

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 137

**On/off valve control panels and actuators functional
and construction requirements**

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1. Scope

This document defines the minimum requirements for the design, construction and supply of on/off valve actuator and associated control panels for Total Exploration & Production facilities, onshore and offshore.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
API RP 14C	Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms
API RP 552	Transmission Systems
ASME VIII	Pressure Vessels
ATEX European Directive 94/9/EC	European Directive on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
BSI PD 5500	Specification for unfired fusion welded pressure vessels
IEC 60079	Parts related to the Electrical apparatus for explosive gas atmospheres
IEC 60529	Degrees of protection provided by enclosures (IP code)
IECEX	IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres (IECEX System)

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Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 354	External protection of onshore structures and equipment by painting
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 102	Instrumentation identification
GS EP INS 104	Design of generation and distribution of instrument air or gas
GS EP INS 107	Design and installation of instrumentation links
GS EP INS 146	Design of generation and distribution of hydraulic energy
GS EP INS 900	Instrument hook-up diagrams
GS EP PVV 142	Valves
GS EP PVV 211	Design and fabrication of pressure vessels according to ASME VIII
GS EP PVV 212	Design and fabrication of pressure vessels according to BSI PD 5500
GS EP SAF 261	Emergency Shutdown and Emergency De-Pressurization (ESD & EDP)
GS EP TEC 260	HIPS Design, Implementation and Life Cycle

3. Definitions

Wellhead safety valves are not part of this specification.

The safety systems mentioned here below and in attached drawings are those to which safety valves are generally assigned to. Nevertheless, this must be confirmed by project documents.

3.1 ESDV

Emergency ShutDown Valve: high integrity shutdown valve, generally Fail to Close, controlled by the ESD system

3.2 SDV

ShutDown Valve: shutdown valve, generally Fail to Close and controlled by the Process Safety System (PSS).

3.3 BDV

BlowDown Valve: automatically operated valve, Fail to Open, generally controlled by the ESD system.

3.4 XV

Process on/off valve controlled from the Process Control System (PCS) or package Unit Control Panel (UCP).

4. Functional requirements

4.1 Generalities

Safety valves control devices shall be designed as normally energized.

Local accumulators/air reservoirs are not normally required to ensure air instrument availability.

If required by projects, all aspects shall be taken into account: air regulator pressure setting, relief valve, U stamp, maintenance etc.

The valve control panels shall comply with **GS EP SAF 261** requirements and enable the controls as described below:

	ESDV	BDV	SDV	XV
Control signal failure action (1)	Close	Open	Close	(8)
Actuator motive fluid failure action	Close	Open	Close	(8)
Local Reset after ESD-0 or ESD-1	Yes	Yes (2)	No	No
Open remote control	No	Yes (5)	(3)	Yes
Close remote control	Yes	No	(3)	Yes
Open/Close local command (7)	Yes	Yes	Yes	(8)
Partial stroking facility	Yes (6)	No	(4) (6)	No
Solenoid signal test facility	Yes (6)	Yes	Yes (6)	No

(1) Control signal includes electrical signals, pneumatic or hydraulic pilot command signals

(2) Automatic reset or reset from control room may be envisaged in specific cases

(3) As required by Process and Field Operations

(4) For SDVs partial stroking is required case by case, depending on SIL target and schedule maintenance periodicity

(5) Interlocked with “permissive” to Emergency De-Pressurization signal

(6) Partial stroking and solenoid signal test facilities are not required on ESDV and SDV bypasses

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(7) Local open/close command for ESDV, BDV and SDV shall be inside an enclosed valve control panel

(8) As per project requirements

Samples of typical functional schematic drawings are given for information in Appendix 1, for pneumatic or hydraulic actuators.

These typical functional schematic drawings do not show all possible combinations of functions.

These above functional requirements shall also be provided when electrical or electro-hydraulic actuators are selected.

Functional, design and construction requirements shall be fully detailed at basic engineering stage, detailed engineering stage and at actuated valve call for tender stage.

Vendor shall perform the necessary detail engineering to fulfill the requirements and produce the final design and construction documents.

4.2 Control functions

4.2.1 Remote Control

Valves shall be remotely controlled by means of solenoid controlled pilot valves. When a valve needs to be controlled from more than one system or package, one solenoid valve per system shall be provided.

Solenoid valves will be monostable; pilots will be 3-way/2-position for single acting actuators and 5-way/2-position for double acting actuators.

Except for double acting 'stay put' XV's, valves shall move to their safety or 'fail to' positions in case control signal, electrical power supply or power fluid inside the local control panel is lost.

4.2.2 Local Reset

ESDV's must be reset locally before valve may be open through the ESD system.

A "RESET" pushbutton, electrical, shall be installed onto the panels. The signal shall be linked to the ESD system.

4.2.3 Local Control

4.2.3.1 Safety valves

A manual "OPEN/CLOSE" device shall be available. It shall directly act on the power fluid circuitry and shall be lockable in the safety position.

Demand for moving the valve to its safety position shall always override the command from the safety system.

Moving the valve from its safety position shall only be possible if the safety system controlled solenoid is energized.

4.2.3.2 Process valves

The need for a local control device and the type of control shall be specified in the datasheet.

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For double acting 'stay put' XV's, the local command shall override the command from the remote automatic system.

For XV's having a 'fail to' position, the demand to move the valve to this 'fail to' position shall always have priority whether it is local or remote.

4.2.4 Partial Stroke Testing

The partial stroke testing function shall be available for ESDV's and possibly for SDV's and be SIL certified according to the assigned safety instrumented function SIL.

The principle is to stroke the valve over a range of 15% to 20% of full stroke and monitor relevant parameters.

During the partial stroke test, the shutdown signal coming from the safety system shall remain operational and if a shutdown is initiated it will override the partial stroke function.

4.2.4.1 'Smart Valve Test System'

Preference shall be given to 'smart' type devices with enhanced diagnostic capabilities to monitor the valve performance.

The 'smart valve test system' device shall manually initiate the valve test.

The smart valve test system' device shall process and record essential performance parameters so as to generate diagnostic warnings and test logs to the safety and process control system.

Diagnostic capabilities shall be accessed via a smart communication connection allowing predictive maintenance based trend analysis and at minimum:

- Warning of maintenance Operator (adjustable warning delay)
- Load factor
- Air leakage
- Breakaway pressure
- Fault.

The 'Smart Valve Test System' shall include the software maintenance tool for the predictive maintenance.

The air filter regulator for SVTS shall be self-draining type.

4.2.4.2 Manual system

An alternative solution is to have a manually initiated partial stroke testing system with limit switches. Stroke time is monitored by the related safety system.

Safeguard and interlocks shall be provided to prevent full valve closure on limit switch failure or wrong operation.

A key locked switch with two (2) positions, "NORMAL" and "PARTIAL STROKING", spring return to the "NORMAL" position, shall be available at the panel. The key shall be non-removable in the "PARTIAL STROKING" position.

This solution shall not be used for quick closing valves.

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4.2.5 Solenoid Valve Test

Safety valves control panels shall provide the capability for testing the signal from the safety system.

4.2.5.1 'Smart Valve Test System'

This function can be included within the same 'smart valve test system' device as the partial stroking.

4.2.5.2 Manual system

As an alternative, a manual system, based on a key locked switch, can be installed for solenoid test purpose.

The switch shall have two (2) positions: "NORMAL" and "ESD/PSS OVERRIDE". It shall be spring return to the "NORMAL" position and the key shall be locked in the "ESD/PSS OVERRIDE" position.

In the "ESD/PSS OVERRIDE" position the solenoid controlled pilot shall be bypassed so as to allow the solenoid to be de-energized without moving the valve to its safety position.

The signal downstream of the solenoid valve is monitored by means of a pressure gauge.

A "TEST" status shall be sent to the relevant safety system by means of a pressure switch. Electrical contact shall be Single Pole Double Throw (SPDT).

4.2.6 BDVs timer

As required by **GS EP SAF 261**, local BDV timers shall be installed to ensure that ESDVs are closed before BDVs are opened, unless electronic timers are provided in the case where UPS remains active for a sufficient time to avoid flare overload scenarios.

Such local timers will be provided by a pneumatic/hydraulic reserve bottle, maintaining energization of the control circuit operating the actuator for a short period of time.

4.2.7 Hydraulic or pneumatic accumulator

All safety valves with double acting actuators shall be fitted with a local hydraulic or pneumatic accumulator.

Accumulator shall comply with the following requirements:

- The accumulator shall be installed as close as possible to the valve and control panel.
- It shall be sized with a capacity to provide full closure (or opening) of the valve, whereby at any point of the valve stroke there will be at least 130% of the required operating force at the minimum supply pressure.
- The accumulator and associated tubing shall be protected against impacts and pick-ups.
- Hydraulic accumulators shall comply with **GS EP INS 146** requirements.

Fire proofing of the local accumulator and links to the actuator shall be required when associated to safety on/off valves as per **GS EP SAF 261**.

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Hydraulic accumulators shall be bladder type and shall comply with **GS EP PVV 211** or **GS EP PVV 212**. They shall be connected by means of a double block and bleed valve assembly, and shall be fitted with nitrogen pressure monitoring and refilling system.

Pneumatic reserve tanks shall be fitted with draining facility.

4.3 Safety ON/OFF valves stroking time

4.3.1 General requirements

The full stroking time to safety position shall not exceed 1 second per inch of valve flange diameter for valves ≤ 20 inch, with a maximum time of 15 seconds.

Fail-safe position stroking time may be extended:

- For valves > 20 inch
- When dictated by process dynamic simulations (eg for reducing surge effect).

However, the valve stroke time to safety position shall always be compliant with the total duration of the shut-down sequence (from initiator to final valve actuation) which shall be less than 45 seconds as per **GS EP SAF 261** requirement.

Such cases shall be clearly identified and safety impact shall be carefully assessed.

In case fast stroking time (e.g. a few seconds) is required, or when stroking time shall be less than 1 second per inch for large valves (> 20 inch), dynamic studies shall be carried out to assess surge or "hammer" impact.

The stroking time to fail-safe position for valves related to a HIPS function shall be in accordance with the HIPS dossier;

The typical time from safety position to normal operating position is 2 to 3 seconds maximum per inch of valve body diameter.

4.3.2 Travel Speed Adjustment

Unless otherwise specified by Company in project documents, the control panels shall provide the capability of adjusting valves closing and opening speeds.

However, no device shall be installed in the relief path unless the closure or opening speed may potentially damage the valve seals. In case speed adjustment devices are installed in the relief path, then they shall be inside the valve control panel and be equipped with a security lock preventing adjustment.

In case of large actuator/valve size, the Vendor shall provide complementary component(s) (e.g.: volume booster, quick exhaust valve).

4.4 Position Detection, Sensors and Indication

All on-off valves shall be equipped with position detection sensors and top-mounted beacon position indication:

- Position detection sensors for the open and closed position
- Visual valve position beacon.

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Vibration resistant analog position transmitter based on non-contacting magnetic type can be considered as alternative to position detection sensors.

Rotary potentiometer transmitter shall not be used.

In specific circumstances, position detection may be inferred by a motive fluid pressure transmitter fitted on the actuator supply line. This shall require Company approval

Proximity switches shall be Single-Pole-Double-Throw (SPDT) inductive type. When a the valve position needs to be monitored by more than one system or package, then one set of proximity switches for each system shall be provided.

Proximity switches shall be connected as 'normally open', in order that the contact will be closed when the designated valve position is reached. Proximity switches shall operate within 3 degrees of the valve travel from the respective open and closed limits.

Proximity switches or pressure switches shall not be used for safety logic interlocks functions. Analogue position transmitters or pressure transmitter shall be used instead.

Separate cables and cable entries shall be used when position detection sensors for more than one system are to be provided.

Cable termination blocks shall be spring-loaded type and be adequately numbered. The wire designation (number or colours) for normally-open (NO) and normally-closed (NC) contacts shall be clearly and permanently advertised inside the valve monitoring unit.

Visual beacons shall be mounted on top (highest elevation) of the valve monitoring unit, and shall be direct-coupled to the actuator stem.

Valve monitoring units shall be made of either AISI 316 or epoxy resin. All mounting supports and associated bolting shall be AISI 316. The use of galvanised/painted carbon steel or aluminium components is not allowed. Spare cable entries shall be adequately blinded with AISI 316 ATEX blind plugs.

The tag numbers of all limit switches shall be permanently mounted in the direct vicinity outside of the valve monitoring unit, using engraved or stamped AISI 316 tag plates.

Valve monitoring units may not be used for valve control purposes.

For submerged valves located in F(P)SO hull tanks, the valve position detection shall be established by means of two SPDT pressure switches, located inside the local valve control panel. One pressure switch shall detect normal supply pressure (closed contact when power medium pressure) and the other pressure shall detect no supply pressure (closed contact when no power medium pressure).

These pressure switches shall be connected on the final supply line to the actuator, i.e. no other devices (such as hand pump check valve connections) shall be located in between the actuator and pressure switches. Manual isolation valves between the actuator and pressure switches may be installed only when provided with a locking device to ensure reliable position detection.

4.5 Particular requirements by IMO Class Society

In the case of floating production facilities, which are subject to certification by an IMO Class Society, additional valve control requirements may apply for certain hydraulic on-off valves installed on the hull.

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For general compliance with IMO Class Societies, the following additional requirements are to be provided:

- 'Classified' submerged hydraulic on-off valves located in the "Collision Zone" shall be equipped with a permanent individual manual back-up pump, next to the valve control panel.
- Other 'Classified' submerged hydraulic on-off valves shall be able to be opened locally by means of a mobile manual back-up pump. A minimum of 2 mobile pump units shall be provided.

Other 'Non-Classified' submerged hydraulic on-off valves do not require the provision of a local back-up pump facility.

5. Actuator design

5.1 General requirements

Compact spring return actuators are preferred to match the installation space constraints, minimise the number of parts, integrate all functions (torque transmission, piston, spring) in a single casing so increasing the overall reliability.

The internal part of actuators shall be protected against corrosion from atmosphere and actuator power fluid and fully sealed to prevent corrosive fluid to enter.

Single piston technology shall be used only.

The actuator shall be sized to provide at least 130% of the maximum operating torque at any point of the valve stroke, and for the specified closing time. The actuator torques shall be defined as per [GS EP PVV 142](#).

A pressure relief valve shall not be used to reduce the actuator design pressure. However, if necessary, a pressure relief valve may be used as per [GS EP PVV 142](#) appendix 11 – torque table, to reduce the maximum actuator supply pressure to the maximum regulated on the actuator. Maximum actuator torque shall be defined as pressure relief valve set pressure +10%.

Actuator cylinders shall comply with [GS EP PVV 211](#) or [GS EP PVV 212](#).

5.2 Safety ON/OFF valves actuators

Actuators may be pneumatic, hydraulic or electro-hydraulic operated, provided that the actuator is of a fail-safe design.

Safety valves will be fitted preferably with spring return actuators.

Use of double acting actuators shall only be considered upon space availability criteria where no compact helical spline spring return actuator will meet the particular requirements. Such cases shall be subject to COMPANY approval.

Refer to [GS EP TEC 260](#) for HIPS valves actuators and control panels design requirements

5.3 Process ON/OFF valves (XV) actuators

XV are normally operated by Process Control System (PCS).

Actuators can be pneumatic, hydraulic or electric.

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Actuators can be double acting or single acting spring-return depending on the required action upon control signal and fluid supply failure.

5.4 Electrical actuators

Electrical actuators shall be monitored and controlled through the ICSS and a master station.

A field network may be considered when significant electrically actuated valves are used on the plant. This communication network will also include and provide diagnostic features.

This network shall be redundant.

6. Control Panel Design and Construction requirements

The statements and requirements of this specification shall be completed by those of Company's General Specifications [GS EP INS 101](#), [GS EP INS 102](#), [GS EP INS 104](#), [GS EP INS 107](#), [GS EP INS 146](#) and [GS EP INS 900](#).

Recommendations and prescriptions of [IEC 60079](#), [IEC 60529](#), [API RP 14C](#) and [API RP 552](#) shall also be followed.

6.1 Generalities

The control panels shall be fully designed and supplied by the actuator manufacturer.

The valve control panels are the sole responsibility of the actuator manufacturer.

They shall be designed to be mounted on the valve itself or as close as possible to the valve.

For some specific services (e.g. Chemical injection lines connected to wellhead equipment), valves may be controlled from the wellhead control panel.

The control panels shall incorporate all functions required for control, except the pressure vessel.

Isolation valve shall not be fitted on the actuator relief path.

Relief path shall be protected against mechanical damage to avoid blockage.

Distributors, solenoid valves and, more generally, all components and links shall be sized and selected to meet all valve opening and closing time criteria.

All components shall be corrosion resistant and IP 65 rated. Metallic parts shall be stainless steel AISI 316 at the minimum

If instrument gas is used, wetted parts of all components shall be suitable with the gas composition, taking into account all chemical products (methanol, corrosion inhibitor, etc.) injected in the gas.

[ATEX European Directive 94/9/EC](#) shall apply in European Countries and associated countries (e.g. Norway, Island).

[ATEX European Directive](#) or [IECEX](#) standards shall apply in other countries.

All field instruments shall be certified for zone 1.

When a valve is controlled by two different systems then the control panel shall include a dedicated solenoid for each system.

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Solenoid valves shall be of the low energy consumption type, 10 W maximum. Operating voltage shall be 24 VDC except otherwise specified in the instrument datasheet. Solenoid valves coils shall incorporate surge suppression diodes.

Air-filter regulators, pressure gauges, check valves, pressure pilots, safety relief valves and solenoid valves shall be of a Company approved brand and model, and these shall therefore be clearly specified during tender by the Valve Manufacturer and on the engineering data sheets used for Purchase Order, and will be subject to standardization.

6.2 Safety Integrity Level (SIL)

For ON/OFF safety valves the valve control panel contributes to the safety instrumented function and shall therefore be coherent with the SIF's SIL requirement. The SIL requirement will have been identified during the SIL assessment and specified in the valve/actuator data sheet.

The verification that the SIL has been achieved shall take account of the panel design and the selection of all components, including control panel and actuator.

Particular care shall be taken with pilots and fast exhaust valves to ensure that their reliability is taken into account in the overall verification of the SIL achieved.

6.3 Construction details

All components shall be mounted on an AISI 316 stainless steel plate and be housed in a fully enclosed lockable AISI 316 IP55 stainless steel cabinet. All screws, bolting and mounting accessories shall be AISI 316 stainless steel.

A pressure regulator/filter and a pressure gauge shall be installed at power fluid input. Air-filters/regulators shall be self-draining type, and shall be installed with their drain outlet vertically downwards. The Actuator Manufacturer shall select the proper filter characteristics. Manual drains shall be operable by hand (no tools required).

Particular attention shall be paid to pressure regulators installed on valves equipped with SVTS units: the regulator Cv coefficient shall be 1.5 times the smallest solenoid Cv coefficient, and the self-draining filter unit must be able to withstand the pulsating air consumption of the SVTS unit

A double check valve of the bubble tight type, shall be installed downstream of the regulator.

A pressure gauge shall be installed to monitor the actuator supply at panel output.

The hydraulic pilots drain lines shall be piped to a common return header.

When selecting components of the control panel, the return header back pressure shall also be considered to counterbalance the head static pressure, especially for low pressure return with hydraulic operated logic supply; it will of course depend on the general hydraulic lay out (i.e. valve position below the HPU).

Vent outlets of any pneumatic component shall be fitted with full AISI 316 exhaust silencers and bug screens, pointing downwards. In case of winterisation, special vent outlets shall be carefully selected to prevent freezing.

Instrument gas vents shall be collected and piped to an external vent header.

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The air relief of spring-return pneumatic actuators shall be routed through the opposite (spring) side of the piston, unless quick-exhaust valves are required to obtain the required stroking time. Actuator vent outlets shall be equipped with full AISI 316 exhaust silencers pointing downwards.

Use of close-coupled stacked manifold blocks is subject to Company approval, and may not be used for ESD and PSS related valves.

Control and monitoring devices shall not be fitted on the door.

All local control and monitoring devices (e.g. gauges, reset push-button) shall be flush mounted on the fixed upper part of the cabinet front face.

Dimensions shall be such that all components can be easily accessed for maintenance operations.

The cabinet shall be equipped with a breather.

Tubes penetrations inside the cabinet shall be through bulkhead connectors in the bottom plate. Tubes shall be secured to the plate using hydrophobic blocks.

Cables penetration shall be through cable glands in the bottom plate. Cables shall be protected from liquid stagnating inside the cabinet.

A hole shall be drilled in the bottom plate to allow liquids to drain out; it shall have a screwed plug secured to the cabinet with a stainless steel chain.

6.4 Labelling and marking

All panel components shall be tagged and identified according to the principles set out in [GS EP INS 101](#) and [GS EP INS 102](#).

Panel front face shall be labelled with the associated valve tag number.

Local commands devices shall be clearly labelled; command modes and operation shall be described on an engraved plate close to each device:

- For ESDV's and SDV's, manual control shall be identified as "MANUAL CLOSE CONTROL"; the closed position shall be labelled "CLOSED" and the other position shall be identified as "AUTO".
- For BDV's, manual control shall be identified as "MANUAL OPEN CONTROL"; the open position shall be labelled "OPEN" and the other position shall be identified as "AUTO".
- For XV's, the same principle shall be adopted with the marking depending on the valve fail back position.

7. Special cases

ESDV's may be installed on pipelines with cathodic protection. These ESDV's must be electrically insulated from the rest of the installation.

In such cases, the control panels will preferably be mounted remote from the valves. The links between the valves and the panels shall therefore be via insulated flexible hoses.

8. Documentation

Documentation shall include Vendor standard documents and project specific documents generated by Contractor and Vendor.

Valve documentation requirements are specified in [GS EP PVV 142](#).

8.1 Bid stage documentation requirements

Documents shall be issued at bid stage as follows:

DOCUMENTS	Contractor	Valve Vendor	Actuator and Control Panel Vendor	Company Approval
Common valve/actuator data sheet	Bid stage			X
Common valve/actuator torque table		Bid stage		
Functional schematic diagrams	Bid Stage			X
Detailed schematic diagrams			Bid stage	
Functional design description of all actuator controls including testing facilities			Bid stage	X
Actuator and control panel bill of material			Bid stage	X
Inspection and testing strategy including any specific test requirements	Bid stage			X
Actuator and control panel data sheet			X	

Table 1 - Documents to be issued at bid stage

A common valve/actuator data sheet shall be developed for each valve and shall include the service conditions, valve requirements and actuator requirements.

A common valve/actuator data sheet shall be developed for each valve and shall include the actuator and valve torque values as specified in [GS EP PVV 142](#) Appendix 10.

The functional design description of all actuator controls shall be project specific and shall include the testing facilities.

The comprehensive bill of material shall include the make and model of all actuator control panel components, quick exhaust valves and position switches. The above documents shall be updated as required during the design, manufacturing and testing stages.

8.2 Design, manufacturing and testing documentation requirements

In addition to the above documents, Vendor shall provide documentation for approval as follows:

- Engineering design documents including:
 - Technical data with specification and catalogue for all provided items and accessories
 - Detailed functional design description of all actuator controls including testing facilities

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- Estimated actuator and valve torque table for each valve/actuator item at mini pressure/normal pressure including maximum allowable working pressure
- Actuator and valve torque table with torque values at minimum and maximum supply pressure as measured and recorded during FAT
- Reliability and availability calculation notes
- Third party SIL/PFD_{avg} certificates for individual components
- Stroking time for valve opening and valve closing
- Response time calculation notes
- Response time as measured and recorded during FAT
- Interconnection diagrams
- Inspection and test plan
- Test procedures
- Procedures for handling, transportation, preservation and storage.
- Detail drawing of the on/off valve assembly, including:
 - General arrangement drawings with weight and dimensions including handling / lifting locations
 - Weight of actuator and control panel
 - Actuator type and size
 - Accessories, and in particular: local accumulator, air/hydraulic line arrangement, solenoid valve installation, tubing and wiring, limit switch arrangement and wiring
 - All documentation in compliance with the local regulations and applicable pressure codes of the pressure retaining parts (e.g. [ASME VIII](#), [BSI PD 5500](#)...):
 - (a) Material certificate conformity
 - (b) Material certificate compliance
 - (c) Material tests certificates including chemical analysis and mechanical characteristics
 - Drawing of local accumulator(s) associated to double acting type actuator or to BDV timer, including:
 - (a) Overall dimension accessories
 - (b) Capacity and autonomy time calculations

9. Inspection and Testing

All actuators, local control panels and pressure vessels shall be subject to Factory Acceptance Tests (FAT).

Valve control panels and actuators shall be tested independently by the actuator manufacturer prior to shipment to valve manufacturer for full FAT of complete assembly. Valve control panel and actuator testing shall include torque measurements.

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The complete assembly (valve/actuator/local control panel) shall be hooked up and FAT'd at the valve Manufacturer premises in the as-installed configuration. Particular care shall be taken in length and diameter of temporary connections as well as valve/actuator orientation.

An inspection and testing strategy of the valve assembly including the actuator and the actuator controls shall be established by Contractor and shall be subject to Company approval.

The actuators shall be presented for FAT assembled to the valve, with all specified accessories and necessary supplies connected (air, hydraulic, electric), and with specified line pressures applied to the valve.

The Vendor shall be responsible for supplying and implementing all necessary equipment and accessories to demonstrate the panel provides the required service.

At the end of the FAT, panels shall be blown, dried, and all bulkhead connections shall be plugged.

Vendor shall provide a detailed test procedure

No FAT shall be performed before Vendor documents are approved.

Prior to submitting for FAT, Vendor shall have performed full factory testing and inspection to confirm that the equipment meets purchase specifications.

The following documents shall be available prior to start the FATs:

- Valve/Actuator torques tables
- Actuator and control panel FAT procedures
- Valve/Actuator/Control panel FAT procedure
- Functional design description of all actuator controls including testing facilities
- Detailed control panel schematic diagrams
- Valve/Actuator data sheet
- Calculation notes for local accumulator (Double acting actuators)
- Vendor Manufacturing Data Book (preliminary), including as-built drawings, material certificates, etc
- Inspection and test plan
- Vendor inspection plan results
- Vendor factory test results and records
- Vendor actuator and control panel leak test reports
- ATEX/IECEx certificates
- Third party SIL certificates for individual components.

FAT shall include, but not limited to:

- a) Visual inspection of quality, workmanship, layout, labels, paint finish etc.

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- b) Full functional test of actuator (fail safe position, closing/opening time, opening/closing torque values at min/max supply pressure, maximum allowable working pressure facilities), and accessories including operation of SVTS and/or the local control station.
- c) Functional tests of each actuated valve fully integrated with its dedicated actuator and local control station. These tests shall be performed at full valve differential pressure and at minimum and maximum motive fluid supply pressure.

The following requirements shall be recorded during these tests:

- Full valve differential pressure
- Minimum motive fluid supply pressure
- Maximum motive fluid supply pressure
- Closing/opening stroke times
- Closing/opening valve torques.

Minimum test and sequence requirements are included on the valve/actuator functional tests check-list attached in Appendix 2. Those minimum requirements shall be included in the FAT procedure and performed during FAT. The check list is available as an MS Excel© spreadsheet in Appendix 2 (attached to the GS).

This check-list does not include the results of Valve + Actuator tests performed and recorded according to **GS EP PVV 142** procedures (e.g. body cavity at atm. pressure, line pressure to side A / side B, torque tests, etc).

- d) Local accumulator shall be inspected as per **GS EP PVV 211**.
- e) Valve, actuator and local accumulator painting shall be inspected versus **GS EP COR 350** (or **GS EP COR 354** for onshore valves) requirements.

Remote stations/devices including the associated software related to advanced device diagnostics and/or remote control, normally installed inside technical rooms shall be provided by the Vendor and connected to field instruments as per final architecture. The Vendor shall issue the test procedure and remote devices Suppliers shall attend the FAT.



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Appendix 1

Appendix 1 On/Off Valves Functional Drawings

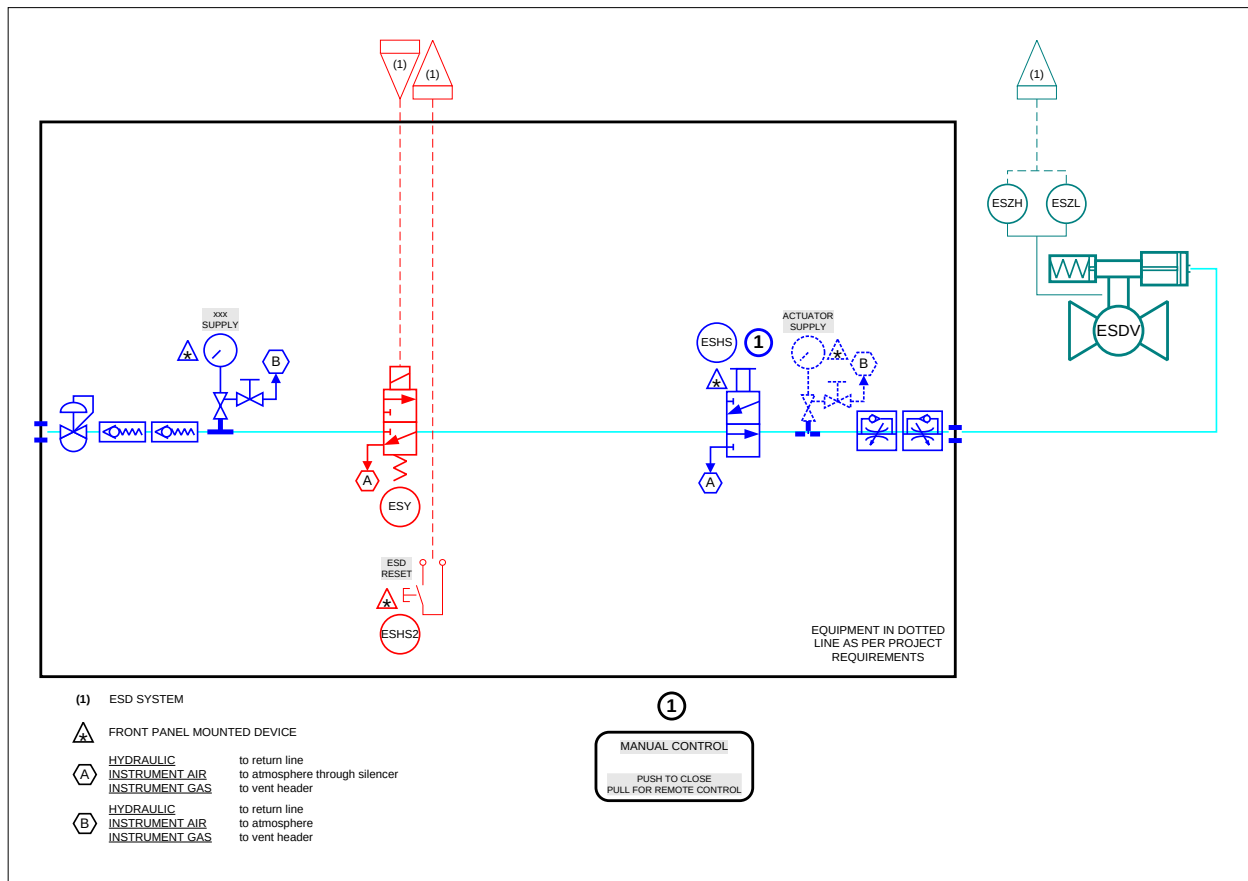
(SAMPLES FOR INFORMATION ONLY)

Samples of typical functional schematic drawings are given for minimum functional requirements only. They shall be fully developed during FEED/basic and detailed engineering stages.

Typical No	Rev.	Description
101	01	ESDV Single Acting
102	01	ESDV Single Acting + Solenoid Valve Test
103	01	ESDV Single Acting + Partial Stroke Testing
104	01	ESDV Single Acting + Solenoid Valve Test + Partial Stroke Testing
105	01	ESDV Single Acting + PSS Control
106	01	ESDV Single Acting + Solenoid Valve Test + Partial Stroke Testing + PSS Control
110	01	ESDV Smart test facility
151	01	ESDV Double Acting
201	01	SDV Single Acting
202	01	SDV Single Acting + Solenoid Valve Test
203	01	SDV Single Acting + Partial Stroke Testing
204	01	SDV Single Acting + Solenoid Valve Test + Partial Stroke Testing
205	01	SDV Single Acting + PCS (or UCP) Control
206	01	SDV Single Acting + Solenoid Valve Test + Partial Stroke Testing + PCS (or UCP) Control
251	01	SDV Double Acting
301	01	BDV Single Acting
302	01	BDV Single Acting + Solenoid Valve Test
311	01	BDV Single Acting + Local Reset
312	01	BDV Single Acting + Solenoid Valve Test + Local Reset
351	01	BDV Double Acting
352	01	BDV Double Acting + Local Reset
401	01	XV Single Acting
402	01	XV Single Acting + Local Control
451	01	XV Double Acting – 'Stay Put'
452	01	XV Double Acting – 'Fail to Close'
453	01	XV Double Acting – 'Fail to Close' + Local Control

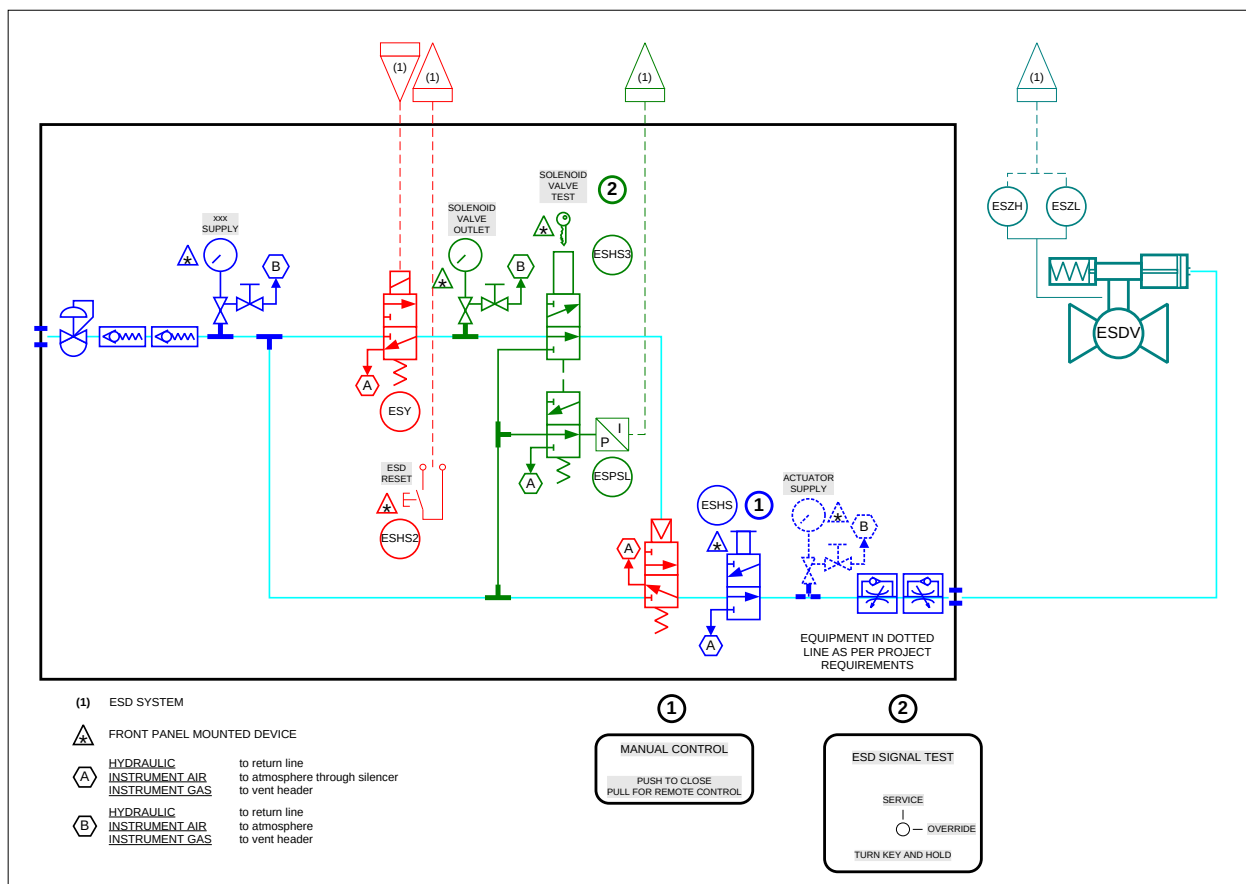
TYPICAL 101:
ESDV - SINGLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



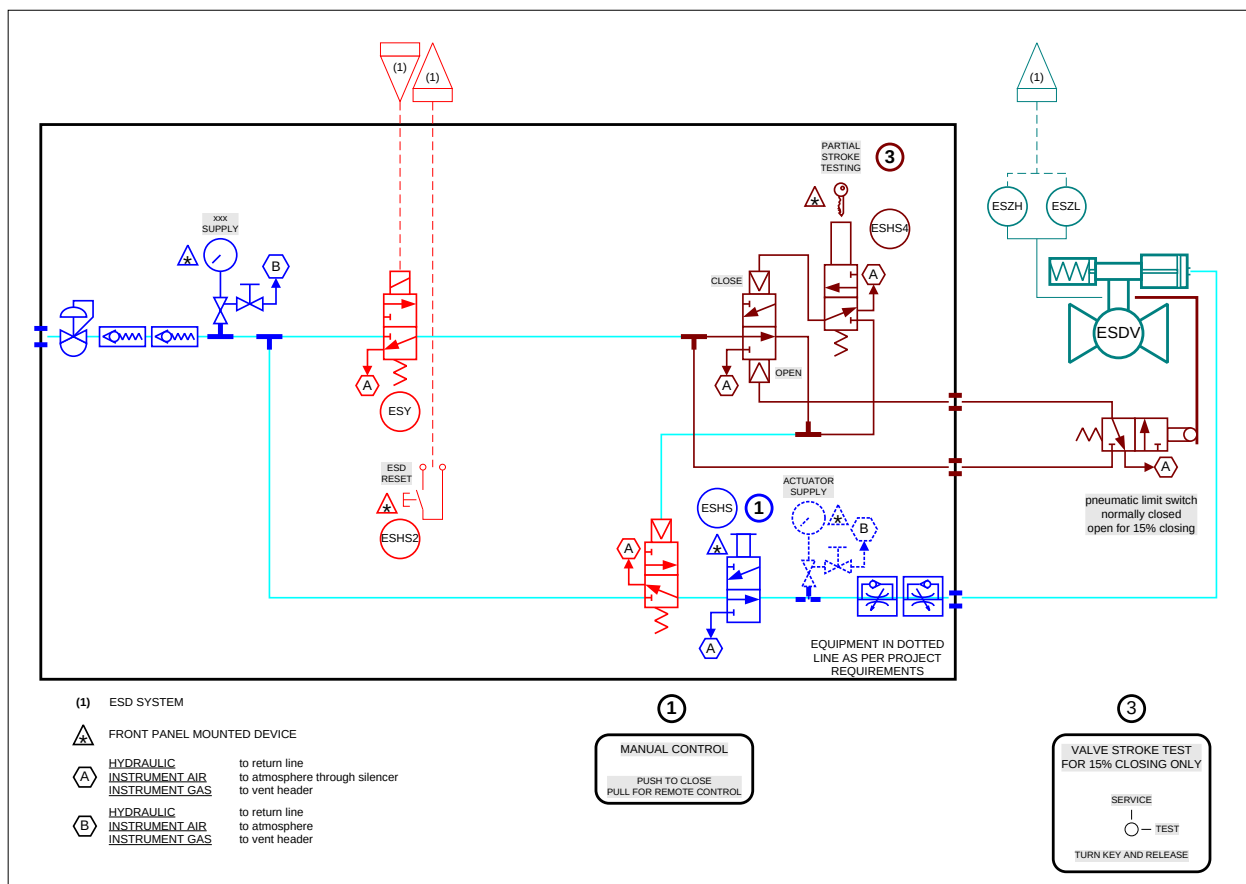
TYPICAL 102:
ESDV - SINGLE ACTING
+ SOLENOID VALVE TEST

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 103:
ESDV - SINGLE ACTING
+ PARTIAL STROKE TESTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



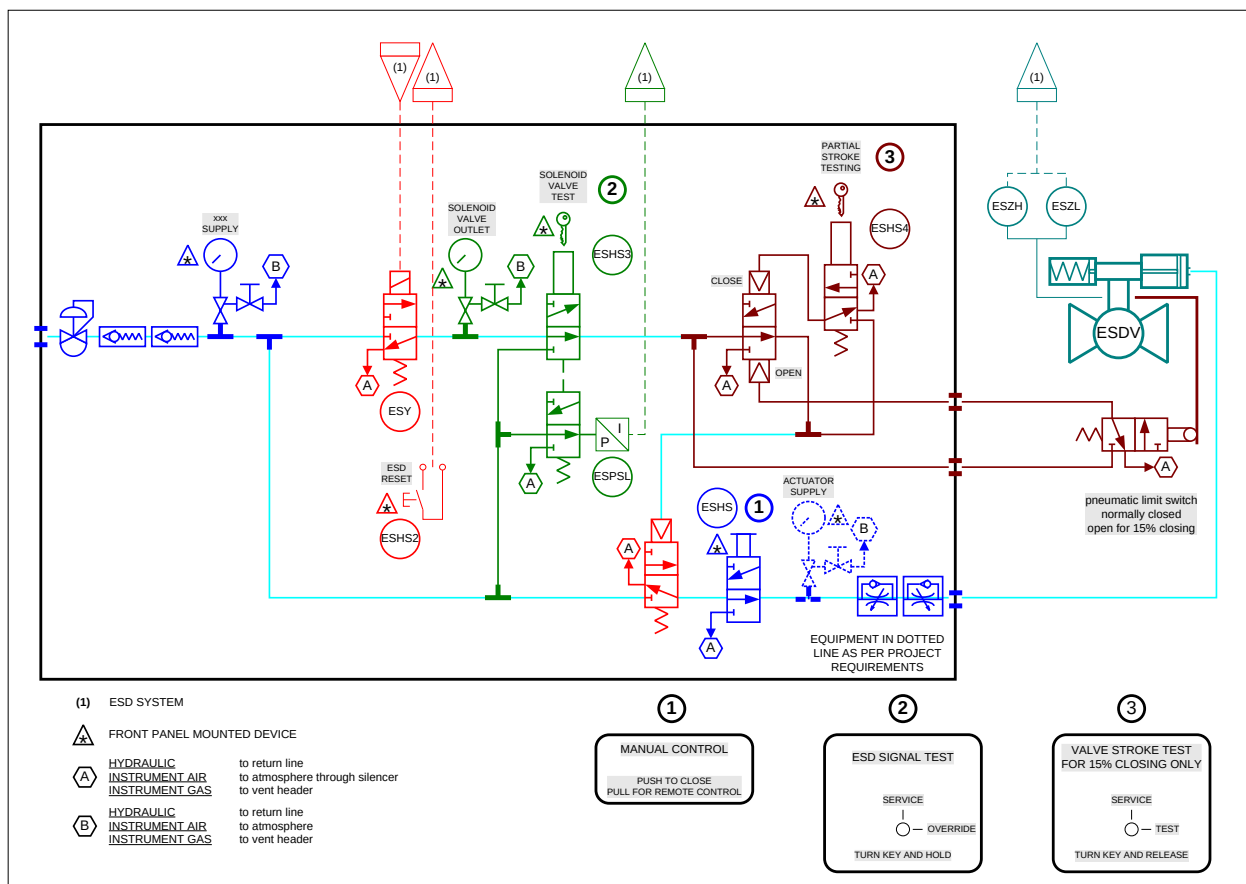
TYPICAL 104:

ESDV - SINGLE ACTING

+ SOLENOID VALVE TEST

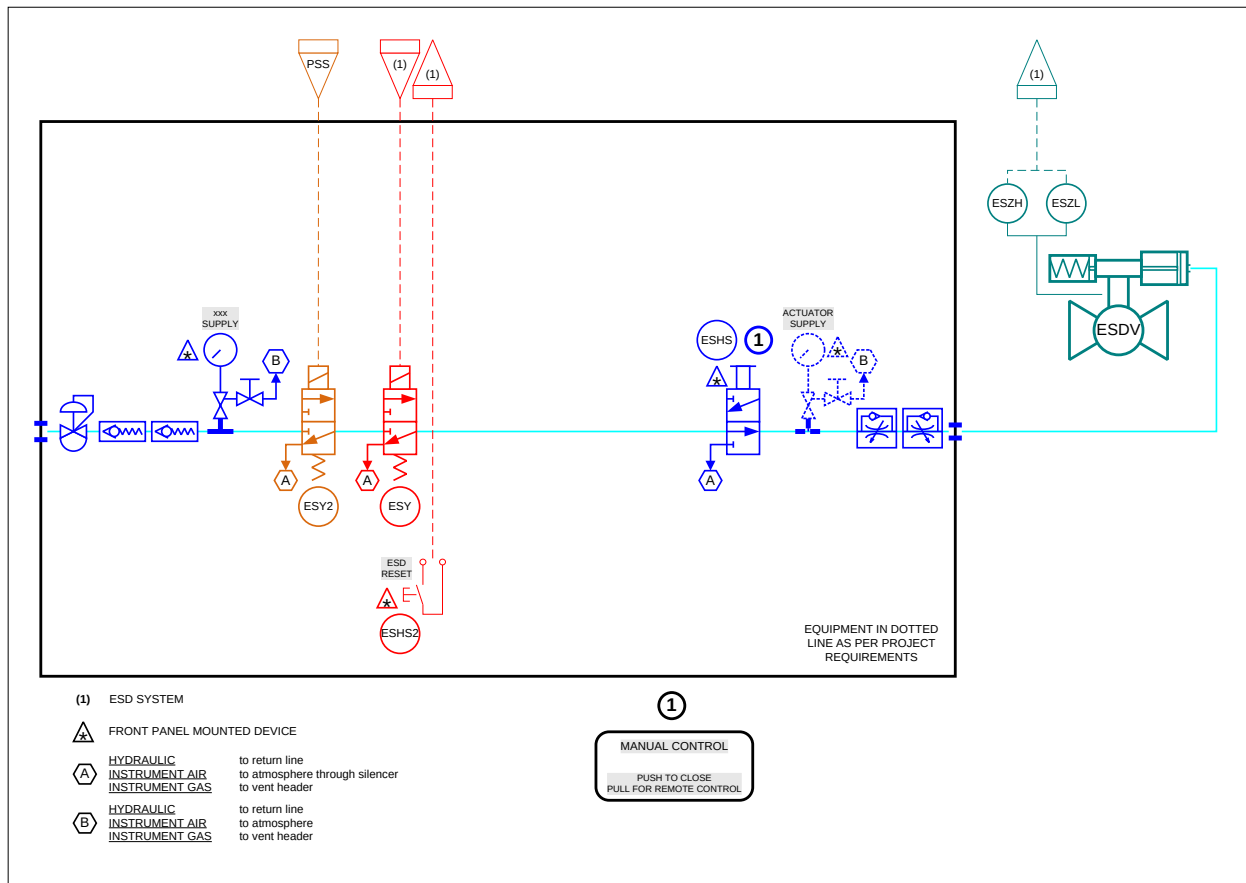
+ PARTIAL STROKE TESTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 105:
ESDV - SINGLE ACTING
+ PSS CONTROL

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 106:

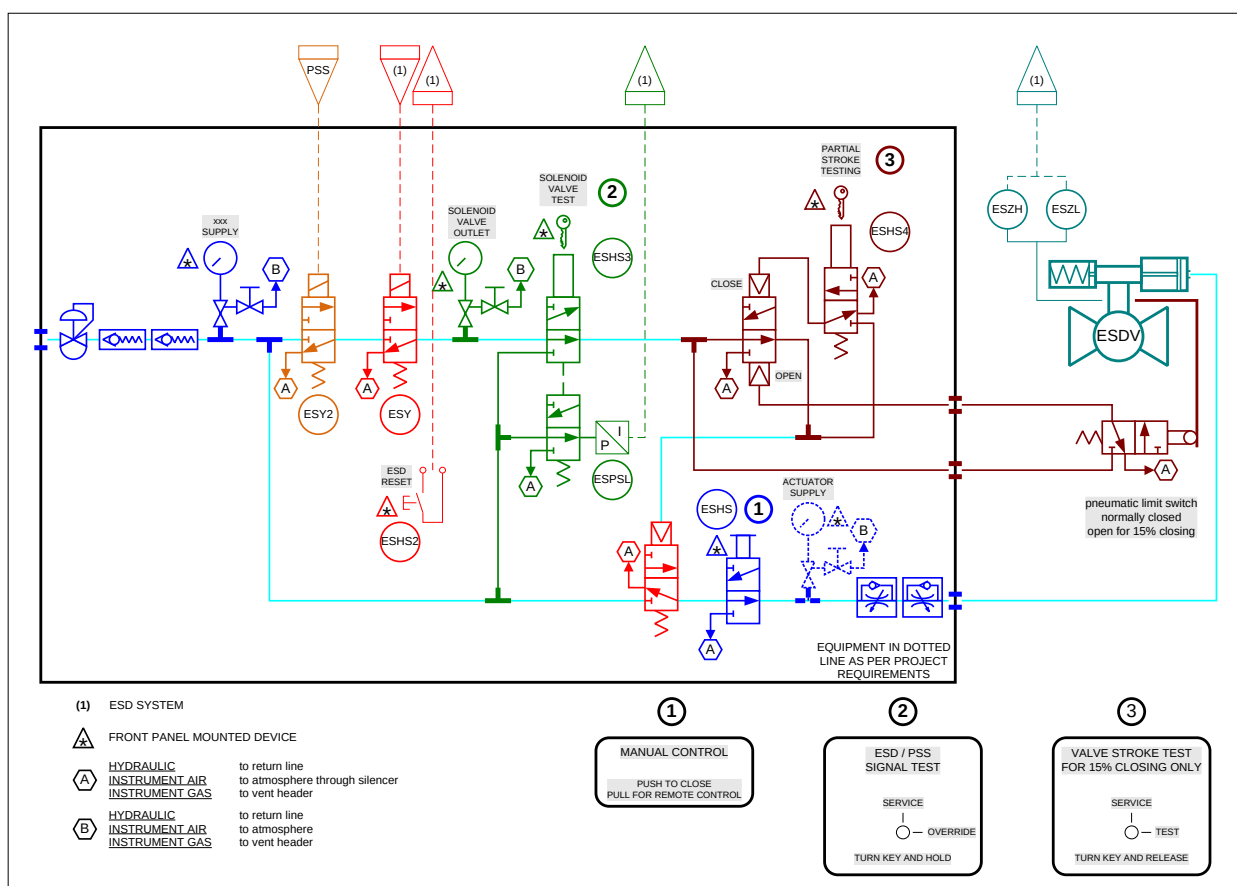
ESDV - SINGLE ACTING

+ SOLENOID VALVE TEST

+ PARTIAL STROKE TESTING

+ PSS CONTROL

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

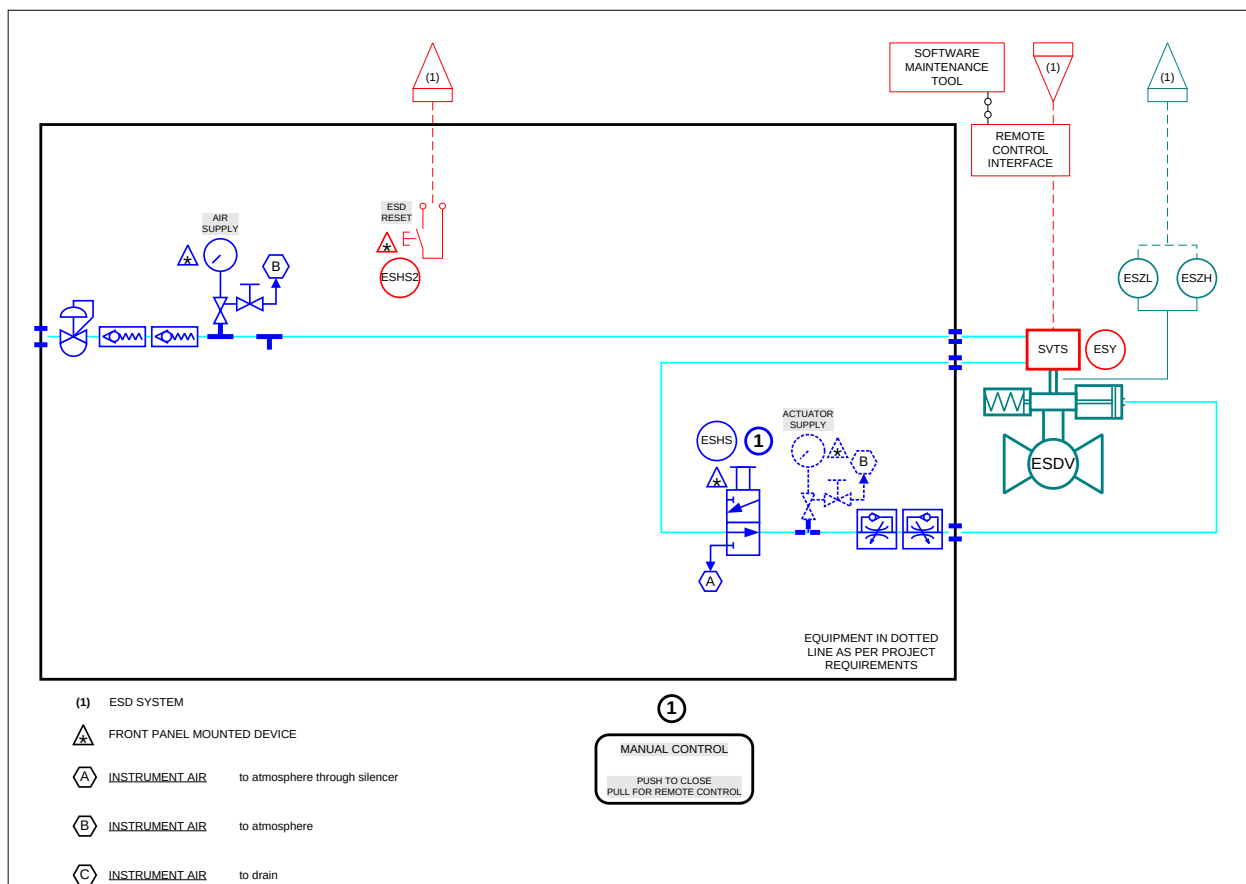


TYPICAL 110:

ESDV - SINGLE ACTING

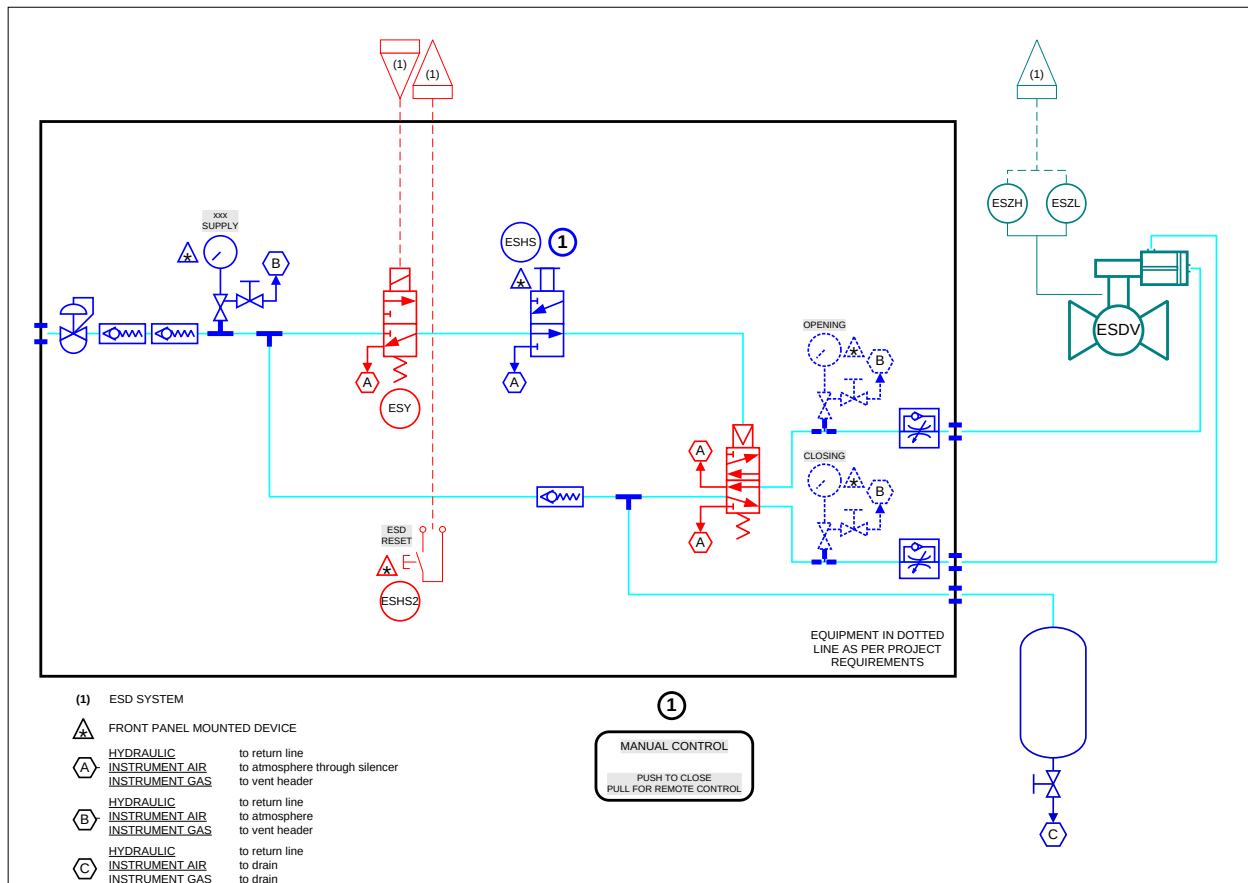
SMART TEST FACILITY

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 151:
ESDV - DOUBLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



On/off valve control panels and actuators functional and construction requirements

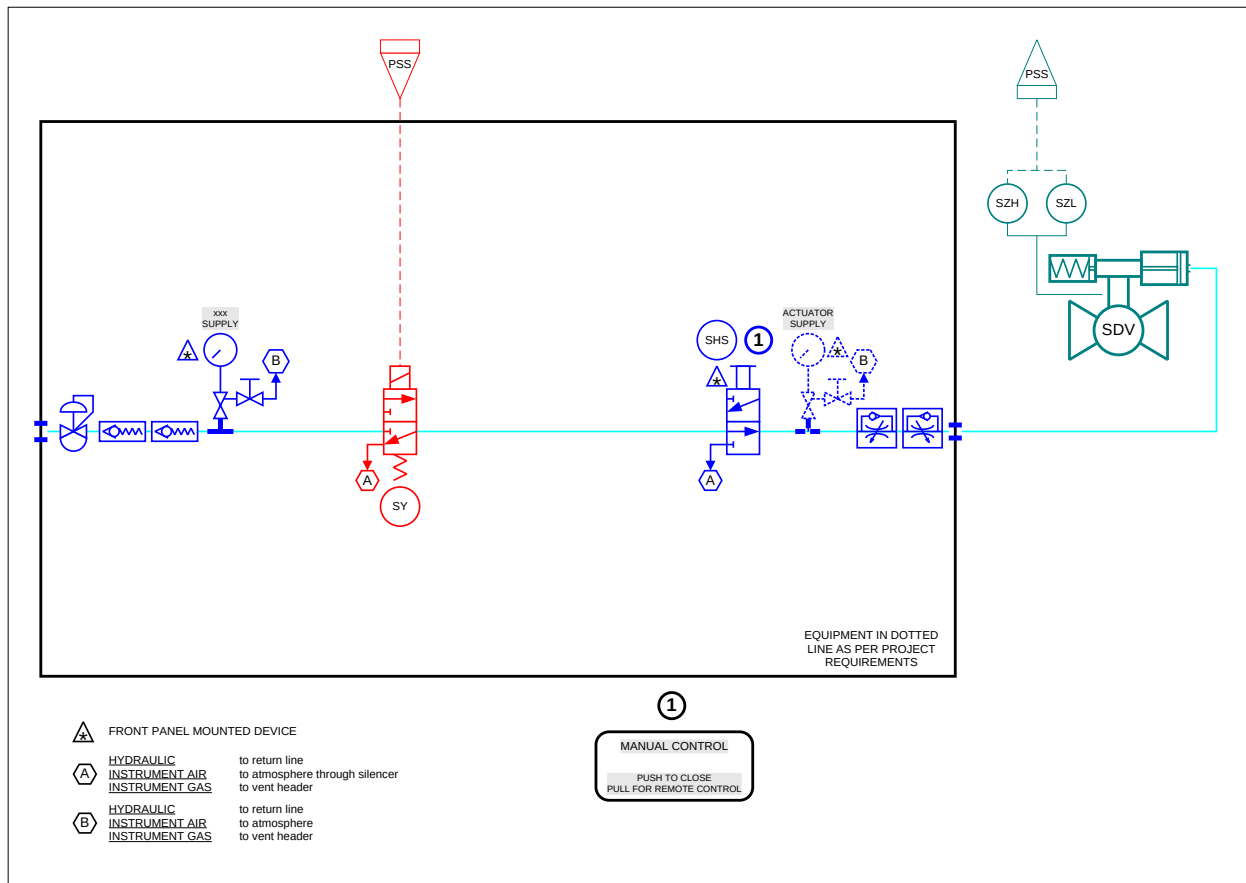
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TYPICAL 201:
SDV - SINGLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



On/off valve control panels and actuators functional and construction requirements

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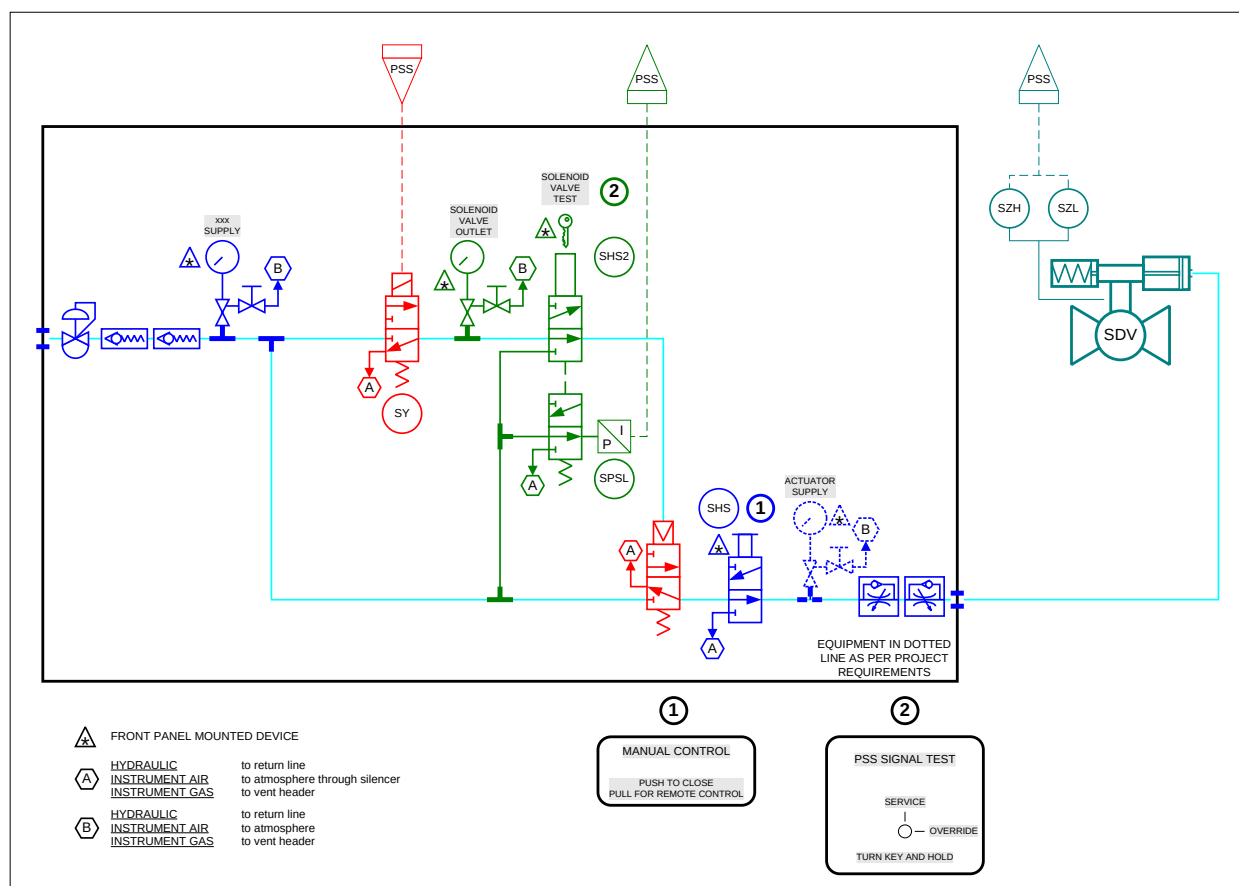
Appendix 1

TYPICAL 202:

SDV - SINGLE ACTING

+ SOLENOID VALVE TEST

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

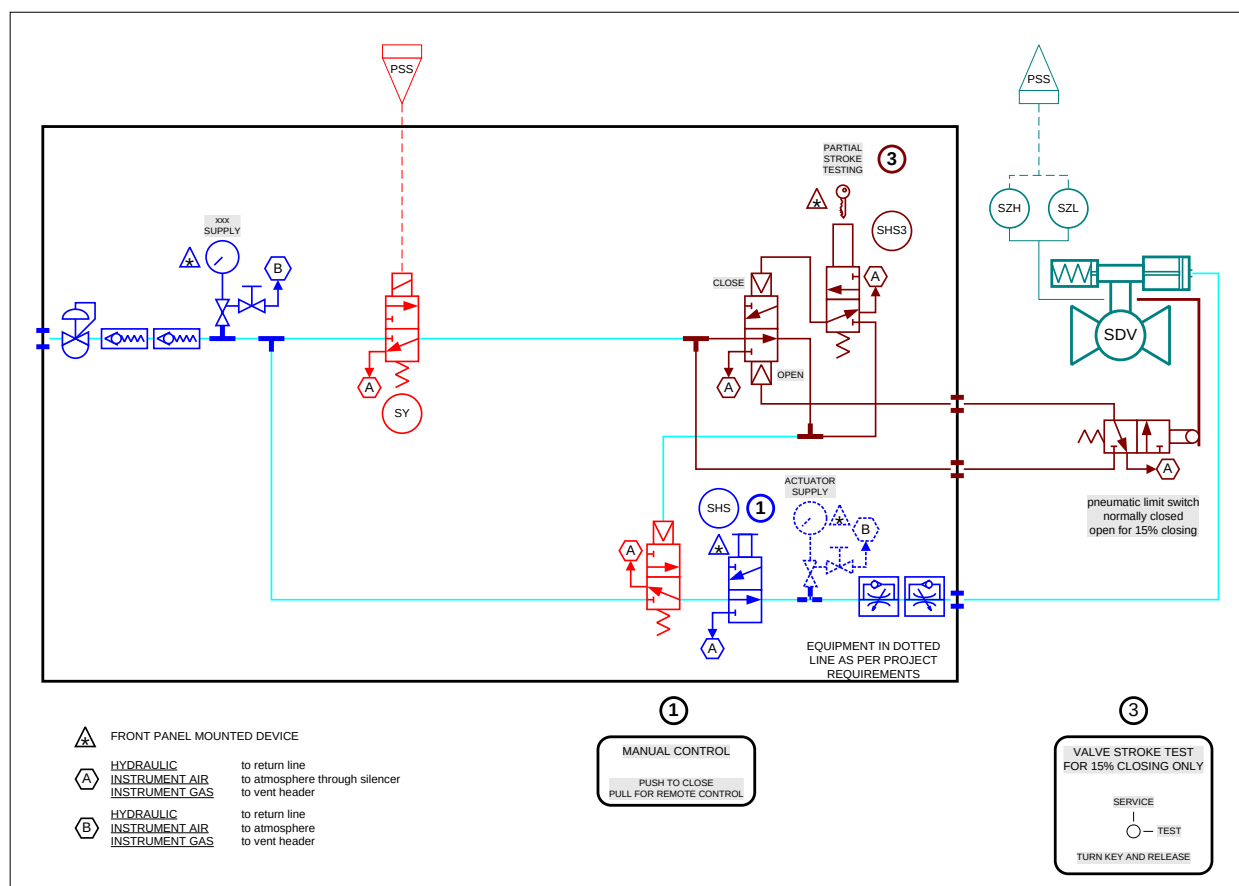


TYPICAL 203:

SDV - SINGLE ACTING

+ PARTIAL STROKE TESTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



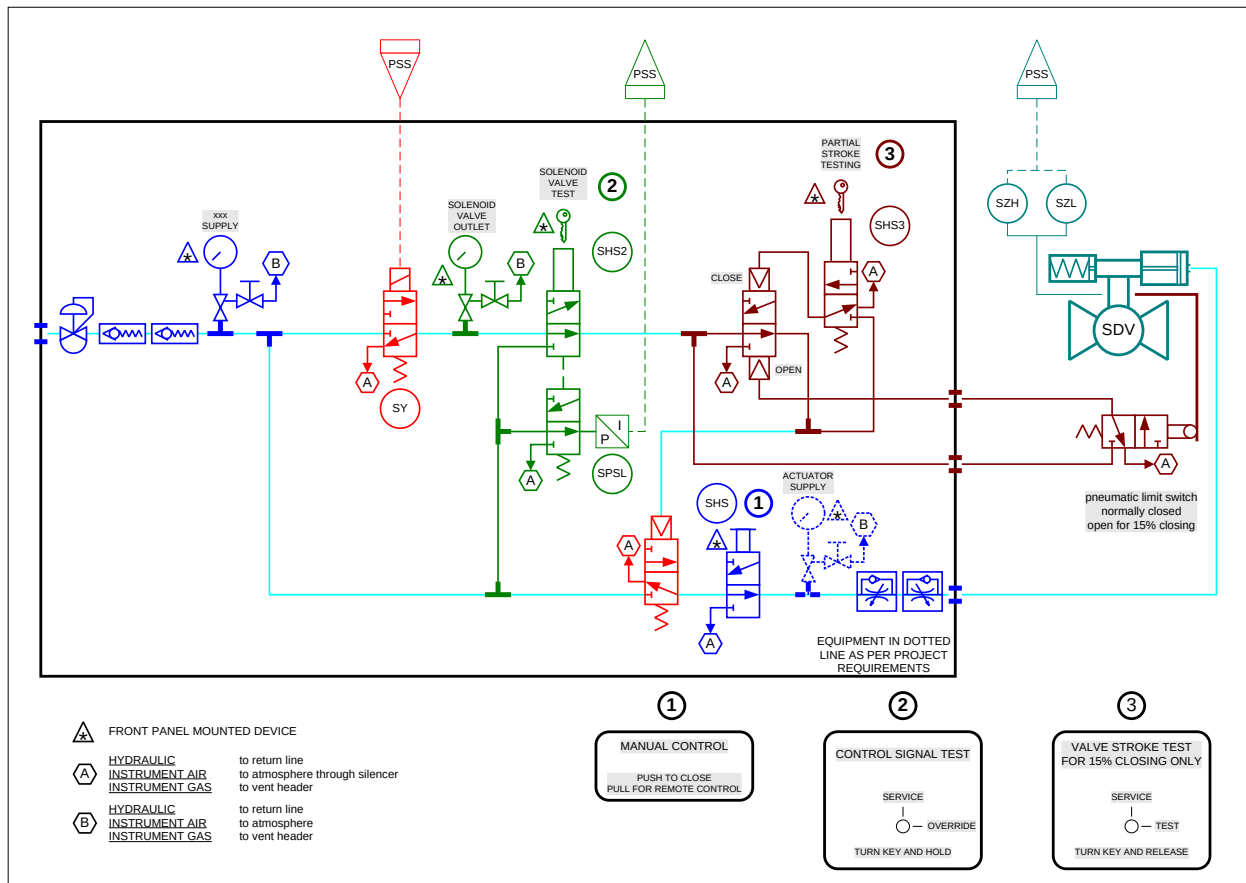
TYPICAL 204:

SDV - SINGLE ACTING

+ SOLENOID VALVE TEST

+ PARTIAL STROKE TESTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

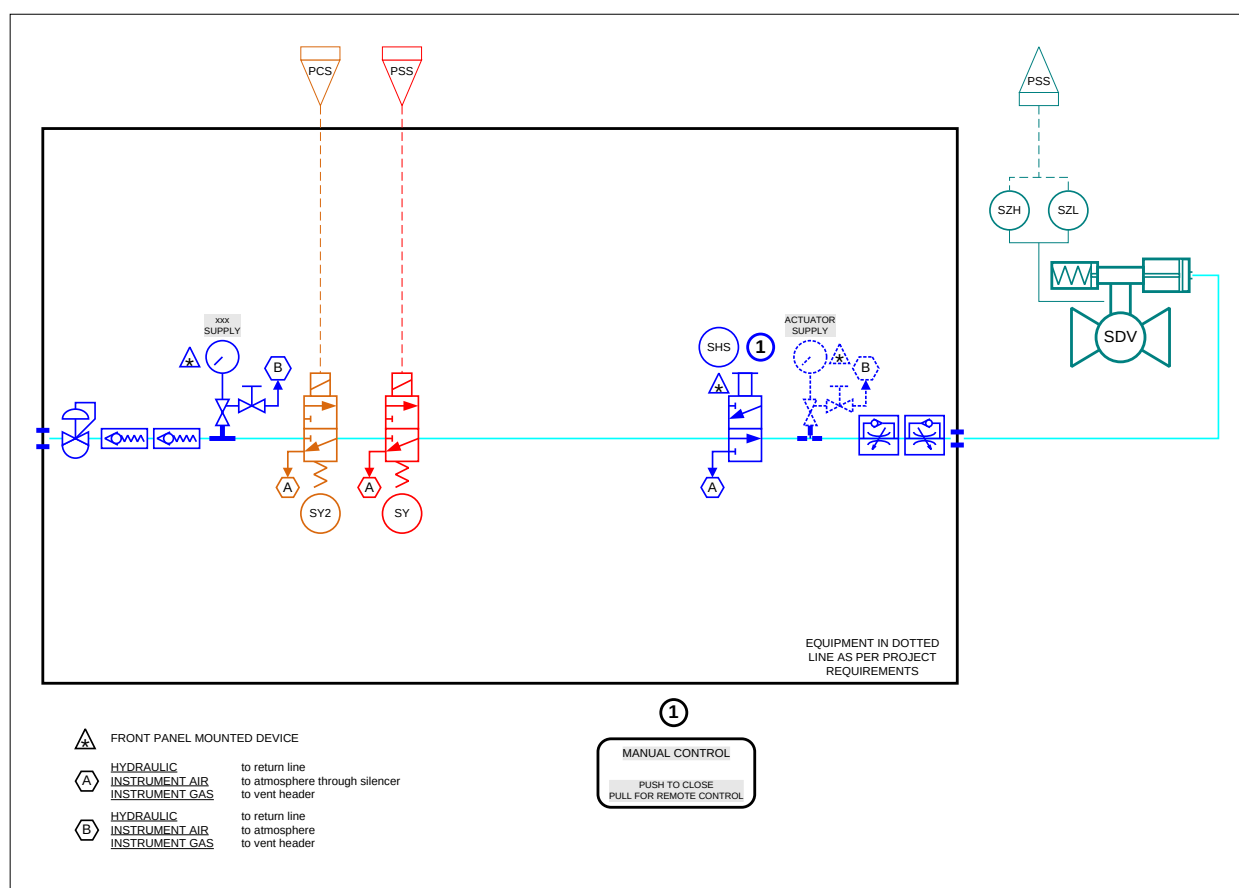


TYPICAL 205:

SDV - SINGLE ACTING

+ PCS/UCP CONTROL

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 206:

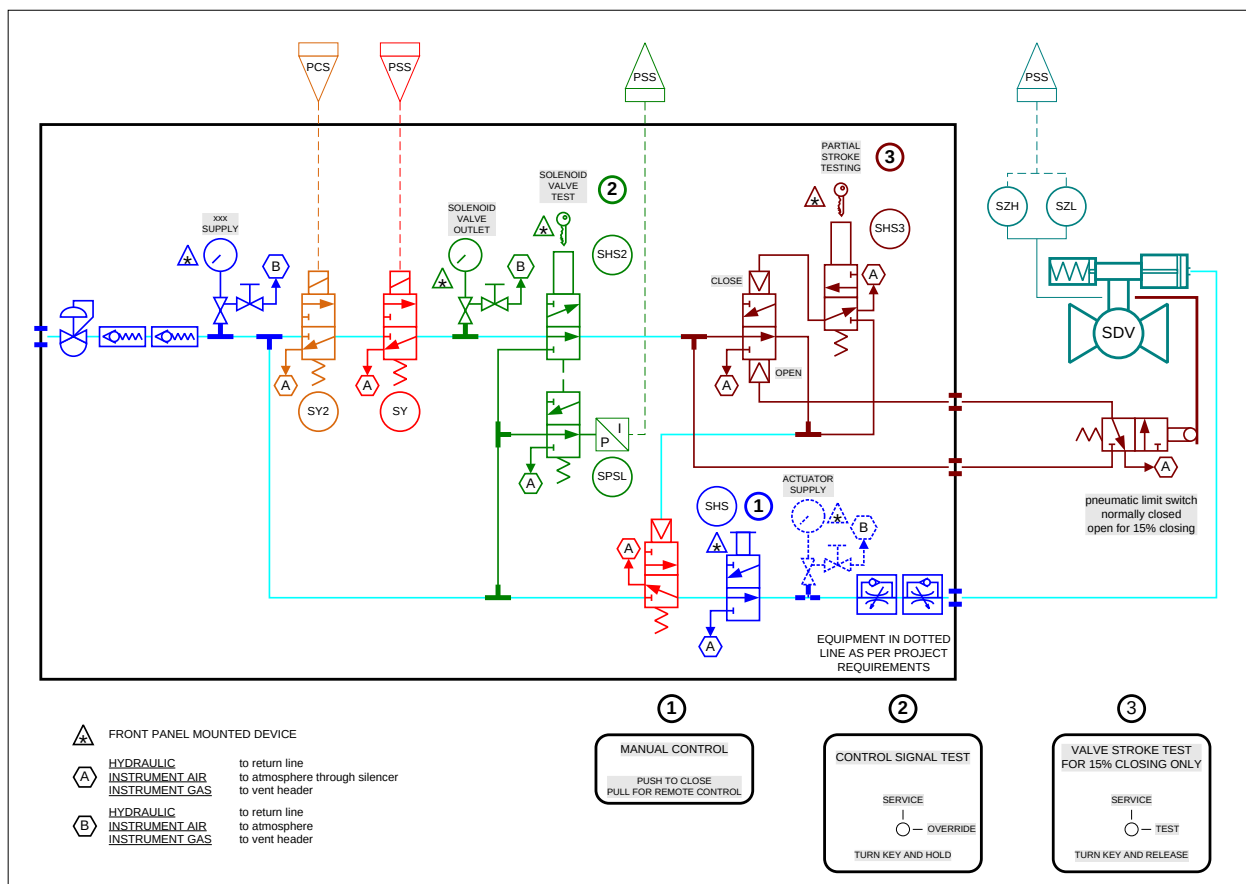
SDV - SINGLE ACTING

+ SOLENOID VALVE TEST

+ PARTIAL STROKE TESTING

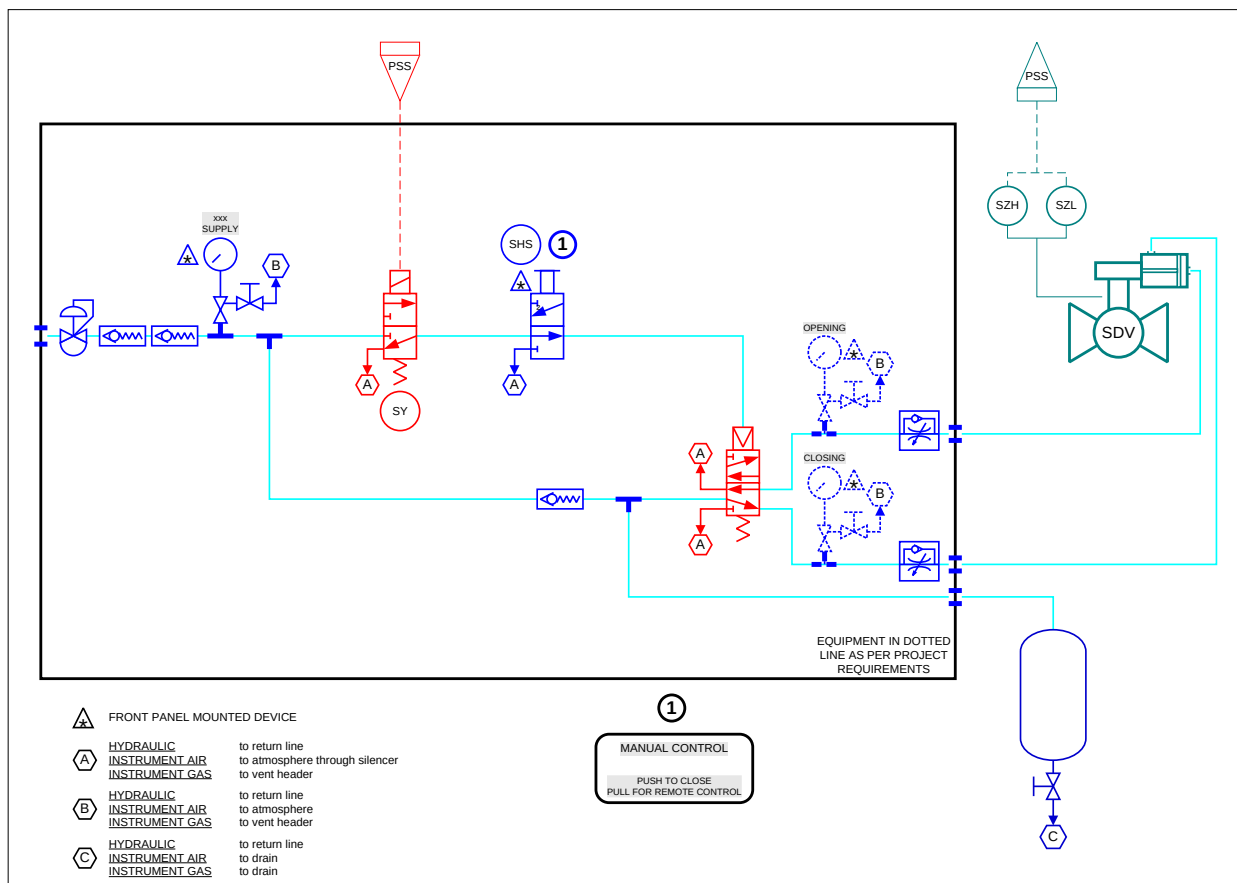
+ PCS/UCP CONTROL

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



SDV - DOUBLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



On/off valve control panels and actuators functional and construction requirements

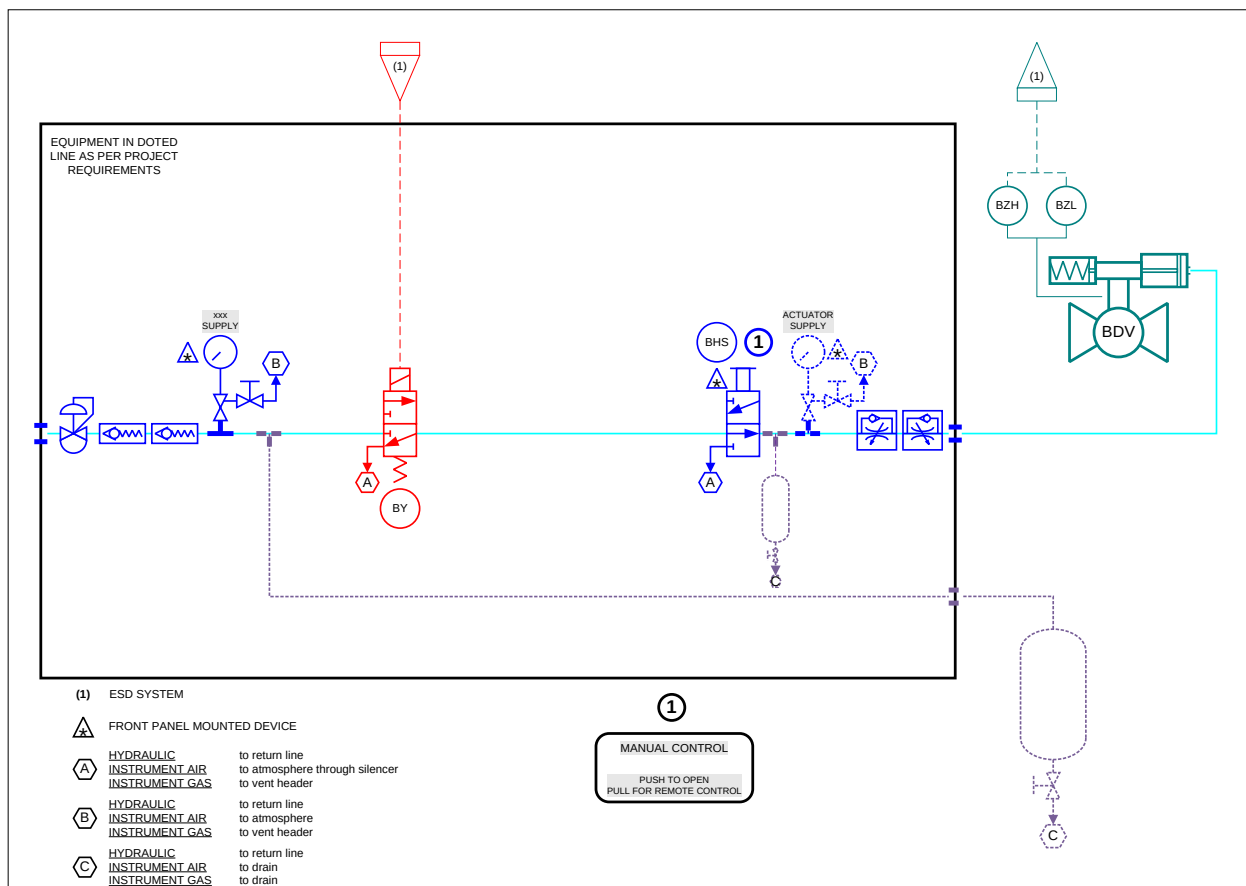
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Appendix 1
TYPICAL 301:
BDV - SINGLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

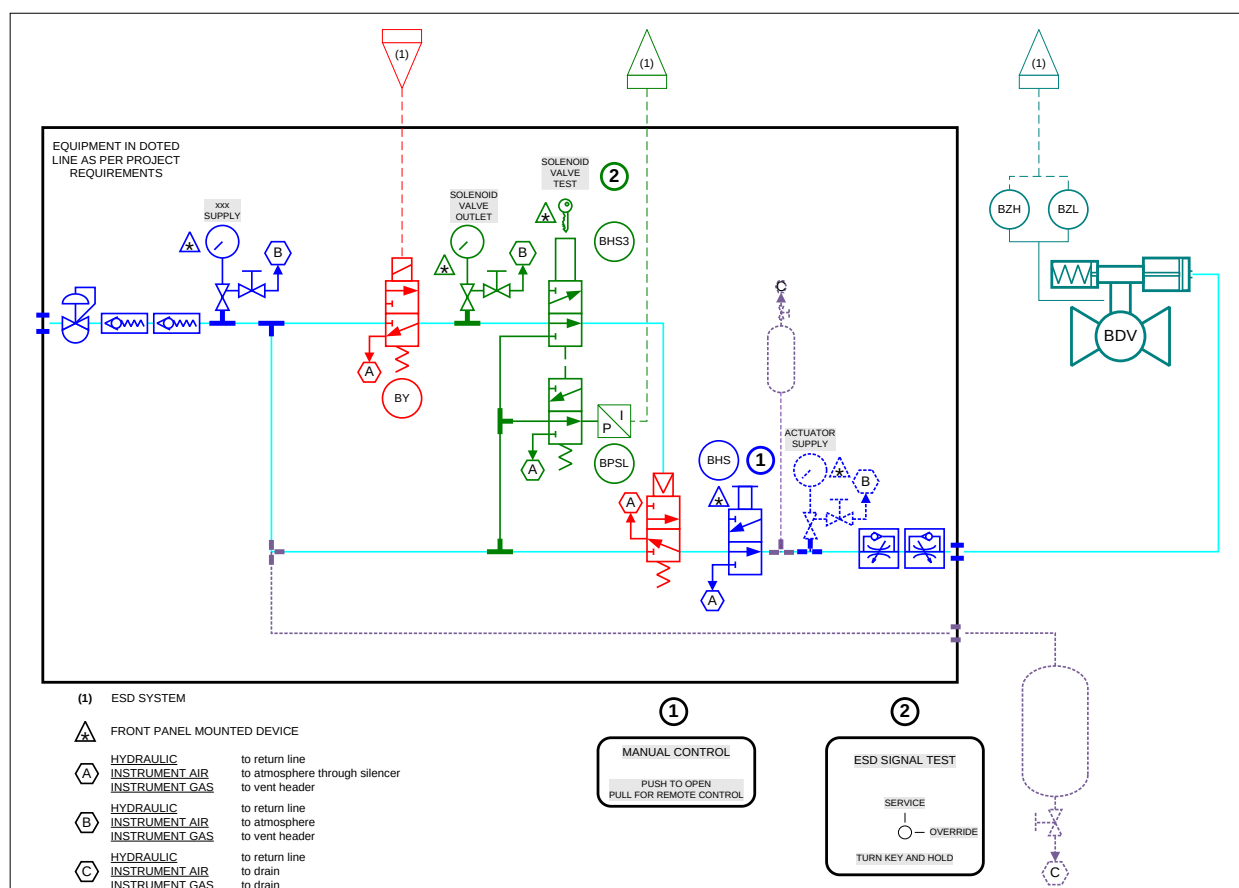


TYPICAL 302:

BDV - SINGLE ACTING

+ SOLENOID VALVE TEST

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

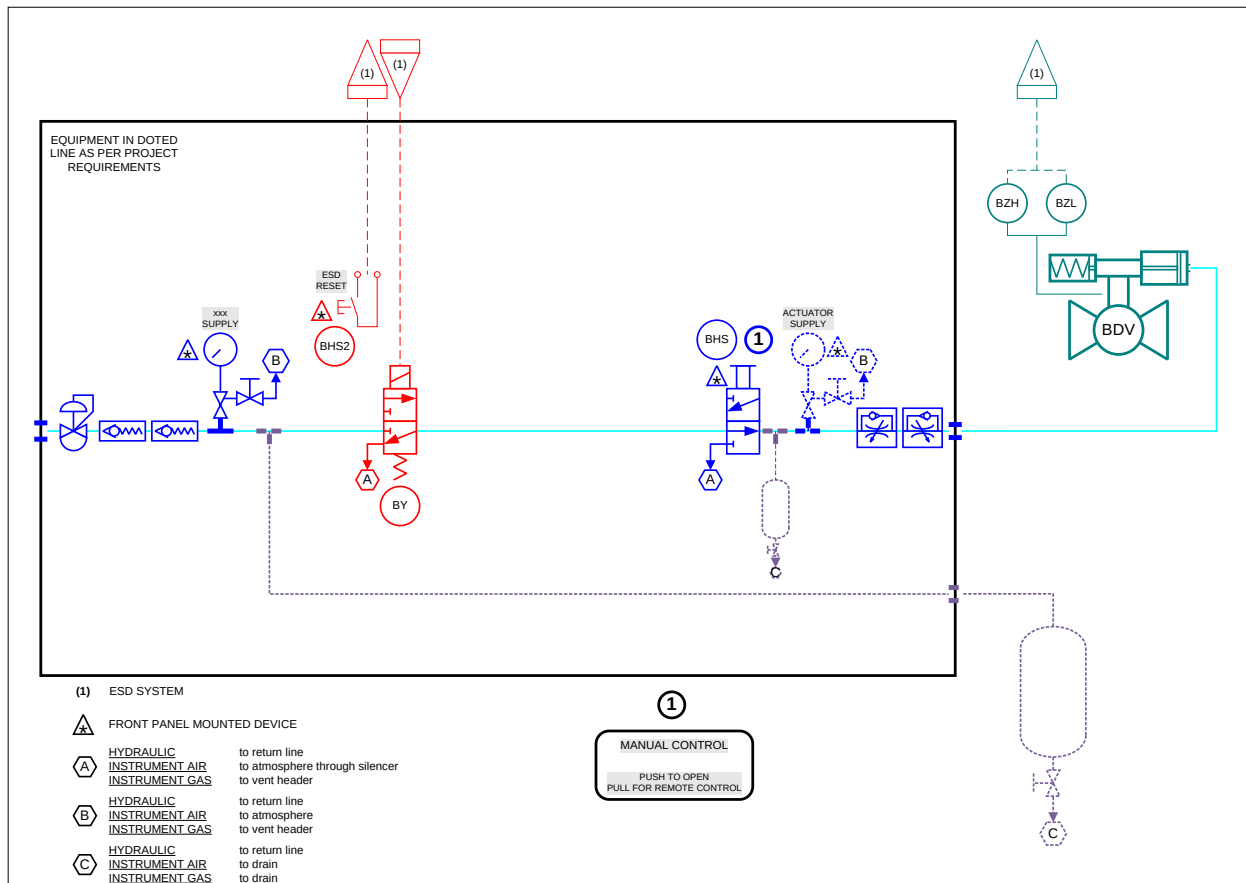


TYPICAL 311:

BDV - SINGLE ACTING

+ LOCAL RESET

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



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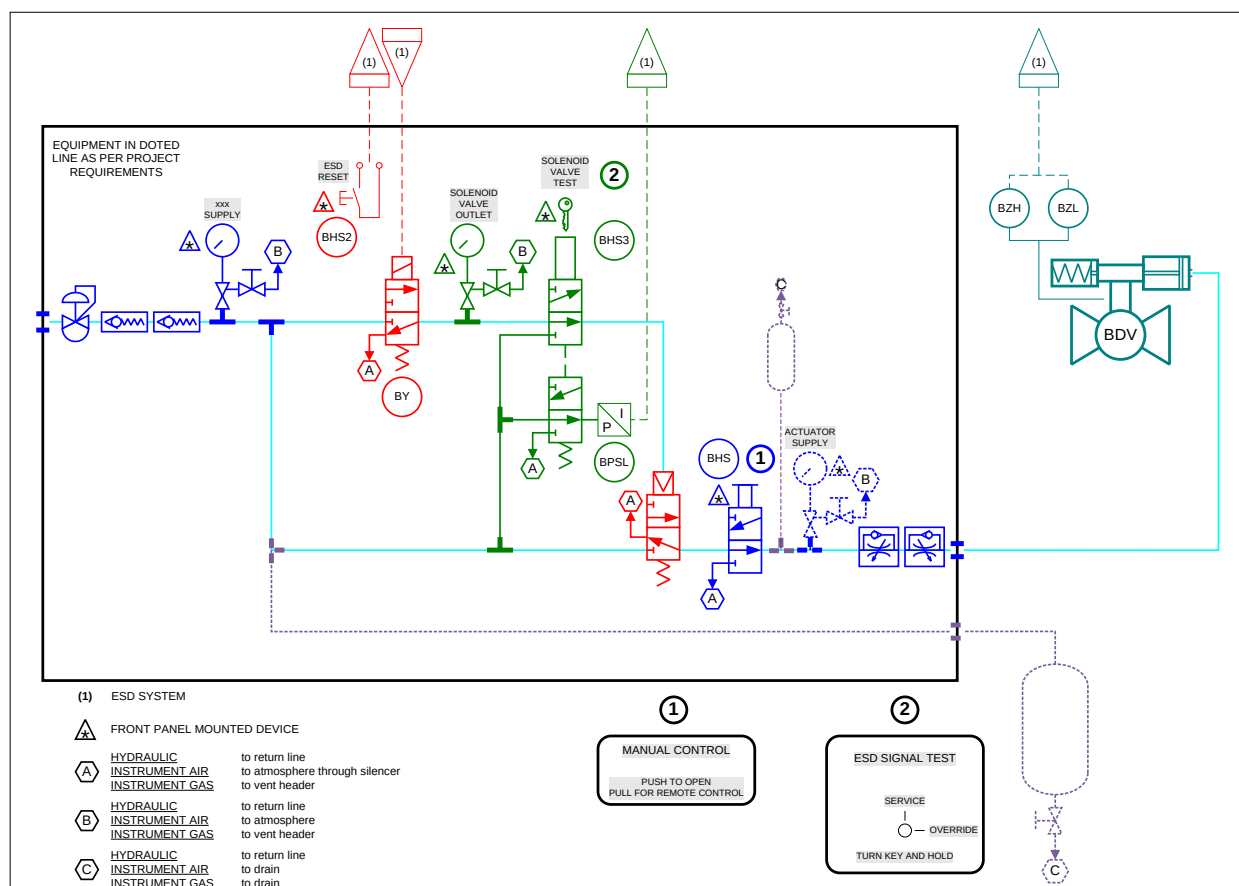
Appendix 1
TYPICAL 312:

BDV - SINGLE ACTING

+ LOCAL RESET

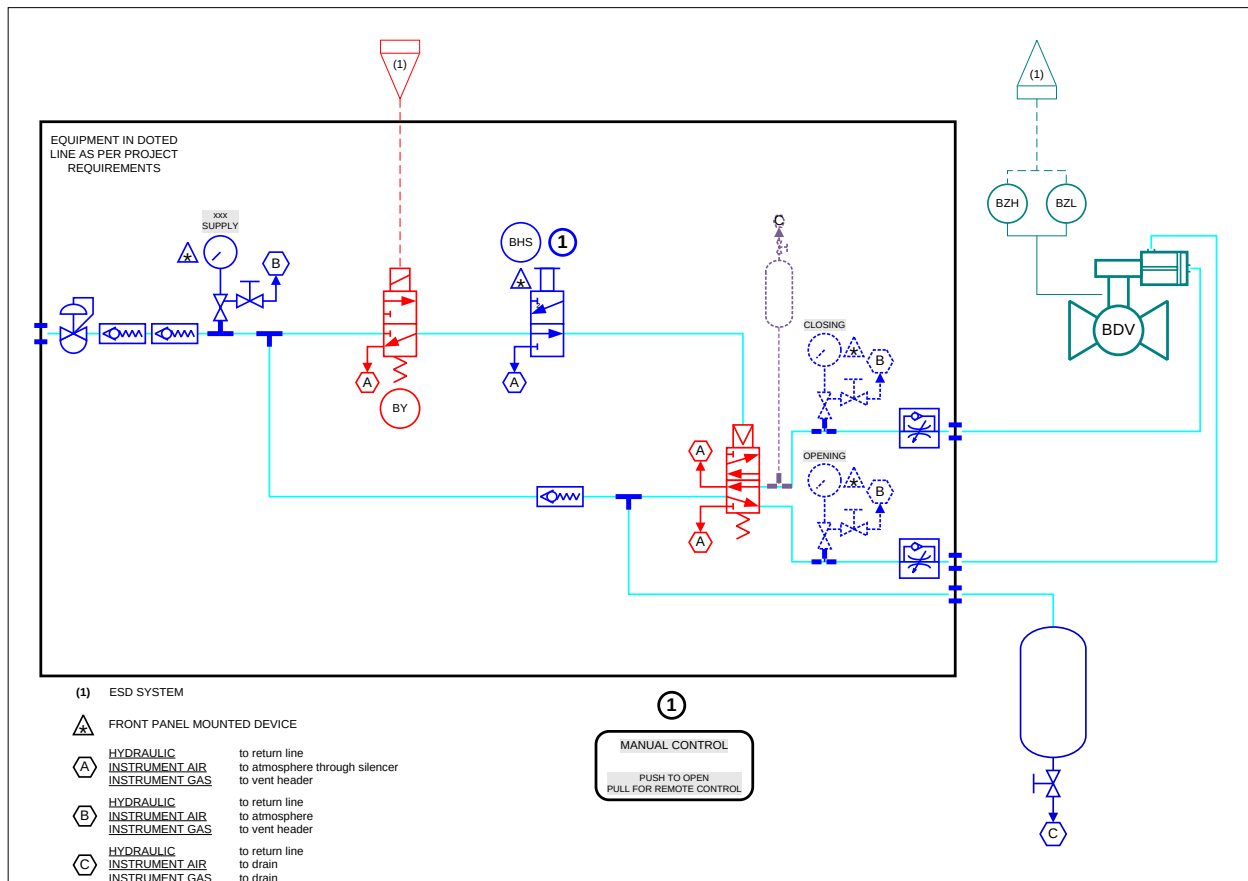
+ SOLENOID VALVE TEST

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 351:
BDV - DOUBLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

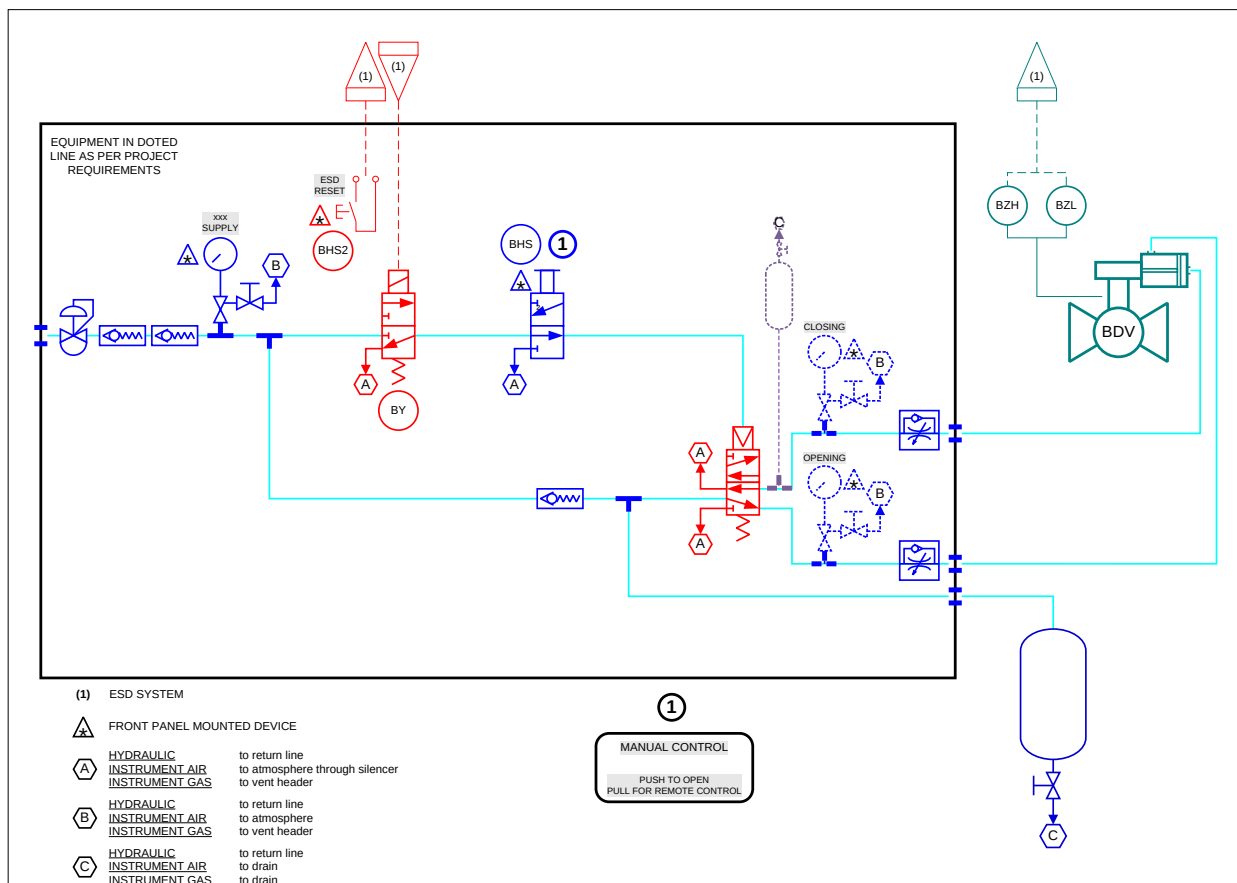


TYPICAL 352:

BDV - DOUBLE ACTING

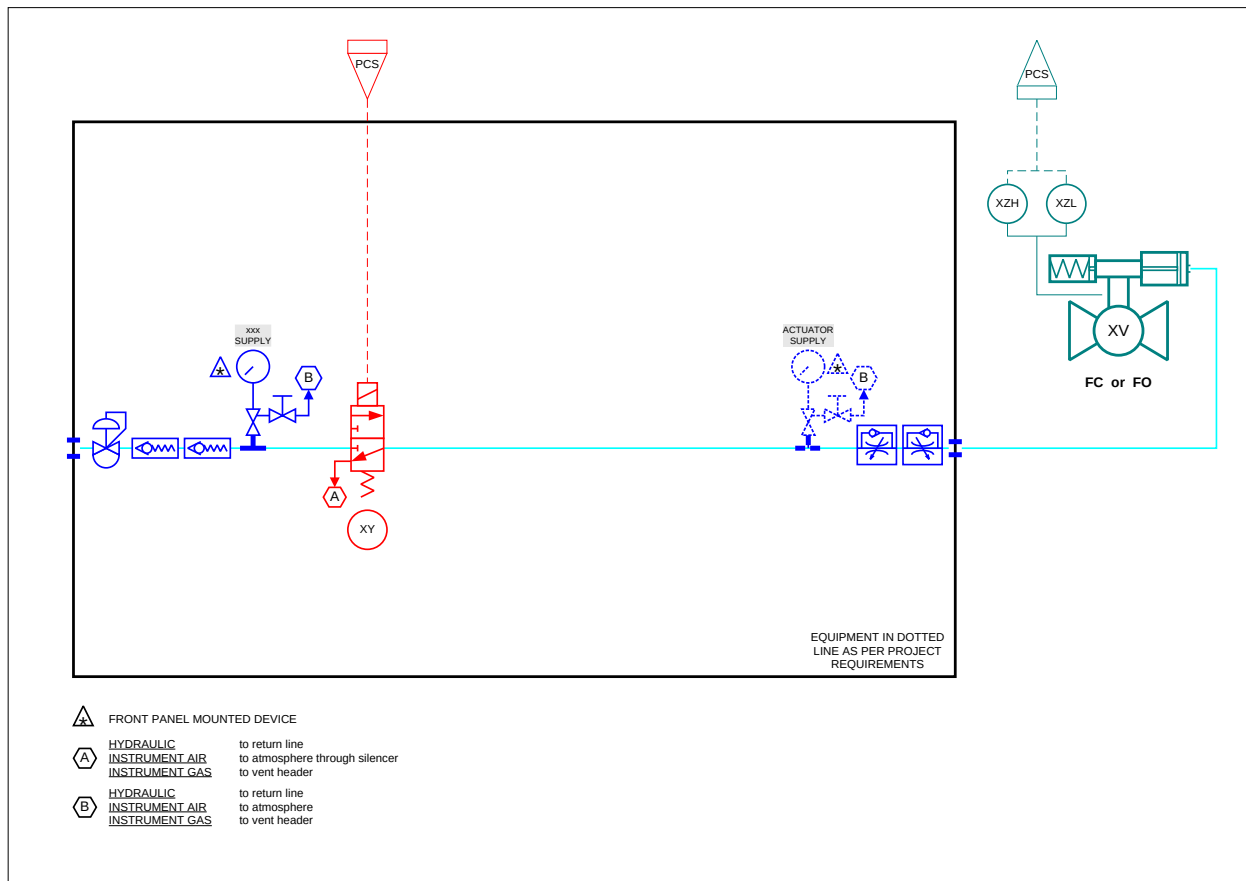
+ LOCAL RESET

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 401:
XV - SINGLE ACTING

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.

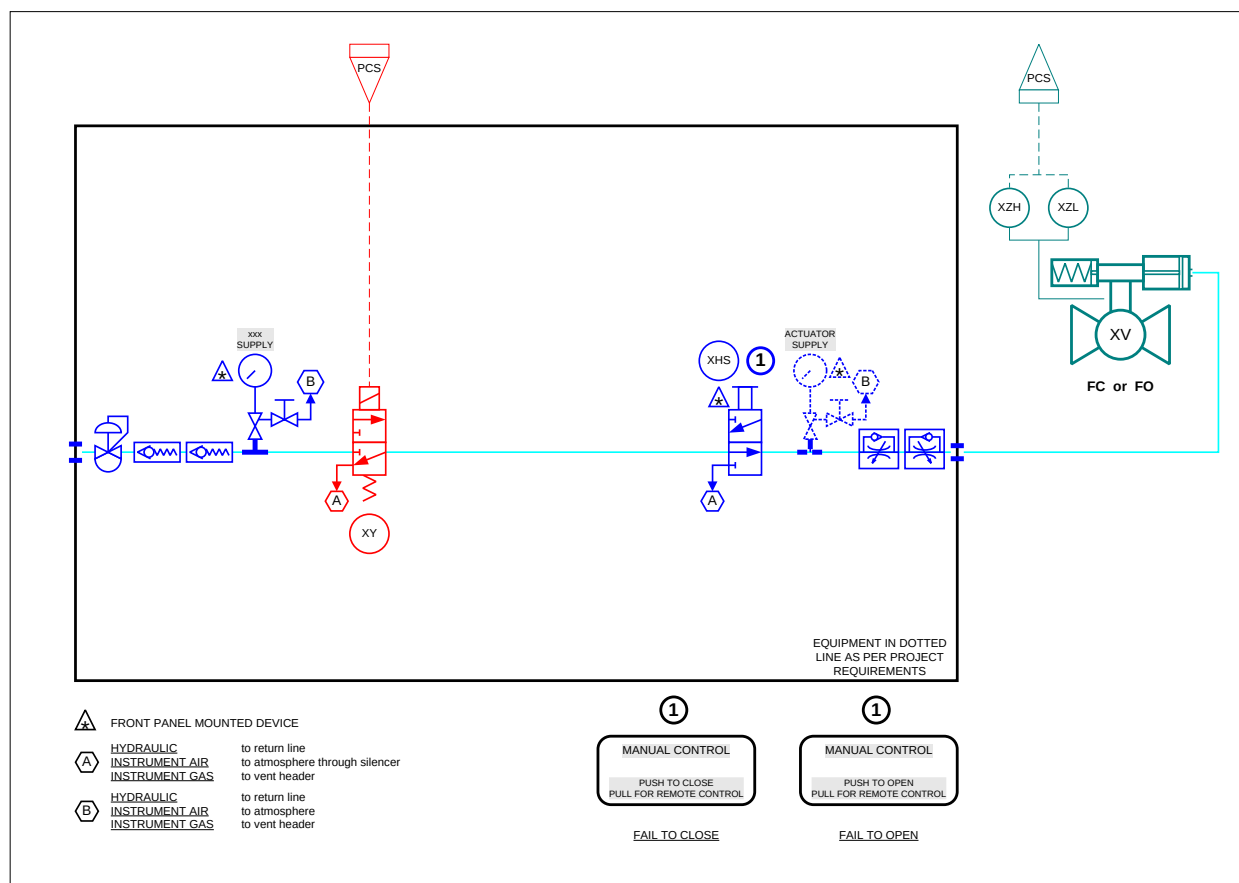


TYPICAL 402:

XV - SINGLE ACTING

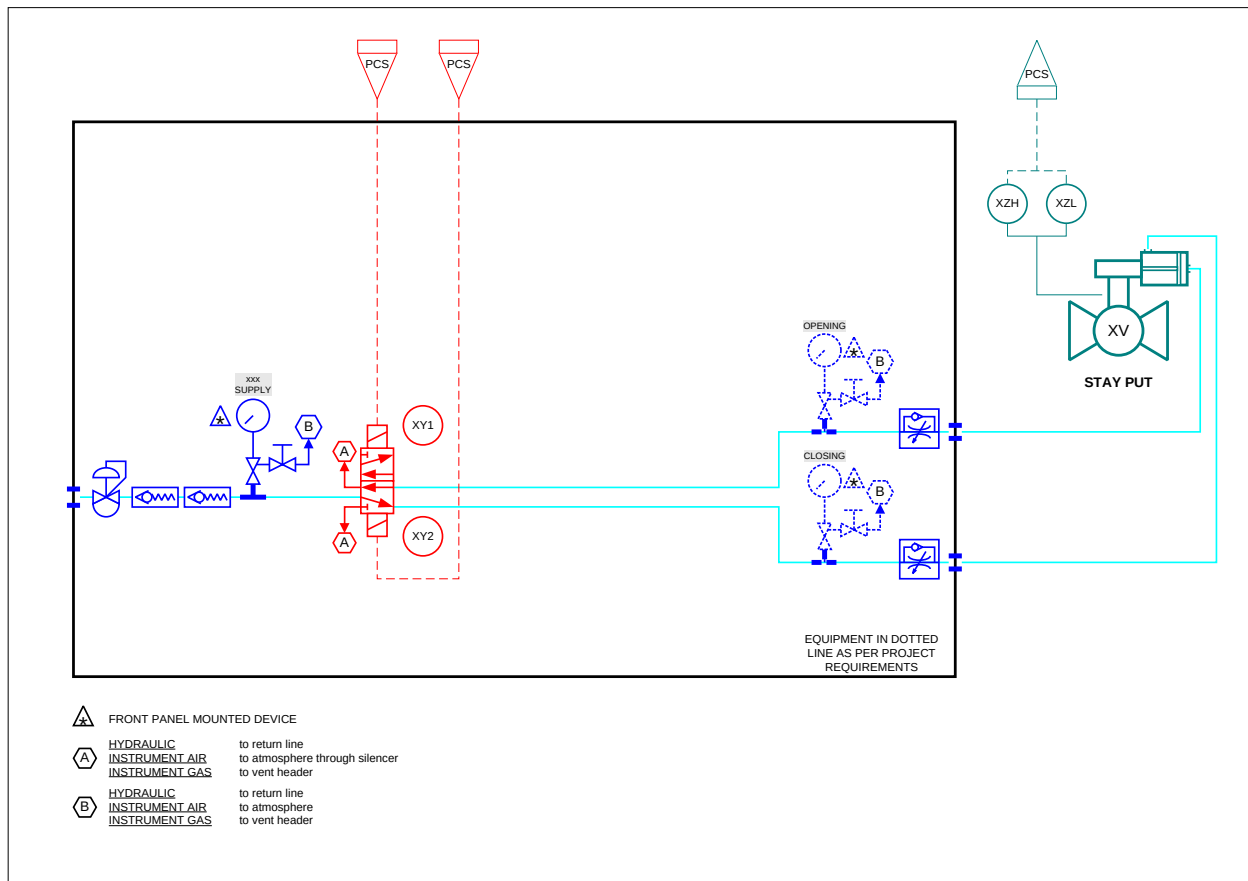
+ LOCAL CONTROL

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



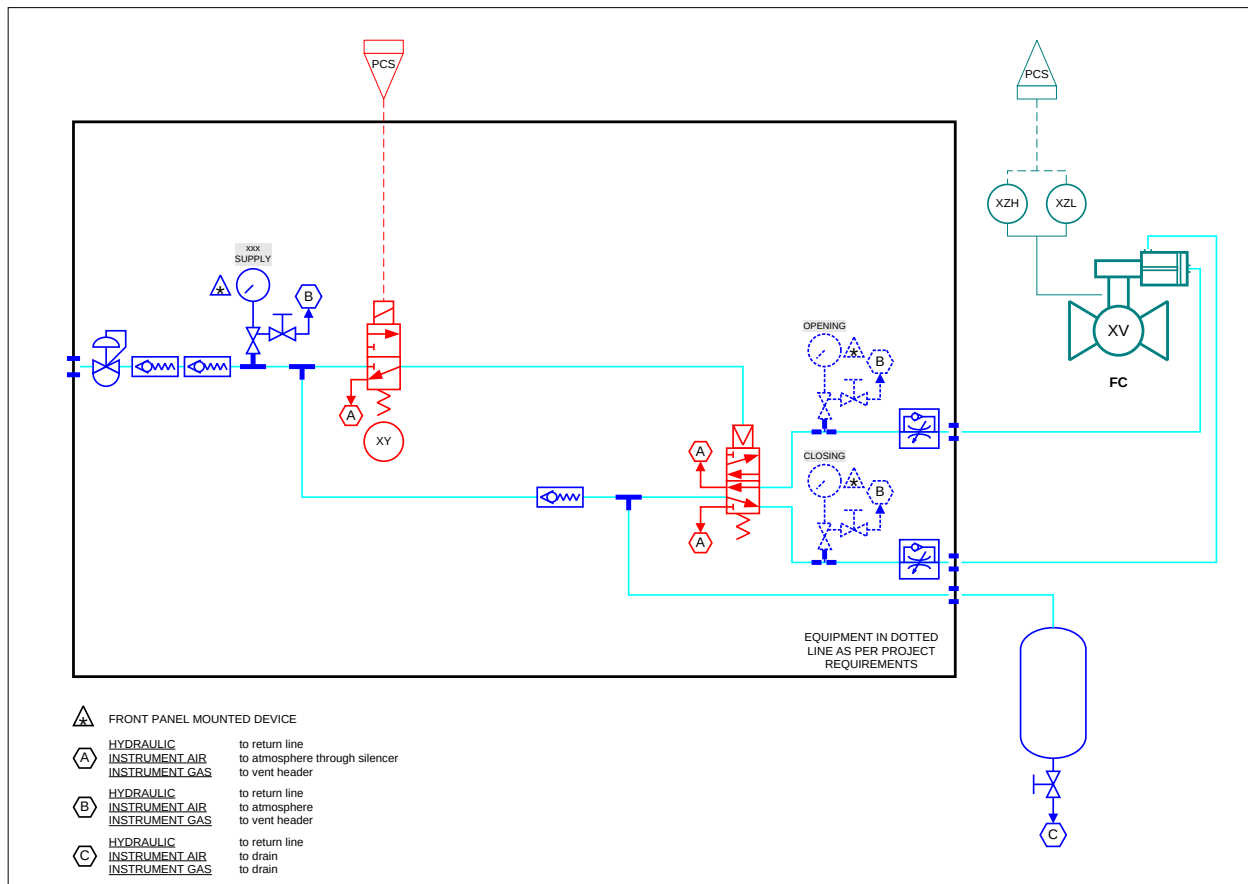
TYPICAL 451:
XV - DOUBLE ACTING - 'STAY PUT'

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



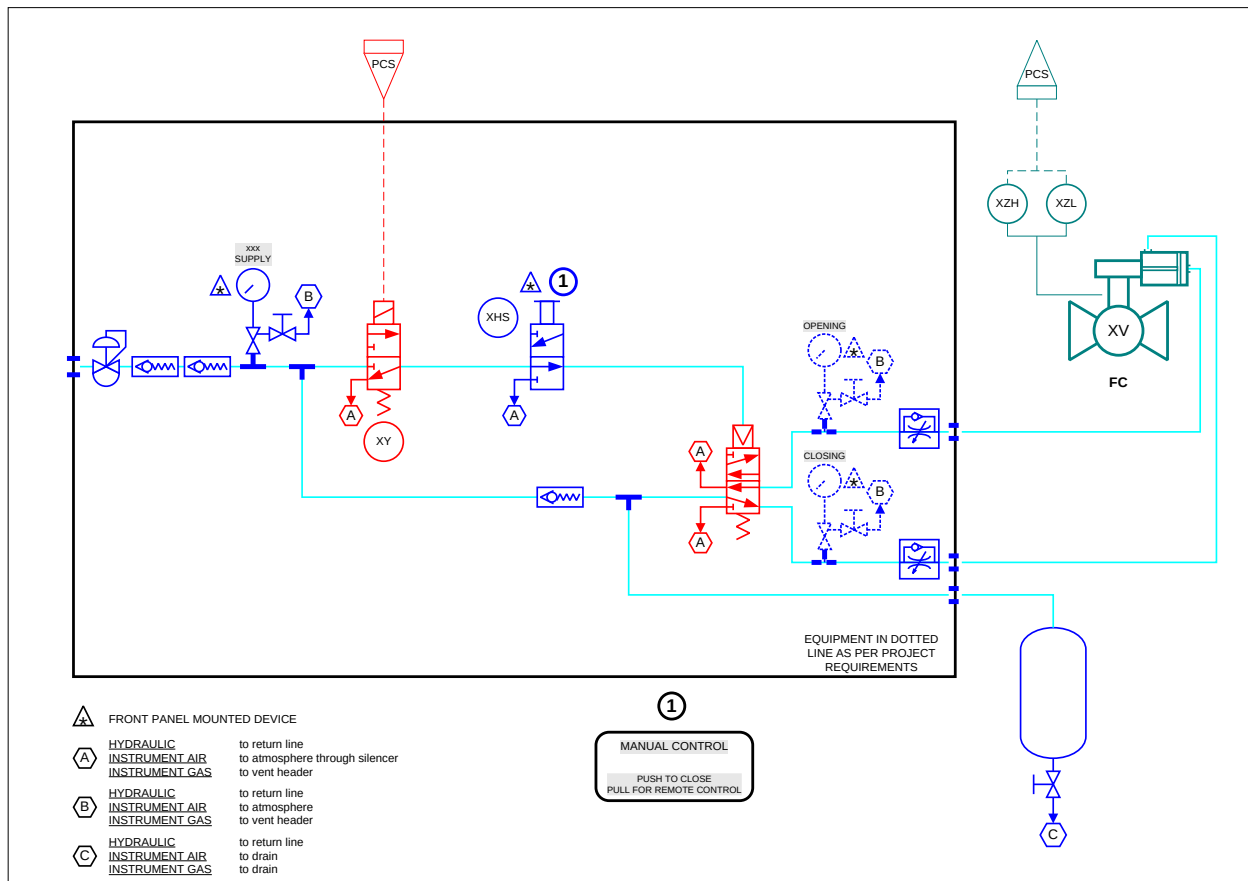
TYPICAL 452:
XV - DOUBLE ACTING - 'FAIL TO CLOSE'

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.



TYPICAL 453:
XV - DOUBLE ACTING - 'FAIL TO CLOSE' + LOCAL CONTROL

Functional schematic drawing is given for information only. It shall be fully developed during FEED/basic and detailed engineering stages.





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Appendix 2

Appendix 2 Valve / Actuator Functional Tests



ON / OFF VALVE ASSEMBLY FACTORY ACCEPTANCE TESTS

CHECK-LIST

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CLIENT:		Project Reference:	
Valve Tag Number:	Valve S/N:	Actuator S/N:	

Reference Documents	Number	Revision	Date
Purchase Order			
Valve Data Sheet			
General Assembly Drawing			
Control Schematic Diagram			
Torque Table			

1. Conformity Checking

Checks to be performed	Check results	Comments
• Valve Type / Bore / Diameter	☐ OK ☐ NO ☐ NA	
• Valve Rating / End Connections	☐ OK ☐ NO ☐ NA	
• Actuator Type:	☐ OK ☐ NO ☐ NA	
• Control Cabinet Type:	☐ OK ☐ NO ☐ NA	
• Actuator End Stops checking (alignment between valve & actuator)	OPEN ☐ OK ☐ NO CLOSE ☐ OK ☐ NO	
• Labeling (to be in accordance with General & Project Specifications)		
- Trafalloyte label on control cabinet front door	☐ OK ☐ NO ☐ NA	
- Trafalloyte labels at cabinet inlets & outlets connections	☐ OK ☐ NO ☐ NA	
- Trafalloyte labels on components	☐ OK ☐ NO ☐ NA	
- Trafalloyte label on limit switches box	☐ OK ☐ NO ☐ NA	
- Trafalloyte instruction plates	☐ OK ☐ NO ☐ NA	
- Stainless Steel name plate on instruments	☐ OK ☐ NO ☐ NA	
- Stainless Steel name plate on valve	☐ OK ☐ NO ☐ NA	
- Stainless Steel name plate on actuator	☐ OK ☐ NO ☐ NA	
- Stainless Steel name plate on reserve vessel	☐ OK ☐ NO ☐ NA	
• Control Cabinet: components type & reference	☐ OK ☐ NO ☐ NA	
• Control Cabinet & Components: material	☐ OK ☐ NO ☐ NA	
• Control Cabinet: components & connections diameters	☐ OK ☐ NO ☐ NA	
• Control Cabinet: breathing/venting	☐ OK ☐ NO ☐ NA	
• Control Cabinet: draining	☐ OK ☐ NO ☐ NA	
• ATEX / IECEx Certification: electrical components	☐ OK ☐ NO ☐ NA	
• ATEX / IECEx Certification: cable glands	☐ OK ☐ NO ☐ NA	
• ATEX / IECEx Certification: valve + actuator assembly	☐ OK ☐ NO ☐ NA	
• Grounding of instruments inside the cabinet	☐ OK ☐ NO ☐ NA	
• Control Cabinet earthing facility	☐ OK ☐ NO ☐ NA	
• Limit switches type	☐ OK ☐ NO ☐ NA	
• Valve position beacon indicator	☐ OK ☐ NO ☐ NA	
• Valve position mechanical indicator	☐ OK ☐ NO ☐ NA	
• Dimensional checking: actuator	☐ OK ☐ NO ☐ NA	
• Dimensional checking: cabinet	☐ OK ☐ NO ☐ NA	
• Visual checking: reserve vessel	☐ OK ☐ NO ☐ NA	
• Painting	Type Color Thickness Aspect	
- Actuator	☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA	
- Safety accumulator	☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA	
- Control cabinet	☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA ☐ OK ☐ NO ☐ NA	



ON / OFF VALVE ASSEMBLY **FACTORY ACCEPTANCE TESTS**

CHECK-LIST

Page 2 of 4

CLIENT:		Project Reference:	
Valve Tag Number:	Valve S/N:	Actuator S/N:	

2. Other Verifications to be performed before functional tests			
• Actuator power supply	☐ PNEUMATIC	☐ HYDRAULIC	☐ ELECTRIC
• Operating pressure or voltage	 barg	 volt	
• Pilot supply	☐ PNEUMATIC	☐ HYDRAULIC	☐ ELECTRIC
• Pilot pressure or voltage	 barg	 volt	
• Instrument tubes between control panel and actuator are as per future site conditions	- diameter	☐ OK ☐ NO	
	- thickness	☐ OK ☐ NO	
	- length	☐ OK ☐ NO	

3. Functional Tests			
3.1 Open / Close Commands test (local and remote)			
Test operations	Test results	Check results	Comments
1. Solenoid #1 is not energized & Solenoid #2 is not energized	→ valve is in the safety position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
2. Put the local control in the "Remote" position	→ valve stays in position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
3. Energize solenoid valve #1	→ valve stays in position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
4. Energize solenoid valve #2	→ valve moves to normal position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
5. Put the local control in the "Close" position (Note: "Open" position for BDVs)	→ valve moves to safety position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
6. Put the local control in the "Remote" position	→ valve moves to normal position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
7. De-energize solenoid valve #1	→ valve moves to safety position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
8. Energize solenoid valve #1	→ valve moves to normal position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
9. De-energize solenoid valve #2	→ valve moves to safety position	☐ OK ☐ NO ☐ NA	
	• check beacon indication	☐ OK ☐ NO ☐ NA	
	• check limit switches contacts	☐ OK ☐ NO ☐ NA	
3.2 Partial Stroking test			
Test operations	Test results	Check results	Comments
1. Check solenoid valve is energized	→ valve is open	☐ OK ☐ NO ☐ NA	
2. Turn and release the "Valve Stroke Test" key	→ valve moves 15% to its safety position and returns to normal operating position	☐ OK ☐ NO ☐ NA	



ON / OFF VALVE ASSEMBLY FACTORY ACCEPTANCE TESTS

CHECK-LIST

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CLIENT:		Project Reference:	
Valve Tag Number:	Valve S/N:	Actuator S/N:	

3. Functional Tests (Cont'd)					
3.3 Solenoid Valve test					
Test operations	Test results	Check results	Comments		
1. Energize the solenoid valve(s)	→ pressure at "Solenoid Outlet" gauge is at supply pressure	☐ OK ☐ NO ☐ NA			
2. Turn the "Signal Test" key in the "Override" position	→ the pressure switch signal moves to "Test ON"	☐ OK ☐ NO ☐ NA			
3. De-energize solenoid #1	→ pressure at "Solenoid Outlet" gauge is zero	☐ OK ☐ NO ☐ NA			
4. Energize solenoid valve #1	→ pressure at "Solenoid Outlet" gauge is at supply pressure	☐ OK ☐ NO ☐ NA			
5. De-energize solenoid #2	→ pressure at "Solenoid Outlet" gauge is zero	☐ OK ☐ NO ☐ NA			
6. Energize solenoid valve #2	→ pressure at "Solenoid Outlet" gauge is at supply pressure	☐ OK ☐ NO ☐ NA			
7. Release the key back to "Service" position	→ the pressure switch signal moves to "Test OFF"	☐ OK ☐ NO ☐ NA			
THE VALVE STAYS IN POSITION ALL ALONG THE TEST		☐ OK ☐ NO ☐ NA			
3.4 Operating Time					
Parameters	Required Values	Results	Check Results	Comments	
Valve Diff. Pressure	 bar	 bar	☐ OK ☐ NO		
Min. Actuator Oil / Air supply pressure	 barg	 barg	☐ OK ☐ NO		
• Closing Time	 sec	 sec	☐ OK ☐ NO		
• Opening Time	 sec	 sec	☐ OK ☐ NO		
Max. Actuator Oil / Air supply pressure	 barg	 barg	☐ OK ☐ NO		
• Closing Time	 sec	 sec	☐ OK ☐ NO		
• Opening Time	 sec	 sec	☐ OK ☐ NO		
4.5 BDV Timer test					
Parameters	Required Values	Results	Check Results	Comments	
Accumulator Volume	 litre	 litre	☐ OK ☐ NO		
Accumulator precharged value	 barg	 barg	☐ OK ☐ NO		
Time Delay adjustment range	min sec	max sec			
Set Time Delay before BDV Opening	 sec	 sec	☐ OK ☐ NO		
4.6 Reserve Vessel (Double Acting Actuators)					
Parameters	Required Values	Results	Check Results	Comments	
Accumulator Volume	 litre	 litre	☐ OK ☐ NO		
Number of strokes - starting from...					
... minimal pressure	 barg	 strokes	 strokes	☐ OK ☐ NO	
... nominal pressure	 barg	 strokes	 strokes	☐ OK ☐ NO	
4.7 Additional Tests for Electrical Actuators					
Opening stops on	Limit Switch	☐ OK ☐ NO	Closing stops on	Limit Switch	☐ OK ☐ NO
	Torque Limitor	☐ OK ☐ NO		Torque Limitor	☐ OK ☐ NO
NOTE: Specific functional tests might be required for devices like Smart Valve Test System (SVTS), Electrical Actuator local control station, etc, with connection to external interfacing or acquisition systems. The test procedure shall be prepared by the supplier of these devices, and attached to this check-list.					

On/off valve control panels and actuators functional and construction requirements

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Appendix 2



ON / OFF VALVE ASSEMBLY FACTORY ACCEPTANCE TESTS

CHECK-LIST

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CLIENT:		<u>Project Reference:</u>	
<u>Valve Tag Number:</u>	<u>Valve S/N:</u>	<u>Actuator S/N:</u>	

[illegible]

	MANUFACTURER	INSPECTION Rep.	THIRD PART INSP.	COMPANY Rep.
Date:				
Name:				
Visa:				