# U.S.C.G. Merchant Marine Exam

## First Assistant Engineer

## Q513 Steam Plants

## (Sample Examination)

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

1. According to the data given in illustration, which of the following would be the physical state of the fluid at a gauge vacuum of 28.09 inches Hg, and 117.99 degrees Fahrenheit? Illustration SG-0026

   A. Saturated liquid
   B. Mixture of saturated liquid and vapor
   C. Superheated vapor
   D. Subcooled liquid

   Correct answer: C

2. A high carbon monoxide content in the flue gases of a boiler indicates _____.

   A. too much excess air
   B. a high carbon content fuel
   C. incomplete combustion
   D. complete combustion

   Correct answer: C

3. Cratering and water tracking in boiler tubes is caused by _____.

   A. burning a fuel with a high vanadium content
   B. soot corrosion
   C. baked on slag deposits
   D. water trapped between tubes and refractory

   Correct answer: D

4. As Chief Engineer, while at sea, the engine room reports the superheater outlet temperature is erratic and fluctuating. Which of the following could be a possible cause?

   A. Boiler carryover
   B. Too much excess air
   C. Low boiler water level
   D. Low feed water temperature

   Correct answer: A

5. Under normal operating conditions, a drop in the steam temperature leaving an uncontrolled interdeck superheater could be caused by a _____.

   A. drop in the feedwater temperature
   B. decrease in combustion gas velocity through the superheater
   C. decrease in steam velocity through the superheater
   D. badly fouled economizer

   Correct answer: B

6. Excessive foaming in a steaming boiler can cause damage to the _____.

   A. economizer
   B. desuperheater
   C. superheater
   D. internal feed pipe

   Correct answer: C

7. Slag buildup on boiler furnace refractory is undesirable because it causes _____.

   A. shrinking of the brickwork
   B. fracturing of the anchor bolts
   C. excessive cooling of the brickwork
   D. peeling or spalling of the brickwork

   Correct answer: D

8. Which of the listed mediums should be used when water washing a boiler?

   A. Cold salt water
   B. Cold fresh water
   C. Heated salt water
   D. Heated fresh water

   Correct answer: D

9. Which of the listed refractory materials should be used for patching a burner front formed of plastic, castable, or tile?

   A. Air-setting mortar
   B. Plastic chrome insulation
   C. Chrome castable insulation
   D. Plastic fireclay

   Correct answer: D

10. Which of the conditions listed may be indicated by the lifting of the DC heater relief valve?

    A. Excessive deaeration of the feedwater
    B. Low water level continually maintained in the DC heater
    C. Low back pressure in the auxiliary exhaust line
    D. A malfunctioning auxiliary exhaust make-up steam regulating valve

    Correct answer: D

11. The water level in a steaming boiler has risen to within 2 inches from the top of the gauge glass. Your immediate action should be to _____.

    A. secure the fires and open the bottom blow valve
    B. open the surface blow line
    C. secure the feedwater flow to the boiler
    D. reduce the feedwater flow to the boiler

    Correct answer: D

12. Compared to the return flow oil burner system, an internally mixed steam atomizer requires _____.

    A. less excess air
    B. greater turbulence in the air/oil stream
    C. higher air velocity
    D. higher fuel oil viscosity

    Correct answer: A

13. According to the illustration, what part number identifies the "air door handle"? Illustration SG-0016

    A. 4
    B. 6
    C. 7
    D. 12

    Correct answer: D

14. Testing boiler water for chloride content will indicate the amount of _____.

    A. phosphates present in the water
    B. dissolved salts from sea contamination
    C. total alkalinity in the water
    D. methyl orange that should be added

    Correct answer: B

15. Fluctuations in the atomizing steam pressure at the burners could be caused by a/an _____.

    A. malfunctioning steam trap in the atomizing steam system
    B. incorrectly assembled air register
    C. partially closed atomizing fuel valve
    D. partially opened recirculating valve

    Correct answer: A

16. If the temperature of the fuel oil entering an atomizer is too low, the burner will _____.

    A. require more excess air for combustion
    B. produce heavy black smoke at any load condition
    C. require more fuel for atomization
    D. produce smoke white

    Correct answer: B

17. Condensate accumulation in the steam side of a fuel oil heater could result in _____.

    A. water contamination of the fuel oil
    B. scale accumulation in an operating heater
    C. reduced heating capacity in an operating heater
    D. annealing of the heater tube bundles

    Correct answer: C

18. Calcium minerals in boiler water are precipitated out of solution by the use of which of the listed chemicals?

    A. Sodium hydroxide
    B. Phenolphthalein
    C. Sodium phosphate
    D. Caustic soda

    Correct answer: C

19. Excessive alkalinity of boiler water will cause _____.

    A. caustic embrittlement
    B. calcium carbonate precipitation
    C. sodium sulfite reacting with dissolved oxygen
    D. scale formation

    Correct answer: A

20. A malfunction in the DC heater is indicated by _____.

    A. the boiler requiring excessive amounts of oxygen scavenging chemicals
    B. condensate coming in contact with steam inside the heater
    C. air flowing from vent condenser vent
    D. water and steam entering the DC heater at different temperatures

    Correct answer: A

21. If an automatically fired burner ignites, but repeatedly goes out within two seconds, the cause could be a/an _____.

    A. burned out solenoid coil in the low fire oil valve
    B. dirty flame scanner window
    C. faulty pressure signal to the time delay relay circuit
    D. excessively high fuel oil temperature

    Correct answer: B

22. In a boiler automation system, if a burner fuel oil solenoid valve continually trips closed under normal steaming conditions, you should _____.

    A. wedge the valve in the open position and report it to the chief engineer
    B. secure the burner and determine the cause of the valve failure
    C. bypass the solenoid valve and enter the fact in the logbook
    D. wedge the valve in the open position and reduce the fuel oil pressure at that burner

    Correct answer: B

23. Your vessel is steaming full ahead and operating on both boilers. If the boiler water level of one boiler drops out of sight low in the sight glass and the burners have been secured, besides slowing down the main engine, what further action should be taken?

    A. start the standby feed pump
    B. manually feed the boiler to bring up the level
    C. blowdown the gage glass
    D. close the main steam stop

    Correct answer: D

24. If the water level in one boiler of a two-boiler plant rapidly falls out of sight, which of the following actions should be carried out FIRST?

    A. Raise the feed pump pressure.
    B. Secure the fuel oil to that boiler.
    C. Secure the steam stop to that boiler.
    D. Blowdown the gage glass.

    Correct answer: B

25. In the event of a failure of the pneumatic control system, a multi-element feedwater regulator is designed to operate as a _____.

    A. thermo-hydraulic feedwater regulator
    B. constant-volume feedwater regulator
    C. constant-pressure regulator
    D. manually controlled feedwater regulator

    Correct answer: D

26. Which of the following statements is true concerning boiler inspections?

    A. At the first inspection for certification after a water-tube boiler has been installed for ten years, it shall be gauged by drilling to determine the actual extent of deterioration.
    B. Any user of a non-destructive testing device must demonstrate that results with an accuracy of plus or minus one percent are consistently obtainable.
    C. The marine inspector may require any boiler to be drilled to determine its actual thickness any time its safety is in doubt.
    D. If the thickness found as a result of gauging is less than original thickness, the boiler must be condemned.

    Correct answer: C

27. In accordance with 46 CFR Subchapter F (Marine Engineering), which of the following statements is true concerning the inspection of water-tube boilers?

    A. All boiler mounting studs or bolts shall be removed for examination by a Coast Guard inspector every 4 years after initial inspection.
    B. All mountings shall be opened up and examined by a Coast Guard inspector at eight-year intervals after the initial inspection.
    C. Boiler mountings attached directly to the boiler plating by screwed studs and nuts shall be removed and examined every 10 years.
    D. Boiler mountings attached to boiler nozzles must be opened and removed for examination every 8 years.

    Correct answer: C

28. The safety valve nominal size for propulsion boilers and superheaters must be not less than 1 1/2 inches and not more than 4 inches. The term 'nominal size' refers to the _____.

    A. free spring length
    B. diameter of the huddling chamber
    C. diameter of the inlet opening
    D. diameter of the feather

    Correct answer: C

29. To prevent damage to the turning gear mechanism, which of the following procedures must be carried out before the turning gear is engaged?

    A. The brake on the first reduction worm shaft must be set.
    B. The speed of the astern turbine must be reduced.
    C. The propeller shaft must be stopped and held stationary until the clutch is engaged.
    D. The engine order telegraph must be on 'stop'.

    Correct answer: C

30. After properly lining up the main propulsion turbine for warm up, steam should first be admitted to the rotor through the _____.

    A. astern throttle valve
    B. ahead throttle valve
    C. HP turbine bleed valve
    D. LP turbine bleed valve

    Correct answer: A

31. From which of the areas listed are condensate drains normally collected and returned to the low-pressure drain system?

    A. Steam systems operating in excess of 150 psi
    B. Main and auxiliary air ejector aftercondensers
    C. Steam whistle separator/trap
    D. Each main feed pump steam supply line

    Correct answer: B

32. A basic comparison can be made between a low-pressure evaporator operation and a main condenser with regards to the removal of non-condensable gases. The vacuum drag line for the main condenser is specifically connected in which area?

    A. steam lane
    B. main tube bank
    C. hotwell
    D. air cooler section

    Correct answer: D

33. Which of the listed systems would be a potential source for the high-pressure drain system?

    A. Fuel oil tank heating coils
    B. Steam systems operating in excess of 150 psi
    C. Laundry steam pressing machines
    D. Galley steam tables

    Correct answer: B

34. The flash point of a residual fuel oil should be used to determine the highest temperature to which the oil may be heated _____.

    A. in the recirculating line
    B. for atomizing
    C. in a storage tank
    D. for centrifuging

    Correct answer: C

35. The property of a fuel oil, which is a measurement of its available energy, is known as its _____.

    A. cetane number
    B. viscosity index
    C. heating value
    D. cetane index

    Correct answer: C

36. A common cause of the Babbitt linings cracking in a turbine journal bearing is from _____.

    A. prolonged operation at full-speed
    B. prolonged operation at low-speed
    C. excessive thrust bearing wear
    D. vibration generated by the rotor

    Correct answer: D

37. If the main propulsion turbine begins to vibrate severely while you are increasing speed, you should _____.

    A. immediately slow the turbine to see if the vibration will stop
    B. hold the turbine at that speed until vibration stops
    C. open the throttle wider to pass through the critical speed
    D. stop the turbine and not answer any more bells

    Correct answer: A

38. An overheated bearing in the main propulsion unit is indicated by _____.

    A. bubbles in the sight flow glasses
    B. high level in the lube oil sump
    C. sludge in the lube oil strainers
    D. high temperature of the lube oil leaving the bearing

    Correct answer: D

39. The turbine of a turbo-electric drive should be secured by _____.

    A. closing the main steam stops
    B. tripping the throttle trip by hand
    C. dynamic braking of the generator
    D. closing the throttle by hand

    Correct answer: B

40. After starting the main lube oil pump in a gravity-type lube oil system, you should verify that the gravity tanks are full by _____.

    A. observing the overflow sight glass
    B. sounding the gravity tanks
    C. observing the flow from the bearings
    D. sounding the lube oil sump

    Correct answer: A

41. Which of the following operational practices is helpful in avoiding the accumulation of condensate in the main reduction gear casing?

    A. Avoid applying gland sealing steam to the low-pressure turbine until you are ready to start up the first stage air ejector.
    B. After the main unit is secured, lubricating oil should be circulated until the temperature of the oil and reduction gear casing approximates the engine room temperature.
    C. Always ensure that the lubricating oil pressure is 14-17 psi when operating in unusually cold waters.
    D. The temperature of the lubricating oil should not exceed the gear manufacturer's recommendation when the unit is operating at full load.

    Correct answer: B

42. Which of the listed parts illustrated in the turbo-generator governing system, provides the follow-up to prevent the nozzle valves from cycling between the fully open and fully closed positions, with each variation in turbine speed? Illustration SE-0009

    A. D
    B. E
    C. H
    D. O

    Correct answer: B

43. An excess pressure governor would normally be used on a _____.

    A. turbine-driven feed pump
    B. forced draft fan
    C. low-pressure propulsion turbine
    D. main circulator pump

    Correct answer: A

44. Which of the following statements represents the significance of the differential pressure existing between the nozzle block and steam chest of a turbogenerator equipped with a lifting beam mechanism?

    A. The pressure differential eliminates the possibility of valve binding in the lifting beam.
    B. The pressure differential requires the installation of a special biasing spring to open the valves.
    C. The pressure differential necessitates the use of a special balance piston.
    D. The pressure differential assists in seating the valves when the lifting beam is lowered.

    Correct answer: D

45. In the illustrated device, what would be a reason for oil being discharged from port "N"? Illustration GS-0124

    A. This would be normal for the operation.
    B. The ring dam size is too large.
    C. The device being operated as a clarifier.
    D. The ring dam size is too small.

    Correct answer: B

46. When a sudden increase in pressure occurs in a forced lubrication system, you should check for a _____.

    A. high lube oil sump level
    B. ruptured tube in the lube oil cooler
    C. loss of oil flow across one of the bearings
    D. clogged lube oil pump suction

    Correct answer: C

47. If a lube oil pump fails to build up discharge pressure, the cause could be the _____.

    A. suction vacuum is high
    B. discharge valve is open
    C. suction valve is closed
    D. bypass valve is closed

    Correct answer: C

48. Which of the following conditions may exist if you detect an excessive amount of metal particles on a main engine lube oil strainer magnet?

    A. Reduction gear damage
    B. Journal bearing damage
    C. Main shaft bearing damage
    D. Turbine shrouding damage

    Correct answer: A

49. A cloudy or milky appearing lube oil sample, taken from the main lubricating oil system could be caused by _____.

    A. excessive cooling water to the lube oil cooler
    B. insufficient gland sealing steam
    C. excessive gland sealing steam
    D. insufficient cooling water to the lube oil cooler

    Correct answer: C

50. Which of the following would cause the dowel or locking lip of a split-type, precision insert, main bearing to shear and allow the bearing to rotate with the journal?

    A. Excessive bearing bolt torque
    B. Unequal torque to any two adjacent bearing bolts
    C. Insufficient bearing crush
    D. Short periods of above normal operating speeds

    Correct answer: C

51. Which immediate action should you take when the temperature of one line shaft bearing increases above its normal operating temperature?

    A. Check the bearing for proper lubrication.
    B. Check for proper water circulation to the lube oil coolers.
    C. Stop the unit and replace the bearing.
    D. Stop the unit and carefully inspect the bearing.

    Correct answer: A

52. As found in a reduction gear drive system, thrust bearings serve to _____.

    A. limit the radial movement of the shaft
    B. transmit the force produced by the propeller to the structure of the ship
    C. hold the main engine in place
    D. increase the shaft speed

    Correct answer: B

53. Which of the following statements is true concerning the turbine shown in the illustration? Illustration SE-0016

    A. The low-pressure turbine is designed with reaction type stages.
    B. The ahead rotor can be classified as a helical flow, Parsons type turbine.
    C. The astern element is of the Curtis type consisting of two three-row stages.
    D. A steam deflector is provided between the astern element and the ahead stages of the LP turbine.

    Correct answer: D

54. Labyrinth seals used to reduce leakage around a turbine shaft are constructed of _____.

    A. spring bound carbon segments
    B. machined metallic packing strips or fins
    C. staged rubber composition seal stripping
    D. braided asbestos covered core segments

    Correct answer: B

55. Deaeration of condensate primarily occurs in what section of the illustration shown? Illustration SG-0010

    A. first stage feed heater
    B. distilled water tank
    C. main condenser hotwell
    D. DFT

    Correct answer: D

56. Which of the pumps listed takes fuel oil suction from the double bottom tanks and discharges it to the settling tanks?

    A. Centrifugal type general service pump
    B. Settler service pump
    C. Fuel oil service pump
    D. Fuel oil transfer pump

    Correct answer: D

57. The temperature of the fuel oil received during bunkering operations is critical in determining the _____.

    A. temperature to which the fuel must be heated
    B. rate at which the fuel can be pumped during transfer operations
    C. flash point at which the fuel will burn
    D. expansion space to leave in a tank

    Correct answer: D

58. Which of the listed types of safety valves is shown in the illustration? Illustration SG-0018

    A. Jet flow type
    B. Pressure-loaded type
    C. Huddling chamber type
    D. Nozzle reaction type

    Correct answer: C

59. What is the primary operational difference between a nozzle reaction safety valve and a huddling chamber safety valve?

    A. The difference in valve relieving capacities.
    B. The manner in which lifting pressure is adjusted.
    C. The manner in which steam pressure causes initial valve opening.
    D. The principle by which blowdown is accomplished.

    Correct answer: D

60. Boiler refractory firebrick is secured to the casing by _____.

    A. slots in the brick engaging anchor bolts
    B. high strength tensile fasteners
    C. fast drying plastic refractory mortar
    D. studding on the waterwall tubes

    Correct answer: A

61. Which of the conditions listed could cause a boiler economizer to leak?

    A. High feedwater temperatures
    B. Water hammer
    C. Low feedwater pressure
    D. High stack gas temperatures

    Correct answer: B

62. The boiler main feed stop check valve is located nearest the _____.

    A. first stage feedwater heater outlet
    B. main feedwater regulator inlet
    C. DC heater feedwater outlet
    D. boiler water drum inlet

    Correct answer: B

63. Proper lagging of a single-element feedwater regulator is accomplished by applying the insulation material _____.

    A. to the steam connection, but not water connection
    B. to both connections, including finned areas
    C. only as necessary to prevent possible injury
    D. to the water connection, but not steam connection

    Correct answer: A

64. The gland exhaust fan draws steam and non-condensable vapors from the gland exhaust condenser and discharges to the _____.

    A. vent condenser
    B. main condenser
    C. atmosphere
    D. atmospheric drain tank

    Correct answer: C

65. Generally, a 12% to 14% content of carbon dioxide in boiler flue gases indicates _____.

    A. proper combustion of the fuel oil
    B. too much excess air
    C. a high vanadium content in the fuel oil
    D. carbon deposits in the uptakes

    Correct answer: A

66. When burning fuel oil in a boiler, a high CO2 content is desired in the stack gas because _____.

    A. efficient combustion is indicated, and the heat liberated is equal to the heat produced by the formation of CO
    B. less excess air is required to produce CO2 than CO
    C. efficient combustion is indicated even though the heat liberated is less than the heat produced by burning to CO
    D. more heat is liberated by the production of CO2 than CO

    Correct answer: D

67. A flue gas analysis is performed to determine the _____.

    A. specific heat of combustion products
    B. percentage of nitrogen by volume
    C. carbon content of the fuel being burned
    D. correct fuel/air ratio for efficient combustion

    Correct answer: D

68. Vapor blowing from the air ejector condenser vent may be caused by _____.

    A. insufficient condensate flow
    B. excessive condensate pump speed
    C. excess makeup feed being taken into the system
    D. low condensate temperature

    Correct answer: A

69. During maneuvering on a steam vessel, the condenser vacuum begins to decrease when the turbines are slowed for a slow ahead bell. Which of the following should be checked?

    A. The main circulating pump to ensure flow is not excessive.
    B. The turbine gland seal steam to ensure proper pressure.
    C. The air ejector to ensure the steam flow is not excessive.
    D. The condensate pump to ensure the recirculation valve is closed.

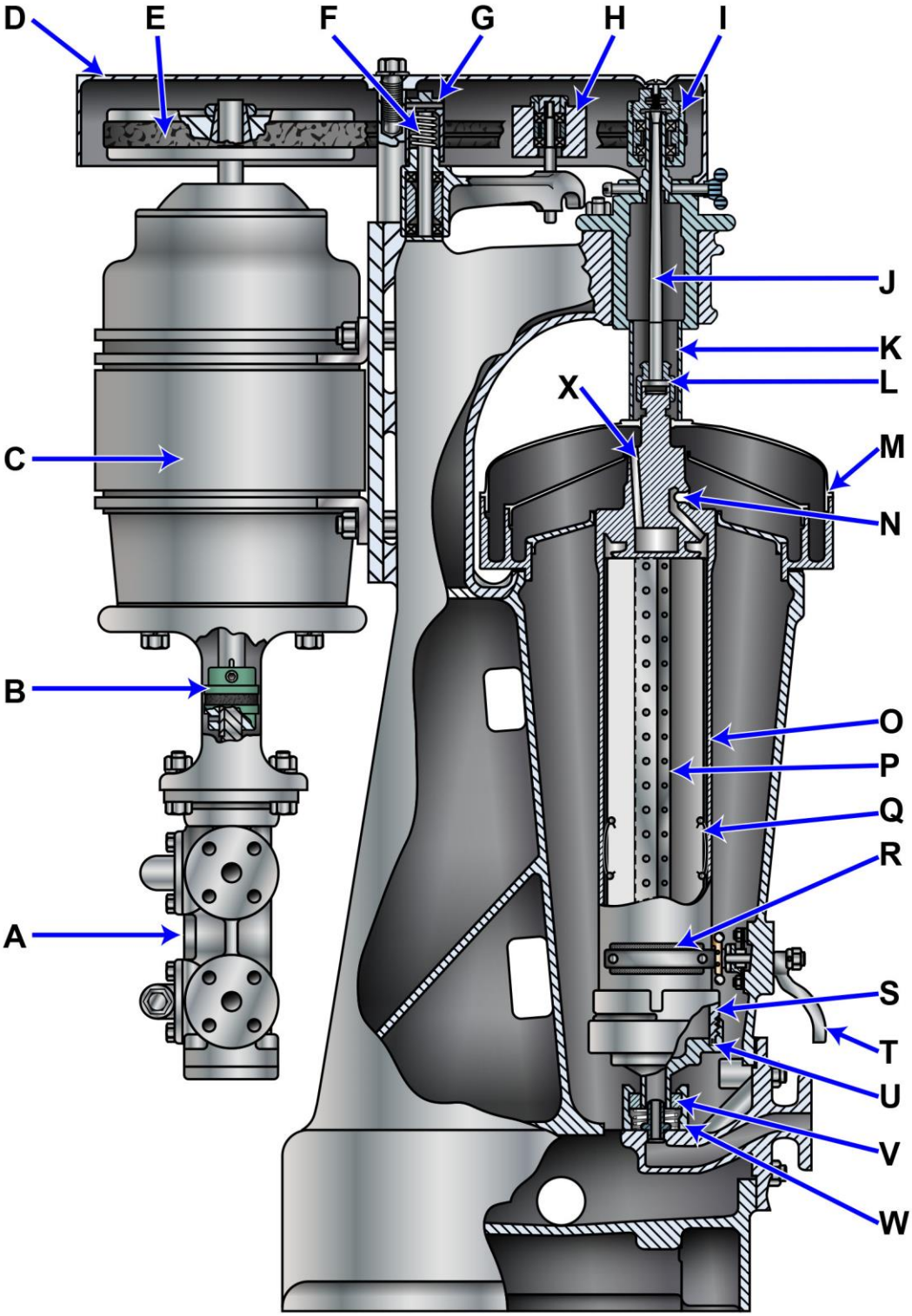
    Correct answer: B

70. The duty engineer reports an alarm on the condensate observation tank oil sensor. Which of the following could be a possible cause?

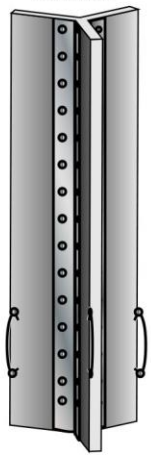
    A. A leaking hot water heater
    B. A leaking main engine lube oil cooler
    C. A leaking bunker tank heating coils
    D. A leaking fuel cooler

    Correct answer: C

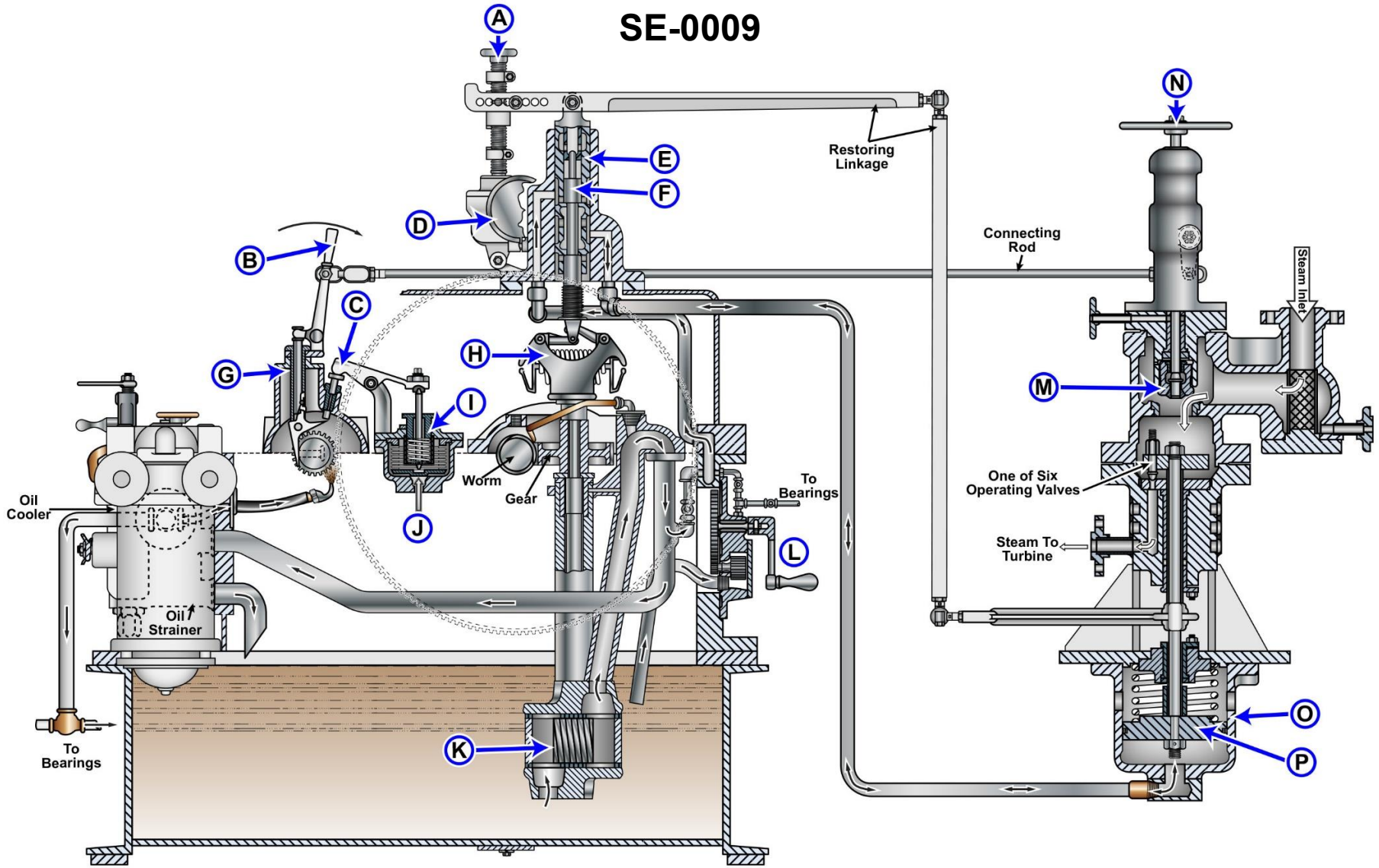
## GS-0124




Three-Wing Device



# SE-0009

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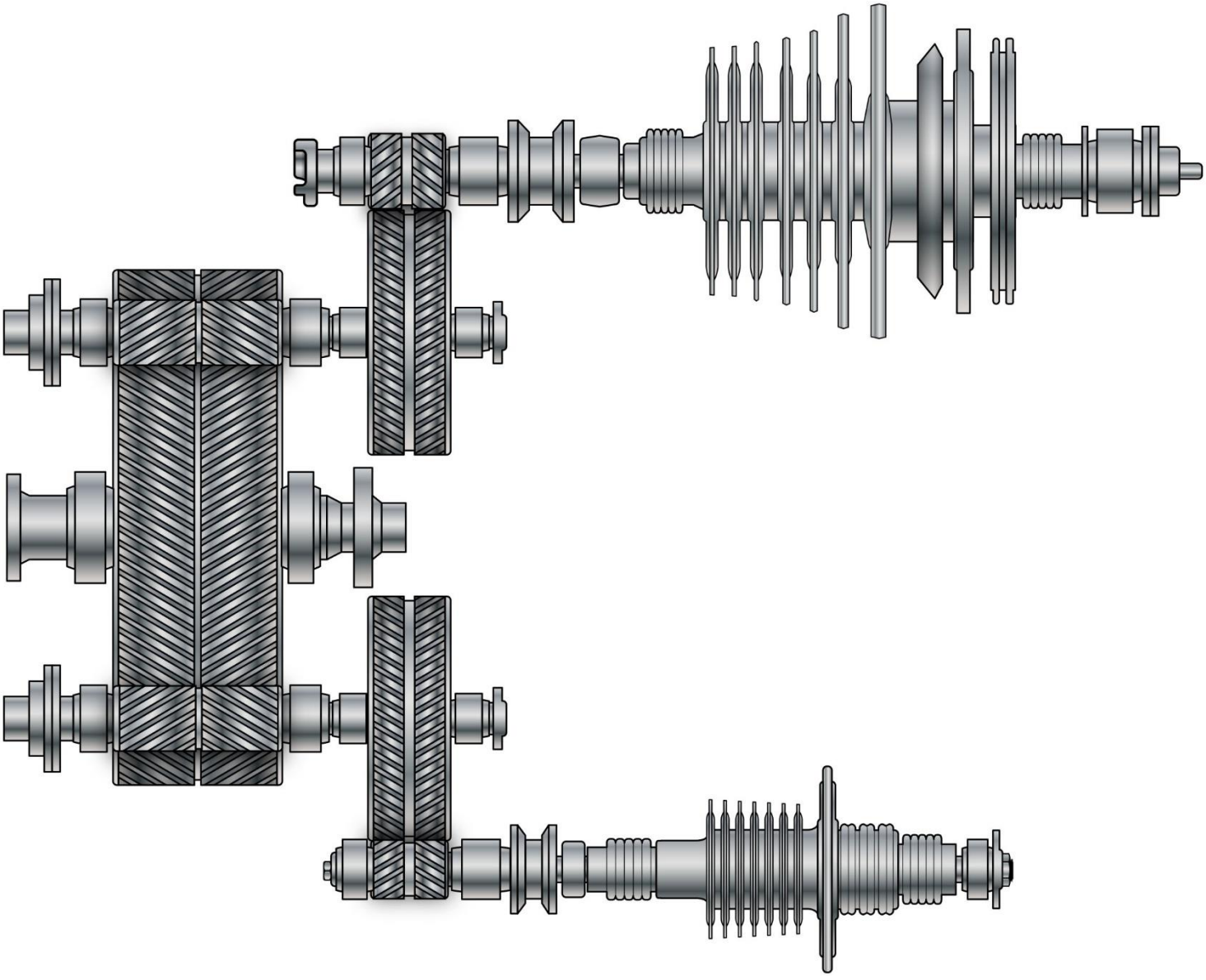
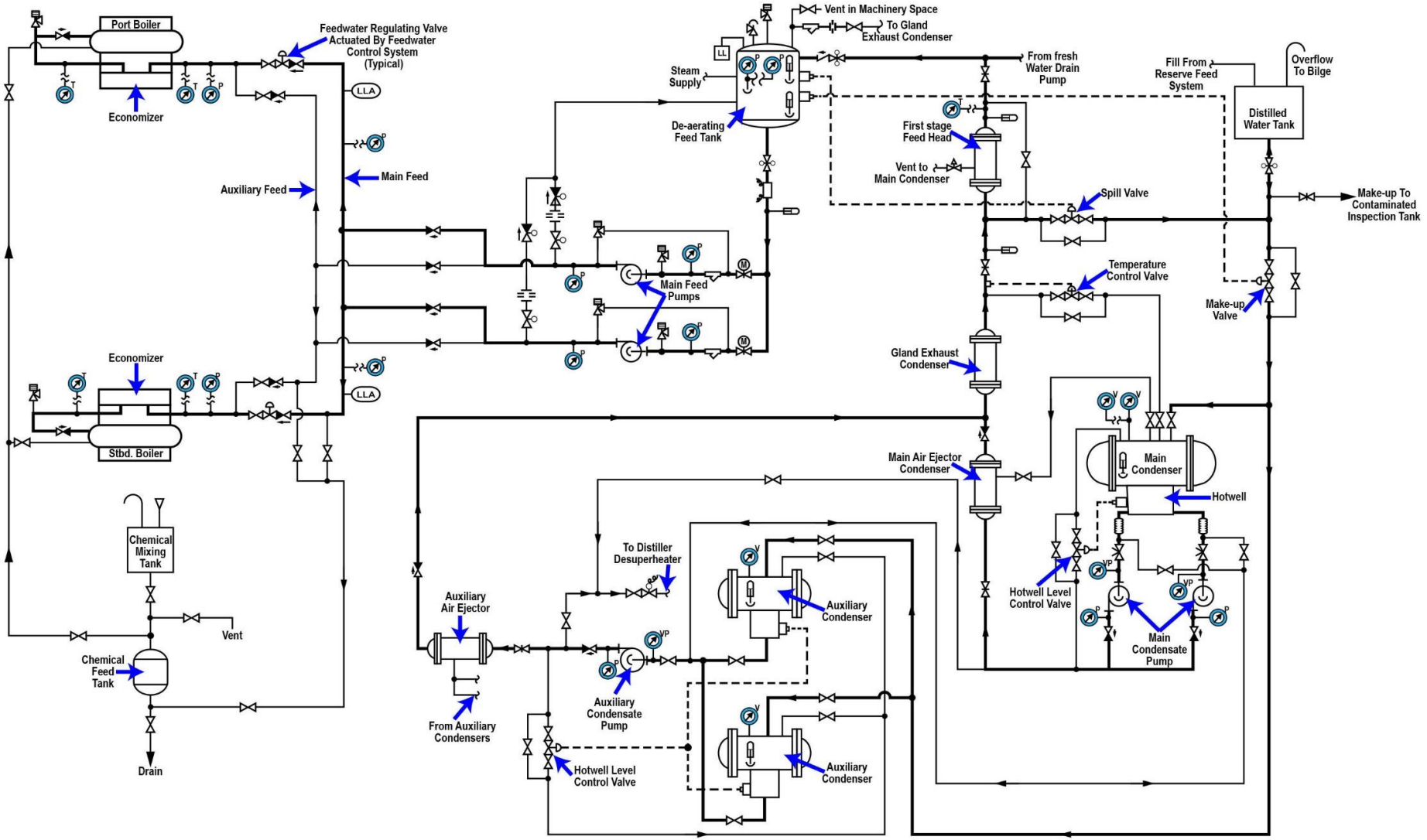
# SE-0016



# SG-0010



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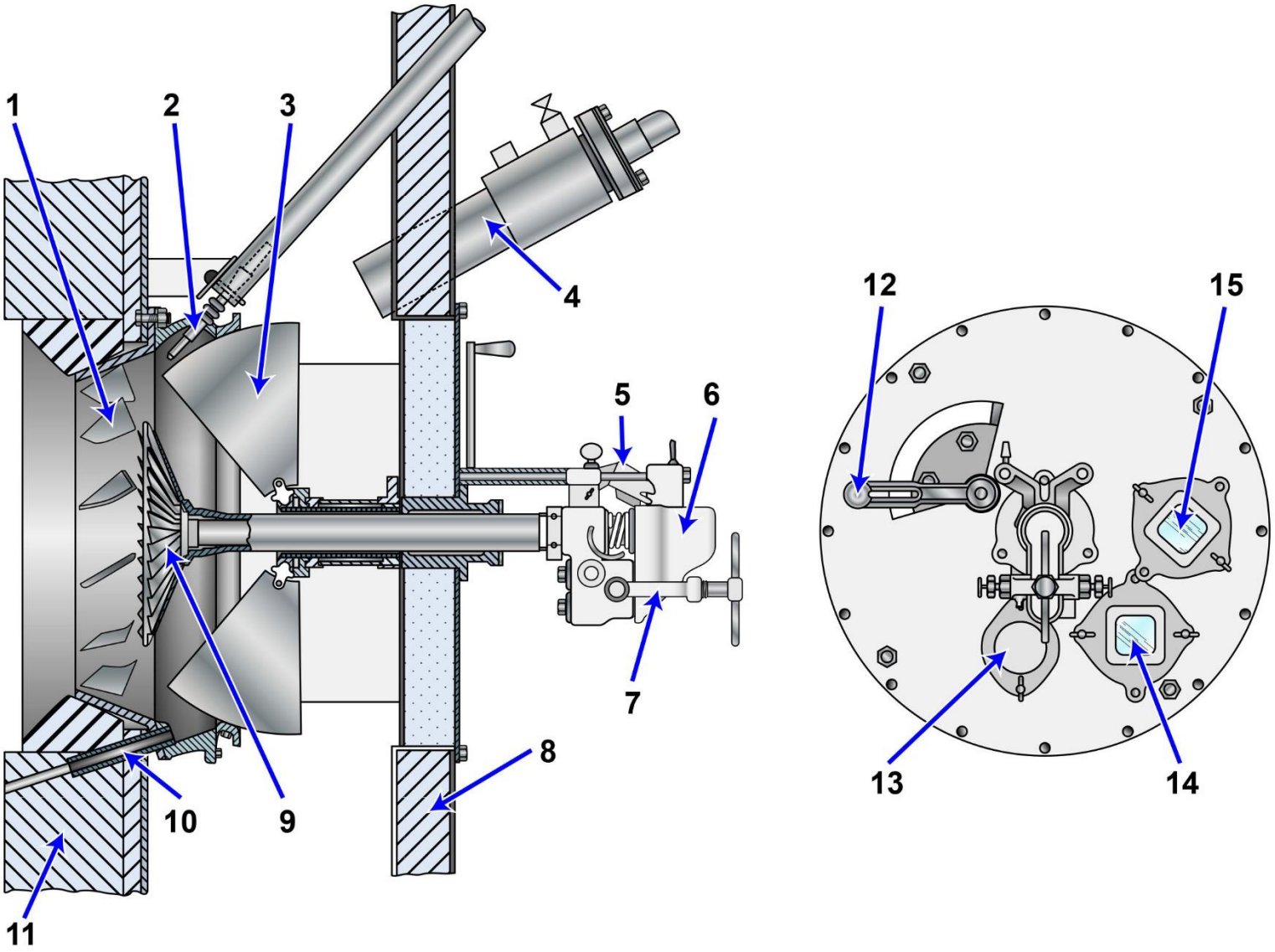
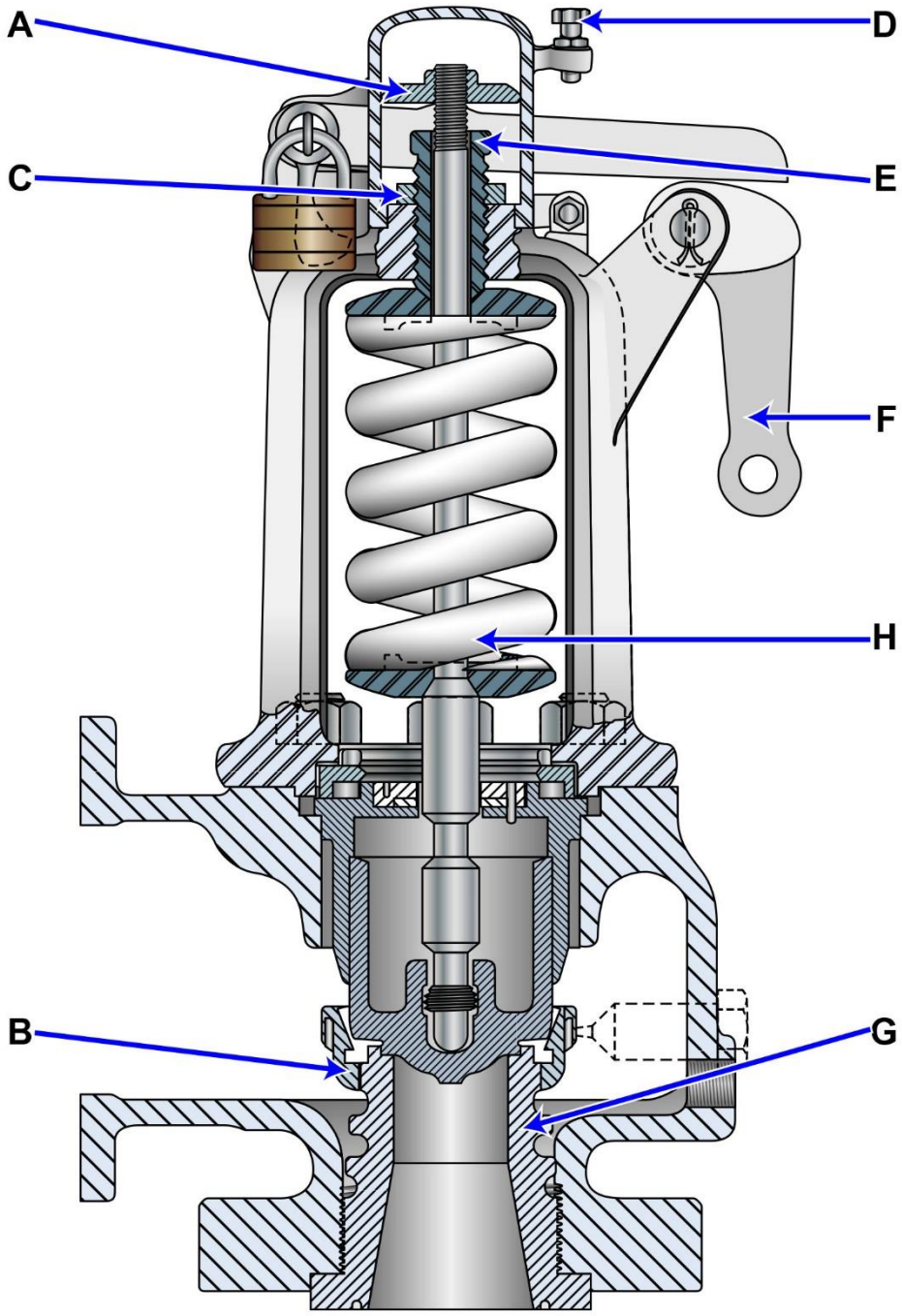


# SG-0018



# SG-0026

## Properties of Saturated Steam

| Vacuum Inches of Hg Gage | Temperature °C | Temperature °F |
|---|---|---|
| 29.51 | 11.74 | 53.14 |
| 29.41 | 15.17 | 59.30 |
| 29.31 | 18.04 | 64.47 |
| 29.21 | 20.52 | 68.93 |
| 29.11 | 22.70 | 72.86 |
| 29.00 | 24.66 | 76.38 |
| 28.90 | 26.43 | 79.58 |
| 28.70 | 29.56 | 85.21 |
| 28.49 | 32.27 | 90.08 |
| 28.29 | 34.66 | 94.38 |
| 28.09 | 36.80 | 98.24 |
| 27.88 | 38.74 | 101.74 |
| 27.48 | 42.18 | 107.92 |
| 27.06 | 45.14 | 113.26 |
| 26.66 | 47.77 | 117.99 |
| 26.26 | 50.13 | 122.23 |
| 25.85 | 52.27 | 126.08 |
| 25.44 | 54.23 | 129.62 |
| 25.03 | 56.05 | 132.89 |
| 24.63 | 57.74 | 135.94 |
| 24.22 | 59.33 | 138.79 |
| 23.81 | 60.82 | 141.48 |
| 22.79 | 64.21 | 147.57 |
| 21.78 | 67.21 | 152.97 |
| 20.76 | 69.91 | 157.83 |
| 19.74 | 72.36 | 162.24 |
| 18.72 | 74.61 | 166.30 |
| 17.70 | 76.70 | 170.06 |
| 16.69 | 78.64 | 173.56 |
| 15.67 | 80.47 | 176.85 |
| 14.65 | 82.14 | 179.86 |
| 13.63 | 83.81 | 182.86 |
| 12.61 | 85.36 | 185.64 |
| 11.60 | 86.82 | 188.28 |
| 10.58 | 88.22 | 190.80 |
| 9.56 | 89.57 | 193.21 |
| 7.52 | 92.08 | 197.75 |
| 5.49 | 94.42 | 201.96 |
| 3.45 | 96.60 | 205.88 |
| 1.42 | 98.64 | 209.56 |