



Weatherford®

Well Controlled Solutions



Production Optimization

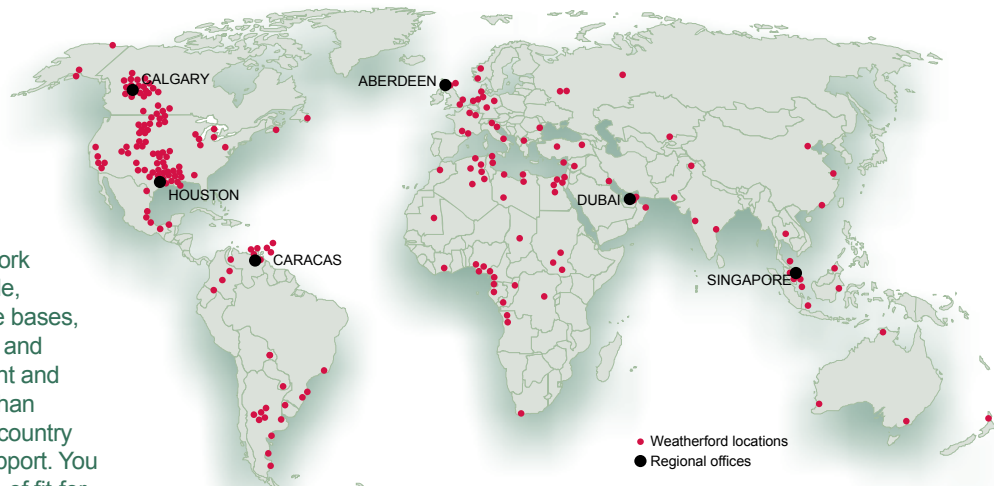
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Introduction

Weatherford's global network of more than 25,000 people, operating from 730 service bases, 87 manufacturing facilities and 13 technology development and training facilities, in more than 100 countries, ensures in-country expertise and logistical support. You also have the reassurance of fit-for-purpose solutions, best practices, best services and best products.

Weatherford's manufacturing and service facilities maintain dedicated departments for the supply of spare parts, repair kits, tube fittings, pipe fittings and various other components used in the fabrication and installation of control systems. Most components are in stock and available for quick delivery.



The CAC Control Systems product line of Weatherford's production optimization group, eProduction Solutions (eP), designs, manufactures, installs and commissions turnkey pneumatic, hydraulic and electro-hydraulic process control and safety shutdown systems for the oil and gas industry. With over half a century of combined experience, our dedicated staff of engineers and technicians takes pride in producing high quality, cost effective and well designed solutions for all your operational needs. Weatherford believes that after sales, support and service is key to the long term maintenance of any critical piece of equipment. To support these needs Weatherford maintains control system manufacturing and service facilities in the following locations:

- Houston, Texas, United States
ISO 9001:2000 certified (PJR)
- Jebel Ali Free Zone, U.A.E.
BS-EN-ISO 9001:2000 certified (MI)
- Gt. Yarmouth, England
BS-EN-ISO 9001:2000 certified (DNV)
- Aberdeen, Scotland
BS-EN-ISO 9001:2000 certified (DNV)
- Abu Dhabi, U.A.E.

In addition to operational support, quality control and assurance is key.

Introduction

Design Overview

The process control or safety shutdown panel is a fail-safe system using control logic to provide emergency shutdown (ESD), fusible loop fire protection and wellhead valve opening/closing sequencing. Standard monitoring, control and shutdown functions are available for the following applications:

- Master platform process facilities
 - ESD systems
 - Fusible loop charging systems
- Oil and gas separators
- Water injection systems
- Chemical injection systems
- Heater treaters
- Pipelines
- Gas injection systems
- Blowout preventors
- Gas scrubbers
- Individual well control
- Well kill systems

Features

Standard control panel features:

- Sequential valve opening and closing
- Monitor flowline pressure status
- Emergency shutdown
- Manual override
- Fire safety shutdown
- Any combination of hydraulic and/or pneumatic valve actuator controls
- Remote telemetry control
- Easy serviceability
- Corrosion resistant type 316 stainless steel (SS)
- Removable doors for easy access to panel components
- Intrinsically safe to meet requirements such as ATEX, U.L., CENELEC, BASEEFA, C.S.A. and others



Introduction

Options

Weatherford control panels are available with a wide selection of options to insure that every condition is taken into account. The common elements from Weatherford are exceptional quality and reliability. Our control panels are particularly suitable for use in remote areas, on offshore platforms and in hostile environments. Options available include:

- Single well control panels
- Multi-well control panels
- Removable well control modules
- Process control panels
- Custom designed well control panels
- Solar powered electro-hydraulic systems
- Gasoline or diesel generator powered systems
- Remote terminal unit (RTU)/programmable logic controller (PLC) based safety logic
- Panel mounted pressure pilots
- Additional safety valve control
- Process shutdown logic with pneumatic first out indicators
- Hydraulic accumulation for backup
- SCADA interface for remote control and monitoring



Control Panels

Single and multi-well panels are planned and manufactured in-house to Weatherford or client-defined specifications. Using the very latest design technologies and components, we are able to offer high quality, well designed and constructed well control systems with a proven track record for reliability and ease of maintenance. These panels are suitable for use in remote areas, on offshore platforms and even in hostile environments. We are able to fast track the delivery period and meet client key project requirements of cost and quality.

Single Well Control Panel

The standard single well control panel is designed to operate one hydraulic-controlled subsurface safety valve and up to two hydraulic- or pneumatic-controlled surface safety valves for any type of well. The standard single well panel automatically closes the safety valves in response to alarm conditions requiring shut-in. Safety valves can be shutdown either manually or automatically, at the panel or remotely. Some panels include logic, enabling the wells to be controlled by an ESD/temperature safety element (TSE) plug loop and high/low process pressure pilot.

The panel monitors the status of the flowline high-low pressure sensors and provides shut-in of the well during emergency conditions. It is available with a wide selection of options to ensure that your particular production requirements are addressed. Standard panel enclosures are constructed of 12 gauge (3 mm) 316 SS. All fittings and tubings are constructed of 316 SS. However, we will customize to user specific requirements.



Type	Pneumatic/hydraulic control system
Pneumatic Supply	
Type	Air or natural gas
Pressure	100- to 200-PSIG (6.9- to 13.8-BARG)
Service	Standard or H ₂ S-CO ₂ (NACE)
Consumption	15 SCFM (max.) when pumping 5 SCFD (normal)
Hydraulic outputs	Subsurface safety valve and surface safety valves, 1,000- to 10,000-PSIG (68.9- to 689.5-BARG)
Pneumatic outputs	ESD loop, 50 PSIG (3.4 BARG) Pilot supply, 50 PSIG (3.4 BARG) Surface safety valves, 100- to 200-PSIG (6.9- to 13.8-BARG)
Shutdown functions	Remote ESD Fusible plugs Low pressure/high pressure Manual at panel
Pneumatic/hydraulic components	300 series SS where possible, all components suitable for marine environment Hydraulic pump: combination manual/pneumatic drive A hydraulic regulator is provided for panels with hydraulic SCSSV
Environment	
Temperature	0° to 130°F (-17.7° to 54.4°C)
Atmosphere	Desert/marine
Reservoir capacity	5 U.S. gallons (18.9 U.K. liters)
Tubing	316 SS
Fittings	316 SS
Enclosure	
Material	12 gauge (3 mm), 316 SS
Height	36 in (91.44 cm)
Width	12 in (30.48 cm)
Depth	24 in (60.96 cm)
Weight	300 lbs (136 kg)

Control Panels

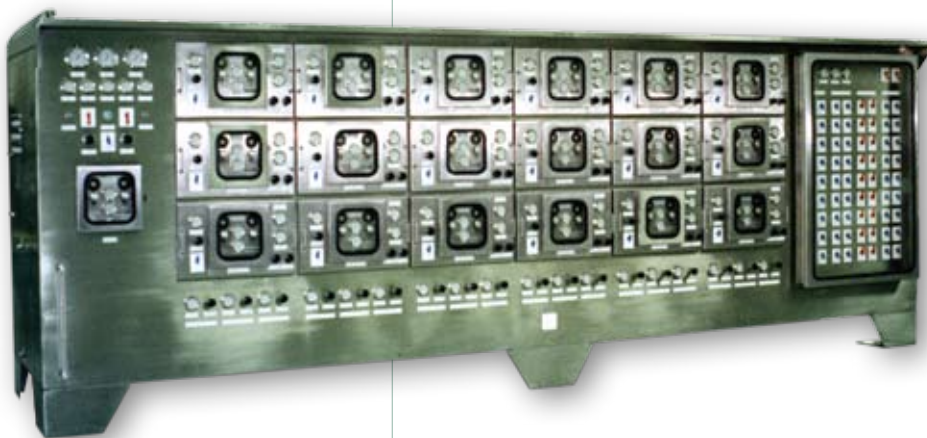
Multi-Well Control Panels

All the features of the single well panel are offered in the multi-well design. Multi-well control panels are a combination of standard pneumatic, hydraulic and electronic based logic in a single integrated solution for multiple wells in both onshore and offshore applications. The pneumatic pressure source could be either process gas from the wellsite or compressed air. Hydraulic control pressure is developed through the use of hydraulic pumps within the control system.

The multi-well control panel is a fail-safe system using control logic to provide ESD, fusible loop fire protection and wellhead valve opening/closing sequencing. Solutions can be completely customized to meet customer operational requirements from weight and footprint layout to operational functionality. Weatherford also offers standard designs where client preferences are not defined.

As an option, our multi-well control panels can incorporate removable and interchangeable well control modules, each controlling a single well. Any well module can be easily isolated and removed without affecting the operation of any other part of the well control panel. Existing modules can be removed and a spare module installed with a minimum of downtime.

These custom designed panels can be built to accommodate any number of wells. There is also an option to add a functional PLC to the panel. Our design engineers are available to assist customers with development of their project design.



Control Panels

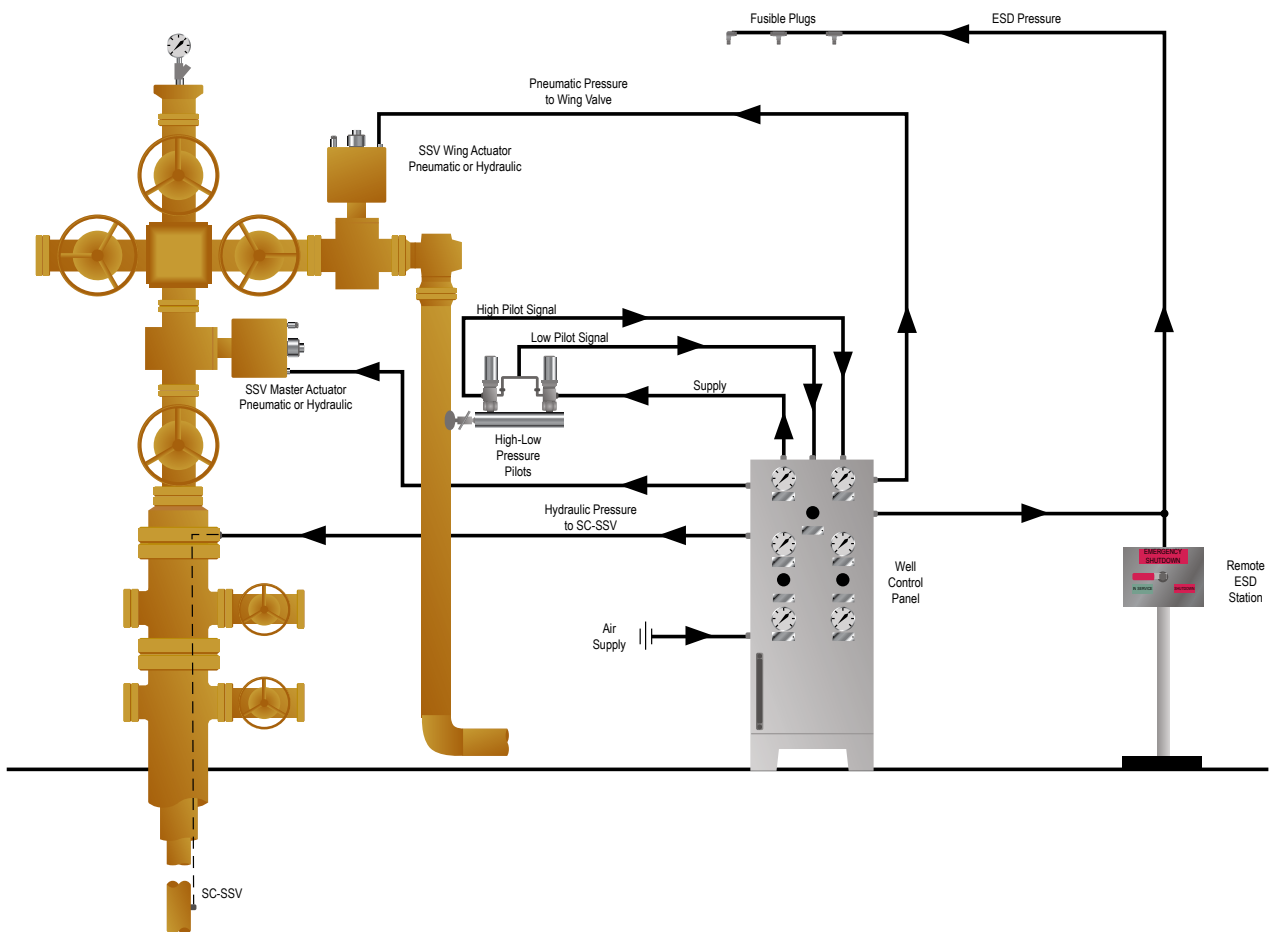
Shutdown Chart*

Response	Action						
	Remote ESD	Fusible Plugs	High Pilot	Low Pilot	Manual WV at Panel	Manual MV at Panel	Manual SCSSV at Panel
Close WV	✓	✓	✓	✓	✓	✓	✓
Close MV	✓	✓		✓		✓	✓
Close SCSSV	✓	✓		✓			✓

*Shutdowns can be changed to meet customer requirements.

Notes:

1. Customers should specify the number and type of surface safety valves (wing, master or both) and pneumatic or hydraulic.
2. If NACE service is required, customer should specify.
3. Typical delivery is only four to six weeks upon receipt of purchase order.
4. All safety system accessories: pressure pilots, ESD stations, fusible plugs, gas scrubbers and installation kits are available.



Electro-Hydraulic and Electric Control Systems

The CS7X system is designed to:

- Increase system reliability/availability
 - Highly reliable, microprocessor based architecture
 - Wide temperature range, low power, CMOS technology
 - Prime and backup CPUs at each level
- Reduce maintenance/operating costs
 - Extremely low power consumption
 - Designed for online maintenance
 - Self-testing remote system diagnostics
 - Reduces weight and footprint
- Integrate well control and ESD with field management automation goals
 - Distributed process systems and subsystems
 - Remote/local interface options
 - Modbus protocol
 - Integrated SCADA and platform functionality

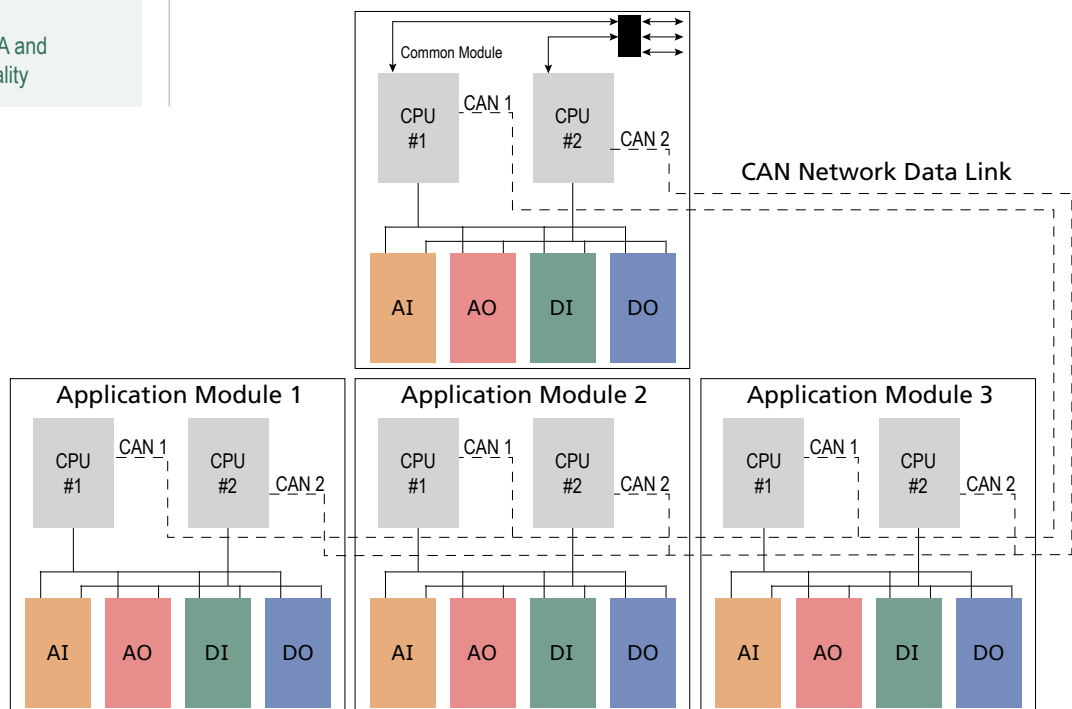
Weatherford's **CS7X™** electro-hydraulic safety shutdown system is a low power, highly reliable, microprocessor based, distributed wellhead and production control system.

The system provides supervisory control of wellheads and other production applications on a logical application module basis. Control decisions are performed in the control hierarchy.

Redundancy provides extremely high reliability in the critical areas of communications, power and control.

The CS7X system is designed for production applications where conventional power sources are not available. The system can be integrated with hydraulic/pneumatic logic to support shutdown operations and SCADA systems to provide remote wellhead control.

The system is assembled and tested to the latest CENELEC standards for use in hazardous areas.



Chemical Injection

From conceptual design through final completion, Weatherford is able to manufacture and supply turnkey chemical injection and dosing packages for the petrochemical and process industries. Applications include:

- Wax inhibitors
- Demulsifiers
- Scale inhibitors
- Corrosion inhibitors
- Glycol
- Odorization
- Methanol injection



Pilots



HLU Universal High-Low Pilot

The HLU high or low-pressure pilot is designed to protect equipment and installations against abnormal pressures. The assembly operates as a normally open block-and-bleed device for sensing undesirably low or high pressure conditions. The sensing element can be readily converted from one pressure range to another by reconfiguring its components. All needed parts and diagrams are included with every assembly and conversion can be made by field personnel as operating requirements change.

The pilot body is patterned after the HL-2 design which has years of proven reliability and reflects the same high precision and quality. The HLU universal high-low pilot includes the following features:

- Complete range of pressure settings within a compact package
- Four unique configurations to respond to pressures ranging from 25- to 10,000-PSI (1.7- to 689.5-BAR)
- Constructed of materials in accordance with NACE MR0175-91
- Standard type 316 SS components can be fabricated from practically any alloy, including:
 - Hastelloy
 - Monel
 - Inconel
 - Duplex

Supply pressure 125 PSI (8.5 BAR) maximum
 Operating temperature -20° to +250°F (-29° to 120°C)
 Weight ~3.7 lb. (~1.7 kg.)
 Production test pressure 1.5 x sensed pressure, 10,000 PSI (689.5 BAR) minimum
 Set point repeatability <1% of set pressure
 Hysteresis or deadband <10% of full range

Ordering Information	
Part Number	Description
434201	Low pressure sense head assembly, 25- to 150-PSI (1.7- to 10.3-BAR)
434202	Intermediate pressure sense head assembly, 100- to 600-PSI (6.9- to 41.4-BAR)
434203	Medium pressure sense head assembly, 400- to 2,500-PSI (27.6- to 172.4-BAR)
434204	High pressure sense head assembly, 1,600- to 10,000-PSI (110.3- to 689.5-BAR)

Pilots

High-Low Direct Dial Pilots

Weatherford's dial-adjustable pilots offer accurate, reliable operation and feature full stainless steel construction to insure years of dependable operation even in the most severe applications. To further protect each pilot from the elements, every pilot is mounted in a lockable weather-tight fiberglass or 316 SS case. Models are available to sense a wide range of pressures to 10,000 PSI (689.5 BAR). Standard supply and output pressure is 30 PSI (2.1 BAR), with other pressures available.

Weatherford's high-low direct dial pilots include the following options:

- Single or dual porting
- Facility manual reset
- Indicating pressure gauges
- Adjustable setting dials
- Pressure sensing ranges
- Extreme corrosive applications
- Various mounting options

Service	Pilot Models		
	SDA™	SDE™	SDEP™
Standard, H ₂ S and CO ₂	876-32	876-41	876-45
Arctic	876-33	876-42	876-46



Pilots



Model SDA Pilot

This model features two independently operating pilots, one for high and one for low pressure. A fully instrumented panel is standard, showing sensed and output pressure. Two separate dials select high and low pressure trip points.

- Nominal supply pressure 30 PSI (2.07 BAR)
- Low set point repeatability 1% full scale
- High set point repeatability 1% full scale
- Hysteresis dead band (trip or reset) when output signal restored automatically 5%
- Weight 18.5 lbs (8.4 kg)
- Operating temperature:
 - Standard, H₂S, CO₂ -20° to 180°F (-29° to 82°C)
 - Arctic -75° to 180°F (-60° to 82°C)
- Dimensions:
 - Stainless steel 12.5" W x 13" H x 8" D
 - Fiberglass enclosure 12.75" W x 12.75" H x 8" D

Model SDA-	PSI/BAR				
	100	1,000	2,000	4,000	10,000
Maximum test pressure	160 11	1,500 103.4	3,000 206.8	5,000 344.7	10,000 689.5
Pressure sensor ranges	15-100 1-6.9 10-50 0.7-3.4 6-25 0.4-1.7	100-1,000 6.9-68.9 50-500 3.4-34.4 25-250 1.7-17.2	200-2,000 13.8-137.9 150-1,500 10.3-103.4 100-1,000 6.9-68.9 50-500 3.4-34.4 25-250 1.7-17.2	600-4,000 41.4-275.8 600-3,000 41.4-206.8 600-2,000 41.4-137.9 400-1,000 27.6-68.9 400-1,000 27.6-68.9	1,600-10,000 110.3-689.5 600-4,000 41.4-275.8 600-3,000 41.4-206.8 600-2,000 41.4-137.9 400-1,000 27.6-68.9
Sensing gauge	0-1,500 0-103.4	0-1,500 0-103.4	0-3,000 0-206.8	0-5,000 0-344.7	0-15,000 0-1034.2

Model SDE Pilot

The single pilot SDE model senses either high or low pressure. This pilot is fully instrumented with gauges for sensed and output pressure.

Model SDEP Pilot

This unit is the panel mountable version of the SDE pilot and is supplied without the instrument gauges and fiberglass case. The SDEP model is usually used in a control panel.

Pilots

High-Low Piston (Stick) Pilots

Weatherford's HL-2 high or low pressure pilot is designed to protect equipment and installations against abnormal pressures. It is available in pressure ranges to 15,000 PSI (1034.2 BAR) and can operate as a normally open block-and-bleed high pressure or closed block-and-bleed low pressure device for pneumatic or hydraulic service.

HL-2 pilot bodies and sense heads are available in any combination of the following five materials:

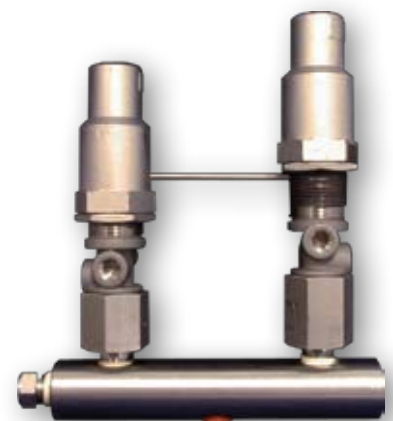
- 316 SS (standard)
- Hastelloy
- Duplex stainless steel
- Inconel 625
- Monel 400

Maximum supply pressure 125 PSI (8.5 BAR)
 Operating temperature -20° to 450°F (-29° to 232°C)
 Production test pressure 1.5 x working pressure
 Repeatability of set point 1% of set pressure max.
 Hysteresis or dead band 10% of full range max.
 Material NACE MR-01-75 standards*
 Maximum working pressure:
 5- to 115-PSI (0.3- to 7.9-BAR) 1,500 PSI (103.4 BAR)
 115- to 10,000-PSI (7.9- to 689.5-BAR) 10,000 PSI (689.5 BAR)
 *Charpy impact value exceeds 15 ft. lb. (20 N-m) at 75°F (6°C)



High-Low Pilots Manifold Assembly

Two HL-2 pilots can be mounted on a manifold to produce a high-low (PSHL) assembly for pressures to 10,000 PSI (689.5 BAR). Any two ranges can be used with consideration of the maximum working pressure for the low pilot. The pilots are block-and-bleed valve devices. One is set to monitor low pressure and the other high pressure. A common pressure is sensed through the manifold block. If either the high or low limit is reached, the assembly blocks and bleeds control pressure to provide failsafe shutdown of the system.



HL-2 Pressure Ranges		
Part Number	PSI	BAR
433741	5-50	0.3-3.4
433742	30-115	2-7.9
433744	100-1,000	6.9-68.9
433743	1,000-5,000	68.9-344.7
433745	500-1,500	34.4-103.4
433746	1,500-3,500	103.4-241.3
433730	3,000-6,000	206.8-413.7
433747	5,000-10,000	344.7-689.5

Safety Systems Field Instruments



Flowline Scrubber Assembly

Designed to provide a regulated instrument gas supply from a high GOR well, the high-low pressure flowline scrubber assembly combines high and low pressure scrubbers connected by a pressure regulator. An automatic drain is provided for discharging any liquid buildup.

Maximum inlet pressure	6,000 PSI (414 BAR)
Outlet pressure (field adjustable)	150 PSI (10 BAR)
Operating temperature	-20° to 180°F (-29° to 82°C)
Outlet flow (maximum)	38-SCFM at 150-PSI (10.3 BAR)
Minimum GOR	600 SCF/BBL
Relief (safety valve, adjustable)	250 PSIR (17.2 BAR)
Inlet connection	1-1/2" FNPT
Outlet connection	1" FNPT

Quick Exhaust Valves

Quick exhaust valves should be installed at the actuator wherever the rapid venting of fluid is desired. Two types of quick exhaust valves are available.

- **Pneumatic Quick Exhaust Valve**—a 316 SS, three-way valve with an extra large exhaust orifice, designed to be fitted directly at the inlet port to a pneumatic actuator.
- **Hydraulic Quick Exhaust Valve**—designed to shift to the closed vent position before the inlet check opens, thereby supplying the actuator.



Maximum pressure	10,000 PSI (689.5 BAR)
Minimum pressure	10 PSI (0.7 BAR)
Inlet check open	50 PSI (3.4 BAR)
Outlet and vent ports	1/2" NPT
Inlet port	1/4" NPT
Material	316 SS



Safety System Field Instruments

Emergency Shutdown Station

The emergency shutdown station is a high visibility panel and valve designed for quickly shutting down operations from a safe location. This assembly features a two-way, manually operated ball valve constructed of 316 SS.

Size 1/2" FNPT
 Pressure 1,500 PSIG (103.4 BAR)

Fire Detection Devices

High and low pressure fusible plugs are designed to act as fire sensors in a complete safety system. These plugs are available in two types.

- **Bleed**—contains a fusible alloy that will melt at fire temperatures and bleed control pressure downstream.

Sizes 1/4", 3/8", 1/2" and 1" MNPT
 Low pressure 300 PSI (20.7 BAR)
 High pressure 10,000 PSI (689.5 BAR)
 Melting points 158°, 184°, 203°, 255° and 281°F (70°, 84°, 95°, 124° and 138°C)

- **Block and Bleed**—contains a fusible alloy that will melt at fire temperatures and bleed control pressure downstream, while at the same time blocking upstream pressure.

Size 1/4" FNPT
 Low pressure 250 PSI (17.2 BAR)
 High pressure 10,000 PSI (689.5 BAR)
 Melting points 158°, 184°, 203°, 255° and 281°F (70°, 84°, 95°, 124° and 138°C)



Safety System Field Instruments



Portable Hydraulic Test Unit

The standard portable hydraulic test is a fully instrumented source of regulated hydraulic pressure. This unit features a 316 SS enclosure with internal components and a pneumatic driven hydraulic pump that may be operated manually. Options available include fiber glass cases and units for lower and higher pressures.

Pneumatic input 100 PSI (6.9 BAR)
 Hydraulic output 10,000 PSIG (689.5 BAR)

Sand Probe

Continuous monitoring of the effects of an abrasive product on flowline and valves is possible with the use of the sand probe. A sensing probe of a predetermined thickness extends into the flow path of the abrasive product. When the probe has been cut, indicating a known degree of erosion, the sand probe assembly shifts, blocking and bleeding a control pressure signal. This signal is used to either close a valve or trigger an alarm. The assembly is available for use with either low or high pressure control systems.



Valve pressures 30- to 250-PSI (2- to 17.2-BAR)
 150- to 10,000-PSI (10.3- to 689.5-BAR)
 Standard material 316 SS
 Standard line sizes 2", 3" and 4" (5.08, 7.62 and 10.16 cm)

Components

High-quality components are utilized in the construction of Weatherford's control systems. These components include parts manufactured by Pneu-Hydro, a leading manufacturer of pneumatic and hydraulic valves. Some of the Pneu-Hydro products used in our control systems include:

Needle Valves

Low profile, high pressure, 6,000 and 10,000 PSI (413.7 and 689.5 BAR), needle valves are ideally suited for panel-mounted or other limited space applications. Teflon stem packing provides isolation from the process fluid and prevents contamination and lubrication washout. Standard features include self-aligning swivel pintles to minimize seat scoring, Teflon stem seal and 316 SS construction to provide maximum compatibility with corrosive fluids.

Hydraulic-Pneumatic Interface Valves

This hydraulic, three-way, two position, normally closed, 316 SS valve permits a low-pressure pneumatic signal to control a high-pressure hydraulic signal. In this unique spool valve design, the usual pilot diaphragm is replaced by a piston. The use of a stainless steel piston and an O-ring or Teflon "cup" seal eliminates failures due to diaphragm leakage and incompatibility of diaphragm with process fluids. The high ratio of hydraulic power pressure to pilot control pressure insures safe operation and positive control under all conditions.

Pneumatic Pilot Section

Fluid	Air or hydraulic
Operating pressure	50 PSI (3.4 BAR) controls 5,000 PSI (344.7 BAR) 100 PSI (6.9 BAR) controls 10,000 PSI (689.5 BAR)
Maximum pressure	1,000 PSI (68.9 BAR)
Proof pressure	1,500 PSI (103.4 BAR)

Hydraulic Valve Section

Fluid	Hydraulic or diesel
Operating pressure	6,000 PSI (413.7 BAR); 10,000 PSI (689.5 BAR)
Proof pressure	15,000 PSI (1034.2 BAR)
Burst pressure	20,000 PSI (1379 BAR)
Operating temperature	-40° to 450°F (-40° to 230°C)
Flow capacity	+0.5 Cv (equivalent .224" diameter orifice)
Flow	39 GPM at 5,000 PSI (149 LPM at 344.7 BAR)
Internal/external leakage	Zero
Port connections	1/4" FNPT



Components



Check Valves

These check valves seal bubble tight even without back pressure and provide a smooth, minimum resistance flow path when open. The poppet is spring loaded for operation in any position. The spring load is borne by a metal stop, rather than by the soft seat, ensuring long seal life and minimum maintenance. Operation is smooth and chatter-free.

Sizes	1/4" and 3/8" FNPT
.....	1/4" and 1/2" MNPT
Maximum operating pressure	10,000 PSIG (689.5 BARG)
Operating temperature	-40° to 450°F (-40° to 232°C)
Seals	Buna N or Viton

Relief Valves

Right angle relief valves are pressure balanced internally and pressure referenced to atmosphere. This yields insensitivity to downstream pressure and permits the valve to be used as an accurate back-pressure regulator.

Proof pressure	20,000 PSIG (1379 BARG)
Minimum burst pressure	40,000 PSIG (2758 BARG)
Design standard	316 SS
Operating temperature ranges	
Buna N seals	-40° to 250°F (-40° to 121°C)
Viton seals	-20° to 450°F (-29° to 232°C)
Inlet port	1/4" MNPT
Vent port	1/4" MNPT or FNPT
Relief pressure ranges	100- to 150-PSIG (6.9- to 10.3-BARG)
.....	150- to 250-PSIG (10.3- to 17.2-BARG)
.....	250- to 350-PSIG (17.2- to 24.1-BARG)
.....	350- to 600-PSIG (24.1- to 41.4-BARG)
.....	600- to 900-PSIG (41.4- to 62-BARG)
.....	900- to 1,500-PSIG (62- to 103.4-BARG)
.....	1,500- to 3,000-PSIG (103.4- to 206.8-BARG)
.....	3,000- to 5,000-PSIG (206.8- to 344.7-BARG)
.....	5,000- to 10,000-PSIG (344.7- to 689.5-BARG)



Components

Visual Pressure Indicators

These indicators are designed to assist personnel operating pneumatic panels with an indication of the presence of control pressures and status in various legs of the pneumatic circuitry. It is intended to be placed in those circuits where there will be an instant indication of loss of pressure.

Service	Standard and H ₂ S-CO ₂
Design standards	316 SS
Fluids	Air, N ₂ , Natural Gas, H ₂ S-CO ₂
Operating temperature	-20° to 450°F (-29° to 232°C)
Working pressure	250 PSIG (17.2 BARG)
Proof pressure	500 PSIG (34.4 BARG)
Internal/external leakage	Zero
Port sizes	1/8" and 1/4"



Shuttle Valves

The shuttle valve utilizes a stainless steel ball sealing against an o-ring. Unpredictable breakaway friction usually associated with sliding seals is eliminated through the use of this contact seal principle. The ball offers frictionless response to pressure from either inlet and closes the opposite inlet with a bubble-tight seal.

Service	Hydraulic or pneumatic
Maximum operating pressure	250 PSIG (17.2 BARG)
Proof pressure	357 PSIG (24.6 BARG)
Burst pressure	500 PSIG (34.4 BARG)
Temperature	-40° to 450°F (-40° to 232°C)
Design standard	316 SS
O-rings	Buna N or Viton



Subsea Control Systems



Based on decades of experience in this industry, the engineers and technicians of Weatherford have developed well controlled solutions comprised of the best of breed products.

Subsea systems include the following components:

- Hydraulic power unit (HPU)
- Master control station (MCS)
- Electrical power unit (EPU)
- Topside umbilical termination unit (TUTU)
- Subsea control module (SCM)
- Subsea control module mounting base (SCMMB)
- Subsea distribution unit (SDU)
- Underwater termination assembly (UTA)
- Subsea accumulation module (SAM)

Weatherford's electro-hydraulic subsea control system is a modular design concept incorporating well proven technology and qualified components to minimize both CAPEX and OPEX costs.

The integrated system provides the requisite monitoring, control and shutdown functions by means of multiplexed electro-hydraulic control. The control uses communications through the power line between a surface master control station and subsea control module, via a composite services umbilical and appropriate subsea distribution units.

The system can be used as a tie back to an existing platform to economically produce hydrocarbons from a marginal field, or from a floating production storage and offloading vessel (FPSO) for full field production.

The system is designed for deployment and intervention by means of ROV, guideline running tool and guideline less running tool with ROV assistance in very deep water, featuring a simple sliding-plate design lock-down mechanism.

The subsea electronics module is surface removable and replaceable without the need to disturb the module hydraulics chamber.

Electric and hydraulic connections are made using low force connectors mounted on the base of the unit, which automatically connect when the unit is locked into place.

Communications between topside and subsea modules is by means of a Lonworks power line carrier, with a maximum tested step out of 45 Km. Communication options offered are comms on power, twisted pair, or fiber optic, dependent on field configuration.

CALM Buoy Telemetry Systems

Weatherford offers integrated control and monitoring systems for offshore loading buoys including Hawser load monitoring, process monitoring and control, navigation aids, weather monitoring, solar power systems and SCADA solutions.

Weatherford offers project management, decades of experience and a complete, integrated system solution which can limit compatibility problems often found with multiple vendor situations. Our team of experts partner with you to address your particular production scenario. You can feel comfortable working with a company with an extensive track record around the globe, working with majors, super majors, national oil companies, and small independents as well as buoy manufacturers. We offer a full project documentation package to customer specification for total piece of mind. Streamlined production operations, integrated mechanical and electronic packages, and an experienced team of engineers and project specialists, allow us to exceed expectations for enterprise excellence and achieve better than industry standard delivery.

The intelligence for the systems are provided by the **EXS 1000™** remote terminal unit (RTU). Zone 1 or 2 systems are normally supplied on the buoy. These extreme service RTUs are ideally for buoy applications featuring a wide temperature range (-40° to 176°F, -40° to 85°C) and low power requirements including solar. The units feature a flexible I/O and are designed to operate radio modems. The *EXS-1000* RTU is not only designed and programmed by Weatherford, but it is also manufactured in Weatherford facilities. That means you are dealing with one company that fully understands the RTU and can make configuration changes quickly and easily, including deep-level programming.

Weatherford is an approved integrator for Citect™ SCADA software. For real-time interface, Weatherford offers Citect, Wonderware Intouch software, and Realflex™ SCADA for use on Microsoft® Windows NT, 2000, XP QNX and Vista® operating systems. With years of experience creating systems, Weatherford provides integrated systems that allow users to monitor and control their CALM buoy systems in an easy-to-use format.

Special projects are no problem. Weatherford also offers portable integrated control units, radio systems with wide operation frequency bands and solar-powered systems that can be customized for your

particular project parameters. Portable units are designed to be carried directly onto the supertanker. They are a single integrated control unit including radio modems and antenna sockets and a repeater function built right in. The units are waterproof when the lid is closed.



Ancillary components to CALM buoy systems include:

- Hawser load pin
- Navigation aids including:
 - Marine lanterns
 - Foghorns
 - Fog detectors
 - Alarm/warning beacons
- Weather monitoring products
- Tide, sea current and direction
- Security monitoring devices
- Buoy location global positioning systems (GPS)

Workover and Control Systems

Weatherford's Workover and Control Systems (WOCS) group has a comprehensive rental and services capability. The range of services provided is inclusive of design, manufacture, maintenance and storage of WOCS equipment. The offered equipment can be seamlessly integrated into different types of workover scenarios and with other third party equipment. In addition to the equipment, Weatherford also provides the service personnel required to operate and maintain equipment (including third party). Our WOCS facilities are equipped to provide manufacturing, storage and maintenance capabilities. The facilities are also certified to provide flushing to NAS 6 and lower, pressure testing and carrying out subsea stack-up services.

All Weatherford WOCS are fully interchangeable and can be integrated to suit any type of tree or intervention systems by changing the stab plate only.

The WOCS has been designed to provide flexibility to support all subsea projects. Current systems have various line functions/pressures which can run all types of Tree/intervention completions up to 2500 feet (762 meters) with umbilical rates to 199°F (93°C) at 12,500 PSI (861.8 BAR).

A new WOCS design is currently being manufactured by Weatherford. This new system offers more flexibility to support the new generation of subsea Trees. It is planned that the new WOCS system has the capacity to run subsea Trees/intervention completions up to 4500 feet (1371.6 meters) using direct hydraulics. For depths beyond this, an electric multiplex control system would be utilized.

Weatherford's WOCS systems are constantly evolving and expanding to meet the changing needs of the oil and gas industry.



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