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Heavy mechanical - Design specifications for hydraulic system

重型机械 液压系统设计规范

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Foreword

This document was drafted in accordance with the rules given in GB/T 1.1-2020 "Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents".

This is the first edition of the standard: it does not replace an earlier document.

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1 Scope

This document specifies the design criteria, the design procedure, the system composition and the design requirements of the hydraulic systems of heavy machinery, referred to below as hydraulic systems.

It applies to the design of the hydraulic systems of heavy machinery.

NOTE: heavy machinery mainly includes metallurgical equipment, heavy extrusion and forging equipment, mining machinery and similar plant.

2 Normative references

The content of the following documents constitutes, through normative reference in this text, indispensable provisions of this document. For dated references, only the edition corresponding to that date applies; for undated references, the latest edition (including all amendments) applies.

GB/T 786.1 Fluid power systems and components - Graphical symbols and circuit diagrams - Part 1: Graphical symbols · GB/T 786.2 Fluid power systems and components - Graphical symbols and circuit diagrams - Part 2: Circuit diagrams · GB/T 1047 Pipework components - Definition and selection of DN (nominal size) · GB/T 1048 Pipework components - Definition and selection of PN (nominal pressure) · GB/T 3766 Hydraulic fluid power - General rules and safety requirements for systems and their components · GB/T 4458.1 Mechanical drawings - Representation of views · GB/T 4459.1 Mechanical drawings - Representation of screw threads and threaded parts · GB 5083 General rules for designing the production facilities in accordance with safety and health requirements · GB/T 7935 General technical rules for hydraulic components · GB/T 8163 Seamless steel tubes for liquid service · GB/T 14039 Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles · GB/T 14043.1 Hydraulic fluid power - Valves - Identification code - Part 1: Mounting surfaces and cavities · GB/T 14976 Seamless stainless steel pipes for fluid transport · GB/T 16898 Guidelines for the use of fire-resistant hydraulic fluids · GB/T 17395 Dimensions, shapes, masses and tolerances of seamless steel tubes · GB/T 17446 Fluid power systems and components - Vocabulary · GB/T 17490 Hydraulic control valves - Identification of ports, subplates, control devices and solenoids · GB 18613 Minimum allowable values of energy efficiency and energy efficiency grades for motors · GB/T 20079 Specifications for hydraulic filters · GB/T 20663 Accumulator pressure vessels · GB/T 25133 Hydraulic system assemblies - Methods of pipe flushing · GB/T 36997 Hydraulic fluid power - Identification of manifold assemblies and their components · GB/T 37400.3 Heavy mechanical general technical specification - Part 3: Welded parts · GB/T 37400.10 Heavy mechanical general technical specification - Part 10: Assembly · GB/T 37400.11 Heavy mechanical general technical specification - Part 11: Piping · GB/T 37400.12 Heavy mechanical general technical specification - Part 12: Painting · GB/T 37400.16 Heavy mechanical general technical specification - Part 16: Hydraulic system · JB/T 10607 Specification for the use of working fluids in hydraulic systems

3 Terms and definitions

The terms and definitions given in GB/T 17446 apply to this document.

4 Design criteria

The design criteria of a hydraulic system are: a) safety - of personnel, of equipment and of production operation; b) reliability - redundancy and fault-tolerant design, fail-safe design, margin design; c) technical advancement - digitalization, intelligence, green design; d) inheritance - preference for mature technology, modular reuse, design by analogy; e) supportability - ease of maintenance, modularity, standardization; f) economy - economical scheme, economical selection, economical operation and maintenance.

5 Design procedure

The design of a hydraulic system should proceed in five stages: a) scheme demonstration; b) overall scheme design; c) schematic design; d) structural design; e) test verification. The design procedure is set out in Annex A.

6 System composition

A hydraulic system is made up of the power section, the control section, the actuating section, the auxiliary devices and the working fluid, as shown in Figure 1.

7 Design requirements

7.1 General requirements. The system shall comply with GB/T 37400.16 and GB/T 3766; pressure ratings are selected to GB/T 1048 and the nominal sizes of pipes, fittings and in-line valves to GB/T 1047; motor energy efficiency grades shall meet GB 18613; accumulators shall be used in accordance with GB/T 20663; noise and vibration shall meet GB 5083; painting shall meet the process specification and GB/T 37400.12 or the manufacturer's recommendation; and the system should carry components for fault diagnosis, to make digital and intelligent control possible.

7.2 Safety requirements. The design shall meet the safety provisions of GB 5083 and GB/T 3766 and shall take preventive, control or protective measures for the safety of people and machines. Clear and durable warning marks shall state high-pressure hazards, hot surfaces, operating instructions and emergency steps. Critical electrical points shall be connected to an emergency supply so that the safety functions keep working during a power failure. The system shall have complete safety interlocks - hydraulic control interlocks, interlocks with the main machine and forced interlocks in maintenance mode - an obvious pressure-relief point or device in an accessible position, and, against the risk of pressure loss or pipe burst at critical parts, a quick shut-off device in the circuit.

7.3 System schematic diagram. Schematics follow GB/T 786.1 and GB/T 786.2 and the port letter codes of GB/T 7935, GB/T 14043.1 and GB/T 17490. Near a pipe connection the function letter code, the connection type and the nominal bore shall be marked, a numeral being added after the letter where circuits run in parallel. Table 1 fixes the function letter codes: S for suction lines, P for pressure lines, T for return lines, A and B for the two working lines, L for drain lines, X for control-oil supply and Y for control-oil return. Typical circuit designs are given in Annex B.

7.4 Hydraulic pumps and pump sets. Pumps are selected with reduced pressure, speed or power to improve reliability and life; a pump should have its own cooling and flushing circuit to avoid overheating. A system that runs continuously, is safety-critical or is costly to shut down shall have a standby pump set with condition monitoring and automatic changeover.