U.S.C.G. Merchant Marine Exam

DDE – 1000/4000 HP

Q630 Motor Plants

(Sample Examination)

Q630 Motor Plants
U.S.C.G. Merchant Marine Exam
DDE – 1000/4000 HP
Illustrations: 24

Choose the best answer to the following Multiple-Choice Questions:

1. What statement concerning fuel cetane rating and the ignition delay period is true as it applies to towboat main propulsion diesel engines?

   A. The ignition delay period is the lag in time between when fuel injection actually begins and when combustion actually begins, and the higher the cetane rating of the fuel the longer the ignition delay period.
   B. The ignition delay period is the lag in time between when fuel injection actually begins and when combustion actually begins, and the higher the cetane rating of the fuel the shorter the ignition delay period.
   C. The ignition delay period is the lag in time between when fuel injection is initiated and when fuel injection actually begins, and the higher the cetane rating of the fuel the shorter the ignition delay period.
   D. The ignition delay period is the lag in time between when fuel injection is initiated and when fuel injection actually begins, and the higher the cetane rating of the fuel the longer the ignition delay period.

   Correct answer: B

2. The pressure-volume (P-V) diagram shown in the illustration represents a theoretical diesel engine cycle which ideally represents all diesel engines, including those used in the towing industry. What statement is true concerning the combustion cycle event represented between points "2" and "3" in figure "B" of the illustration? Illustration MO-0205

   A. This represents the compression event occurring at constant pressure.
   B. This represents the combustion event occurring at constant volume.
   C. This represents the expansion event occurring at constant volume.
   D. This represents the combustion event occurring at constant pressure.

   Correct answer: D

3. Suppose the diesel generator set drive engines are of the type shown in the illustration on your ship docking tug. What description best represents the operating cycle and aspiration method? Illustration MO-0165

   A. Crankcase scavenged, two-stroke cycle engine
   B. Naturally aspirated, two-stroke cycle engine
   C. Roots-blown, four-stroke cycle engine
   D. Roots-blown, two-stroke cycle engine

   Correct answer: D

4. You are serving as a designated duty engineer onboard a harbor tug equipped with main propulsion diesel engines of the type shown in the illustration. What scavenging flow pattern is used in this engine type? Illustration MO-0227

   A. Cross-flow
   B. Return-flow
   C. Loop
   D. Uniflow

   Correct answer: D

5. Suppose the diesel generator set drive engines are of the type shown in the illustration on your towing vessel. Assuming the engine is naturally aspirated, within an individual cylinder in terms of piston stroke and position, under what circumstances are the intake and exhaust valves both open? Illustration MO-0163

   A. When the piston is at top dead center (TDC) transitioning from the compression stroke to the power stroke.
   B. When the piston is at bottom dead center (BDC) transitioning from the intake stroke to the compression stroke.
   C. When the piston is at top dead center (TDC) transitioning from the exhaust stroke to the intake stroke.
   D. When the piston is at bottom dead center (BDC) transitioning from the power stroke to the exhaust stroke.

   Correct answer: C

6. The ship-docking tug to which you are assigned is fitted with main propulsion diesel engines of the type shown in the illustration. In terms of valve operating gear, cylinder liner type, and connecting rod type, what statement is true? Illustration MO-0192

   A. This is a pushrod operated overhead valve engine, with jacketed cylinder liners and articulated connecting rods.
   B. This is an overhead cam engine, with wet cylinder liners and conventional connecting rods.
   C. This is an overhead cam engine, with jacketed cylinder liners and marine-type connecting rods.
   D. This is a pushrod operated overhead valve engine, with wet cylinder liners and conventional connecting rods.

   Correct answer: D

7. The tractor tug to which you are assigned is fitted with main propulsion diesel engines of the type shown in the illustration. In terms of valve operating gear, cylinder liner type, and connecting rod type, what statement is true? Illustration MO-0227

   A. This is a pushrod operated overhead valve engine, with wet cylinder liners and hinged-strap, fork-and-blade connecting rods.
   B. This is an overhead cam engine, with jacketed cylinder liners and hinged-strap, fork-and-blade connecting rods.
   C. This is an overhead cam engine, with wet cylinder liners, and marine-type connecting rods.
   D. This is a pushrod operated overhead valve engine, with jacketed cylinder liners and conventional connecting rods.

   Correct answer: B

8. In preparation for getting a salvage tug underway, what is the primary factor to consider in whether or not pre-lubrication of the main propulsion engines shall be necessary?

   A. The length of time that the engine has been shutdown
   B. The interval of time since the last engine overhaul
   C. The ambient temperature in the engine room
   D. The viscosity of the lubricating oil

   Correct answer: A

9. When checking the cylinder jacket water cooling expansion tank level on a main propulsion diesel engine on your towing vessel while underway on a coast-wise voyage, what should be the expansion tank level?

   A. The level should be out of sight high in the sight glass when the engine is at operating temperature.
   B. The level should be in the lower part of the sight glass when the engine is at operating temperature.
   C. The level should be in the upper part of the sight glass when the engine is at operating temperature.
   D. The actual level is unimportant as long as it is visible in the sight glass when the engine is at operating temperature.

   Correct answer: C

10. The ship-docking tug to which you are assigned is fitted with auxiliary diesel engines of the type shown in the illustration. In terms of valve operating gear and cylinder liner type, what statement is true? Illustration MO-0165

    A. This is an overhead cam engine with wet cylinder liners.
    B. This is a pushrod operated overhead valve engine with wet cylinder liners.
    C. This is an overhead cam engine with dry cylinder liners.
    D. This is a pushrod operated overhead valve engine with dry cylinder liners.

    Correct answer: D

11. The ship-docking tug to which you are assigned is fitted with auxiliary diesel engines of the type shown in the illustration. In terms of valve operating gear and cylinder liner type, what statement is true? Illustration MO-0006

    A. This is an overhead cam engine with jacketed cylinder liners.
    B. This is an overhead cam engine with wet cylinder liners.
    C. This is a pushrod operated overhead valve engine with jacketed cylinder liners.
    D. This is a pushrod operated overhead valve engine with wet cylinder liners.

    Correct answer: D

12. Prior to starting a diesel generator engine fitted on your river push boat, the crankcase oil level must be checked. At what checked level would you be required to add make-up oil?

    A. When the oil level drops below the ADD mark on the dipstick
    B. When the oil level drops to between the ADD and FULL marks on the dipstick
    C. When the oil level drops to where it is no longer visible on the dipstick
    D. When the oil level drops below the FULL mark on the dipstick

    Correct answer: A

13. Prior to starting a diesel generator set engine fitted on your salvage tug, it has been determined that the transfer of make-up oil is required. At what checked level should you stop adding make-up oil?

    A. When the oil level rises to the FULL mark on the dipstick
    B. When the oil level rises to a level well above the FULL mark on the dipstick
    C. When the oil level rises to the ADD mark on the dipstick
    D. When the oil level rises to the between the ADD and FULL marks on the dipstick

    Correct answer: A

14. The generator drive engines fitted on your harbor tug are started by the type of starter shown in figure "A" of the illustration. What type of starter is shown? Illustration MO-0201

    A. Turbine type air motor
    B. Radial piston hydraulic motor
    C. Sliding vane air motor
    D. Axial piston hydraulic motor

    Correct answer: D

15. The main propulsion diesel engines fitted on your salvage tug are started with compressed air using the system illustrated. What is the starting method used with this system? Illustration MO-0199

    A. Hydraulic cranking motor(s) with air over hydraulics
    B. Direct air admission with air start distributor
    C. Air cranking motor(s)
    D. Direct air admission with cam actuated air start valves

    Correct answer: C

16. The deck winch drive engine onboard your salvage tug uses a lubricating oil filtration scheme as shown in the illustration. What type of filtration system is illustrated? Illustration MO-0182

    A. Shunt filtration
    B. Full-flow filtration
    C. Sump filtration
    D. Bypass filtration

    Correct answer: D

17. The diesel generator engines onboard your ship-docking tug use a lubricating oil filtration scheme as shown in the illustration. What type of filtration system is illustrated? Illustration MO-0181

    A. Shunt filtration
    B. Bypass filtration
    C. Full-flow filtration
    D. Sump filtration

    Correct answer: C

18. Various diesel engines onboard your salvage tug are started by means of either vane-type or air-turbine air-starting motors. At a minimum, in the absence of automatic drain valves, how often should moisture separators be drained of moisture while the vessel is underway?

    A. Hourly
    B. Daily
    C. Weekly
    D. Monthly

    Correct answer: B

19. A diesel generator set on your ship-docking tug has a simplex lube oil strainer of the type shown in the illustration, situated on the discharge side of the lube oil pump. At a specified engine rpm and lube oil temperature, you notice that the inlet pressure is increasing, and the outlet pressure is decreasing, resulting in an unacceptable pressure drop. What should be done? Illustration MO-0057

    A. While the engine is running, the drain plug (B) should be carefully loosened to drain the sludge from the strainer sump.
    B. While the engine is running, the cleaning handle (A) should be rotated one or more full turns to remove the accumulated dirt from the disk stack (C).
    C. The drain plug (B) is removed to drain the sludge from the strainer sump, but the engine must be stopped to perform this operation.
    D. While the engine is running, the cleaning handle (A) should be rotated one-half turn to remove the accumulated dirt from the disk stack (C).

    Correct answer: B

20. Concerning the diesel fuels used for the auxiliary and main propulsion diesel engines used on board the towing vessel to which you are assigned, what fuel property is directly a measure of the ignition quality of the fuel?

    A. Density
    B. Heating value
    C. Cetane rating
    D. Viscosity

    Correct answer: C

21. The diesel fuels burned in auxiliary and main diesel engines of tugboats operating in harbor areas are required to meet certain specifications. Among these are limits of certain contaminants to limit atmospheric emissions to acceptable levels. Which of the following soluble contaminants is applicable?

    A. Water
    B. Asphaltenes
    C. Total sediment
    D. Sulfur

    Correct answer: D

22. The harbor tug to which you are assigned has a main engine fuel system as shown in the illustration. Besides preventing the attached fuel oil pump and the hand priming fuel oil pump from discharging through the other, what other purpose do the anti-flood check valves serve? Illustration MO-0152

    A. They prevent backflow of fuel from the engine to the day tank when the engine is shut down and when the day tank is located above the engine.
    B. They prevent backflow of fuel from the engine to the day tank when the engine is running and when the day tank is located below the engine.
    C. They prevent backflow of fuel from the engine to the day tank when the engine is shut down and when the day tank is located below the engine.
    D. They prevent backflow of fuel from the engine to the day tank when the engine is running and when the day tank is located above the engine.

    Correct answer: C

23. The main diesel engines on the tug to which you are assigned are fitted with a metal-edge duplex suction fuel strainer, where the elements must be periodically cleaned. The engine manufacturer recommends using a petroleum-based solvent for cleaning. Which of the following would typically be acceptable?

    A. Kerosene or diesel fuel
    B. Benzene or toluene
    C. Perchloroethylene or trichlorethylene
    D. White mineral spirits

    Correct answer: A

24. The tractor tug to which you are assigned has diesel generators fitted with a fuel injection system that have a complete absence of high-pressure fuel lines. Which figure of the illustration represents the most likely type of fuel injection equipment used? Illustration MO-0149

    A. 1
    B. 2
    C. 3
    D. 4

    Correct answer: C

25. The river push boat to which you are assigned has diesel generators fitted with fuel injectors of the type shown in figure "2" of the illustration. What statement is true concerning this type of injector? Illustration MO-0150

    A. The injector is of the open type and features pressure-time metering.
    B. The injector is of the closed type and features port and helix metering.
    C. The injector is of the open type and features port and helix metering.
    D. The injector is of the closed type and features pressure-time metering.

    Correct answer: B

26. The sea-going tug to which you are assigned has main engines fitted with intake and exhaust systems as shown in the illustration. What statement is true concerning the turbocharger charge air discharge arrangements? Illustration MO-0177

    A. It is not possible to determine the turbocharger charge air discharge arrangements in this particular drawing.
    B. The left side turbocharger discharges charge air to the left cylinder bank, and the right side turbocharger discharges charge air to the right cylinder bank.
    C. The left side turbocharger discharges charge air to the right cylinder bank, and the right side turbocharger discharges charge air to the left cylinder bank.
    D. The left side turbocharger discharges charge air to both cylinder banks, and the right side turbocharger discharges charge air to both cylinder banks.

    Correct answer: C

27. The river push boat to which you are assigned has diesel generators fitted with intake and exhaust systems as shown in the illustration. What does the component labeled "3" represent? Illustration MO-0176

    A. Exhaust manifold
    B. Charge air cooler
    C. Charge air manifold
    D. Wet muffler

    Correct answer: B

28. The harbor tug to which you are assigned has main engines fitted with intake and exhaust systems as shown in the illustration. What type of turbo-charging configuration is used? Illustration MO-0076

    A. Constant pressure turbocharging
    B. Pulse turbocharging
    C. 2-stage turbocharging
    D. Boost-controlled turbocharging

    Correct answer: B

29. The sea-going tug to which you are assigned has main engines fitted with intake and exhaust systems as shown in the illustration. What statement is true concerning the turbocharger exhaust piping arrangements? Illustration MO-0177

    A. The left side turbocharger receives exhaust gas from the right cylinder bank, and the right side turbocharger receives exhaust gas from the left cylinder bank.
    B. The left side turbocharger receives exhaust gas from both cylinder banks, and the right side turbocharger receives exhaust gas from both cylinder banks.
    C. The left side turbocharger receives exhaust gas from the left cylinder bank, and the right side turbocharger receives exhaust from the right cylinder bank.
    D. It is not possible to determine the turbocharger exhaust piping arrangements in this particular drawing.

    Correct answer: C

30. In order to minimize the abrasive action of dust particles entering the combustion spaces of the diesel engines used on the towing vessel to which you are assigned, each engine is protected with a heavy-duty air intake filter. Which one of the listed air intake filter elements is periodically cleaned as opposed to being periodically replaced with a new element?

    A. Multi-tube filter element
    B. Spiral-rotor filter element
    C. Oil bath wire-mesh filter element
    D. Round pleated filter element

    Correct answer: C

31. The freshwater cooling systems serving the main engines of the towing vessel to which you are assigned are arranged as shown in the illustration. What statement best describes the arrangement of the freshwater keel cooler shown in the system diagram? Illustration MO-0138

    A. The keel cooler is mounted on the inside of the hull below the water line.
    B. The keel cooler is mounted on the outside of the hull above the water line.
    C. The keel cooler is mounted on the inside of the hull above the water line.
    D. The keel cooler is mounted on the outside of the hull below the water line.

    Correct answer: D

32. The raw water boxes of the freshwater coolers serving the main propulsion diesel engines on your towing vessel are fitted with sacrificial zinc anodes. Upon inspection, at what percentage of deterioration should the zinc anodes be replaced?

    A. 25%
    B. 50%
    C. 75%
    D. 100%

    Correct answer: B

33. Assuming the use of ultra-low sulfur content diesel fuel, what combination of conditions associated with harbor tug engine room operations would require the most frequent draining of exhaust systems of condensation?

    A. Summer operations with prolonged idling on station
    B. Winter operations with prolonged idling on station
    C. Summer operations with lengthy ship escort transit times
    D. Winter operations with lengthy ship escort transit times

    Correct answer: B

34. The winch drive engine on the harbor tug to which you are assigned is fitted with a Roots-type blower as shown in the illustration. What statement is true concerning this blower? Illustration MO-0082

    A. Rotor "1" turns counter-clockwise, and rotor "2" turns clockwise. Area "3" is the discharge passage, and area "4" is the suction passage.
    B. Rotor "1" turns clockwise, and rotor "2" turns counter-clockwise. Area "3" is the suction passage, and area "4" is the discharge passage.
    C. Rotor "1" turns counter-clockwise, and rotor "2" turns clockwise. Area "3" is the suction passage, and area "4" is the discharge passage.
    D. Rotor "1" turns clockwise, and rotor "2" turns counter-clockwise. Area "3" is the discharge passage, and area "4" is the suction passage.

    Correct answer: A

35. You are assigned to a tractor tug with a drive system as shown in figure "A" of the illustration. What type of propulsion drive system is illustrated? Illustration MO-0140

    A. Conventional fixed-propeller drive
    B. Azimuthing propeller drive (z-drive)
    C. Controllable pitch propeller drive
    D. Cycloidal propeller drive

    Correct answer: D

36. You are assigned to a tractor tug with a drive system as shown in figure "B" of the illustration. What type of propulsion drive system is illustrated? Illustration MO-0140

    A. Azimuthing drive (z-drive)
    B. Conventional fixed-propeller drive
    C. Controllable pitch propeller drive
    D. Cycloidal propeller drive

    Correct answer: A

37. The two-stroke cycle main propulsion engines on the harbor tug to which you are assigned are fitted with turbochargers for scavenging purposes. Assume that you are checking the air box drains in an installation that is valved with external drain piping to a drains tank. When you open the air box drain valves, no drainage occurs when in fact there is an accumulation of oil and moisture on the floor of the air boxes. What should you do?

    A. Blow through the drain openings with compressed air to clear the drains.
    B. Increase the crankcase pressure to blow the air box drain openings clear.
    C. Increase the air box pressure to blow the air box drain openings clear.
    D. Mechanically poke through the drain openings with a rod to clear the drains.

    Correct answer: D

38. The lubricating oil system supporting the main propulsion reduction gear on the ship-docking tug to which you are assigned is fitted with a lube oil strainer as shown in the illustration. What strainer attribute will dictate the degree of filtration in terms of the particle size capable of being filtered? Illustration MO-0057

    A. The length of the oil sump enclosing the straining element
    B. The dimensions of the triangular oil passages in each disc conveying the strained oil upward
    C. The number of discs in the disc-stack making up the straining element
    D. Vertical spacing between the metal discs as determined by the thickness of the cleaner blades

    Correct answer: D

39. The main engines on your river towboat are fitted with speed control governors of the type shown in the illustration. What technology is used to transmit the desired speed setting from the navigational bridge to the final input signal to the engine governor? Illustration MO-0156

    A. Pneumatic (variable control air pressure)
    B. Mechanical (cable or chain)
    C. Hydraulic (variable control oil pressure)
    D. Electronic (variable DC current)

    Correct answer: A

40. Suppose each of the main propulsion engines on your harbor assist tug is equipped with a variable speed governor equipped with a solenoid actuated shutdown device. After a high temperature alarm, after continuing to rise, what is the most likely engine high temperature condition that would initiate a safety trip shutdown?

    A. High exhaust temperature
    B. High fuel temperature
    C. High charge air temperature
    D. High jacket water temperature

    Correct answer: D

41. The pneumatic propulsion control system used on your towing vessel is configured as shown in the illustration. In terms of clutch air system maintenance, what statement best represents operational requirements? Illustration MO-0168

    A. Whereas the cleanliness of clutch air is critical, the dryness and pressure are clutch air are of secondary concern.
    B. Whereas the dryness of clutch air is critical, the pressure and cleanliness of the clutch air are of secondary concern.
    C. Whereas the clutch air pressure is critical, the dryness and cleanliness of the clutch air are of secondary concern.
    D. The pressure, dryness, and cleanliness of clutch air are all critical to successful pneumatic propulsion control operations.

    Correct answer: D

42. Suppose the main propulsion diesel engines on your river pushboat are fitted with pressure-compensated governors as shown in the illustration. What function does the engine lube oil pressure connection provide? Illustration MO-0156

    A. It is used as a governor lubricant and as a hydraulic power medium for the power cylinder.
    B. It is used solely for the purpose of achieving engine shutdown on low engine lube oil pressure.
    C. It is used solely for the purpose of activating an alarm on low engine lube oil pressure.
    D. It is used for both activating an alarm and achieving engine shutdown on low engine lube oil pressure.

    Correct answer: D

43. The heating boiler on your harbor tug is of the type shown in the illustration. Which of the following arrangements describe a boiler of this type? Illustration MO-0195

    A. The boiler is of the water-tube type and utilizes forced circulation.
    B. The boiler is of the fire-tube type and utilizes forced circulation.
    C. The boiler is of the fire-tube type and utilizes natural circulation.
    D. The boiler is of the water-tube type and utilizes natural circulation.

    Correct answer: A

44. The thermal fluid heating oil system on your articulated tug-barge unit is configured similarly to that shown in the illustration. What system component performs expansion and deaeration functions? Illustration MO-0198

    A. 1
    B. 2
    C. 4
    D. 5

    Correct answer: D

45. Which of the following statements describes pertinent criteria for performing a surface blow for the purposes of removing excess chemicals and/or salinity as indicated by boiler water testing on an auxiliary steam boiler as fitted on your sea-going tug?

    A. The surface blow would be performed when the boiler is steaming AND the level would be maintained normal during the duration of the blow.
    B. The surface blow would be performed when the boiler is steaming AND the level would be maintained above normal during the duration of the blow.
    C. The surface blow would be performed when the boiler is secured AND the level would be maintained normal during the duration of the blow.
    D. The surface blow would be performed when the boiler is secured AND the level would be maintained above normal during the duration of the blow.

    Correct answer: B

46. Which of the following conditions best describes the reason for performing a bottom blow on an auxiliary steam boiler as fitted on your harbor tug?

    A. High water
    B. Priming and carryover
    C. Excess chemicals and/or salinity
    D. Sludge removal

    Correct answer: D

47. Since towing vessels take on fresh water from shore as a source of make-up water for the closed, re-circulating cooling water systems supporting diesel engines, what property of the make-up water is most important in contributing to cooling system problems?

    A. The degree of contamination of suspended solids, such as sand
    B. The amount of dissolved solids associated with mineral content
    C. The amount of dissolved oxygen (and other various gases)
    D. The degree of contamination with microbiological organisms

    Correct answer: B

48. A main propulsion diesel engine on your ship docking tug has experienced a safety shutdown due to high lubricating oil temperature. What is the appropriate response?

    A. Immediately restart the engine and monitor the oil temperature to verify the cause of the shutdown.
    B. Allow 2 hours for the engine to cool down before attempting to inspect the engine and correct the cause of the trip before attempting to restart the engine.
    C. Allow the engine to cool off for two minutes, then restart and monitor the lubricating oil temperature to verify the cause of the shutdown.
    D. Immediately perform the engine inspections to determine the cause of the high oil temperature safety shutdown.

    Correct answer: B

49. While warming up the main engines on your harbor tug while tied up at your own pier, one of the main engines suddenly sounds the low lube oil pressure alarm. What is the appropriate initial response?

    A. Immediately add make-up oil or service lube oil coolers, strainers, and filters, as appropriate.
    B. Monitor closely oil pressures, temperatures, and levels while continuing to run the engine.
    C. Reduce the load and speed on the engine and continue to monitor the oil pressure.
    D. Immediately shutdown the engine, then investigate the cause for the low-pressure alarm.

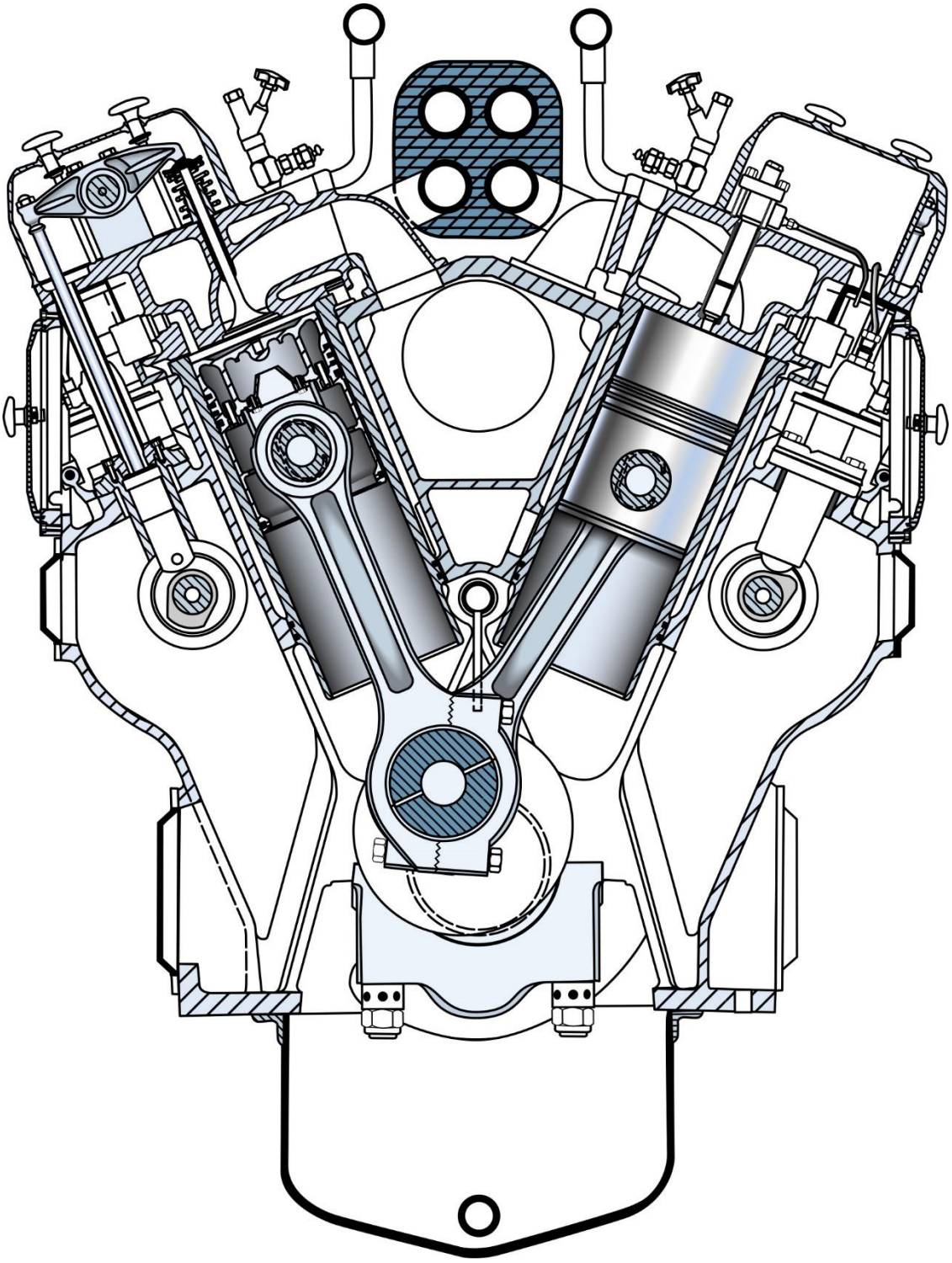
    Correct answer: D

50. While proceeding in open waters to a ship requiring docking assistance, one of the main engines on your ship-docking tug overheats. The high jacket water temperature alarm sounds, the freshwater thermometers indicate out of range (high), and the expansion tank level sight glass indicates out of range (high) with vapor bubbles forming and escaping through the vent. What is the appropriate initial response?

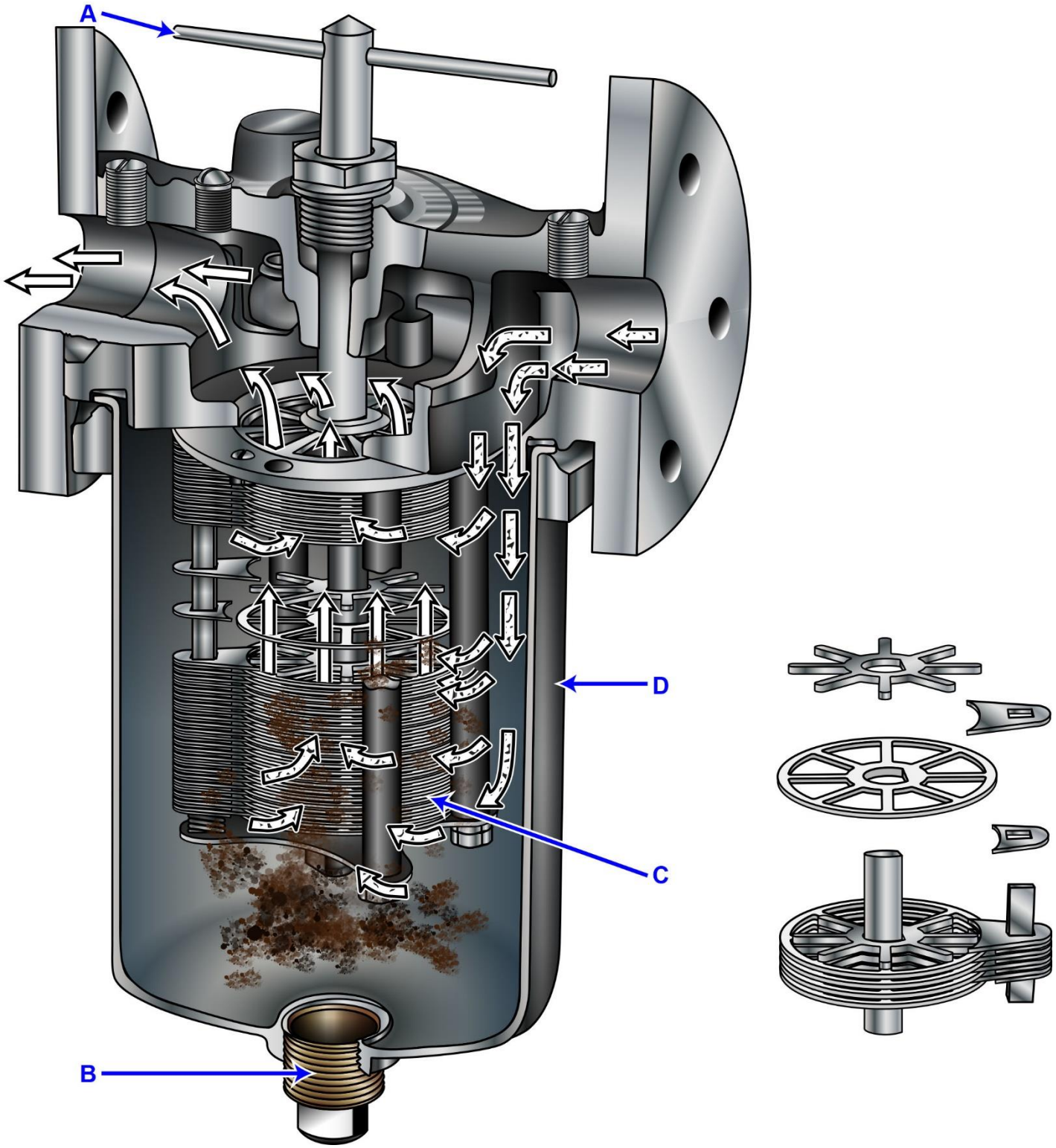
    A. Shut down the engine immediately.
    B. Add makeup water to the expansion tank.
    C. Reduce the load and speed on the engine.
    D. Drain water from the expansion tank.

    Correct answer: C

MO-0006



MO-0057



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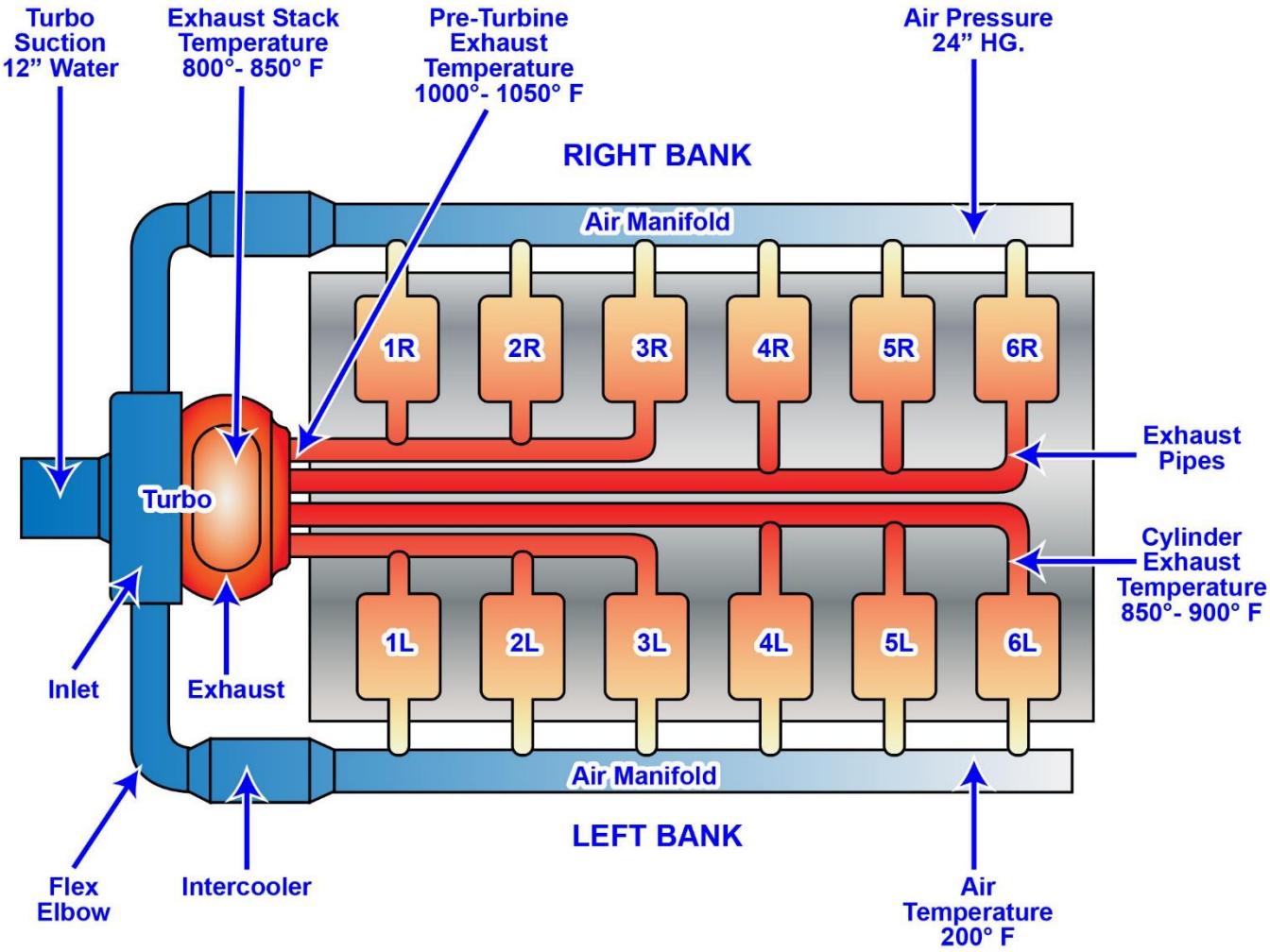
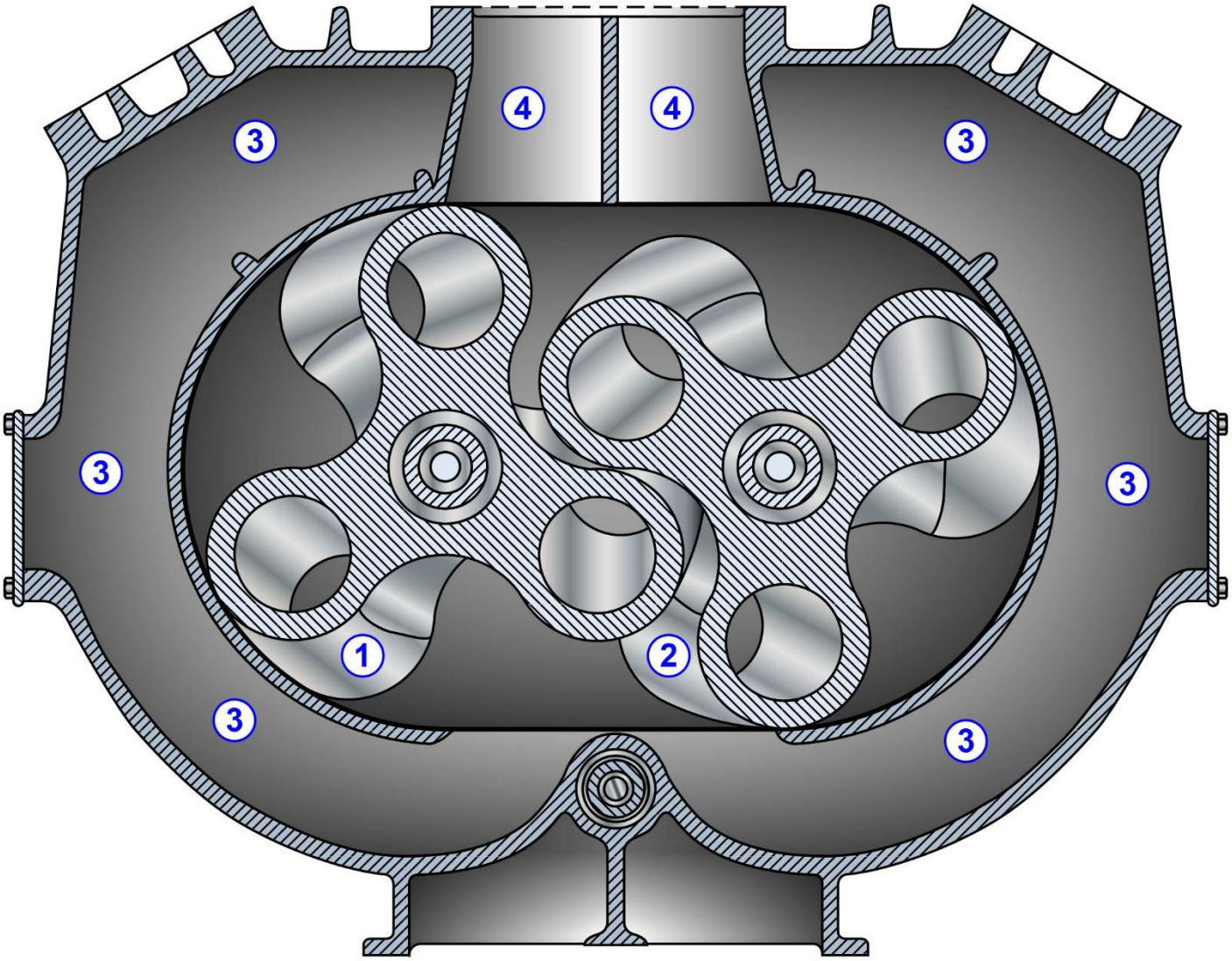
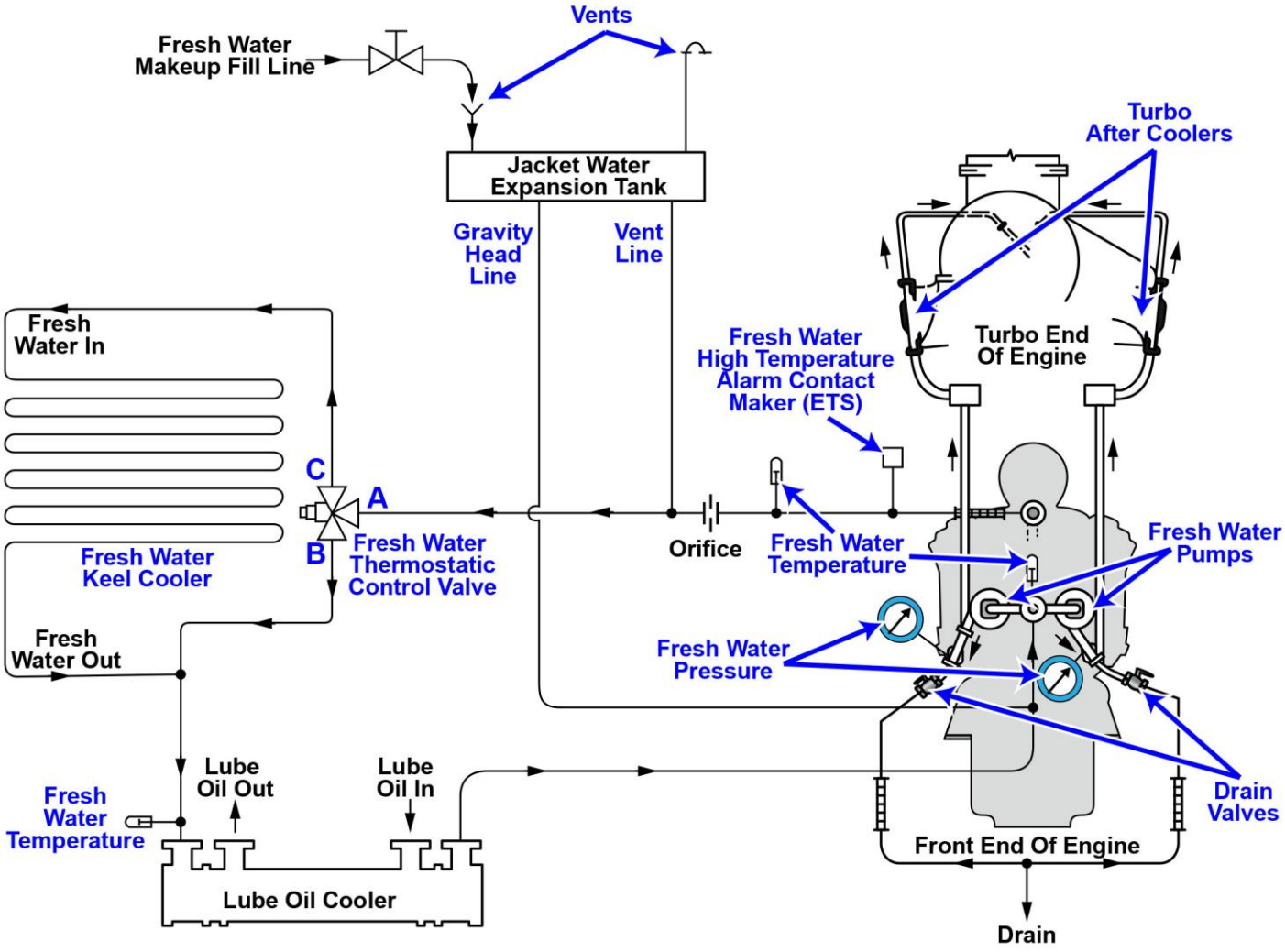


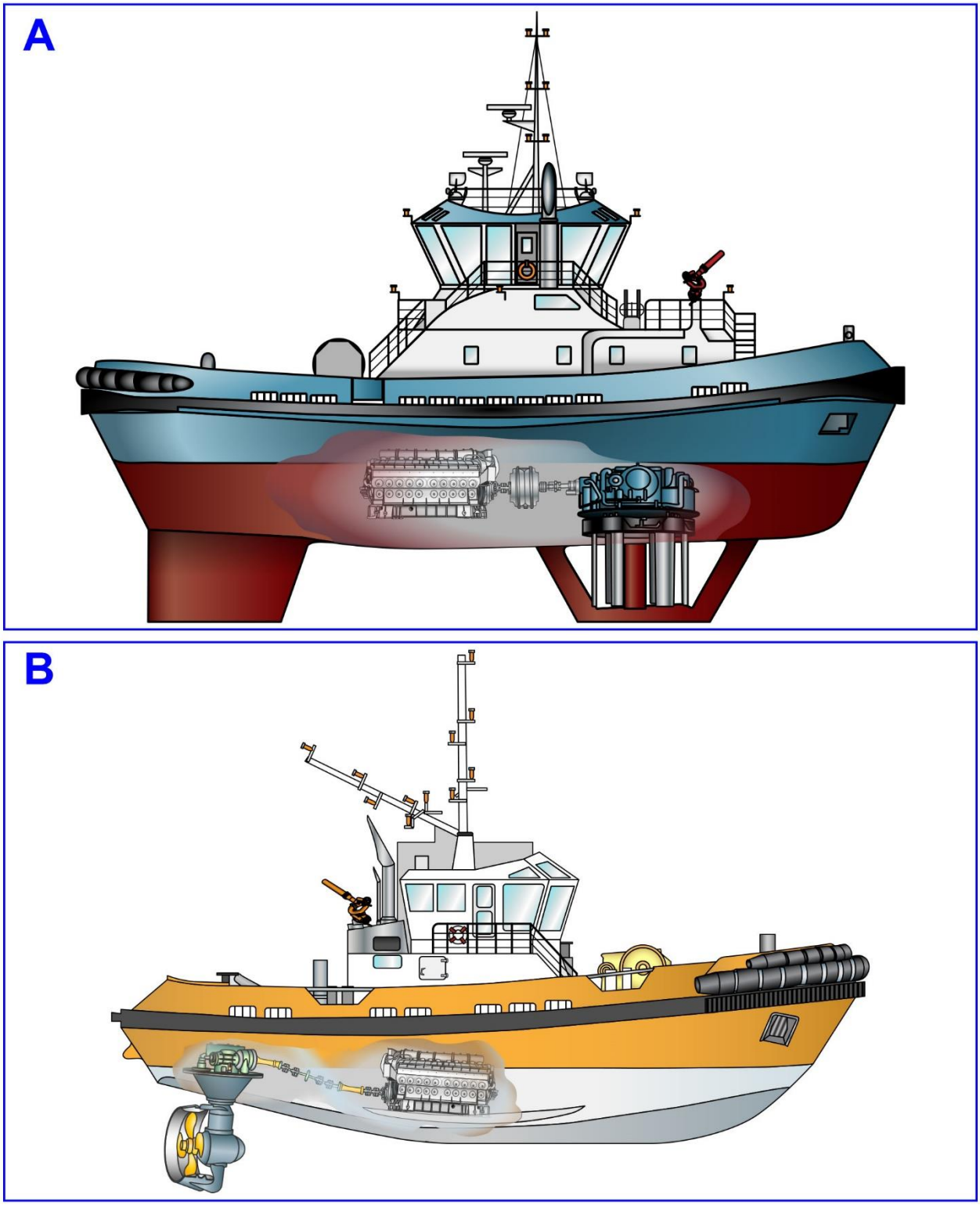
MO-0082



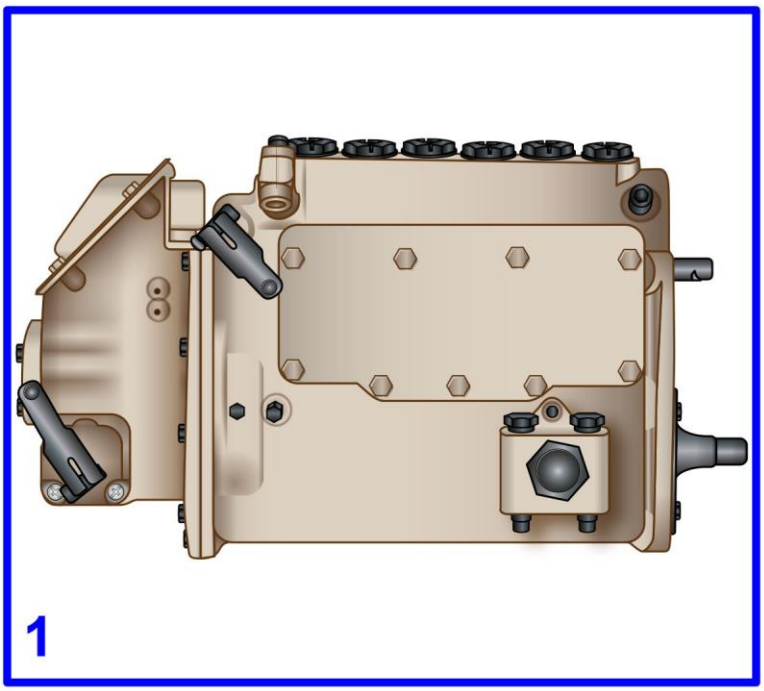
MO-0138
EMD Engine Fresh Water Cooling System with Keel Cooler

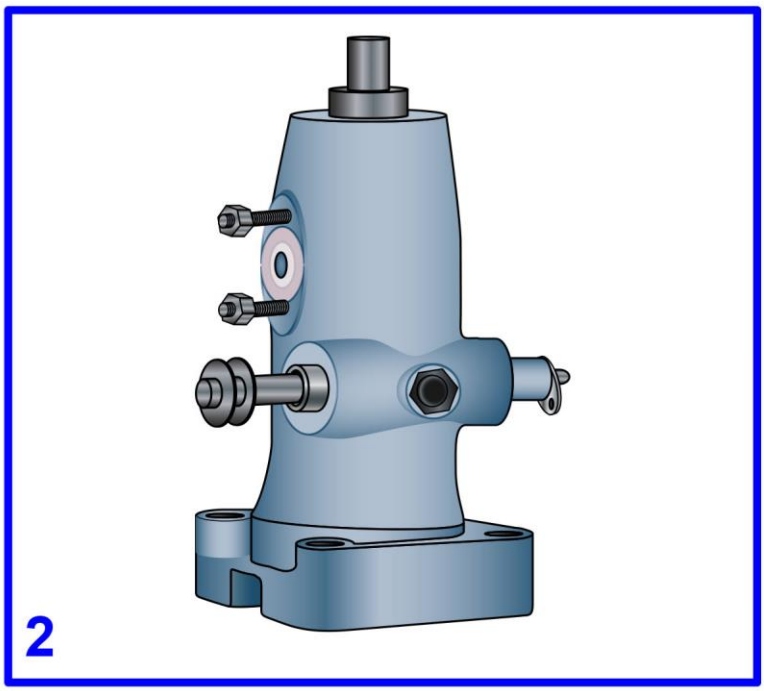


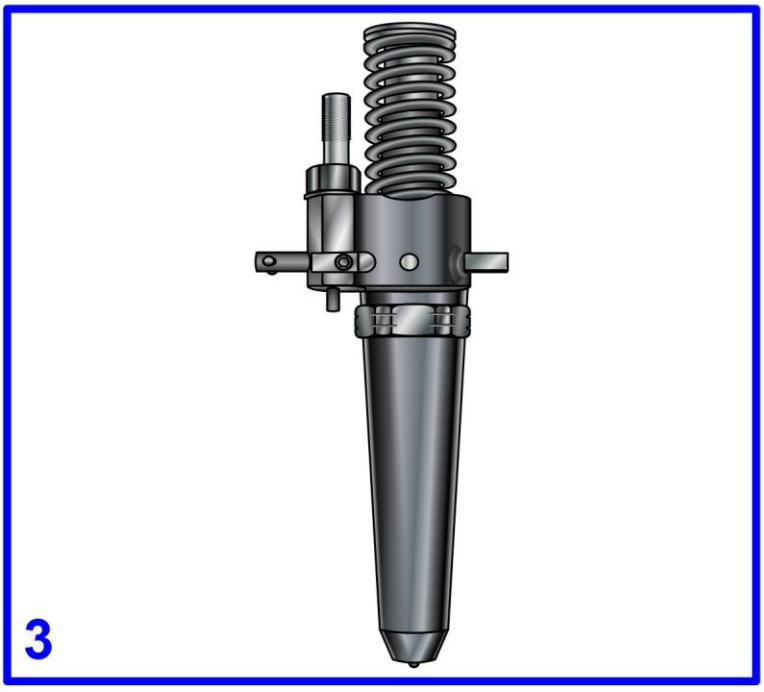
MO-0140

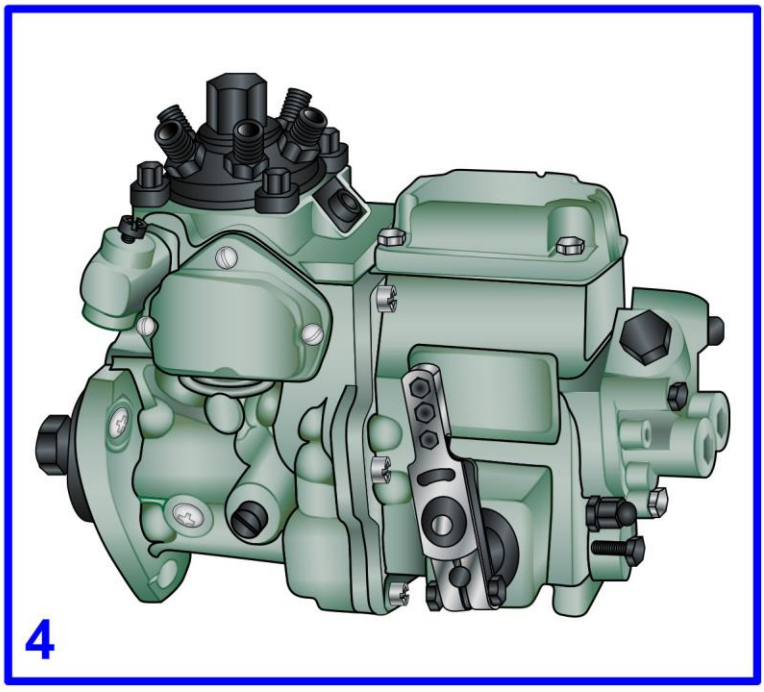


MO-0149









MO-0150

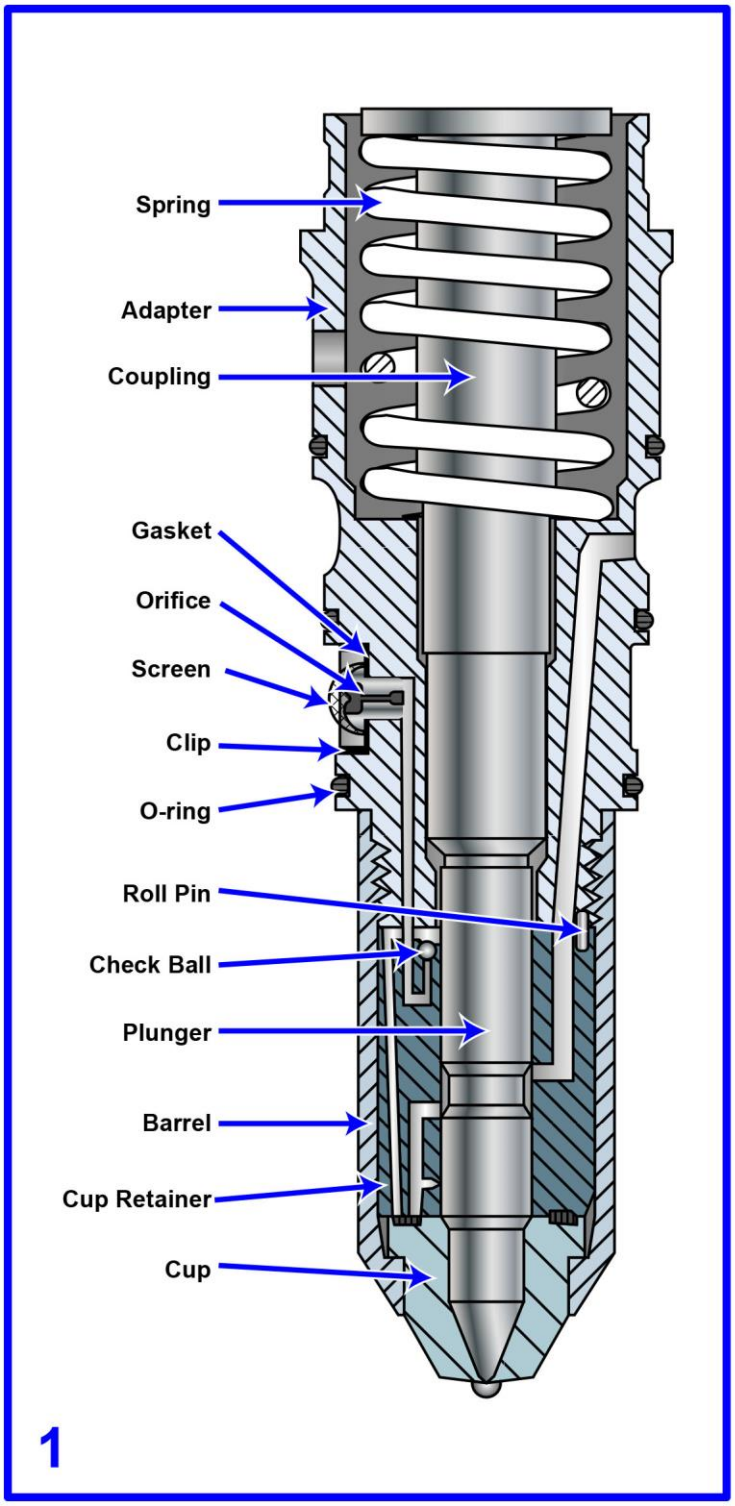


Figure 1: Adapted for testing purposes only from NORMAN, Diesel Technology: Fundamentals, Service, Repair

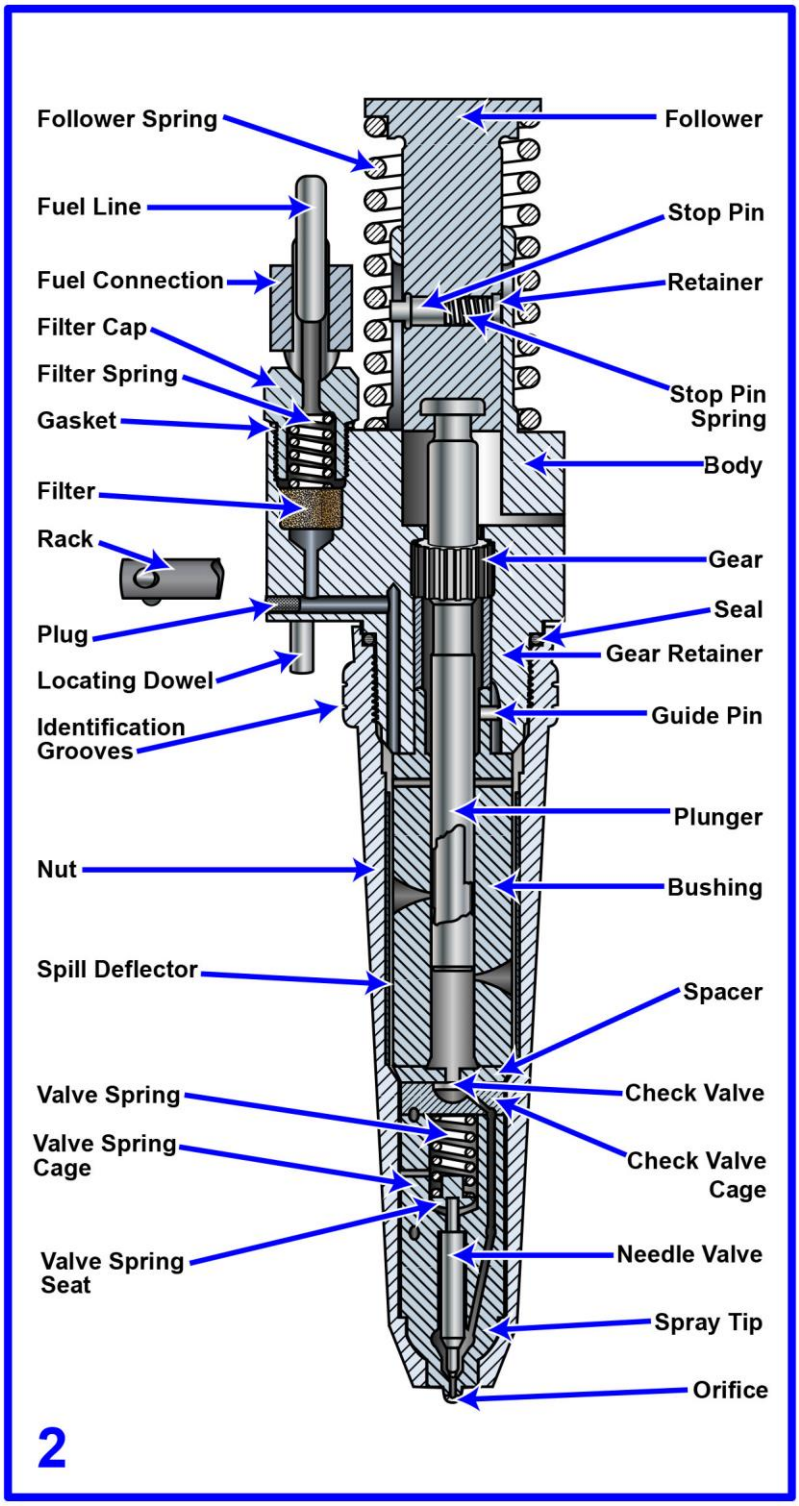
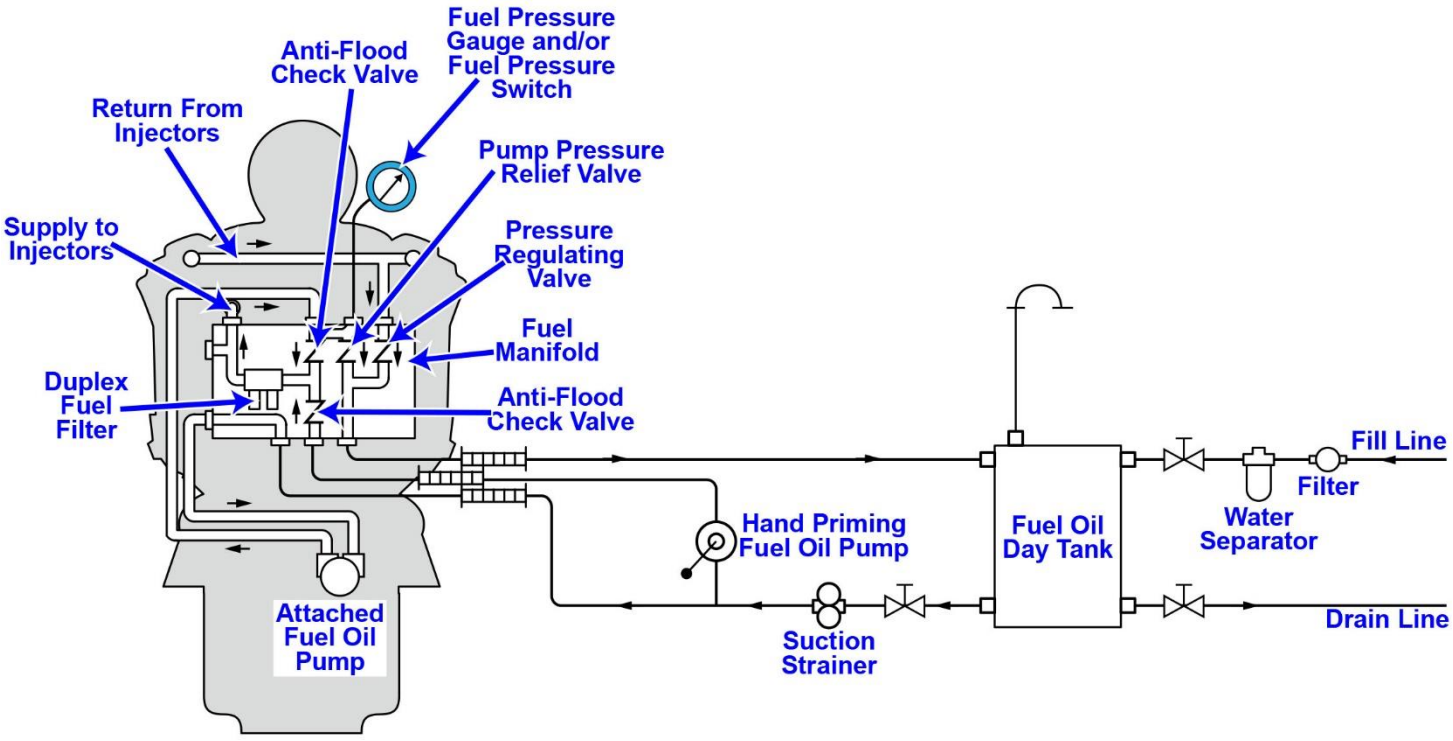
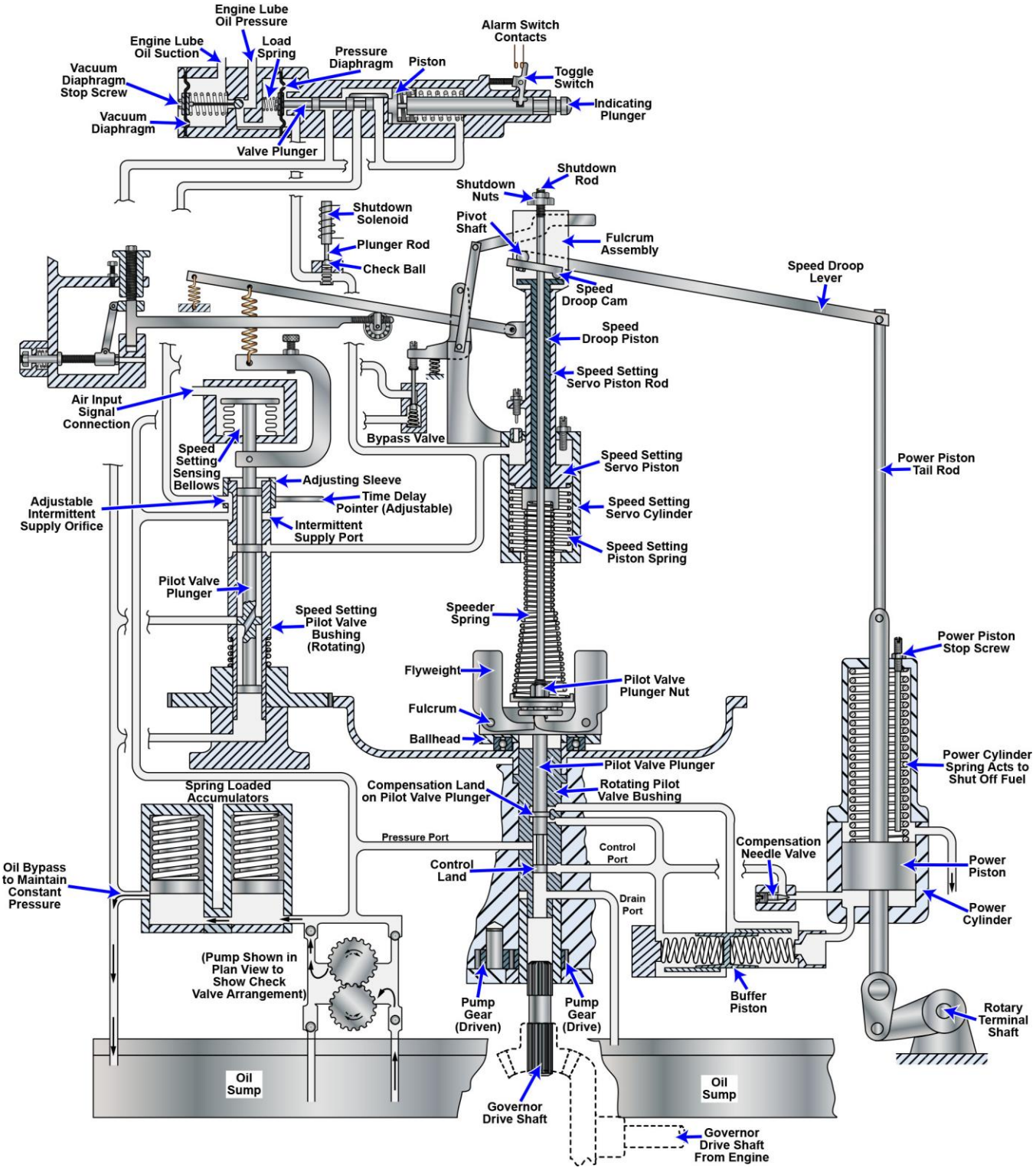


Figure 2: Adapted for testing purposes only from STINSON, Diesel Engineering Handbook, 12th Ed.

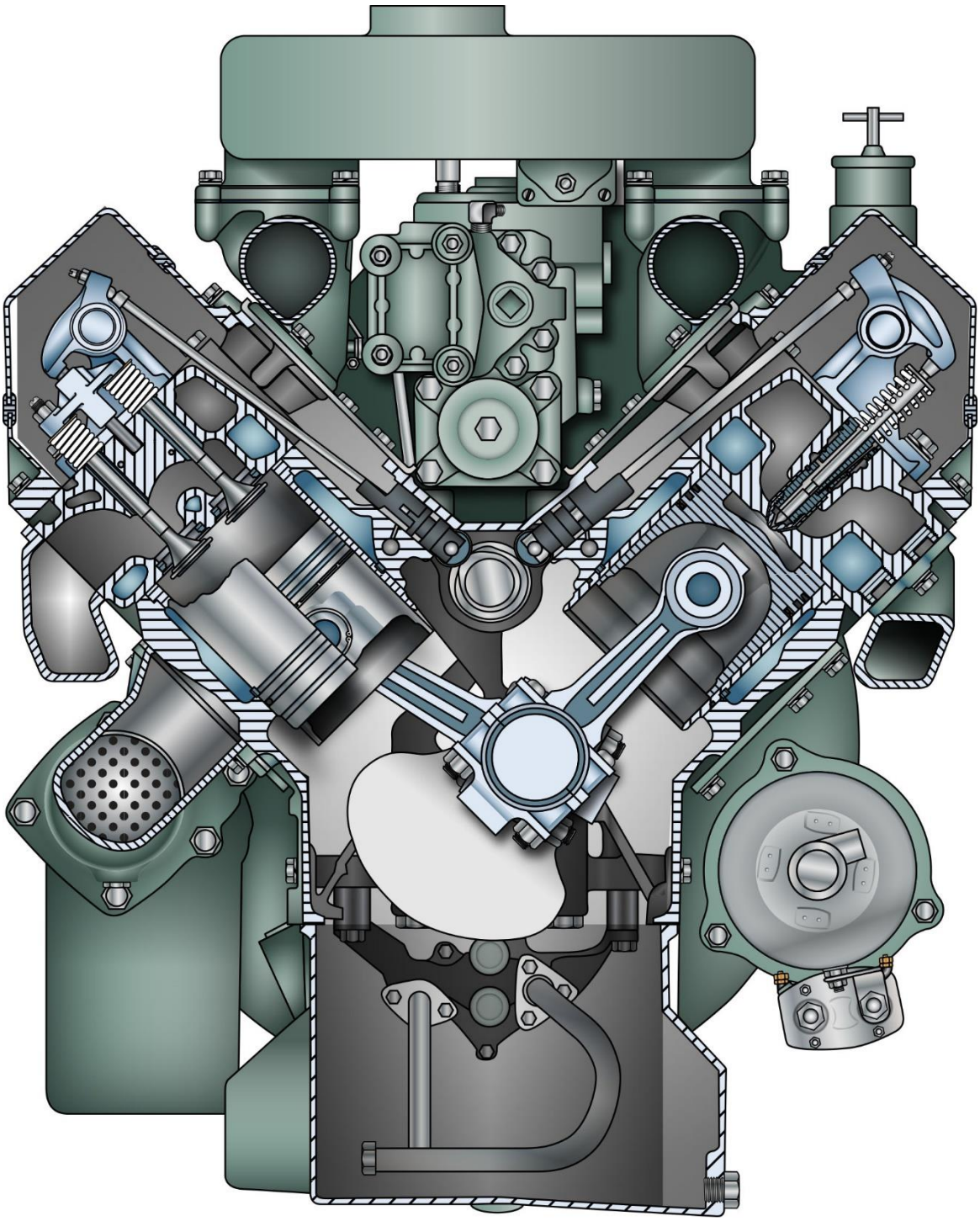
MO-0152



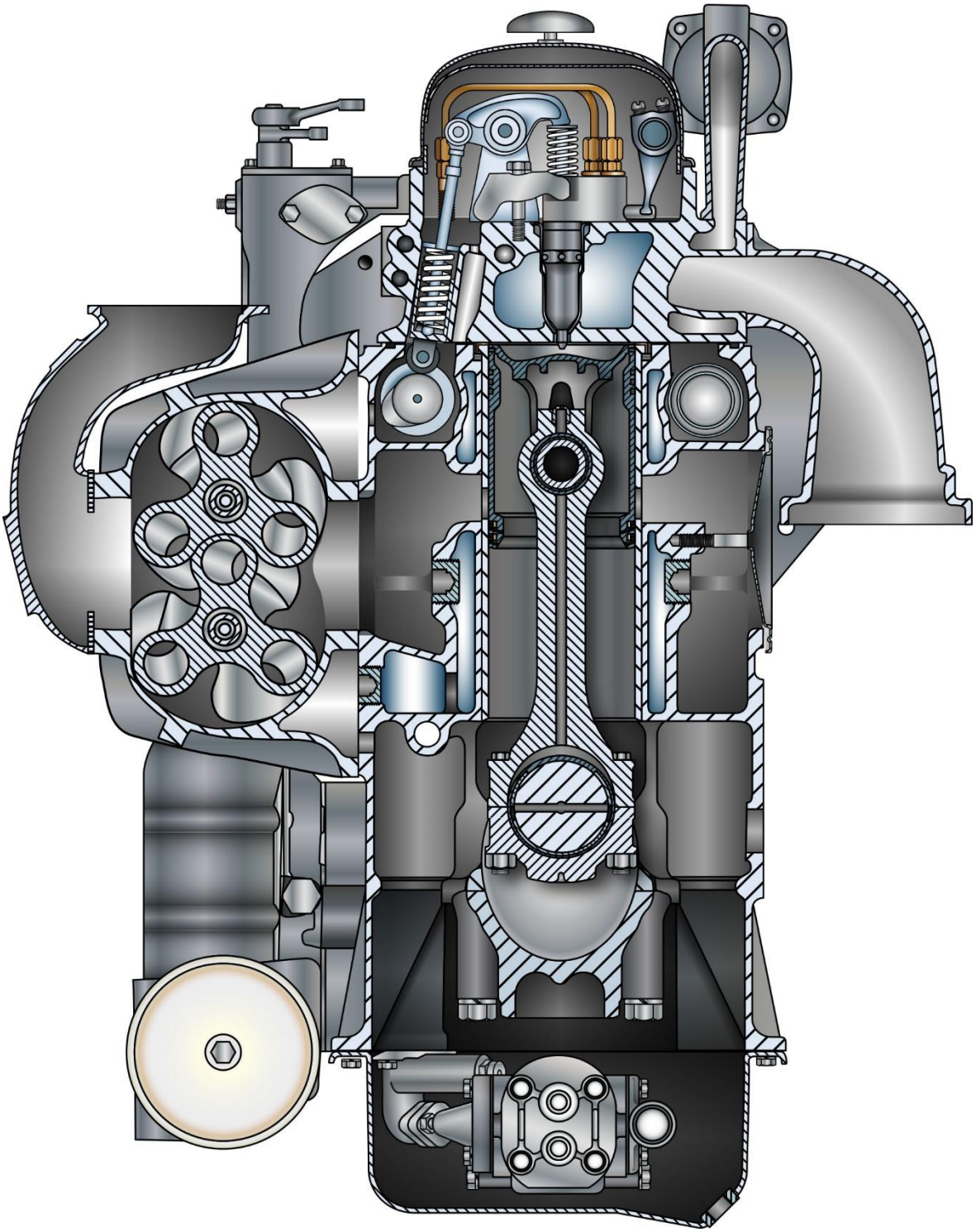
MO-0156
Woodward Type PGA Governor Schematic Diagram



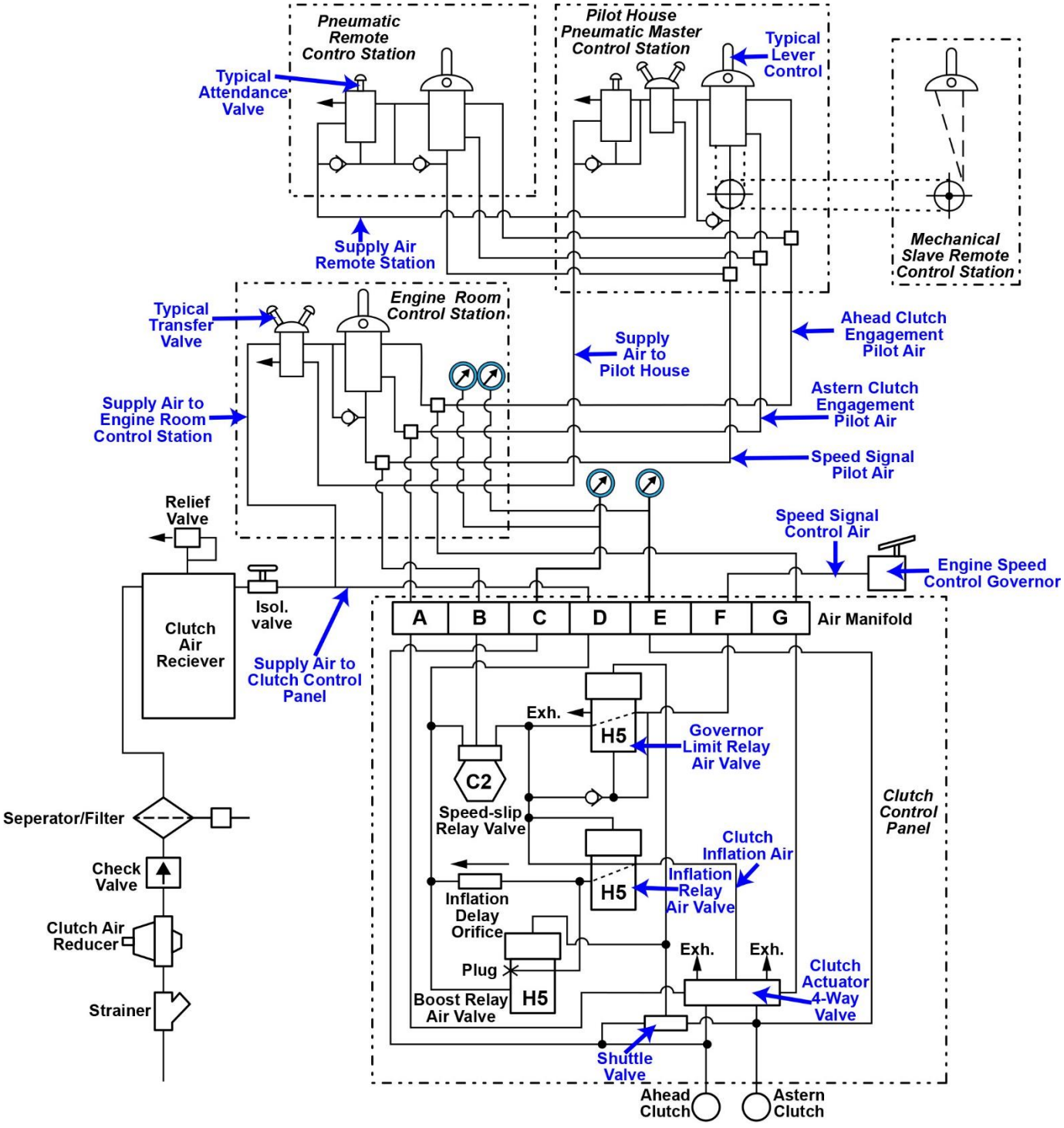
MO-0163



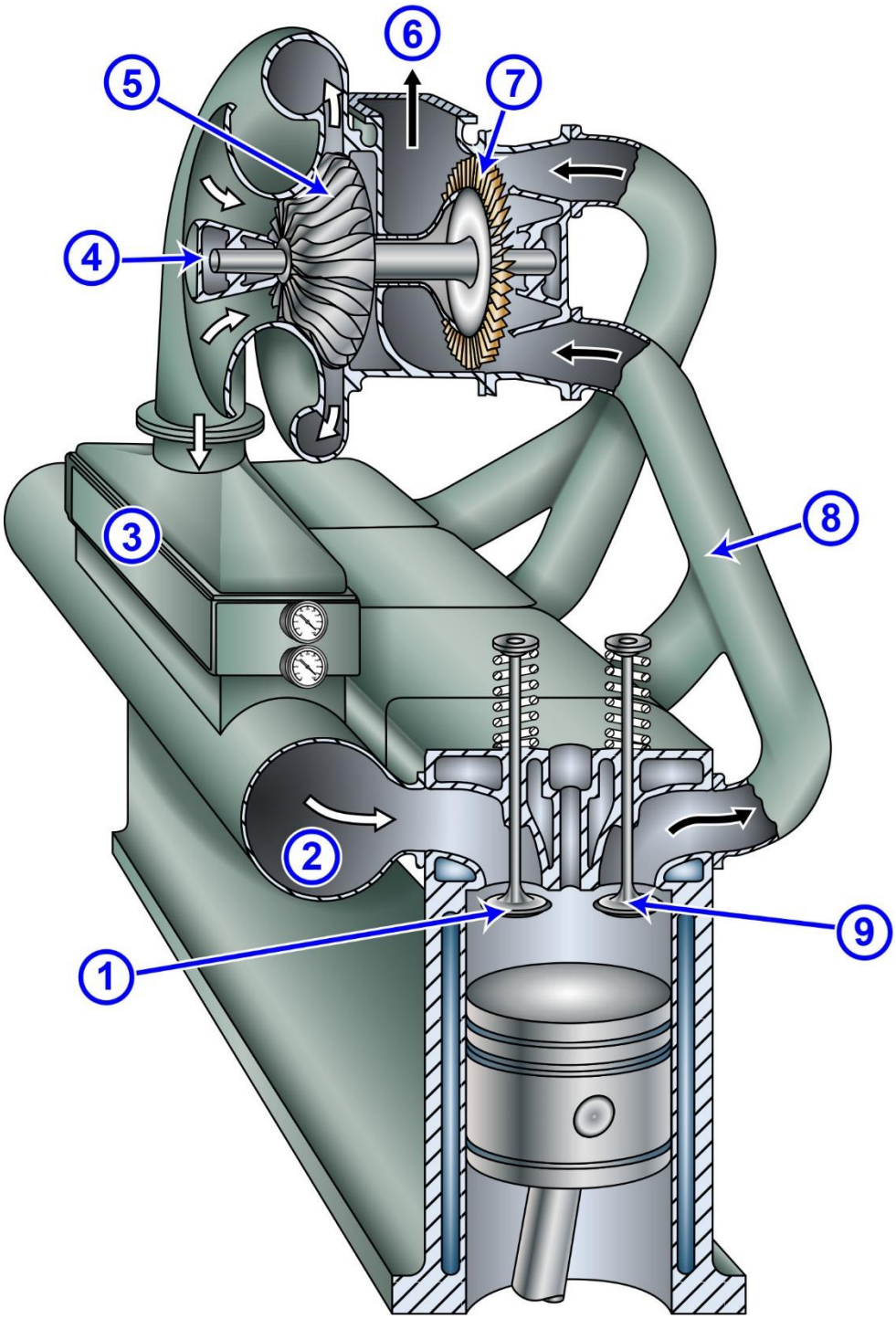
MO-0165



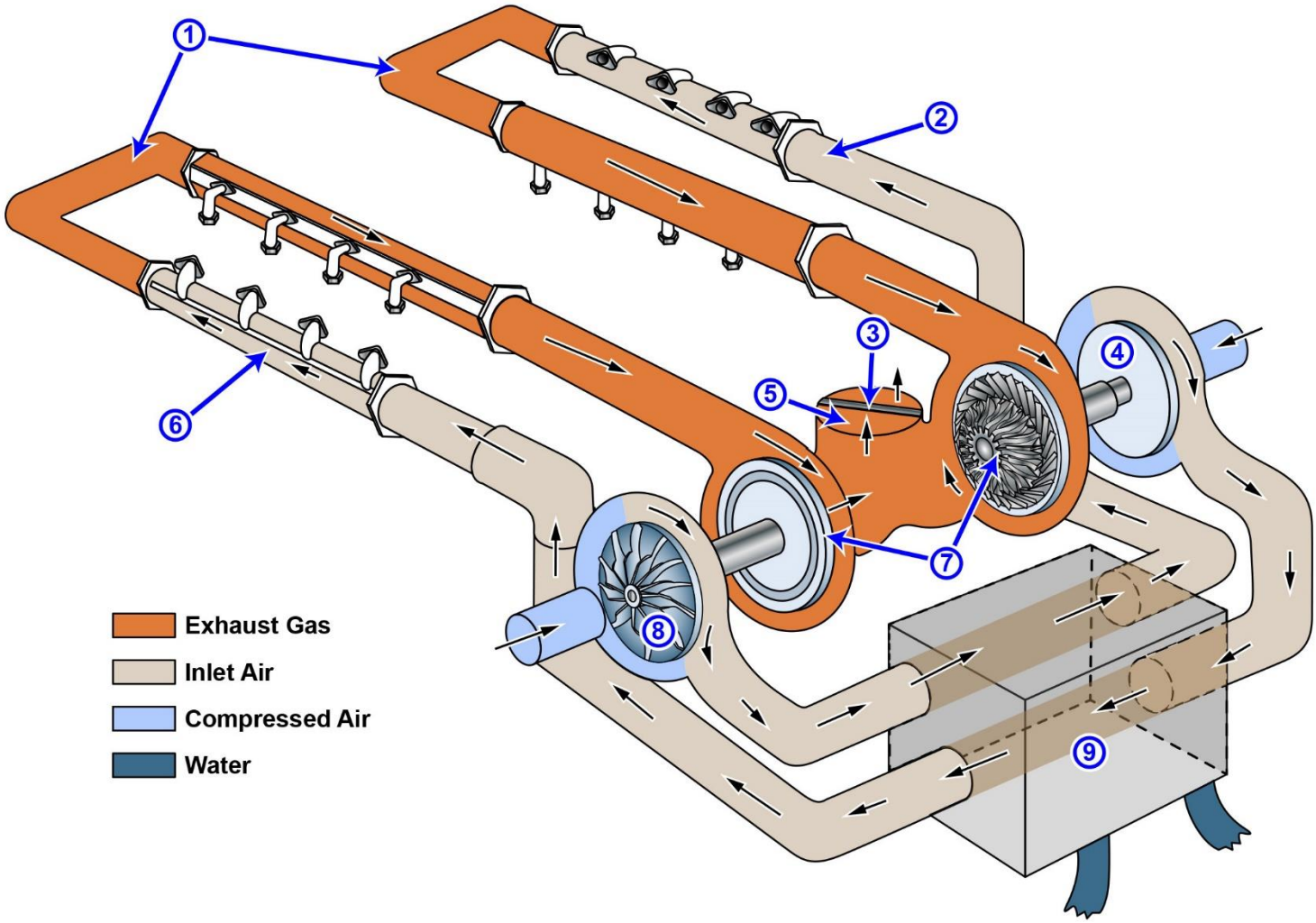
MO-0168
Pneumatic Propulsion Control System



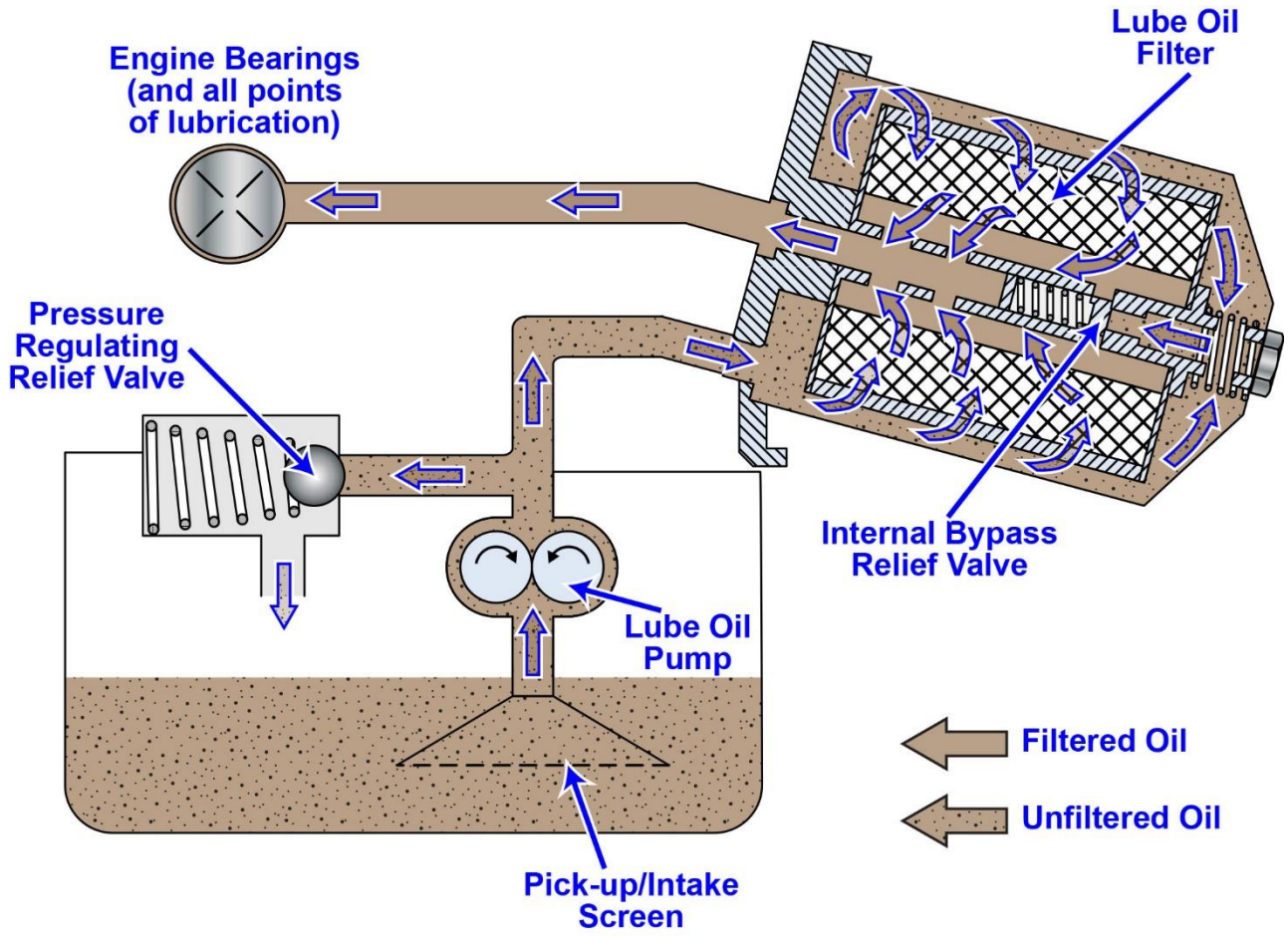
MO-0176



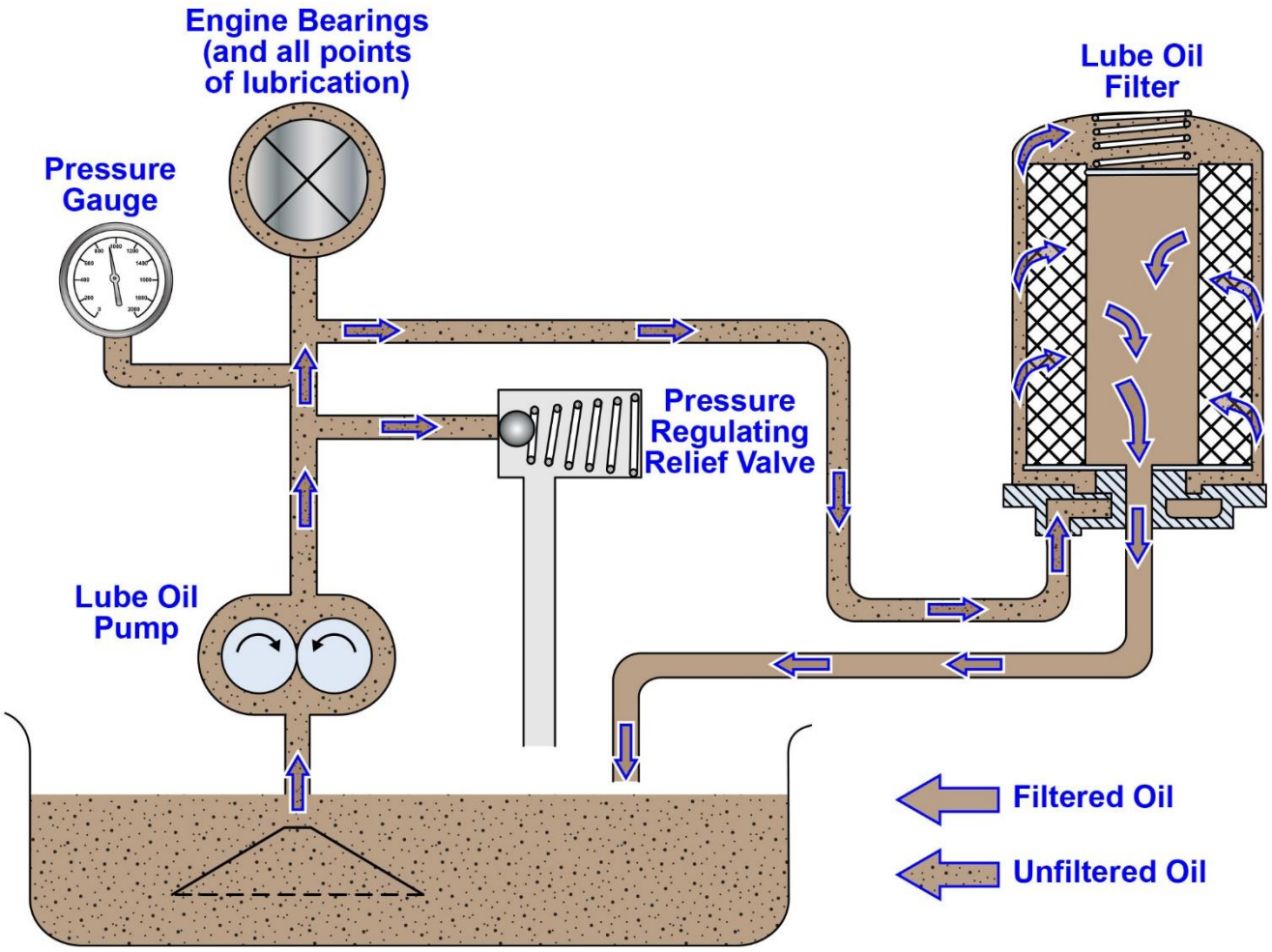
MO-0177



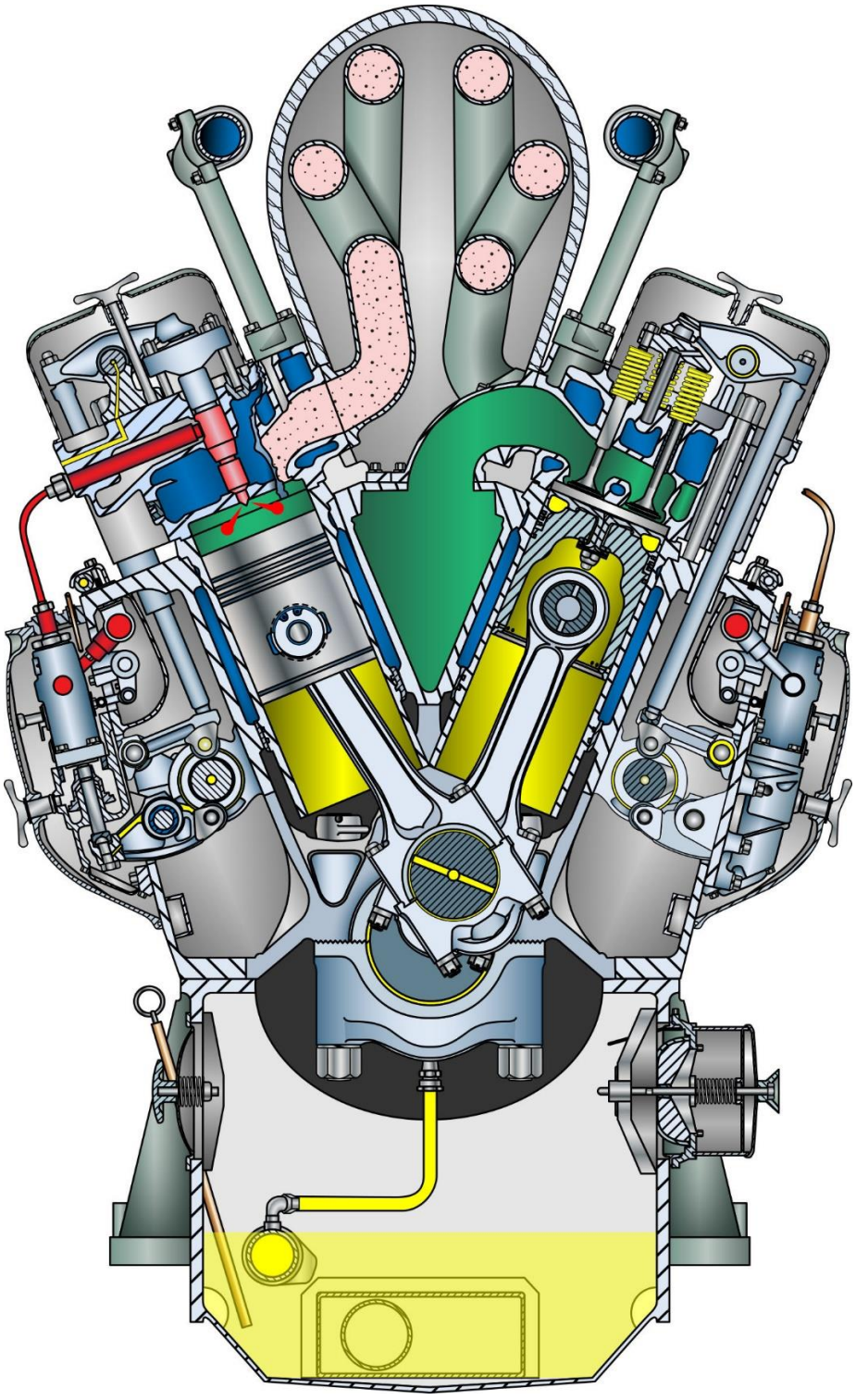
MO-0181
Simplified Lube Oil Filtration System



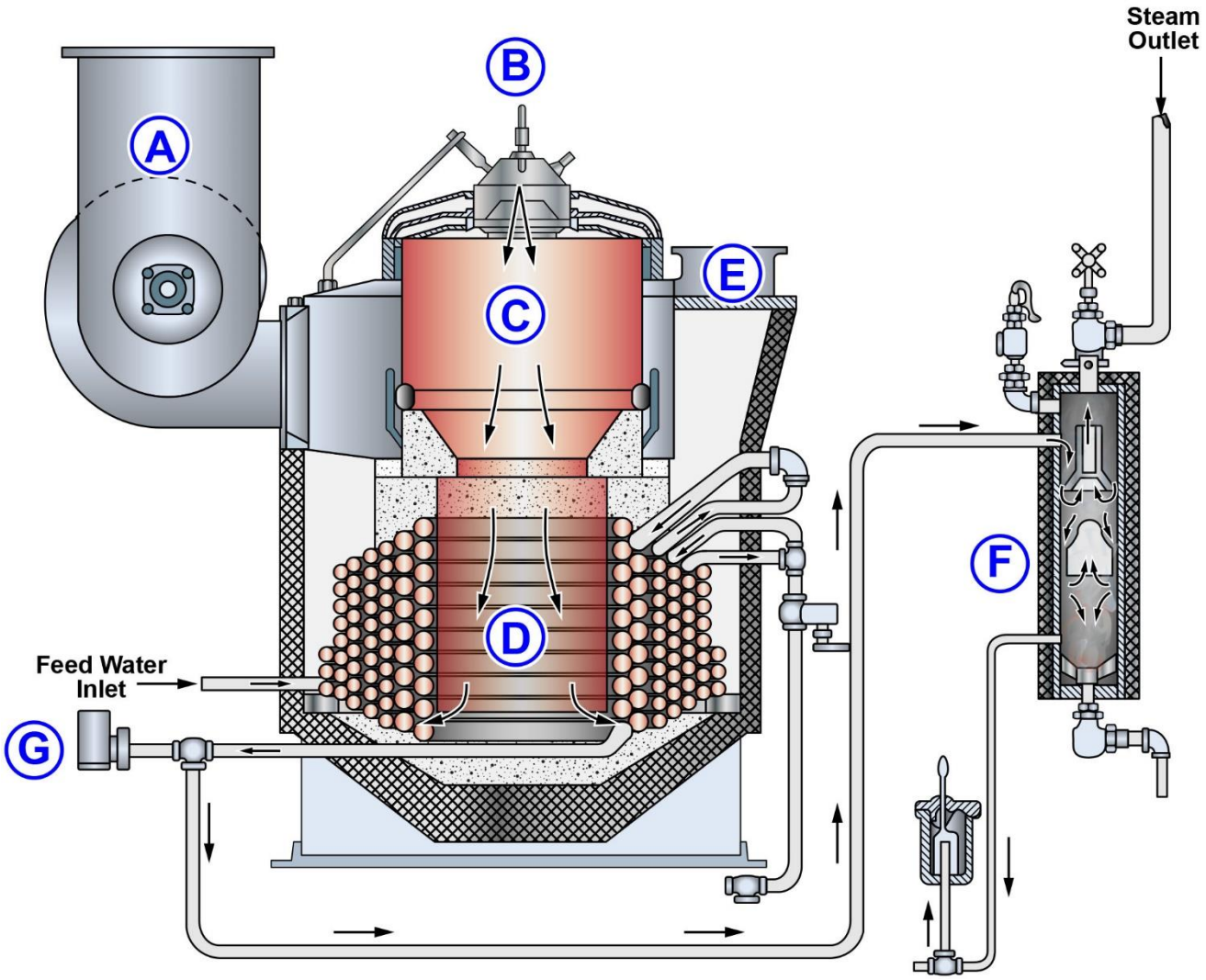
MO-0182
Simplified Lube Oil Filtration System



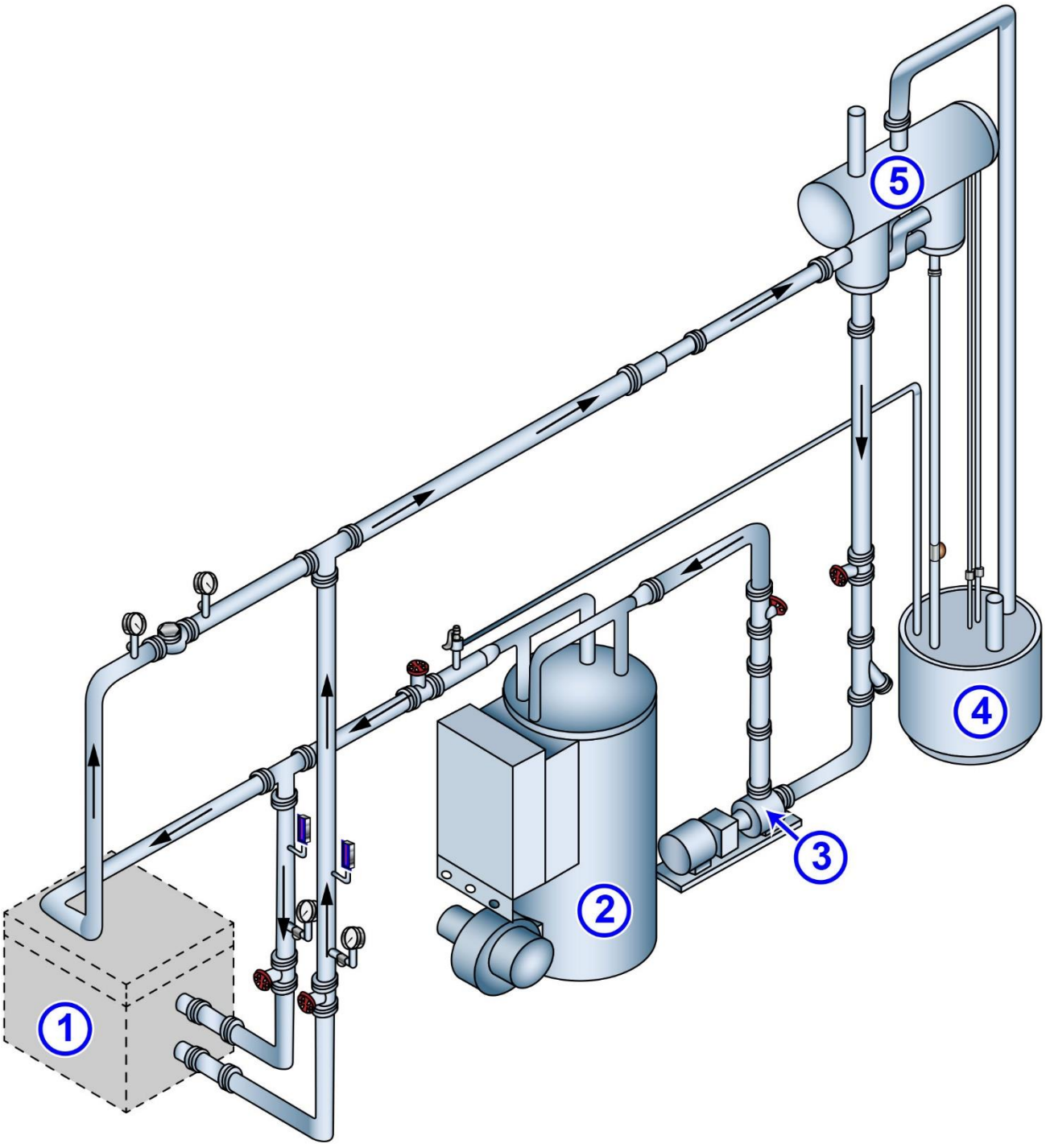
MO-0192
ALCO 251 Series Engine



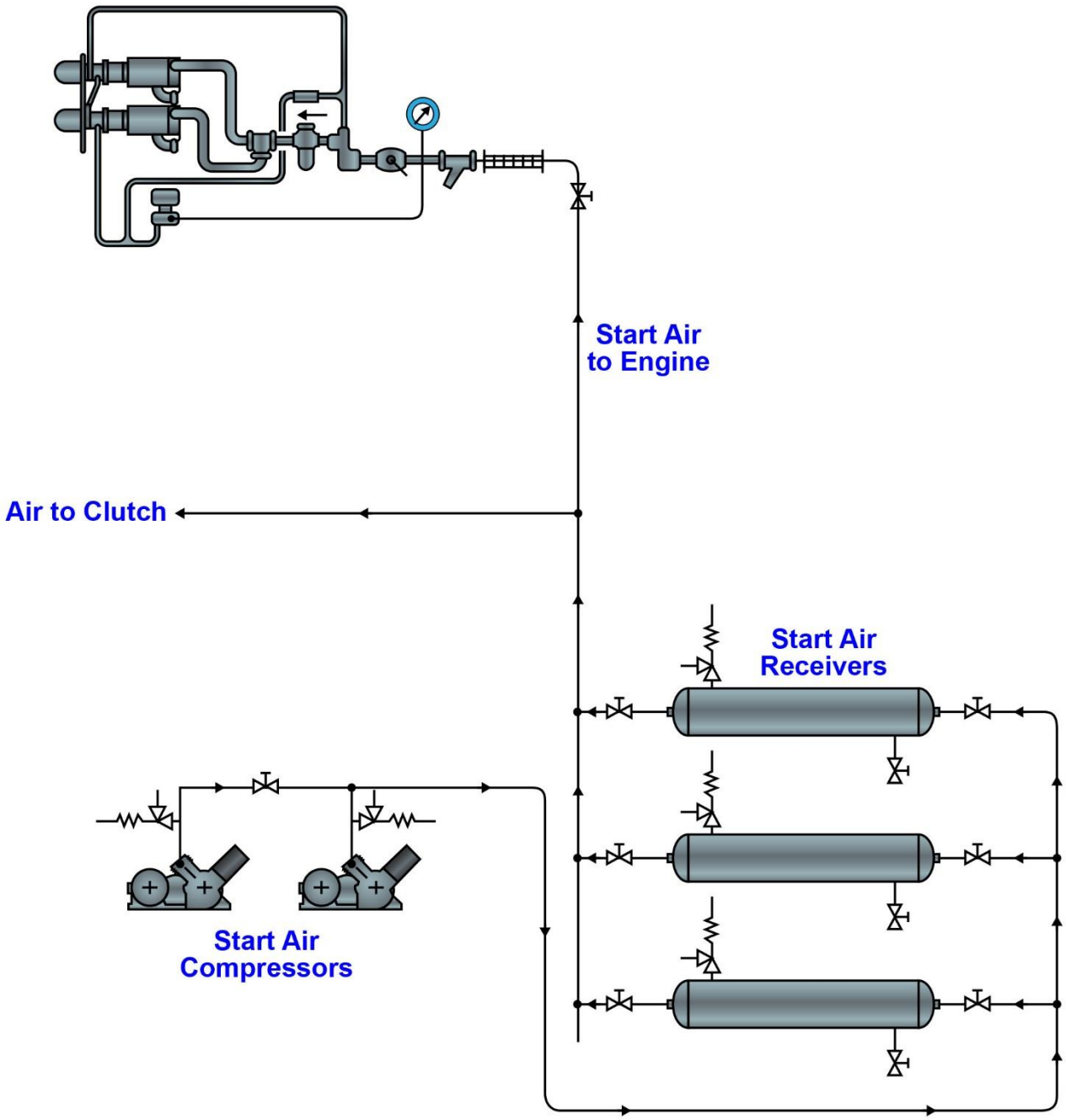
MO-0195
Once-through Boiler



MO-0198
Thermal Fluid Heating Oil System

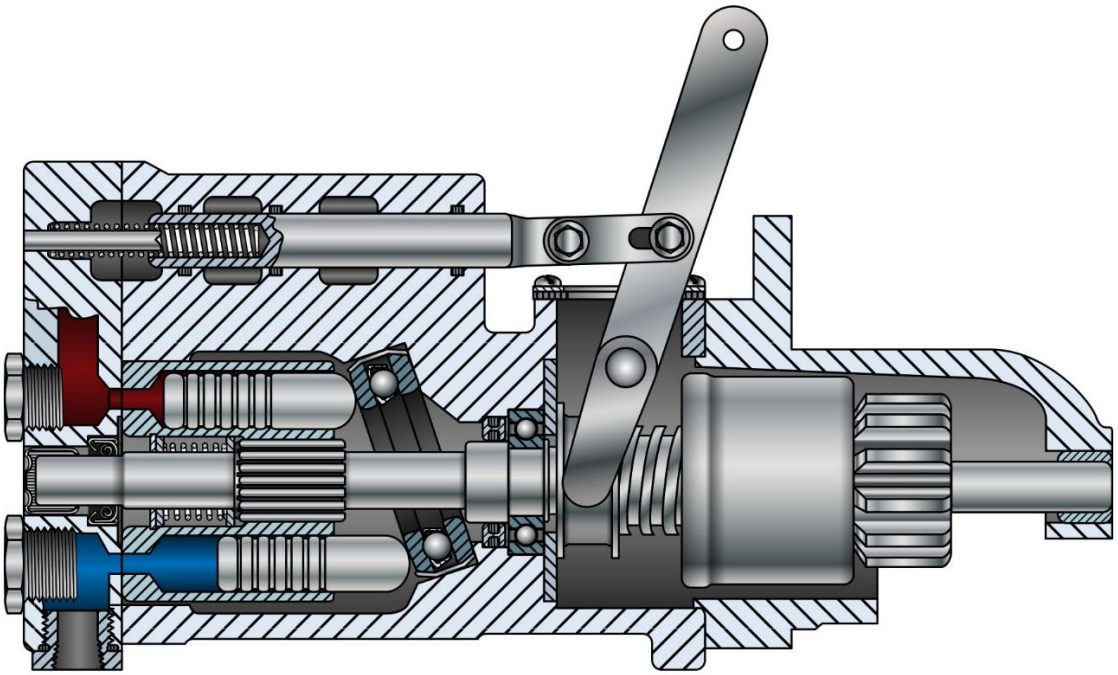


MO-0199
EMD Air Start System



MO-0201
Starting Motors

A



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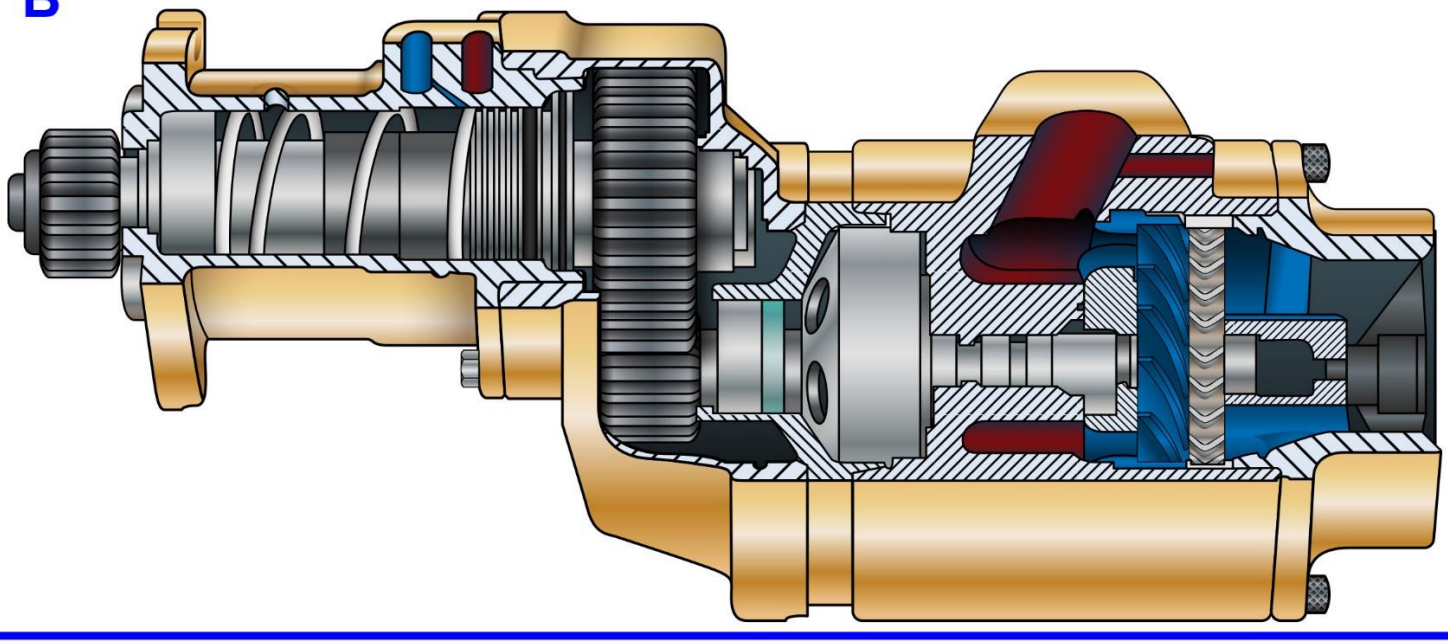
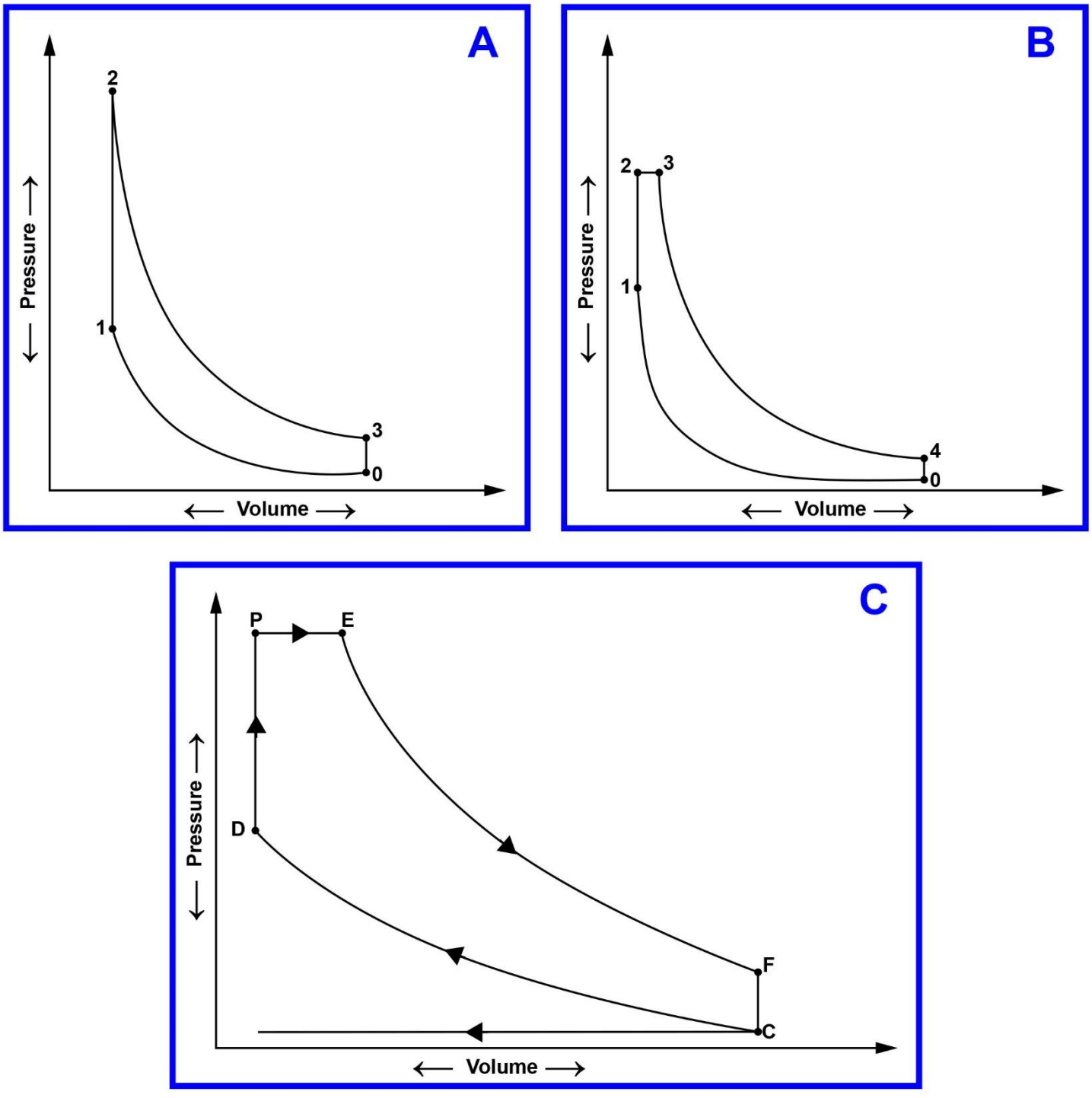


MO-0205

Theoretical Engine Pressure-Volume Diagrams



MO-0227