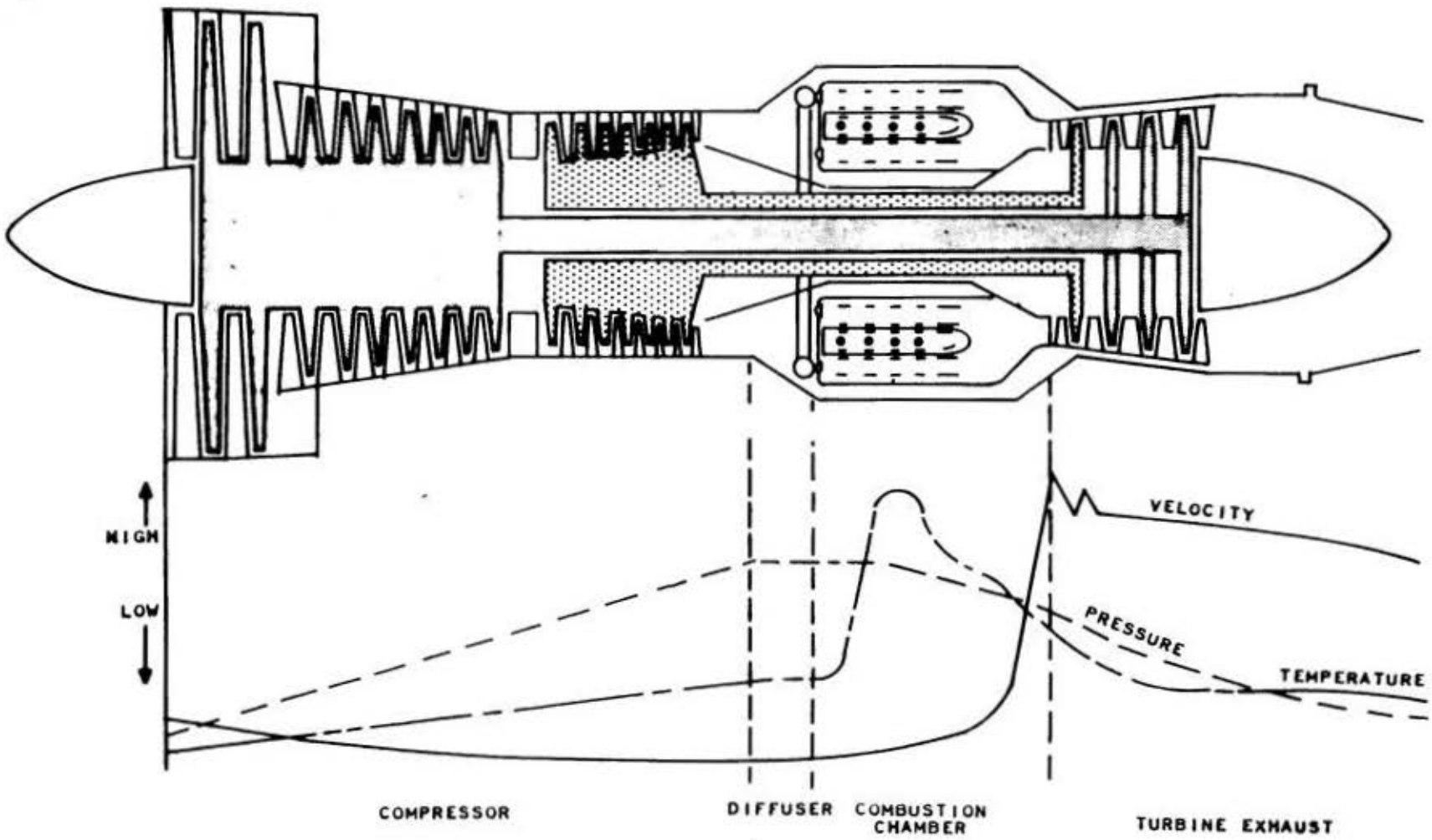
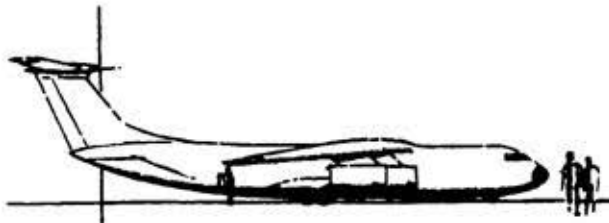


VELOCITY, TEMPERATURE, PRESSURE RELATIONSHIPS



GENERAL DESCRIPTION AND SPECIFICATIONS

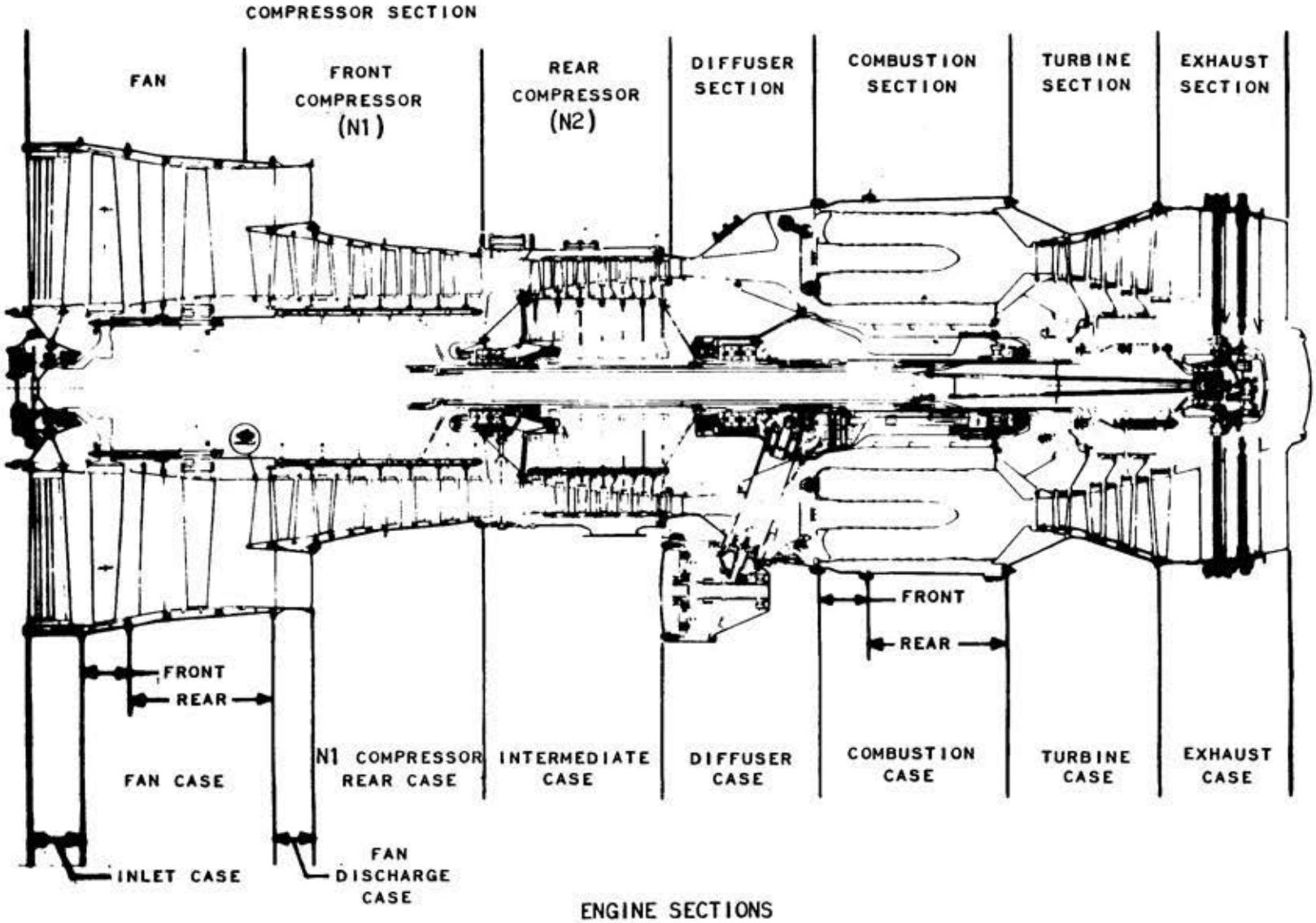
Lockheed's StarLifter has four Pratt and Whitney JT3D (TF-33) turbofan engines. Each engine has a sixteen-stage dual compressor, an eight-can, can-annular combustion section, and a four-stage axial flow, dual-type turbine. Each engine also carries two accessory gear boxes: one mounted on the bottom of the engine and the other on the front of the N1 compressor front hub. The engine is composed of five operating sections:

- o Compressor
- o Diffuser
- o Combustion
- o Turbine
- o Accessory

COMPRESSOR.

The twin spool compressor delivers air for combustion, internal cooling, and the airplane's pneumatic systems. The compressor section includes the air inlet case, front compressor rotor case, fan discharge case, front compressor rear case, compressor intermediate case, and the rear compressor case.

The first two stages of the nine-stage N1 compressor have relatively large blades which make up the fan. The inner portion of the two-stage fan is part of the first two stages of the N1 compressor. The outer portion of these large fan blades delivers air into ducts around the engine. The N1 compressor and fan are relatively slow turning in relation to the N2 compressor which allows the fan to rotate at its most efficient speed. The fan develops approximately 10,000 pounds of thrust at maximum power settings.



ENGINE SECTIONS

The seven-stage N2 compressor is the high-pressure compressor. N2 compressor speed is higher than N1 and is the controlled speed compressor. The speed of N2 is controlled by fuelflow. Fuel control establishes desired thrust according to speed and airflow through the N2 compressor.

As discussed in Chapter 1, compressor stall is a breakdown or interruption of airflow through the compressor. To aid in preventing stalls, the JT3D compressor is protected by a compressor bleed system. There are two valves mounted right and left on the compressor intermediate case that allow the compressor to unload during starting, acceleration, and deceleration.

The compressor air inlet of each engine is protected from ice formation in icing conditions by an ice detection and anti-icing system. Should ice form on the inlet and restrict airflow to the engine, the automatic ice detection system will turn on anti-icing. Anti-icing is accomplished by sixteenth-stage air from the diffuser. Hot air flows through the inlet guide vanes and lip duct, breaking up the ice and preventing reformation.

DIFFUSER.

The diffuser case attaches to the rear flange of the N2 compressor's rear case. The diffuser maintains the high pressure-low velocity air from the sixteenth stage and adapts the air for entry into the combustion section. Internally, the diffuser case provides support for the dual-split type fuel manifold and fuel nozzles. Externally, the case provides support for mounting the accessory gearbox and bosses for attaching the air ducts for the pneumatic systems.

COMBUSTION.

The combustion section is composed of an outer combustion case, eight burner cans, and an inner combustion case liner. The inner liner is a heat shield for the N1 and N2 turbine shafts.

At the front of each burner can are six holes for mounting the fuel nozzles. Each burner can has slots and perforations to allow air to mix with the fuel for proper burning and for cooling airflow.

The outer combustion case serves as a heat shield and a container for the combustion section.

TURBINE.

The turbine section houses the four-stage, twin-spool turbine. The first stage of turbine rotor is used to drive the N2 high speed compressor. Second, third, and fourth stages drive the N1 compressor and fan.

The turbine exhaust case attaches to the rear of the turbine section and is used to collect and straighten the exhaust gases as they leave the turbine. The rear opening of this convergent duct is critical in the respect that if the size of the opening is changed, a change in the velocity of exhaust gases will directly affect thrust produced by the engine. The exhaust case also supports the thrust reverser assembly.

ACCESSORY GEARBOX.

The main accessory gearbox, on the bottom of the engine, mounts the main oil pump, fuel control, fuel pump, constant speed drive, thrust reverser pump, hydraulic pump, tachometer generator, and a pneumatic starter. Power to drive the engine accessories is taken from the rear hub of the N2 compressor. The other accessory gearbox is mounted in the air inlet housing, forward of the No. 1 bearing. It is driven by a gear from the N1 compressor's front hub.
The N1 tachometer generator and the No. 1 bearing oil scavenge pump are mounted on this forward accessory gearbox.

ENGINE SPECIFICATIONS

Model	JT3D-5a (TF33-P-7)
Type	Axial Flow, Turbofan Gas Engine
Compressor	Axial Flow
Fan	Two Stage
N1 (Low Speed-Low pressure)	Seven Stage
N2 (High Speed-High pressure)	Seven Stage
Turbine	
1st Stage	Drives N2 Compressor
2nd, 3rd and 4th Stages	Drives N1 Compressor
Direction of Rotation	Clockwise
Number of Combustion Cans	Eight
Type of Combustion Cans	Can-annular - Straight Flow

ENGINE SPECIFICATIONS (Continued)

Dry weight (including standard equipment)	4605 pounds
Installed on Pylon	6700 pounds
Dimensions - room temperature	
Length	142.26 inches
Diameter	54.06 inches
Dimensions - operating temperature	
Length	142.86 inches
Diameter	54.12 inches
Fuel	
Specification	MIL-F-5624
Grade	JP-4 or Commercial Equivalent
Lubrication	
Oil Specification	MIL-L-7808E (latest MIL Spec.)
Oil Consumption (30 hours average)	0.234 gal/hr

ENGINE OPERATING LIMITS
(Sea Level, Standard Day - Static Thrust)

Thrust Setting	Rated Engine Thrust (pounds)	Time Limit ③	Max. Observed E. G. T. (° C)	Oil Pressure PSIG (Normal)
Takeoff ①	21,000	5 min.	555	45 ± 5 ④
Max. continuous ⑤	18,000	continuous	488	45 ± 5
Starting	Not applicable	-	454 ②	-
Engine acceleration	Not applicable	2 min.	555	45 ± 5

① To be used for takeoff only. EPR settings are limiting.

② Temperature is time-limited to momentary - not to exceed 15 seconds.

③ If E. G. T. exceeds 555° C at anytime - shut down engine.

④ Oil pressure may exceed 50 PSI but not 55 PSI for takeoff only.

⑤ EPR settings are limiting (Takeoff Thrust EPR Setting Charts)