

U.S.C.G. Merchant Marine Exam

Chief Engineer – Limited

Q605 Steam Plants

(Sample Examination)

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

1. Which of the following statements represents the purpose of boiler sliding feet?
- A. To accommodate the changing length of the water drum as it expands or contracts with temperature changes.
 - B. To ensure an airtight seal between the boiler inner and outer casings.
 - C. To allow for unequal expansion between the wrapper and tube sheets.
 - D. To compensate for deflection of the hull in way of the boiler supports.

Correct answer: A

2. Desuperheated steam can be found at the _____.
- A. high pressure turbine steam chest
 - B. generator steam stop
 - C. spray attemperator outlet
 - D. main steam stop

Correct answer: C

3. In what section of a boiler would you find a steam quality of 90%?
- A. Superheater outlet
 - B. Steam drum
 - C. Last pass of the superheater
 - D. Desuperheater outlet

Correct answer: B

4. Steam baffles are used in the steam drum of a water-tube boiler to _____.
- A. remove boiler water dirt deposits
 - B. reduce the possibility of carryover
 - C. support the drum safety valve nozzles
 - D. extend the internal feed pipe

Correct answer: B

5. Boiler refractory previously baked out and fired is most sensitive to _____.
- A. sustained high furnace temperature
 - B. rapid heating
 - C. radiant heat of the burner
 - D. rapid cooling

Correct answer: D

6. In most marine boilers, the primary reason the first few rows of generating tubes, called screen or furnace row tubes, are made larger in diameter than the rest of the generating tubes is because _____.
- A. they must screen the superheater from the direct radiant heat of the burners
 - B. their main function is to retard combustion gas flow for maximum heat transfer rates
 - C. they must act as downcomers to ensure proper circulation
 - D. they require more water flow since they are exposed to the greatest heat

Correct answer: D

7. The primary purpose of a control desuperheater installed in the steam drum of a boiler is to _____.
- A. regulate the superheater outlet temperature by cooling a portion of the superheated steam
 - B. regulate saturated steam temperature through the desuperheater
 - C. regulate the temperature of superheated steam by adding moisture
 - D. assure a constant volume of steam flow through the entire superheater under all load conditions

Correct answer: A

8. 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 principle by which blowdown is accomplished.
 - C. The manner in which lifting pressure is adjusted.
 - D. The manner in which steam pressure causes initial valve opening.

Correct answer: B

9. A furnace wall in which there are open spaces around the brick as a result of firebrick shrinkage, is _____.
- A. spalled and must be replaced
 - B. loose and should be repaired
 - C. cracked and must be patched
 - D. normal and need only be cleaned

Correct answer: B

10. Which of the listed mediums should be used when water washing a boiler?
- A. Cold salt water
 - B. Cold fresh water
 - C. Heated fresh water
 - D. Heated salt water

Correct answer: C

11. After patching refractory with plastic firebrick, holes are poked in the patch on 1 1/2 inch centers in order to _____.
- A. allow for expansion
 - B. prevent slag buildup
 - C. vent escaping moisture
 - D. prevent spalling

Correct answer: C

12. Which of the tools listed is used to remove a boiler tube from a header?
- A. Swaging tool
 - B. Backing out tool
 - C. Laminating tool
 - D. Expanding tool

Correct answer: B

13. Steam line water hammer can be best prevented by _____.
- A. always opening steam valves rapidly
 - B. keeping lines drained and insulated
 - C. keeping steam temperature below the saturation point
 - D. replacing all 90° elbows with capped tees

Correct answer: B

14. Which combustible element in fuel oil is considered a significant and major source of air pollution?
- A. Nitrogen
 - B. Sulfur
 - C. Hydrogen
 - D. Vanadium

Correct answer: B

15. 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 centrifuging
 - C. in a storage tank
 - D. for atomizing

Correct answer: C

16. The viscosity of a residual fuel oil is measured in Saybolt _____.
- A. Minutes Universal
 - B. Millimeters Universal
 - C. Milliliters Universal
 - D. Seconds Furol

Correct answer: D

17. Fireside burning of boiler tubes is usually the direct result of _____.

- A. gas laning in tube banks
- B. overheating due to poor heat transfer
- C. high furnace temperatures
- D. oxygen corrosion of metallic surfaces

Correct answer: B

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

Correct answer: A

19. Blisters developing on boiler tubes can be caused by _____.

- A. waterside scale deposits
- B. air in the feedwater
- C. cold feedwater
- D. hot feedwater

Correct answer: A

20. When the rate of heat transfer through tube walls is so reduced that the metal becomes overheated, which of the following conditions will result in the boiler?

- A. Fireside thinning
- B. Steam gouging
- C. Steam binding
- D. Fireside burning

Correct answer: D

21. If a boiler generates saturated steam at 75.3 psig, how much heat is required to change the water into steam if the feedwater temperature is 220°F? Illustration SG-0004

- A. 30.5 Btu/lb.
- B. 116.5 Btu/lb.
- C. 582.7 Btu/lb.
- D. 862.8 Btu/lb.

Correct answer: D

22. Which of the conditions listed would indicate excessive soot buildup on the economizer?

- A. High feedwater temperature entering the boiler
- B. Lower than usual air pressure in the furnace
- C. Low air temperature entering the boiler
- D. High superheater temperature

Correct answer: D

23. An excessively high superheater temperature could be the result of _____.
- A. soot accumulation on the superheater
 - B. excessive air
 - C. excessive steam demand
 - D. high feedwater temperature

Correct answer: B

24. Which of the following would indicate a moderate leak in the desuperheater?
- A. Lower than normal auxiliary steam temperature
 - B. Higher than normal fuel oil consumption
 - C. Higher than normal auxiliary steam pressure
 - D. Lower than normal fuel oil consumption

Correct answer: A

25. When testing boiler flue gas with a chemical absorption apparatus, to obtain accurate results _____.
- A. run each analysis for at least 3 minutes
 - B. analyze for nitrogen content before oxygen content
 - C. purge the apparatus with air before use
 - D. prevent any air from contaminating the gas sample

Correct answer: D

26. If an analysis of boiler flue gas determines there is no excess air for combustion, you should expect the nitrogen content of the flue gas to be approximately _____.
- A. 10.5%
 - B. 14.0%
 - C. 21.0%
 - D. 79.0%

Correct answer: D

27. Fuel oil is transferred to the settling tanks for _____.
- A. the purpose of removing any volatile gases present in the fuel
 - B. heating to the correct temperature for proper burner atomization
 - C. purging of any large air bubbles that have formed
 - D. heating to allow water and sediment to settle out

Correct answer: D

28. Which of the following actions should be taken FIRST when water is found in the fuel oil settling tank?
- A. Determine the extent of water contamination by reading the pneumericators.
 - B. Sound the settling tank with water indicating paste.
 - C. Shift pump suction to an alternate settling tank.
 - D. Shift to alternate or standby fuel oil service pump.

Correct answer: C

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

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

Correct answer: C

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

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

Correct answer: C

31. Excessive alkalinity of boiler water will cause _____.

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

Correct answer: D

32. Carbon dioxide dissolved in boiler water is dangerous in a modern power boiler because the gas _____.

- A. combines with sulfates to cause severe waterside pitting
- B. breaks the magnetic iron oxide film inside boiler tubes
- C. forms carbonic acid which attacks the watersides
- D. combines with oxygen to cause severe waterside scaling

Correct answer: C

33. As found in a basic pneumatic automatic combustion control system, the function of a standardizing relay is to _____.

- A. provide a backup means for manual control of the system
- B. introduce a control for maintaining constant steam pressure regardless of boiler load
- C. introduce a control for maintaining constant superheated steam temperature regardless of boiler load
- D. control the boiler drum water level within acceptable limits regardless of the load

Correct answer: B

34. Which of the following represents a significant system limitation to be aware of when a burner management system is operated in the 'HAND' mode?

- A. The flame failure alarm cannot function when the boiler is 'HAND' fired.
- B. The burner sequence control is fully automatic even in the 'HAND' mode.
- C. Some boiler safety interlocks are bypassed when the boiler is 'HAND' fired.
- D. The burner is not capable of maintaining a high firing rate when the boiler is in the 'HAND' mode.

Correct answer: C

35. Modern day boiler automation allows bypassing the "flame safeguard" system to permit a burner to have a "trial for ignition" period during burner light-off. This period may not exceed _____.
- A. 5 seconds
 - B. 10 seconds
 - C. 15 seconds
 - D. 30 seconds

Correct answer: C

36. In a boiler automation system, if a burner fuel oil solenoid valve continually trips closed under normal steaming conditions, you should _____.
- A. bypass the solenoid valve and enter the fact in the logbook
 - B. wedge the valve in the open position and reduce the fuel oil pressure at that burner
 - C. secure the burner and determine the cause of the valve failure
 - D. wedge the valve in the open position and report it to the chief engineer

Correct answer: C

37. Which of the precautions listed should be taken when gagging a boiler safety valve?
- A. Do not allow the gag to contact the safety valve stem.
 - B. Tighten the gag only finger tight to prevent damage to the valve stem, disc or seat.
 - C. Tighten the gag only with the special wrench supplied with the gag.
 - D. Ensure that all moving parts of the safety valve are free to move before installing the gag.

Correct answer: B

38. Prior to rolling the main turbines in preparation for getting underway, you should _____.
- A. open the reduction gear casing access plates and inspect the lube oil spray pattern
 - B. circulate the lube oil through the emergency lube oil cooler
 - C. disengage the turning gear
 - D. secure the gland sealing steam regulator

Correct answer: C

39. Before placing the jacking gear in operation on a main turbine unit, you must always ensure that _____.
- A. the main saltwater circulating pump is operating
 - B. the gland seal steam system is operating
 - C. the main lube oil system is operating
 - D. the condensate system is operating

Correct answer: C

40. With vacuum up and the main propulsion turbine standing by while awaiting engine orders, it is necessary to roll the unit alternately ahead and astern every five minutes to _____.
- A. slowly bring the lube oil and bearings to operating temperature
 - B. warm the astern guarding valve and the low lube oil pressure throttle trip
 - C. distribute the gland sealing steam evenly throughout the glands
 - D. reduce the possibility of warping the turbine rotors

Correct answer: D

41. To stop the rotor of a main turbine while underway at sea you should _____.
- A. tighten the stern tube packing gland
 - B. admit astern steam to the turbine after securing the ahead steam
 - C. apply the Prony brake
 - D. secure all steam to the turbine

Correct answer: B

42. While a vessel is underway the low-pressure turbine high-speed pinion is damaged. The pinion is then removed from the gear train. Under these circumstances, the main unit is capable of which speed and direction?
- A. Reduced speed ahead only
 - B. Reduced speed astern only
 - C. Reduced speed ahead and full speed astern
 - D. Reduced speed astern and full speed ahead

Correct answer: A

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

Correct answer: A

44. Which action should be taken if the water level in the boiler gauge glass drops out of sight and the burners fail to secure automatically?
- A. Repair the feedwater regulator.
 - B. Trip the master solenoid.
 - C. Blowdown the gauge glass.
 - D. Increase the feed pump speed.

Correct answer: B

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

Correct answer: B

46. One boiler of a two-boiler plant has ruptured a tube and the water cannot be maintained in sight in the gauge glass. After securing the fires, your next action should be to _____.
- A. stop the fuel oil service pump
 - B. secure the forced draft fans
 - C. secure the feedwater supply to the boiler
 - D. close the main steam stop

Correct answer: C

47. Turbine casing flanges are sometimes provided with a system of joint grooving to _____.
- A. form a labyrinth seal between the casing halves
 - B. inject sealing compound between the casing halves
 - C. increase contact pressure between the casing halves' flanges
 - D. ensure perfect alignment of casing halves

Correct answer: B

48. An efficient seal is normally obtained between the upper and lower halves of a turbine casing by _____.
- A. precision metal-to-metal contact
 - B. flexible steel seal strips
 - C. asbestos gaskets
 - D. copper gaskets

Correct answer: A

49. Excessive thrust bearing wear in a main propulsion turbine rotor should FIRST become apparent by _____.
- A. taking rotor position indicator readings
 - B. an intermittent vibration when changing speed
 - C. metal particles in the lube oil purifier
 - D. rubbing noises when jacking over the main unit

Correct answer: A

50. When a turbine bearing shows signs of overheating, you should _____.
- A. immediately reduce speed
 - B. increase the lube oil pump discharge pressure
 - C. increase the cooling water supply to the lube oil cooler
 - D. stop the turbine

Correct answer: A

51. If steam is admitted to the main propulsion turbine with the jacking gear engaged, which of the following problems can occur?
- A. Excessive tooth stress on the high-pressure first reduction pinion
 - B. Uneven warming of the turbine
 - C. Destruction of the jacking gear
 - D. A possibility of shearing the jacking gear flexible coupling

Correct answer: C

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

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

Correct answer: B

53. A sequential lift, nozzle valve control bar on a turbogenerator, utilizes which of the following operating principles?

- A. A hydraulic piston raises or lowers groups of valves according to pressure received from a governor.
- B. A lifting beam mechanism engages nozzle valve stems of varying lengths.
- C. A hydraulic piston raises or lowers individual valves according to pressure received from a governor.
- D. A servomotor, mechanically connected to nozzle valve handwheels, opens or closes the valves in accordance with the type of electrical signal received.

Correct answer: B

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

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

Correct answer: C

55. Which of the listed actions will occur when there is an increase in load on a ship service generator equipped with a centrifugal type hydraulic governor? Illustration SE-0009

- A. The operating piston is forced to move lower.
- B. The governor weights move outward.
- C. Steam flow to the turbine decreases.
- D. More oil will enter the operating cylinder (O).

Correct answer: D

56. The most practical method of determining the condition of a shaft bearing while the shaft is in operation is to _____.

- A. check the lube oil temperature
- B. perform a carbon blot test on an oil sample from the bearing
- C. visually inspect the bearing
- D. check the lube oil viscosity

Correct answer: A

57. If a line shaft bearing begins to overheat, the shaft speed should be reduced. If overheating persists, you should then _____.
- A. decrease lube oil pressure to the bearing
 - B. flood the bearing with a higher viscosity oil to provide emergency lubrication and cooling
 - C. increase lube oil pressure to the bearing
 - D. apply emergency cooling water externally to the bearing

Correct answer: D

58. What is the significance of pinion deflection in the operation of reduction gears?
- A. Pinion deflection causes unequal tooth loading.
 - B. Deflection causes excessive wear at both ends of the pinion.
 - C. Deflection is minimal because a longer pinion is more rigid.
 - D. Deflection causes excessive wear at the center of the pinion.

Correct answer: A

59. The splits located in the halves of main reduction gear bearings are aligned at an angle to the horizontal in order to resist _____.
- A. axial stress
 - B. oil loss
 - C. steam loss
 - D. wiping

Correct answer: D

60. A Kingsbury, or pivot shoe type thrust bearing, can bear much greater loads per square inch of working surface than can parallel surface bearings because provisions are made in the Kingsbury bearing _____.
- A. for automatically adjusting clearances to the correct value when wear occurs
 - B. for adjusting the filler piece thickness behind the pivotal-shoes to give a more accurate fit
 - C. to allow the leveling plates to pivot on the collar when thrust loads are applied
 - D. for the shoes to tilt slightly, thereby allowing the formation of a wedge-shaped oil film under a thrust load

Correct answer: D

61. As found in a reduction gear drive system, thrust bearings serve to _____.
- A. hold the main engine in place
 - B. increase the shaft speed
 - C. transmit the force produced by the propeller to the structure of the ship
 - D. limit the radial movement of the shaft

Correct answer: C

62. Which of the listed operational checks should be made "continuously" on the main propulsion reduction gears?
- A. Check bearing lube oil temperatures.
 - B. Inspect alignment between gears and turbine.
 - C. Check teeth for pitting and scuffing.
 - D. Check radial bearing wear.

Correct answer: A

63. The part shown in the illustration would be located between which of the following components of a modern geared turbine main propulsion unit? Illustration SE-0001
- A. Between the bull gear and line shaft on the side of the gear opposite the thrust bearing.
 - B. Between the first reduction gears and high-speed pinions of the high-pressure and low-pressure turbines.
 - C. Between the bull gear and line shaft on the thrust bearing side of the gear.
 - D. Between the rotors and high-speed pinions of the high-pressure and low-pressure turbines.

Correct answer: D

64. The valve cam slope angle determines the _____.
- A. diameter of intake and exhaust valves
 - B. acceleration rate of valve opening and closing
 - C. engine fuel efficiency
 - D. engine torque characteristics

Correct answer: B

65. In diesel engines, hydraulic valve lifters are used to _____.
- A. reduce valve gear pounding
 - B. increase valve operating lash
 - C. create longer valve duration
 - D. obtain greater valve lift

Correct answer: A

66. Before any auxiliary diesel engine hydraulic starting system is opened for servicing or repair, you must _____.
- A. bleed off all hydraulic pressure from the system
 - B. ensure that the hydraulic fluid reservoir is full
 - C. block all hydraulic hoses using high-pressure covers
 - D. place all control levers in the 'HOLD' position

Correct answer: A

67. A four-stroke cycle auxiliary diesel engine fuel cam has shifted from its original position during maintenance. To ensure correct timing of the fuel pump, the intake and exhaust valves should be in what position when approaching top dead center for injection?
- A. Exhaust valve open, intake valve closed
 - B. Intake and exhaust valves open
 - C. Intake and exhaust valves closed
 - D. Intake valve open, exhaust closed

Correct answer: C

68. If an auxiliary diesel engine equipped with an electric starting system cranks very slowly after repeated attempts to start, the cause could be a/an _____.

- A. ring gear with broken teeth
- B. overheated motor windings
- C. low compression pressure
- D. low lube oil viscosity

Correct answer: B

69. One remedy for a high firing pressure, in addition to a high exhaust temperature in one cylinder of a diesel engine, is to _____.

- A. adjust the fuel rack
- B. increase scavenge air pressure
- C. reduce fuel booster pump pressure
- D. retard fuel injector timing

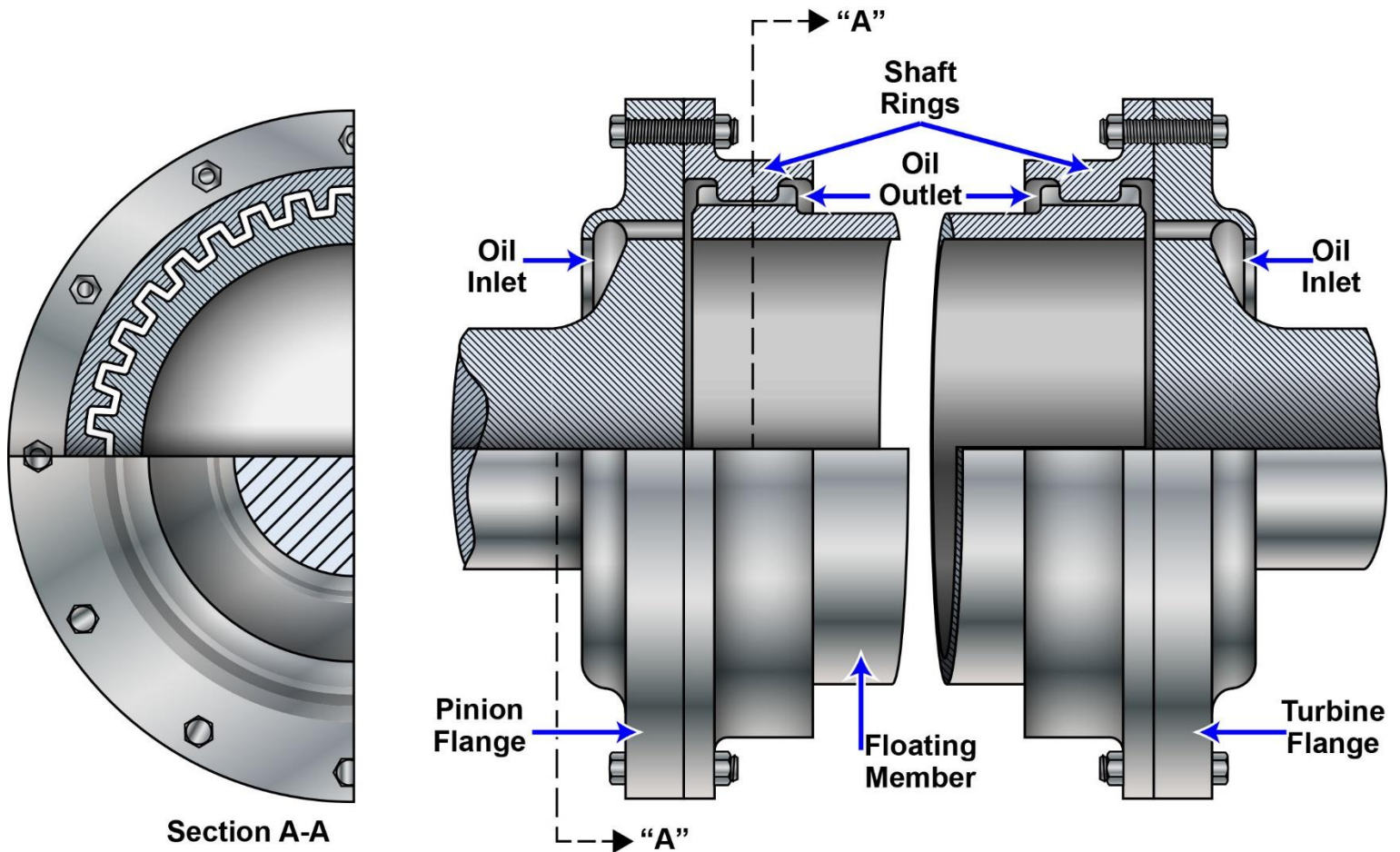
Correct answer: A

70. In a four-stroke cycle diesel engine, badly worn intake valve guides can cause excessive _____.

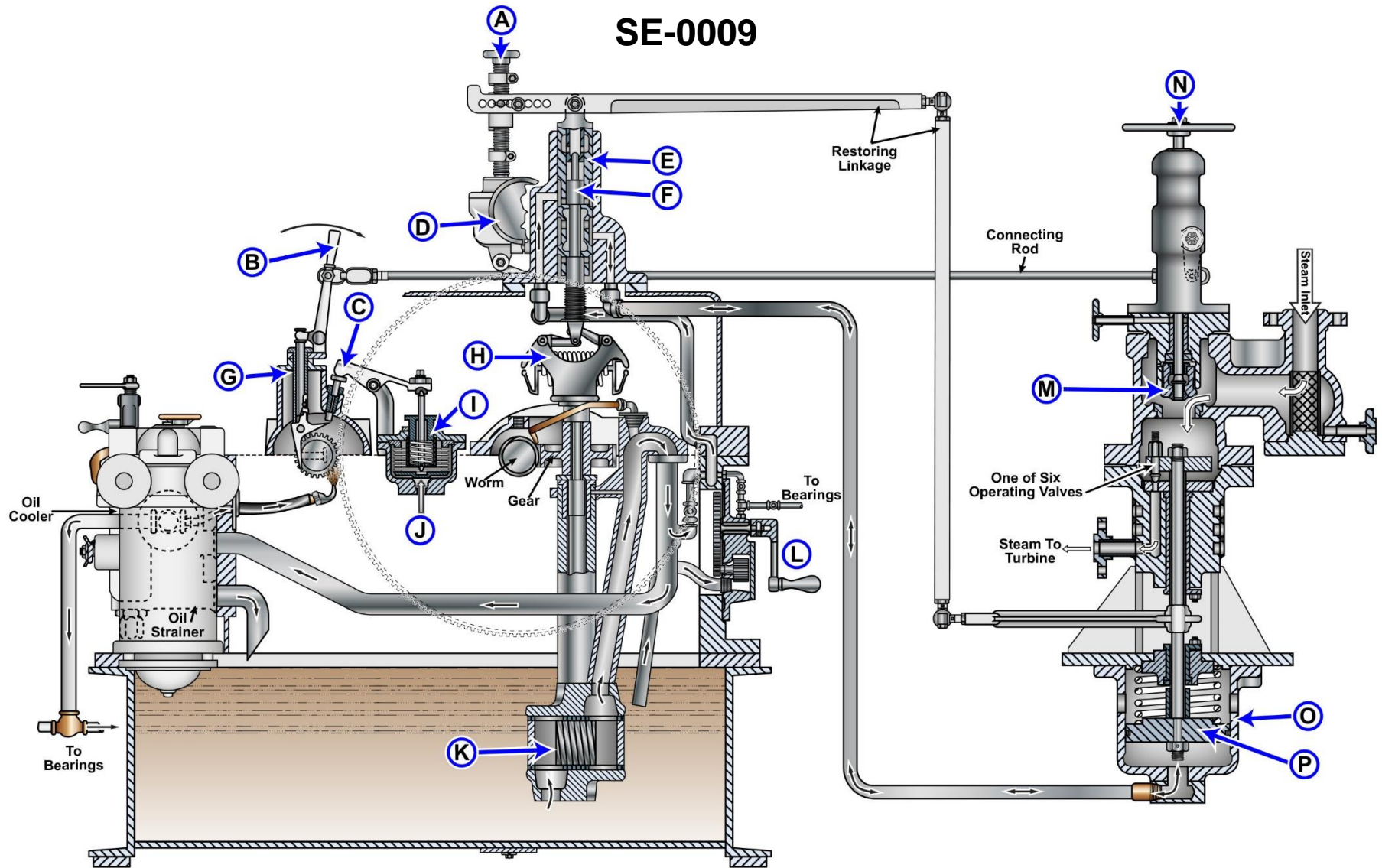
- A. lube oil consumption
- B. exhaust temperatures
- C. exhaust pressure
- D. cooling water temperatures

Correct answer: A

SE-0001



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SG-0004

Table 1
Thermodynamic Properties of Saturated Steam (Temperature)

Temp, °F	Absolute Pressure, psi	Enthalpy (BTU/lb) of Liquid	Enthalpy (BTU/lb) of Evaporation	Enthalpy (BTU/lb) of vapor
32	0.08859	0.01	1075.5	1075.5
40	0.12170	8.05	1071.3	1079.3
50	0.17811	18.07	1065.6	1083.7
60	0.25630	28.06	1059.9	1088.0
70	0.36310	38.04	1054.3	1092.3
80	0.50690	43.02	1048.6	1096.6
90	0.69820	57.99	1042.9	1100.9
100	0.94920	67.97	1037.2	1105.2
110	1.27480	77.94	1031.6	1109.5
120	1.69240	87.92	1025.8	1113.7
130	2.22250	97.90	1020.0	1117.9
140	2.88860	107.90	1014.1	1122.0
150	3.71800	117.90	1008.2	1126.1
160	4.74100	127.90	1002.3	1130.2
170	5.99200	137.90	996.3	1134.2
180	7.51000	147.90	990.2	1138.1
190	9.33900	157.90	984.1	1142.0
200	11.52600	168.00	977.9	1145.9
212	14.69600	180.00	970.4	1150.4
220	17.18600	188.10	965.2	1153.4
240	24.96900	208.30	952.2	1160.5
280	49.20300	249.10	924.7	1173.8
300	67.01300	269.60	910.1	1179.7
340	118.01000	311.10	879.0	1190.1
380	195.77000	353.50	844.6	1198.1
400	247.31000	375.00	826.0	1201.0

Table 2
Thermodynamic Properties of Saturated Steam (Pressure)

Absolute Pressure, psi	Temp, °F	Enthalpy (BTU/lb) of Liquid	Enthalpy (BTU/lb) of Evaporation	Enthalpy (BTU/lb) of vapor
0.5	79.58	47.6	1048.8	1096.4
1.0	101.74	69.7	1036.3	1106.0
5.0	162.24	130.1	1001.0	1131.1
10.0	193.21	161.2	982.1	1143.3
14.7	212.00	180.0	970.4	1150.4
15.0	213.03	181.1	969.7	1150.8
20.0	227.96	196.2	960.1	1156.3
25.0	240.07	208.5	952.1	1160.6
30.0	250.33	218.8	945.3	1164.1
40.0	267.25	236.0	933.7	1169.7
50.0	281.01	250.1	924.0	1174.1
60.0	292.71	262.1	915.5	1177.6
70.0	302.92	272.6	907.9	1180.6
80.0	312.03	282.0	901.1	1183.1
90.0	320.27	290.6	894.7	1185.3
100.0	327.81	298.4	888.8	1187.2
110.0	334.77	305.7	883.2	1188.9
120.0	341.25	312.4	877.9	1190.4
130.0	347.32	318.8	872.9	1191.7
140.0	353.02	324.8	868.2	1193.0
150.0	358.42	330.5	863.6	1194.1
200.0	381.79	355.4	843.0	1198.4
250.0	400.95	376.0	825.1	1201.1
300.0	417.33	393.8	809.0	1202.8
350.0	431.72	409.7	794.2	1203.9
400.0	444.59	424.0	780.5	1204.5

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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

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