CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY
MARINE ENGINEER OFFICER

STCW 78 as amended MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-32 - APPLIED HEAT

MONDAY, 9 DECEMBER 2019

1315 - 1615 hrs

Materials to be supplied by examination centres

Candidate's examination workbook Graph paper Thermodynamic and Transport Properties of Fluids (5^{th} Edition) Arranged by Y.R. Mayhew and C.F.C. Rogers

Examination paper inserts:

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.
2. Candidates should note that 96 marks are allocated to this paper. To pass, candidates must achieve 48 marks.
3. Non-programmable calculators may be used.
4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

APPLIED HEAT

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer

1. A mass of 2 kg of carbon dioxide at a pressure and temperature of 12 bar and 800°C respectively, expands in an isentropic process to a pressure of 2 bar.

   It is then cooled at constant pressure to a temperature of 15°C.

   (a) Sketch the processes on Pressure-Volume and Temperature-specific entropy diagrams. (2)

   (b) Calculate EACH of the following:

   (i) the net-work transfer; (5)

   (ii) the net-heat transfer; (3)

   (iii) the overall change in entropy; (3)

   (iv) the mean temperature of heat rejection. (3)

   Note: Atomic mass relationships C= 12 O = 16
   Universal gas constant R_o = 8.3145 kJ/kmol K
   For Carbon dioxide γ = 1.33

2. In the open cycle gas turbine plant shown in Fig Q2, turbine 1 drives the compressor and turbine 2 provides the power output.

At a particular operating condition:

The power output is 5 MW.

The combustion chamber exit temperature is 1500 K.

The temperature of the air entering the compressor is 15°C.

The isentropic efficiency of the compressor is 88% at a pressure ratio of 8:1.

The isentropic efficiency of each turbine is 85% at a pressure ratio of 8:1.

The mass flow of fuel and other system losses may be ignored.

Calculate EACH of the following:

(a) the mass flow of gas through turbine number 2; (5)

(b) the mass flow of air through the compressor; (8)

(c) the thermal efficiency of the plant. (3)

Note: *for air* $\gamma = 1.4$, $c_p = 1.005$ *kJ/kgK*
for gas $\gamma = 1.33$, $c_p = 1.15$ *kJ/kgK*

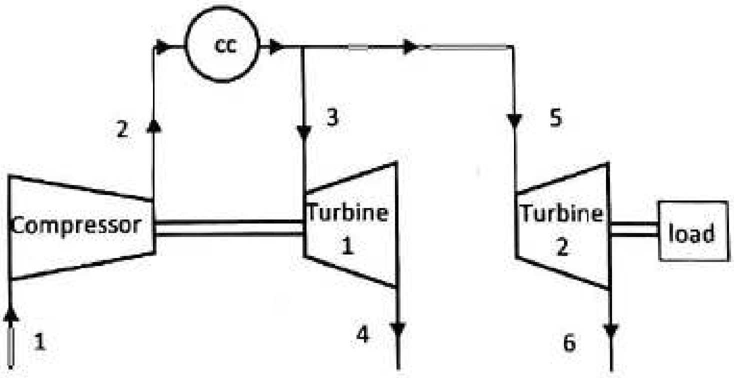

Fig Q2

3. A gaseous fuel has a volumetric composition of 20% CH_4, 24% H_2, 12% CO, 3% O_2 and 41% nitrogen.

It is completely burned in air with an air to fuel ratio of 6 to 1 by volume.

(a) Calculate the volumetric analysis of the combustion products. (7)

(b) Calculate EACH of the following for the dry combustion products:

(i) the characteristic gas constant; (3)

(ii) the specific heat at constant pressure; (4)

(iii) the adiabatic index. (2)

Note: atomic mass relationships C = 12, O = 16, N = 14. H = 1

Air contains 21 % oxygen by volume

Universal gas constant R_o = 8.3145 kJ/kmolK

For CO_2 c_p = 0.939 kJ/kgK

For N_2 c_p = 1.044 kJ/kgK

For O_2 c_p = 0.941 kJ/kgK

4. At entry to a throttle, a mass of 1 kg of wet steam has a pressure of 16 bar and volume of 0.1221 m^3.

It leaves the throttle at a pressure of 8 bar and expands in a hyperbolic process to a pressure of 1 bar.

(a) Calculate EACH of the following:

(i) the steam temperature at the throttle exit; (3)

(ii) the work transfer; (4)

(iii) the change of internal energy for the hyperbolic process; (4)

(iv) the final temperature of the steam. (2)

(b) Sketch the process on a Temperature-specific entropy diagram indicating the pressures and temperatures. (3)

5. The nozzle angle of a two row Curtis wheel is 25° to the plane of rotation. The isentropic specific enthalpy drop in the nozzle is 312.5 kJ/kg and the isentropic efficiency is 90%.

The first row of moving blades has symmetrical blades.

The outlet angle of the fixed blades is half the inlet angle.

The second row of moving blades has an outlet angle designed so that the absolute velocity at stage exit is in the axial direction.

All the blades have a friction coefficient of 0.95 and the mean blade speed is 200 m/s.

(a) Calculate the absolute velocity of the steam leaving the nozzle. (2)

(b) Draw the moving blade velocity vector diagrams to a scale of 1 mm = 5 m/s. (6)

(c) Determine EACH of the following:

(i) the fixed and moving blade angles; (2)

(ii) the power output for a steam flow of 1 kg/s; (3)

(iii) the axial thrust for a stem flow of 1 kg/s. (3)

6. A vapour compression cycle using R134a as the working fluid is to be used as a heat pump.

The working fluid enters the compressor at a pressure and temperature of 2.006 bar and 0°C respectively with a specific volume of 0.1 m^3/kg. It leaves the compressor at a pressure and temperature of 7.7 bar and 50°C respectively and leaves the condenser at a temperature of 25°C.

The compressor has a swept volume of $5.556 \times 10^{-4} m^3$ and a volumetric efficiency of 90% at a speed of 300 rev/min.

The air cooling the condenser has flow rate of 25.73 m^3/min.

The temperature of the air flowing over the evaporator falls by 8 degrees.

(a) Sketch the cycle on Pressure-specific enthalpy and Temperature-specific entropy diagrams, inserting the values on the pressure and temperature axes. (4)

(b) Calculate EACH of the following:

(i) the compressor power; (4)

(ii) the coefficient of performance; (2)

(iii) the volume of air flowing over the evaporator; (3)

(iv) the temperature rise of the air flowing over the condenser. (3)

Note: for air $c_p = 1.005$ *kJ/kgK, density* = 1.177 kg/m^3

7. A steam pipe 150 m in length has an internal diameter 150 mm and wall thickness of 15 mm is covered in a layer of insulation 50 mm thick.

Dry saturated steam enters the pipe at a pressure of 20 bar with a flow rate of 750 kg/hour.

The ambient temperature is -10°C.

Calculate EACH of the following:

(a) the overall heat transfer coefficient of the pipe; (4)

(b) the heat lost from the pipe per hour; (2)

(c) the mass of steam condensed per hour; (6)

(d) the percentage change in the steam velocity between inlet at exit. (4)

Note: inner surface heat transfer coefficient = 8 W/m²K
thermal conductivity of steel = 55 W/mK
thermal conductivity of the insulation = 0.05 W/mK
outer surface heat transfer coefficient = 14 W/m²K

8. A single stage single acting reciprocating air compressor has a bore of 250 mm and stroke of 400 mm.

The inlet pressure and temperature are 95 kN/m² and 30°C respectively, the delivery pressure is 950 kN/m².

The compressor has a volumetric efficiency of 82.5% at a speed of 300 rev/min.

The polytropic index of expansion and compression is 1.28.

The mechanical efficiency of the drive train is 90%.

(a) Sketch the cycle on a Pressure-volume diagram identifying the volumes. (3)

(b) Calculate EACH of the following:

(i) the clearance ratio; (3)

(ii) the compressor input power; (4)

(iii) the rate of heat rejection during the compression process. (6)

Note: for air $\gamma = 1.4$

9 A tank containing lubricating oil has two sharp edge orifice outlets on one side.

The upper orifice has a diameter of 20 mm and its centre is located 1.275 m below the surface of the oil. The centre of the lower orifice is located 2.8 m below the surface.

The oil level in the tank in maintained constant and the mass flow rate through each nozzle is the same.

Calculate EACH of the following:

(a) the mass of oil flowing into the tank per hour; **(8)**

(b) the diameter of the lower orifice. **(8)**

Note: *for oil* $\rho = 850\ kg/m^3$

for the upper orifice $C_v = 0.97,\ C_c = 0.67$

for the lower orifice $C_v = 0.91,\ C_c = 0.72$

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY
MARINE ENGINEER OFFICER

STCW 78 as amended MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-31 - APPLIED MECHANICS

TUESDAY, 15 OCTOBER 2019

1315 - 1615 hrs

Materials to be supplied by examination centres

Candidate's examination workbook Graph paper

Examination Paper Inserts

Notes for the guidance of candidates:

1. Examinations administered by the SQA on behalf of the Maritime & Coastguard Agency.
2. Candidates should note that 96 marks are allocated to this paper. To pass, candidates must achieve 48 marks.
3. Non-programmable calculators may be used.
4. All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

APPLIED MECHANICS

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

All formulae used must be stated and the method of working and all intermediate steps must be made clear in the answer.

1. A jib-crane supports a 15.29 tonne mass from the crane head as shown in Fig Q1. The Samson post is 10 m in length between the derrick and the tie-bar. The ties are not horizontal.

   Determine EACH of the following:

   (a) the magnitude and nature of the force in the derrick; (10)

   (b) the magnitude and nature of the force in each tie. (6)

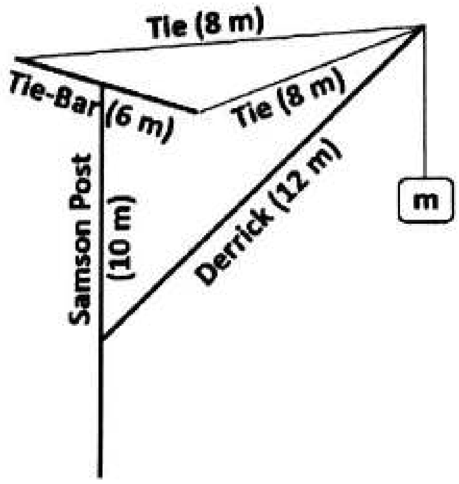

Fig Q1

2. A container of mass 500 kg is hauled up a slope by a light cable attached to a drive mass of 325 kg via a frictionless pulley as shown in Fig Q2. The slope rises 2 m in every 5 m (tan) and the friction angle is 14°.

Calculate EACH of the following:

(a) the acceleration of the container; (10)

(b) the additional mass required to move the container down the slope at constant velocity. (6)

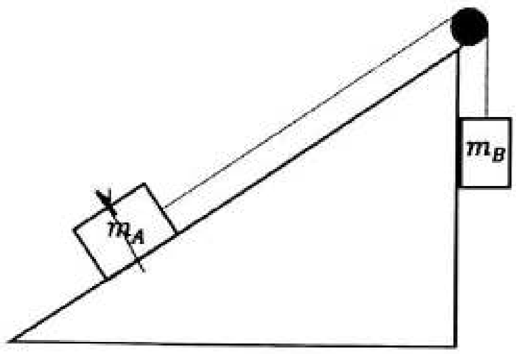

Fig Q2

3. A projectile is fired at an angle of 40° above the horizontal on a cliff top 80 m above sea level. Its initial velocity is 35 m/s.

Calculate EACH of the following:

(a) the velocity and angle of impact; (8)

(b) the maximum linear displacement of the projectile. (8)

4. The tension in a flat belt pulley is 110 N when stationary. The drive wheel is 240 mm diameter and rotates at 1500 rpm. The coefficient of friction between contact surfaces is 0.32 and the angle of lap is 165°.

Using the relationship:

$$\frac{F_1}{F_2} = e^{\mu\theta}$$

where: F_1 = the maximum force in the tight side of the belt
F_2 = the minimum force in the slack side of the belt
μ = the coefficient of friction
θ = the angle of lap in radians

Calculate EACH of the following:

(a) the tension on each side of the belt during operation; (14)

(b) the maximum power transmitted. (2)

5. A 300 mm diameter 525 kg solid shaft is held at rest on an inclined plane. When released it rolls down the incline and takes 2.3 s to attain a velocity of 4.5 m/s.

Calculate EACH of the following:

(a) the release height; (10)

(b) the angle of incline. (6)

6. A 3 kg mass rotates as a conical pendulum on a 1.6 m cord at constant velocity. The cord forms a 25° angle with the vertical axis of its fixing point.

Calculate EACH of the following:

(a) the instantaneous linear velocity of the mass; (8)

(b) the rotational frequency; (4)

(c) the change in height for an increase of 10% in angular velocity. (4)

7. A 1.75 m long steel tube, 4 mm thick with external diameter of 35 mm is simply supported 130 mm from either end. It is loaded with 1.3 kN point loads at both ends.

Neglecting the weight of the tube:

(a) sketch the shear force and bending moment diagrams; (6)

(b) calculate EACH of the following.

(i) the radius of curvature of the tube at mid-span position; (6)

(ii) the shearing stress induced at either support. (4)

Note: Modulus of Elasticity for steel = 206 GN/m^2

8. A 300 mm diameter solid steel drive shaft transmits 2500 kW at 115 rpm to a hollow steel shaft via a flanged coupling. The coupling has 8 bolts with a safe working stress of 46 MN/m^2 fitted on a pitch circle diameter of 650 mm. The hollow shaft has a diameter ratio of 0.75 with the same external diameter as the drive shaft.

Calculate EACH of the following:

(a) the minimum diameter of the coupling bolts; (6)

(b) the maximum shear stress in the hollow shaft; (6)

(c) the angle of twist per unit length of the solid shaft in degrees. (4)

Note: Modulus of Rigidity for steel = 80 GN/m^2

9. A 10 m straight length of steel steam pipe, 180 mm external diameter and 7 mm thick, connects two bulkheads. It is fitted at a temperature of 16°C with linear expansion restricted to 8 mm.

Calculate EACH of the following:

(a) the stress in the pipe when heated to 200°C; (6)

(b) the force exerted by the pipe due to compression; (6)

(c) the strain energy stored within the pipe. (4)

Note: Modulus of Elasticity for steel = 206 GN/m^2
Coefficient of linear expansion for steel = 12 x 10^{-6} /°C

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – MARINE ENGINEER OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 78 as amended MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-34 – NAVAL ARCHITECTURE

FRIDAY, 20 JULY 2018

0915 - 1215 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Non-programmable calculators may be used.
2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate’s examination workbook

NAVAL ARCHITECTURE

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

1. The end bulkhead of the wing tank of an oil tanker has the following widths at 3 m intervals, commencing from the deck are 6.0, 6.0 5.3, 3.6 and 0.6 m.

   The tank is full of oil of density 800 kg/m^3.

   Calculate EACH of the following:

   (a) the load on the bulkhead; (8)

   (b) the position of the centre of pressure. (8)

2. A ship of 4000 tonne displacement floats at a mean draught of 6 m in sea water of density 1025 kg/m^3 but is unstable and has an angle of loll.

   Hydrostatic particulars for the ship in the upright condition at the above displacement are as follows:

Centre of buoyancy above the keel (KB)	=	3.225 m
Height of transverse metacentre above the keel (KM)	=	5.865 m
Tonne per centimetre immersion (TPC)	=	8.0

   To achieve a satisfactory stable condition with a metacentric height of 350 mm, a load of 480 tonne at a Kg of 2.5 m is added to the ship on the centreline.

   Calculate, for the original unstable condition, EACH of the following:

   (a) the height of the original centre of gravity above the keel (KG); (12)

   (b) the angle of loll. (4)

   Note: The vessel may be considered 'wall-sided' between the limits of draught, hence: $GZ = \sin\theta\ (GM + \tfrac{1}{2} BM \tan^2\theta)$

3. A ship of length 140 m has the following hydrostatic particulars when floating at an even keel draught in sea water of density 1025 kg/m^3.

Waterplane area = 1756 m^2
displacement = 12194 tonne
longitudinal metacentric height (GM_L) = 155 m
centre of flotation from midships (LCF) = 2 m aft

The ship in the above condition grounds on a rock which may be assumed to be at a point 50 m forward of midships and settles such that the end draughts are 6.465 m aft and 5.425 m forward.

Calculate the original even keel draught of the ship. (16)

4. A ship of displacement 14000 tonne has a length 130 m, breadth 17 m, and even keel draught of 6.11 m in sea water of density 1025 kg/m^3. The area of the waterplane is 1600 m^2 and the second moment of area of the waterplane about a transverse axis through midships is 1.25×10^6 m^4 with the LCF at midships.

The ship has a full depth empty rectangular compartment of length 13 m and breadth 11 m. The centre of the compartment is on the centreline of the ship 30 m forward of midships.

Calculate the end draughts after the compartment is bilged. (16)

Note: For the purposes of calculating the MCT1cm it can be assumed that $GM_L = BM_L$

5. A uniformly constructed box shaped vessel of length 60 m and breadth 10 m has an even keel draught of 2 m when floating in the light condition in sea water of density 1025 kg/m^3.

The vessel has five holds of equal length and is to be loaded with 4000 tonne of cargo, with equal quantities in each of the centre and end holds, and the balance equally distributed in No.2 and No.4 holds.

The cargo in all holds will be trimmed level.

Calculate EACH of the following:

(a) the maximum amount to be loaded in the centre and end holds in order that a maximum hogging bending moment amidships of 3000 tm will not be exceeded; (10)

(b) the resulting shear force at EACH of the bulkheads. (6)

6. (a) Explain how a force normal to the rudder is produced when the rudder is turned to a helm angle. (3)

(b) Define the term *centre of effort* as applied to a rudder. (1)

(c) Describe how the position of centre of effort changes as helm angle increases. (2)

(d) Explain the term *balanced*, describing the benefits of fitting a balanced rudder. (3)

(e) Describe, with the aid of a sketch, how an angle of heel is produced due to the force on the rudder. (7)

7. A ship consumes an average of 60 tonne of fuel per day on main engines at a speed of 16 knots.

The fuel consumption for auxiliary purposes is 8 tonne per day.

When 1000 nautical miles from port it is found that only 160 tonne of fuel remains on board and this will be insufficient to reach port at the normal speed.

Determine the speed at which the ship should travel to complete the voyage with 20 tonne of fuel remaining. (16)

Note: A graphical solution is recommended

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8. (a) The residuary resistance of a 1/25 scale model of a ship is 7.65 N when tested at 1.75 m/s in fresh water of density 1000 kg/m^3.

The frictional resistance of the ship at 15 knots in sea water of density 1025 kg/m^3 is 185 kN.

Frictional resistance can be assumed to vary with speed to the power 1.825.

Calculate the effective power (naked) for the ship at the speed corresponding to the model test. (8)

(b) The following additional data apply to the ship operating in service at the corresponding speed as calculated in Q6(a), with a propeller having a pitch of 4.75 m.

Appendage and weather allowance	=	23%
Quasi-propulsive coefficient (QPC)	=	0.71
Propeller speed	=	1.9 revs/sec
Taylor wake fraction	=	0.33
Propeller thrust	=	640 kN

Calculate EACH of the following:

(i) the torque delivered to the propeller; (3)

(ii) the propeller efficiency; (3)

(iii) the real slip ratio. (2)

9. (a) Describe how cavitation occurs on a ship's propeller, explaining how it is more likely to occur as draught reduces and sea water temperature increases. (8)

(b) Describe FOUR types of propeller cavitation. (4)

(c) State FOUR detrimental effects of propeller cavitation. (4)

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY –
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STCW 78 as amended MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-33 - ELECTROTECHNOLOGY

THURSDAY, 19 JULY 2018

0915 - 1215 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Non-programmable calculators may be used.
2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook

ELECTROTECHNOLOGY

Attempt SIX questions only.

All questions carry equal marks.

Marks for each part question are shown in brackets.

1. For the circuit shown in Fig Q1, calculate EACH of the following:

   (a) the current in each battery; (10)

   (b) the load voltage; (3)

   (c) the load power. (3)

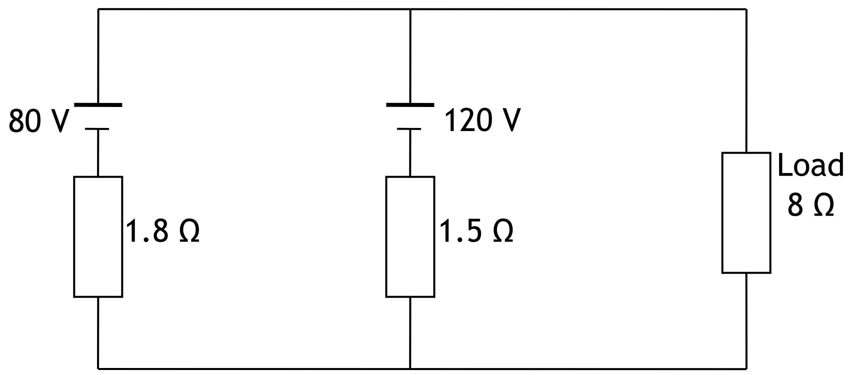

Fig Q1

2. When connected to a 20 V d.c. supply a relay starts to operate 0.52 ms after switching on the supply at which time the instantaneous current is 200 mA. The relay coil has a time constant of 5 ms.

   (a) Calculate EACH of the following:

      (i) the final steady state relay current; (6)

      (ii) the resistance and inductance of the relay coil. (4)

   (b) To increase the operating time a 40 Ω resistor is connected in series with the relay coil.

      Calculate the new operating time. (6)

3. A balanced, star connected, three phase load has a coil of inductance 0.2 H and resistance of 50 Ω in each phase. It is supplied at 415 V, 50 Hz.

Calculate EACH of the following:

(a) the line current; (5)

(b) the power factor; (2)

(c) the value of each of three identical delta connected capacitors to be connected to the same supply to raise the overall power factor to 0.9 lag; (7)

(d) the value of the new line current. (2)

4. A three phase, 440 V, 60 Hz, 8 pole induction motor runs at a power factor of 0.85 lag and drives a load of 8 kW at a speed of 14.4 rev/s. The stator loss is 1 kW and the rotational losses (windage and friction) amount to 0.8 kW.

Calculate EACH of the following:

(a) the synchronous speed; (3)

(b) the rotor copper loss; (5)

(c) the input power to the motor; (4)

(d) the motor current. (4)

5. A three phase, 440 V a.c. generator supplies the following loads:

- 400 kW at power factor 0.8 lagging
- 300 kW at unity power factor
- 250 kW at power factor 0.9 leading

Calculate EACH of the following:

(a) the total kW, kVA and kVAR supplied by the generator; (12)

(b) the generator current and power factor. (4)

6. A single phase, 50 Hz transformer has a turns ratio of 144:432 and a maximum flux of 7.5 mWb. The no load input is 0.24 kVA at 0.26 lagging. The transformer supplies a 1.2 kVA load at a power factor of 0.8 lagging.

Calculate EACH of the following:

(a) magnetising current; (5)

(b) primary current; (8)

(c) primary power factor. (3)

7. With reference to an automatic voltage regulator (AVR) for ship's a.c. generators:

(a) explain why it is needed; (3)

(b) state TWO minimum performance criteria; (2)

(c) sketch a labelled block diagram; (6)

(d) describe the operation of the block diagram sketched in Q7(c). (5)

8. (a) Sketch a labelled diagram of the power circuit for a star/delta starter. (8)

(b) Describe the sequence of operation of the circuit sketched in Q8(a). (6)

(c) State TWO limitations of the star/delta starting. (2)

9. An unstabilised d.c. supply voltage varies between 25 V and 35 V. A voltage stabiliser circuit comprising a 12 V zener diode and a series resistor R is connected across the unstabilised supply. The zener has a slope resistance of 14 Ω and requires a minimum operating current of 1 mA. A 0-80 mA variable load is to be supplied by the stabiliser circuit.

(a) When the supply voltage is minimum and the load current demand is maximum, calculate EACH of the following:

(i) the maximum value for R to give a stable load voltage; (4)

(ii) the load voltage. (2)

(b) Using the value of R determined in Q9(a), calculate EACH of the following:

(i) the load voltage when the supply voltage and load current are both at maximum values; (4)

(ii) the zener diode current when the supply voltage is minimum and the load is switched off; (3)

(iii) the load voltage when the supply voltage is 30 V and the load current is 30 mA. (3)

CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY
MARINE ENGINEER OFFICER

STCW 78 as amended MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-36 - ENGINEERING, SYSTEMS AND SHIP'S DRAWINGS

WEDNESDAY, 15 JULY 2020

1315 - 1615 hrs

Materials to be supplied by examination centres

Candidate's examination workbook
Graph paper

Examination Paper Inserts

DRG - 076
DRG - 077
DRG - 078
DRG - 079
DRG - 080

Notes for the guidance of candidates:

1. Examinations administered by SQA on behalf of the Maritime & Coastguard Agency
2. Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass **AND** also obtain a minimum 40% in Sections A and B of the paper.
3. Non-programmable calculators may be used.
4. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Maritime & Coastguard Agency

SQA

ENGINEERING, SYSTEMS AND SHIP'S DRAWINGS

Attempt ALL questions

Marks for each part question are shown in brackets

Section A

1. Piping Systems - DRG 076

(a) State the identification number of the crossover valve that enables cargo hold bilge water tank to be pumped by ER bilge pump. (2)

(b) State the identification number of the crossover valve that enables engine room bilge water to be pumped by either Cargo hold bilge pump, or Fire/bilge pump. (2)

(c) Describe the function of the compressed air line. (2)

(d) State the function of valve 091, near the forward end of the engine room, describing how and when it is used. (2)

(e) Describe the functions of outlet valves 083 and 084 at the dirty bilge tank. (2)

2. Mechanical Assembly - DRG 077

(a) On the elevation shown, state the discharge side. (2)

(b) State how the impellers are radially located on the shaft. (2)

(c) State with reasons, the type of service for which this pump may be suitable. (2)

(d) Describe how the casing sections and bearing supports are located and secured. (4)

3. Ship's Construction Drawing - DRG 078

(a) State the frame number the flat bottom of the hull starts at. (2)

(b) State the distance from the aft perpendicular to the transom. (2)

(c) State the dimensions and thickness of plate section 'A', identified on the drawing. (2)

(d) With the aid of a sketch, describe the difference in form between longitudinal stiffeners 46-49 and longitudinal stiffeners 43-44. (4)

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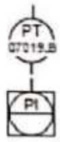
4. Hydraulic and Pneumatic System Drawings - DRG 079

(a) State what the following symbol indicates, and explain its function. (2)



(b) Generator safety control air is stored at 30 bar. State, with reasons, if this can be used to start the generator in an emergency. (2)

(c) State, with reasons, the total supply capacity per hour of the system shown. (2)

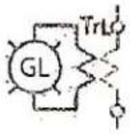
(d) State the diameter of the safety valve discharge line, from the main air receiver. (2)

(e) State the THREE working pressures evident in the system. (2)

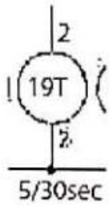
5. Electrical Power Systems and Control Drawings - DRG 080

(a) Describe the function of the supplied drawing. (2)

(b) State what the following items are and describe their function:

(i) 

(2)

(ii) 

(2)

(iii) 6 - 2 
(2)

(c) State the indication given if fuse 'FL' was blown (open circuit) and what effect it would have on the motor starting. (2)

Section B

6. Mechanical Assembly - DRG 077

(a) State the type of seal arrangement used by the pump. (2)

(b) State the total number of casing sections that make up the pump assembly, including the bearing supports. (3)

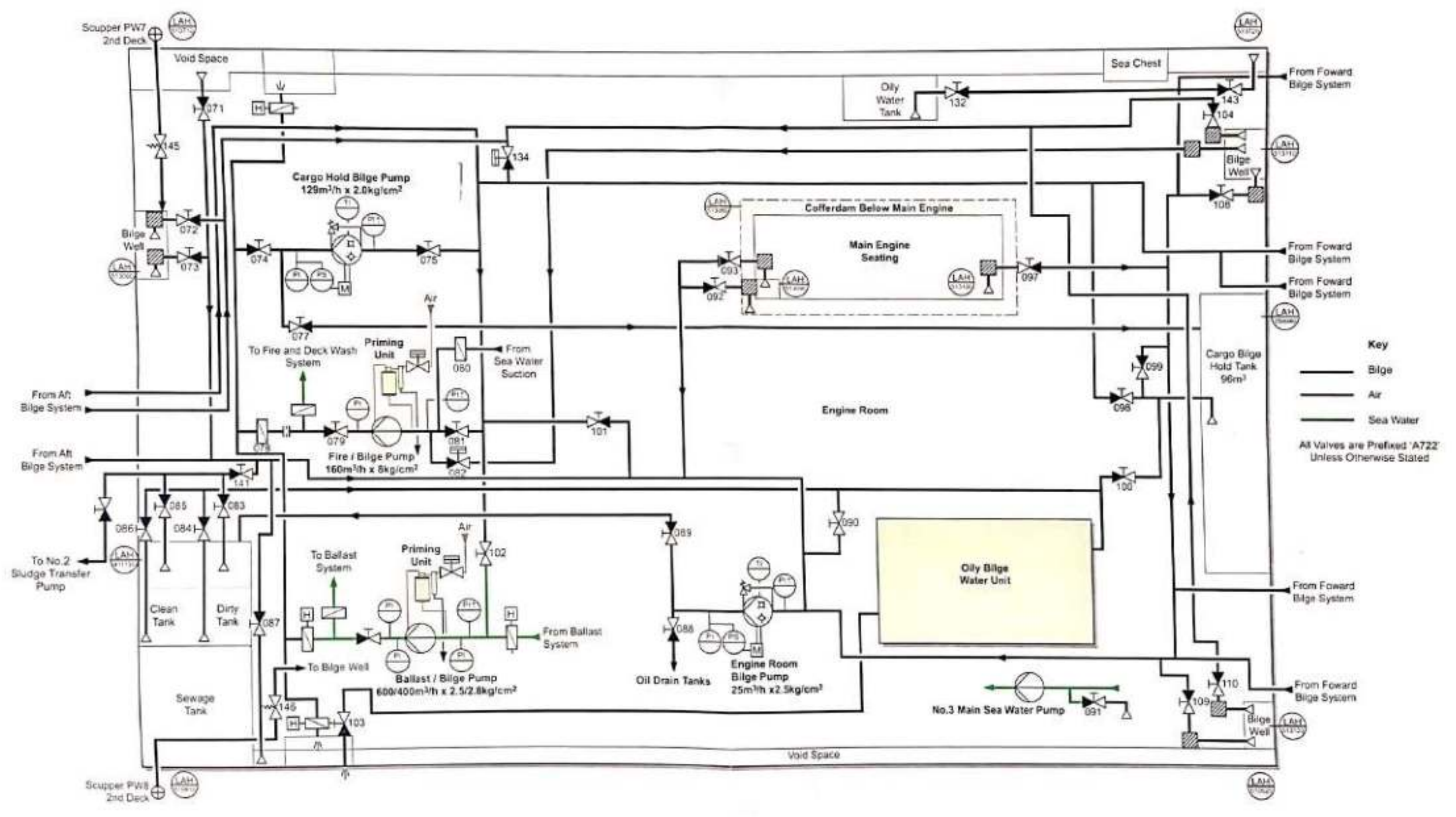
(c) Describe, using drawing references, the procedure for overhaul of the pump assembly. The overhaul should include replacement of all components subject to wear, and reinstatement of correct impeller clearance. (20)

7. Electrical Power Systems and Control Drawings - DRG 080

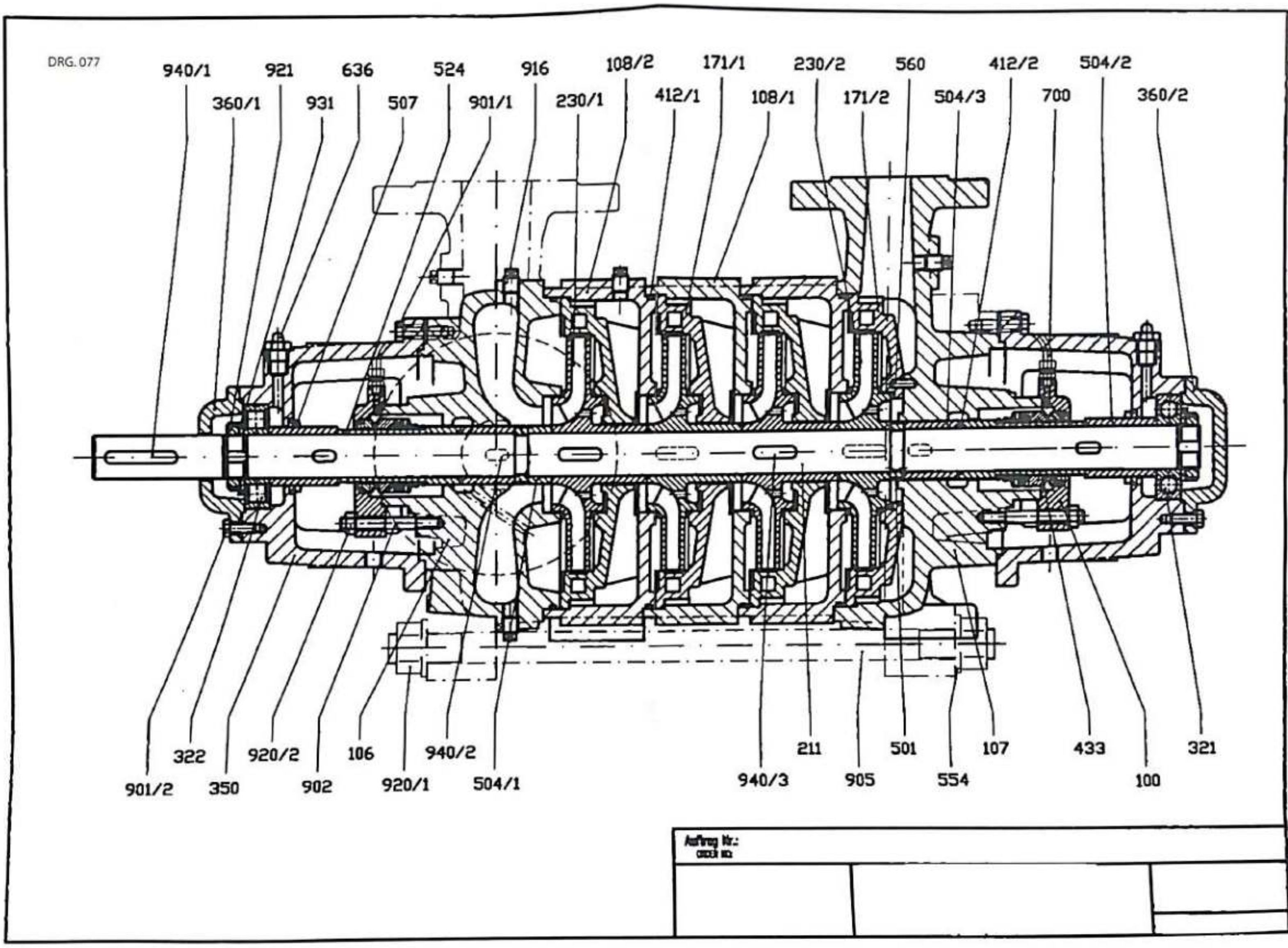
(a) Using drawing references, describe the action and sequence of automated actions that occur for the circuit to complete its designed function. (20)

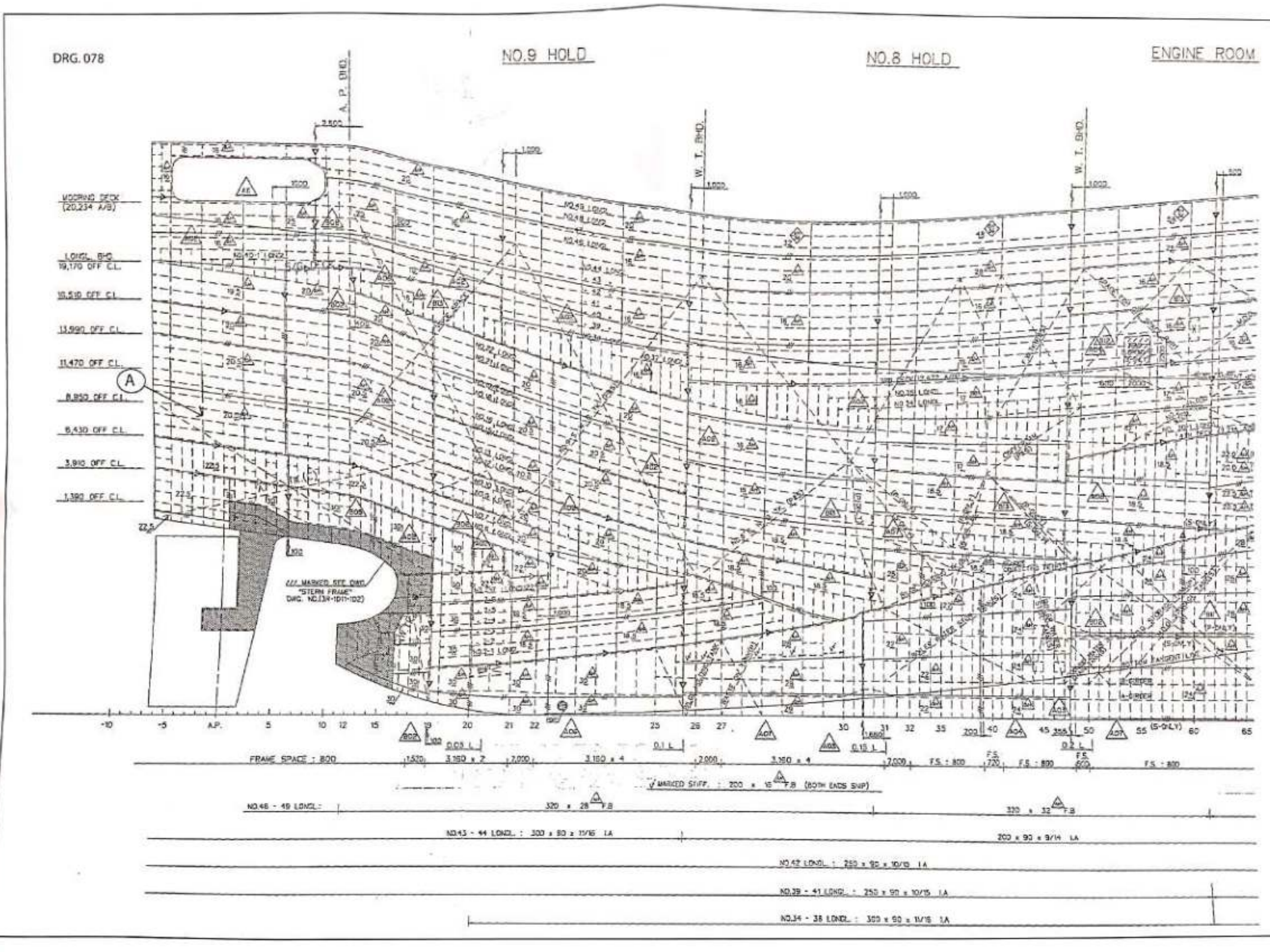
(b) Using drawing references, explain what would occur if there was an open circuit fault in cable '22' when the above sequence was initiated. (5)

DRG. 076

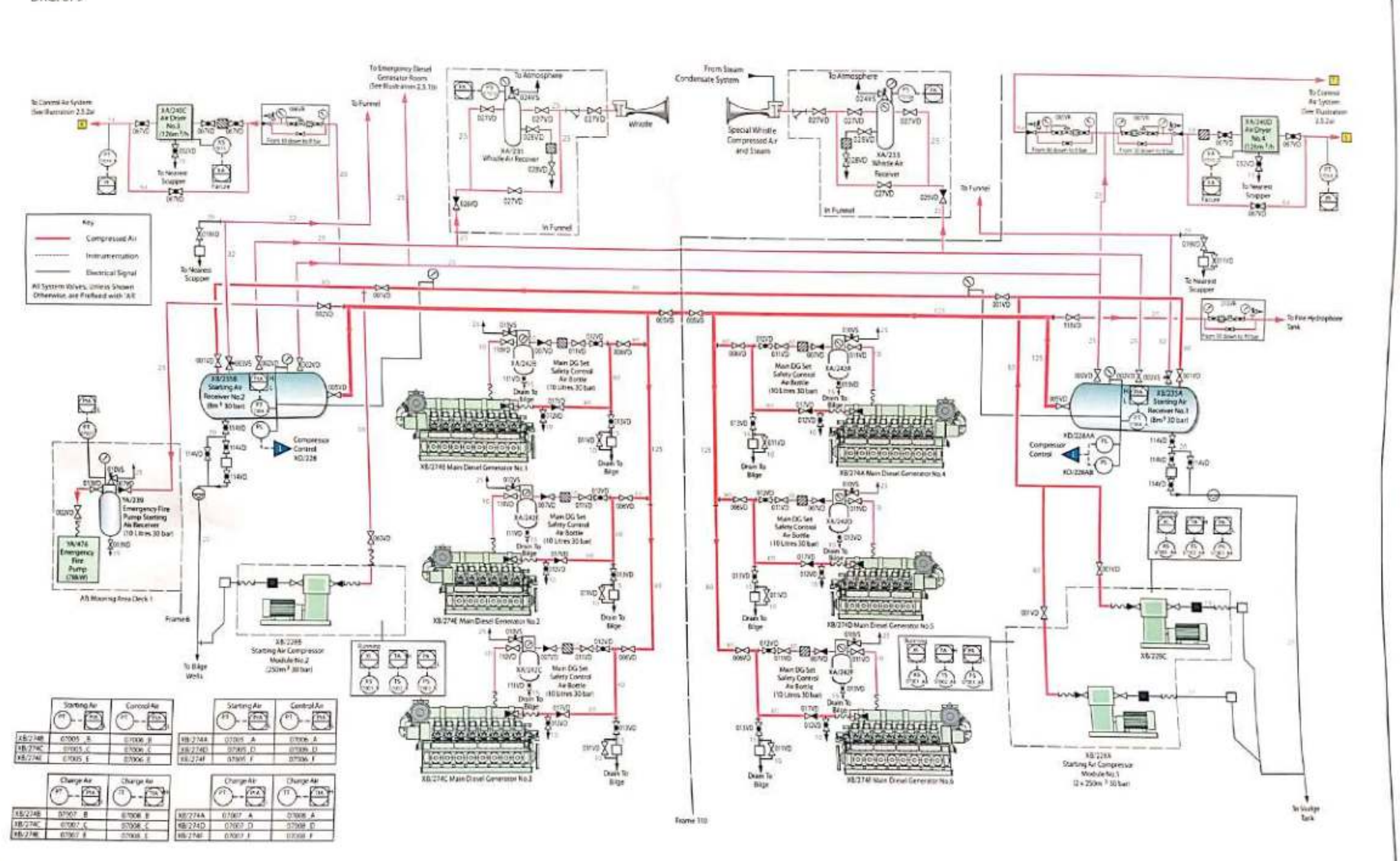


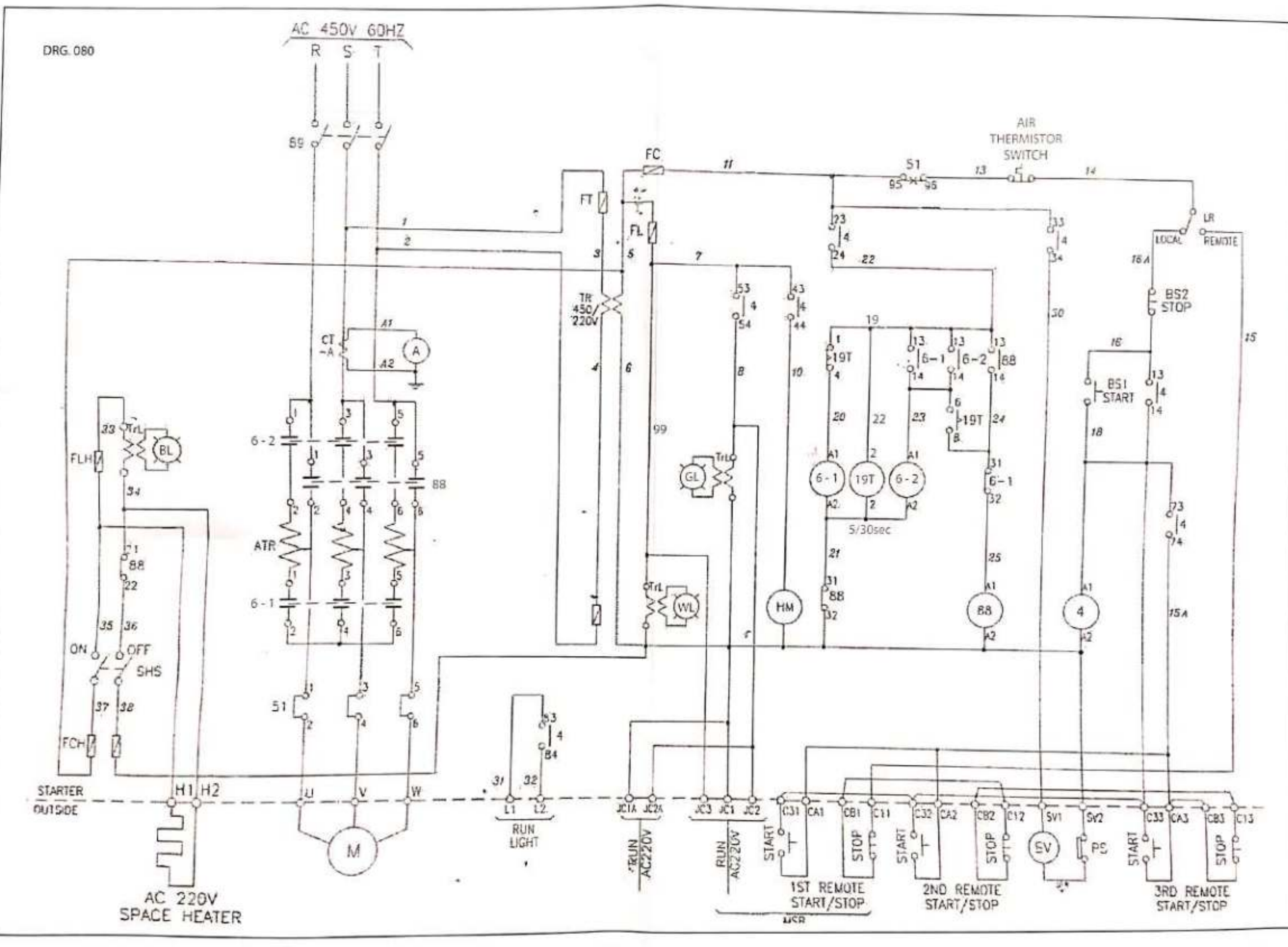
Scupper PW7 2nd Deck
Void Space
Sea Chest
Oily Water Tank
From Foward Bilge System
Bilge Well
Cargo Hold Bilge Pump 129m³/h x 2.0kg/cm²
Cofferdam Below Main Engine
Main Engine Seating
To Fire and Deck Wash System
Priming Unit
Air
From Sea Water Suction
From Aft Bilge System
Fire / Bilge Pump 160m³/h x 8kg/cm²
Engine Room
Cargo Bilge Hold Tank 96m³
Key
Bilge
Air
Sea Water
All Valves are Prefixed 'A722' Unless Otherwise Stated
To No.2 Sludge Transfer Pump
Clean Tank
Dirty Tank
Sewage Tank
To Ballast System
From Ballast System
To Bilge Well
Ballast / Bilge Pump 600/400m³/h x 2.5/2.8kg/cm²
Oil Drain Tanks
Engine Room Bilge Pump 25m³/h x2.5kg/cm²
Oily Bilge Water Unit
No.3 Main Sea Water Pump
Scupper PW8 2nd Deck
LAH


DRG. 077
940/1
921
636
524
916
108/2
171/1
230/2
560
412/2
504/2
360/1
931
507
901/1
230/1
412/1
108/1
171/2
504/3
700
360/2
322
920/2
106
940/2
211
501
107
433
321
901/2
350
902
920/1
504/1
940/3
905
554
100
Auftrag Nr.:
ORDER NO.:


DRG. 078
NO.9 HOLD
NO.8 HOLD
ENGINE ROOM
A. P. BHD.
W. T. BHD.
W. T. BHD.
MOORING DECK
LONGL. BHD
"STERN FRAME"
FRAME SPACE : 800
NO.46 - 49 LONGL.
NO.43 - 44 LONGL. : 300 x 90 x 11/16 I.A
200 x 90 x 9/14 I.A
NO.42 LONGL. : 250 x 90 x 10/15 I.A
NO.39 - 41 LONGL. : 250 x 90 x 10/15 I.A
NO.34 - 38 LONGL. : 300 x 90 x 11/16 I.A

DRG. 079


Key
Compressed Air
Instrumentation
Electrical Signal
All System Valves, Unless Shown Otherwise, are Prefixed with 'A'
To Atmosphere
Whistle
From Steam Condensate System
Special Whistle Compressed Air and Steam
In Funnel
To Funnel
To Emergency Diesel Generator Room (See Illustration 2.5.1b)
To Control Air System (See Illustration 2.5.2a)
To Nearest Scupper
To Fire Hydrophore Tank
XB/235B Starting Air Receiver No.2 (8m³ 30 bar)
XB/235A Starting Air Receiver No.1 (8m³ 30 bar)
Compressor Control
XB/274E Main Diesel Generator No.1
XB/274E Main Diesel Generator No.2
XB/274C Main Diesel Generator No.3
XB/274A Main Diesel Generator No.4
XB/274D Main Diesel Generator No.5
XB/274F Main Diesel Generator No.6
Main DG Set Safety Control Air Bottle (10 Litres 30 bar)
Drain To Bilge
XB/228B Starting Air Compressor Module No.2 (250m³ 30 bar)
XB/228A Starting Air Compressor Module No.1 (2 x 250m³ 30 bar)
XB/229C
YA/239 Emergency Fire Pump Starting Air Receiver (10 Litres 30 bar)
YA/476 Emergency Fire Pump (78kW)
A/B Mooring Area Deck 1
Frame 6
Frame 110
To Bilge Wells
To Sludge Tank
Starting Air
Control Air
Charge Air


DRG. 080
AC 450V 60HZ
R S T
89
FC
FT
FL
TR 450/220V
CT -A
A
6-2
88
ATR
6-1
51
FLH
TrL
BL
ON
OFF
SHS
FCH
GL
WL
HM
AIR THERMISTOR SWITCH
LR
LOCAL
REMOTE
BS2 STOP
BS1 START
19T
5/30sec
STARTER
OUTSIDE
H1 H2
U V W
M
AC 220V SPACE HEATER
L1 L2
RUN LIGHT
JC1A JC2A
RUN AC220V
JC3 JC1 JC2
C31 CA1 CB1 C11 C32 CA2 CB2 C12 SV1 SV2 C33 CA3 CB3 C13
START
STOP
SV
PS
1ST REMOTE START/STOP
2ND REMOTE START/STOP
3RD REMOTE START/STOP