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ARROW 1 SERVICE DATA

ENGINE INSTALLATION

2 MAY 57

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ARROW 1 SERVICE DATA

LIST OF REVISIONS

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ENGINE INSTALLATION

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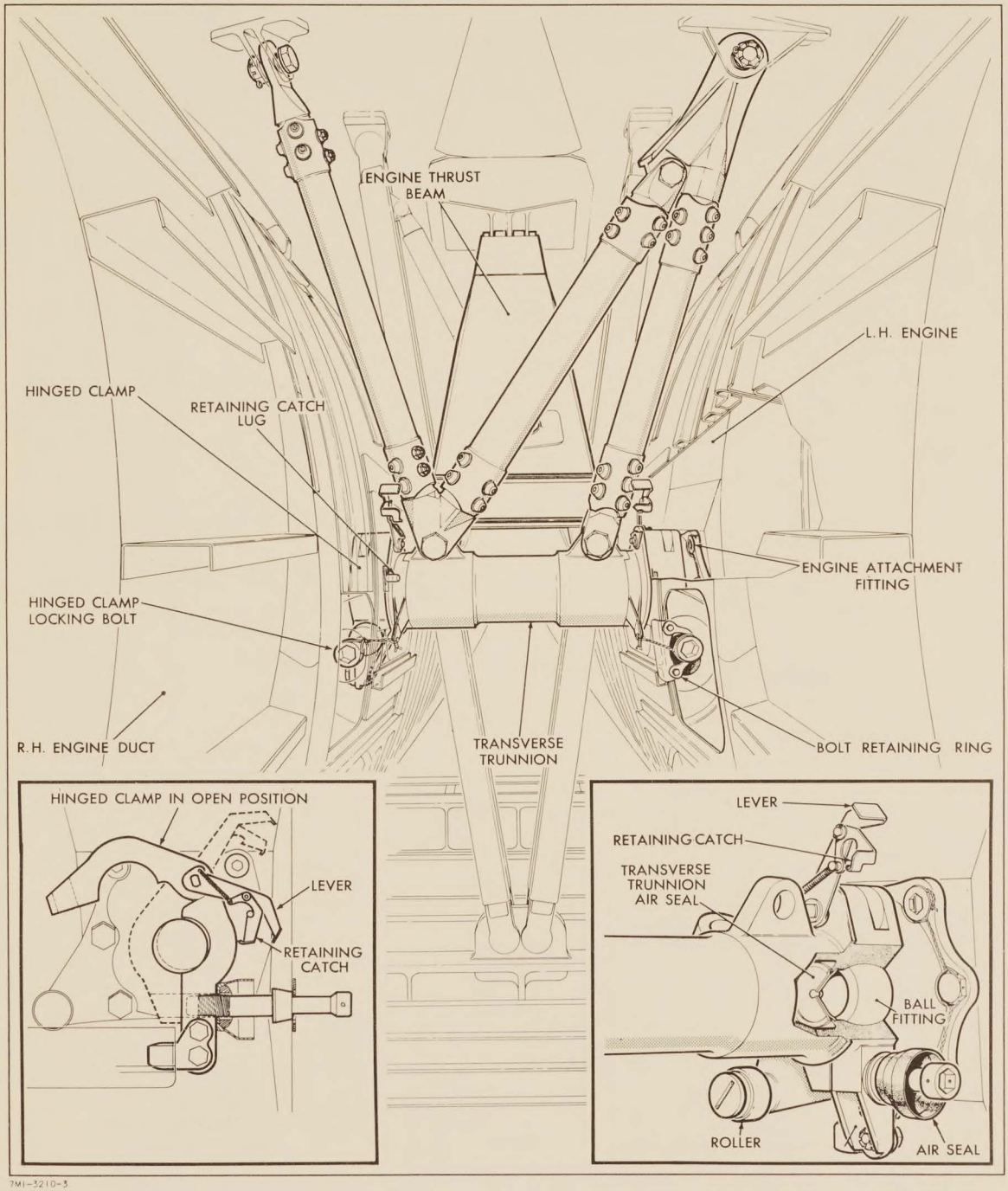
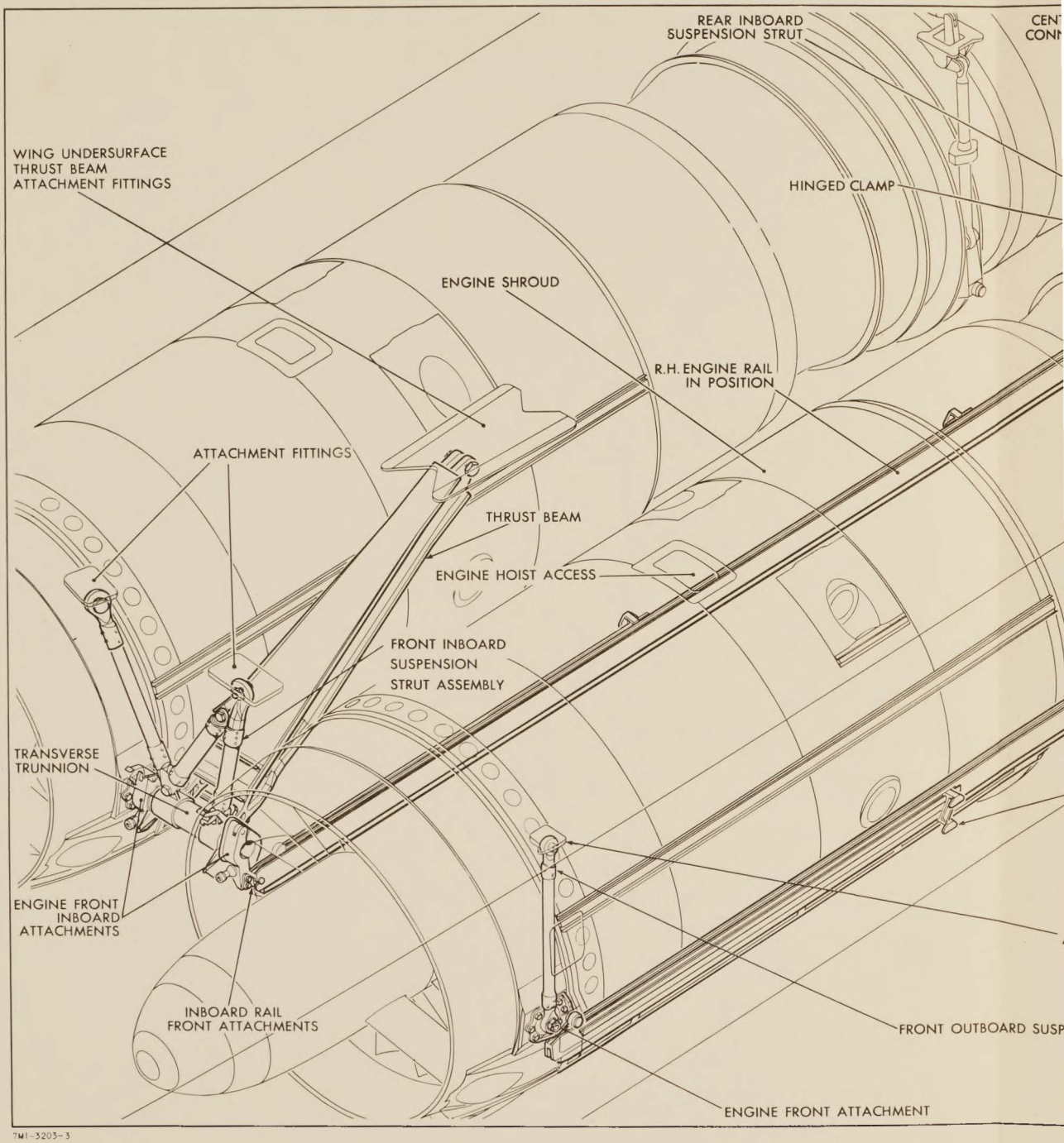


FIG. 1 ENGINE SUSPENSION - FRONT INBOARD


REAR INBOARD
SUSPENSION STRUT
WING UNDERSURFACE
THRUST BEAM
ATTACHMENT FITTINGS
HINGED CLAMP
ENGINE SHROUD
R.H. ENGINE RAIL
IN POSITION
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THRUST BEAM
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ATTACHMENTS
INBOARD RAIL
FRONT ATTACHMENTS
FRONT OUTBOARD SUSP
ENGINE FRONT ATTACHMENT

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ARROW 1 SERVICE DATA

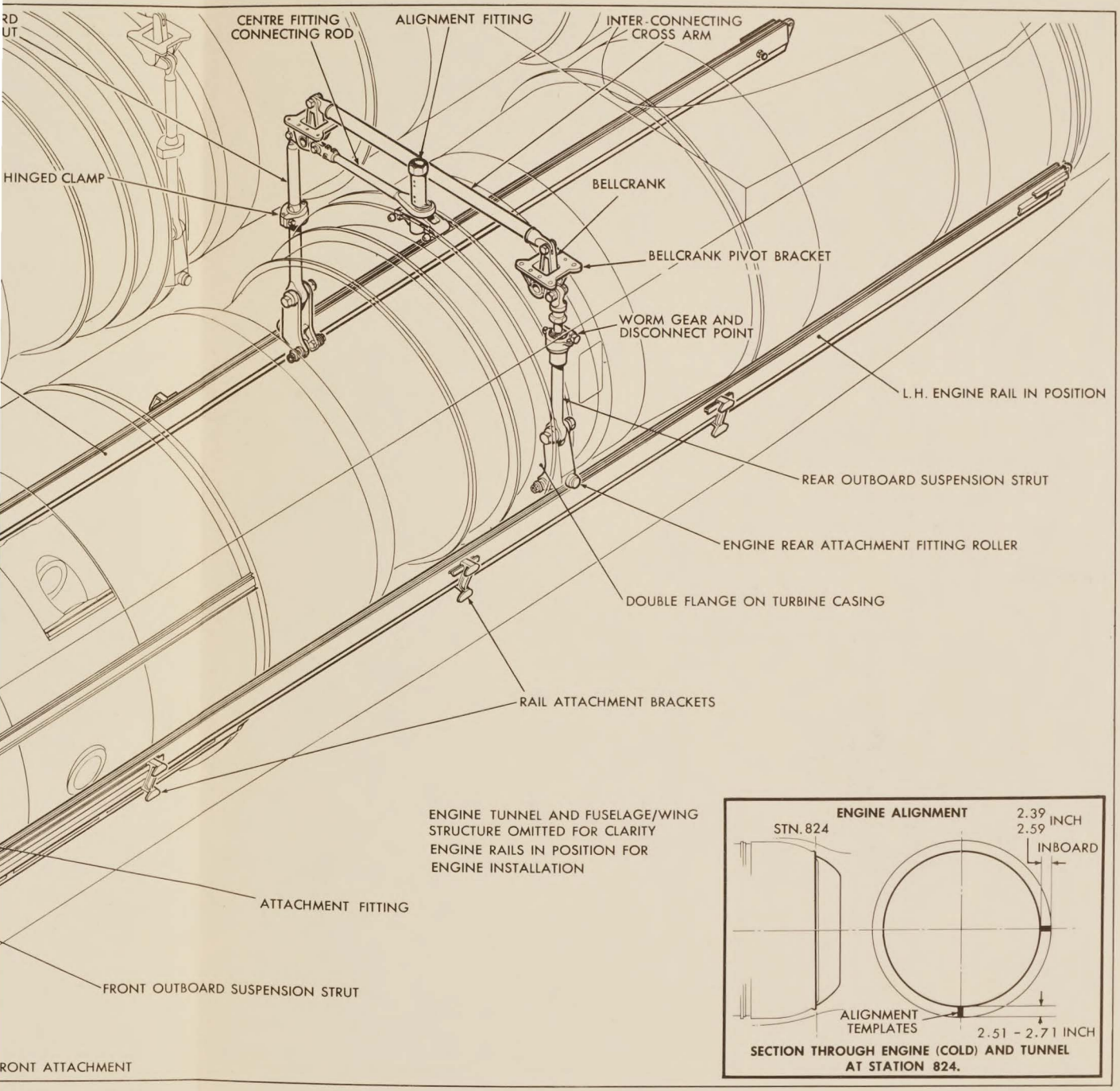

FIG. 2 ENGINE SUSPENSION AND ALIGNMENT

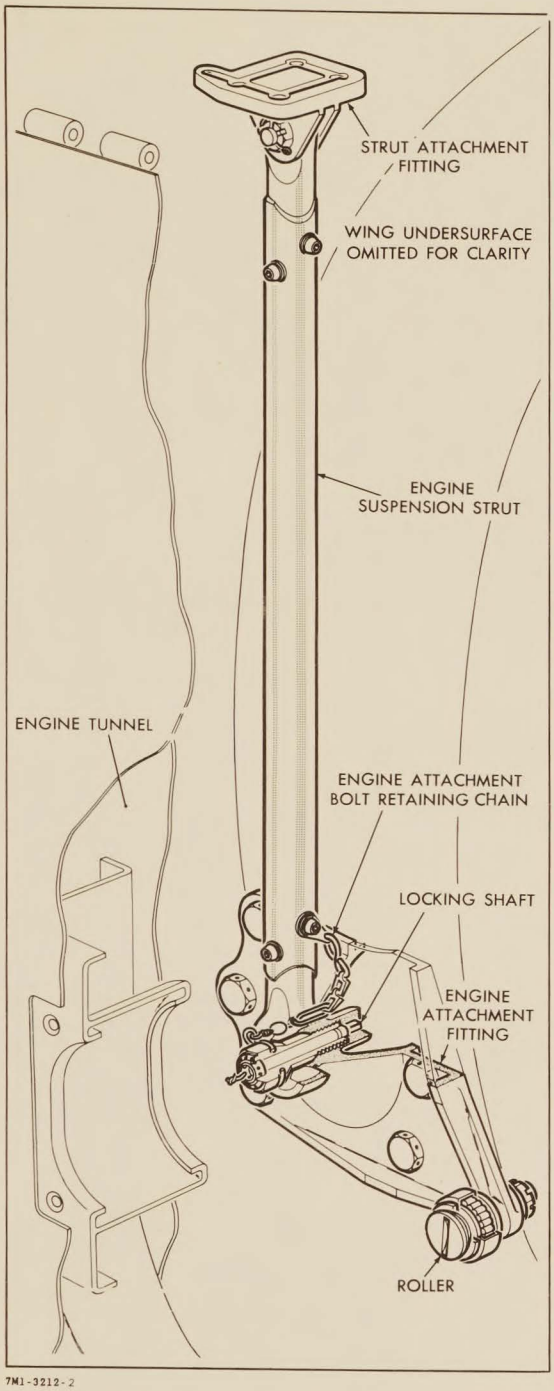

FIG. 3 ENGINE SUSPENSION - FRONT OUTBOARD

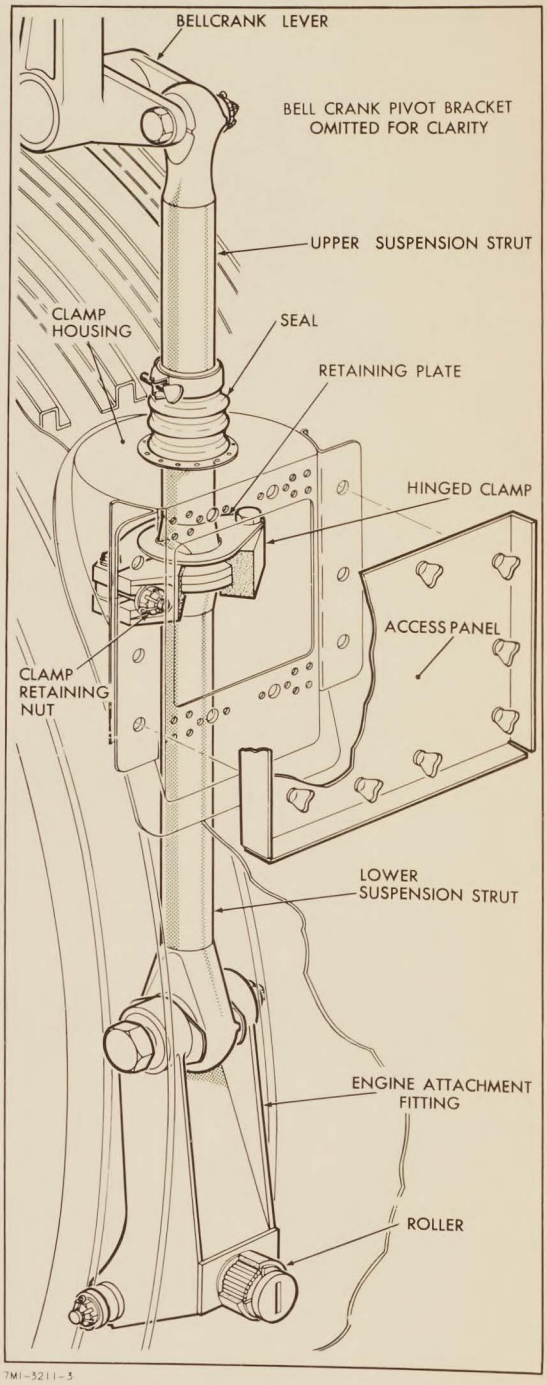

FIG. 4 ENGINE SUSPENSION - REAR INBOARD

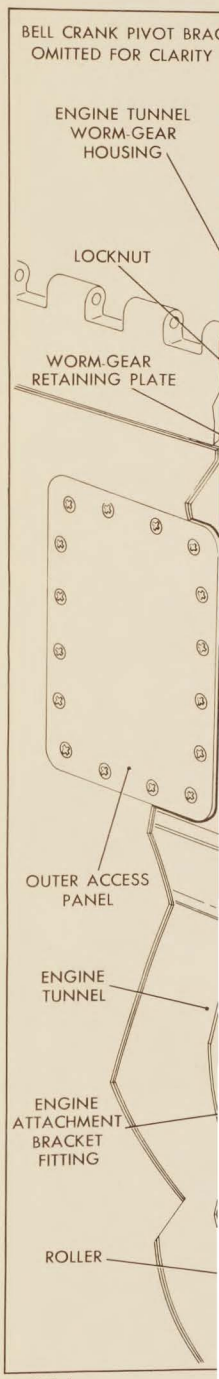

FIG. 5 ENGINE SUS

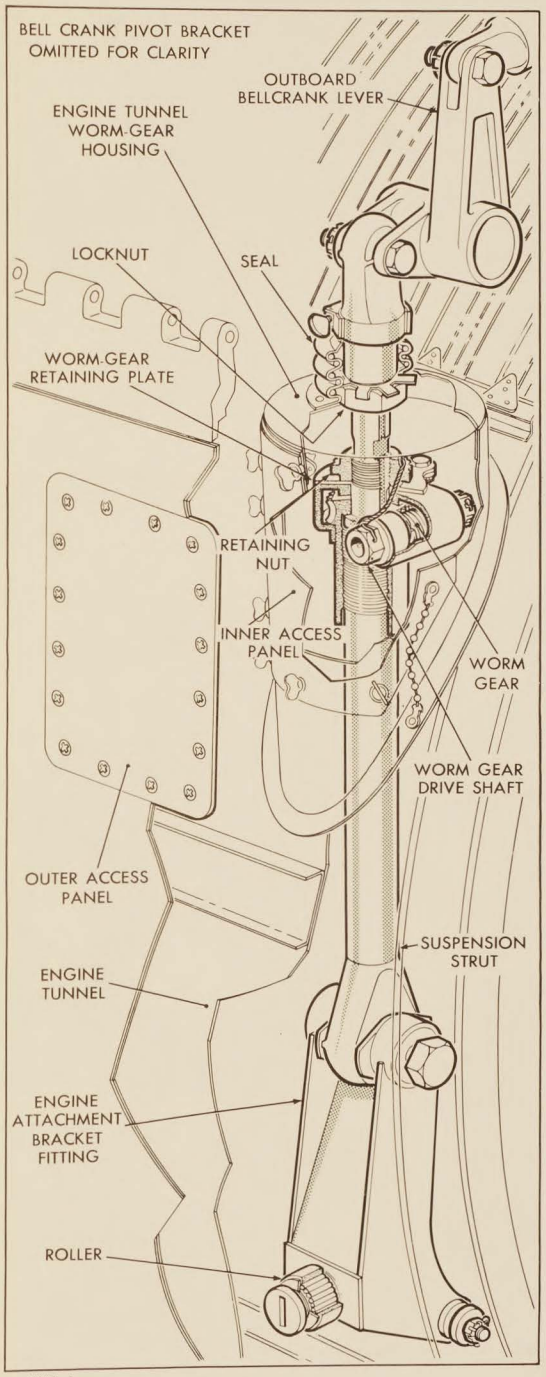

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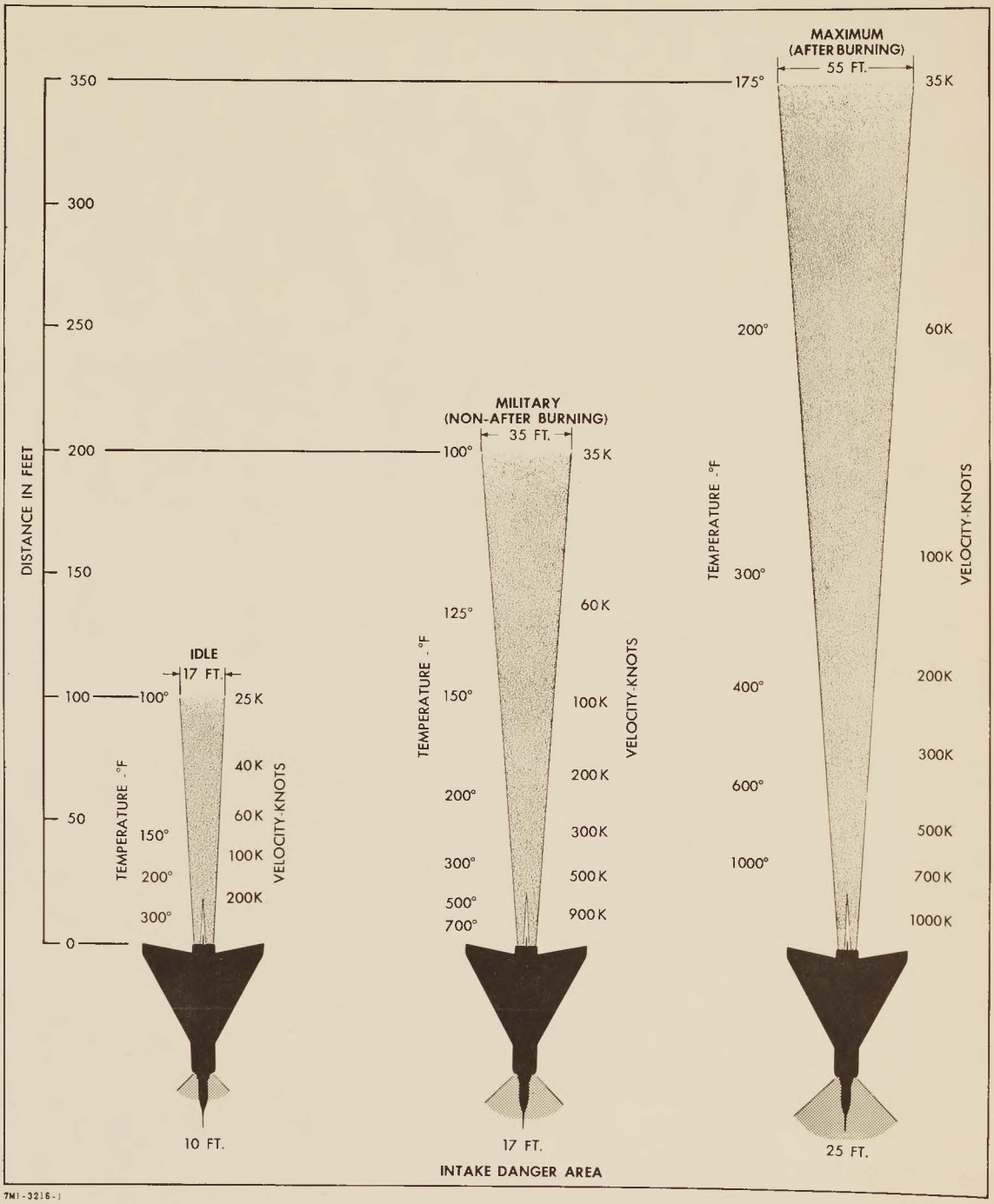
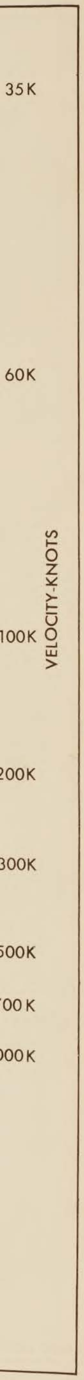
FIG. 5 ENGINE SUSPENSION - REAR OUTBOARD

ARROW 1 SERVICE DATA



7M1-3216-1

FIG. 15 JET WAKE AND INTAKE DANGER AREAS


35K
60K
100K
VELOCITY-KNOTS
200K
300K
500K
700 K
000K

ARROW 1 SERVICE DATA

SYSTEM DATA SHEET

SYSTEM	SUB-SYSTEM	AIRCRAFT EFF'TY	REF. NO.
ENGINE INSTALLATION		25201	25

DESCRIPTION

General

1. The aircraft is powered by two Pratt and Whitney YJ75-P-3 gas turbine engines with afterburners. Each engine develops approximately 15,500 lb. thrust without afterburning and 23,800 lb. thrust with efterburner opereting. The engines are mounted in two tunnels loceted in the rear fuselage. The engine installation allows for engine expansion and is so designed thet the engine is unaffected by airframe structural flexing.

Engine Suspension (Figs 1, 2, 3, 4 and 5)

2. Each engine is attached to three suapension atruts end a common thrust beam. The suspension struts and thrust beem ere secured to ettachments on the lower surface of the wing.

3. The engine thrust is transmitted through the front inboerd ettachment to the thrust beam end aircreft structure. The front inboard ettechment consists of e ball fitting, e hinged clemp end a trensverse trunnion. The bell fitting is attached to the engine compressor casing end is secured in the clamp. The clemp is mede in two helves which are hinged at the top and are locked by e bolt et the bottom. A lever and a reteining catch ere provided to open the clemp end meintein it open during engine removal and installetion. The RH end LH clamps ere mounted on the transverse trunnion which is atteched to the lower end of the thrust beam.

4. The engine front outboard attechment consists of e suspension strut atteched at ita upper end to e fitting on the lower surface of the wing, end at its lower end to en engine ettechment fitting. Both ends of the strut have spherical bearings. The lower attechment bolt is wire locked to a locking shaft inserted through the bolt and into the engine fitting.

5. The inboard and outboerd rear suspension struts are connected together by two bellcranks and a cross arm. This errangement permits vertical elignment of the engine by adjustment of the length of the outboard strut only. The engine is prevented from twisting during adjustment by e leterel alignment fitting. Spherical bearings at each end of both suspension struts allow for engine expansion. Seals fitted to each suspension strut isolate the engine tunnel from the hydraulic and equipment bey.

6. To facilitate removal and installation of the engine the inboard strut is mede in two sectiona, locked together by a hinged clemp. A retaining plate retains the clemp on the upper section of the strut when the clamp is released.

7. The outboard strut is also constructed in two sections with a long tubular worm gear driven nut on the upper section, end the lower section threaded to fit into the nut. The nut provides the adjustment for raising and lowering the engine in the tunnel. The nut is disengaged from the lower section of the strut for engine removal.

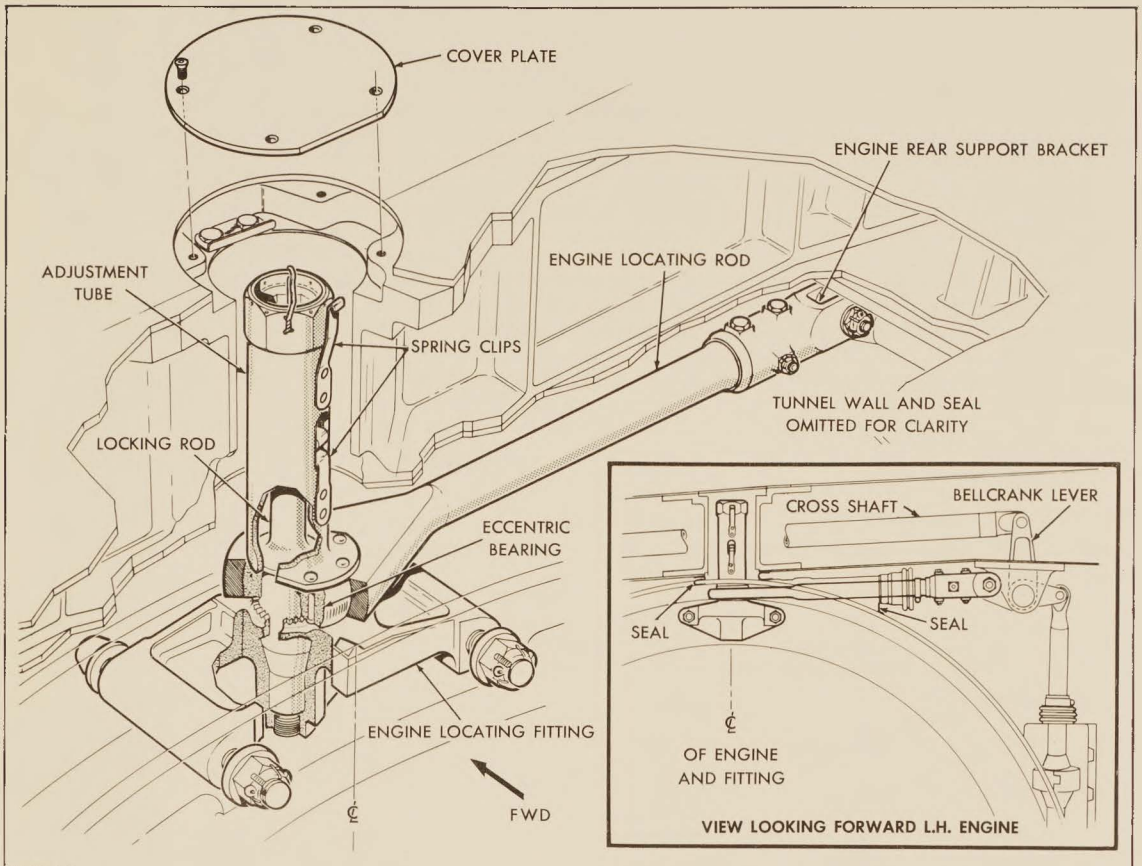


FIG. 6 ENGINE LATERAL ALIGNMENT FITTING

Engine Lateral Alignment

8. The rear section of the engine is aecured to the aircraft structure by a transverse rod which ia attached to the rear inboard suspension fitting. The rod ia secured to the engine fitting by means of an eccentric bearing. Positioning of the bearing adjusta the lateral location of the engine. A tube rivetted to the bearing allows the bearing to be turned after removal of an access panel on the wing upper skin. A rod, fitted inside the tube and screwed into the engine fitting, clamps the bearing to the engine fitting. Spherical bearings are fitted to both ends of the transverse rod to allow for engine expansion.

Engine Cooling (Figs. 7 and 8)

9. The engine cooling system provides for the varying cooling requirements under all conditions from ground running to maximum aircraft speed. During ground running and at low aircraft speeds a depression exists in the engine air intake. This causes duct gills fitted forward of the engine intake to cloae, and all air entering the intake passes through the engine. The air intake depression operates a pressure awitch which supplies

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electrical power to actuate an air ejection control valve, This valve directs compressor bleed air to an ejector nozzle located forward of the transverse firewall. The nozzle ejects a stream of H.P. air through a vent in engine access panel number two. The venturi effect caused by the air ejection nozzle and the afterburner nozzle, creates a depression in the forward and rear ends of the engine tunnel. This depression causes blow-in air flaps to open and allow air at atmospheric pressure to enter the engine tunnel. The depression at the air ejection nozzle draws air forward and through holes in the forward end of the engine shroud to cool the engine compressor and ventilate the forward section of the engine to atmosphere. This area beneath the engine shroud and forward of the transverse firewall is designated Zone 1. The depression at the afterburner nozzle draws cooling air rearward to cool the hot end of the engine. This area above the engine shroud and to the rear of the transverse firewall is designated Zone 2.

10. At air speeds above Mach 0.5 ram air in the engine air intake opens the duct gills, and approximately 15% of the ram air passes through the gills to cool the forward and rear sections of the engine. Ram air is also directed through the three heat exchangers located below the engine air intake.

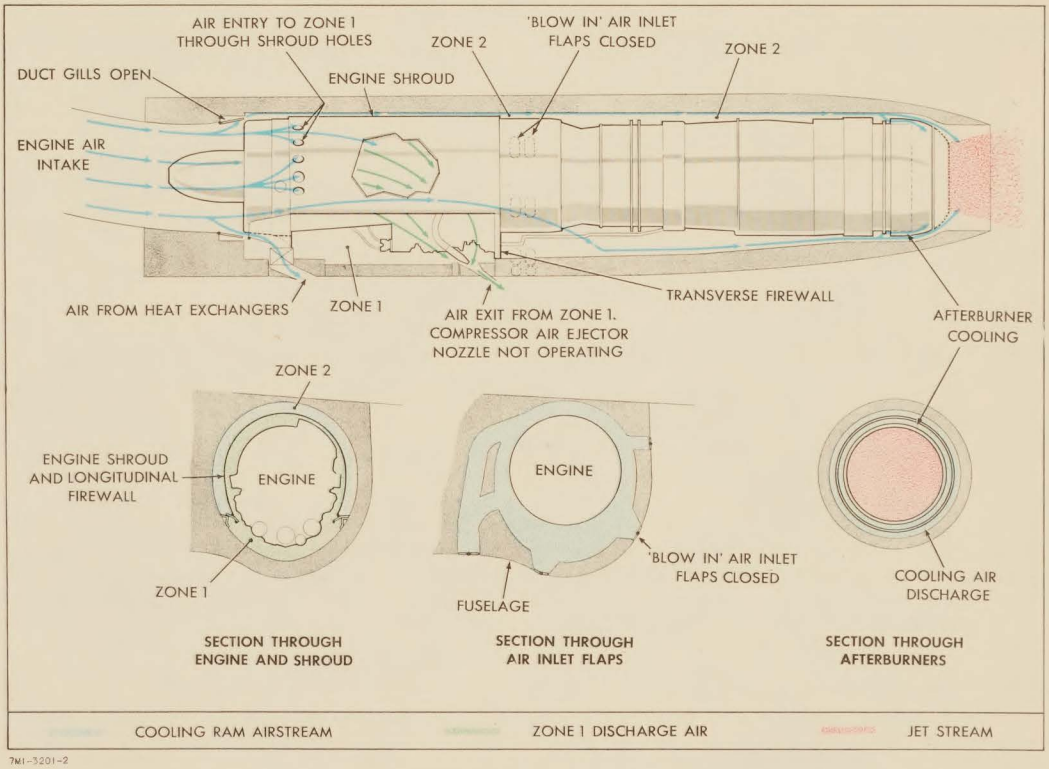

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FIG. 7 ENGINE COOLING - GROUND RUNNING AND AIRSPEEDS BELOW MACH 0.5

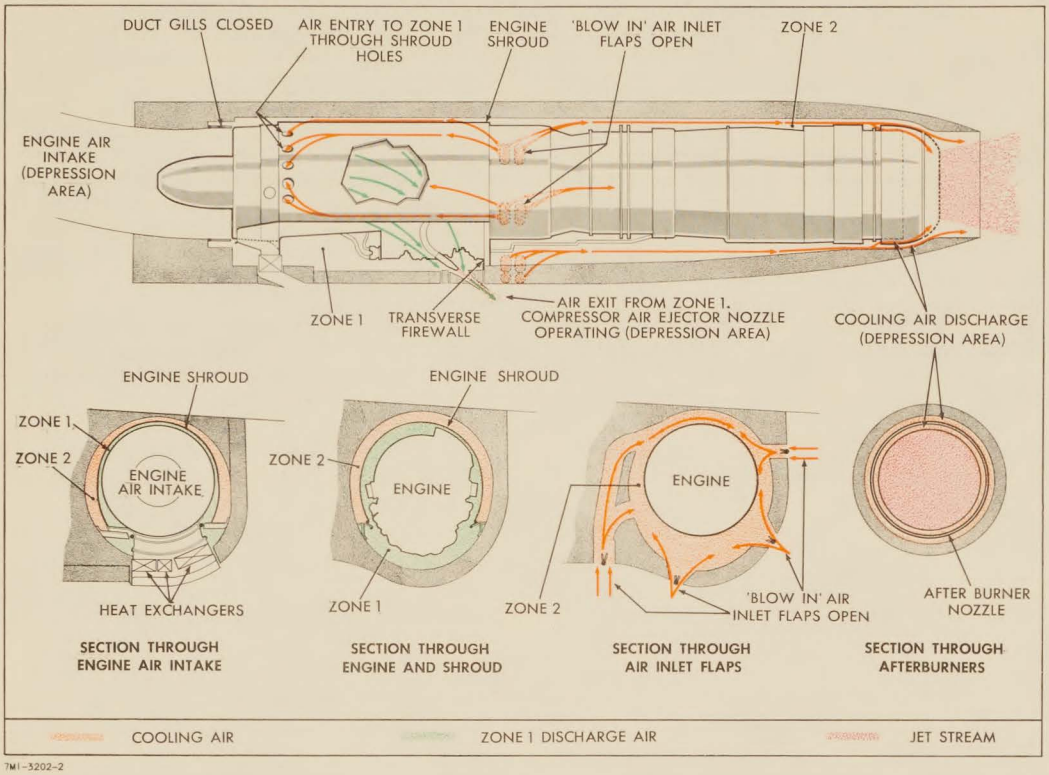

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FIG. 8 ENGINE COOLING - AIRSPEEDS ABOVE MACH 0.5

Air Ejection System (Fig. 9)

11. The air ejection system provides a flow of cooling air over the forward part of the engine and is designed to operate during ground running and in flight at speeds below Mach 0.5. See para 9.

12. The air ejection system consists of a pipeline tapped into the air conditioning bleed manifold and an air ejection valve operated by an electric actuator. A pressure switch located on the structure below the engine intake senses a pressure drop in the intake and supplies electrical power to actuate the valve. High pressure air is ejected from a nozzle on the end of the pipeline through a vent hole in number two engine acceas panel. The venturi effect set up by the air jet creates a depression around the forward section of the engine, drawing in cooling air through the blow-in flaps and through holes in the forward part of the engine shroud.

Engine Oil System (Fig. 10)

13. The engine oil is contained in a saddle type tank fitted on top of the engine compressor case. The tank is replenished by pumping the oil into a connection under the engine. An overflow valve is fitted adjacent to the filler connection to indicate when the tank is full.

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14. The engine oil ia cooled by two oil-to-fuel and one oil-to-air heat exchangers. The oil is pumped from the engine to the oil-tc-air heat exchanger located below the engine intake adaptor ring. This heat exchanger ia equipped with a relief valve to by-pass the oil during cold starting or in the event of the heat exchanger becoming choked.

15. From the oil-to-air heat exchanger the oil is passed to an oil-to-fuel heat exchanger fitted between the engines in the equipment bay. Oil flow through this component is controlled by a solenoid operated by-pass valve which opens and allowa oil to pass through the heat exchanger when the afterburner ia operating. This heat exchanger is a section of a combination heat exchanger which provides cooling for the utility hydraulics, flying control hydraulica, accesaories drive oil, and engine oil. The engine oil is

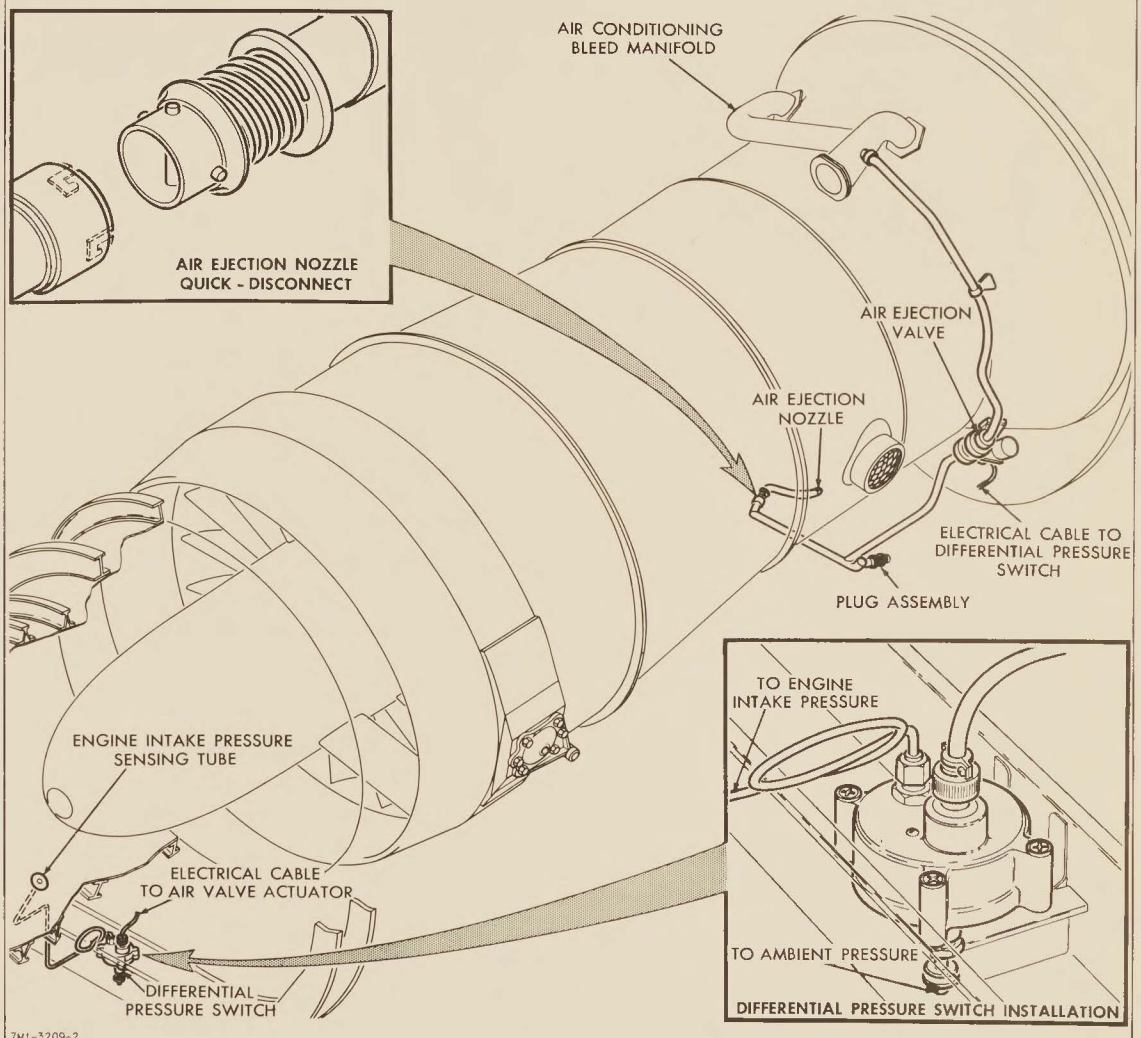

FIG. 9 AIR EJECTION SYSTEM

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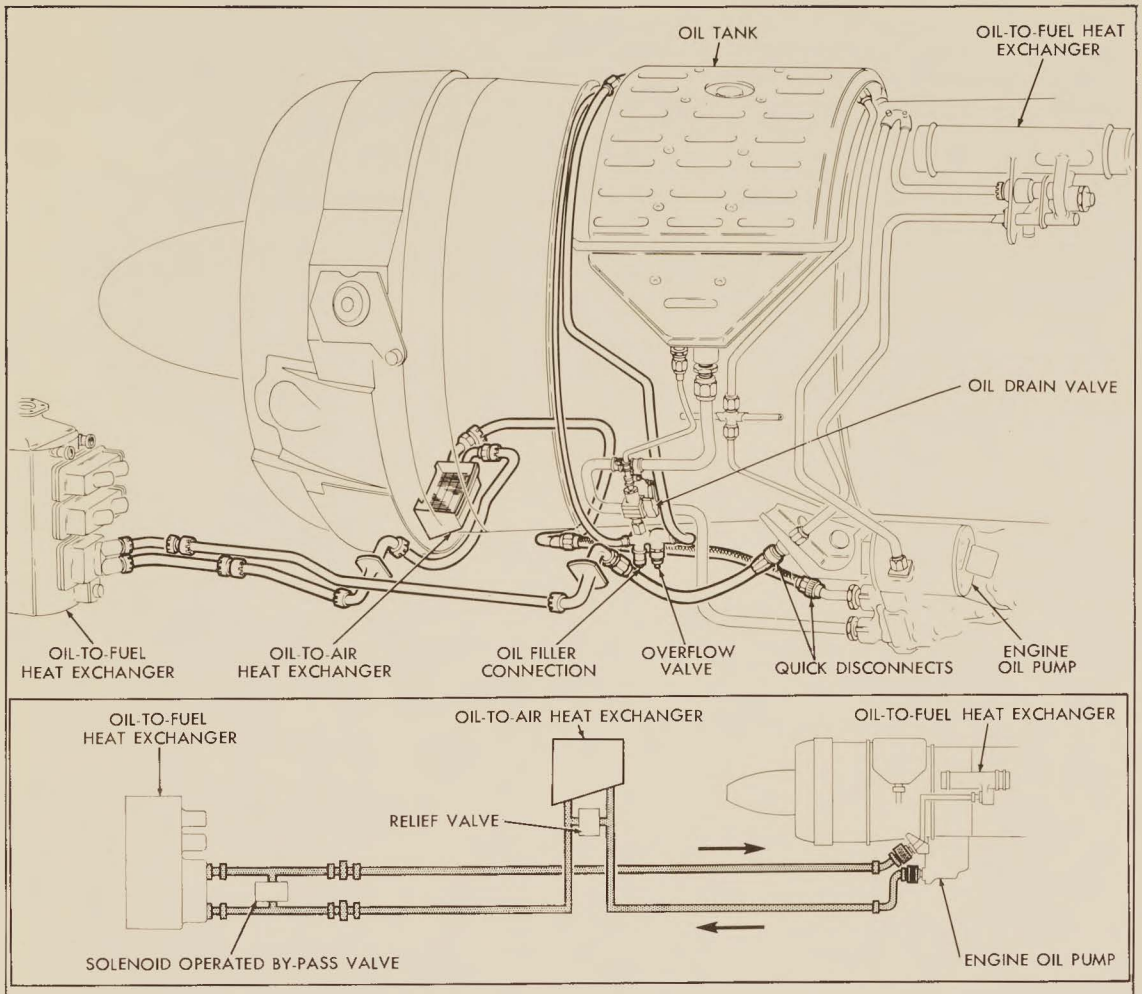

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FIG. 10 ENGINE OIL SYSTEM

finally cooled by an oil-to-fuel heat exchanger fitted on the LH side of the engine behind the oil tank.

16. The latter oil-to-fuel heat exchanger and the oil tank are both engine componenta.

Pressure Ratio Syatem (Fig. 11)

17. The presaure ratio system senses the pressure differential between the engine intake and the turbine outlet and transmits this to an electrical indicator in the cockpit. The indicator reading is uaed to compute the engine thrust.

18. The system consists of a pressure ratio transducer located between the tunnels in the engine bay. This unit ia connected by pipelines to pressure probes in the engine intake and turbine outlet. Flexible pipelines and quick disconnecta connect the engine

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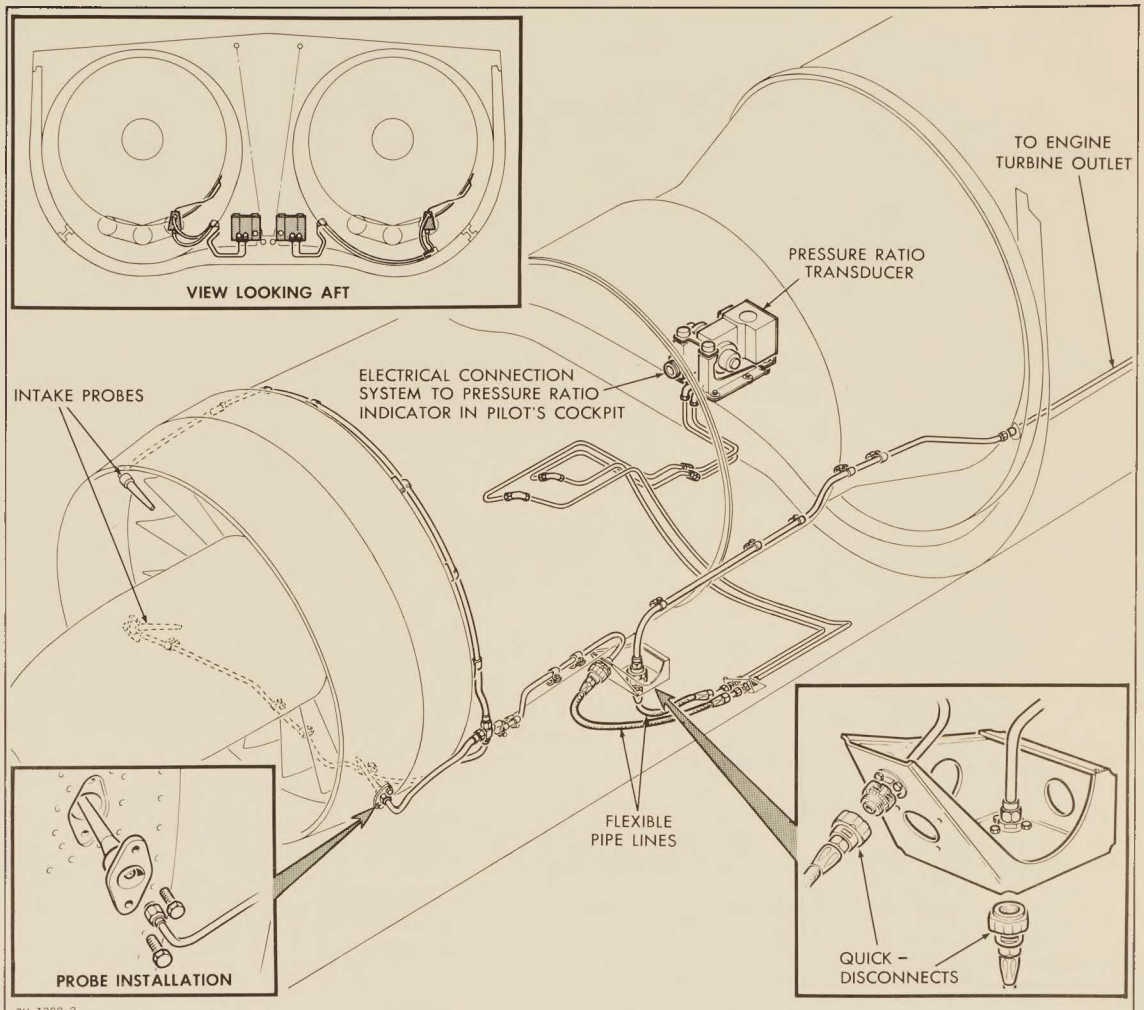


FIG. 11 PRESSURE RATIO SYSTEM

pipelines to the pipelines on the structure.

Engine Service Connections (Figs. 12 and 13)

19. Quick disconnects are used wherever practicable to facilitate engine removal and replacement. Access doors on the undersurface and removable panels on the side of the aircraft provide accesa to the connections and suspension struts.

Engine Installation (Fig. 14)

20. Prior to installation the engine is built up into a complete power plant by fitting equipment which is not supplied by the engine manufacturer. Two guide raila are inatalled in the engine tunnel, each being locked in position by a locating pin

and a thumb screw.

21. The power plant is lowered on to the engine change stand and is secured to the stand rear attachment. Alignment of the stand with the aircraft is achieved by locking the rear of the stand and adjusting the height of the forward legs. These legs incorporate a hydraulic jack and are raised by operating a hand pump and lowered by opening a valve. The two rails are secured to the engine stand by inserting a connecting pin.

22. The engine rests on four rollers, one fitted on each engine attachment fitting. A cranking mechanism on the rear of the engine stand provides a chain drive to the engine-to-stand attachment. Cranking of the two handles winds the engine onto the rails and into the engine tunnel.

23. When the engine is secured to the suspension struts and raised into position (see para 2), the engine stand is disconnected and the rails are withdrawn from the aircraft.

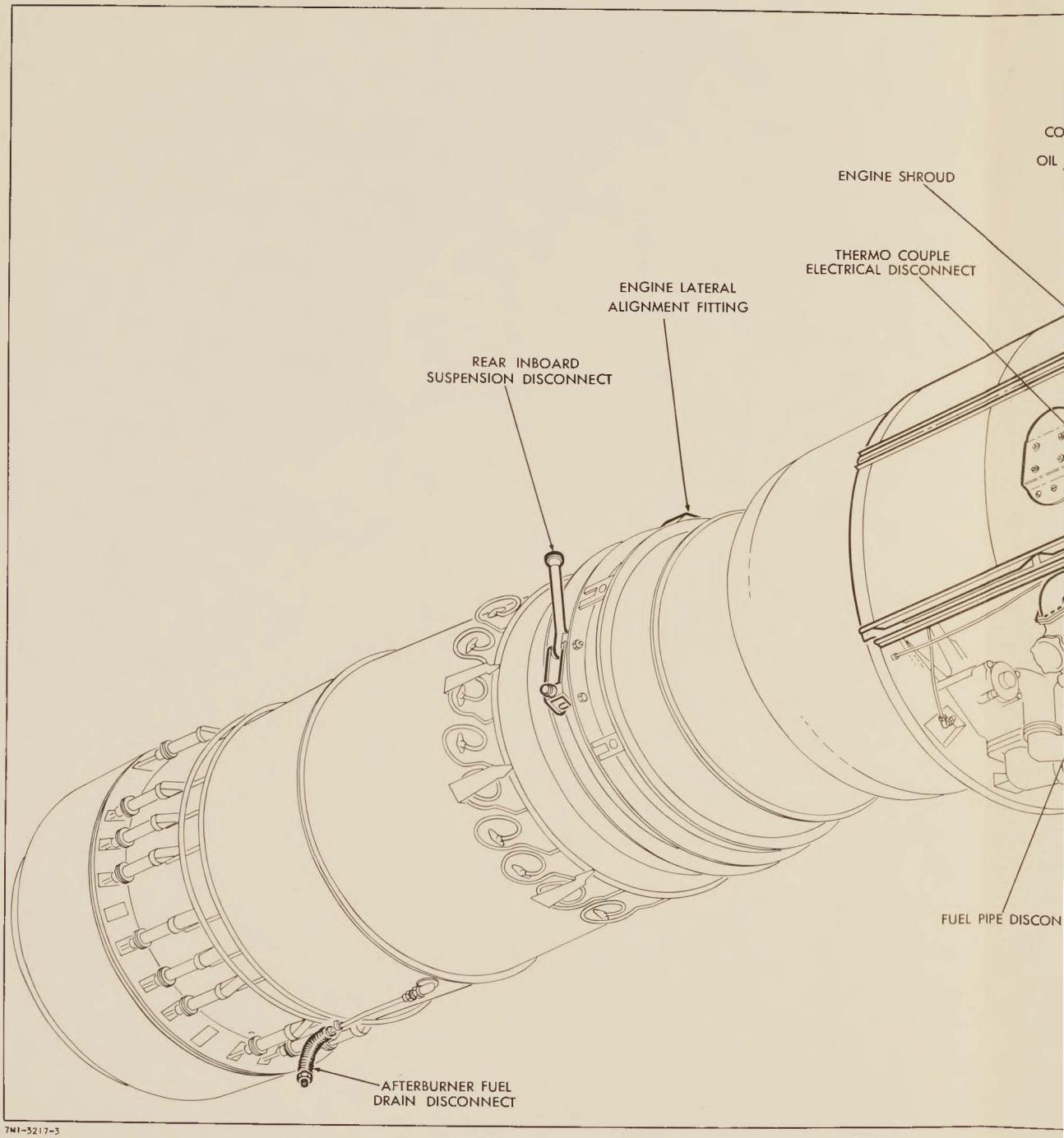
Ground Running Safety Precautions (Fig. 15)

24. In addition to normal jet aircraft ground running safety precautions, extra care should be exercised when observing the danger area around the intake and jet wake. Ear protectors should be worn at all times and ground test equipment placed as far as is practicable from the aircraft.

25. When carrying out high power ground runs the aircraft must be located on a running up base. This is equipped with two ground picket points and two concrete curbs with steel facings. The aircraft main wheels are positioned in the curbs and each main landing gear leg is secured to a picket point with a steel tie bar. Threaded end fittings provide the tie bar with adjustment for length.

26. An engine compressor relief valve vents a hot air blast from an oval shaped louvre in the side of the fuselage, just aft of the landing gear. Personnel and equipment should be kept at least five feet away from this area.

27. Interphone communication is necessary between the ground equipment operator and the occupant of the pilot's cockpit. In the event of an internal engine fire, the engine should be motored with the power levers OFF and all fuel and start switches OFF, until the fire is extinguished.


CO
OIL
ENGINE SHROUD
THERMO COUPLE
ELECTRICAL DISCONNECT
ENGINE LATERAL
ALIGNMENT FITTING
REAR INBOARD
SUSPENSION DISCONNECT
FUEL PIPE DISCON
AFTERBURNER FUEL
DRAIN DISCONNECT

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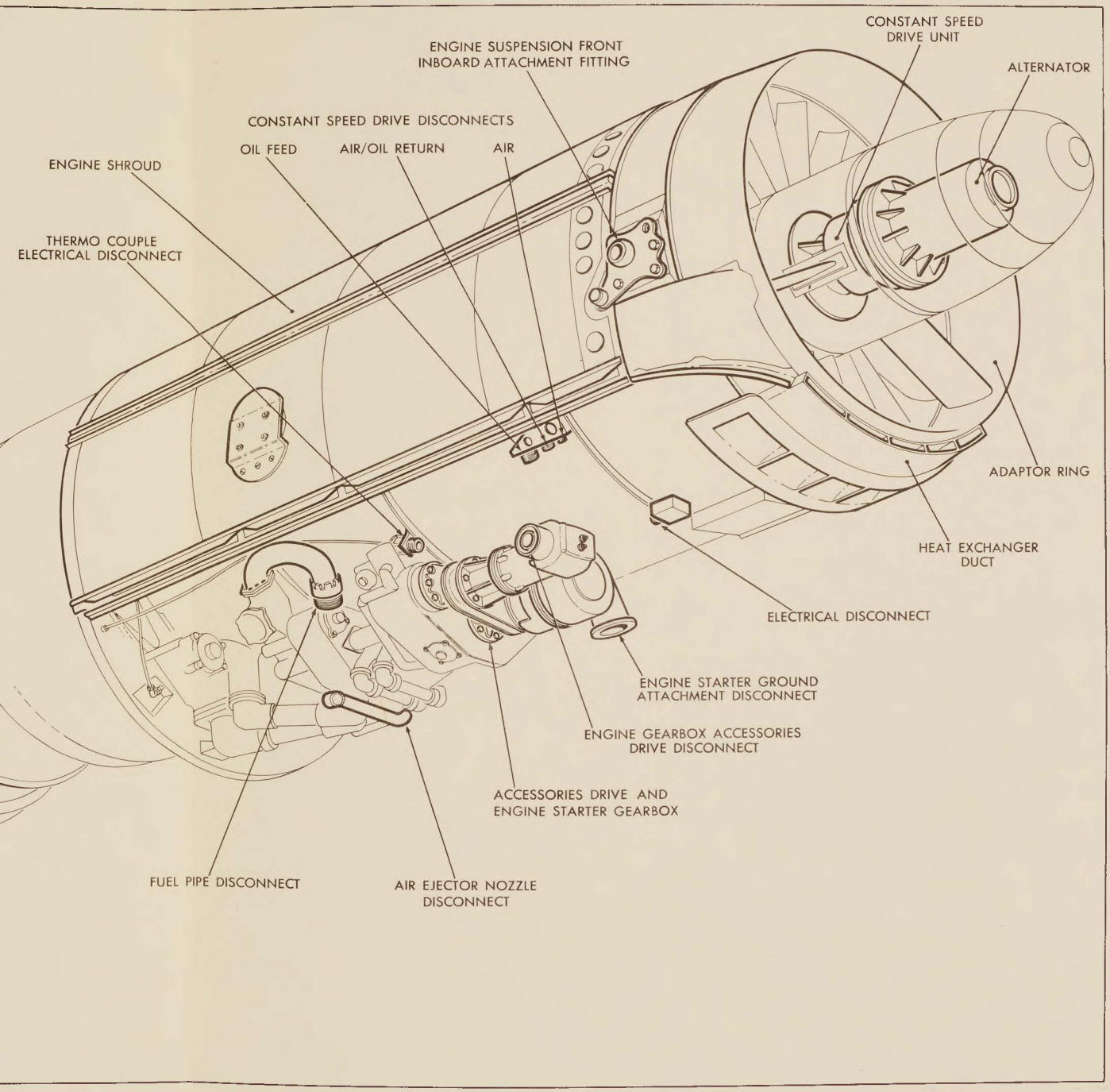

FIG. 12 ENGINE DISCONNECT POINTS - INBOARD

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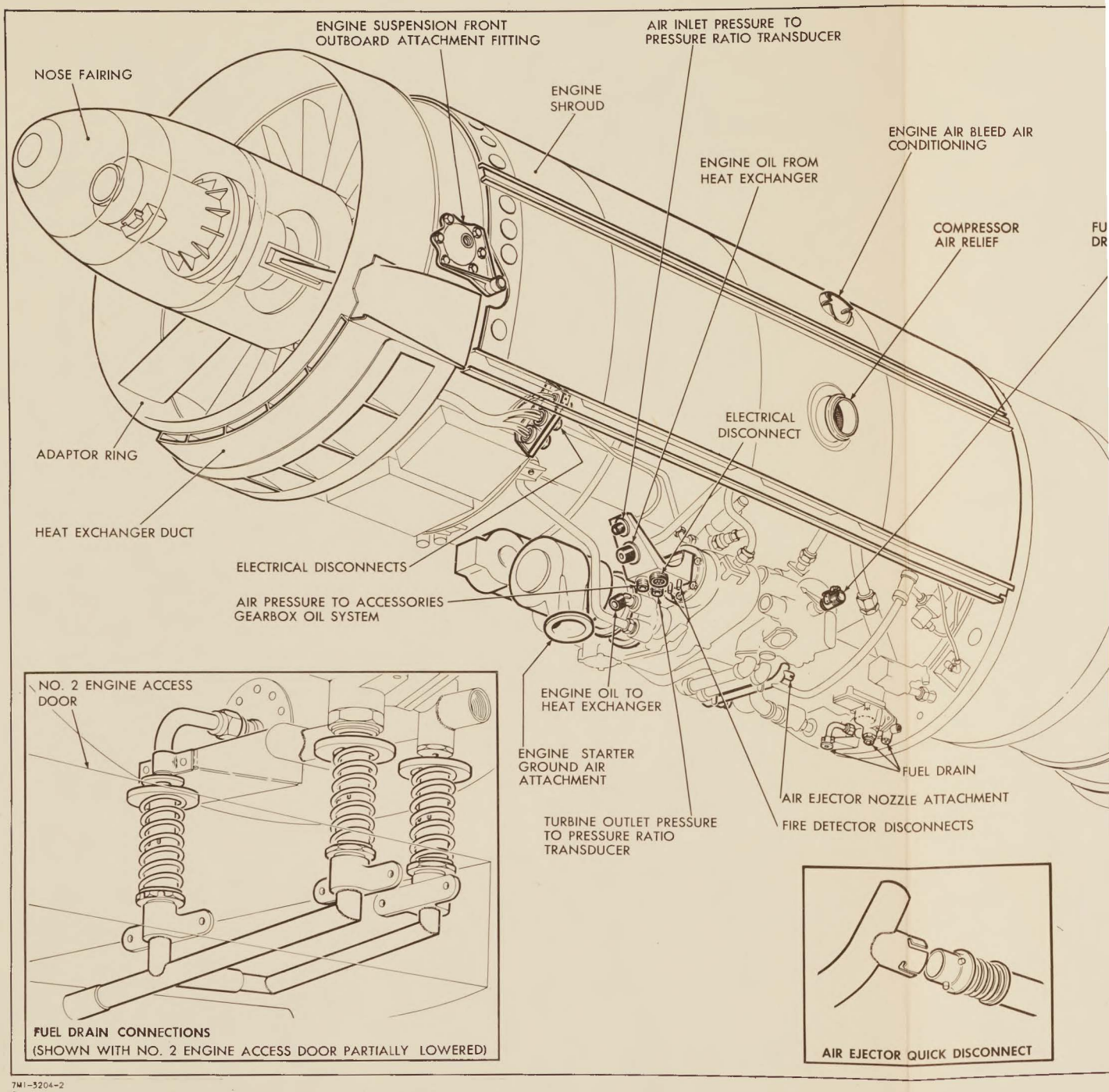

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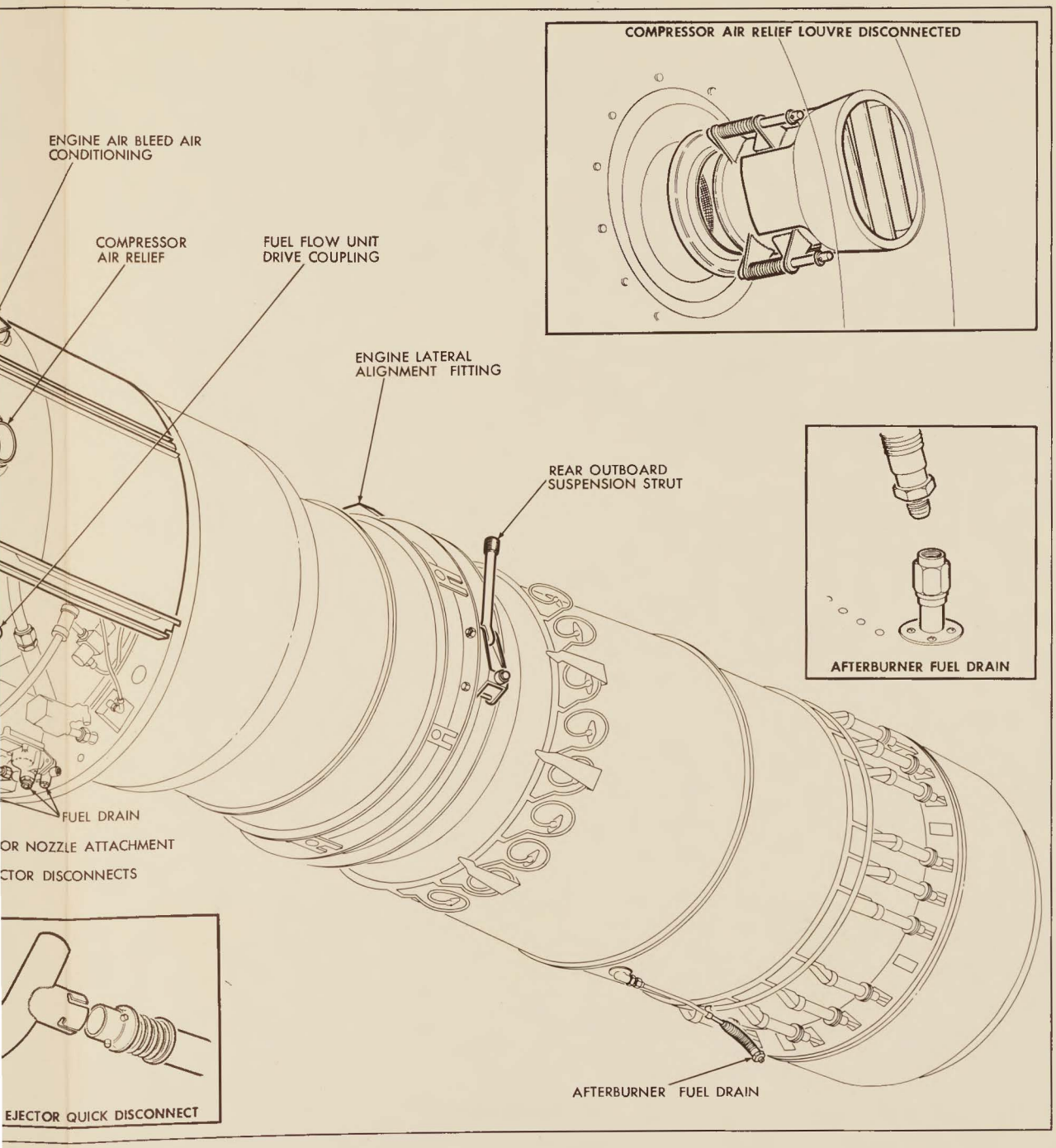
FIG. 13 ENGINE DISCONNECT POINTS - OUTBOARD


COMPRESSOR AIR RELIEF LOUVRE DISCONNECTED
ENGINE AIR BLEED AIR CONDITIONING
COMPRESSOR AIR RELIEF
FUEL FLOW UNIT DRIVE COUPLING
ENGINE LATERAL ALIGNMENT FITTING
REAR OUTBOARD SUSPENSION STRUT
AFTERBURNER FUEL DRAIN
FUEL DRAIN
OR NOZZLE ATTACHMENT
CTOR DISCONNECTS
EJECTOR QUICK DISCONNECT
AFTERBURNER FUEL DRAIN

ARROW 1 SERVICE DATA

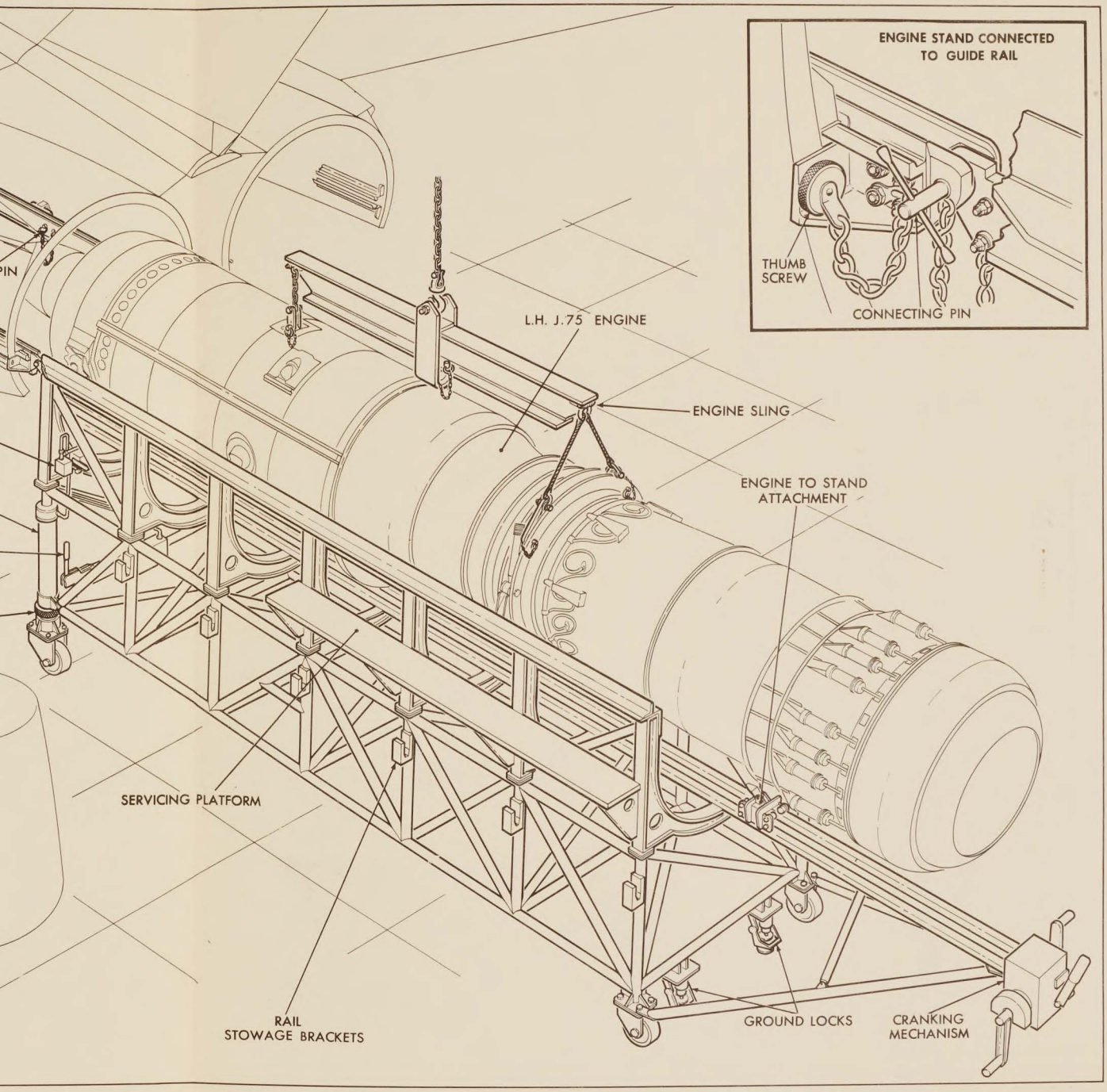


FIG. 14 ENGINE CHANGE STAND AND RAILS

ARROW 1 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
ENGINE INSTALLATION		Oil-to-air Heat Exchanger	25-1

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-2556-3/4			25201

OVERHAUL LIFE: KNOWN– ESTIMATED– 1500 hours

FUNCTION

To cool oil from engine oil system.

LOCATION

Below the engine air intake adaptor ring, station 577-581.

ACCESS

MEN X MINUTES

Engine must be removed to service this component.
Access for limited visual inspection through the cooling air exit.

REPLACEMENT PROCEDURE

MEN X MINUTES

Place heat exchanger in position and fit four mounting bolts.
Fit slip joint and install four retaining nuts.
Install the engine.

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ARROW 1 SERVICE DATA

INSPECTION	MEN X MINUTES	
Check the heat exchanger core and air exit for obstruction. Check for oil leaks. Check for security, corrosion and damage.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Engine installation equipment.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

ISSUE	1								
DATE	2 May 57								

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ARROW 1 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
ENGINE INSTALLATION		Air Turbine Starter	25-2

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-2995-6	AiReaearch		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To atart the aircraft engine.

LOCATION

On engine input gearbox.

ACCESS

Accessible through front engine accesa door.

MEN X MINUTES

REPLACEMENT PROCEDURE

Install the starter on the engine input gearbox.
Connect electrical wiring.

MEN X MINUTES

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ARROW 1 SERVICE DATA

INSPECTION	MEN X MINUTES	
Remove level plug and check lubricant. Check for wear and shaft distortion.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

ISSUE	1								
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ARROW 1 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
ENGINE INSTALLATION		Ejection Control Valve	25-3

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-1895-41			25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To control the supply of engine bleed air to the air ejection system.

LOCATION

Outboard side of the engine.

ACCESS

MEN X MINUTES

Accessible through engine access door No. 2.
33 camlocs and three latches.

REPLACEMENT PROCEDURE

MEN X MINUTES

Secure the valve on the engine.
Connect air piping - two Marmon couplings.
Connect electrical wiring.
Install the engine.

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ARROW 1 SERVICE DATA

INSPECTION	MEN X MINUTES	
Check for security and damage. Check position of indicator.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Engine installation equipment.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

ISSUE	1								
DATE	2 May 57								

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ARROW 1 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
ENGINE INSTALLATION		Differential Pressure Switch	25-4

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-1856-11			25201

OVERHAUL LIFE: KNOWN- ESTIMATED-

FUNCTION

Senses pressure differential between the engine intake and ambient pressure.
Controls the actuation of the ejector control valve.

LOCATION

Below the engine intake duct. Station 548 - 553.

ACCESS — MEN X MINUTES

Accessible through electrics access door.
74 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Secure to the structure with four bolts.
Connect pressure sensing line.
Connect electrical wiring.

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INSPECTION	MEN X MINUTES	
Ensure the inlets are free from obstruction and damage. Check switch for security, corrosion and damage.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

B4 stand.
Duct walkway.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

ISSUE	1								
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ARROW 1 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
ENGINE INSTALLATION		Oil Filler Drain Valve	25-5

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-1095-1265			25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 1500 hours

FUNCTION

To provide an indication of a full tank during oil replenishing.

LOCATION

Lower right hand side of the engine.

ACCESS

Accessible through oil filler access panel in engine access door No. 1 - three latches, ten camlocs.

MEN X MINUTES

REPLACEMENT PROCEDURE

Secure the valve to the engine - three bolts.
Connect the oil filler and oil drain pipelines.

MEN X MINUTES

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ARROW 1 SERVICE DATA

INSPECTION	MEN X MINUTES	
Check that the valve seats, after disconnecting the ground service rig. Check for damage, security and correct operation.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Engine ground service rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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