

# LYCOMING OPERATOR'S MANUAL

## TROUBLE—SHOOTING

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O-320 & IO-320 SERIES

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### TROUBLE—SHOOTING

Experience has proven that the best method of trouble-shooting is to decide on the various causes of a given trouble and then to eliminate causes one by one, beginning with the most probable. The following charts list some of the more common troubles, which may be encountered in maintaining engines; their probable causes and remedies.

#### 1. TROUBLE-SHOOTING—ENGINE.

TROUBLE	PROBABLE CAUSE	REMEDY
Failure of Engine to Start	Lack of fuel	Check fuel system for leaks. Fill fuel tank. Clean dirty lines, strainers or fuel valves.
	Overpriming	Leave ignition "off" and mixture control in "Idle Cut-Off", open throttle and "unload" engine by cranking for a few seconds. Turn ignition switch on and proceed to start in a normal manner.
	Defective spark plugs	Clean and adjust or replace spark plugs.
	Defective ignition wire	Check with electric tester, and replace any defective wires.
	Defective battery	Replace with charged battery.

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TROUBLE	PROBABLE CAUSE	REMEDY
Failure of Engine to Start (Cont.)	Improper operation of magneto breaker	Clean points. Check internal timing of magnetos.
	Lack of sufficient fuel flow	Disconnect fuel line and check fuel flow.
	Water in fuel injector or carb.	Drain fuel injector or carburetor and fuel lines.
Failure of Engine to Idle Properly	Internal failure	Check oil screens for metal particles. If found, complete overhaul of the engine may be indicated.
	Incorrect idle mixture	Adjust mixture.
	Leak in induction system	Tighten all connections in the induction system. Replace any parts that are defective.
	Incorrect idle adjustment	Adjust throttle stop to obtain correct idle.
	Uneven cylinder compression	Check condition of piston rings and valve seats.
	Faulty ignition system	Check entire ignition system.
	Insufficient fuel pressure	Adjust fuel pressure.
Low Power and Uneven Running	Mixture too rich indicated by sluggish operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust.	Readjustment of fuel injector or carburetor by authorized personnel is indicated.

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TROUBLE	PROBABLE CAUSE	REMEDY
Low Power and Uneven Running (Cont.)	Mixture too lean; indicated by overheating or back-firing	Check fuel lines for dirt or other restrictions. Readjustment of fuel injector or carburetor by authorized personnel is indicated.
	Leaks in induction system	Tighten all connections. Replace defective parts.
	Defective spark plugs	Clean and gap or replace spark plugs.
	Improper fuel	Fill tank with fuel of recommended grade.
	Magneto breaker points not working properly	Clean points. Check internal timing of magnetos.
	Defective ignition wire	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors	Replace connectors on spark plug wire.
Failure of Engine to Develop Full Power	Leak in induction system	Tighten all connections and replace defective parts.
	Throttle lever out of adjustment	Adjust throttle lever.
	Improper fuel flow	Check strainer, gage and flow at the fuel inlet.
	Restriction in air scoop	Examine air scoop and remove restrictions.

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TROUBLE	PROBABLE CAUSE	REMEDY
Failure of Engine to Develop Full Power (Cont.)	Improper fuel	Drain and refill tank with recommended fuel.
	Faulty ignition	Tighten all connections. Check system with tester. Check ignition timing.
Rough Engine	Cracked engine mount	Replace or repair mount.
	Defective mounting bushings	Install new mounting bushings.
	Uneven compression	Check compression.
Low Oil Pressure	Insufficient oil	Fill to proper level with recommended oil.
	Air lock or dirt in relief valve	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line	Check gasket between accessory housing and crankcase.
	High oil temperature	See "High Oil Temperature" in "Trouble" column.
	Defective pressure gage	Replace.
	Stoppage in oil pump intake passage	Check line for obstruction. Clean suction strainer.
High Oil Temperature	Insufficient air cooling	Check air inlet and outlet for deformation or obstruction.

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<b>TROUBLE</b>	<b>PROBABLE CAUSE</b>	<b>REMEDY</b>
<b>High Oil Temperature (Cont.)</b>	<b>Insufficient oil supply</b>	<b>Fill to proper level with specified oil.</b>
	<b>Low grade of oil</b>	<b>Replace with oil conforming to specifications.</b>
	<b>Clogged oil lines or strainers</b>	<b>Remove and clean oil strainers.</b>
	<b>Excessive blow-by</b>	<b>Usually caused by worn or stuck rings.</b>
	<b>Failing or failed bearing</b>	<b>Examine sump for metal particles. If found, overhaul of engine is indicated.</b>
	<b>Defective temperature gage</b>	<b>Replace gage.</b>
<b>Excessive Oil Consumption</b>	<b>Low grade of oil</b>	<b>Fill tank with oil conforming to specifications.</b>
	<b>Failing or failed bearings</b>	<b>Check sump for metal particles.</b>
	<b>Worn piston rings</b>	<b>Install new rings.</b>
	<b>Incorrect installation of piston rings</b>	<b>Install new rings.</b>
	<b>Failure of rings to seat (new nitrided cylinders)</b>	<b>Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting until oil consumption stabilizes.</b>





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### INSTALLATION AND STORAGE

**1. PREPARATION OF ENGINE FOR INSTALLATION.** Before installing an engine that has been prepared for storage, remove all dehydrator plugs, bags of dessicant and preservative oil from the engine. Preservative oil can be removed by removing the bottom spark plugs and turning the crankshaft three or four revolutions by hand. The preservative oil will then drain through the spark plug holes. Draining will be facilitated if the engine is tilted from side to side during the above operation. Preservative oil which has accumulated in the sump can be drained by removing the oil sump plug. Engines that have been stored in a cold place should be removed to an environment of at least 70°F. (21°C.) for a period of 24 hours before preservative oil is drained from the cylinders. If this is not possible, heat the cylinders with heat lamps before attempting to drain the engine.

After the oil sump has been drained, the plug should be replaced and safety-wired. Fill the sump with lubricating oil. The crankshaft should again be turned several revolutions to saturate the interior of the engine with the clean oil. When installing spark plugs, make sure that they are clean, if not, wash them in clean petroleum solvent. Of course, there will be a small amount of preservative oil remaining in the engine, but this can cause no harm. However, after twenty-five hours of operation, the lubricating oil should be drained while the engine is hot. This will remove any residual preservative oil that may have been present.

#### CAUTION

*Do not rotate the crankshaft of an engine containing preservative oil before removing the spark plugs, because if the cylinders contain any appreciable amount of the mixture, the resulting action, known as hydraulic, will cause damage to the engine. Also, any contact of the preservative oil with painted surfaces should be avoided.*

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*General* - Should any of the dehydrator plugs, containing crystals of silica-gel or similar material, be broken during their term of storage or upon their removal from the engine, and if any of the contents should fall into the engine, that portion of the engine must be disassembled and thoroughly cleaned before using the engine. The oil strainers should be removed and cleaned in gasoline or some other hydrocarbon solvent. The fuel drain screen located in the fuel inlet of the carburetor or fuel injector should also be removed and cleaned in a hydrocarbon solvent. The operator should also note if any valves are sticking. If they are, this condition can be eliminated by coating the valve stem generously with a mixture of gasoline and lubricating oil.

*Inspection of Engine Mounting* - If the aircraft is one from which an engine has been removed, make sure that the engine mount is not bent or damaged by distortion or misalignment as this can produce abnormal stresses within the engine.

*Attaching Engine to Mounts* - See airframe manufacturer's recommendations for method of mounting the engine.

*Oil and Fuel Line Connections* - The oil and fuel line connections are called out on the accompanying installation drawings.

*Propeller Installation* - Consult the airframe manufacturer for information relative to propeller installation.

### **2. PREPARATION OF CARBURETORS AND FUEL INJECTORS FOR INSTALLATION.**

Carburetors and fuel injectors that have been prepared for storage should undergo the following procedures before being placed in service.

*Carburetor* - Remove the fuel drain plug and drain preservative oil. Remove the fuel inlet strainer assembly and clean in a hydrocarbon solvent. Reinstall the fuel drain plug and fuel inlet strainer assembly.

*Fuel Injector* - Remove and clean the fuel inlet strainer assembly and reinstall. Inject clean fuel into the fuel inlet connection with the fuel outlets uncapped until clean fuel flows from the outlets. Do not exceed 15 psi inlet pressure.

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## 3. PREPARATION OF ENGINE FOR STORAGE OR SHIPMENT.

**General** - The following procedure is intended for application to installed engines, which are being removed from aircraft and will provide protection from corrosion for a period of 30 to 60 days.

**Preservation Run** - Immediately prior to removal of the engine from the aircraft, the engine should be given a preservation run under the following operating conditions.

**Fuel** - Normal service fuel.

**Oil** - Fill sump to normal capacity with preservative type lubricating oil (Soconoy's Avrex 901, Esso's "Rust-Ban 626" or equivalent).

**Duration of Run** - Operate the engine for a period of four minutes, holding the engine speed to a maximum of 1800 RPM. All precautions pertaining to ground running should be carefully observed. Cylinder head, ignition harness, and magneto temperatures should not be allowed to exceed the prescribed limits.

**Compound Injection** - Upon completion of the preservation run, drain the preservative oil from the engine and remove, clean and replace the oil suction and oil pressure screens. Perform any of the engine checks, such as valve clearance or ignition timing, which require rotation of the crankshaft. Disconnect the ignition harness and remove the spark plugs. Starting with cylinder No. 1, make certain piston is at the bottom of compression stroke. Fill cylinder with preservative oil (use same oil as specified for preservation run) and rotate crankshaft until piston is at top center. Oil will spill out of spark plug hole. In order to preserve the top wall of the cylinder, it will be necessary to either rock the engine, or blow compressed air with very light pressure into the spark plug hole. Following the engine firing order, preserve the remainder of the cylinders in the same manner. When all cylinders have been treated, then spray the exhaust port and valve of each cylinder with the piston 1/4 turn before top center on the exhaust stroke. When absolutely certain that no further need exists for turning the crankshaft, again spray each cylinder through the spark plug holes. (Maintain spray nozzle temperature at 200°F. to 220°F. (93°C. to 104°C.) for all spraying operations.)

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**Installation of Seals and Plugs** - Install cylinder dehydrator plugs (Avco Lycoming P/N 40238 or equivalent) in spark plug holes. Install ignition cable protectors (Avco Lycoming P/N 40239 or equivalent) over the spark terminal of each ignition cable and secure by attaching to the end of the dehydrator plug. Flush all accessory drives for which oil seals are provided with preservative oil before assembling the drive covers. Suitable covers should be used in sealing the exhaust ports; moisture resistant tape (Minnesota Mining and Manufacturing Company, 711 Acetate Fibre Tape or equivalent) will be sufficient for the ground connections and similar openings. Install a plug (Avco Lycoming P/N 1540 or equivalent) in the thermometer well at the rear of the oil pressure screen housing. Install sealing caps (Avco Lycoming P/N 61595 or equivalent) over the breather opening and (Avco Lycoming P/N 61596 or equivalent) over the generator or alternator blast tube. Install tachometer drive cap (Avco Lycoming P/N 61545 or equivalent) over tachometer drive. Make sure all other openings are properly sealed.

**Exterior Surfaces** - All exposed cadmium plated and machined surfaces should be coated with soft-film corrosion-preventative compound (E. F. Houghton and Company, Cosmoline 1059 or equivalent). The starter ring gear and propeller mounting surfaces in particular should receive a liberal coating of the compound.

**Carburetor** - Drain all residual gasoline from the carburetor, fill with flushing oil (MIL-C-16173, Grade 2) and flush the interior surfaces by rocking the carburetor. Drain excess oil from the fuel passages and replace plugs. Lock the throttle in the closed position and pack the carburetor in a cardboard container.

**Fuel Injector** - Any unit taken out of service, or units being returned for overhaul, must be flushed with preserving oil (Specification MIL-O-6081, Grade 1010), using the following procedure.

Remove plugs and drain all fuel from the injector. If available, apply 10 to 15 psi air pressure to the fuel inlet, until all fuel is discharged from the injector.

Replace plugs and apply flushing oil filtered through a 10 micron filter at 13 to 15 psi to the fuel inlet until oil is discharged from the servo line.

Replace fuel inlet plug.

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## CAUTION

*Do not exceed the recommended air pressure as internal damage to the injector may result.*

After filling with preservative oil the injector should be protected from dust and dirt, and given such protection against moisture as climatic conditions at the point of storage require.

The injector shall be tagged as follows: The fuel chambers and passages of this fuel injector were preserved with oil conforming to Specification MIL-O-6081, Grade 1010. Before using de-preserve in accordance with instructions in operator's manual.

*Shipping Case* - Upon completion of the preceding steps, the engine should be secured in a suitable engine shipping container. The date of preservation and the following legend should be legibly marked on the side of the container:

*"On (Date) the engine was preserved for 60 days short term storage with preservative oil and cylinder and crankcase dehydrator plugs shall be inspected on arrival at destination or 30 days after the above date (whichever occurs sooner) to determine if renewal of the dehydrating agent is necessary."*

**4. RECOMMENDED PROCEDURE FOR RE-PRESERVATION.** The engine shall be examined every 30 days (or less, depending on weather and locality). If any evidence of corrosion is present, the affected area should be cleaned free of corrosion and the engine re-preserved.

Engines prepared in the preceding manner are not adequately protected for extended periods of storage. If at the end of 60 days, it is found that the engine must remain in storage for an additional period, the engine must be re-preserved according to the foregoing procedure.

## NOTE

*Inspection and re-preservation will not be the responsibility of the engine manufacturer after engines have been shipped from the engine manufacturer's plant. It shall be the responsibility of the consignee to put engines into service in the order of storage preparation date to reduce the storage period to a minimum.*

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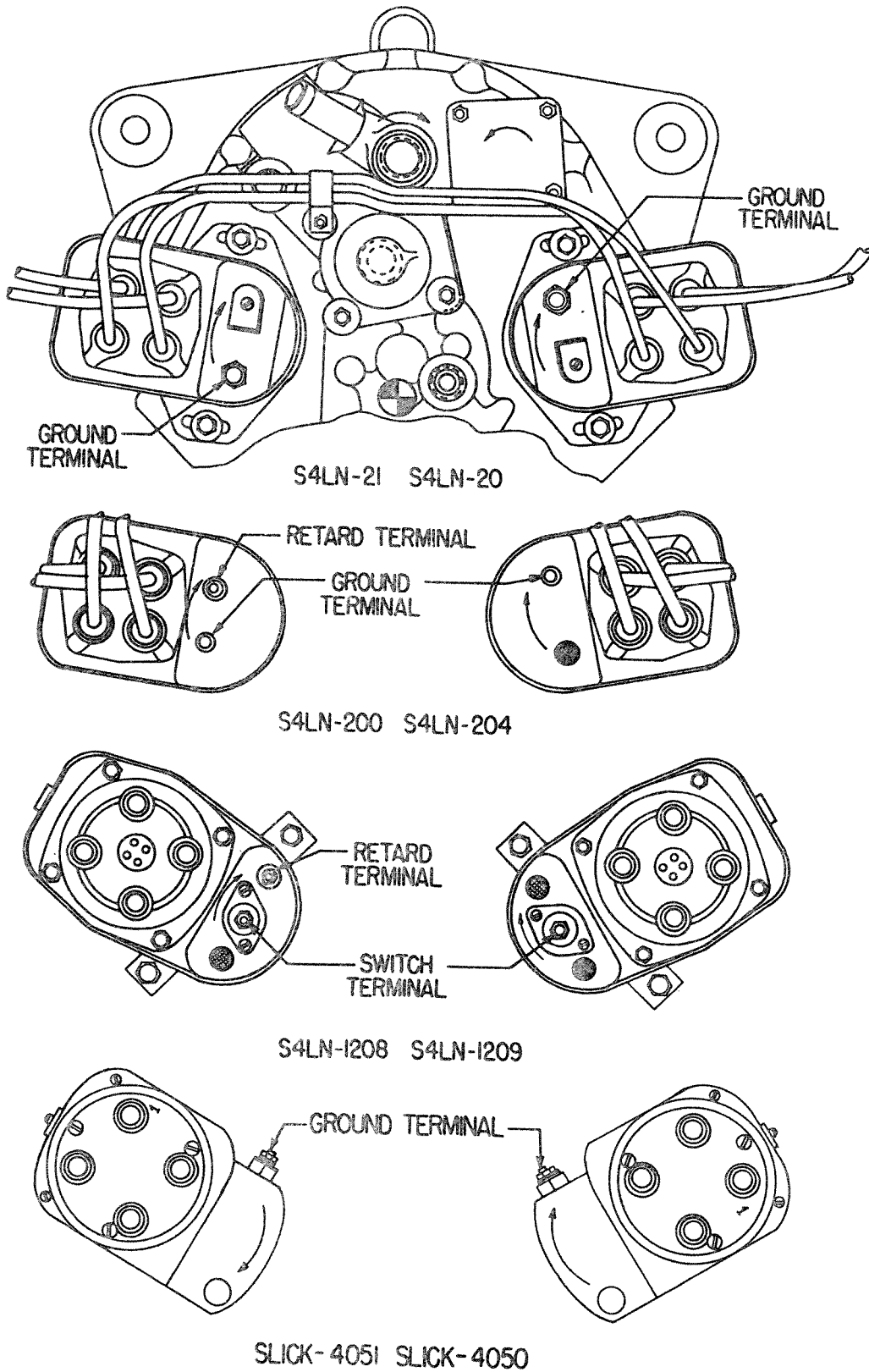


Figure 7-3. Magneto Connections



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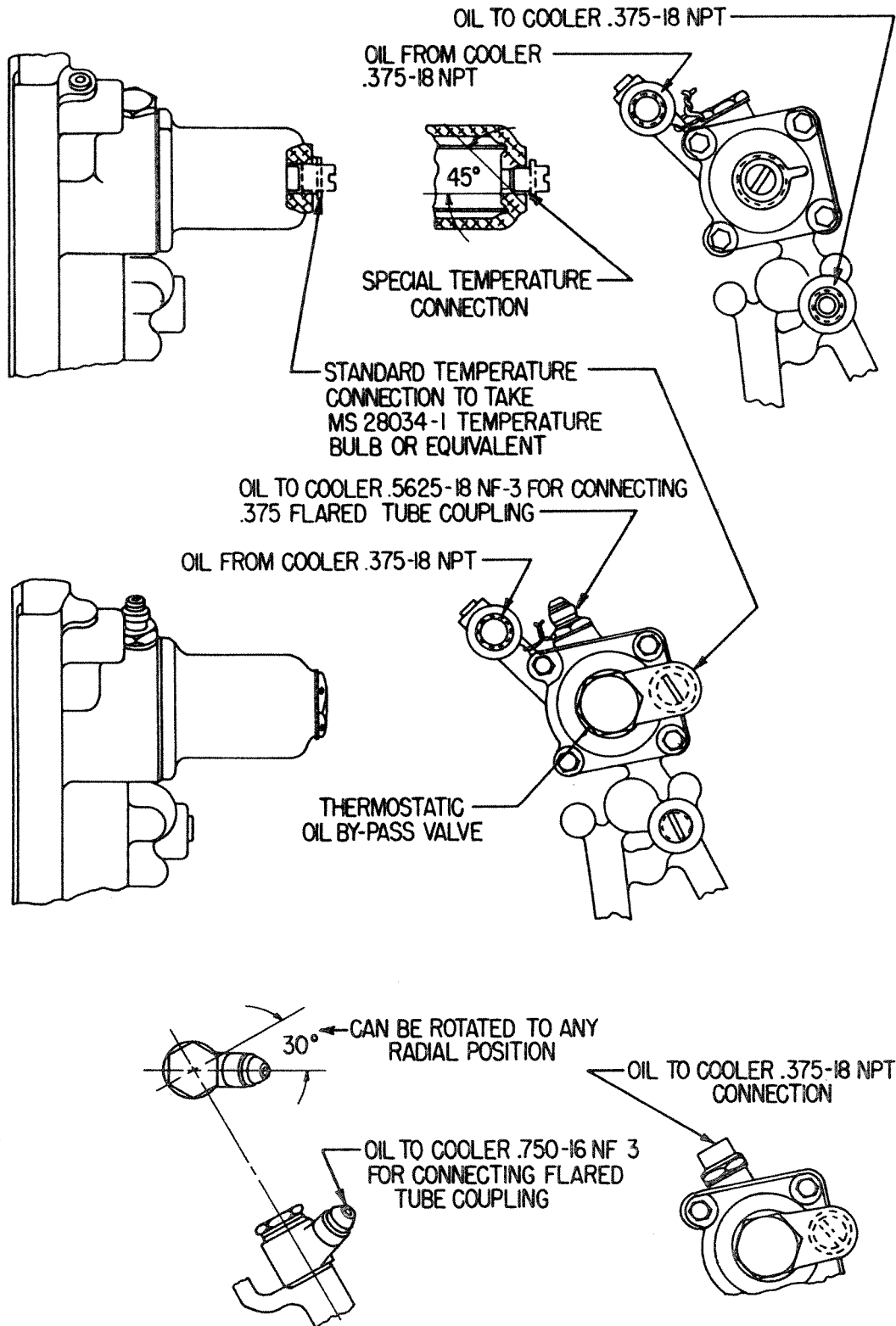


Figure 7-4. Optional Oil Cooler Connections

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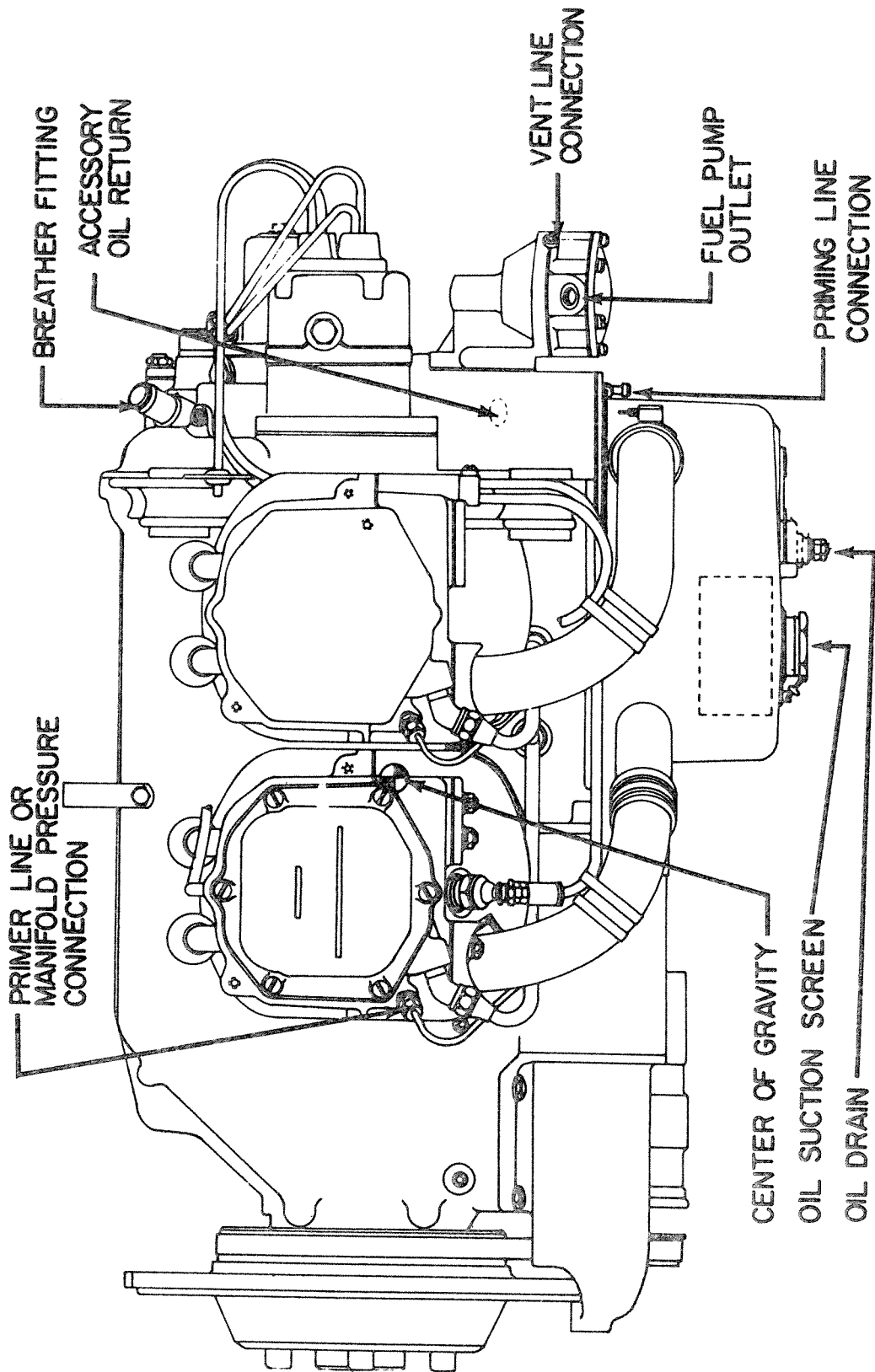


Figure 7-5. Installation Drawing Left Side View - Typical O-320-A, -B Series

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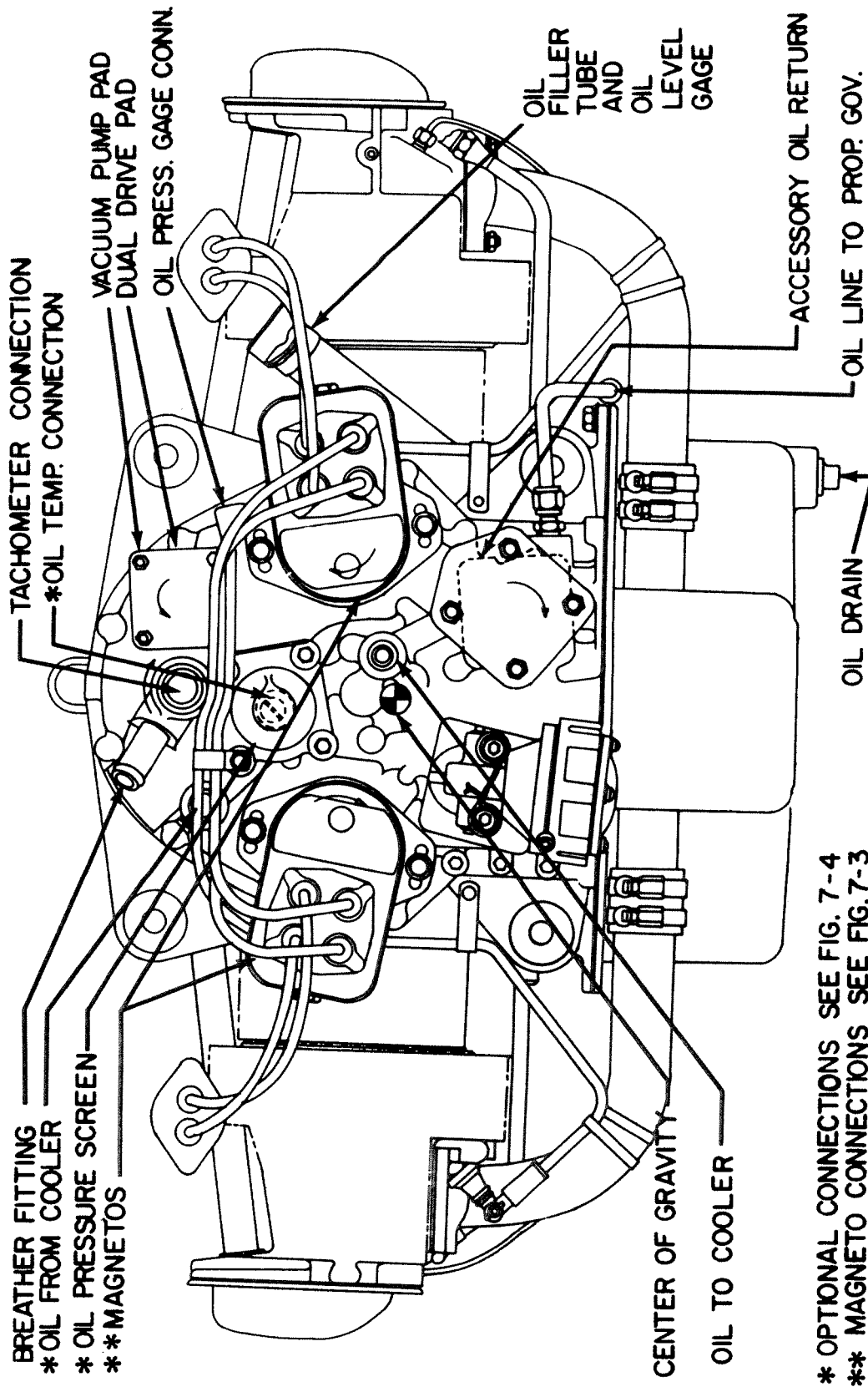


Figure 7-6. Installation Drawing Rear View - Typical O-320-A, -B Series

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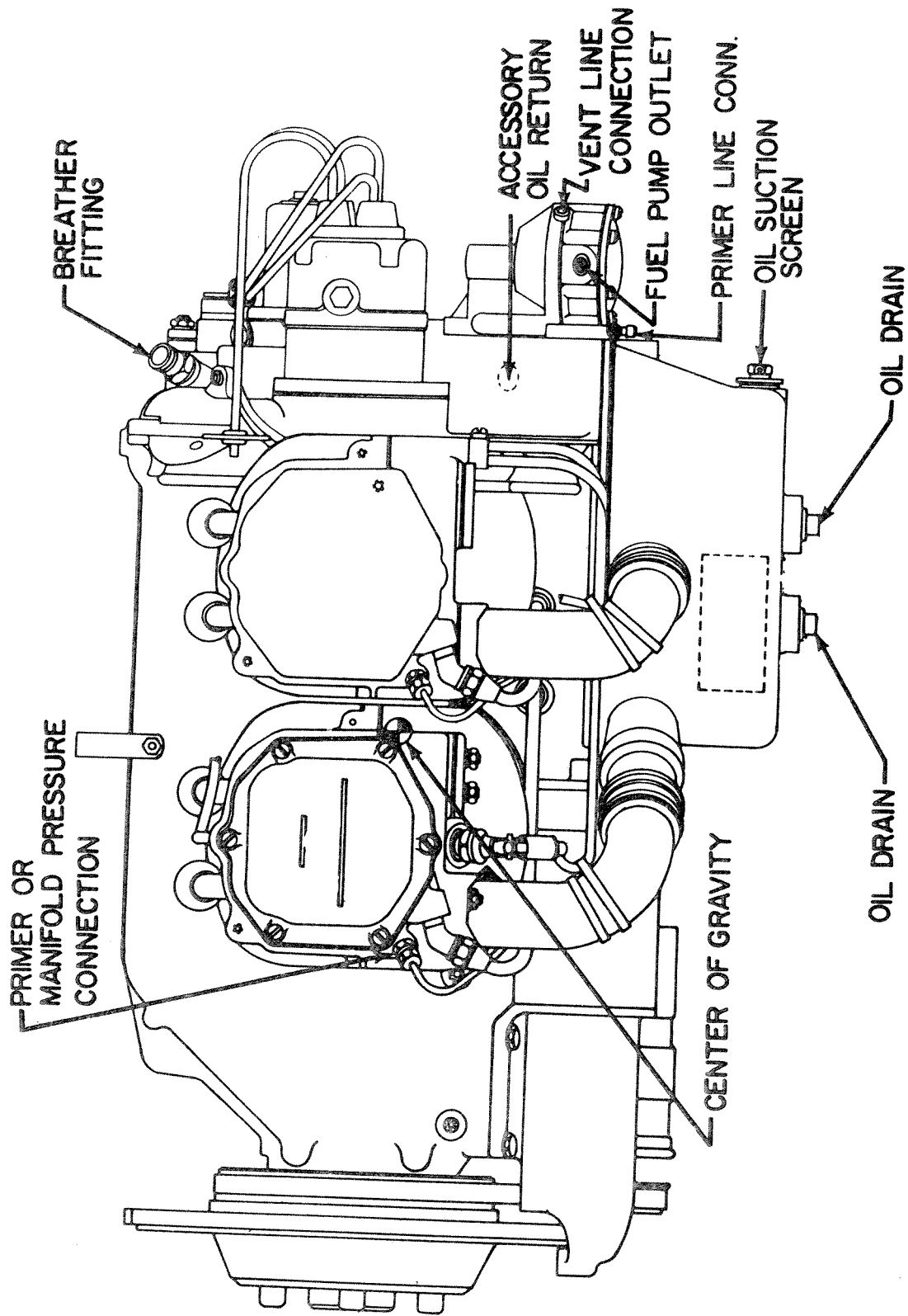


Figure 7-7. Installation Drawing Left Side View - Typical O-320-D, -E Series

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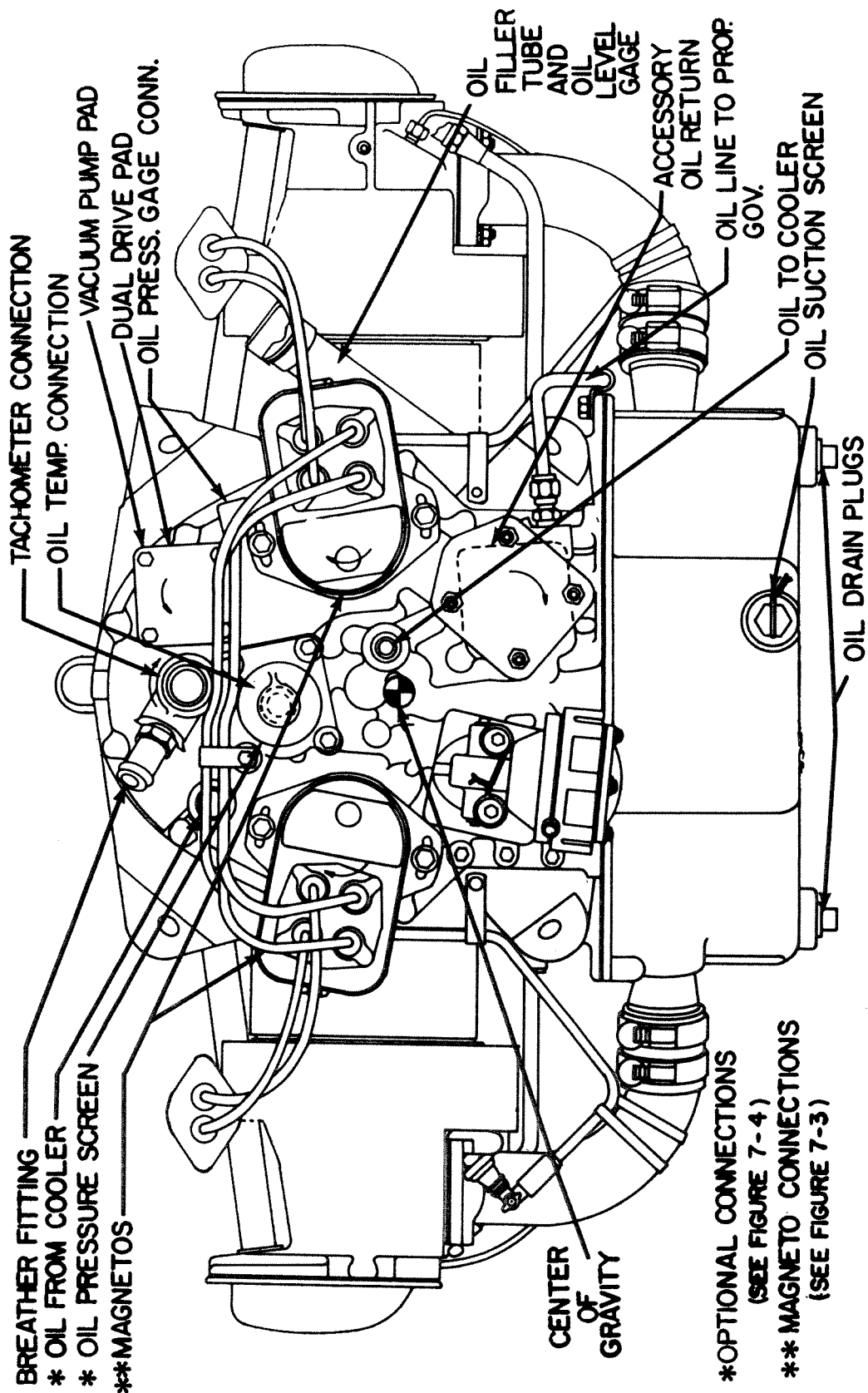


Figure 7-8. Installation Drawing Rear View - Typical O-320-D, -E Series

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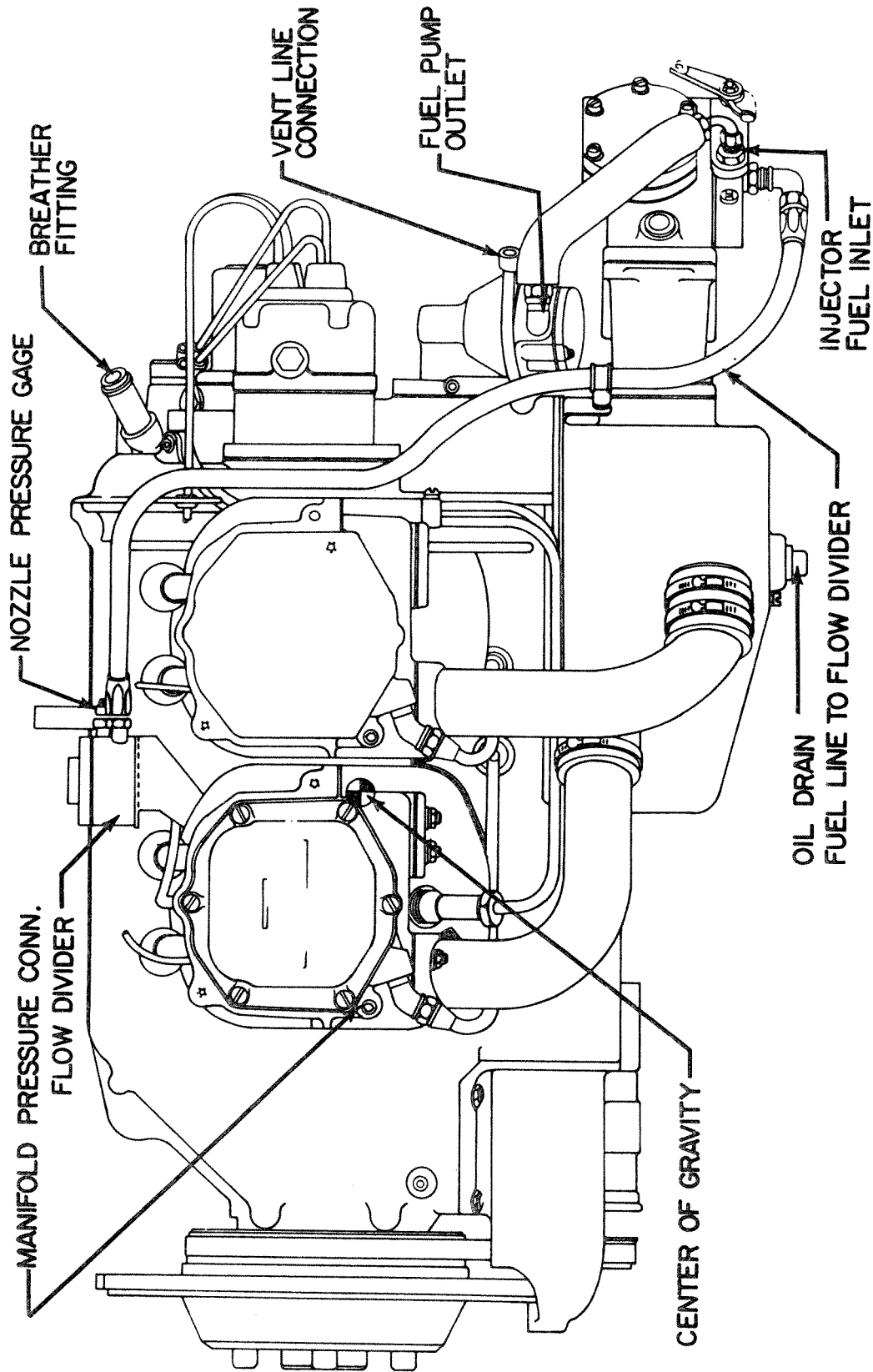


Figure 7-9. Installation Drawing Left Side View - Typical IO-320-B Series

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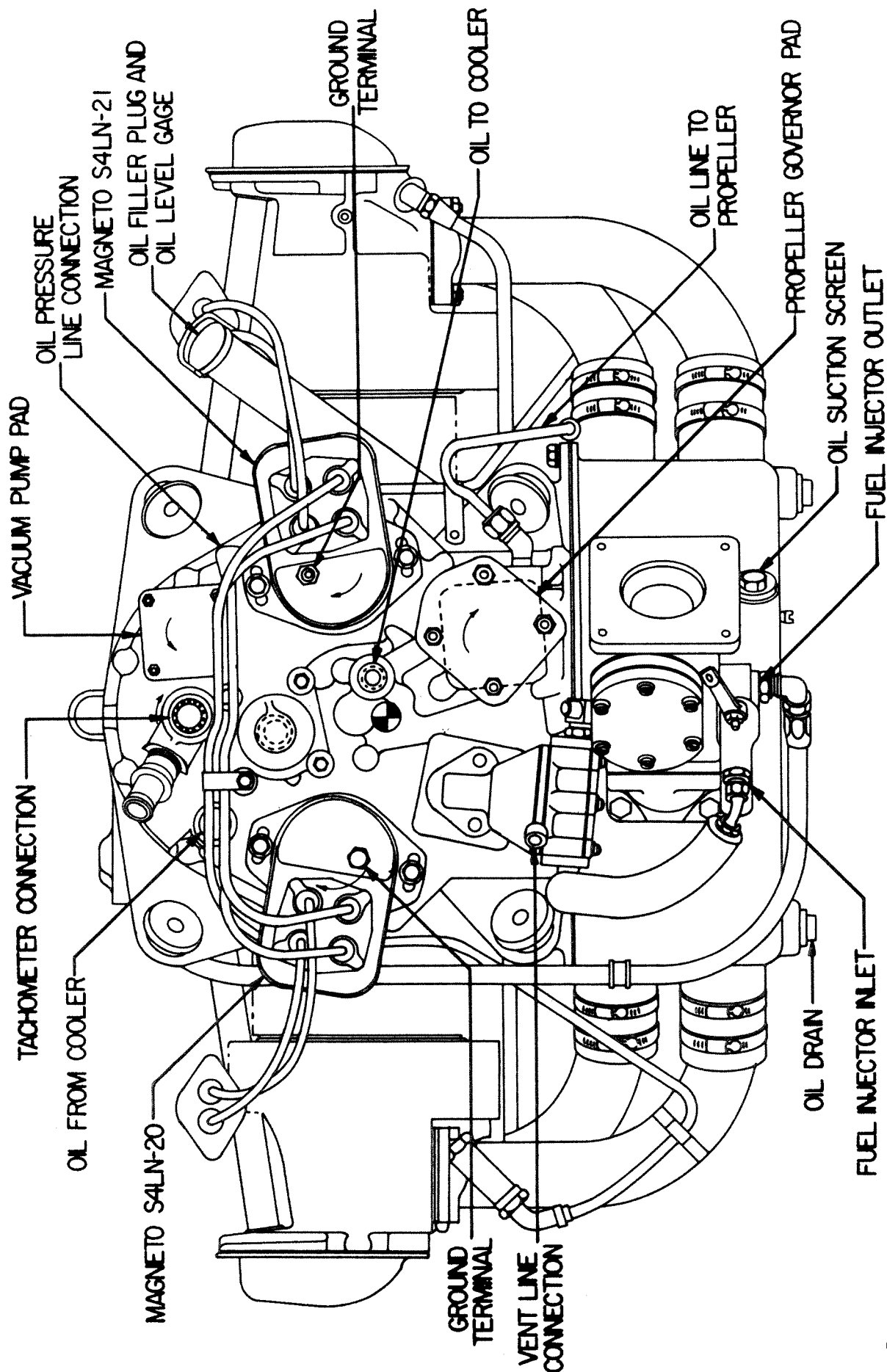


Figure 7-10. Installation Drawing Rear View - Typical IO-320-B Series





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### TABLES

FOR TIGHTENING TORQUE RECOMMENDATIONS AND INFORMATION CONCERNING TOLERANCES AND DIMENSIONS THAT MUST BE MAINTAINED IN LYCOMING AIRCRAFT ENGINES, CONSULT LATEST EDITION OF SPECIAL SERVICE PUBLICATION NO. SSP-1776.

CONSULT LATEST EDITION OF SERVICE INSTRUCTION NO. 1029 AND NO. 1150 FOR INFORMATION PERTINENT TO CORRECTLY INSTALLING CYLINDER ASSEMBLY.

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## O-320 & IO-320 SERIES

### FIXED WING ONLY

**GROUND RUN AFTER TOP OVERHAUL  
OR CYLINDER CHANGE WITH NEW RINGS**

Type Aircraft \_\_\_\_\_

Registration No. \_\_\_\_\_

**(DO NOT USE AFTER MAJOR OVERHAUL)**

Aircraft No. \_\_\_\_\_

1. Avoid dusty location and loose stones.

2. Head aircraft into wind.

3. All cowling should be in place, cowl flaps open.

4. Accomplish ground run in full flat pitch.

5. Never exceed 200°F. oil temperature.

6. If cylinder head temperatures reach 400°F., shut down and allow engine to cool before continuing.

Owner \_\_\_\_\_

Engine Model \_\_\_\_\_ S/N \_\_\_\_\_

Date \_\_\_\_\_

Run-Up By \_\_\_\_\_

### GROUND RUN

Time	RPM	MAP	Temperature				Pressure				Temperature				Fuel Flow			
			L.oil	R.oil	L.cyl	R.cyl	L.oil	R.oil	L.fuel	R.fuel	L.carb	R.carb	Amb.	Air	Left	Right		
5 min	1000																	
10 min	1200																	
10 min	1300																	
5 min	1500																	
5 min	1600																	
5 min	1700																	
5 min	1800																	

Mag. Check

Adjustment Required

After Completion of Ground Run

Power Check

1. Visually inspect engine(s)
2. Check oil level(s)

Idle Check

**FLIGHT TEST AFTER TOP OVERHAUL  
OR CYLINDER CHANGE WITH NEW RINGS**

1. Test fly aircraft one hour.
2. Use standard power for climb, and at least 75% power for cruise.
3. Make climb shallow and at good airspeed for cooling.
4. Record engine instrument readings during climb and cruise.

Tested by \_\_\_\_\_

**FLIGHT TEST RECORD**

Time	RPM	MAP		Temperature				Pressure		Temperature		Fuel Flow					
		L.oil	R.oil	L.cyl	R.cyl	L.oil	R.oil	L.fuel	R.fuel	L.carb	R.carb	Amb.	Air	Left	Right		
(Climb)																	
Cruise																	

Adjustments Required After Flight

After Test Flight

1. Make careful visual inspection of engine(s).
2. Check oil level(s).
3. If oil consumption is excessive, (see operator's manual for limits), remove spark plugs and check cylinder barrels for scoring.

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### FULL THROTTLE HP AT ALTITUDE (Normally Aspirated Engines)

Altitude Ft.	% S. L. H. P.	Altitude Ft.	% S. L. H. P.	Altitude Ft.	% S. L. H. P.
0	100	10,000	70.8	19,500	49.1
500	98.5	11,000	68.3	20,000	48.0
1,000	96.8	12,000	65.8	20,500	47.6
2,000	93.6	13,000	63.4	21,000	46.0
2,500	92.0	14,000	61.0	21,500	45.2
3,000	90.5	15,000	58.7	22,000	44.0
4,000	87.5	16,000	56.5	22,500	43.3
5,000	84.6	17,000	54.3	23,000	42.2
6,000	81.7	17,500	53.1	23,500	41.4
7,000	78.9	18,000	52.1	24,000	40.3
8,000	76.2	18,500	51.4	24,500	39.5
9,000	73.5	19,000	50.0	25,000	38.5

### TABLE OF SPEED EQUIVALENTS

Sec./Mi.	M. P. H.	Sec./Mi.	M. P. H.	Sec./Mi.	M. P. H.
72.0	50	24.0	150	14.4	250
60.0	60	22.5	160	13.8	260
51.4	70	21.2	170	13.3	270
45.0	80	20.0	180	12.8	280
40.0	90	18.9	190	12.4	290
36.0	100	18.0	200	12.0	300
32.7	110	17.1	210	11.6	310
30.0	120	16.4	220	11.2	320
27.7	130	15.6	230	10.9	330
25.7	140	15.0	240	10.6	340

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**SECTION 8**

## CENTIGRADE-FAHRENHEIT CONVERSION TABLE

**Example:** To convert 20°C. to Fahrenheit, find 20 in the center column headed (F-C); then read 68.0°F. in the column (F) to the right. To convert 20°F. to Centigrade; find 20 in the center column and read -6.67°C. in the (C) column to the left.

C	F-C	F	C	F-C	F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
-45.6	-50	-58.0	115.56	240	464.0
-40.0	-40	-40.0	121.11	250	482.0
-34.0	-30	-22.0	126.67	260	500.0
-28.9	-20	-4.0	132.22	270	518.0
-23.3	-10	14.0	137.78	280	536.0
-17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
37.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
48.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	237.70	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

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### INCH FRACTIONS CONVERSIONS Decimals, Area of Circles and Millimeters

Inch Fraction	Decimal Equiv.	Area Sq. In.	MM Equiv.	Inch Fraction	Decimal Equiv.	Area Sq. In.	MM Equiv.
1/64	.0156	.0002	.397	1/2	.5	.1964	12.700
1/32	.0312	.0008	.794	17/32	.5312	.2217	13.494
3/64	.0469	.0017	1.191	35/64	.5469	.2349	13.891
1/16	.0625	.0031	1.587	9/16	.5625	.2485	14.288
3/32	.0937	.0069	2.381	19/32	.5937	.2769	15.081
7/64	.1094	.0094	2.778	39/64	.6094	.2916	15.478
1/8	.125	.0123	3.175	5/8	.625	.3068	15.875
5/32	.1562	.0192	3.969	21/32	.6562	.3382	16.669
11/64	.1719	.0232	4.366	43/64	.6719	.3545	17.065
3/16	.1875	.0276	4.762	11/16	.6875	.3712	17.462
7/32	.2187	.0376	5.556	23/32	.7187	.4057	18.256
15/64	.2344	.0431	5.593	47/64	.7344	.4235	18.653
1/4	.25	.0491	6.350	3/4	.75	.4418	19.050
9/32	.2812	.0621	7.144	25/32	.7812	.4794	19.844
19/64	.2969	.0692	7.540	51/64	.7969	.4987	20.241
5/16	.3125	.0767	7.937	13/16	.8125	.5185	20.637
11/32	.3437	.0928	8.731	27/32	.8437	.5591	21.431
23/64	.3594	.1014	9.128	55/64	.8594	.5800	21.828
3/8	.375	.1105	9.525	7/8	.875	.6013	22.225
13/32	.4062	.1296	10.319	29/32	.9062	.6450	23.019
27/64	.4219	.1398	10.716	59/64	.9219	.6675	23.416
7/16	.4375	.1503	11.112	15/16	.9375	.6903	23.812
15/32	.4687	.1725	11.906	31/32	.9687	.7371	24.606
31/64	.4844	.1842	12.303	63/64	.9844	.7610	25.003