

DEP SPECIFICATION

HYDRAULIC SYSTEMS FOR THE OPERATION OF ON/OFF VALVES IN PROTECTIVE FUNCTIONS

DEP 31.36.10.30-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for hydraulic systems for the operation of double-acting and spring-return on/off valves in (instrumented) protective functions and Remote Operated Valves (ROV) in order to contain inventory in large processing equipment during fire emergencies.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2015; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Abbreviations

Term	Definition
BPCS	Basic Process Control System
ESD	Emergency Shut-Down
FAT	Factory Acceptance Test
IPF	Instrumented Protective Function, also known as SIF
IPS	Instrumented Protective System
MCC	Motor Control Centre
MTBF	Mean Time Between Failure
PAS	Process Automation System (BPCS + SIS)
PEFS	Process Engineering Flow Schemes
PFD	Probability of Failure on Demand
PM	Proactive Maintenance
RED	Requisition for Engineering Documents
ROP	Remote Operating Panel
ROV	Remote Operated Valve
SCU	Self-contained hydraulic unit
SIF	Safety Instrumented Function (also referred to as IPF in Shell DEPs)
SIL	Safety Integrity Level
SIS	Safety Instrumented System

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (21).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2015. The following are the main, non-editorial changes.

Section/Clause	Change
all	Restructured and clarified requirements, enforced use of shall/should/may for normative statements.
multiple	Many minor changes have been incorporated.
4 Item 1	Added spring-return actuator volume to the usable volume of the hydraulic fluid reservoir
4 Items 3 and 4	Clarified when the accumulator shall be charged in 30 minutes or in 120 seconds.
4 Item 6	Removed piping volume from the hydraulic fluid reservoir reserve capacity
5 Item 3	Clarified return pressure levels
7 Item 2	Clarified how the maximum stroking time shall be applied
8 Item 6 sub c	Removed the upper pressure limit of 310 bar (4500 psi)
8 Item 8	Clarified that the liberal clean pressure drop requirements apply to both pressure line filter and return line filter
9 Item 1, Table 1	Distinguished between double-acting actuators and single-acting spring-return actuators for pressure control requirements
10.1 Item 2 sub d. and e.	Clarified that "Pump discharge filter clogging alarm" may be eliminated if a "Hydraulic accumulator header low pressure alarm" is provided for pumps controlled by accumulator pressure.
11 Item 8	Clarified when a hydraulic hand pump shall be provided.
13 Item 3	Added option to install a bursting disk upstream of the nitrogen relief valve to avoid frequent pressure top-up.
14.1 Item 1	Limited the requirement for piston type accumulators to systems containing double-acting actuators.
14.6 item 1	Added pump types for pressures higher than 210 bar (3000 psi), as the original requirement for submerged gear type pumps did not consider that system pressure could be above this limit.
14.11 Item 3	Clarified property requirements and testing for environmentally acceptable hydraulic fluids and replicated product examples listed in ISO 13628-6
20.1 Item 4	Included a suggestion to utilize cleaning pigs to facilitate flushing.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. HYDRAULIC SYSTEMS – GENERAL REQUIREMENTS

2.1 BACKGROUND

The requirements for hydraulic systems within the scope of this DEP are specified for two main functional applications:

- a. manual operation of e.g., Remote Operated Valves (ROV) in order to contain inventory in large processing equipment during fire emergencies: this function requires remote operating panels for manual intervention to combat the emergency;*
- b. automatic operation of e.g., Emergency Shutdown Valves (ESD) as part of a Safety Instrumented Function (SIF) where executive action is performed by a Safety Instrumented System (SIS): this function does not permit the use of remote and/or local operating panels.*

In the context of this DEP, local and remote operating panels are only those panels designed for manual switching of on/off valves by means of directional valves. Field panels designed as part of a SIS (e.g., containing a local ESD button) are not included in the definition.

2.2 GENERAL

1. The hydraulic system shall be designed so that troubleshooting and maintenance can be executed without disruption to the operability of the system.
2. Minor equipment faults (e.g., a small leakage of hydraulic fluid, nitrogen, or instrument air supply) shall not disturb normal plant operations.
 - a. Unintentional opening or closing of the on/off valves shall not be possible (e.g., due to a supply pipe burst or for any other reason).
3. The layout of a hydraulic system shall be as shown schematically in Figure 2.1 and Figure 2.2.

Figure 2.1 Layout of a hydraulic system for the manual operation of on/off valves with a protective function

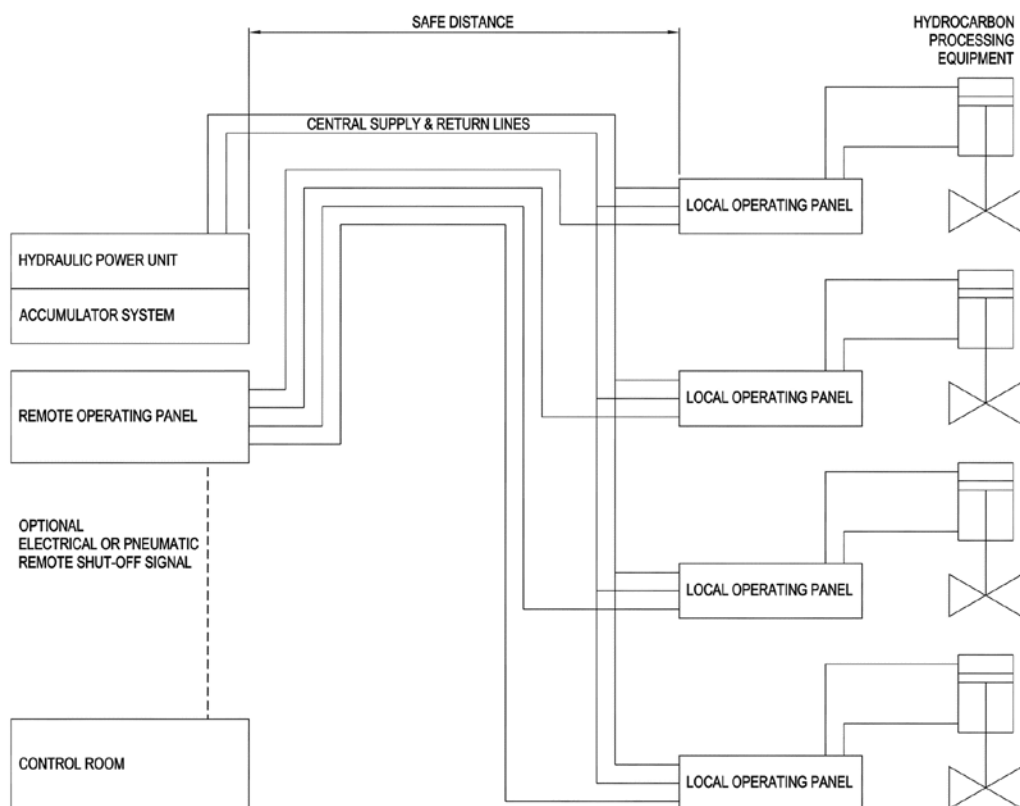
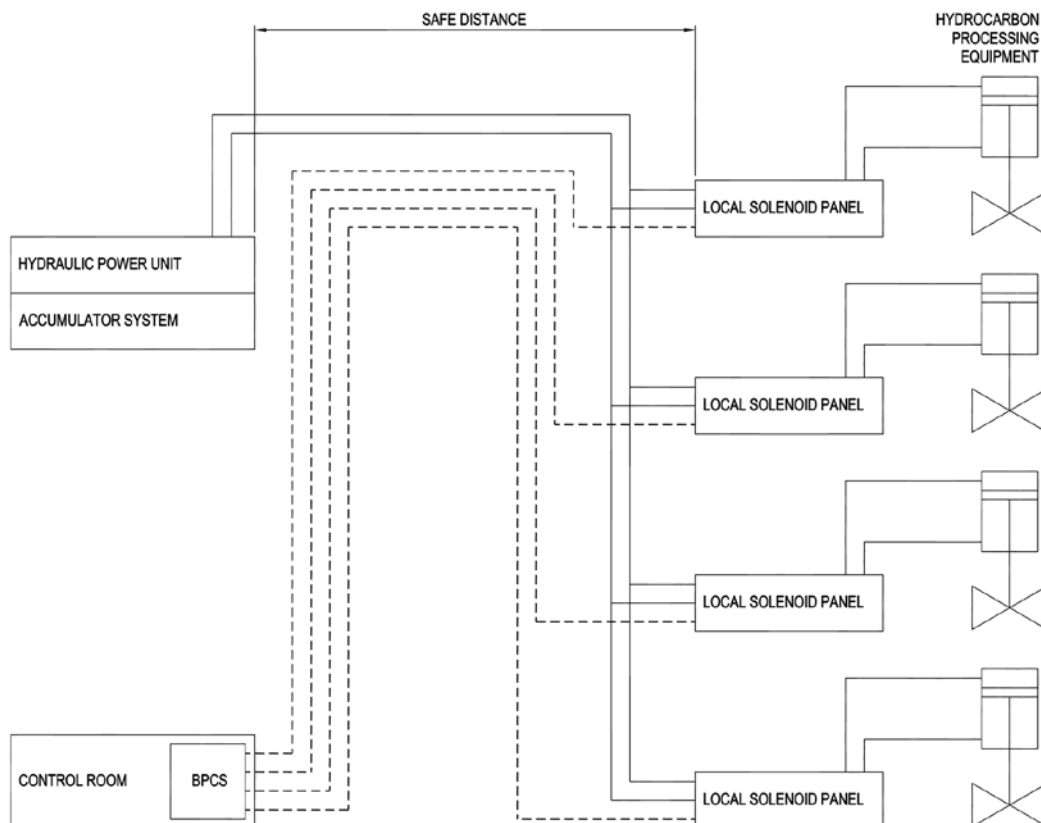


Figure 2.2 Layout of a hydraulic system for the BPCS operation of on/off valves



2.3 ORDERING

2.3.1 Responsibilities

1. The Contractor shall specify in the requisition the functions (manual or automatic operation), requirements, and types of on/off valves to be installed, as well as the basic requirements for the actuator and hydraulic system packages.
2. The hydraulic system Supplier shall be responsible for the engineering, delivery, and functioning of the entire system, including integration of actuators and valves.
3. The valve Manufacturer shall be responsible for the performance of the valve and assembly, and shall provide data to the hydraulic system Manufacturer to sufficiently size the actuator; see (14.3).
4. The Contractor shall specify in the requisition whether or not the hydraulic system Supplier is required to supervise installation at site.

2.3.2 Requisition/Datasheet

1. This DEP shall be used in conjunction with Requisition sheet DEP 31.36.10.93-Gen. and Requisition for Engineering Documents (RED) sheet DEP 40.10.01.93-Gen.

2.3.3 Information to be submitted with the Tender

1. A hydraulic process engineering flow scheme (PEFS) shall be provided showing all equipment, lines, valves, and instrumentation, and indicating limits of supply.
2. The following information shall be included in the Tender:
 - a. the pump capacity, accumulator capacity, tank capacity, heating and/or cooling capacity;
 - b. minimum system pressure to close and open all on/off valves;
 - c. minimum required hydraulic fluid/nitrogen volume;
 - d. maximum system pressure;
 - e. normal operating pressure;
 - f. return line pressure (not applicable to a SCU);
 - g. weights and outline dimensions of the modules;
 - h. main dimensions of the power pack with hydraulic fluid reservoir (tank) and of the mobile unit;
 - i. completed noise limitation sheet - refer to DEP 31.10.00.94-Gen.;
 - j. names of all proposed sub-suppliers with a full description of the equipment being supplied by them;
 - k. required spare parts for commissioning;
 - l. spare parts required for day-to-day maintenance for a period of three years after commissioning;
 - m. special tools required;
 - n. manufacturer recommended maintenance plan, including PM activities and proactive replacement of components for which the time between the detection limit of the degraded condition and the occurrence of critical failure falls within the recommended maintenance and inspection cycle (MTBFs to be advised);
 - o. list of deviations, if any, from the requirements of this DEP or other standards/requirements that have been specified.

3. SYSTEM CONFIGURATION

3.1 DEFINITION OF MAIN COMPONENTS

The main components of the hydraulic system include:

- a power pack for the supply of the hydraulic pressure and flow rate containing:
 - o a hydraulic fluid reservoir (tank) with drain valve (including blind flanges), instrumentation and an inspection hole with cover;
 - o connections for an oil filtration unit/filling unit, including valves and hose quick couplings;
 - o an aeration filter including a water vapour block (H₂O gate or adsorber filter);
 - o two hydraulic fluid pumps;
 - o separate high pressure drop discharge filters for each pump without bypass but with instrumented and alarmed clogging indicator;
 - o (except for SCUs), a return filter with bypass and, for the highest pressure range, in combination with a circulation loop with a filter of finer filtration grade as the return filter;
 - o a mobile hydraulic pump unit;
 - o a hydraulic fluid hand pump.
- an accumulator back-up system to ensure full hydraulic pressure in case of pump failure;
- remote operating panel(s) - only permitted and required in cases where the executive action to the on/off valves is not initiated by a SIS;
- hydraulic actuator(s) to operate the on/off valves;
- tubing inside the power pack;
- interconnecting piping or, where permitted, tubing between power pack and valve actuators;
- electric cables/wiring;
- instrumentation;
- skids/racks.

Simplified flow schemes of the main parts of hydraulic circuits compliant with the requirements in this DEP are shown in Figure 3.1 to 3.5.

3.2 OPTIONAL FUNCTIONALITY

1. Optionally, the hydraulic system may be provided with the following components:
 - a. local operating panel(s);
 - b. heating;
 - c. cooling;
 - d. weather shielding;
 - e. permanent or portable bypass oil filtration unit having an ISO 16889 rating of $\beta_3 \geq 200$.

3.3 TYPICAL HYDRAULIC SCHEMATICS

For explanation of graphical symbols used for components in the circuit diagrams, see ISO 1219-1.

Figure 3.1 Simplified flow scheme for a hydraulic power pack and accumulator rack

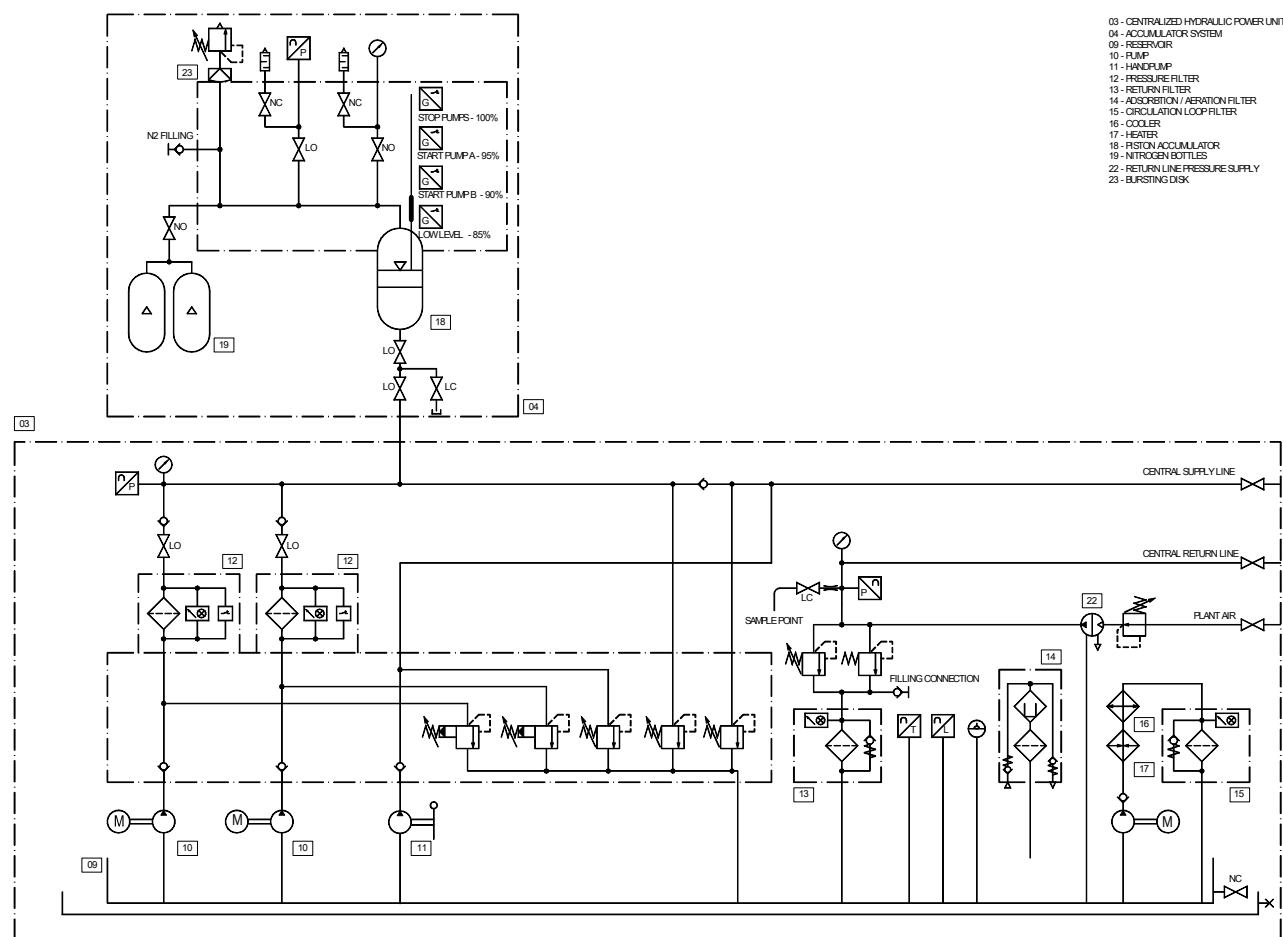


Figure 3.2 Simplified flow scheme for the manual remote operation of on/off valves with a double-acting hydraulic actuator

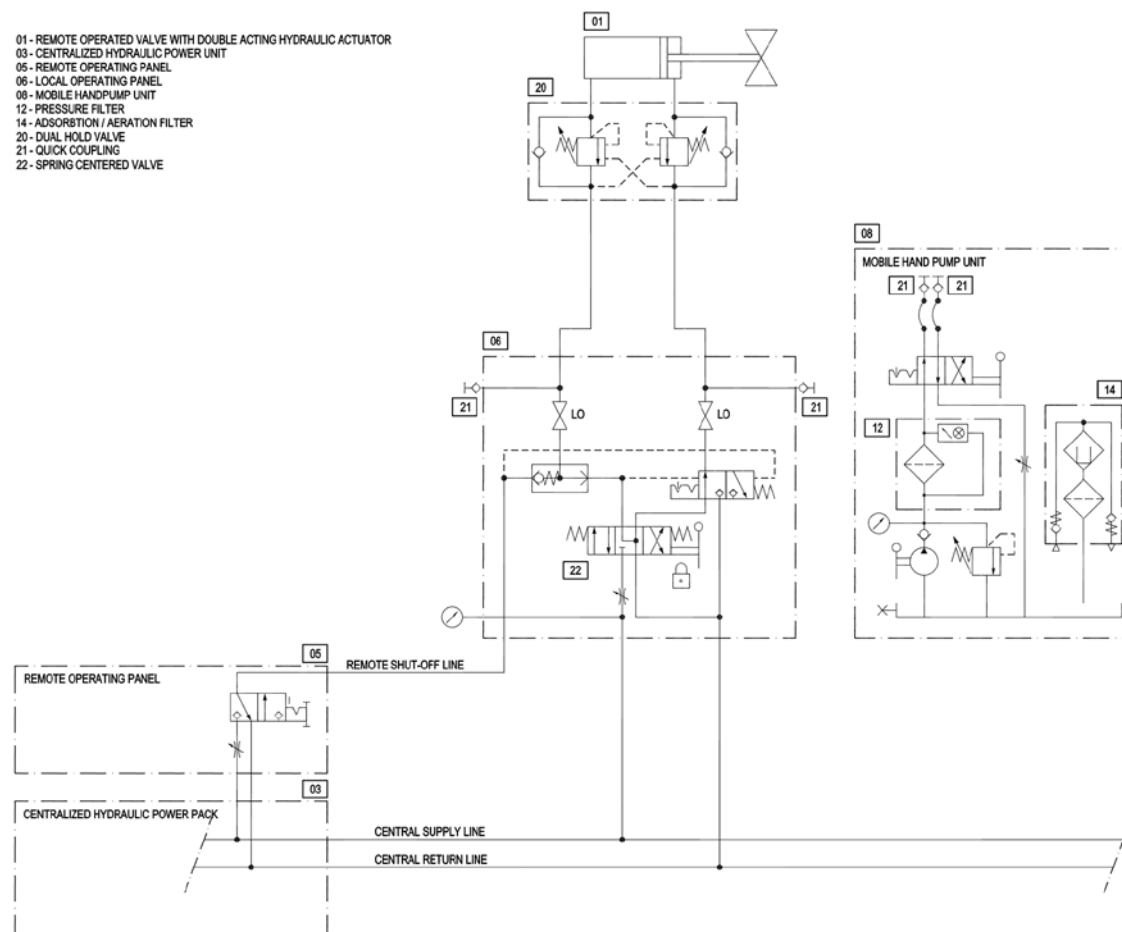


Figure 3.3 Simplified flow scheme for the manual remote operation of on/off valves with a spring-return hydraulic actuator

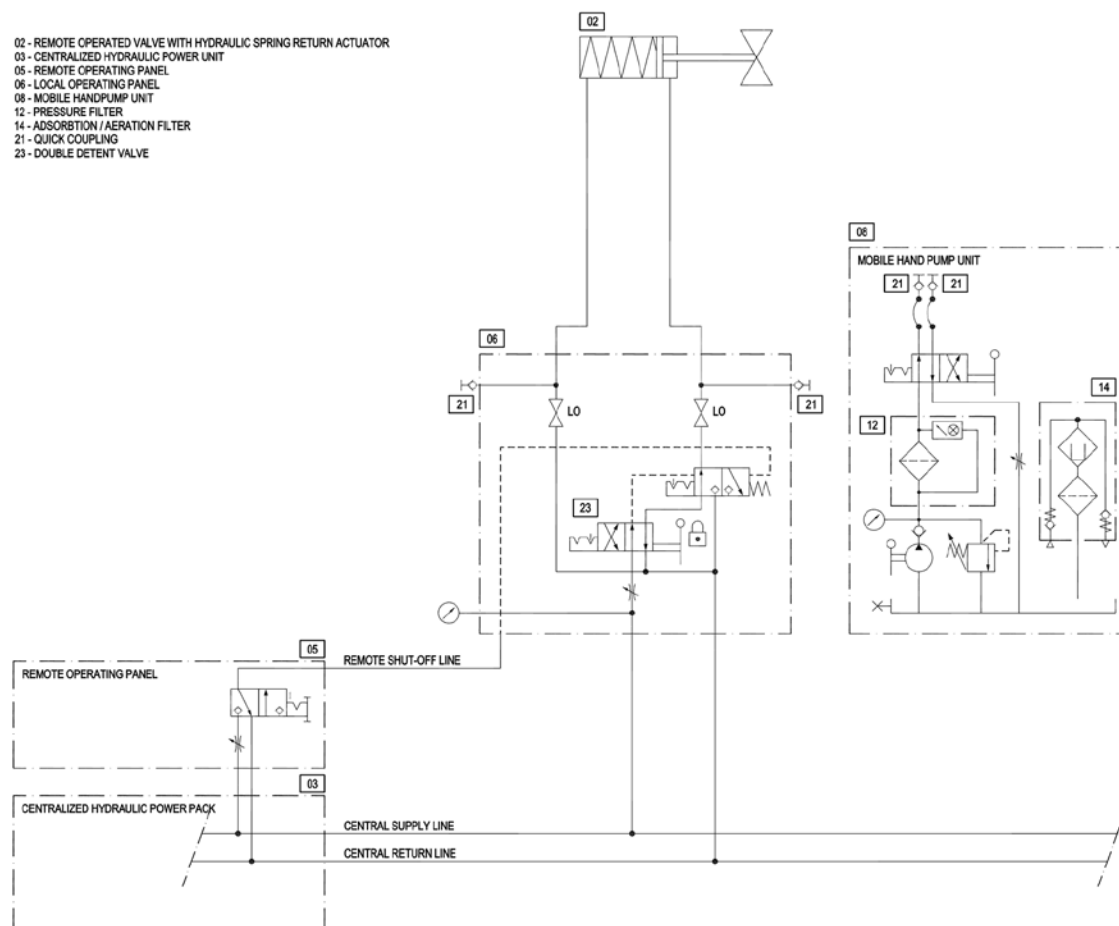


Figure 3.4 Simplified flow scheme for the control room operation of on/off valves with a double-acting hydraulic actuator

