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## 1. GENERAL

1.1 The Tenderer must note that the equipment will be required to work under humid and corrosive conditions and must supply details of design features. To meet these conditions over an extended service life, the maximum working pressure of the system must be limited to 20 MPa.

## 2. DIAGRAMS AND MANUALS

2.1 Graphical diagrams showing each piece of hydraulic equipment including all interconnecting lines, by means of graphical symbols as specified in B.S. 1917/Latest Edition or I.S.O. must be submitted with the tender.

2.2 Final diagrams form part of the drawings that must be supplied according to Specification HE9/2/9. Please refer to HE9/2/9 for details on the requirements for these drawings and delivery times.

2.3 All diagrams should bear SAPO's standard drawing numbering system and should be included in the main drawing index.

2.4 A descriptive text shall be supplied with each diagram and should include the following:

2.4.1 Each item of equipment must have a distinct identification letter or number.

2.4.2 Identification of all hydraulic equipment by name, catalogue number, serial or design number and manufacturer's name.

2.4.3 Size of pipes (outside or inside diameter of pipes and wall thicknesses).

2.4.4 Diameter of each cylinder and length or stroke.

2.4.5 Pump input (kW power required) and speed.

2.4.6 Pressure range and/or setting of all pressure operated components.

2.4.7 The delivery at maximum working pressure for fixed displacement pumps.

2.4.8 Reservoir capacity.

2.4.9 Recommended fluid type and viscosity range as well as cleanliness limits.

2.4.10 Nominal capacity, speed range and torque rating of each hydraulic motor.

2.4.11 Quantity, capacity and type of strainers and/or filters.

2.4.12 Pressure test points.

2.4.13 Identification of directional control valve spool positions.

2.4.14 Flow rate and/or setting of flow controlling or operated components.

2.4.15 Clear identification of all port connections, with the same identification as that marked on the equipment.

2.4.16 Sequence of operations.

2.4.17 Bleed points.

2.5 The service requirements, details and other information for all hydraulic equipment must be incorporated into the manuals as described in HE9/2/9.

2.6 All valves and accessories shall be plainly identified with the same identification as shown on the diagram.

### **3 GENERAL DESIGN REQUIREMENTS**

3.1 All hydraulic system components shall be compatible with the hydraulic fluid used.

3.2 Under conditions of continuous operation, the pump inlet temperature of the fluid must not exceed 65<sup>o</sup>C. The equipment shall operate satisfactorily in an ambient temperature range of 5<sup>o</sup>C to 45<sup>o</sup>C. (Relative humidity 100 %).

3.3 A pressure relief valve capable of relieving the maximum flow at the outlet of the pump shall be provided on the delivery side of the pump and there shall be no other valves between the pump and this relief valve. Where control valves in a closed position or any other circumstances which could result in an excessive hydraulic pressure in any component or circuit, pressure overload must be provided.

3.4 Hydraulic equipment shall be so designed that there is no external fluid leakage or ingress of air into it.

3.4.1 Where the design is such that the ingress of moisture into the hydraulic fluid cannot be completely prevented, the design shall

ensure that moisture is extracted from the system by means of a dryer device.

- 3.4.2 Bleed points shall be provided to release air which would otherwise cause malfunctioning of the system.
- 3.5 Each individual component in a hydraulic circuit shall be capable of functioning satisfactorily after being subjected to a static pressure of 50 % in excess of the maximum working pressure.
- 3.6 Piping shall not be used to support valves or other equipment where such mounting would over stress the piping.
- 3.7 All short stroke cylinder rods shall be protected by means of suitable bellows. On longer stroke cylinders where this is not feasible, full details shall be submitted by the Tenderer on exactly what steps will be taken to minimise the effect of the aggressive environment on the cylinder rods.
- 3.8 Cylinders, motors and pumps shall be mounted in such a way that replacement of seals can be done in situ and without removing other equipment.

#### **4 GENERAL CIRCUIT DESIGN REQUIREMENTS**

- 4.1 All the hydraulic equipment and piping shall be so located or protected as to prevent damage from external forces and adverse atmospheric conditions. All piping must be insulated electrically from the structure.
- 4.1 Hydraulic circuits shall be designed so that load variations and changes in fluid temperature will not cause variations in the cycle time inconsistent with the service intended.
- 4.2 Where pressure testing points are necessary, they shall be provided in accessible positions.
- 4.3 All equipment and piping shall be accessible and shall be mounted in a position that will permit adequate maintenance and adjustment. Components must be removable without undue loss of fluid.
- 4.4 Hydraulic circuits shall be so designed that any failure of a pipe or joint in a circuit will not endanger the operation. All cylinders used for hoisting/luffing motions shall be fitted with burst pipe protection devices directly on the cylinder ports.
- 4.5 Hydraulic circuits for hoisting/luffing shall be fully redundant in terms of both the actuators and hydraulic supply. When a cylinder/pump fails, the motion must still be functional at full load but a reduced speed.

## **5 INSTALLATION REQUIREMENTS**

- 5.1 All openings in hydraulic equipment shall be sealed, and all hydraulic reservoirs shall be thoroughly cleaned prior to installation.
- 5.2 The bores of all piping and fittings shall be cleaned to ensure that all scale, swarf and foreign matter are removed prior to final assembly.
- 5.3 Hydraulic power packs shall be mounted on a common base with a drip pan fixed underneath the machine to catch leaks and spills.

## **6 PUMPS AND MOTORS**

- 6.1 Positive displacement pumps and motors are preferred.
- 6.2 Means are to be provided for filling or draining pump motor casings in accordance with the manufacturer's specifications.
- 6.3 When drive shafts of hydraulic pumps or motors are subjected to side loading, approval of the drive shall be obtained from the supplier of this equipment.

## **7 CYLINDERS**

- 7.1 Cylinder shafts shall be of high quality stainless steel and protected by bellows against dust.
- 7.2 Double seals shall be used on all cylinders.
- 7.3 The end caps of big hydraulic cylinders shall be bolted to the cylinders to enable easy replacement of the seals.
- 7.4 All valves shall be suitable for continuous use in a highly corrosive marine environment, preferably stainless steel construction. Details to be provided with tender.

## **8 VALVES**

- 8.1 Wherever possible, valves should be mounted so that their removal and replacement can be made without disconnecting pipe fittings.
- 8.2 Adjustable valves shall be such that their settings, when made, will be maintained against vibration.
- 8.3 Variable flow control valves shall show the direction of operation for increase and decrease of throughput.

- 8.4 Electrically operated control valves and other hydraulic control equipment shall be grouped and fitted in IP65 panels (as per electrical specifications). All pipes shall enter the panel from the sides or bottom only and through suitable pipe glands.

## 9 FLUID RESERVOIRS

- 9.1 The capacity of the fluid reservoirs shall be sufficient to contain all the fluid that can flow from the system into the reservoir, and maintain the fluid level at a safe working height to prevent cavitation in the pump during the operation cycle.
- 9.2 Reservoirs shall be equipped with flush mounted or protected fluid level indicators. They must be provided with markings indicating high and low levels with pump(s) running and high level with pump(s) stopped.
- 9.3 Reservoirs shall be constructed to prevent entry of foreign matter, including fluid contamination and moisture.
- 9.4 Both fluid intake and return points shall terminate sufficiently below the minimum fluid level to prevent aeration.
- 9.5 Ample and accessible provision shall be made for complete cleaning and filling of reservoirs. The bottom of the reservoir must be shaped in such a way that emptying and cleaning is easily facilitated.
- 9.6 Filler holes shall have strainers which do not unduly restrict the filling process, fixed such that hand tools are required for removal, and shall also be provided with well fitting caps. The breather hole on the reservoir must be protected by an air cleaner with replaceable filter.

## 10 FILTERS

- 10.1 The system shall have a "Rosean Tell-Tale", "Fawcett" or similar, full flow, hydraulic filter with electric light or mechanical flag indication. This filter may be fitted either in the intake, pressure or return lines (subject to the filter's limitations), and shall have a 10  $\mu$ m filtration. Hydraulic coping valves and sensitive servo valves shall be supplied with hydraulic fluid via a 5  $\mu$ m pressure line filter. A mesh, with 0,16 mm aperture (or finer), screen shall be fitted to the pump intake except when the main filter is fitted at that point.
- 10.2 Where swash-plate type hydraulic pumps are used, a 6 $\mu$ m pressure line filter shall be fitted.
- 10.3 All filters shall be easily accessible for replacement without draining the reservoir and/or system.
- 10.4 Junctions shall be provided in the hydraulic system for the testing of both the circuit and the hydraulic pump.

- 10.5 A suitable magnet should also be fitted in the bottom of the reservoir between the return side of the reservoir and the suction strainers. Magnets shall be easily removable for service.

## 11 SEALING DEVICES

- 11.1 All sealing devices shall be of materials which are compatible with the hydraulic fluid and operating conditions.

## 12 PIPING, FITTINGS AND FASTENERS

- 12.1 Where-ever practical, rigid piping must be used in lieu of flexible hoses.
- 12.2 Due to the corrosive conditions copper alloy, nickel alloy or stainless steel piping must be used.
- 12.2.1 Copper alloy piping must comply with the latest version of BS 2871 Part 2.
- 12.2.2 Nickel alloy piping must comply with the latest version of BS 3074.
- 12.2.3 Stainless steel piping must comply with the latest version of BS 3605 Part 1.
- 12.3 Flexible hoses and couplings shall be in accordance with the requirements of B.S.2640 or B.S.3832/Latest.
- 12.4 Piping between actuating and control devices shall be as short as possible and pipes must be removable without dismantling equipment, components or adjacent piping. All rigid piping shall be securely supported to minimise vibration or movement. The length and method of supporting flexible piping shall be such as to avoid sharp flexing and straining, particularly at end fittings.
- 12.5 All hydraulic connectors and adaptors shall have dimensions complying with the latest version of BS 5200.
- 12.6 Only compression fittings must be used throughout (no capillary fittings).
- 12.7 All fittings and couplings shall be corrosion resistant, preferably brass, CUPRO-NICKEL alloy or stainless steel. Surface treated steel fittings are not acceptable.
- 12.7.1 Copper and copper alloy fittings must conform to the latest version of BS 2051 Part 1 or Part 2.
- 12.7.2 Braided Stainless steel fittings must conform to the latest version of BS4368.

- 12.8 All saddles and other accessories for fixing the hydraulic components to a structure shall be corrosion resistant and UV stabilised (where applicable). All threaded and other fasteners shall be stainless steel.
- 12.9 Long pipe runs shall be broken up into sections by flanged connections and manual shut-off valves where necessary.

### 13 SERVICE LIFE OF HYDRAULIC EQUIPMENT

- 13.1 All hydraulic equipment shall be designed to last the design life of the machines they are fitted on.
- 13.2 The following minimum service intervals shall be guaranteed unless otherwise specified:-
- |  |         |
|--|---------|
| 13.2.1 Filter change:                            | 5 000h  |
| 13.2.2 Hydraulic oil changes:                    | 10 000h |
| 13.2.3 Overhauls of pumps, motors and cylinders: | 10 000h |

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**END OF SPECIFICATION HE 9/2/2 [Version6]**

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