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Guidance on Industry Standard for Hydraulic Power Supplies

GIS 38-400

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GIS 38-400. This Guidance on Industry Standard (GIS) is based on parts of heritage documents from the merged BP companies as follows:

BP

GS 134-1

Hydraulic Power Supplies

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1. Scope

This GIS provides guidance on industry standard for the design, fabrication, testing, and installation of hydraulic power supplies and associated piping systems for applications that require on demand transmission of fluid power.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

American Society of Mechanical Engineers (ASME)

ASME B16.9	Factory Made Wrought Steel Butt-welding Fittings.
ASME VIII	Pressure Vessel Codes

British Petroleum (BP)

GP 12-20.	Motors
GIS 12-201.	IEC Low Voltage Induction Motors
GIS 12-202.	NEMA Low Voltage Induction Motors
GIS 12-203.	IEC High Voltage Induction Motors
GIS 12-204	NEMA High Voltage Motors
GIS 30-051	Pressure Gauges
GIS 34-305	Diesel Engines
GP 60-50	General Issues – Equipment Packages

British Standards Institute (BSI)

BS 1306	Copper and Copper Alloy Pressure Piping Systems.
BS EN 837-1	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements, and testing.
BS 4368	Carbon and Stainless Steel Compression Couplings and Tubes: Part 1: Specifications for Heavy Series Couplings. Part 3: Compression Couplings for Tubes. Part 4: Specification for Type Test Requirements.
BS 5045	Transportable Gas Containers: Part 1: Specification for Seamless Steel Gas Containers Above 0.5 litre Water Capacity.
PD 5304	Safe Use of Machinery.
PD 5500	Pressure Vessel Codes

International Organisation for Standardisation (ISO)

ISO 1219	Specification for Graphical Symbols Used on Diagrams for Fluid Power Systems and Components.
ISO 1436	Specification for Wire Reinforced Rubber Hoses and Hose assemblies for Hydraulic Installations.



ISO 3862	Specification for Spiral Wire Reinforced Rubber Covered Hydraulic Hoses and Hose Assemblies.
ISO 4406	Hydraulic Fluid Power Standards Contamination Coding
ISO 16889	Hydraulic Fluid Power Filters

Occupational Safety and Health Administration (OSHA)

Part 1910.95	Occupational Noise Exposure
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Society of Automotive Engineers (SAE)

SAE J517	Hydraulic Hose Standard.
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3. Definitions

actuator

Device for converting fluid power (pressure and flow) into mechanical power, e.g., motor or hydraulic cylinder.

closed loop system

System in which one (or several) pumps are associated with one (or several) motors, allowing oil to continuously circulate between pump(s) and motor(s). Oil loss from loop is replenished by separate makeup pump supplying oil to low pressure side of loop.

design pressure

Pressure at which components within system are designed to withstand. At least equal to maximum working pressure.

maximum working pressure

Maximum pressure at which circuit or component may operate under extreme conditions, for example, at that governed by relief valve setting. Special interpretation may be required for systems involving cross line relief valves.

open loop system

System in which hydraulic fluid is drawn from reservoir by pump and then delivered to motor or cylinder drivers via control system, before dumping back to reservoir.

test pressure

Pressure to which system is tested prior to commissioning. This is highest pressure hydraulic system will be subject to under normal circumstances.

working pressure

Pressure generated in circuit or component during steady state operation of system.

4. Safety

4.1. Emergency stop

Manually initiated emergency stop facility shall be provided local to power pack and at remote operator console.

Normally, button switch, red, mushroom headed, stay put, manual reset type will suffice. If activated, prime movers should stop and equipment motions cease, even with motion controls in the fully selected position.



4.2. Overpressure protection

- a. Components in hydraulic circuit shall be protected against overpressure.
- b. If overpressure can result from single component failure and if this could lead to major system or component damage, components or parts of systems susceptible to such overpressure shall have overpressure protection.
- c. Components or parts requiring protection include:
 - 1. Parts of systems located downstream of pressure regulator should be protected by relief valve in case of regulator failure if they are not able to withstand higher supply pressure.
 - 2. Differential area cylinders operated through pilot operated non-return valves shall either be designed for intensified supply pressure or fitted with local relief valve, in case of pilot operated non-return valve failure.

Such considerations are also relevant to FMEA performed.

- d. Overpressure protection shall permit full fluid flow without maximum working pressure of components and piping being exceeded.

4.3. Hazardous areas

- a. If equipment may be subjected to hazardous atmosphere, appropriately protected and certified equipment shall be used.
- b. Electrical equipment should be certified for use in appropriate hazardous area by British Approvals Service for Electrical Equipment in Flammable Atmospheres (BASEEFA) or Underwriters Laboratories (UL).

Equipment certified by other organisations may be suitable - seek expert advice.

4.4. Failure modes and effects analysis (FMEA)

Vendor shall consider whether complexity of system or consequences of failure of system are serious enough to warrant FMEA being performed.

An FMEA is a useful tool to highlight weaknesses in a complex system design and means to overcome them. FMEAs should always be considered if the consequence of the systems failure to function properly can result in loss of life or major equipment loss.

An FMEA would usually be performed by an independent consultant, in accordance with an agreed standard. This requires, in advance of the FMEA, Vendor and BP to agree on which of the failure consequences is subject to corrective action.

Consequences are often categorised as:

- I Loss of life or catastrophic equipment loss.*
- II Serious injury or major equipment loss.*
- III Minor injury or minor unacceptable equipment damage.*
- IV Minor acceptable equipment damage.*

Depending on a judgment or calculation of the likelihood of these consequences, Category I and II failures will usually demand corrective action through revised system design.



5. Design considerations

5.1. General

- a. System shall be designed such that all components operate within manufacturer specifications, data sheets, and procurement documentation.
- b. Units shall be sized and its main features specified by use of data sheets. Data sheets shall be completed jointly by Vendor and BP and form basis for purchase order.
- c. System shall not present hazard to personnel or cause damage to other equipment.
- d. Unless otherwise specified in this GIS, the data sheets, or the procurement documentation, the applicable requirements in GP 60-50 shall be followed. Company and supplier shall determine the requirements that are applicable.

5.2. Design philosophy

- a. Design philosophy for system should be based on minimising life cycle costs.
- b. Overall design philosophy should be based on:
 1. Component reliability rather than redundancy.
 2. Avoidance of components of known low reliability.
 3. Simplicity of design.
 4. Indication of fault states rather than their observation through malfunction.
 5. Minimisation and ease of maintenance.
 6. Fail safe logic.
 7. Compatibility with local environmental conditions.
- c. Hydraulic system capacity shall be:
 1. Defined on its volume and flow rate.
 2. Sufficient to maintain system pressure within defined band, if subject to hydraulic service loads specified.
 3. Dwell, thermal storage, and differential actuator volume effects shall be taken into account.
- d. Provisions shall be made to permit air bleeding of system.
- e. Hydraulic circuits shall be protected from gas, liquid, or solid contaminants during assembly and normal operation. Filters shall be installed to protect sensitive components
- f. Design pressure shall be adequate to meet testing requirements. Design pressure of any part of system and its associated components shall be not less than maximum working pressure of any component in that part of system.
- g. If system is required to operate continuously and/or with high reliability, component redundancy shall be provided.

These circumstances will typically require either:

- *A duplicate (standby) pump to the running pump, with automatic quick changeover, alarm, and isolation of defective pump circuit.*
- *Multiple running pumps.*

Multiple actuators may possibly be required.



In either case, each pump should have individual prime movers, pressure line filter, pressure control valve, associated loading valve, if required, and relief valve with dump line sight glass.

- h. System should be designed such that interaction between duplicated components, particularly relief valves would not be possible.
- i. Pressure drops resulting from maximum operating fluid flow, selected line size, and number of bends shall be compatible with safe system operation across operating temperature range.
- j. System shall be fitted with bleed points to permit safe release of air at positions where build-up of air is likely. Bleeding device shall be of design such that moving part remains captive at all times.

Air in a hydraulic system will affect system operation.

- k. Means to prevent ingress of airborne liquid or solid contaminants and moisture accumulation through breathing shall be provided.

Bladder compensators are preferred and, if used, overpressure and vacuum relief check valves need to be fitted to protect the bladder. This requirement may be relaxed for systems permanently sited in a controlled indoor environment.

- l. Hydraulic fluid and additives used shall be agreed between Vendor and BP. If practical and appropriate for duty, BP fluids shall be used. Fluid shall retain its essential properties at all temperatures between maximum and minimum design temperature. Fluid with high viscosity index is preferred. Due consideration shall be given to predicted fluid viscosity at both start up and operating temperatures.

Viscosity index (VI) indicates the change in viscosity to be expected with increased temperature. The higher the VI, the more stable the system behaviour will be under load.

- m. Components used in hydraulic systems shall be compatible with selected hydraulic fluid and with maximum operating temperature. In particular, care shall be taken if selecting materials for “O” rings, gaskets, and seals.
- n. Materials of system components shall also be compatible with or adequately protected from environment in which system will operate.
- o. Lifting points designed and certified to statutory requirements shall be fitted to heavy or bulky equipment to assist in handling and removal.
- p. If grit blasting is required, hydraulic components shall be protected from contamination.

5.3. Maintenance and operations

- a. Drip trays shall be provided to collect fluid lost during maintenance.
- b. Removal of main components from system for maintenance shall be possible with minimum loss of fluid and minimal disturbance to surrounding pipe-work.

It can be assumed that maintenance which requires the dismantling of individual components will be performed away from the system site in a clean workshop.

- c. For major components (pumps) or those requiring frequent maintenance, means of isolation prior to component removal shall be provided if this would otherwise result in major loss of fluid or inconvenience (draining of reservoir).
- d. Facilities for air bleeding shall be provided.
- e. Component layout shall be such that adjustment or removal of major components or pipe-work shall be possible without dismantling of adjacent equipment.

