CHAPTER 2

A. BASIC ENGINE (72-00)

1. GENERAL DESCRIPTION

a. The airplane is powered by three JT8D turbo fan engines mounted on the aft fuselage area. One engine is strut mounted, in a conventional nacelle, on each side of the fuselage. A center engine is mounted aft of the fuselage structure. Air is ducted to this engine through an inlet in the vertical fin leading edge just above the fuselage. All three engines are secured to the engine mount fittings at three points. Two cone bolts, bolted to a double flange at the fan discharge intermediate case, and one cone bolt attached to a double flange at the fan discharge turbine exhaust outer duct, secure the engine to the forward and rear mount fittings.

b. The major accessories fitted to each engine include a fuel pump, fuel control unit, constant speed drive unit, pneumatic starter and N_1 and N_2 tachometer generators. A generator is mounted on the constant speed drive unit. Hydraulic pumps are installed on engines No. 1 and No. 2. Fire detection and fire extinguishing systems are provided in each engine area.

c. The power section of the engine consists of a twin spool, 13 stage, front fan, axial flow compressor, a fan discharge duct, a diffuser case, a combustion section of nine separate burner cans symmetrically arranged within an annular chamber and a split four-stage turbine.

d. The four-state turbine extracts enough energy from the expanding gases to operate the compressors, including two fan stages and accessories. The first stage turbine drives the high pressure (N_2) compressor and the remaining three stages drive the low pressure (N_1) compressor and integral fan.

e. The engine starting system provides a means of rotating the N_2 compressor to establish a flow of air through the engine. Rotation of the N_2 compressor also drives the engine fuel pump and fuel control to meter fuel, under pressure, to the combustion chamber. An ignition system provides a high voltage discharge for ignition of the fuel/air mixture. Following ignition, continuous combustion takes place and the rotors accelerate until the engine becomes self sustaining. There are two flow paths which the air follows through the engine - one through the fan, and one through the primary engine, or gas generator. All of the air that enters the inlet cowl flows through the first two stages of N_1 compressor and fan. As the air leaves the N_1 second stage, it is forced to divide. At this point, the peripheral air enters the fan discharge duct and flows rearward where it it allowed to discharge to atmosphere to produce thrust. The inner air mass is forced to flow into the remaining N_1 compressor stages. From the N_1 compressor discharge, the air enters the N_2 compressor where it it further compressed and discharged into the diffuser. Rotation and velocity of the air are somewhat reduced in the diffuser before it enters the combustion section.

f. As the fuel/air mixture burns in the combustion chambers, it expands and due to the design of the chambers, increases the velocity of the gasses while the pressure remains relatively constant. The hot gasses, thus accelerated, pass through the turbine section and decrease in velocity and temperature as energy is extracted to turn the compressors and operate the accessories. After the gasses leave the final turbine stage, they are discharged through the exhaust nozzle to atmosphere.

g. Each engine is fitted with a self contained oil system to provide cooling and lubrication of engine gears and bearings.

h. Air is bled from the low pressure and high pressure compressors and the fan discharge duct to operate various airplane systems. A thrust reverser is attached to the exhaust section of each engine.

i. The engine at sea level on a standard day will develop in pounds thrust:

JT8D ENGINE	7A & 7B	15	17A
Take-Off Thrust.....	14,000 lbs	15,500	16,000
Maximum Continous Thrust.....	12,600 lbs	13,750	14,200
Maximum Cruise Thrust.....	11,400 lbs	12,400	12,800

j. At sea level take-off thrust, the fan produces approximately 43% and the basic engine 57% of the gross thrust.

2. Engine Specifications (ATA 72-00)

a. General

Type	Axial-Flow, gas turbine turbo-fan
Number of Combustion Chambers	9
Type of Combustion Chambers	Can-annular, two piece
Type of Compressor	Two-spool, 13 stage, front fan, having a 6 stage low pressure compressor and a 7 stage high pressure compressor
Type of Turbine	4 stage, split, having first stage high pressure and second, third, and fourth stage low pressure
Engine Dry Weight	2994 pounds (approx.)
Engine Length at Room Temperature	120 in. (approx.)
Engine Inlet Diameter at Room Temperature	42.5 in. (approx.)

b. Ignition System

Ignition Exciter	Bendix-Scintilla
Igniter Plugs	Champion

c. Lubrication System

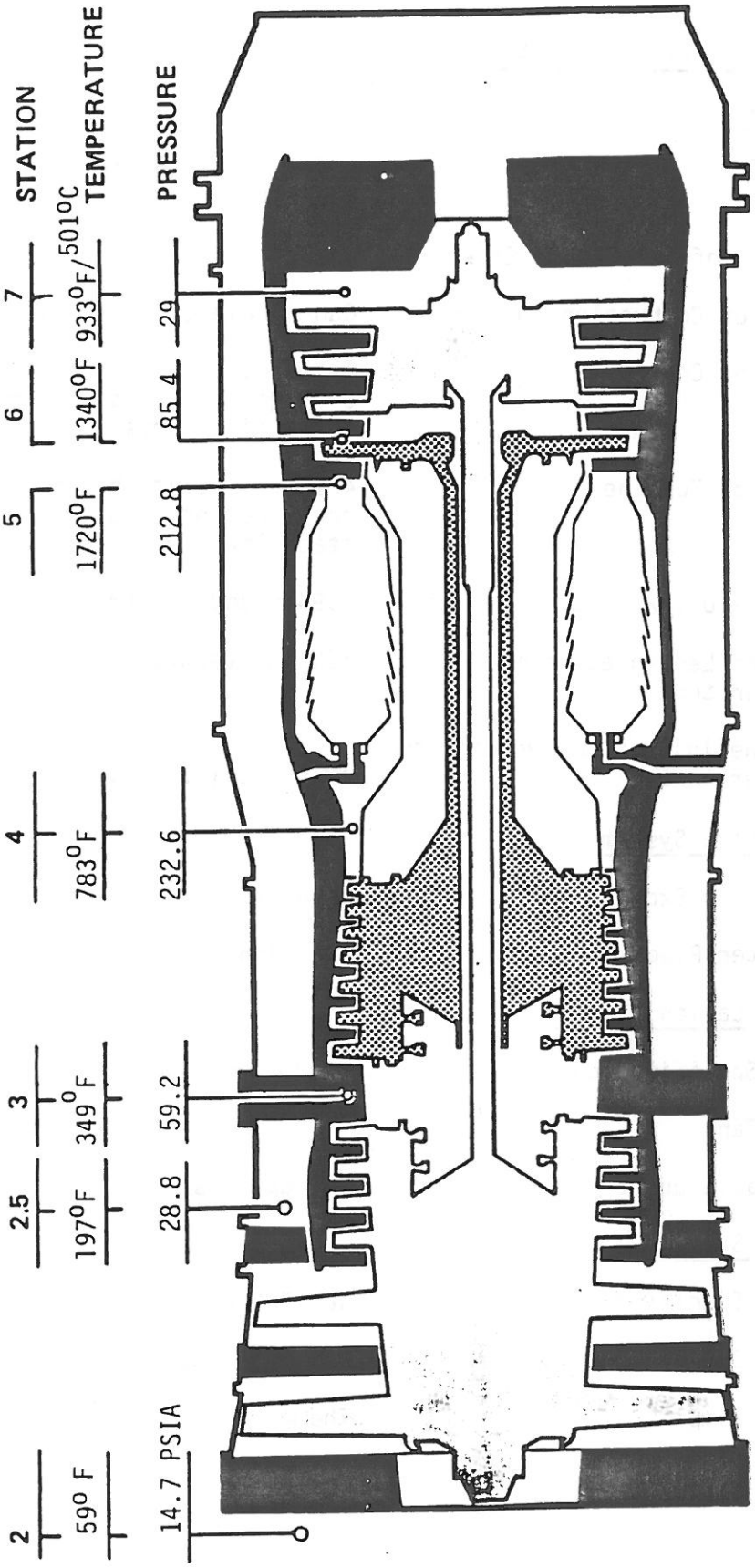
Oil Specification	Mobil Jet 254
Oil Tank	
Usable quantity	4.0 gallons

d. Fuel System

Fuel Specification	Jet "A" or "B"
Fuel Control	Hamilton Standard
Fuel Pump	Thompson Ramo Woolridge

JT8D -7, -7A, -7B

TYPICAL TAKE-OFF VALUES



JT8D -7, -7A, -7B

Fn	14,000	Wap	150#/Sec	BPR = Waf / Wap =	1.1:1
Fnf	5,870	Waf	165#/Sec	Wf	8,190
Fnp	8,130	Wat	315#/Sec	TSFC	.585

Pt2.5/Pt2 = 1.96 Pt3/Pt2 = 4.02

Pt4/Pt3 = 3.95 Pt4/Pt2 = 15.8 Pt7/Pt2 = 1.98

N_1 TYPICAL	8010 RPM 93.3 %	N_2 TYPICAL	11,520 RPM 94.1 %
N_1 100%	8589 RPM 100 %	N_2 100%	12,245 RPM 100 %
RED LINE N_1	8675 RPM 100.1%	RED LINE N_2	12,245 RPM 100 %
EGT TYPICAL	500°C	EGT RED LINE	-7 Eng. 570°C -7A Eng. 580°C -7B Eng. 590°C

ENGINE OPERATING CONDITIONS

Tam = 59 °F 15 °C

1. SEA LEVEL, STANDARD DAY

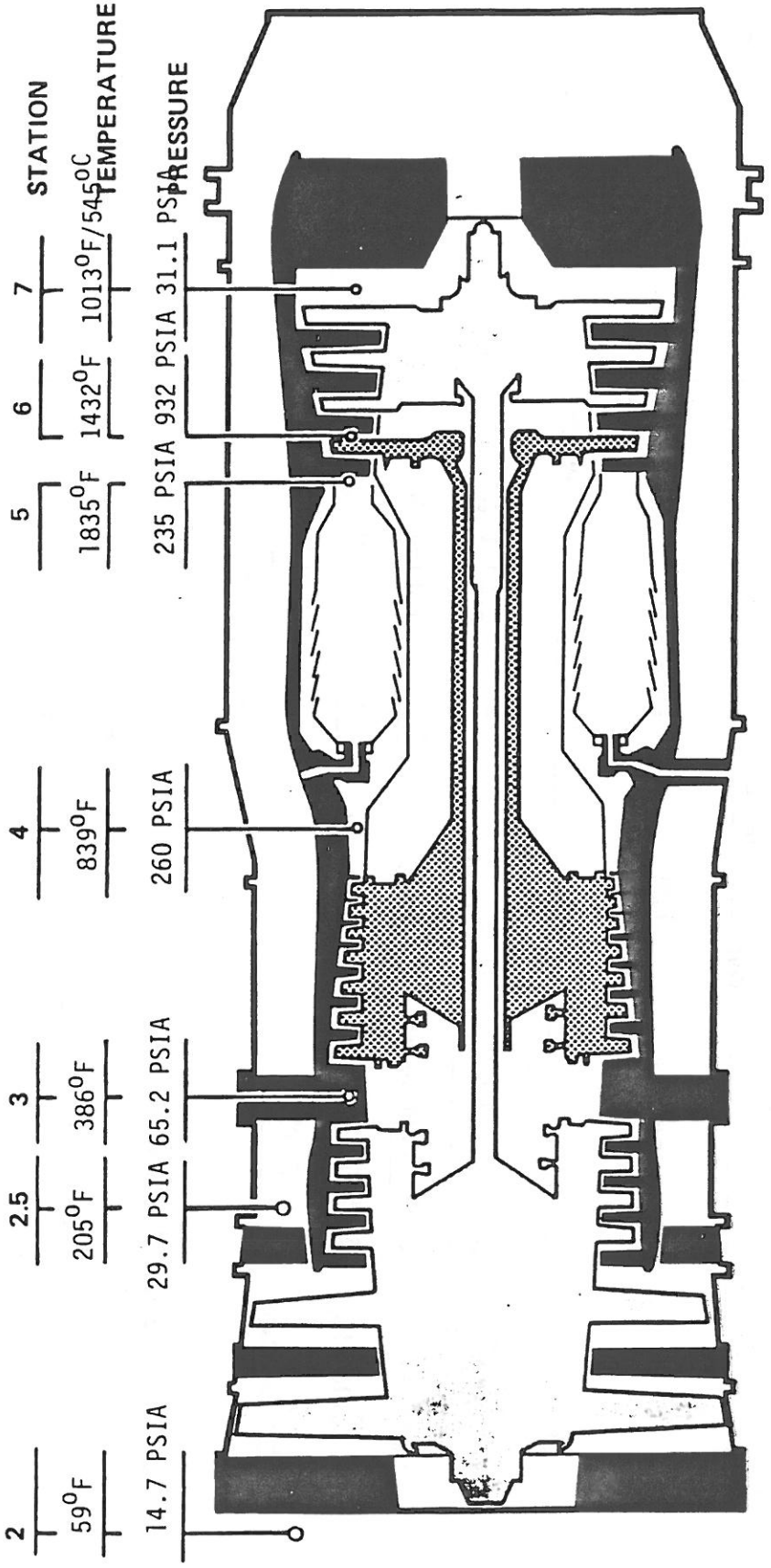
Pam = 29.92 "Hga 14.7 Psia 1013.2 MILLIBARS Hg

2. RATED TAKE-OFF THRUST (STATIC)

3. NO POWER OR BLEED AIR EXTRACTION

PERFORMANCE DATA WORKSHEET

TYPICAL TAKE-OFF VALUES



JT8D - 15

Fn 15,500 Wap 160 #/sec BPR = Waf / Wap = 1.01:1

Fnf 6,510 Waf 163 #/sec Wf 9207 #/Hr

Fnp 8,990 Wat 324 #/sec TSFC .594

Pt2.5/Pt2 = 2.02 Pt3/Pt2 = 4.43

Pt4/Pt3 = 3.99 Pt4/Pt2 = 17.67 Pt7/Pt2 = 2.12

N_1 TYPICAL	8340 RPM 97.1%	N_2 TYPICAL	11,580 RPM 94.5 %
N_1 100%	8589 RPM 100 %	N_2 100%	12,245 RPM 100 %
RED LINE N_1	8800 RPM 102.4%	RED LINE N_2	12,245 RPM 100 %
EGT TYPICAL	545	EGT RED LINE	620°C

ENGINE OPERATING CONDITIONS

1. SEA LEVEL, STANDARD DAY

Tam = 59 °F 15 °C

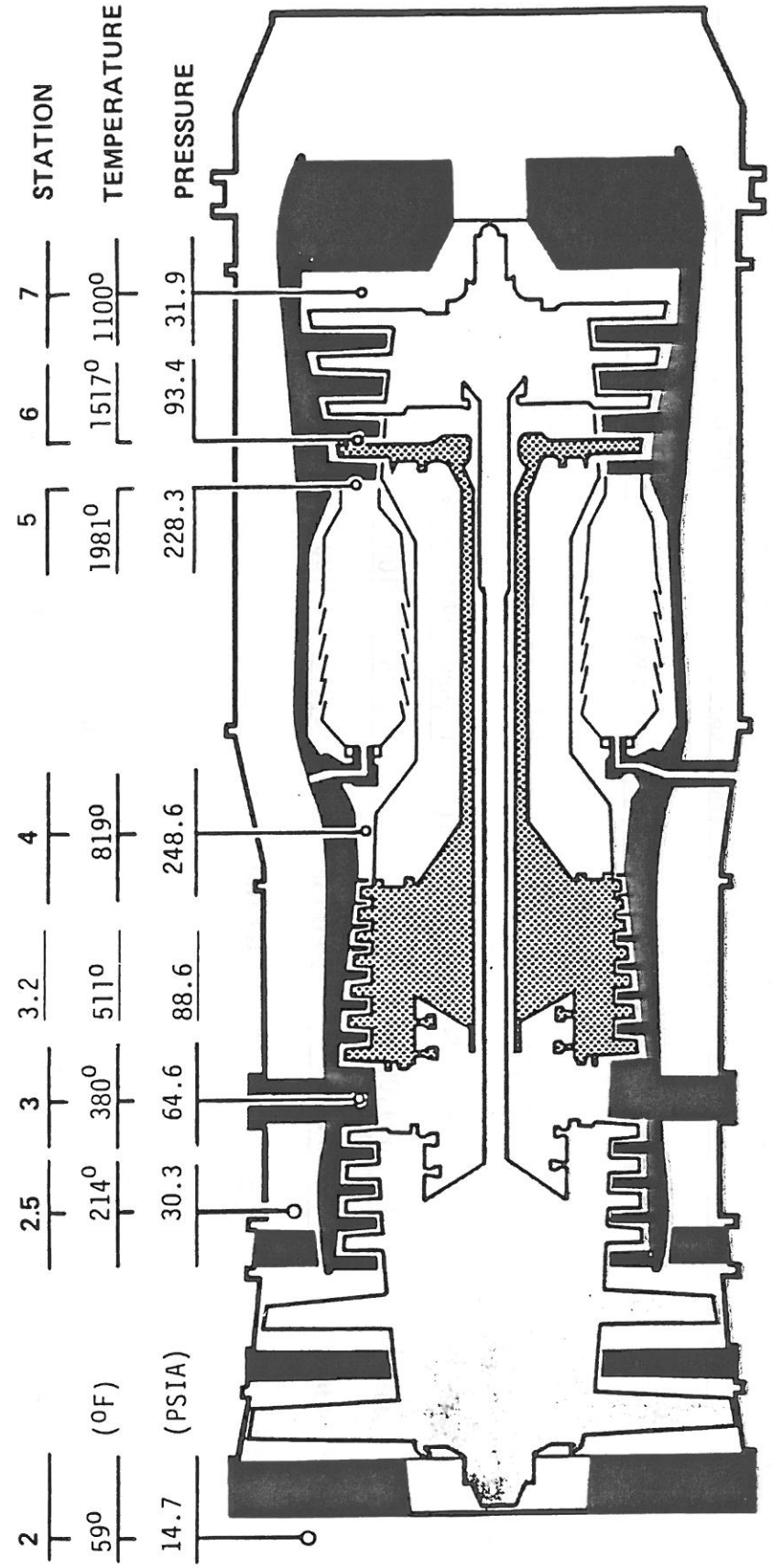
Pam = 29.92 "Hga 14.7 Psia 1013.2 MILLIBARS Hg

2. RATED TAKE-OFF THRUST (STATIC)

3. NO POWER OR BLEED AIR EXTRACTION

PERFORMANCE DATA WORKSHEET

TYPICAL TAKE-OFF VALUES



JT8D - 17A

Fn 16,000 Lbs. Wap 160.5 lbs/sec BPR = Waf / Wap = 1.02:1

Fnf _____ Waf 163.5 lbs/sec Wf 10,320 PPH

Fnp _____ Wat 324 lbs/sec TSFC .645

Pt2.5/Pt2 = 2.06 Pt3/Pt2 = 4.39

Pt4/Pt3 = 3.85 Pt4/Pt2 = 16.9 Pt7/Pt2 = 2.17

N_1 TYPICAL	8293 RPM 96.6%	N_2 TYPICAL	11,471 RPM 93.7 %
N_1 100%	8589 RPM 100 %	N_2 100%	12,245 RPM 100 %
RED LINE N_1	8800 RPM 102.4%	RED LINE N_2	12,250 RPM 100 %
EGT TYPICAL	590°C	EGT RED LINE	650°C

ENGINE OPERATING CONDITIONS

1. SEA LEVEL, STANDARD DAY

Tam = 59 °F 15 °C

Pam = 29.92 "Hga 14.7 Psia 1013 MILLIBARS Hg

2. RATED TAKE-OFF THRUST (STATIC)

3. NO POWER OR BLEED AIR EXTRACTION

PERFORMANCE DATA WORKSHEET

e. Directional References (72-00)

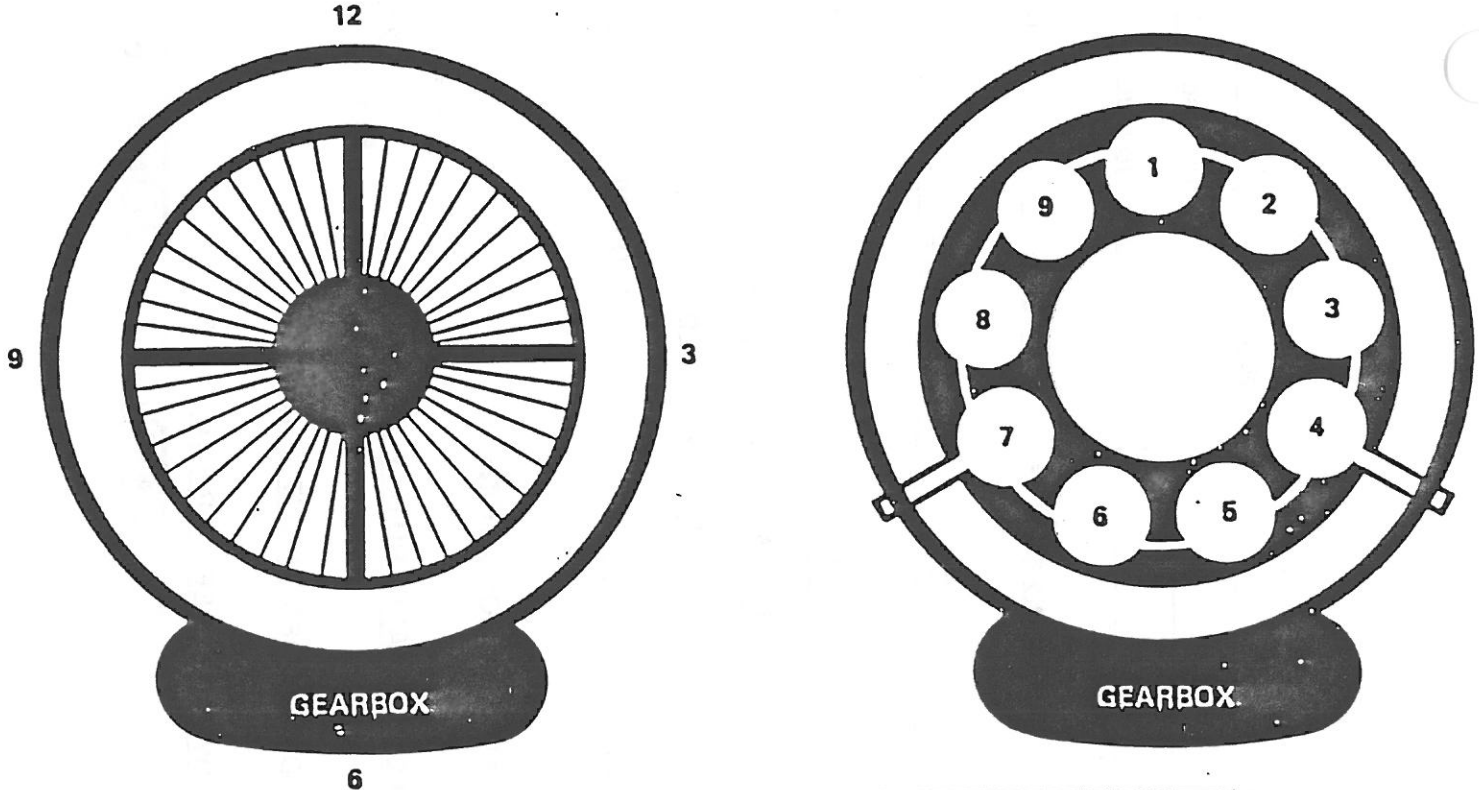
Unless otherwise specified right and left, clockwise and counterclockwise, upper and lower, and similar directional references apply to the engine as viewed from the rear (exhaust end) with the engine in a horizontal position and with the main accessory section at the bottom of the engine. The rotation of the rotor assemblies is clockwise.

f. Combustion Chamber Numbering (72-00)

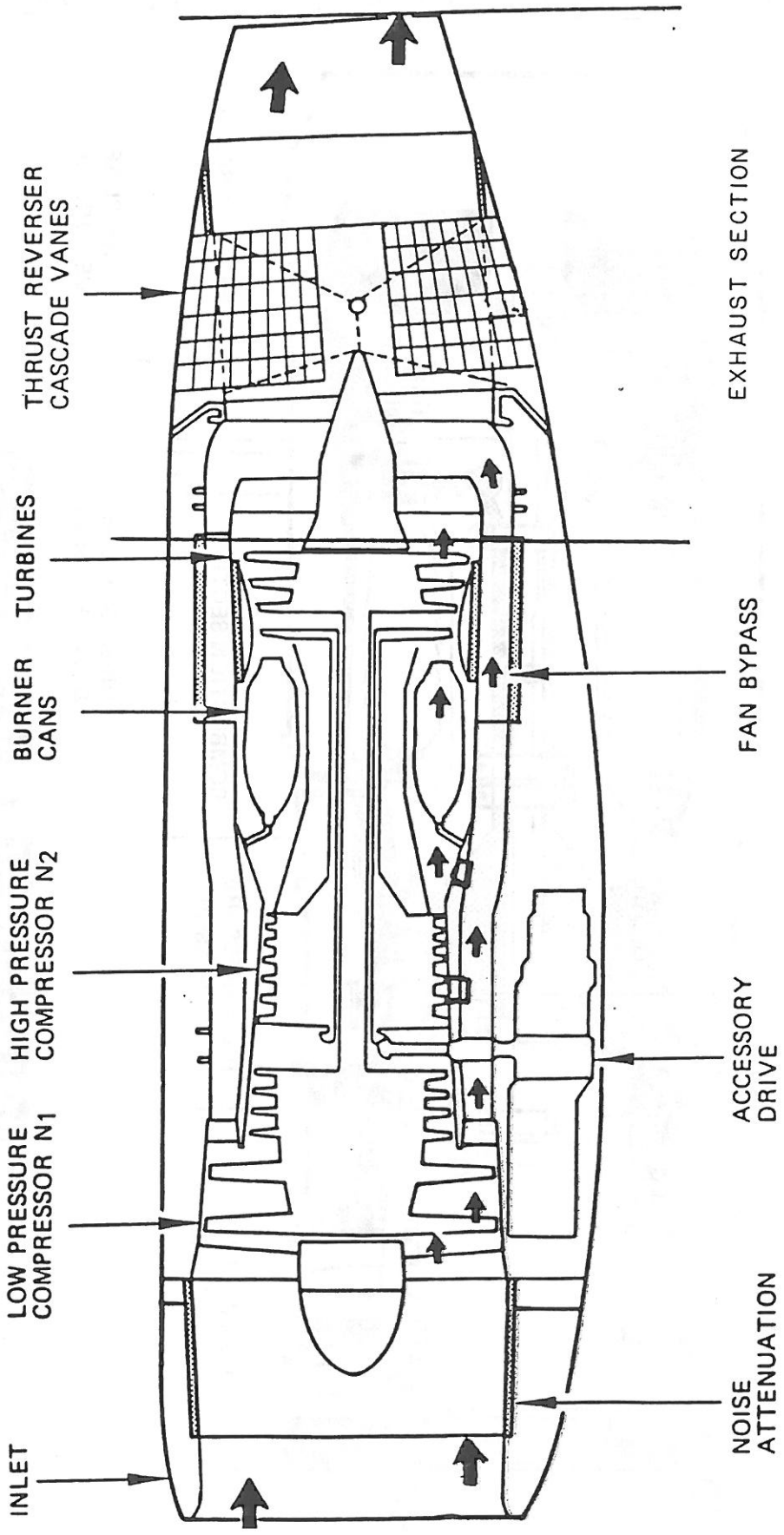
The combustion chambers are numbered one to nine in a clockwise direction, with the top center combustion chamber designated as number one. The number four and seven chambers have sparkigniter bosses.

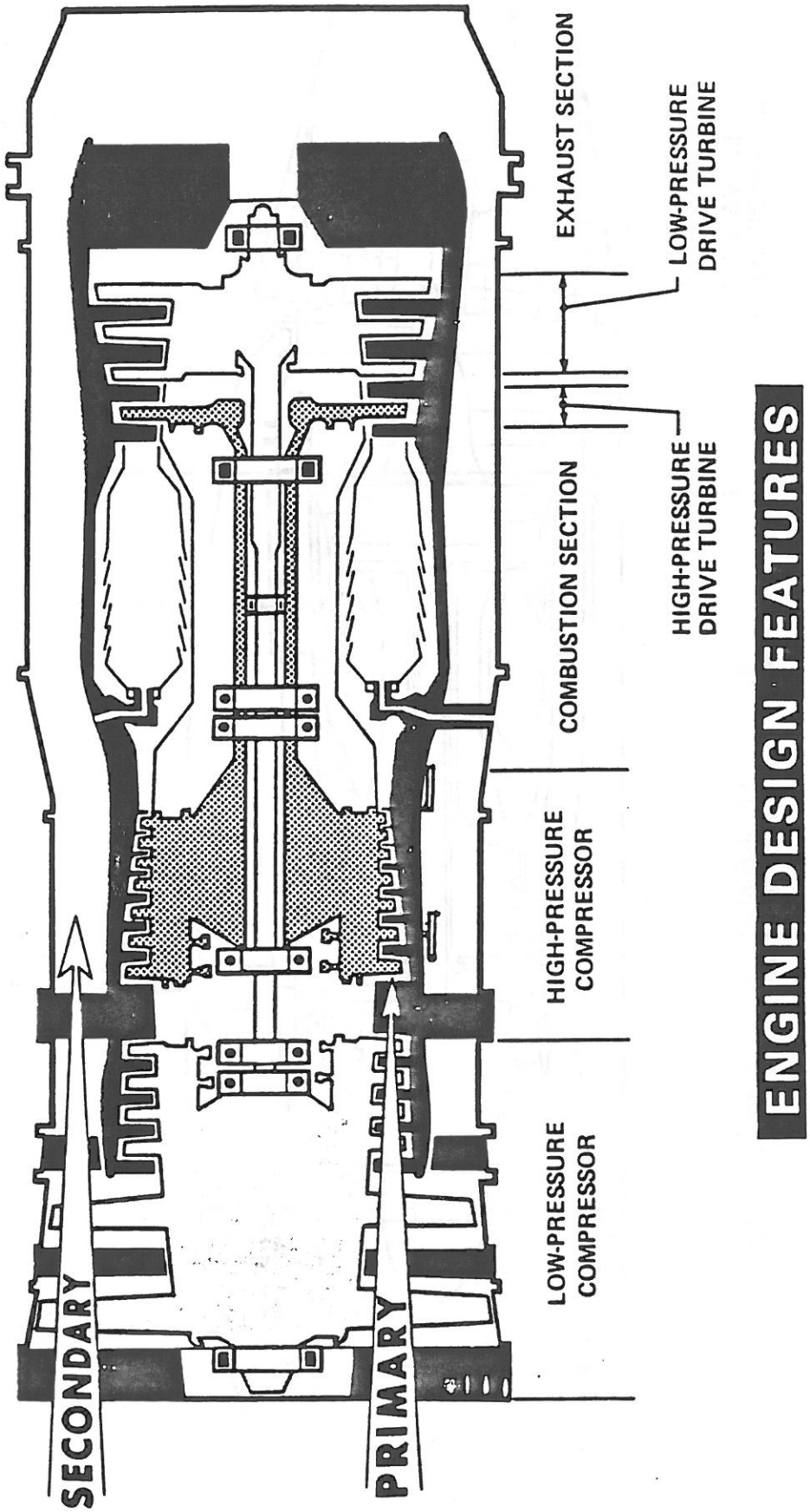
g. Bearing Locations

The rotating masses inside the engine turn at two different speeds. They must turn as freely as possible so that we have bearings placed at the best locations to properly support these units.



DIRECTIONAL REFERENCES


THRUST REVERSER CASCADE VANES
TURBINES
BURNER CANS
HIGH PRESSURE COMPRESSOR N2
LOW PRESSURE COMPRESSOR N1
INLET
EXHAUST SECTION
FAN BYPASS
ACCESSORY DRIVE
NOISE ATTENUATION



ENGINE DESIGN FEATURES

h. Engine Sections (ATA 72-00)

The engine has six general sections, the air inlet section, the compressor section, the combustion section, the turbine and exhaust section, the accessory drives, and the fan discharge section. Detailed information on each is given within the appropriate sections of this manual.

(1) Engine Section Numbering

AIR INLET SECTION	72-20
COMPRESSOR SECTION	72-30
COMBUSTION SECTION	72-40
TURBINE AND EXHAUST SECTION	72-50
ACCESSORY DRIVES	72-60

i. Engine Flange Destinations (ATA 72-00)

To facilitate identification of the engine flanges, they are designated by letter. Interruptions in the lettering sequence may result where development changes have removed or added flanges.

j. JT8D Design and Construction Features

(1) General

The JT8D is an axial-flow front turbofan engine. It employs a four-stage turbine to drive a "dual-spool", thirteen-stage compressor.

The term "dual-spool" identifies the compressor design that separates the compressor into two independent rotating assemblies.

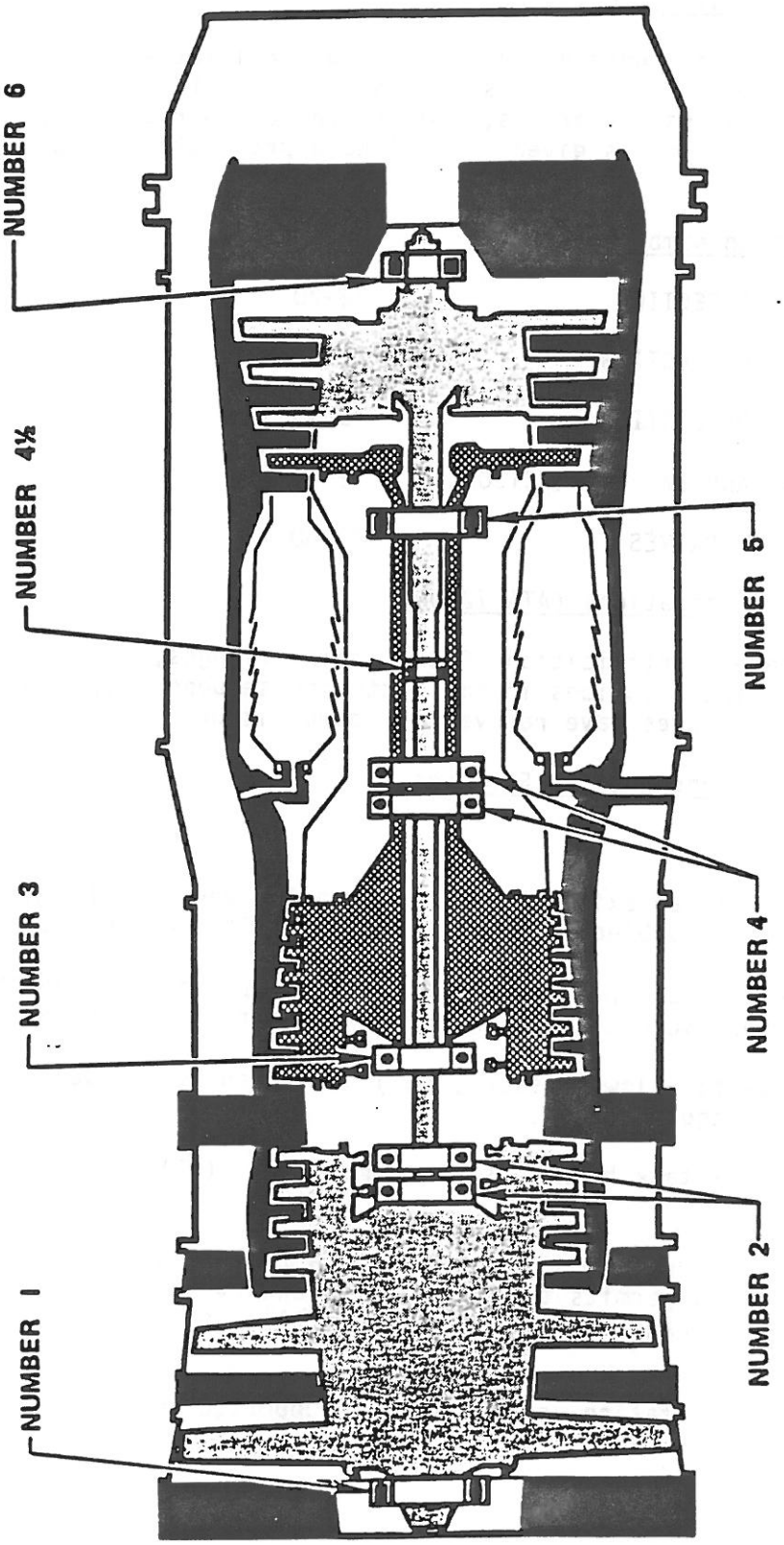
The six-stage low-pressure, (N1) is driven by the second, third and fourth stage turbines.

The seven-stage high pressure compressor, (N2) is driven by the first stage turbine.

The two-stage fan is equipped with a full length annular discharge duct. This permits the fan air (secondary air flow) to be discharged with the exhaust gases (primary gas flow) through a common exhaust nozzle.

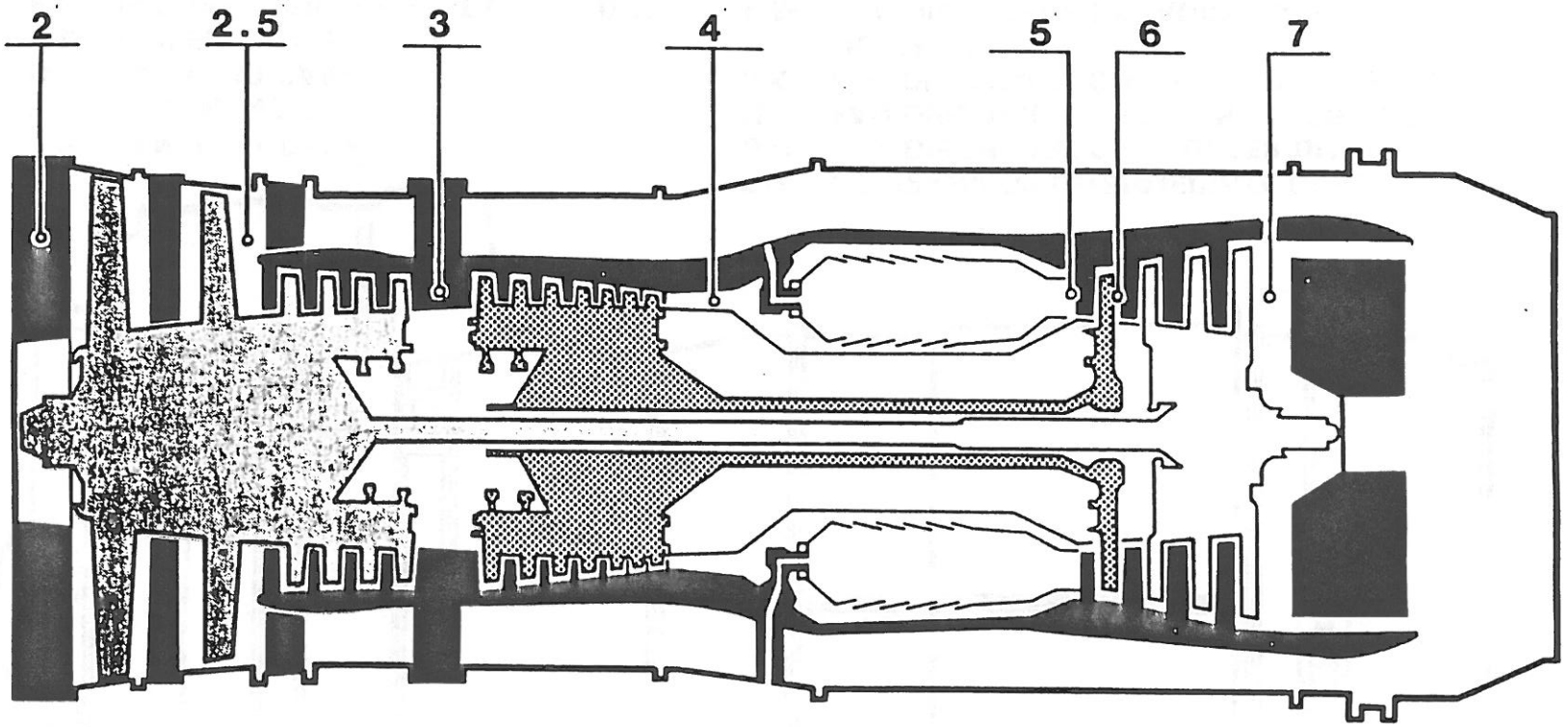
The major rotating assemblies are supported by seven main bearings.

JT8D



BEARING LOCATIONS

JT8D



Gaspath Locations

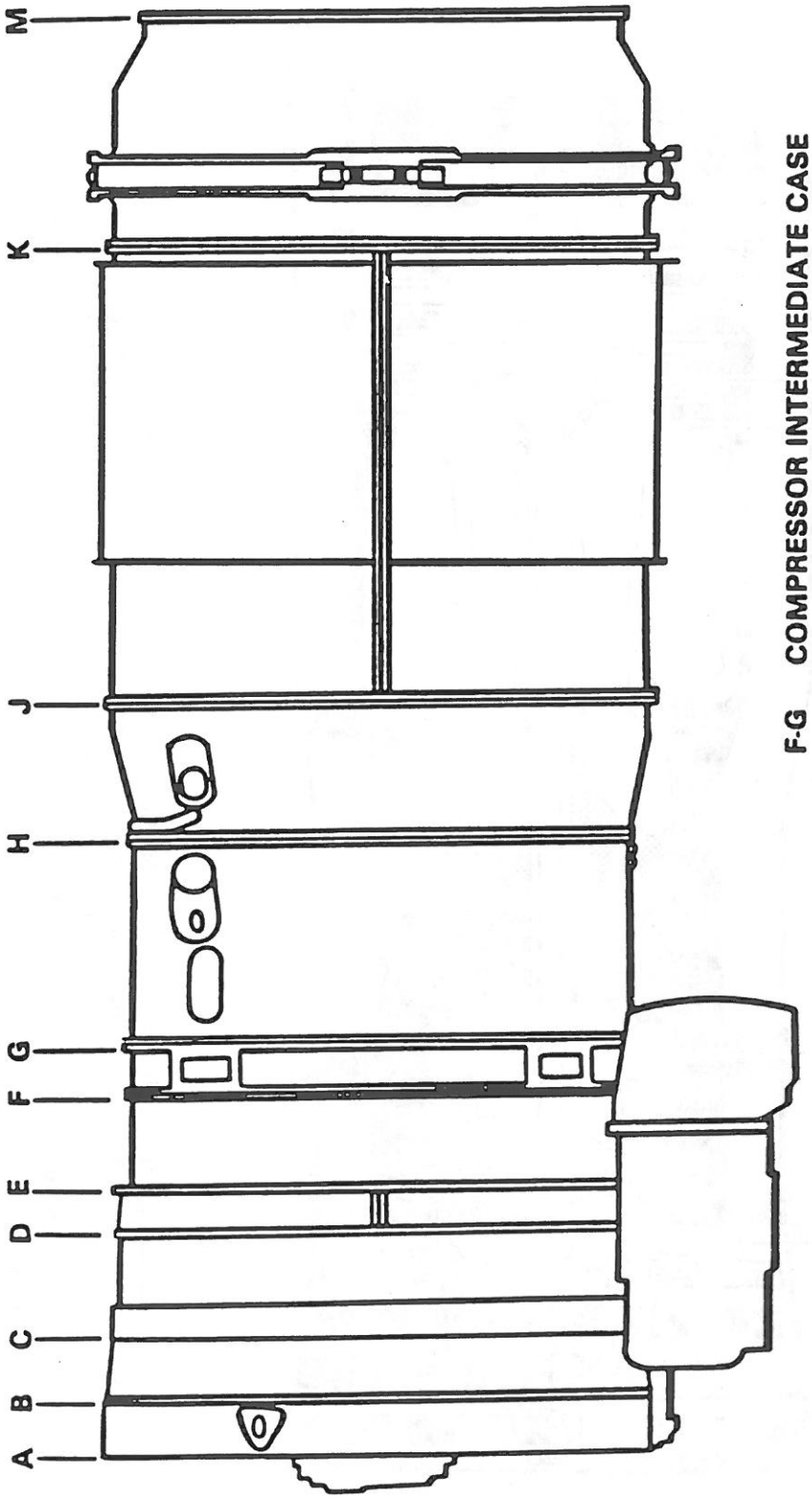
Numerical designators called Station Numbers have been assigned to gaspath locations for general reference purposes. These station numbers are combined with alpha/numerical subscripts to provide a short-form method of identifying the various air temperatures and pressures in the gaspath.

Example: Pt2
P=Pressure
t=Total
2=Station 2 (fan inlet)

ENGINE STATION LOCATIONS

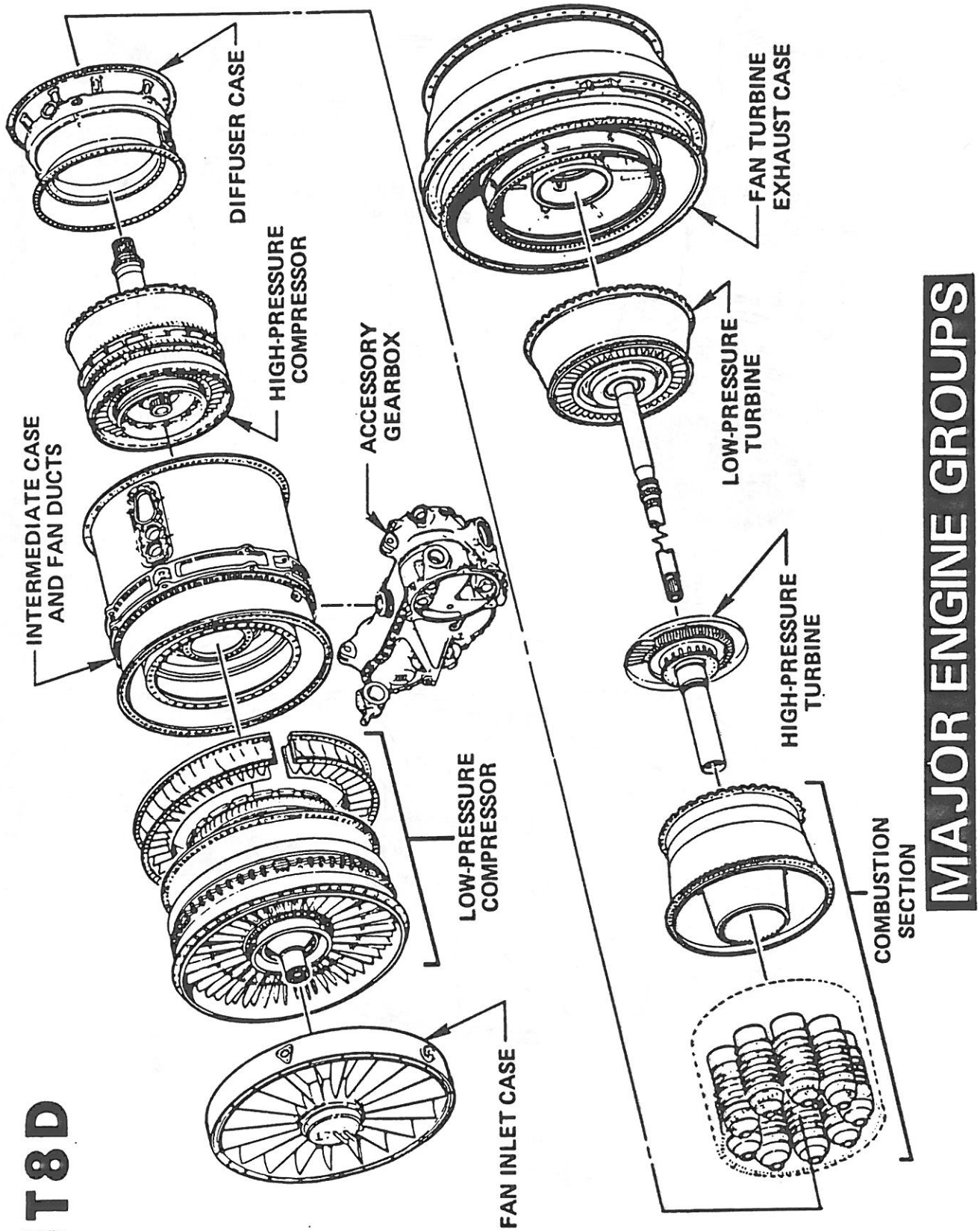
CASES, FLANGES AND DUCTS

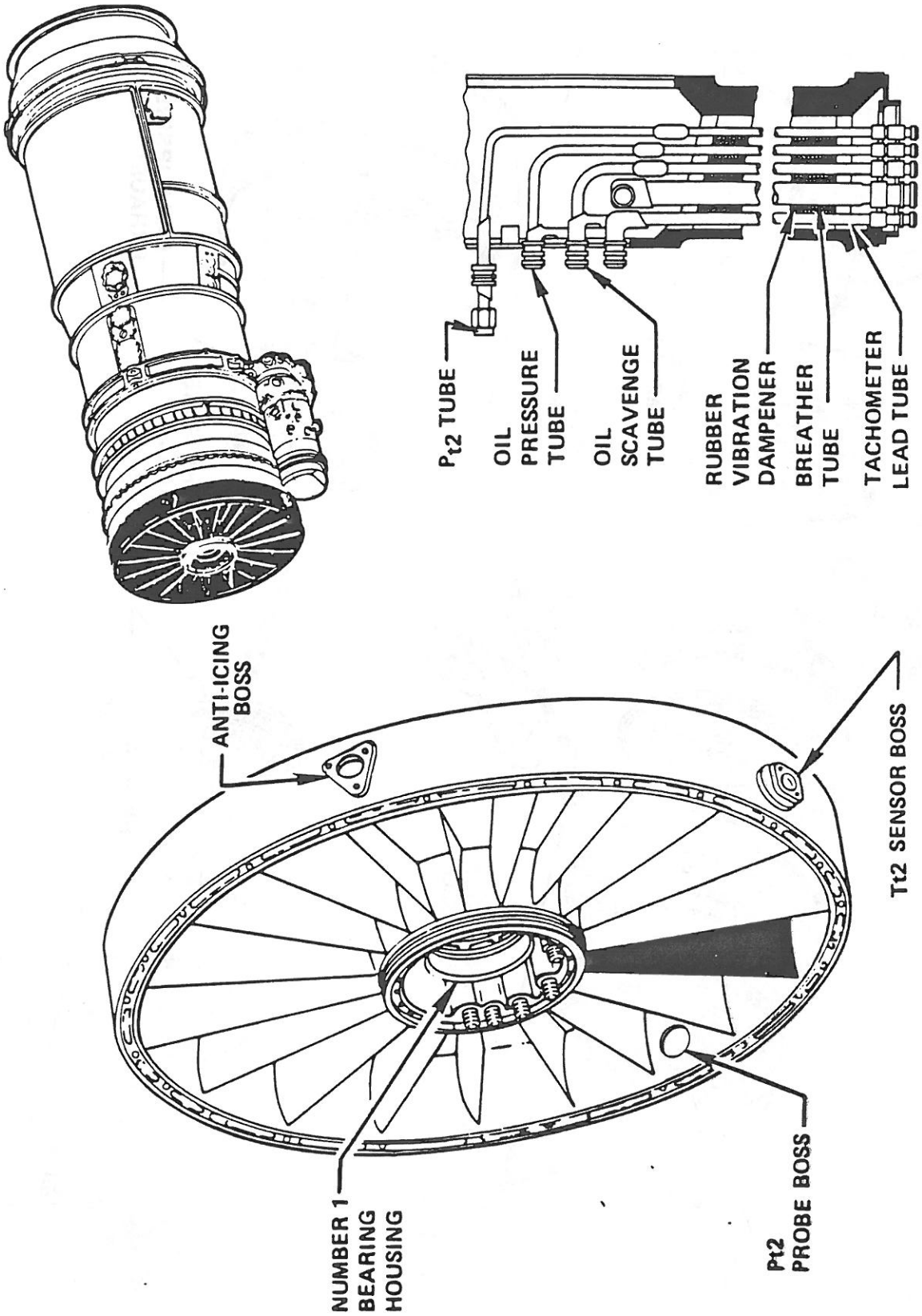
JT8D

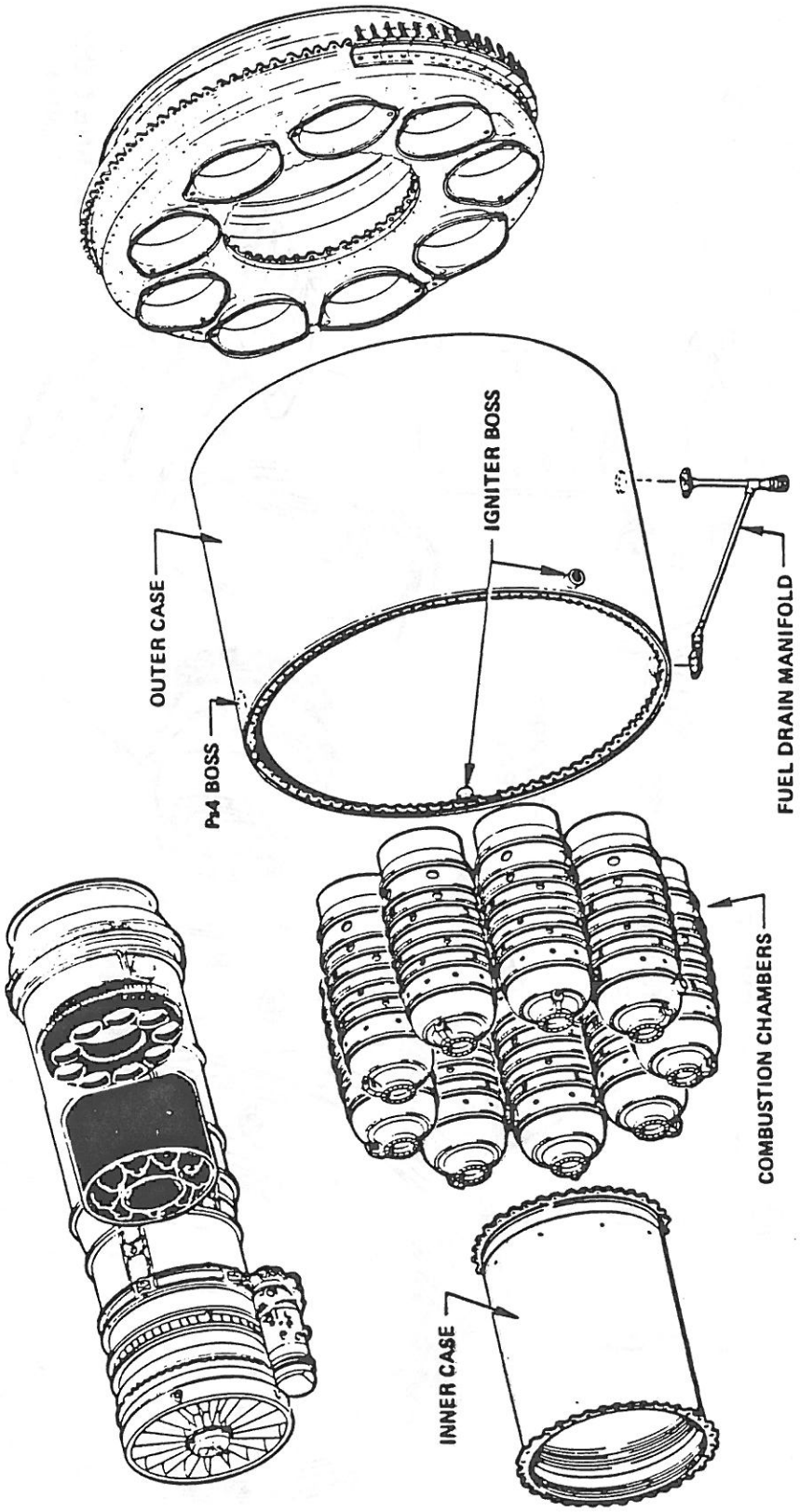


A-B FAN INLET CASE
B-C FAN FRONT CASE
C-D FAN REAR CASE
D-E FAN EXIT CASE
E-F FAN DISCHARGE FRONT OUTER DUCT

F-G COMPRESSOR INTERMEDIATE CASE
G-H FAN DISCHARGE REAR OUTER DUCT
H-J FAN DISCHARGE DIFFUSER OUTER DUCT
J-K FAN DISCHARGE COMBUSTION/TURBINE OUTER DUCT
K-M FAN DISCHARGE EXHAUST OUTER DUCT

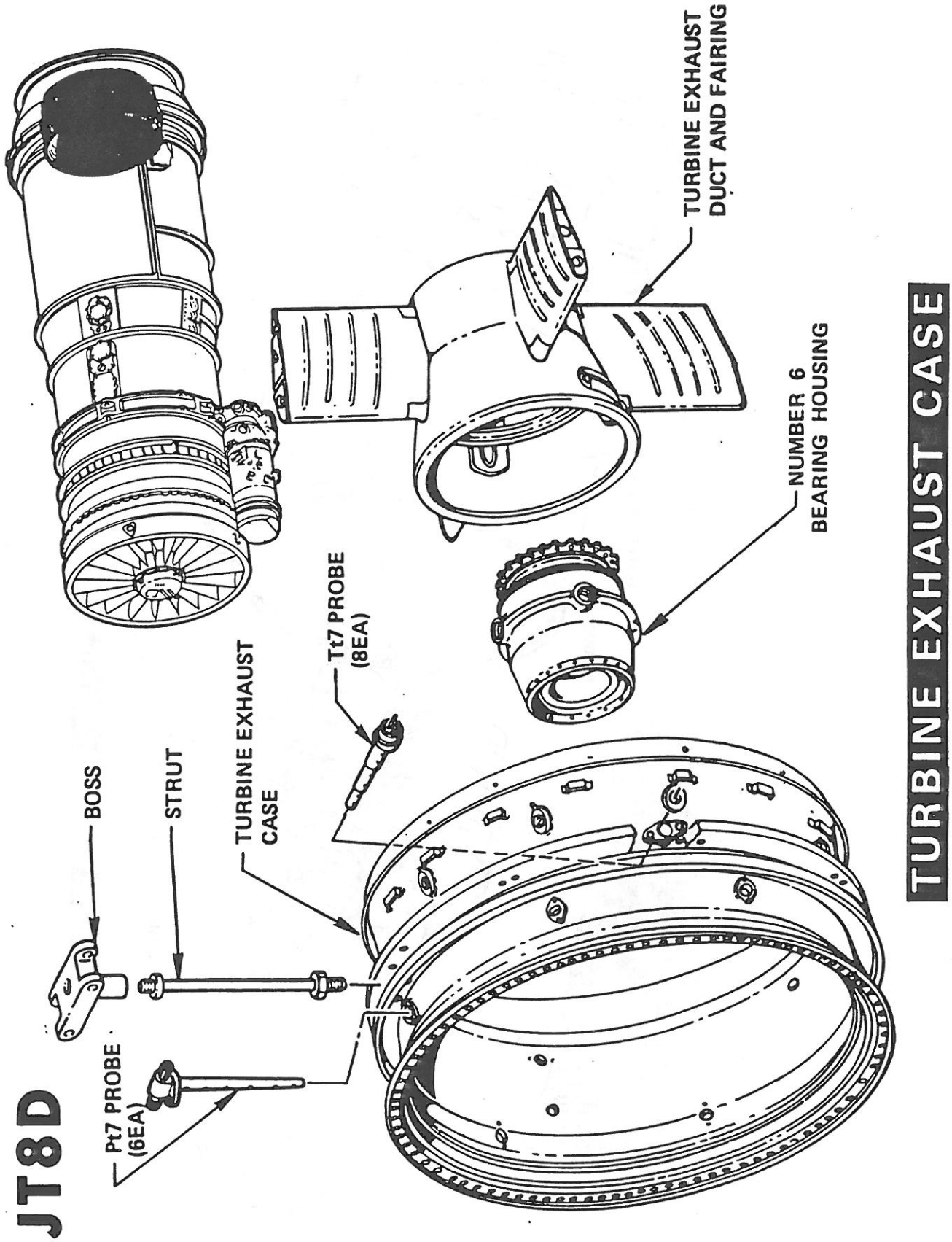

JT8D
MAJOR ENGINE GROUPS
DIFFUSER CASE
HIGH-PRESSURE COMPRESSOR
ACCESSORY GEARBOX
INTERMEDIATE CASE AND FAN DUCTS
LOW-PRESSURE COMPRESSOR
FAN INLET CASE
FAN TURBINE EXHAUST CASE
LOW-PRESSURE TURBINE
HIGH-PRESSURE TURBINE
COMBUSTION SECTION

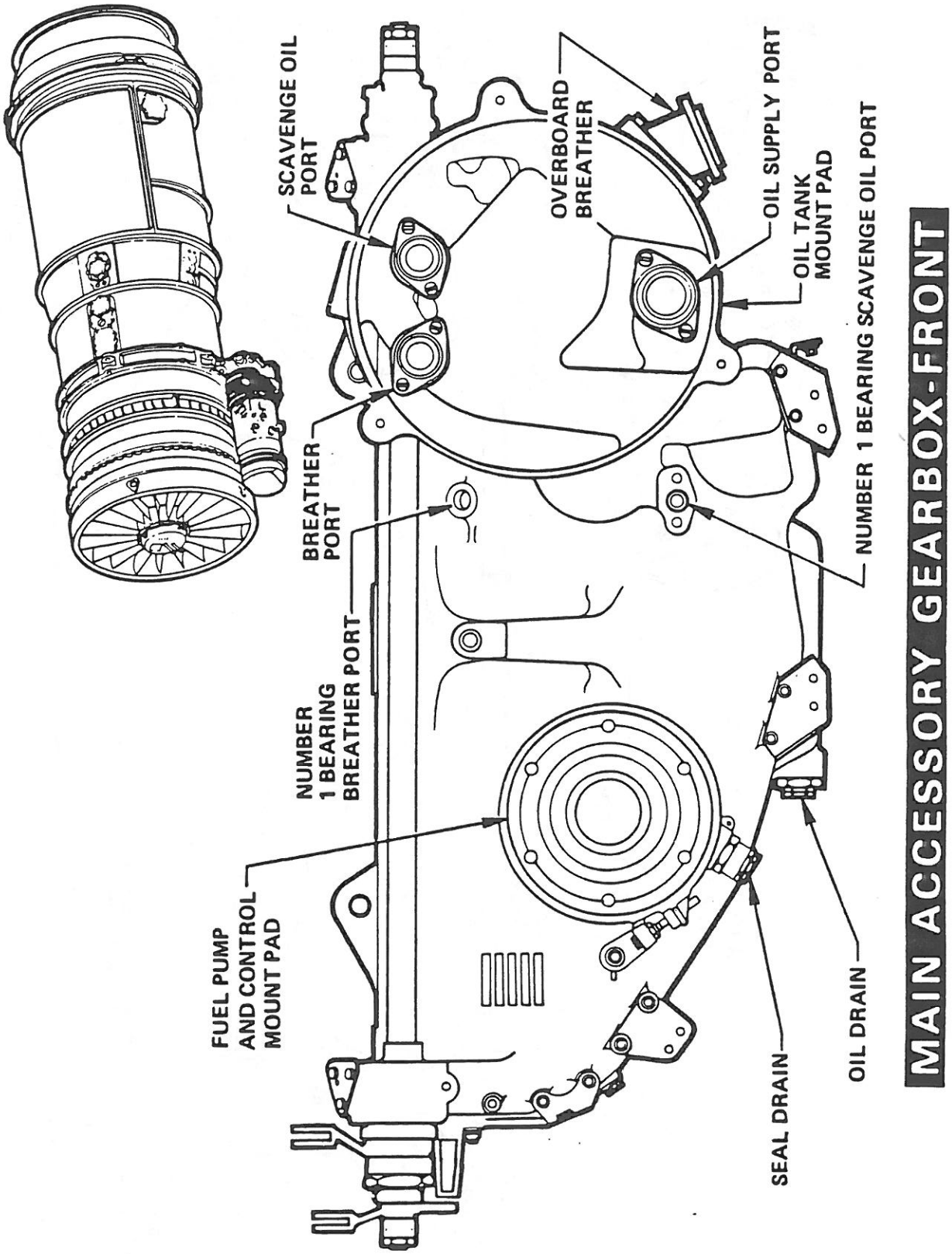

FAN INLET CASE AND VANE ASSEMBLY
Pt2 TUBE
OIL PRESSURE TUBE
OIL SCAVENGE TUBE
RUBBER VIBRATION DAMPENER
BREATHER TUBE
TACHOMETER LEAD TUBE
ANTI-ICING BOSS
Tt2 SENSOR BOSS
NUMBER 1 BEARING HOUSING
Pt2 PROBE BOSS

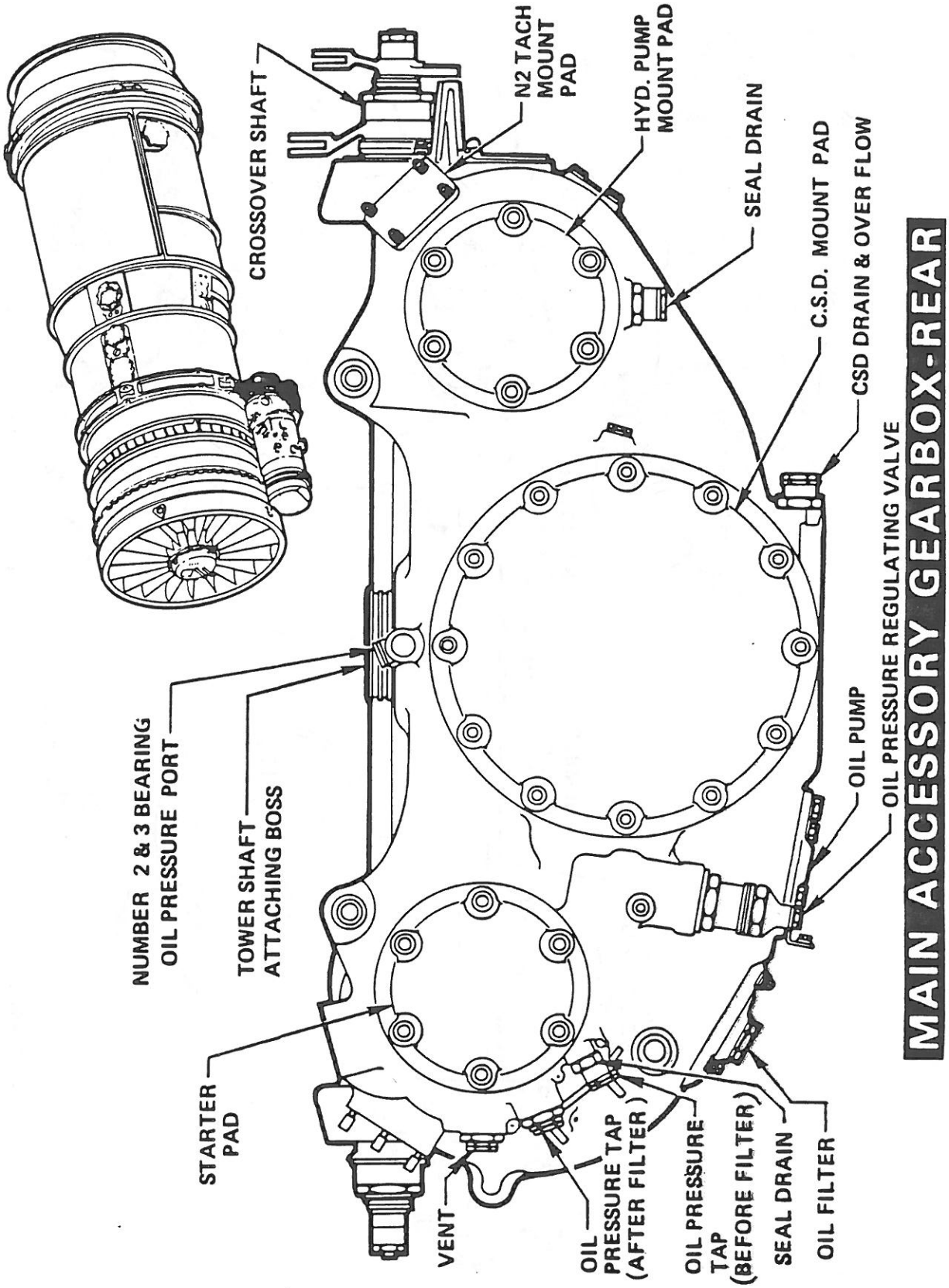


COMBUSTION SECTION

TURBINE EXHAUST CASE




SCAVENGE OIL PORT
OVERBOARD BREATHER
OIL SUPPLY PORT
OIL TANK MOUNT PAD
NUMBER 1 BEARING SCAVENGE OIL PORT
BREATHER PORT
NUMBER 1 BEARING BREATHER PORT
FUEL PUMP AND CONTROL MOUNT PAD
SEAL DRAIN
OIL DRAIN
MAIN ACCESSORY GEARBOX-FRONT


MAIN ACCESSORY GEARBOX-REAR
CROSSOVER SHAFT
N2 TACH MOUNT PAD
HYD. PUMP MOUNT PAD
SEAL DRAIN
C.S.D. MOUNT PAD
CSD DRAIN & OVER FLOW
OIL PRESSURE REGULATING VALVE
OIL PUMP
NUMBER 2 & 3 BEARING OIL PRESSURE PORT
TOWER SHAFT ATTACHING BOSS
STARTER PAD
VENT
OIL PRESSURE TAP (AFTER FILTER)
OIL PRESSURE TAP (BEFORE FILTER)
SEAL DRAIN
OIL FILTER

PROPULSION SYSTEM DESIGN

The JT8D–200 has two independent rotor systems. The low pressure rotor consists of a single stage fan and a six stage compressor driven by a three stage turbine. The fan stage provides additional thrust by accelerating a portion of the intake air (secondary air) through the full length annular duct and discharging it with exhaust gases (primary air) through a common exhaust nozzle. The high pressure rotor system consists of a seven stage compressor driven by a single stage turbine.

- Front Compressor (LPC):
  - 7 stages:
    1 fan stage
    6 primary stages

- Rear Compressor (HPC):
  - 7 stages
  - 8th and 13th stage air used for aircraft bleed air
  - Drives main accessory gearbox

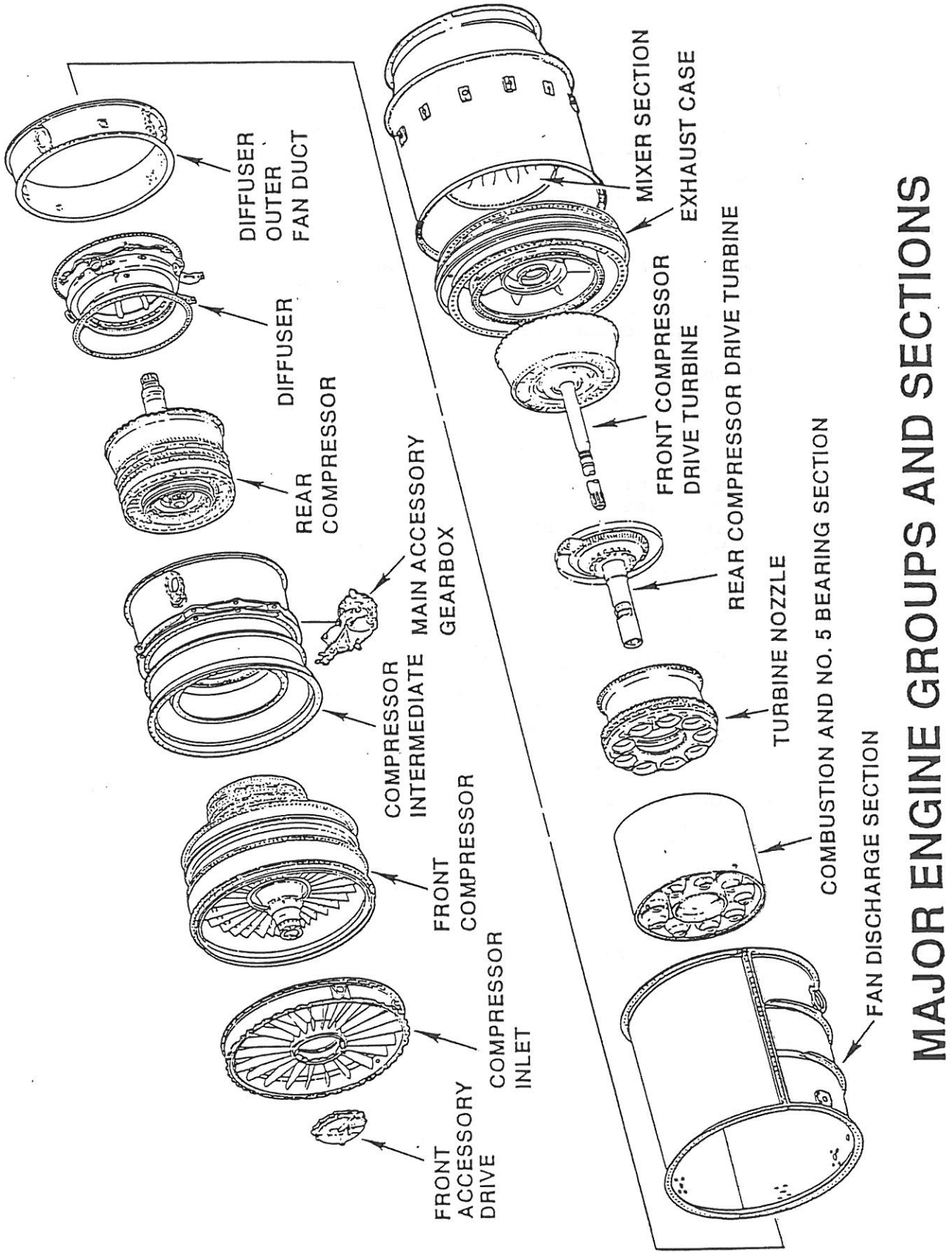
- Combustion Section:
  - 9 low emissions fuel nozzles
  - 9 combustion chambers

- Rear Compressor Drive Turbine (HPT):
  - Single (1) stage
  - Drives rear compressor (HPC)

- Front Compressor Drive Turbine (LPT):
  - 3 stages
  - Drives front compressor (LPC)

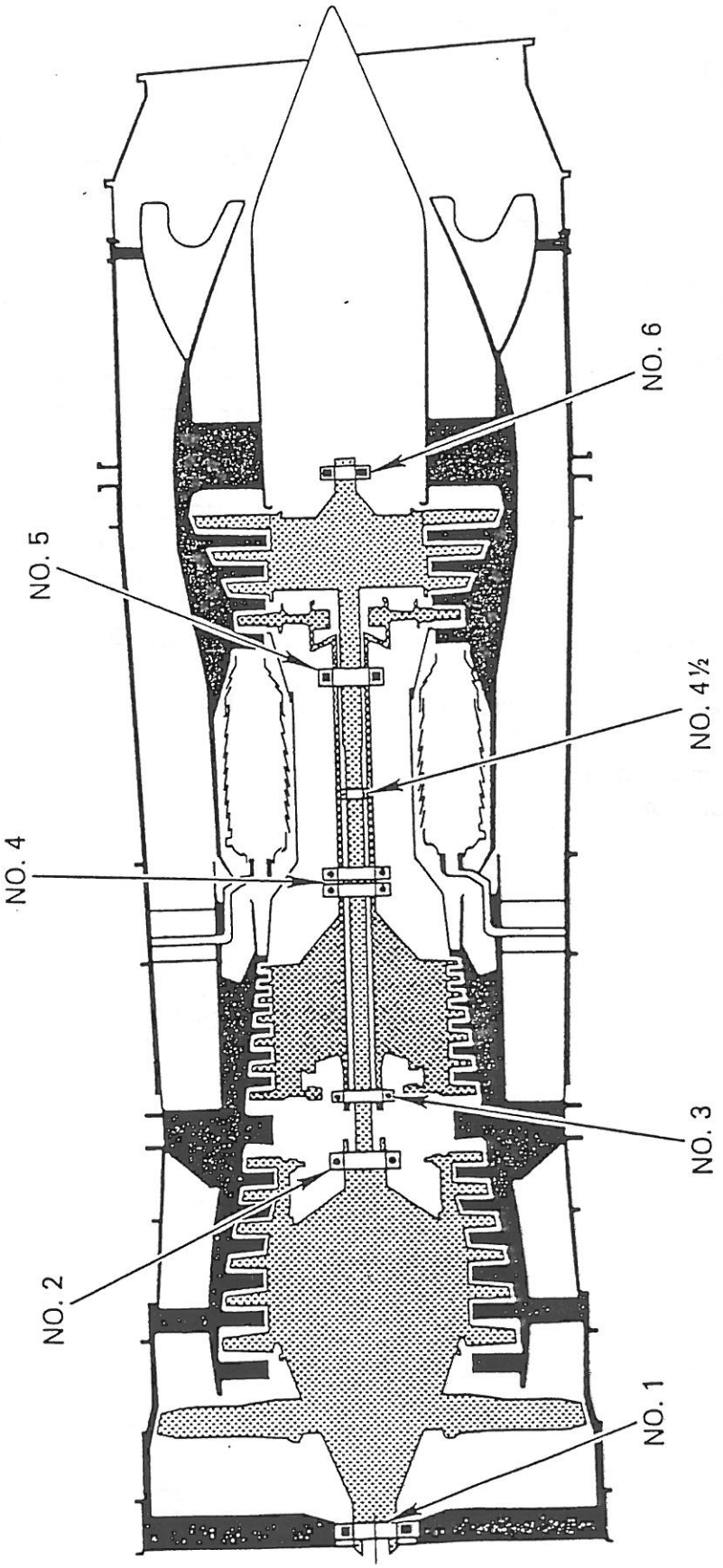
- Exhaust Section:
  - Rear engine mount location

- Mixer Section:
  - 12 lobe mixer



MAJOR ENGINE GROUPS AND SECTIONS

ENGINE MAIN BEARINGS



ENGINE GENERAL – DESCRIPTION

ENGINE SPECIFICATIONS

General

Type	Axial –Flow, gas turbine turbofan
Number of Combustion Chambers	9
Type of Combustion Chamber	Can–annular
Type of Compressor	Two –spool, 14 stage, front fan, having a 7 stage low pressure compressor and a 7 stage high pressure compressor
Type of Turbine	4 stage, split, having 1st stage high pressure and 2nd, 3rd, and 4th stage low pressure turbine
Engine Dry Weight (approx.)	4410 lbs. (2002.14 kilograms)
Engine Length at Room Temperature (approx.)	154.2 In. (3.91 meters)
Engine Inlet Diameter at Room Temperature (approx.)	54 In. (1.37 meters)

Ignition System

Ignition Exciter	Bendix–Scintilla or General Laboratory Associates (GLA)
Igniter Plugs	Champion

Lubricating System

Oil Specification	PWA 521
Oil Tank Usable quantity	4.0 gallons (3.33 imperial gallons or 15.14 liters)

Fuel System

Fuel Specification	SB 2016
Fuel Control	Hamilton Standard
Fuel Pump	Thompson Ramo Woolridge

Engine Operating Limits JT8D-217C

Thrust Setting	Time Limit (Minutes)	Max. EGT (Degrees C) JT8D-217C	Min. Oil Press. (PSI)	Max. Oil Temp (Degrees C)
Takeoff	5 2	590 595	*40 (276 kPa)	135
Max. Continuous	Continuous	580	*40 (276 kPa)	135
Starting	Momentary	**475	*40 (276 kPa)	135

* CAUTION: NORMAL OIL PRESSURE IS 40 TO 55 PSI (276 TO 380 KPA). OIL PRESSURE BETWEEN 35 AND 40 PSI (242 - 276 KPA) IS PERMISSIBLE FOR SUSTAINED OPERATIONS (TO COMPLETE FLIGHT), PREFERABLY AT REDUCED THROTTLE SETTING. OIL PRESSURE BELOW 35 PSI (242 KPA) IS UNSAFE.

** NOTE: Temperature is time limited to momentary. If the maximum EGT temperature is exceeded, the engine should be shut down and inspected in accordance with the instructions contained in Pratt & Whitney JT8D Maintenance Manual, 72-00-00.

A. With the exception of idle, thrust settings are obtained by positioning the thrust control levers to obtain the required engine pressure ratio for existing inlet air temperature.

B. A maximum oil temperature of 163° C is allowable for a time period not to exceed 15 minutes.

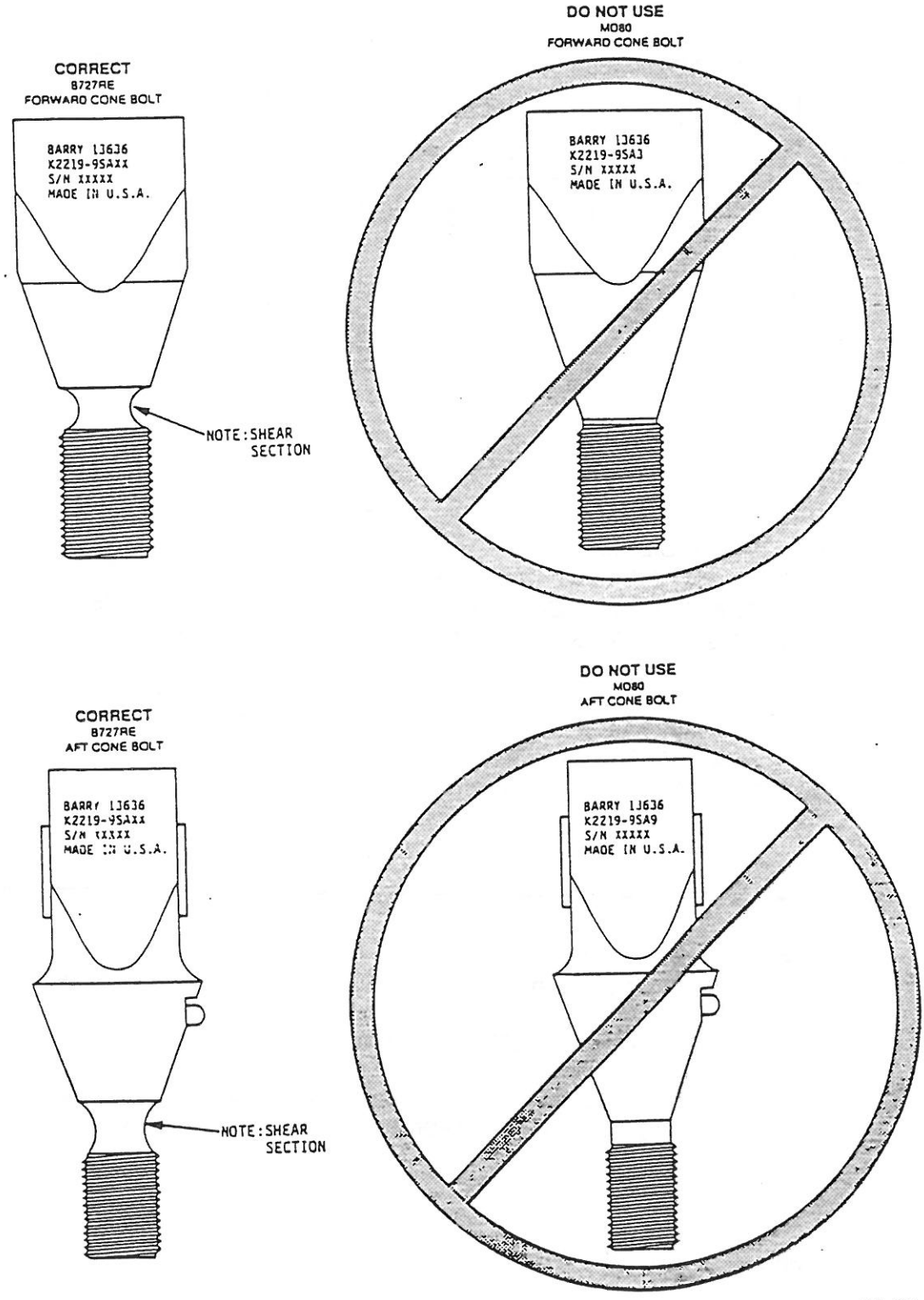
C. At normal takeoff, the N_2 high-pressure compressor rotor speed should not exceed 100.9 percent (12,350 rpm), and the N_1 low-pressure compressor rotor speed should not exceed 98.3 percent (8,080 rpm).

D. Starter duty cycle:

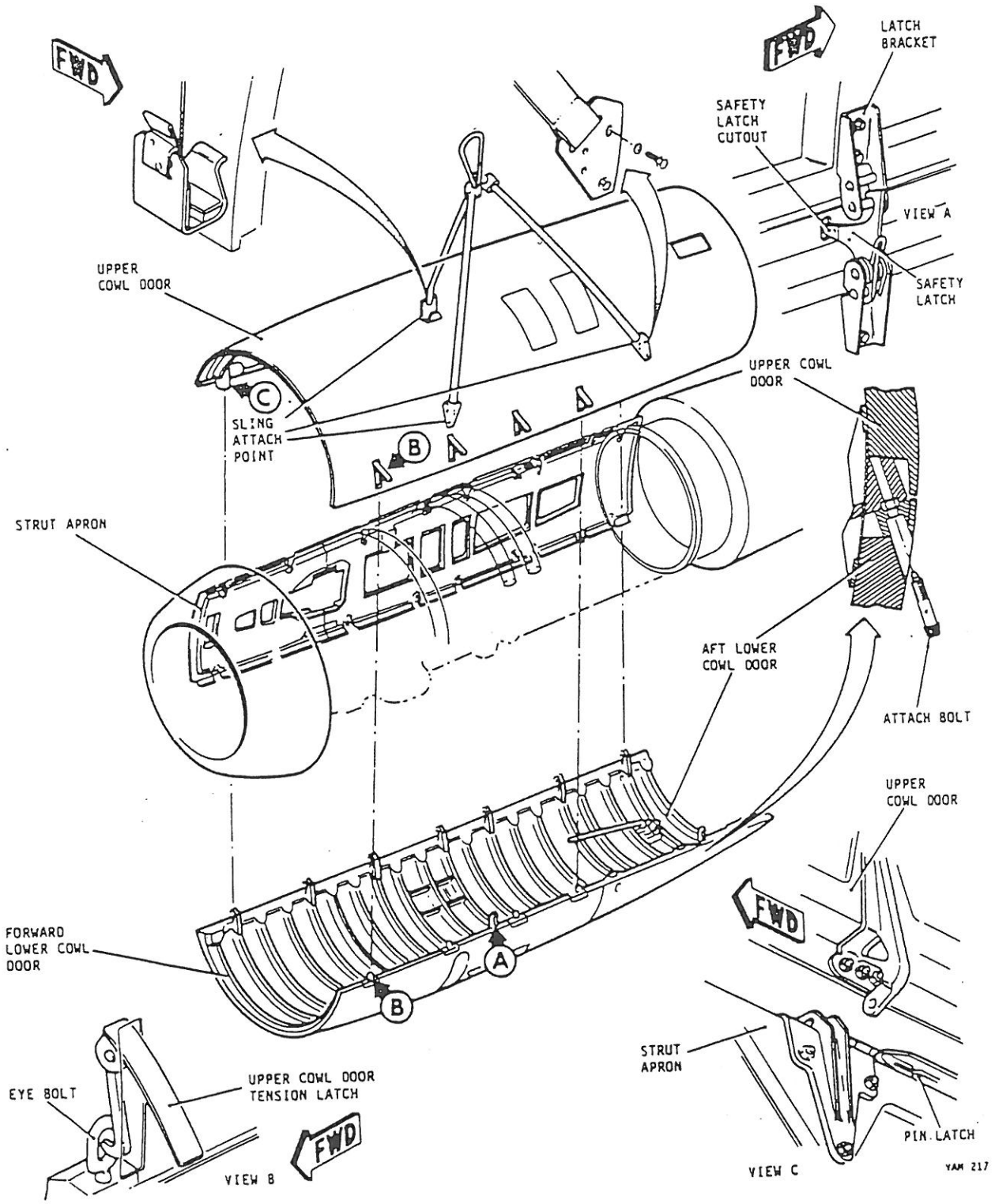
(1) Three successive 30 seconds start attempts i.e.; 90 seconds on, 5 minutes off.

(2) Subsequent start attempts: 30 seconds on, 5 minutes off or 60 seconds on, 10 minutes off.

(3) Dry motoring: 90 seconds on, 15 minutes off.



Cone Bolt – Identification



Cowl Door – Installation

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FUEL SYSTEM COMPONENTS