFTER LANDING.

1.	Flight Idle Stop Release	-After touch-down, release the flight idle stop and move the power lever back until the beta light comes on and then to the GROUND IDLE position and then REVERSE range as required for deceleration.
2.	Condition Lever	-LOW RPM (Leaving run-way)
3.	Flaps	-UP
4.	Elevator Trim	-NEUTRAL

NORMAL ENGINE SHUTDOWN ON GROUND.

NOTE: If the optional parallel/series start system is installed, all normal procedures are the same except that there is only one master switch installed instead of two. In those procedures referring to the master switches, substitute MASTER SWITCH in place of MASTER SWITCHES.

NOTE: Engines with a fuel purge system will not totally charge unless a minimum engine rpm of 95 percent is attained during the operational cycle. Partial purge will result in minor smoking from the engine.

1. Power Lever -GROUND IDLE

CAUTION

ACTIVATION OF THE STOP CIRCUIT FOLLOWING MANUAL SHUT DOWN (Moving the emergency fuel shutoff/feather lever aft) OF AN ENGINE EQUIPPED WITH A FUEL PURGE SYSTEM WILL RESULT IN FUEL ACCUMULATION IN THE PLENUM. DO NOT ACTIVATE THE ELECTRICAL SHUT DOWN CIRCUITS UNTIL ENGINE COOLING PRECLUDES COMBUSTION.

NOTE

Engines with a fuel purge system require actuation of the purge circuit for 5 seconds min. or until engine speed decreases below ground idle speed. The rpm should increase with actuation of the STOP circuit, then decrease when the manifold fuel is depleted.

2. Bleed-air Heat Valve (if installed) -CLOSED
3. Engine Stop Switch -STOP
4. Power Lever -REVERSE below 50 percent RPM (to engage propeller blade start locks during shutdown) hold until propeller stops.

NOTE

To Feather Propeller on Shutdown, use normal procedure, except power lever to FLIGHT IDLE in Step 3.

5. Boost Pump -OFF
6. AUTO/CONT. Ignition Switch -OFF

NOTE

Monitor engine coast-down for unusual noises.

@ 0 percent engine speed:

7. Power Lever -FLIGHT IDLE
8. START/GEN Switch -OFF

CAUTION

MOVING THE START/GEN SWITCH TO THE START POSITION WHILE THE ENGINE IS RUNNING CAN CAUSE SEVERE DAMAGE TO THE STARTER/GENERATOR.

9. Heater Recirculation Fan (if installed) -OFF
10.. Battery Master Switches -OFF

BEFORE LEAVING AIRPLANE.

1.	Wheels	-CHOCKED
2.	Parking brake	-RELEASED

CAUTION

DO NOT LEAVE PARKING BRAKES SET. THERE IS A POSSIBILITY OF SEIZURE, IF BRAKES ARE OVER-HEATED DUE TO HARD TAXIING.

3.	Gyros	-CAGE
4.	Controls	-LOCKED
5.	All switches	-OFF
6.	Elevator Trim	-NEUTRAL, if not done while taxiing.
7.	Have airplane tied down with protective covers placed in position	
8.	REPORT ANY UNSATISFACTORY CONDITIONS –	

SECTION 5
PERFORMANCE

TABLE OF CONTENTS

Page

Performance at 8000 lb Gross Weight 5-2

Cruise Power Settings 5-2

Flight Characteristics 5-2

Stall Speed Chart 5-2

Noise 5-3

PERFORMANCE AT 8000 LB GROSS WEIGHT.

The aircraft performance meets or exceeds that of the original aircraft. Refer to the original DeHavilland DHC-3 Otter Flight Manual for determining performance.

NOTE

Use of the Bleed-air Heater System can degrade the climb performance as much as 100 ft/min. The resulting climb performance still meets or exceeds that of the original aircraft. A torque loss of up to 8% can be seen with the bleed-air heater full open versus closed for the same takeoff EGT.

CRUISE POWER SETTINGS.

For turbine engine aircraft, the best fuel efficiency (relative to fuel consumption vs. horsepower) is usually the maximum turbine temperature allowable at the given engine inlet temperature. This is not possible with the engine installed, because the pilot can easily exceed the airframe speed limits. Therefore, it is recommended to set the power lever to the highest allowable speed for the conditions within the operating envelope and reduce the engine speed (with the condition lever) to 96%. The lower engine speed will reduce fuel consumption and the engine noise level.

FLIGHT CHARACTERISTICS.

The flight characteristics are very similar to the original aircraft although the p-factor is opposite to the original due the counter-clockwise rotation of the engine and propeller.

STALL SPEEDS

1. Airspeeds shown are in mph-calibrated airspeed.
2. Power set at zero thrust.
3. Maximum altitude loss during any stall is 350 feet.
4. Stall characteristics are conventional.

CAUTION

When demonstrating stalls with power on and flaps extended, full rudder deflection may be reached before aircraft stalls. Recovery must be initiated prior to full rudder deflection.

Weight (lbs)	Flap Position	Angle of Bank			
		0°	20°	40°	60°
8,000	Up	77	79	88	109
	Climb	57	59	65	81
	Landing	52	54	59	74
7,500	Up	75	77	85	105
	Climb	55	57	63	78
	Landing	50	52	58	71
7,000	Up	72	74	82	102
	Climb	53	55	61	76
	Landing	49	50	56	69
6,500	Up	70	72	80	99
	Climb	52	53	59	73
	Landing	47	49	54	67
6,000	Up	68	70	77	96
	Climb	50	52	57	71
	Landing	46	47	52	65

NOISE

The FAR 36 Appendix G noise level for this aircraft is 81.8 dB(A). No determination has been made by the Federal Aviation Administration that the noise levels of this airplane are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

SECTION 6
WEIGHT & BALANCE

TABLE OF CONTENTS

Page

General 6-2

Weight Definitions 6-2

Fuel Allowances 6-2

Determining Aircraft Weight & CG 6-2

Balance Diagram 6-3

Operational Loads Diagram 6-4

WEIGHT AND BALANCE LIMITATIONS.

GENERAL

At the maximum gross weight of 8000 lbs., the aircraft complies with the general performance and strength criteria. In the interest of airworthiness it is important that the weight and balance limits for the airplane be adhered to in accordance with the recommendations and information given in the following paragraphs, tables and diagrams.

WEIGHT DEFINITIONS

No changes to the weight definitions from the previous manual.

FUEL ALLOWANCES

The total fuel consumed, fuel flow, and time-to-empty can be determined using the Electronics International fuel flow gauge after accuracy has been positively identified. Do not use the original DeHavilland fuel flow or endurance data with this installation.

DETERMINING AIRCRAFT WEIGHT AND CG

No changes from the original aircraft techniques.

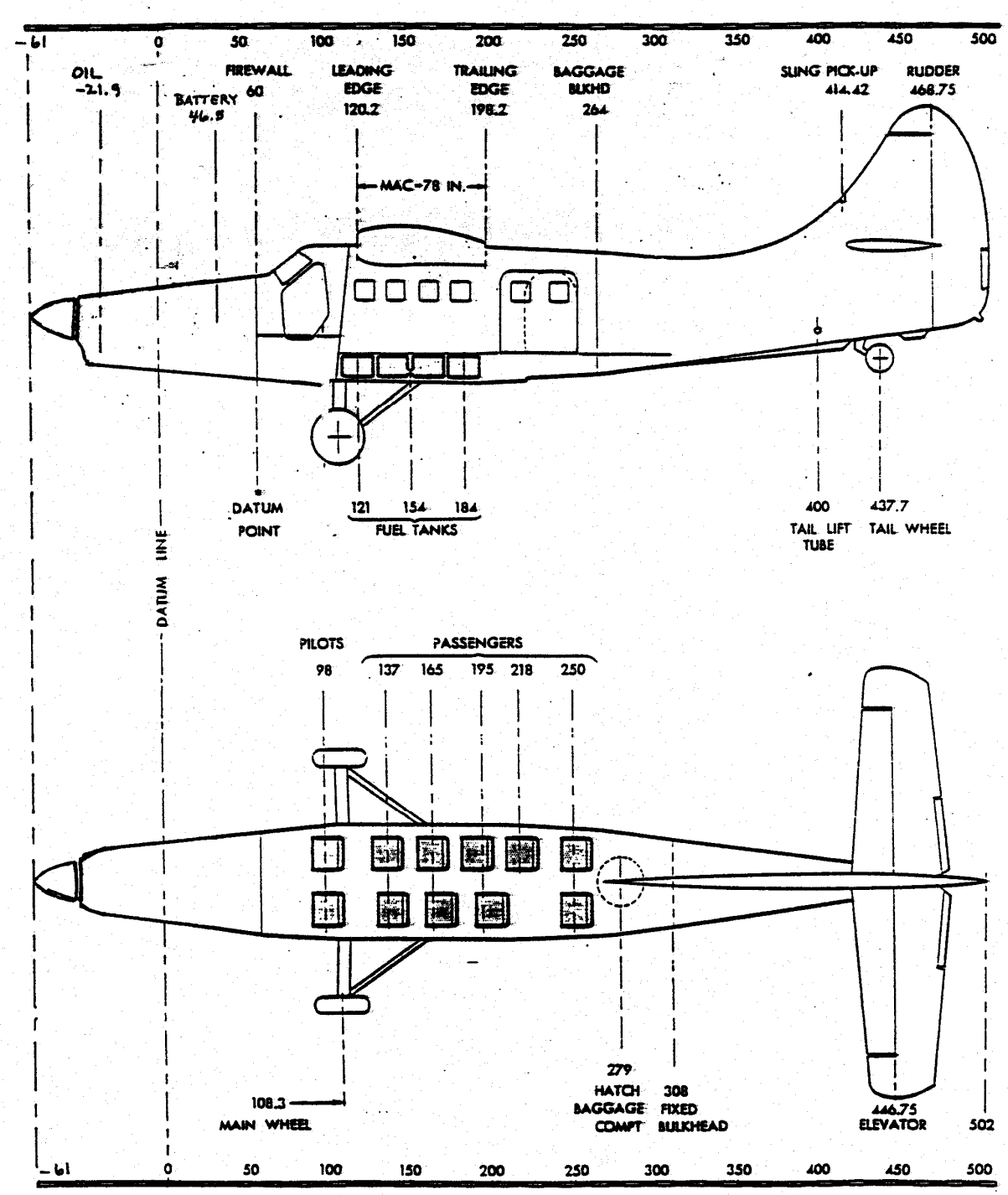


Figure 6-1, Balance Diagram

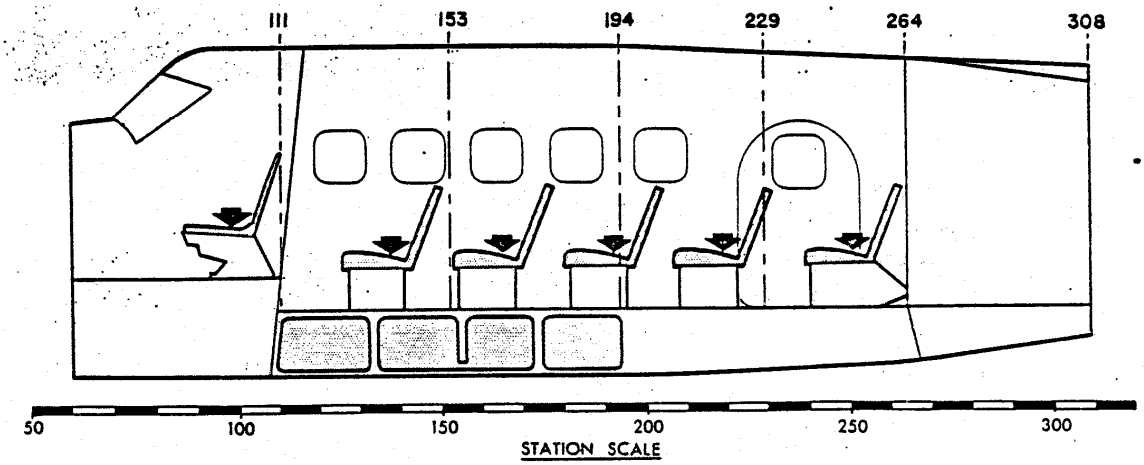
BASIC WEIGHT OF AIRCRAFT .....LB *

BASIC MOMENT ..... *

* (INSERT ACTUAL WEIGHT AND BASIC MOMENT GIVEN IN WEIGHT AND BALANCE REPORT TO BE FOUND IN ENVELOPE ON INSIDE OF REAR COVER)

STD. WEIGHT OF PILOT(S) OR PASSENGER(S). 170 LB

MEAN ARM IN INS.	98		137	165	195	218		250	279	
MOMENT/100	170		235	285	330	371		425	SEE BELOW	
FREIGHT COMPT. NO.	▲	D-1	▲	D-2	▲	D-3	▲	D-4	E	SEE FREIGHT MOMENT TABLE



1) ADD TO BASIC WEIGHT AND TO BASIC MOMENT:
- A) PILOT(S) AND PASSENGER(S)
- B) FREIGHT AND BAGGAGE
- C) FUEL AND OIL

} WEIGHTS AND MOMENTS

2) MAKE SURE:
- A) TAKE-OFF WEIGHT IS LESS THAN MAX ALL-UP WT
- B) TOTAL MOMENT VALUE IS WITHIN SAFE MOMENTS LIMITS
- C) AVAILABLE TAKE-OFF DISTANCE PERMITS TAKE-OFF AT THIS WEIGHT

3) ADDITIONAL INFORMATION:
- FREIGHT MOMENT TABLE
- BALANCE DIAGRAM
- FLOOR LOAD DISTRIBUTION DIAGRAM

OIL
CAP. 9 U.S. QTS

LBS.	ARM	MOM/100
14.0	-21.9	-306.6
1.8	9	16.2

FUEL FRONT TANK
CAP. 62 US GALS. ARM= 121 INS.

GALS.	LBS.	MOM/100
10	67	81.1
20	134	162.1
30	201	243.2
40	268	324.3
50	335	405.4
62	415.4	502.6

FUEL CENTRE TANK
CAP. 102 US GALS. ARM= 154 INS.

GALS.	LBS.	MOM/100
10	67	103.2
20	134	206.4
30	201	309.5
40	268	412.7
50	335	515.9
60	402	619.1
70	469	722.3
80	536	825.4
102	683.4	697.1

FUEL REAR TANK
CAP. 51 US GALS. ARM= 184 INS.

GALS.	LBS.	MOM/100
10	67	123.3
20	134	246.6
30	201	369.8
40	268	493.1
51	341.7	628.7

BAGGAGE COMPARTMENT
ARM = 279 INS.

WEIGHT	MOM /100
50	140
100	279
150	419
200	558
250	698
300	837
350	977
400	1116
450	1256
500	1395
550	1535
600	1674
650	1814

Figure 6-2, Operational Loads Diagram

SECTION 7
SYSTEMS DESCRIPTION

TABLE OF CONTENTS

Page

Engine Ratings and Modes of Operation....7-3
General....7-3
Exhaust Augmentor Tube....7-3
Cockpit and Instrument Panel Layout....7-4
Engine Controls and Instruments....7-5
Power Lever....7-5
Condition Lever....7-5
Emergency Fuel Shutoff/Feather Lever....7-5
Master Switch....7-5
Engine Ignition System....7-5
Boost Pump Switch....7-5
Fuel On/SPR and Stop Switch....7-6
Start/Gen Switch....7-6
Anti-ice Switch....7-6
NTS Switch....7-6
Unfeathering Pump Switch....7-6
Engine Instruments....7-7
Percent RPM Gauge....7-7
EGT Gauge....7-7
Engine Instrument Panel....7-7
Torque Gauge....7-7
Fuel Flowmeter/Fuel Pressure Gauge....7-8
Oil Pressure/Oil Temperature Gauge....7-8
Voltmeter/Ammeter....7-8
Hour Meter....7-8
LED Dimmer Control....7-8
Annunciator Panel....7-8
Annunciator Press-to-Test Switch....7-9
Propeller....7-9
Oil System....7-9
Fuel System....7-10
Fuel System Schematic....7-10
Fuel Selector Handle....7-11
Fuel Booster Pump Switch....7-11
Fuel Contents Gauge....7-11
Fuel Low Level Warning Light....7-11
Emergency Fuel Shutoff Control....7-11
Electrical System....7-12
Electrically Operated Equipment....7-12

Circuit Breaker Panel 7-12
External Power Receptacle 7-12
Flight Controls 7-13
Wing Flaps Hydraulic System 7-13
Landing Gear 7-13
Instruments 7-13
Vacuum Operated Instruments 7-13
Emergency Equipment 7-13
Bleed-air Heater (if installed) 7-13
Miscellaneous Equipment 7-14
Servicing Points Diagram 7-15

ENGINE RATINGS AND MODES OF OPERATION.

The Honeywell TPE331-10 turbo prop engine is a single-shaft turboprop type with a two-stage centrifugal compressor, annular combustion chamber, and a three-stage axial turbine. The engine drives a four-blade constant speed, full-feathering, reversible propeller at 1591 rpm through a 1:26.229 gear reduction. Two controls, an engine speed control (or condition lever) and a power lever, provide all necessary control of the engine and propeller during normal operation.

The engine ratings, power lever, and engine speed control settings areas follows:

Takeoff & Continuous - This rating is the maximum power permissible and corresponds and corresponds to 900 SHP. Takeoff and continuous power limit is determined by either 900 SHP or the maximum allowable exhaust gas temperature (EGT) for the conditions, whichever is reached first.

Normal Cruise- The airframe speed limitations or maximum continuous EGT, which ever is reached first, determine the maximum power allowed in cruise. For slightly quieter cruise operation the engine speed may be reduced to 96% rpm.

Beta Mode- Beta mode operation of the propeller, in which the propeller blades are set at a very low positive angle, is used in the air for fast deceleration and high rates of descent. When operating in the beta mode, the propeller pitch angle is controlled by the position of the power lever instead of the propeller governor. The amount of drag may be varied, as desired, by movement of the power lever. (The propeller will not operate in beta mode at airspeeds above approximately 110 knots IAS). Beta operation is not to be confused with propeller reversing **which is never used in the air**. A blue beta mode indicator light on the instrument panel illuminates whenever the propeller blades are operating in the beta mode. The condition lever should be full forward (100% RPM) when operating in Beta mode.

Reverse- Either full or partial reverse thrust is obtained by lifting the gate and moving the power lever to any position aft of the flight idle stop. A small amount of right torque may be noticeable with full reverse thrust. Reverse thrust is for ground operation only and **is never used in flight**.

EXHAUST AUGMENTOR TUBE:

The exhaust augmentor tube exits the cowling on the lower right-hand side. The exhaust gases passing through the augmentor produce suction strong enough to pull cooling air around the engine and accessories while at the same time providing a measurable amount of thrust in cruising flight. The engine is effectively cooled during steep climbs when the forward airspeed is low and on the ground with little or no ram-air cooling.

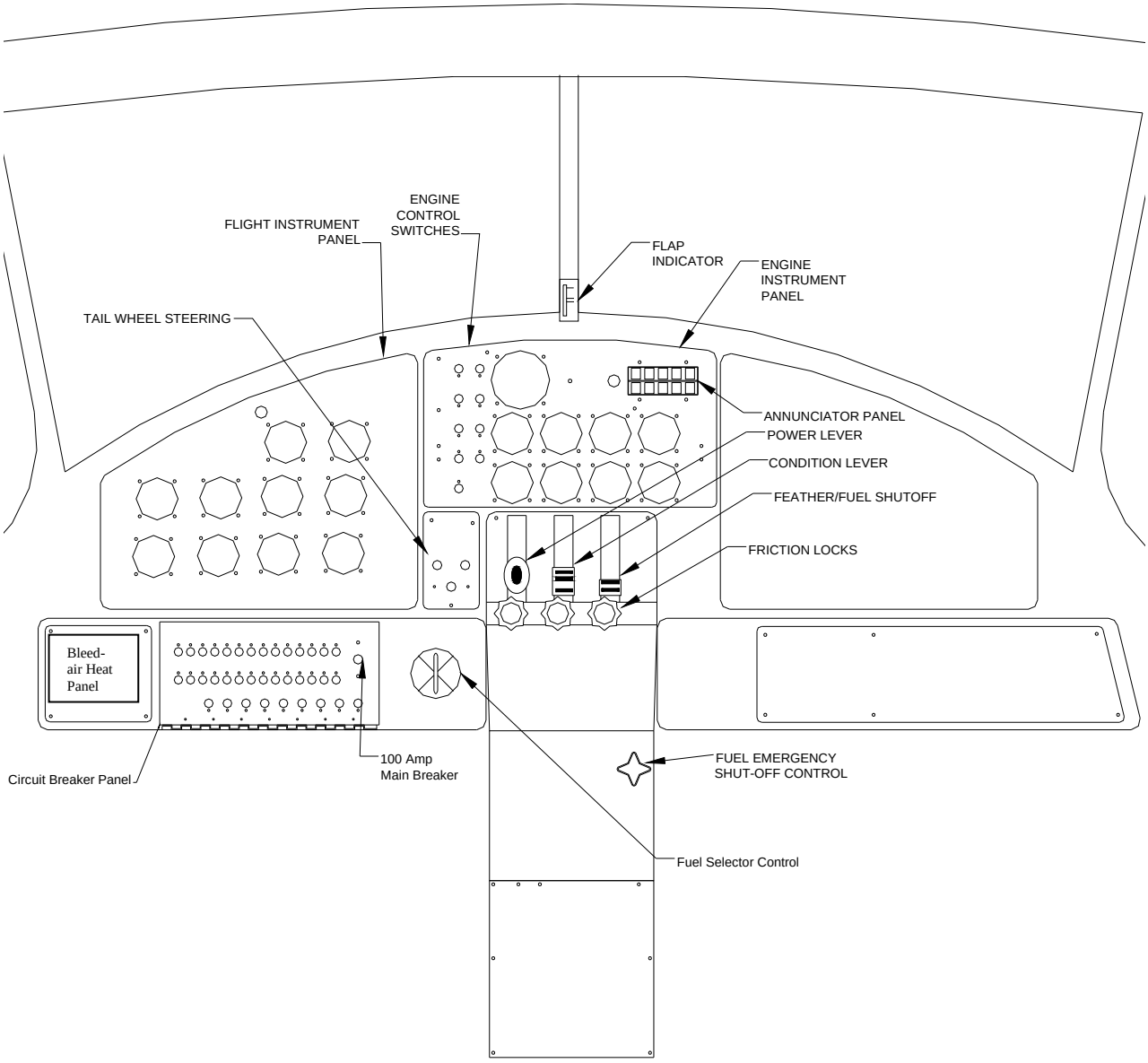


Figure 7-1, Cockpit and Instrument Panel Layout

ENGINE CONTROLS AND INSTRUMENTS.

POWER LEVER. The power lever on the left of the quadrant at the top of the pedestal slides forward and aft between full power and full reverse with a flight idle stop at approximately 40 degrees power lever angle (PLA). The power lever is connected to the engine via control rods.

A friction control below the power lever prevents power lever creep when rotated clockwise.

CONDITION LEVER. The condition lever is linked to the engine fuel control underspeed governor and the propeller governor speed control. Positioning the control full aft sets the fuel control underspeed governor to 68% engine speed (low idle) and the propeller governor to 96% engine speed. Positioning the control full forward sets the fuel control underspeed governor to 97% engine speed (for landing and reverse operation) and the propeller governor to 100% engine speed (for takeoff and climb operation). In-flight cruise adjustment from 100% to 96% rpm is obtained by pulling the condition lever slowly aft to the desired rpm.

CAUTION

Stabilized ground operation is prohibited **below 68%** (1081) rpm and **between 85% (1352) rpm and 92% (1464) rpm**.

EMERGENCY FUEL SHUTOFF/FEATHER LEVER. The emergency fuel shutoff/feather lever is on the far right side of the pedestal and moves fore and aft between two locked positions:

Locked forward: Fuel valve is able to be electrically opened and the feathering valve is closed (propeller operates normally).

Locked aft: Fuel valve is manually shut off and the feathering valve is opened thus feathering propeller. The fuel valve cannot be opened electrically until the lever is moved back to the forward position.

MASTER SWITCHES. The master switches are two-position switches located on the engine instrument panel. Each of the two aircraft batteries is controlled by a corresponding master switch. The batteries will not charge, nor will the aircraft be supplied power from the battery with the respective master switch in the OFF position. NOTE: There is only one master switch installed on aircraft modified with the optional parallel/series start system.

ENGINE IGNITION SYSTEM. There are two methods of providing ignition to the engine.

The first is through the START/GEN switch located on the engine instrument panel. As the start switch is engaged, the igniters are also energized until the start switch is moved to the OFF position.

The second method uses the AUTO/CONT ignition switch. It is a three-position switch located on the engine instrument panel. In the AUTO mode the ignition will be activated automatically when the torque drops below approximately ten percent. In the CONT mode the ignition will be activated continuously until the switch is moved to the OFF position. In the OFF mode both the automatic and the continuous circuits are disabled.

NOTE

Monitor ignition duty cycles (See Limitations, Section 5.).

BOOST PUMP SWITCH. The boost pump switch activates an electric boost pump to provide positive fuel pressure to the engine driven pumps. It is used during engine start, takeoff, landing, fuel tank selection, and high altitudes where inlet pressures on the engine driven pump may drop below allowable limits. It is not necessary to run the boost pump during normal cruise flight.

FUEL ON/SPR AND STOP SWITCH. The Fuel On/SPR (or Fuel Enrichment) and STOP switch is a three-position switch located on the engine instrument panel. In the spring-loaded Fuel On/SPR mode, the switch opens the fuel valve and activates the start fuel enrichment valve. In the protected STOP mode, the switch electrically closes the fuel valve and activates the EPA fuel purge kit. The center position is the RUN position.

START/GEN SWITCH. The START/GEN switch is a three-position switch located on the engine instrument panel. In the START position the switch accomplishes several tasks:

1. The starter/generator operates as a starter to crank the engine.
2. The oil vent valve is activated.
3. The primaries only solenoid is activated (locking out the secondary fuel nozzles).
4. The ignition system is activated.
5. The fuel anti-ice lockout valve is activated.

In the OFF position both the starter and the generator systems are disabled.

In the GEN position, the reverse current relay closes allowing the starter/generator to operate as a generator for the aircraft electrical system.

ANTI-ICE SWITCH. The anti-ice switch is a two-position switch located on the engine instrument panel. When selected ON, it opens the anti-ice valve allowing compression-heated air to the engine intake duct to prevent ice accumulation. When the anti-icing valve opens, an orange ANTI-ICE indicator light on the instrument panel illuminates.

CAUTION

Observe operating limits of anti-ice system

NOTE

Use of anti-ice when the engine is developing power may result in significant power loss.

NTS SWITCH. The negative torque sensing (NTS) switch is a two-position switch located on the engine instrument panel. It is used to test the NTS system during an engine start sequence.

NTS CHECK SYSTEM: This check can be performed for troubleshooting and failure detection of the negative torque sensing system. The NTS check is accomplished by turning the NTS switch on and observing the NTS indicator light during the engine cranking cycle. The unfeathering pump is also energized with the NTS switch to raise the propeller oil pressure level sufficiently to activate a pressure-sensitive switch, which lights the NTS indicator light. When the starter is energized, the NTS light should turn off momentarily, then turn on after the high initial negative torque decreases. If the set levels of negative torque are exceeded, the indicator light will turn off.

UNFEATHERING PUMP SWITCH. The unfeathering pump switch is a two-position switch located on the engine instrument panel. In the momentary ON position, this switch energizes the unfeathering

pump to unfeather the propeller. The emergency fuel shutoff/feather lever must be in the forward locked position to unfeather the propeller.

ENGINE INSTRUMENTS. Digital and conventional engine instruments are mounted on a panel above the engine controls pedestal. The digital instruments are normally powered from the main bus through the engine instruments circuit breaker. In the event that main power is lost, power can be restored to the engine instruments through the engine instruments BACK-UP switch located on the circuit breaker panel. In BACK-UP, the engine instruments are powered from the hot battery bus.

PERCENT RPM GAUGE. The percent rpm gauge has a digital LCD readout that displays engine rpm from 0-100%. There is also a green and red LED arc around the instrument for visual reference between 92-101% rpm.

EGT GAUGE. The exhaust gas temperature (EGT) gauge has a digital LCD readout that displays the temperature of the exhaust as it exits the engine. There is also a red LED at the top of the instrument that signals that the normal flight absolute maximum engine temperature of 620 degrees C has been reached and to reduce power immediately.

NOTE

It is normal for the red LED light to come on during the start of the engine, since engine temperatures regularly exceed 620 degrees C on the start.

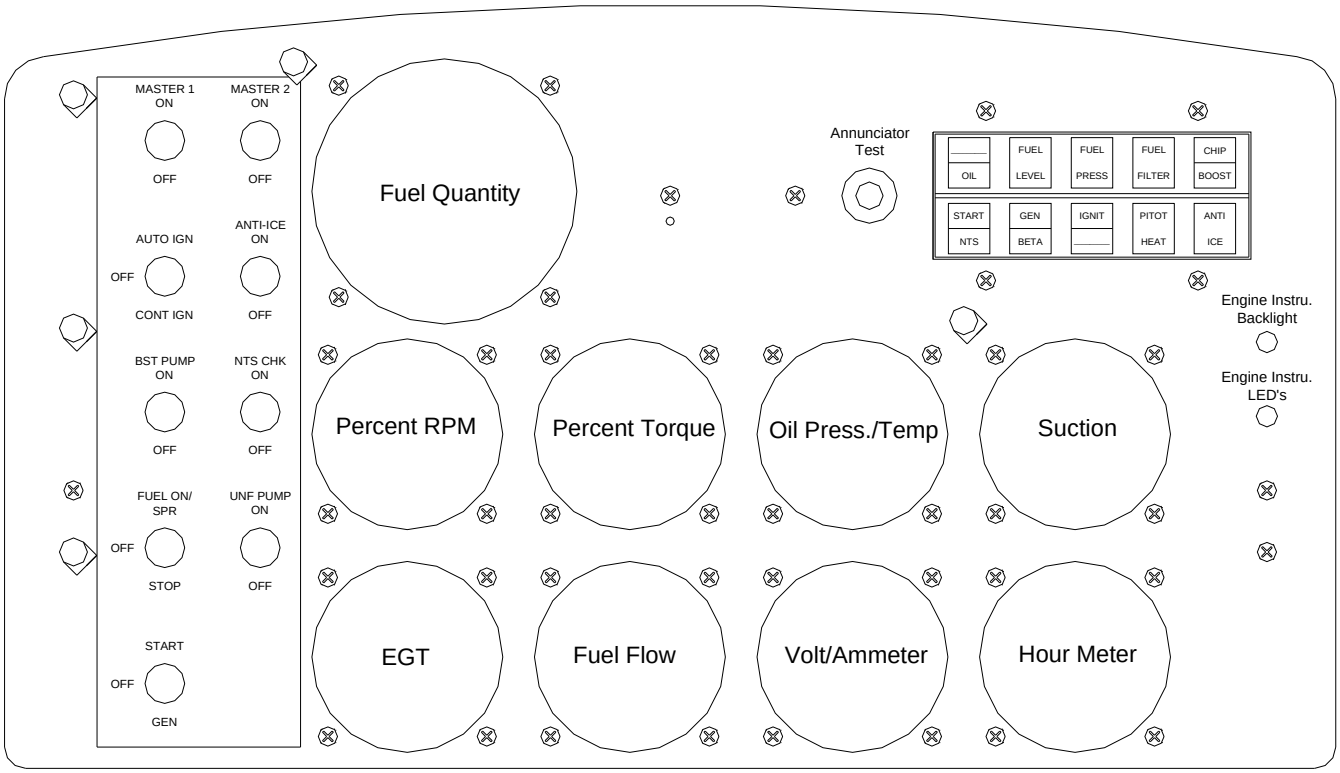


Figure 7-2, Turbine Engine Instrument Panel

TORQUE GAUGE. The torque gauge has a digital LCD readout that displays the engine torque from 10-100%. There is also a green and red LED arc around the instrument for visual reference between 25-101% torque.

FUEL FLOW/FUEL PRESSURE GAUGE. The fuel flow/fuel pressure gauge has a digital LCD readout that displays the fuel flow from 0-100 gal/hr or fuel pressure from 0-100 psi dependent upon the mode selected. It also has the capability to give total fuel burned, fuel remaining, time-to-empty, and GPS interface with the instrument. This instrument also illuminates a FUEL PRESS warning light if the pressure is in a warning area (<10 psi or >80 psi).

OIL PRESSURE/OIL TEMPERATURE GAUGE. The oil pressure/oil temperature gauge has a digital LCD readout that displays oil pressure from 0-120 psi or oil temperature from –40 to 127 degrees C dependent upon the mode selected. There are green, yellow, and red LED arcs on both sides for visual references. This instrument also illuminates an OIL warning light if either the pressure or the temperature is in a warning area.

VOLTMETER/AMMETER. The voltmeter/ammeter gauge has a digital LCD readout that displays bus voltage or total current usage dependent on the mode selected. There are also two LED's on the instrument to indicate DISCHARGE or OVERVOLTAGE.

SUCTION GAUGE The suction gauge shows vacuum applied to the Directional Gyro, Artificial Horizon, and Turn-and-Bank Indicator. The gauge is calibrated from zero to 10 in. Hg.

HOUR METER The hour meter is used to monitor the engine and airframe time. It begins monitoring the engine/airframe hours as the engine oil pressure exceeds 4 psi upon engine start.

LED DIMMER CONTROL. The LED dimmer control is located on the engine instrument panel and is used to dim the engine instrument LED's for either day or night operation.

ANNUNCIATOR PANEL. The annunciator panel is located on the top, right side of the engine instrument panel. It gives the following indications:

OIL.....	Illuminates if the oil pressure or oil temperature is in a warning area.
FUEL LEVEL.....	Illuminates when there is approximately 15 minutes of fuel remaining in the selected tank.
FUEL PRESS.....	Illuminates if the programmable high/low fuel pressure limit is reached.
FUEL FILTER.....	Illuminates when a specific differential pressure is reached across the fuel filter indicating that the filter is clogged.
CHIP DETR.....	Illuminates when the chip detector magnet attracts a loose piece of metal from the engine indicating a possible failure.
IGNIT.....	Illuminates when the ignition system is activated and remains lighted until the system is de-activated.
START.....	Illuminates when the start relay is closed indicating that the starter is in use.
GEN.....	Illuminates when the reverse current relay is open indicating that the generator is not on line or the generator has failed.
BOOST PUMP.....	Illuminates when the boost pump is in use.
BETA.....	Illuminates when the engine is in the Beta mode of operation.
ANTI-ICE.....	Illuminates when the engine intake anti-ice valve is open.

PITOT HEAT.....	Illuminates when the pitot heat is in use.
NTS.....	Illuminates during the NTS system test (see test instructions).

ANNUNCIATOR PRESS-TO-TEST SWITCH. The press-to-test switch is located on the engine instrument panel and is used to test all of the annunciator lights. When pressed, all lights should light up simultaneously.

PROPELLER.

The engine drives a Hartzell 110" diameter, four-blade, constant-speed, reversing, and full-feathering propeller.

PROPELLER CONTROL. The propeller is controlled in three modes: **Normal, Beta, & Feather**

In the **normal** mode of operation (Power lever at or forward of the flight idle stop and beta light out), the propeller blade angle is controlled by the prop governor. The prop governor adjusts the blade angle to maintain the speed selected by the pilot with the condition lever.

In the **beta** mode of operation (Power lever at or behind the flight idle stop and the beta light on), the propeller blade angle is controlled by the pilot with the power lever and the engine speed is maintained by the underspeed governor on the fuel control unit (FCU). The prop governor serves no function in beta mode.

Feather: If the engine fails, the NTS system will automatically attempt to move the blades toward the feather position. However, the pilot must move the emergency fuel shutoff/feather lever to the full aft and locked position to completely feather the propeller. The emergency fuel shutoff/feather lever shuts the fuel off to the engine and pulls the feathering valve, which dumps the oil from the propeller dome. With no oil pressure, the spring forces in the propeller dome drive the blades to the feather position.

OIL SYSTEM.

The oil tank is integral the engine and has a total capacity of 6 quarts. The oil tank filler neck is located on the lower right side of the engine.

The oil cooler is located just aft of the engine and has an internal thermostat for bypassing oil. The oil cooler is cooled by ram air in flight and by air pulled through it by the augmented exhaust on the ground.

The total **oil system** capacity is 8 quarts.

FUEL SYSTEM.

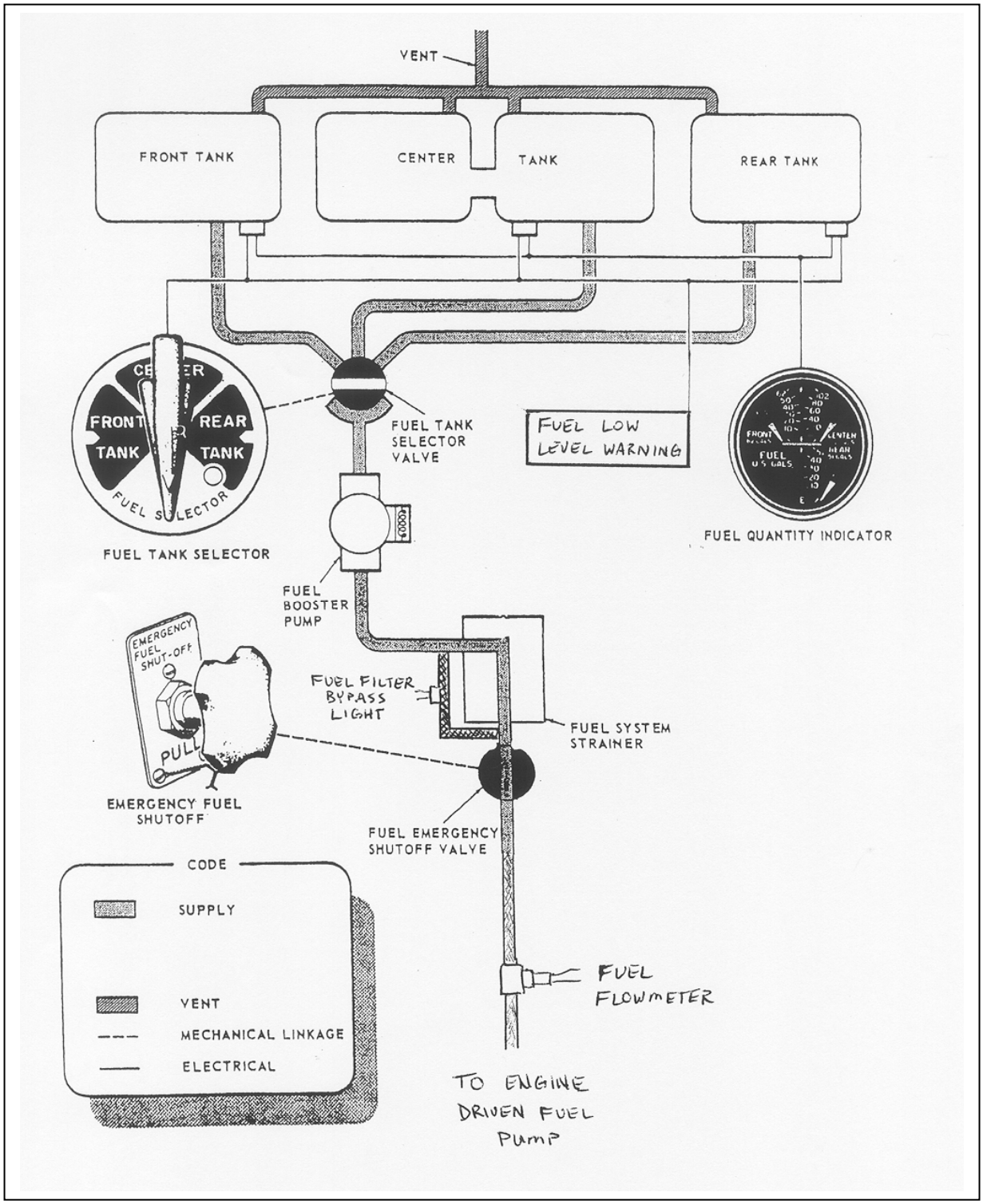


Figure 7-3, Fuel System: Schematic

The fuel system is the same as the original piston Otter fuel system with the exception of a new 25 micron fuel filter that replaces the old screen type and a fuel flowmeter. Fuel is contained in four flexible bag-type tanks beneath the forward portion of the cabin floor. The tanks are buttoned with fasteners to stringers on the underside of the floor and to the skin of the fuselage. The tank capacity is as follows:

	Imp. Gal	U.S. gal	Liters
Front	51	62	233
Center	85	102	389
Aft	42	51	192
TOTAL	178	215	814

NOTE

A placard must be installed above the pilot stating, "**For starting, takeoff, landing, flight above 10,000 ft., and when selecting fuel tanks, the boost pump must be turned ON**".

FUEL SELECTOR HANDLE. The fuel selector handle, located below the bottom right corner of the pilots instrument panel, can be positioned to FRONT, CENTER, AFT or OFF. When the engine is not operating, the selector handle must be selected to OFF to prevent drainage of the fuel supply line into the tank.

FUEL BOOSTER PUMP SWITCH. The fuel booster pump switch is located on the engine instrument panel. The booster pump incorporated into the fuel system between the tank selector valve and the fuel filter is used to supply fuel pressure for starting the engine and can be operated to supply sufficient fuel pressure to the engine driven fuel pump for takeoff, landing, high altitudes, and when selecting fuel tanks.

FUEL CONTENTS GAGE. The triple indicator fuel contents gage, graduated either in Imperial or U.S. gallons, will indicate only when the FUEL CONTENTS circuit breaker is set. This circuit breaker is located on the main circuit breaker panel below the pilot's instrument panel.

NOTE

Calibration in **red** applies to aircraft in the tail-down position.

FUEL LOW LEVEL WARNING LIGHT. A red FUEL LEVEL light gives an indication of low fuel level in the tank from which the engine is operating. The light becomes illuminated when fuel for approximately 15 minutes of cruising remains in the tank.

FUEL FILTER BYPASS LIGHT. A red FUEL FILTER light on the annunciator panel is illuminated when the fuel filter senses a potential bypass condition.

EMERGENCY FUEL SHUT-OFF CONTROL. The shut-off control handle stops the supply of fuel to the engine at the firewall in case of emergency. It is located on the right side of the pedestal, below the engine controls quadrant.

ELECTRICAL SYSTEM.

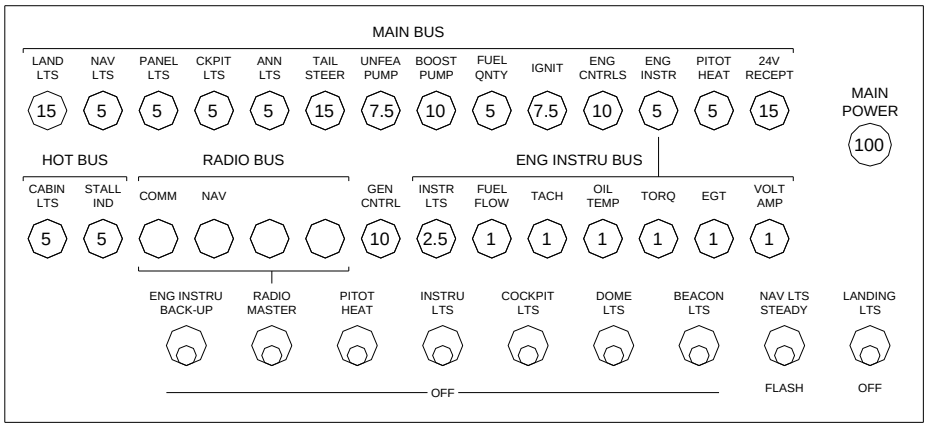
Electrical energy is supplied by a direct current 300 amp, 28-30 volt starter/generator, in conjunction with two 24 volt 43 amp-hr lead-acid batteries connected in parallel. If the optional parallel/series start system is installed, the batteries remain in parallel at all times except during starting from 12-60% where the batteries are switched from parallel (24V) to series (48V) to decrease start time. The 48 volts is isolated from the aircraft buses via relays, so the starter is the only component receiving 48 volts.

The starter/generator is a direct-drive combination unit mounted on the accessory section of the gearbox. It performs starting functions in the start mode and generator functions in the generator mode. The reverse current relay and the START/GEN switch control these modes.

All circuits of the electrical system are protected by manually resetable-type circuit breakers on the lower right panel below the co-pilots instrument panel and on the engine instrument panel.

The batteries are located in a stainless steel battery box mounted in the engine compartment.

CIRCUIT BREAKER PANEL. The circuit breaker panel is located on the sub-panel below the pilot's flight instrument panel. The panel is depicted below:



ELECTRICALLY OPERATED EQUIPMENT. The following equipment and controls are powered by the electrical system.

- Engine Starter
- Fuel Booster Pump
- Pitot Head Heater
- Instrument & Warning Lights
- Interior Lights
- Engine Instruments
- Misc. Electronic Equipment
- Navigation Lights
- Landing Light
- Heater Installation
- COMM & NAV Radios
- Unfeathering Pump
- Engine relays and valves

EXTERNAL POWER RECEPTACLE. For starting the engine or for electrical ground checks, an external power source may be connected to an external power receptacle fitted to the left side of the fuselage, forward of the pilot's door. When external power is connected, the aircraft's battery is isolated if the battery master switch is in the OFF position.

FLIGHT CONTROLS.

No changes have been made to the flight controls.

WING FLAPS HYDRAULIC SYSTEM.

No changes have been made to the hydraulic system.

LANDING GEAR.

No changes have been made to the landing gear.

INSTRUMENTS.

No changes have been made to the flight instrument panel

VACUUM OPERATED INSTRUMENTS

The engine bleed air moving through an ejector nozzle provides suction to operate:

Directional Gyro Artificial Horizon
Turn-and-Bank Indicator

EMERGENCY EQUIPMENT.

No changes to emergency equipment, except that no engine fire extinguisher system is installed.

BLEED-AIR HEATER (If Installed).

The bleed-air heat system utilizes P3 bleed-air from the engine to heat the cabin. The P3 air travels from the engine to a pilot controlled electric bleed valve. The ejector nozzle design of the bleed valve allows the hot bleed-air to mix with outside ram air to create a temperature suitable for the cabin. Incrementally opening the electric bleed valve increases the mass air flow and heat to the cabin.

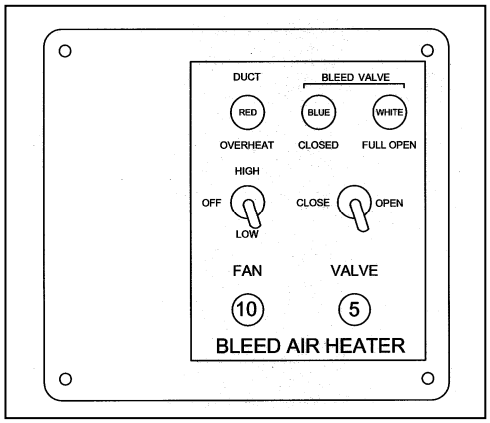


Figure 7-4, Bleed-air Heater Panel

The heater system is provided with an automatic duct overheat detection system. The duct overheat light (red) and the duct overheat relay are activated by a temperature sensor when the duct temperature reaches 250°F ±5°F. The relay automatically drives the bleed valve to a colder position until the overheat condition has ended. When the duct overheat light is illuminated, the heater bleed valve (OPEN/CLOSE) toggle switch is disabled, while the automatic system closes the valve. If the automatic system fails, the pilot should be able to close the valve using the bleed valve toggle switch.

There are two lights to indicate the position of the bleed valve. The blue light indicates that the bleed valve is closed. The white light indicates that the bleed valve is full open. When the valve is in an interim position, neither light will be illuminated.

A recirculation fan is provided to augment the airflow at low bleed rates and to help maintain uniform heating within the cabin and cockpit. It is recommended that the fan be used when the heater is in operation to help prevent duct overheating by re-mixing cabin air. The fan and bleed valve can be operated independently of one another.

CAUTION

If there is a main power failure during use of the bleed-air heat system, the valve will remain in the last position selected and cannot be closed until the engine instruments back-up switch is turned ON. The valve will then be powered by the hot battery bus. If there is a total electrical failure, the valve will remain in the last position selected, which might require an engine shutdown to prevent a duct overheat.

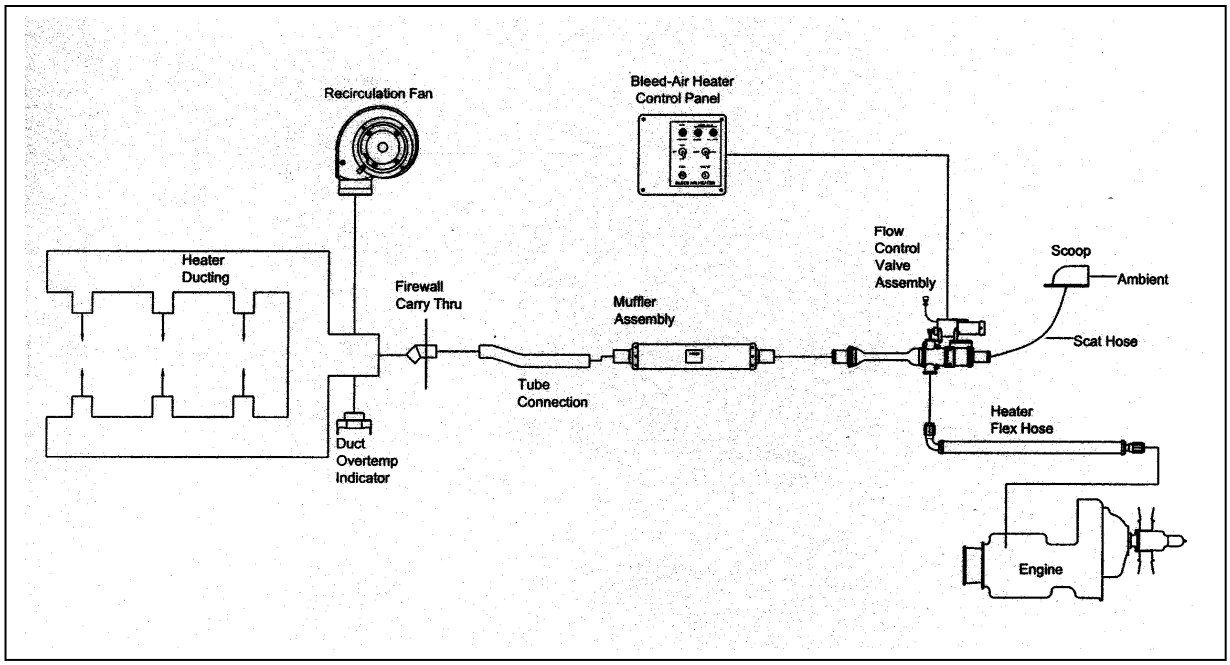


Figure 7-5, Bleed-air Heater Schematic

MISCELLANEOUS EQUIPMENT.

No changes to the miscellaneous equipment.

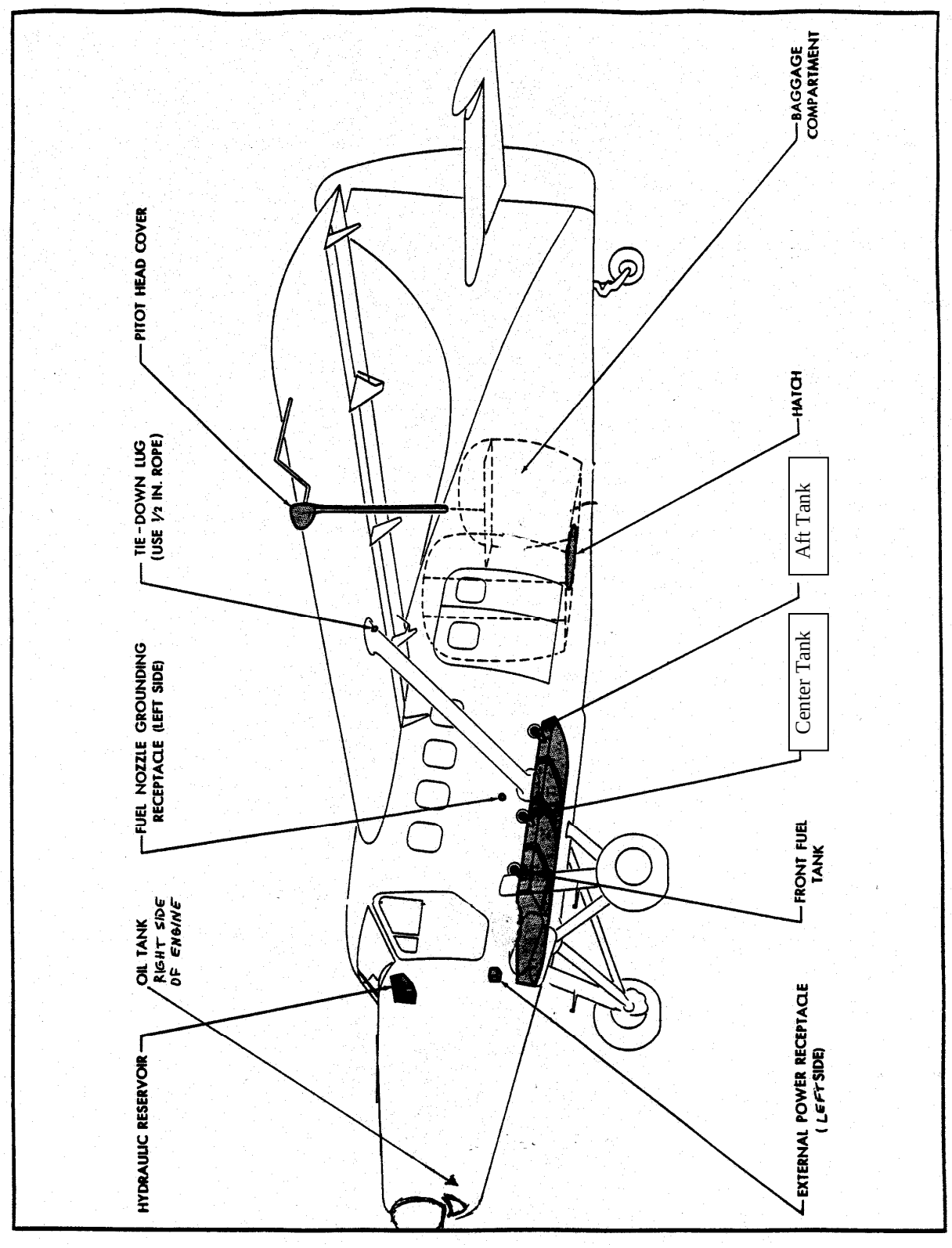


Figure 7-6, General Arrangement and Servicing Points