CHAPTER 9

TROUBLESHOOTING

Section Index

9-1 GENERAL INFORMATION

The troubleshooting chart which follows, discusses symptoms which can be diagnosed and interprets the results in terms of probable causes and the appropriate corrective action to be taken.

For additional information on more specific troubleshooting procedures, refer to Overhaul Manual and Service Bulletins.

All engine maintenance should be performed by a qualified mechanic. Any attempt by unqualified personnel to adjust, repair, or replace any parts, may result in damage to the engine.

WARNING...Operation of a defective engine without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting such damage an injury can be avoided.

9-2 ENGINE TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Engine Will Not Start	Fuel tank empty.	Fill with correct grade of fuel.
	Improper starting procedure.	Refer to Pilot's Checklist for starting procedures and check for performance of each item.
	Cylinder overprimed. Engine flooded.	Place mixture levers in IDLE CUT-OFF position. Open throttle wide allow fuel to drain.
	Induction system leak.	Tighten or replace loose or damaged hose connections.
	Excessive starter slippage.	Replace starter adapter.
	Fuel system malfunction.	Isolate cause and correct (See Troubleshooting the Fuel Injection System.)
	Ignition system malfunction.	Isolate cause and correct. (See Troubleshooting the Ignition System.)
	Manifold valve vent.	Repair or replace manifold valve obstruction.
Engine Will Not Run At Idle Speed	Propeller levers set in high pitch. (DECREASE RPM.)	Use low pitch (Increase RPM) position for all ground operations.
	Fuel injection system improperly adjusted.	See Troubleshooting the Fuel Injection System.
	Air leak in intake manifold.	Tightening loose connection or replace damaged part.

9-2 ENGINE TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Rough Idling	Fuel injection system improperly adjusted.	See Troubleshooting the Fuel Injection System.
	Mixture levers set for improper mixture.	Use FULL RICH position for all ground operation, except high altitude airports.
	Fouled spark plugs.	Remove and clean. Adjust gaps.
	Hydraulic lifters fouled.	Remove and clean lifters. Inspect and clean oil filter at more frequent intervals.
	Burned or warped exhaust valves, worn seat, scored valve guides	Repair cylinder.
Engine Runs Too Lean At Cruising Power	Improper manual leaning procedure. Gage incorrect.	Refer to Section 12 for proper fuel flow settings. Recalibrate.
	Fuel flow reading too low.	Check fuel strainer for clogging. Clean screen.
	Fuel injection malfunction.	See Troubleshooting the Fuel Injection System.
Engine Runs Too Rich At Cruising Power	Restrictions in air intake passages. Gage incorrect.	Check passages and remove restrictions. Recalibrate.
Engine Runs Too Lean Or Too Rich At Throttle Setting Other Than Cruise	Fuel injection malfunction. Gage incorrect.	See Troubleshooting the Fuel Injection System. Recalibrate.
Continuous Fouling Of Spark Plugs	Piston rings excessively worn or broken.	Replace rings. Replace cylinder if damaged.
	Piston rings are not seated.	Hone cylinder walls, replace rings.
Engine Runs Rough At High Speeds	Loose mounting bolts or damaged mount pads.	Tighten mounting bolts. Replace mount pads.
	Plugged fuel nozzle jet.	Clean.
	Propeller out of balance.	Remove and repair.
	Ignition system malfunction.	See Troubleshooting the Ignition System.
Continuous Missing At High Speed	Broken valve spring.	Replace.
	Plugged fuel nozzle jet.	Clean.
	Burned or warped valve.	Repair cylinder.
	Hydraulic tappet dirty or worn.	Remove and clean or replace.
	Ignition system malfunction.	See Troubleshooting the Ignition System.
Sluggish Operation And Low Power	Throttle not opening wide.	Check and adjust linkage (See Rigging of Mixture and Throttle Controls).
	Restrictions in air intake passages.	Check.
	Ignition system malfunction.	See Troubleshooting the Ignition System.
	Fuel injection malfunction.	See Troubleshooting the Fuel Injection System.

9-2 ENGINE TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Sluggish Operation And Low Power (cont'd)	Valve seats worn and leaking. Piston rings worn or stuck in grooves.	Borescope cylinders and check compression.
High Cylinder Head Temperature	Low octane fuel. Incorrect gage.	Drain tanks and replace with correct grade of fuel. Recalibrate.
	Lean fuel/air mixture due to improper manual leaning procedure. Insufficient Airflow	See "CORRECTION" under 'Engine run too lean at cruising power".
	Cylinder baffles loose or bent.	Check and correct.
	Dirt between cylinder fins.	Clean thoroughly.
	Excessive carbon deposits in cylinder head and on pistons.	Check ignition and fuel injection system.
	Magnetos out of time.	Re-time, internally and externally.
	Magneto distributor block contamination.	Disassemble and repair as required or replace magneto.
	Exhaust system gas leakage.	Locate and correct.
	Exhaust valve leaking.	Repair cylinder.
Oil Leaks	At front of engine; damaged crankshaft oil seal.	Replace
	Around propeller mounting flange: damaged hub o-ring seal.	Replace.
	Around plugs, fittings, and gaskets due to looseness or damage.	Tighten or replace.
Low Compression	Piston rings excessively worn.	Repair cylinder.
	Valve faces and seats worn.	Repair cylinder.
	Excessively worn cylinder walls.	Replace cylinder & piston rings.
Slow Engine Acceleration On A Hot Day	Mixture too rich.	Momentarily pull mixture control back until engine acceleration picks up, then set proper mixture.
Rough Idle At Airfields With Elevation Of 3500 Feet Or Higher	Mixture too rich	Pull mixture control back to where the engine operates the smoothest at IDLE RPM.
Slow Engine Acceleration At Airfields With A Ground Elevation Of 3500 Feet Or higher	Mixture too rich.	Adjust mixture per Chapter 12. Calibrate fuel flow gage.
Engine Will Not Stop At Idle Cut-Off.	Fuel manifold valve not seating tightly.	Replace manifold valve.

9-2 ENGINE TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTIONS
High Engine Idle Pressure Impossible to Obtain	Fuel manifold valve sticking closed.	Replace manifold valve.
	Fuel manifold valve vent obstruction.	Replace manifold valve.
Erratic Engine Operation	Fuel manifold valve sticking, or not free.	Repair or replace manifold valve.
Climbing to Altitudes 12,000 Feet, engine Power Fluctuates When Power Reduced	Fuel vaporization.	Operate fuel boost pump according to aircraft manufacturer's instructions. See fuel flow per Chapter 12.
Low Fuel Pressure	Restricted flow to fuel metering valve.	Check mixture control for full travel. Check for restrictions in fuel filter and lines, adjust control and clean filter. Replace damaged parts.
	Fuel control lever interference.	Check operation of throttle control and for possible contract with cooling shroud. Adjust as required to obtain correct operation.
	Incorrect fuel pump adjustment and operation.	Check and adjust using appropriate equipment. Replace malfunctioning pumps.
	Malfunctioning fuel pump relief valve.	Replace pump.
High Fuel Pressure	Restricted flow beyond fuel control assembly.	Check for restricted fuel nozzles jet or fuel manifold valve. Clean or replace nozzles. Replace malfunctioning fuel manifold valve.
	Malfunctioning relief valve operation in fuel pump.	Replace pump.
	Restricted re-circulation passage in fuel injector pump.	Replace pump.
Fluctuating Fuel Pressure	Vapor in fuel system, excessive fuel temperature.	Normally, operating the auxiliary pump will clear system. Operate auxiliary pump and purge system.
	Fuel gage line leak or air in gage line.	Drain gage line and tighten connections.
	Restrictions in vapor separator vent.	Check for restriction in ejector jet of vapor separator cover. Clean jet with solvent (only). Do Not Use Wire as Probe. Replace malfunctioning parts.

9-2 ENGINE TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Low Oil Pressure On Engine Gage	Insufficient oil in oil sump, oil dilution or using improper grade oil from prevailing ambient temperature.	Add oil, or change oil to proper viscosity.
	Gage incorrect	Recalibrate
	High oil temperature.	Malfunctioning vernatherm valve in oil cooler; oil cooler restriction. Replace valve or clean oil cooler.
	Leaking, damaged or loose oil line connections - Restricted screen or filter.	Check for restricted lines and loose connections, and for partially plugged oil filter or screens. Clean parts, tighten connections and replace malfunctioning parts.
Engine Runs Rough At Speeds Above Idle	Improper fuel-air mixture	Check manifold connections for leaks. Tighten loose connections. Check fuel filters and linkage for setting and adjustment. Check for proper pump pressure, and replace pump if malfunctioning.
	Restricted fuel nozzle jet.	Remove and clean all nozzles
	Ignition system and spark plugs malfunctioning.	Clean and regap spark plugs. check ignition cables for defects. Replace malfunctioning components.
Engine Lacks Power, Reduction In Maximum Power	Incorrectly adjusted throttle control, "sticky" linkage or dirty air cleaner.	Check movement of linkage by moving control from idle to full throttle. Make proper adjustments and replace worn components. Service air cleaner.
	Malfunctioning ignition system.	Inspect spark plugs for fouled electrodes, heavy carbon deposits, erosion of electrodes, improperly adjusted electrode gaps, and cracked porcelains. Test plugs for regular firing under pressure. Replace damaged or misfiring plugs. Spark plug gap to be 0.015 to 0.019 inch.
Engine Lacks Power, Reduction in Maximum Manifold Pressure	Loose or damaged intake manifolds.	Inspect entire manifold system for possible leakage at connections. Replace damaged components tighten all connections and clamps.
	Restriced air cleaner.	Clean or replace.
	Fuel nozzles malfunctioning.	Check for restricted nozzles and lines and clean or replace as necessary.
Engine Has Poor Acceleration	Idle mixture too lean.	Readjust idle mixture.
	Incorrect fuel-air mixture, worn control linkage, or restricted air cleaner.	Tighten loose connections, replace worn elements of linkage service air cleaner.
	Malfunctioning ignition system.	Check accessible cables and connections. Replace malfunctioning spark plugs.

9-3 IGNITION TROUBLESHOOTING

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Engine Fails To Start Due To Ignition Trouble	Ignition switch OFF or grounded switch wires.	Turn switch On. Check for grounded wires.
	Magneto malfuction.	Refer to service manual.
	Spark plugs fouled, improperly gaped, or loose.	Remove and clean. Adjust to proper gap. Tighten to specified torque.
	Magnetos improperly timed to engine.	Refer to Installation of Magnetos and Ignition Timing for timing procedures.
	Shorted condenser.	Replace condenser.
	Magneto internal timing incorrect or timed for opposite rotation.	Install correctly timed magneto.
Rough Idling	Spark plugs fouled or improperly gaped.	Clean spark plugs. Adjust spark plug gap.
	Weak condenser.	Replace condenser.
	Loose or improperly gaped spark plug.	tighten to specified torque. Adjust to proper gap.
	High tension leak in ignition harness.	Check for faulty harness, replaced as required.
	Weak or burned out condenser as evidenced by burned or pitted breaker points.	Replace points and condenser.
Sluggish Operation And/Or Excessive RPM Drop	Fouled or faulty spark plugs.	Clean spark plugs. Replace faulty spark plugs.
	Improperly gaped spark plugs.	Adjust to proper gap.
	Magnetos timing incorrect.	Refer to Installation of Magnetos and Ignition Timing for proper timing procedure.
	Damaged magneto breaker points or condenser.	Replace points and condenser.

9-4 OIL SYSTEM TROUBLESHOOTING CHART

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTIONS
High Oil Temperature Indication	Thermostat damaged or held open by solid matter.	Remove, clean valve and seat. If still inoperative, replace.
	Oil viscosity too high.	Drain and refill with correct seasonal oil grade. (See Sect.8-1)
	Prolonged ground operation.	Limit ground operation to a minimum.
	Malfunctioning gage or bulb unit.	Check wiring. Check bulb unit. Check gage. Replace malfunctioning parts.
	High power, low airspeed.	Adjust power - flgiht altitude.
	Low oil supply.	Replenish.
	Cooler air passages clogged.	Clean thoroughly.
	Cooler core plugged.	Remove cooler and flush thoroughly.
Low Oil Pressure Indication	Low oil supply.	Replenish.
	Oil viscosity too low.	Drain and refill with correct seasonal oil grade. (See Sect. 8-1)
	Foam in the oil due to presence of alkaline solids in system.	Drain and refill with fresh oil. (It may be necessary to flush cooler core if presence of alkaline solids is due to previous cleaning with alkaline materials.)
	Pump producing low pressure.	Replace pump.
	Malfunctioning pressure gage.	Check gage. Clean plumbing. Replace if required.
	Weak or broken oil pressure relief valve spring.	Replace spring. Adjust pressure to 30-60 p.s.i. with oil at normal operating temperature.

9-5 FUEL INJECTION SYSTEM TROUBLESHOOTING CHART

This troubleshooting chart is provided as a guide. Review all probable causes given, check other listings of troubles with similar symptoms. Items are presented in sequence of the approximate ease of checking, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Engine Will Not Start And No Fuel Flow Gage Indication	No fuel to engine.	Check tank fuel level.
	Mixture control improperly adjusted.	Check mixture control for proper adjustment.
	Engine not primed.	Place auxiliary pump switch in PRIME position.
	Selector valve in wrong position.	Position selector valve to MAIN TANK position.
Engine Will Not Start With Fuel Flow Gage Indication	Engine flooded.	Open throttle, allow fuel to drain.
	No fuel to engine.	Loosen one line at nozzle. If no fuel is presents with fuel pressure on gage, replace fuel manifold valve.
Rough Idle	Nozzle restricted.	Remove nozzles and clean.
	Improper idle mixture.	Adjust metering unit in accordance with adjustment procedures.
Poor Acceleration	Idle mixture incorrect.	Adjust metering unit in accordance with adjustment procedures.
	Unmetered fuel pressure too high.	Lower unmetered fuel pressure.
	Worn linkage.	Replace worn elements of linkage.
Engines Runs Rough	Restricted nozzle jet.	Remove and clean all nozzles jet.
	Improper mixture.	Improper pump pressure, replace pump.
Low Fuel Flow Gage Indication	Restricted flow to metering unit.	Check mixture control for full travel. Check for clogged fuel filters.
	Inadequate flow from fuel pump.	Adjust engine-driven fuel pump.
High Fuel Flow Gage Indication	Restricted flow beyond metering unit.	Check for restricted nozzles jet or fuel manifold valve. Clean or replace as required.
	Restricted recirculation passage in fuel pump.	Replace engine-driven fuel pump.
Fluctuating or Erroneous Fuel Flow Indications	Vapor in system, excess fuel temperature.	If not cleared with auxiliary pump, check for clogged ejector jet in vapor separator cover. Clean only with solvent, no wires.
	Air in fuel flow gage line. Leak at gage connection.	Repair leak and purge line.
Poor Idle Cut-Off	Engine getting fuel.	Check mixture control is in full idle cut-off. Check auxiliary pump is OFF. If neither, replace manifold valve.

9-5 FUEL INJECTION SYSTEM TROUBLESHOOTING CHART (cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTIONS
Unmetered Fuel Pressure Drop	Relief valve stuck open.	Repair or replace fuel pump.
Very High Idle and Full Throttle Fuel Pressure Present	Relief valve stuck closed.	Repair or replace fuel pump.
No Fuel Pressure	Check valve stuck open.	Repair or replace fuel pump.

CHAPTER 10
ENGINE PRESERVATION AND STORAGE

Section Index

10-1 ENGINE PRESERVATION AFTER OVERHAUL

Engines in aircraft that are flown only occasionally tend to exhibit cylinder wall corrosion more than engines in aircraft that are flown frequently.

Of particular concern are new engines with new or freshly honed cylinders after a top or major overhaul. In areas of high humidity, there have been instances where corrosion has been found in such cylinders after an inactive period of only a few days. When cylinders have been operated for approximately 50 hours, the varnish deposited on the cylinder walls offers some protection against corrosion. Hence a two step program for Flyable Storage category is recommended.

Obviously, proper steps must be taken on engines used infrequently to lessen the possibility of corrosion. This is especially true if the aircraft is based near the sea coast or in areas of high humidity and flown less than once a week.

In all geographical areas the best method of preventing corrosion of the cylinders and other internal parts of the engine, is to fly the aircraft at least once a week, long enough to reach normal operating temperatures, which will vaporize moisture and other by-products of combustion. In consideration of the circumstances mentioned, TCM has listed three reasonable minimum preservation procedures, that if implemented, will minimize the detriments of rust and corrosion. It is the owners responsibility to choose a program that is viable to the particular aircrafts mission.

Aircraft engine storage recommendations are classified by the following categories:

A. FLYABLE STORAGE (Program I or II)

B. TEMPORARY STORAGE (up to 90 days)

C. INDEFINITE STORAGE

10-2 FLYABLE STORAGE (Program I or II)

Program I- Engines or cylinders with less than 50 operating hours:

a. Operate engine every 5 days; and

b. Fly every 15 days as per paragraph.

Program II- Engines or cylinders with more than 50 operating hours to TBO if not flown weekly:

a. Operate engine every 7 days; and

b. Fly every 30 days as per paragraph.

1. Service aircraft per normal airframe manufacturer's instructions.

WARNING...For maximum safety, accomplish engine rotation as follows:

a. Verify magneto switches are "OFF"

b. Throttle position "CLOSED"

c. Mixture control "IDLE CUT-OFF"

d. Set brakes and block aircraft wheels

e. Leave aircraft tie-downs installed and verify that the cabin door latch is open.

f. Do not stand within the arc of the propeller blades while turning the propeller.

3. The aircraft should be flown for thirty (30) minutes, reaching, but not exceeding, normal oil and cylinder temperatures. If the aircraft cannot be flown it should be represerved in accordance with "B" (Temporary Storage) or "C" (Indefinite Storage). Ground running is not an acceptable substitute for flying.

It is necessary that for future reference, that the engine run and flight time be recorded and verified in the engine maintenance record/log with the date, time and signature.

10-3 TEMPORARY STORAGE (up to 90 days)

1. Preparation for Storage

a. Remove the top spark plug and spray preservative oil (Lubrication Oil - Contact and Volatile Corrosion - Inhibited, MIL-L-46002, Grade 1) at room temperature, through upper spark plug hole of each cylinder with the piston in approximately the bottom dead center position. Rotate crankshaft as each pair of opposite cylinders are sprayed. Stop crankshaft with no piston at top dead center. A pressure pot or pump-up type garden pressure sprayer may be used. The spray head should have ports around the circumference to allow complete coverage of the cylinder walls.

NOTE...Shown below is an approved preservative oil recommended for use in Teledyne Continental engines for temporary and indefinite storage:

MIL-L-46002, Grade 1 Oils:

NOX RUST VCI-105 Daubert Chemical Company
May be purchased through:
Rock Island Lubricant & Chemical Company
P.O. Box 5015
1320 1st Street
Rock Island, Illinois 61204
1-800-522-1150

b. Re-spray each cylinder without rotating crank. To thoroughly cover all surfaces of the cylinder interior, move the nozzle or spray gun from the top to the bottom of the cylinder.

c. Re-install spark plugs.

d. Apply preservative to engine interior by spraying the above specified oil (approximately two ounces) through the oil filler tube.

e. Seal all engine openings exposed to the atmosphere using suitable plugs, or moisture resistant tape, and attach red streamers at each point.

f. Engines, with propellers installed that are preserved for storage in accordance with this section should have a tag affixed to the propeller in a conspicuous place with the following notation on the tag: "DO NOT TURN PROPELLER - ENGINE PRESERVED" PRESERVATION DATE_____.

NOTE ...If the engine is not returned to flyable status at the expiration of the Temporary Storage (90 Day), it must be preserved in accordance with the Indefinite Storage procedures.

2. Preparation for Service

a. Remove seals, tape, paper and streamers from all openings.

b. With bottom spark plugs removed from the cylinders, hand turn propeller several revolutions to clear excess preservative oil and re-install spark plugs.

c. Conduct normal run-up procedure and inspect for leaks.

d. Clean aircraft throughly and conduct a visualy inspection and test flight per airframe manufactures instructions.

10-4 INDEFINITE STORAGE

1. Preparation for Storage

a. Drain the engine oil and refill with MIL-C-6529 Type II (Aeroshell Fluid 2F). The aircraft should be flown for thirty (30) minutes, reaching, but not exceeding normal oil and cylinder temperatures. Allow engine to cool to ambient temperature. Accomplish steps "1.a." and "1.b" of Temporary Storage.

NOTE...MIL-C-6529 Type II may be formulated by thoroughly mixing one part compound MIL-C-6529 Type I (Esso Rust-Ban 628, Cosmoline No. 1223 or equivalent) with three parts new lubricating oil of the grade recommended for service (all at room temperature). Single grade oil is recommended.

b. Apply preservative to engine interior by spraying MIL-L-46002, Grade I oil (approximately two ounces) through the oil filler tube.

c. Install dehydrator plugs MS27215-1 or -2, in each of the top spark plug holes, making sure that each plug is blue in color when installed. Protect and support the spark plug leads with AN-4060 protectors.

d. The TCM fuel injection system does not require any special preservation preparation.

e. Place a bag of desiccant in the exhaust pipes and seal the openings with moisture resistant tape.

f. Seal the cold air inlet to the heater muff with moisture resistant tape to exclude moisture and foreign objects.

g. Seal the engine breather by inserting a dehydrator MS27215-2 plug in the breather hose and clamping in place.

h. Attach a red streamer to each place on the engine where bags of desiccant are placed. Either attach red streamers outside of the sealed area with tape or to the inside of the sealed area with safety wire to prevent wicking of moisture into the sealed area.

i. Engines with propellers installed that are preserved for storage in accordance with this section should have each propeller tagged in a conspicuous place with the following notation on the tag: "DO NOT TURN PROPELLER - ENGINE PRESERVED", - PRESERVATION DATE_____

10-5 PROCEDURES NECESSARY FOR RETURNING AN AIRCRAFT TO SERVICE ARE AS FOLLOWS:

1. Remove the cylinder dehydrator plugs and all paper, tape, desiccant bags and streamers used to preserve the engine.

2. Drain the corrosion preventive mixture and re-service with recommended lubricating oil.

   WARNING ...When returning the aircraft to service do not use the corrosion preventive oil referenced in, 10-4, (1a) for more than 25 hours.

3. With bottom plugs removed, rotate propeller to clear excess preservative oil from cylinders.

4. Re-install the spark plugs and rotate the propeller by hand through the compression strokes of all the cylinders to check for possible liquid lock. Start the engine in the normal manner.

5. Clean aircraft thoroughly and conduct a visual inspection and test flight per airframe manufacturer's instructions.

10-6 AIRCRAFT STORED IN ACCORDANCE WITH THE INDEFINITE STORAGE PROCEDURES SHOULD BE INSPECTED PER THE FOLLOWING INSTRUCTIONS:

1. Aircraft prepared for Indefinite Storage should have the cylinder dehydrator plugs visually inspected every 15 days. The plugs should be changed as soon as their color indicates unsafe conditions of storage. If the dehydrator plugs have changed color in one-half or more of the cylinders, all desiccant material on the engine should be replaced.

2. The cylinder bores of all engines prepared for Indefinite Storage should be re-sprayed with corrosion preventive mixture every six months, or more frequently if bore inspection indicates corrosion has started earlier than six months. Replace all desiccant and dehydrator plugs. Before spraying, the engine should be inspected for corrosion as follows: Inspect the interior of at least one cylinder through the spark plug hole. If cylinder shows start of rust, spray cylinder corrosion preventive oil and turn prop over six times, then re-spray all cylinders. Remove at least one rocker box cover and inspect the valve mechanism.

The above procedures are a general specifications for rust and corrosion prevention. Since local conditions are different and Teledyne Continental Motors has no control over the application, more stringent procedures may be required. Rust and corrosion prevention are the owner's responsibility.

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CHAPTER 11
AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations Section is FAA Approved and specifies maintenance required under §21.31 of the Federal Aviation Regulations unless an alternative program has been FAA approved. This section is part of the type design of the IO-360 Series pursuant to §21.31 of the Federal Aviation Regulations.

1. Mandatory Inspection Intervals

   50 hour, 100 hour and 500 hour inspections as described in the IO 360 Maintenance and Operator's Manual subject to additional information contained in FAA Approved Mandatory Service Bulletins issued after date of certifications, and inspections mandated by the FAA and under Parts 43 and 91 of the Federal Aviations Regulations.

2. Other Related Procedures

   Unless subsequently noted in FAA approved Mandatory Service Bulletins, the IO360 Series Engine does not have any inspections related or replacement time-related procedures required for type certifications.

3. Distribution of Changes to Airworthiness Limitations

   Changes to Airworthiness Limitations section constitute changes to the type design of the IO-360 Series engine and require FAA approval pursuant to Federal Aviation Regulations §21.95, 21.97 or 21.99. Such changes will be published in FAA Approved Mandatory Service Bulletins, which are furnished to subscribers to TCM Service Bulletins and can be obtained by writing Teledyne Continental Motors, P.O. Box 90, Mobile, Alabama 36601.

CHAPTER 12
ENGINE PERFORMANCE AND CRUISE CONTROL

Section Index

12-1 CRUISE CONTROL BY PERFORMANCE CURVE

1. Set manifold pressure and RPM at cruise power selected.

2. To determine actual horsepower, employ the following procedure:

   a. Correct horsepower for inlet air temperature as follows:
   (TS = Standard Altitude Temperature)
   (1)Add 1% for each 10˚F below TS.
   (2)Subtract 1% for each 10˚F above TS

3a. Adjust the mixture to the value specified in the aircraft operators manual, using he above corrected horsepower.

3b. The ES engine is equipped with altitude compensating fuel pump which automatically provides the proper full rich mixture at any given altitude. Adjust mixture to lean out fuel flow for cruise settings according to applicable fuel flow vs. brake horsepower curve.

CAUTION... When increasing power, enrich mixture, advance RPM and adjust throttle in that order. When reducing power, retard throttle, then adjust RPM and mixture.

NOTE...It may be necessary to make minor readjustments to fuel flow (mixture) after changing RPM.

12-2 CRUISE CONTROL BY E.G.T.

If an exhaust gas temperature gage is used as an aid to leaning, proceed as follows:

1. Adjust manifold pressure and RPM for desired cruise setting.

2. Slowly move mixture control toward "lean" while observing E.G.T. gage. Note position on the instrument were the needle "peaks" or starts to drop as mixture is leaned further.

3. Advance mixture control toward "rich" until EGT is 50˚F. rich of peak.

4. Operation at peak EGT is permitted ONLY at powers and speeds lower than 65% NRP. See Service Bulletin M89-18 or subsequent revision as applicable.

CAUTION...Do not attempt to adjust mixture by use of EGT at settings above 75% of rated power. Also, remember that engine power will change with ambient conditions. Changes in altitude or outside air temperature will require adjustments in manifold pressure and fuel flow.

Gage fuel flow should fall between the maximum and minimum values on the curve. If not, the fuel injection system or instrumentation (including tachometer, manifold pressure, fuel flow gage or EGT system) should be checked for maladjustment or calibration error.

12-3 PERFORMANCE CHARTS

The curves in this section represent uninstalled performance and are provided as a reference in establishing power conditions for takeoff, climb and cruise operation. Refer to aircraft manufacturer's flight manual for tabular climb and cruise data.

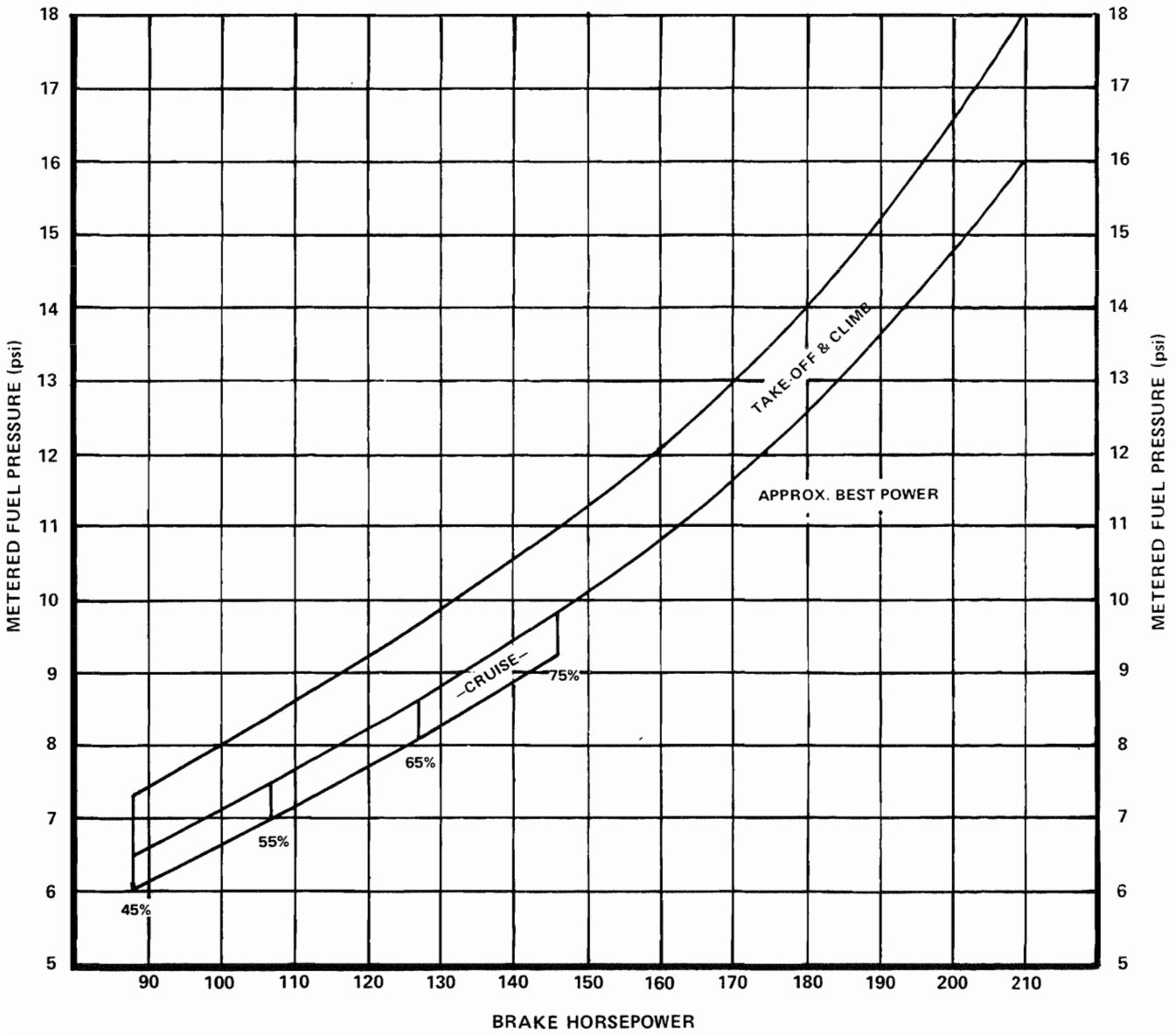

FIGURE 12-1. FUEL PRESSURE VS. BRAKE HORSEPOWER IO-360-A,AB

SEA LEVEL PERFORMANCE

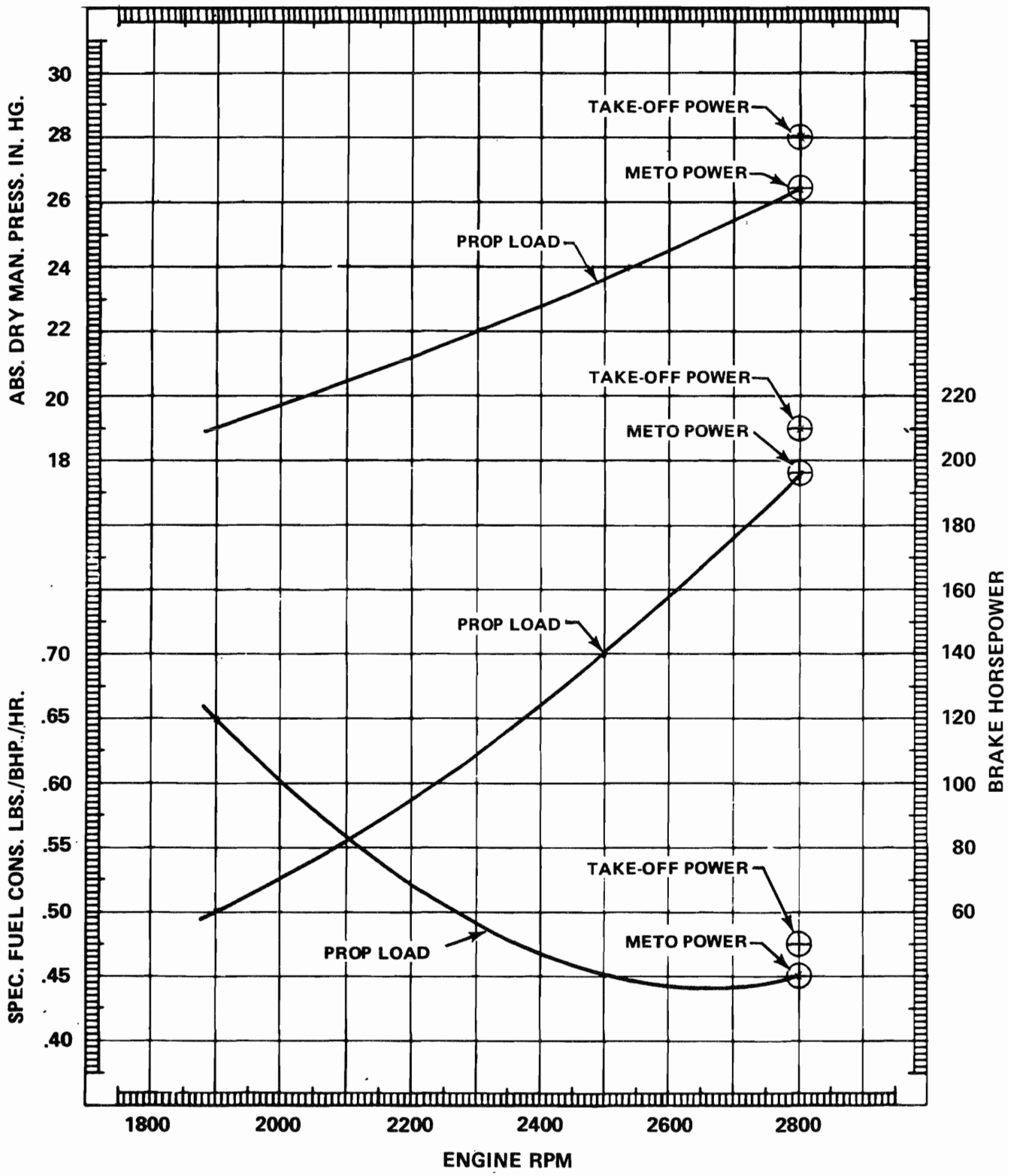

FIGURE 12-2. SEA LEVEL PERFORMANCE, IO-360-A,AB

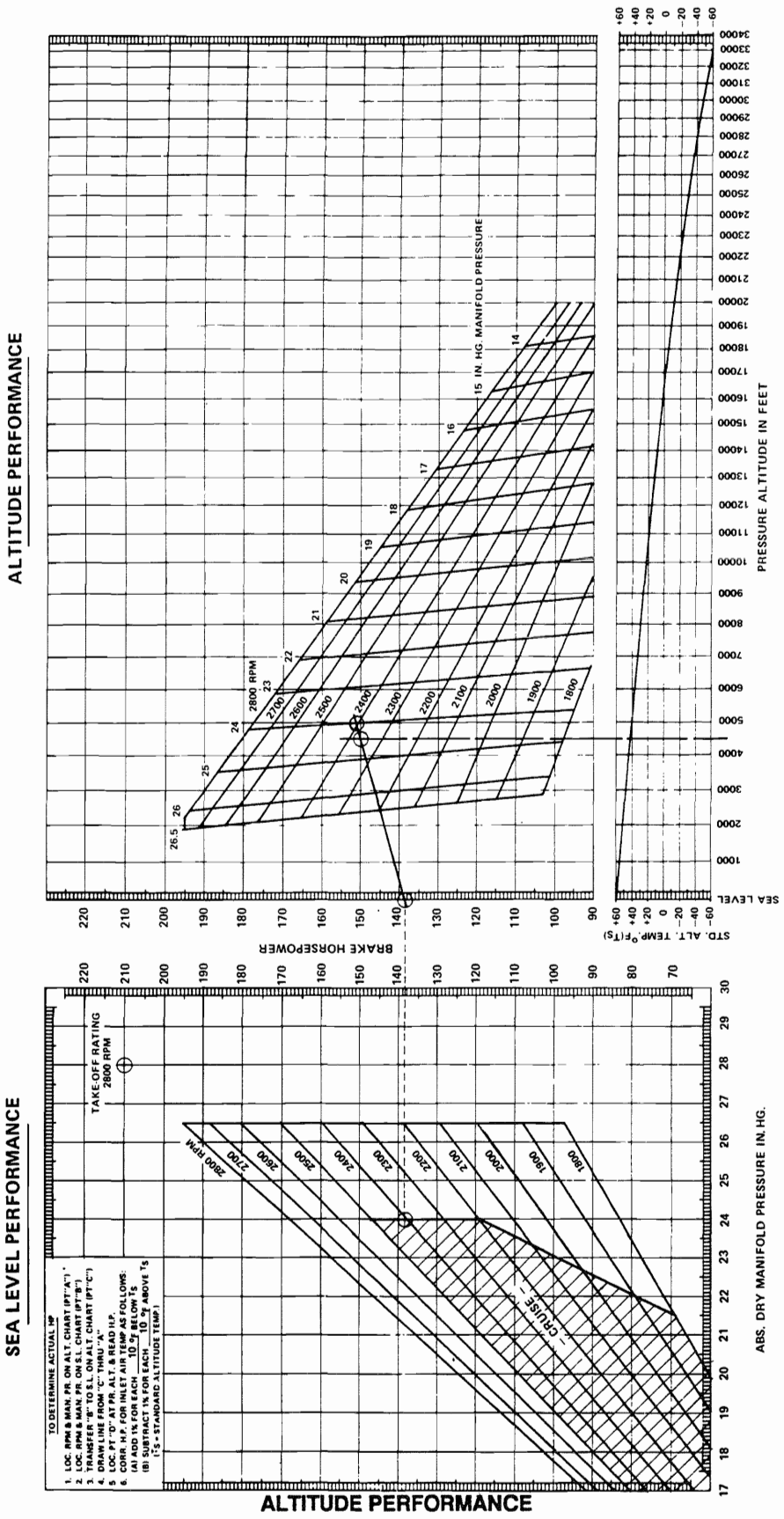

FIGURE 12-3. ALTITUDE PERFORMANCE IO-360-A,AB

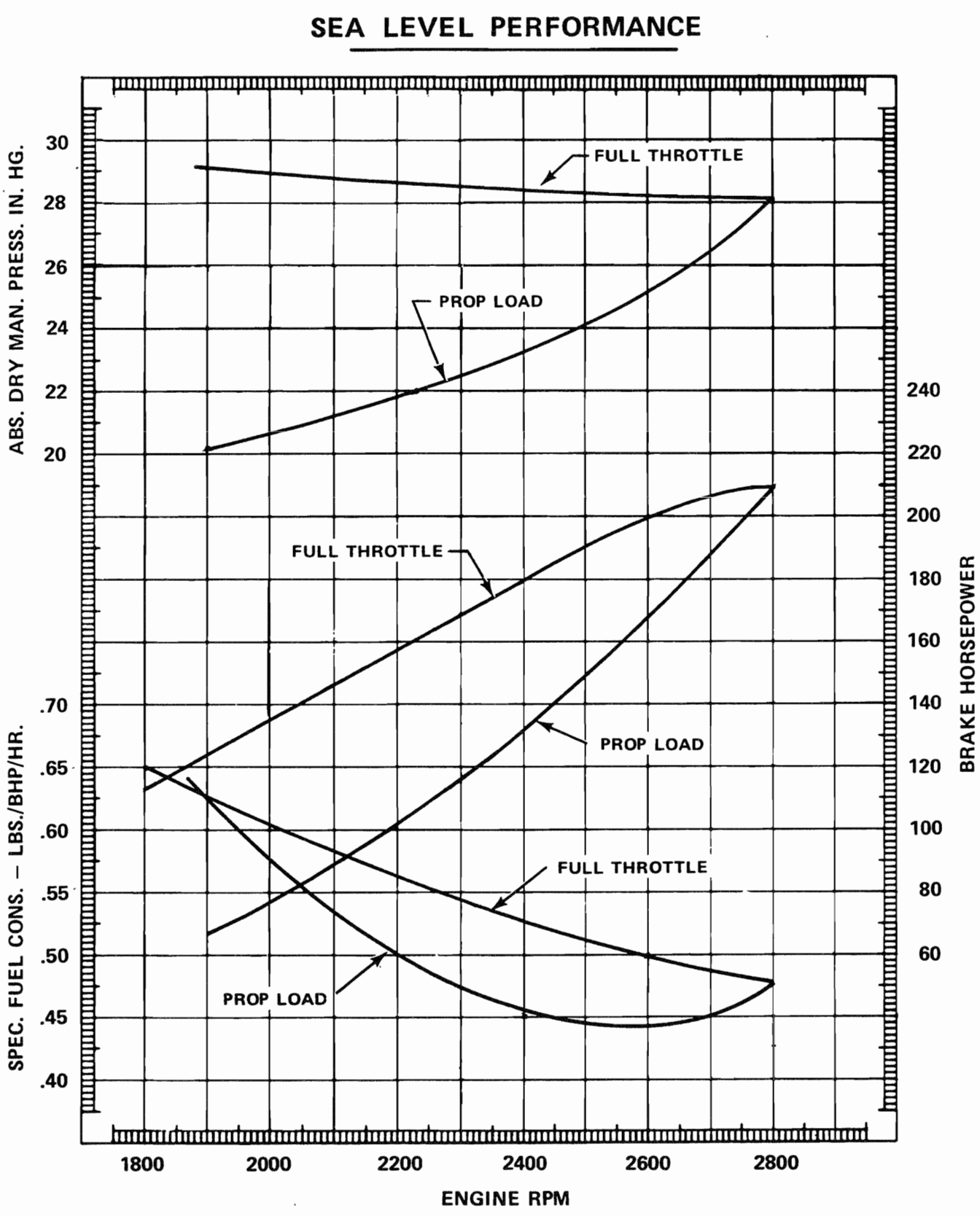

FIGURE 12-4. SEA LEVEL PERFORMANCE
IO-360-C,CB,D,DB,G,GB,H,HB

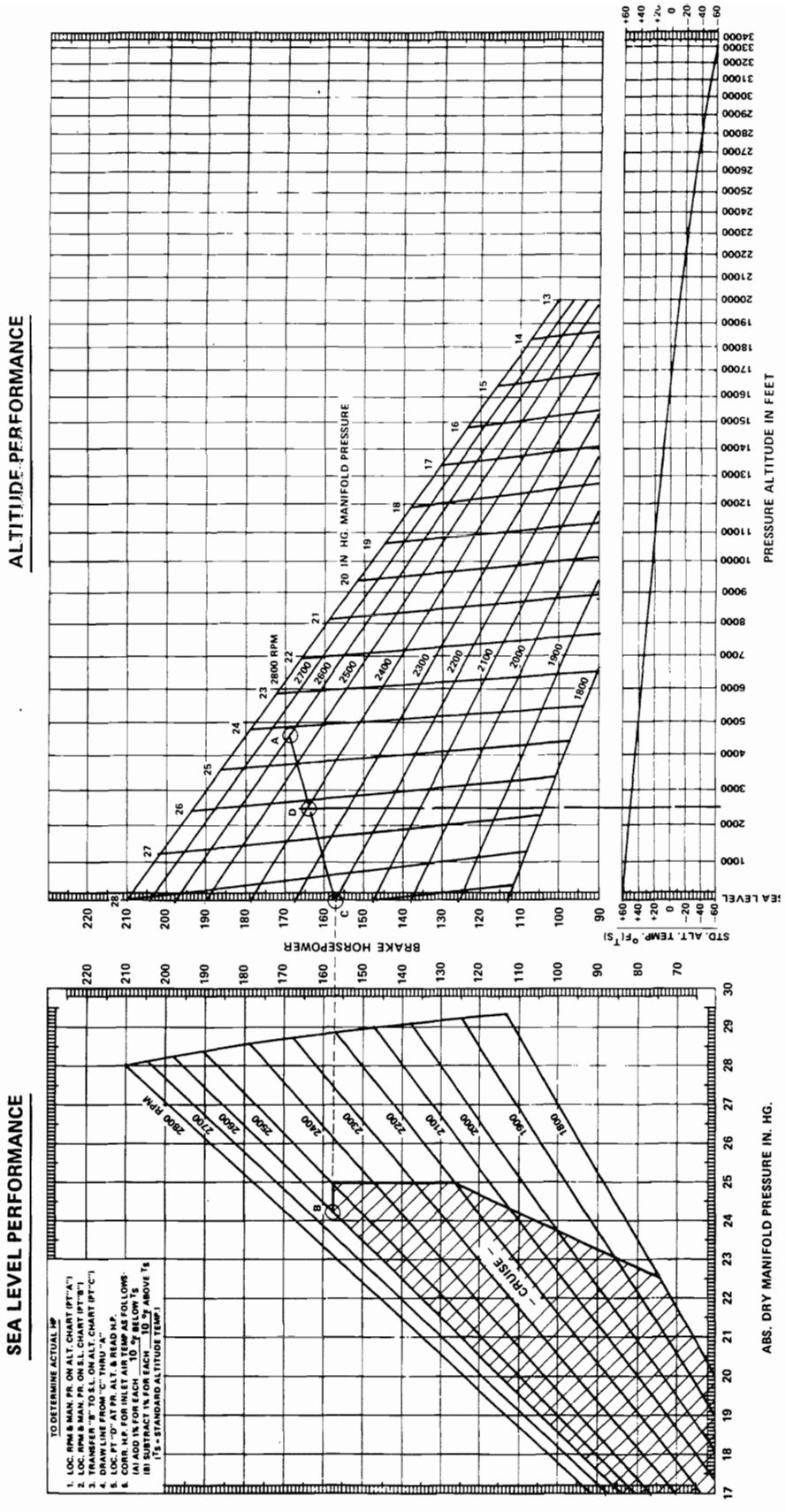

FIGURE 12-5. ALTITUDE PERFORMANCE CURVES
IO-360-C,CB,D,DB,G,GB,H,HB

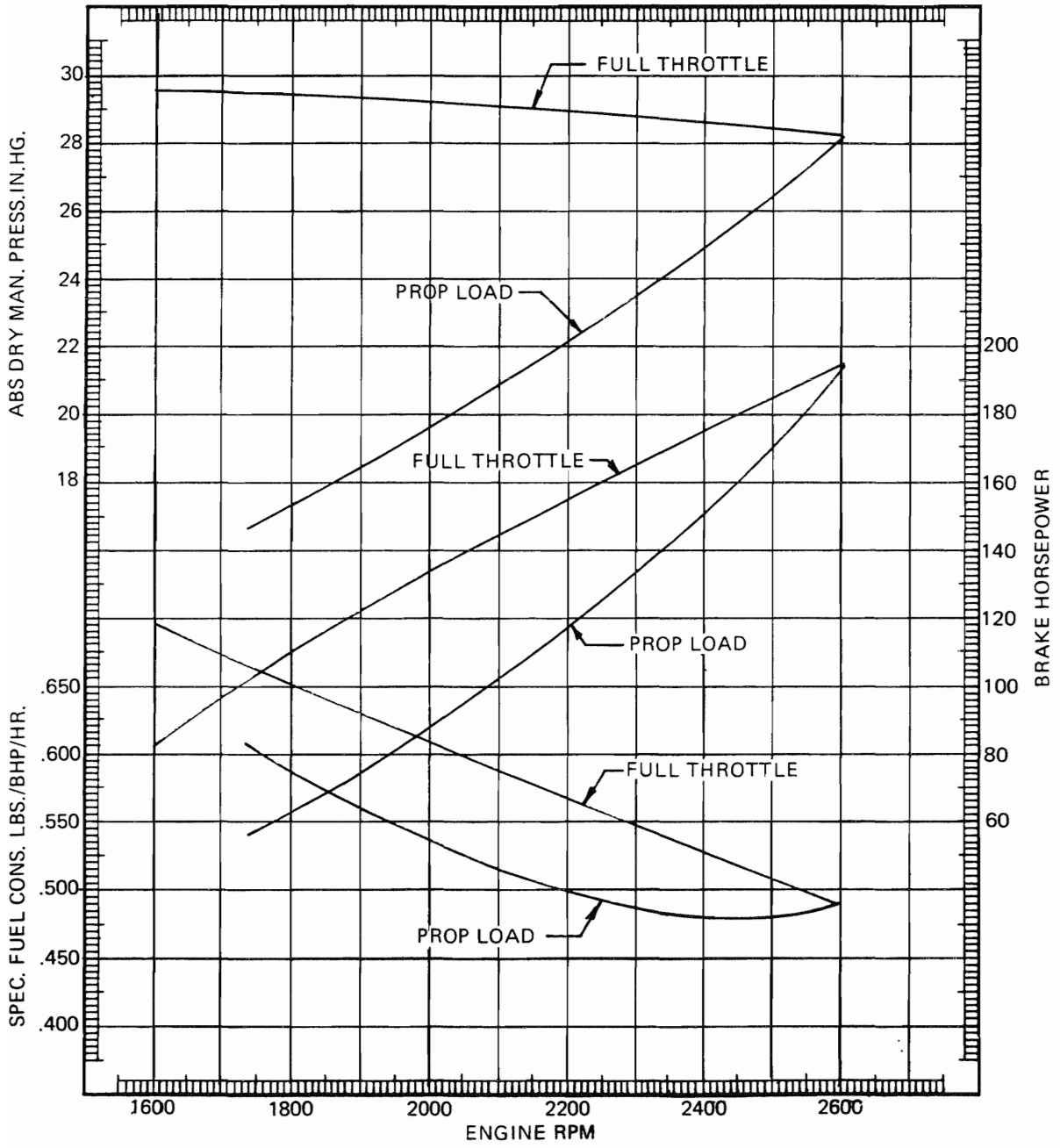

FIGURE 12-6. SEA LEVEL PERFORMANCE
IO-360-K,KB

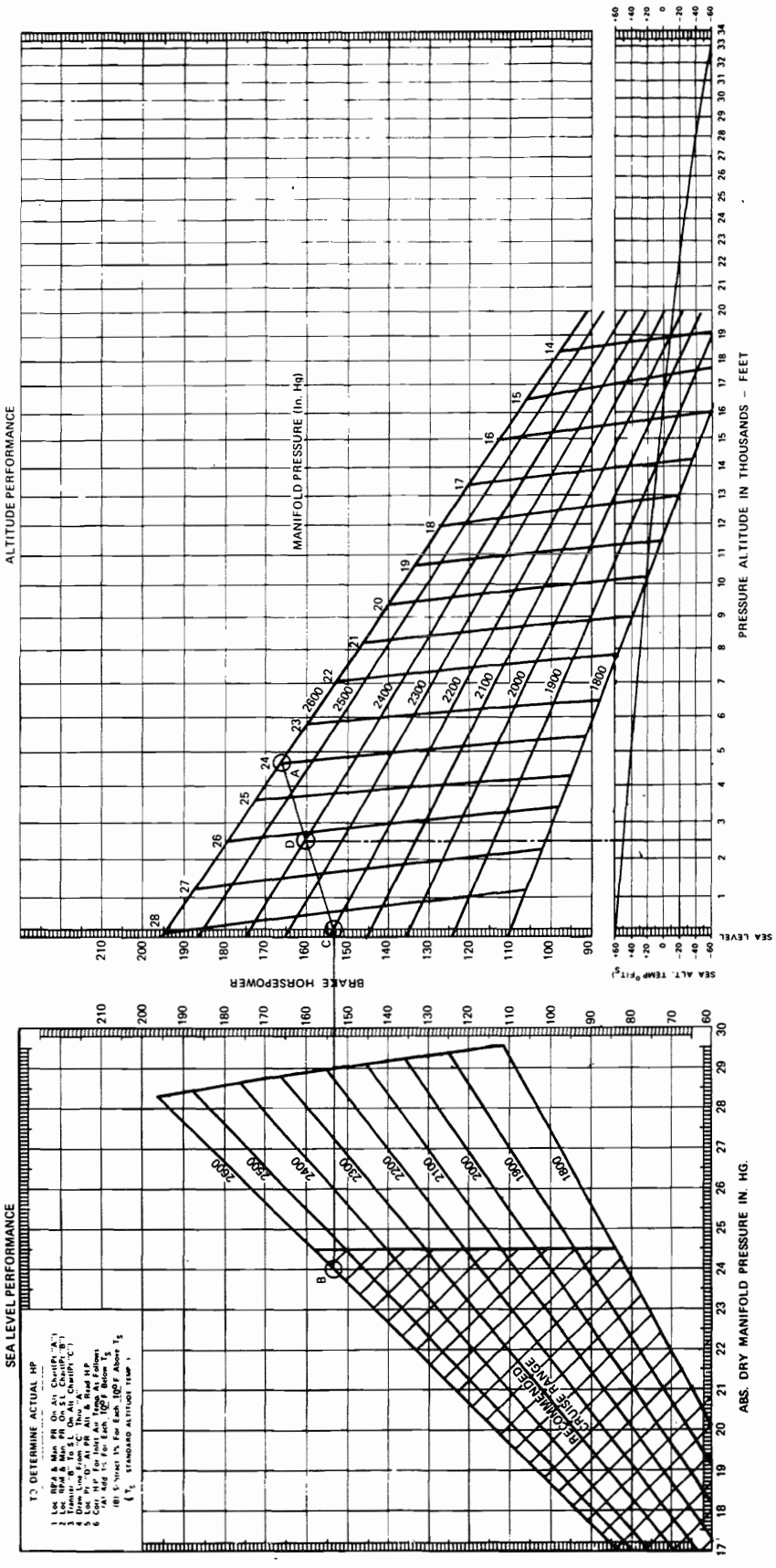

FIGURE 12-7. ALTITUDE PERFORMANCE IO-360-K,KB

SEA LEVEL PERFORMANCE

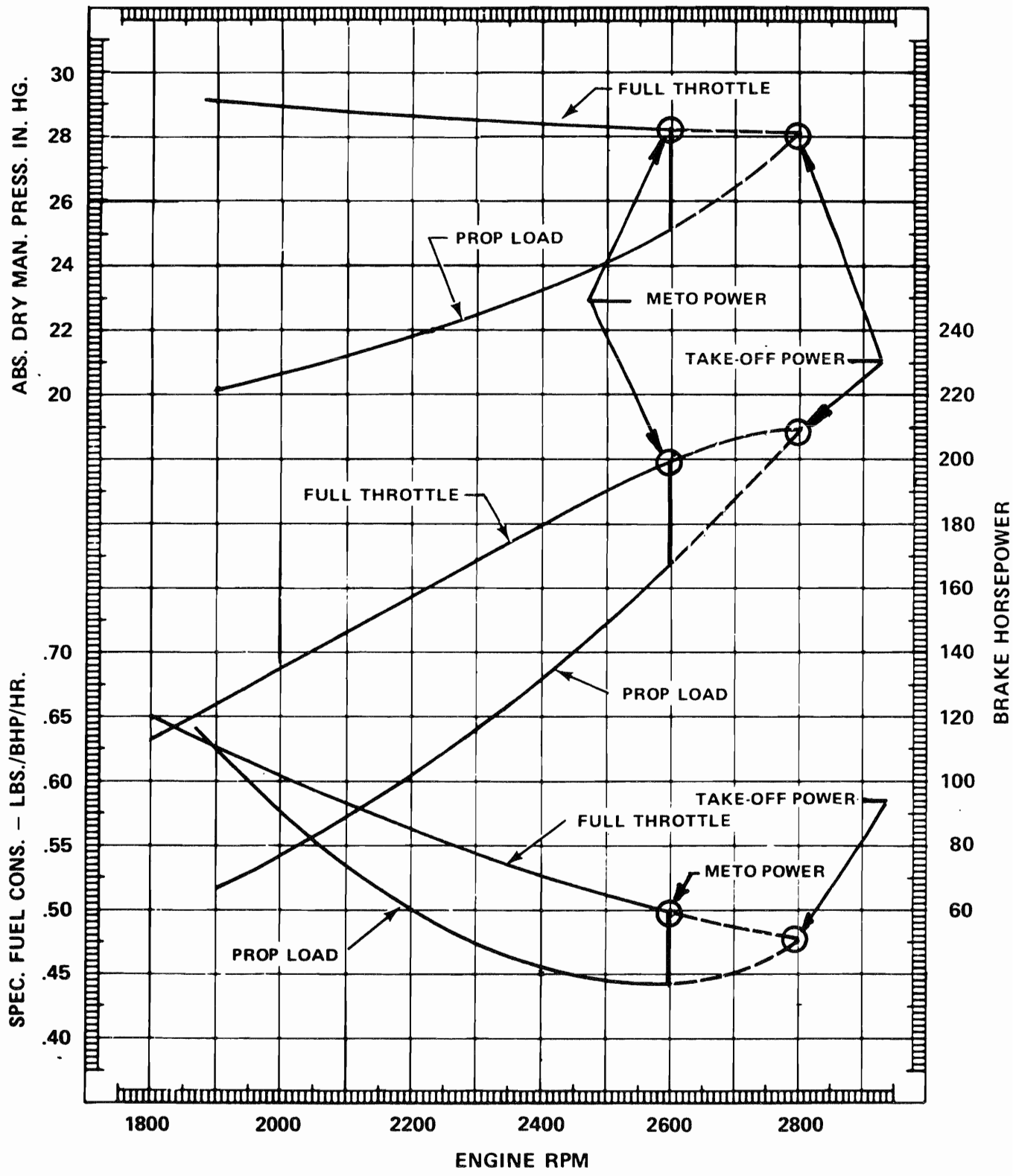

FIGURE 12-8. SEA LEVEL PERFORMANCE
IO-360-J,JB

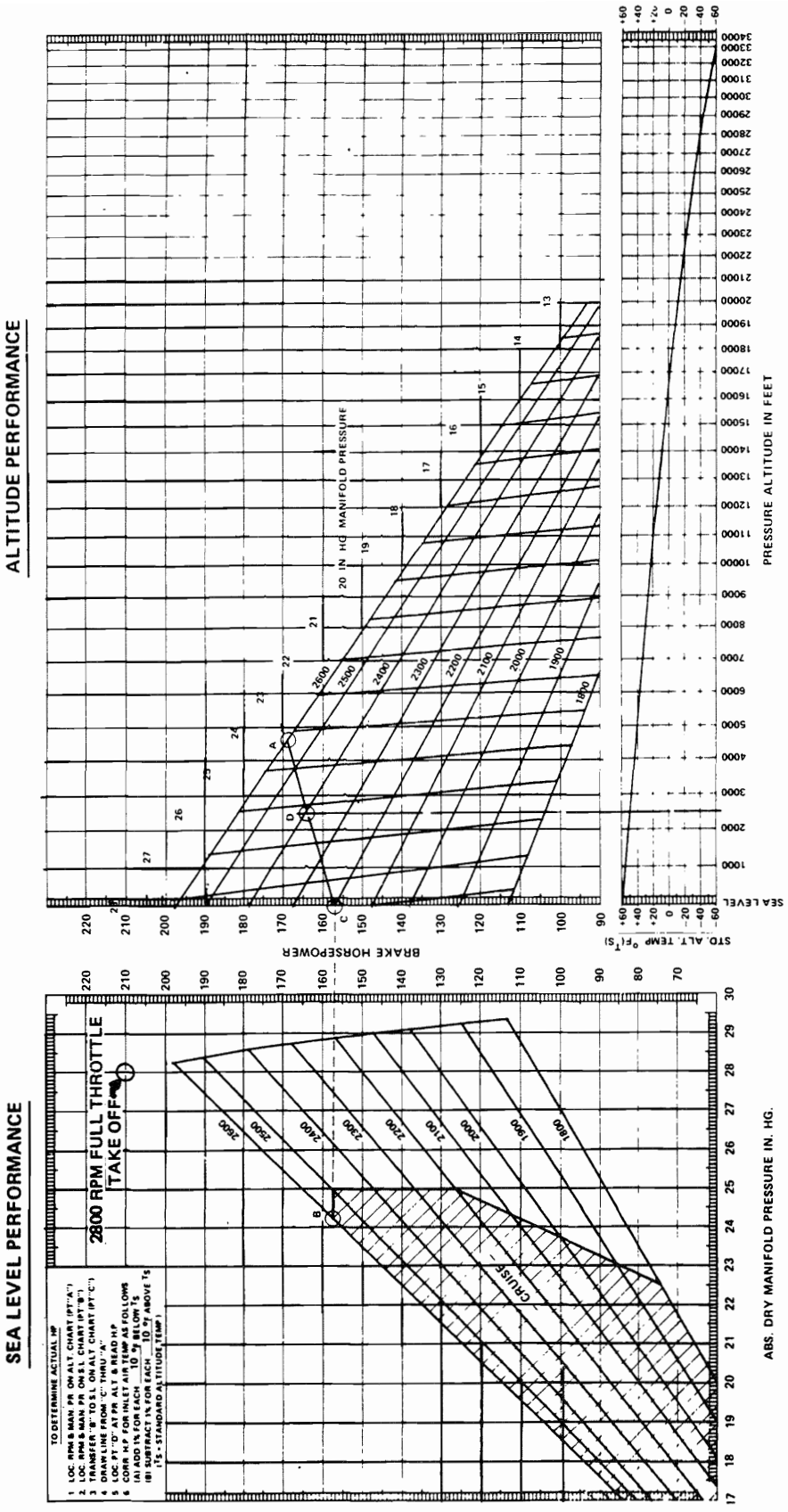

FIGURE 12-9. ALTITUDE PERFORMANCE IO-360-J,JB

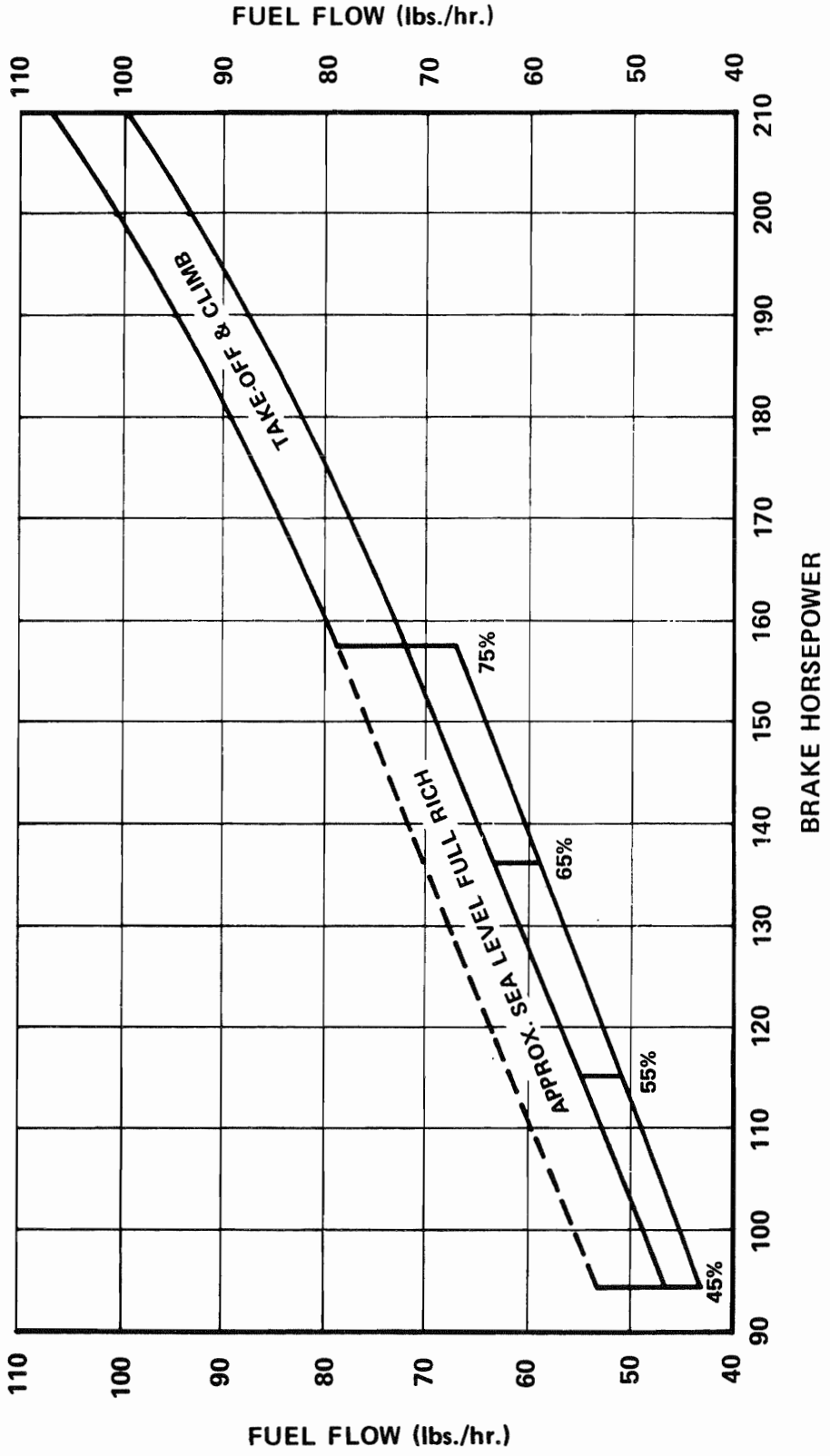

FIGURE 12-10. FUEL FLOW VS. BRAKE HORSEPOWER, IO-360-C,CB,D,DB,G,GB,H,HB,J,JB

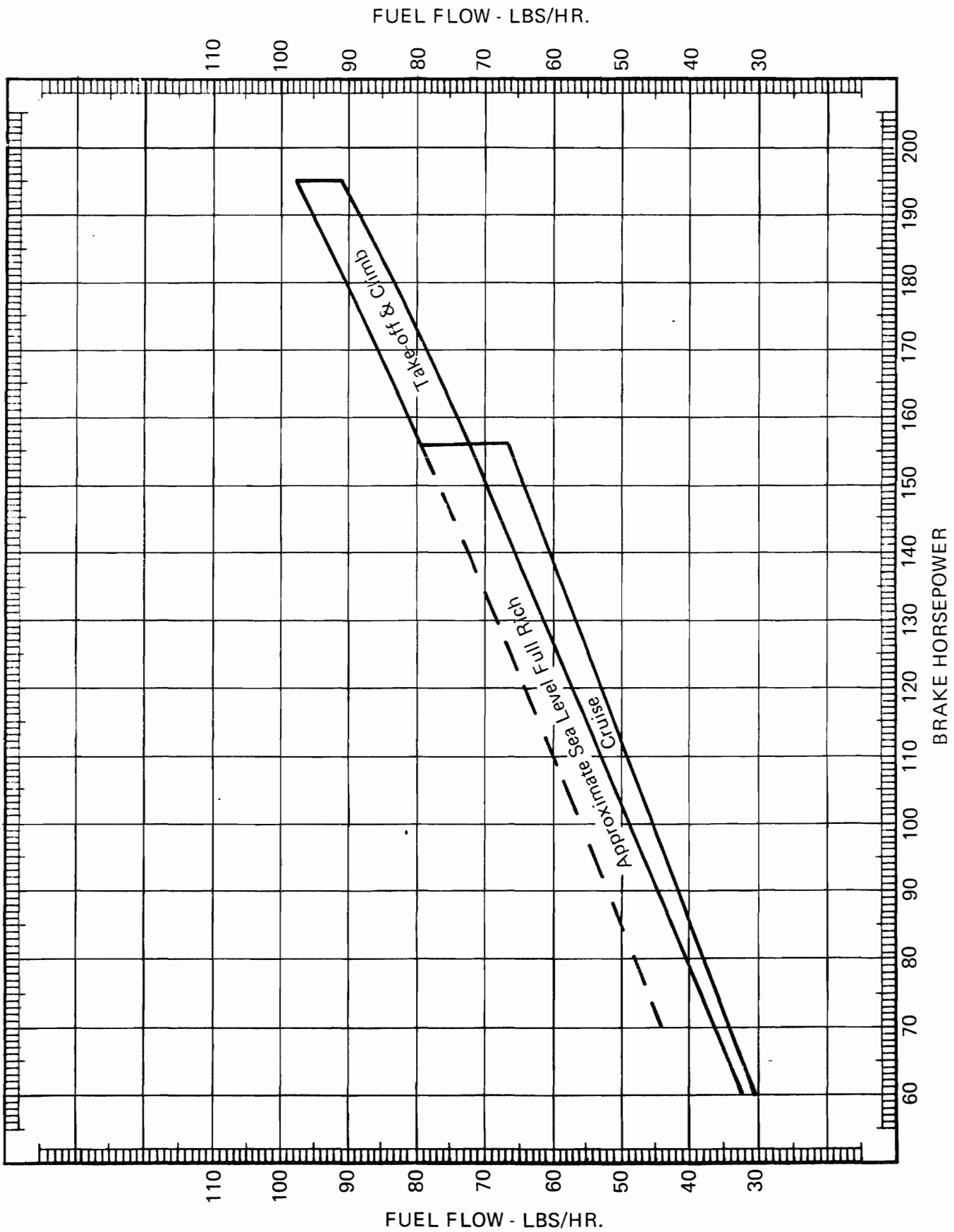

FIGURE 12-11. FUEL FLOW VS. BRAKE HORSEPOWER IO-360-K,KB

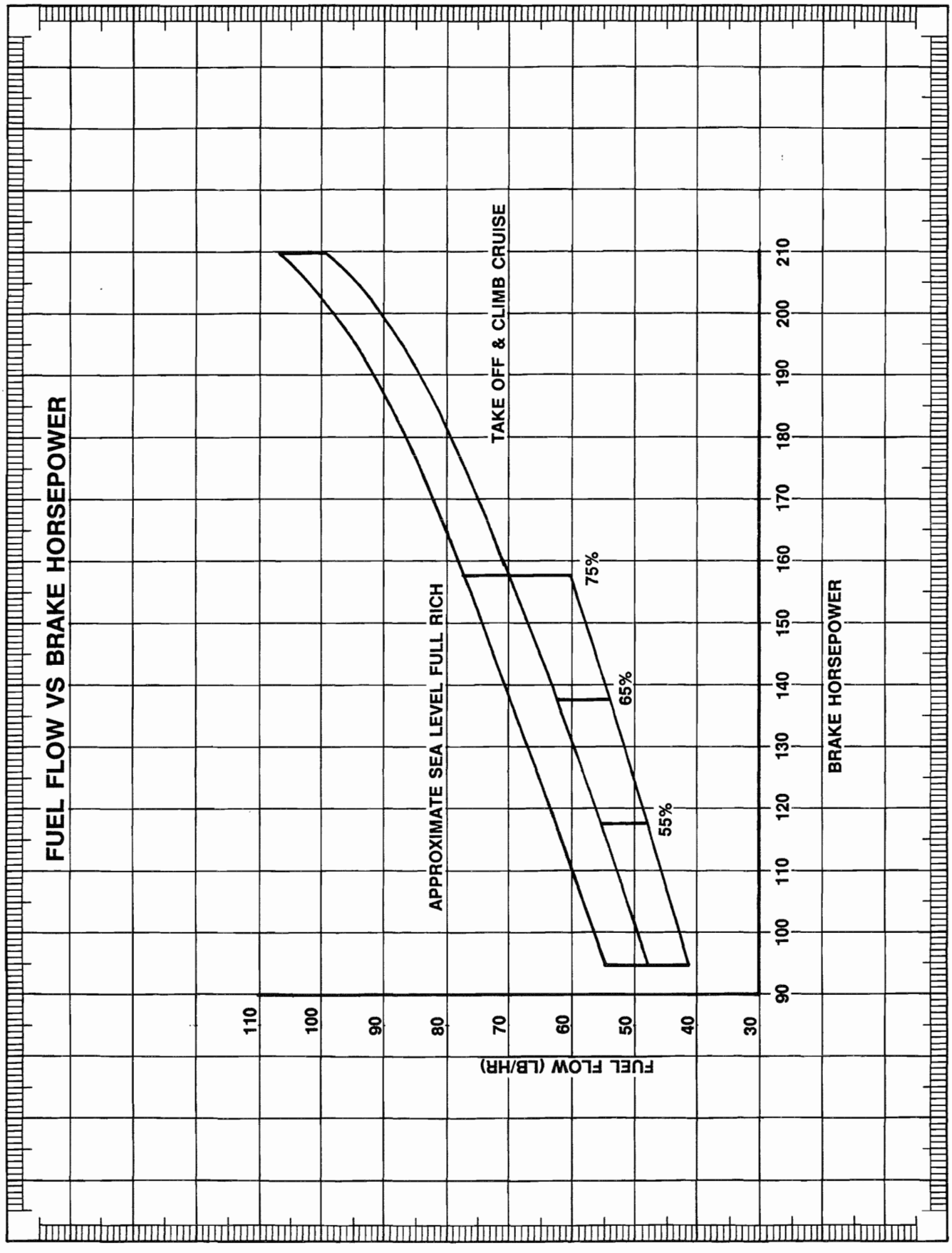

FIGURE 12-12. FUEL FLOW VS. BRAKE HORSEPOWER
ES

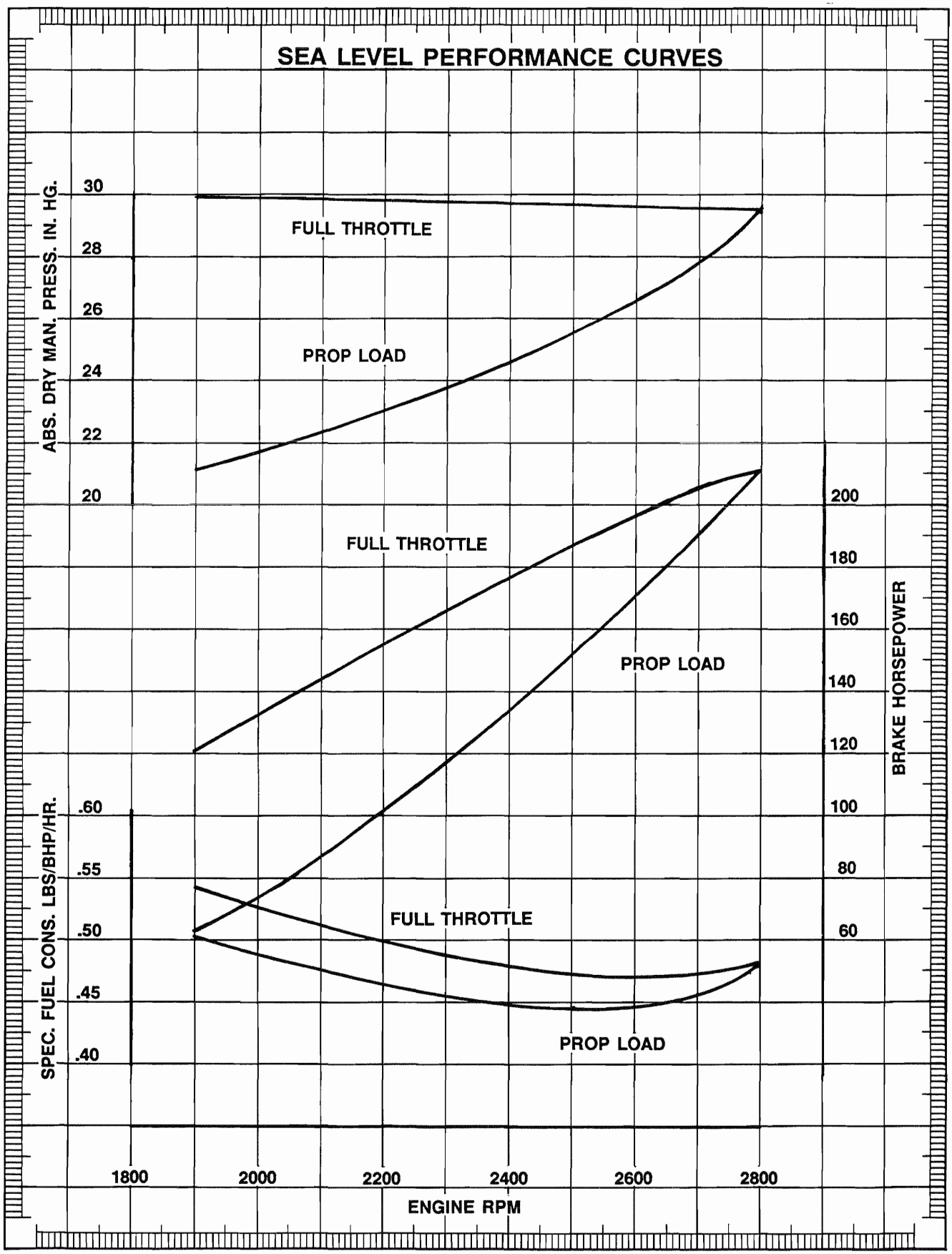

FIGURE 12-13. SEA LEVEL PERFORMANCE CURVES
ES

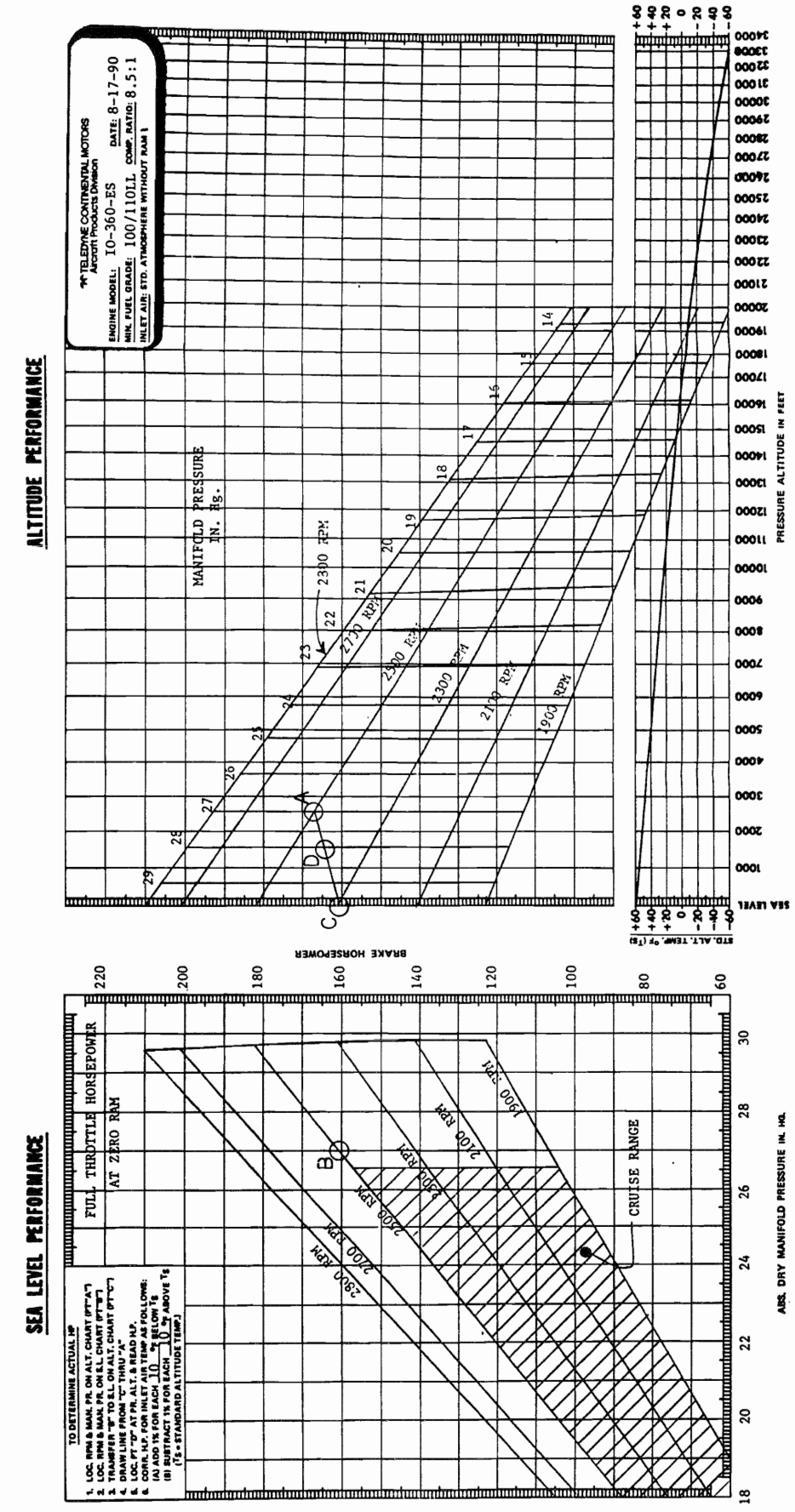

FIGURE 12-14. ALTITUDE PERFORMANCE
ES

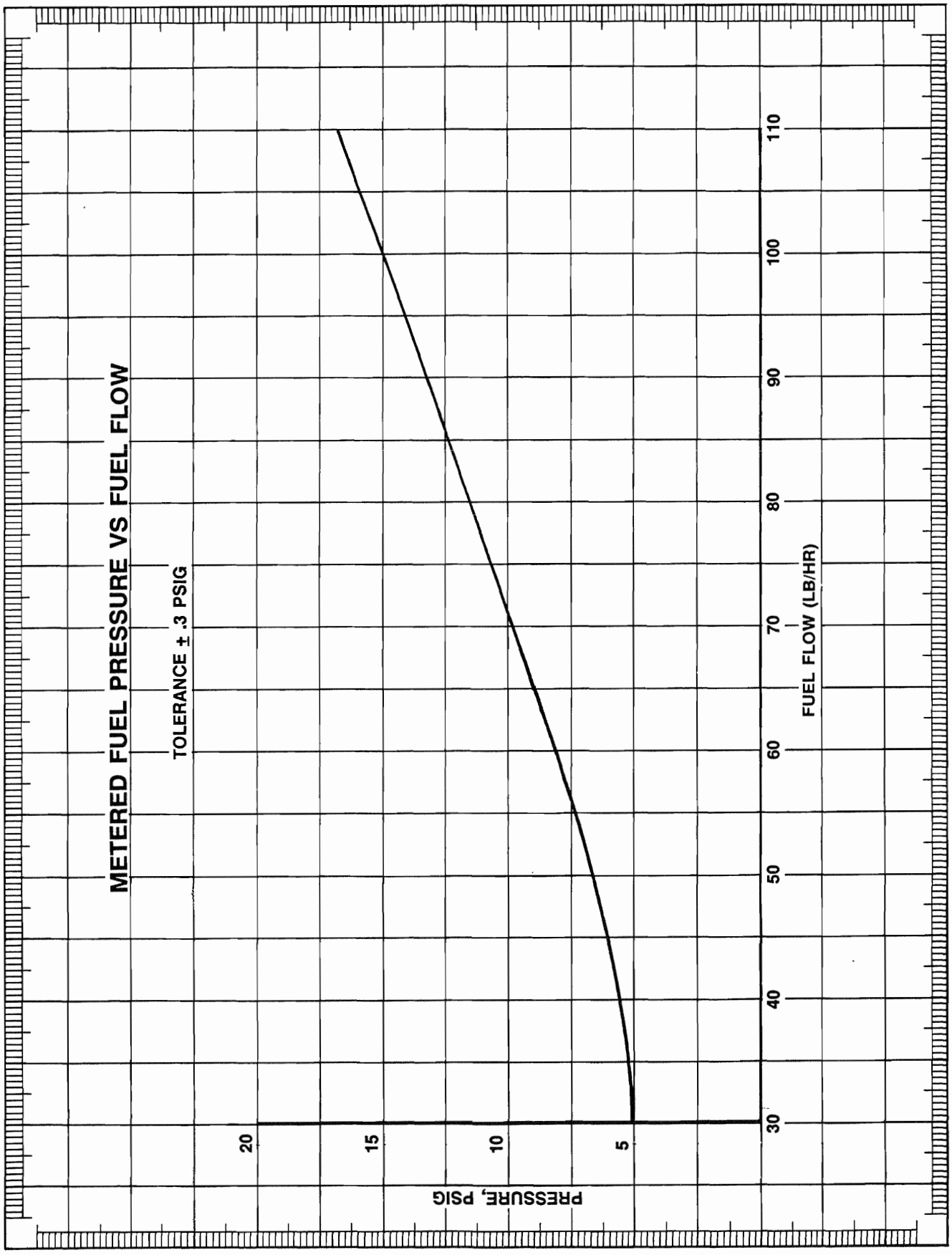

FIGURE 12-15. METERED FUEL PRESSURE VS. FUEL FLOW
ES

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