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# *XH3D – USER'S MANUAL*

# SELF-CONTAINED, DUAL PUMP WELLHEAD CONTROL PANEL

**GENERAL**

The XH3D self-contained system is a device designed and built for protecting oil and gas production wells. It includes a switch-gage to detect high and low pressures as well as hydraulic interface for fire and manual ESD.

The XH3D is self-sufficient and doesn't need external sources of energy or supply pressure for keeping a wellhead open and protected. It uses hydraulic fluid for driving the surface and sub-surface valves and it has two separate hand pumps and dump valves for independent control of the SSV and SCSSV

The detection of High and Low pressures is done by a switch-gage with adjustable contacts for detecting when the monitored pressure is out of acceptable limits. The switch-gage connects to an electronic module that indicates High and Low pressure conditions as well as initiates the shutdown when a pressure alarm is detected. The electronic circuits are fed by a battery module capable of keeping the system operating for five (5) years.

The XH3D is built to operate exposed to the elements as all hydraulic components are enclosed in a stainless steel box while the electronic circuits and battery module are enclosed in a explosion proof box inside the stainless steel box. The front of the panel includes the gages and controls as shown in Fig1 while the inside components are shown in Fig. 2.

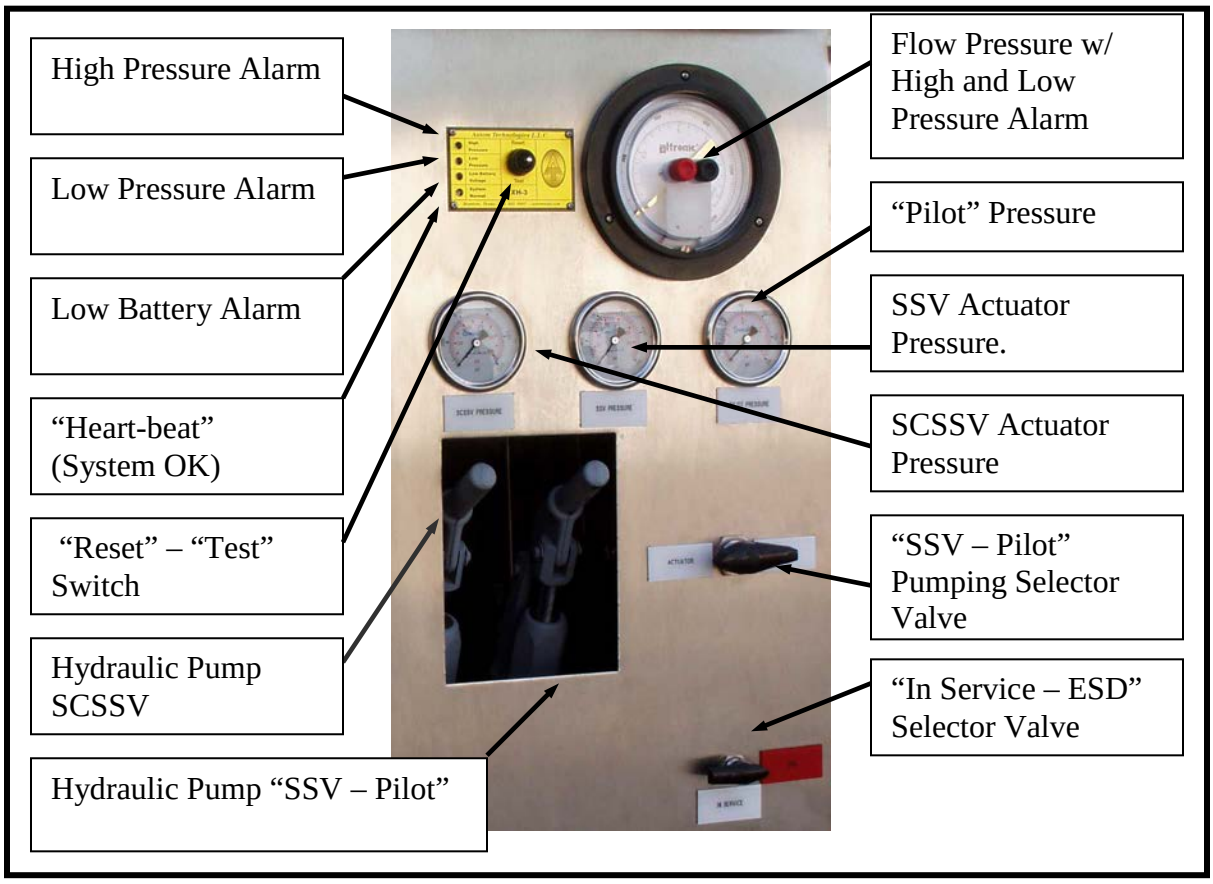


**Fig. 1 XH3D Control Interface**

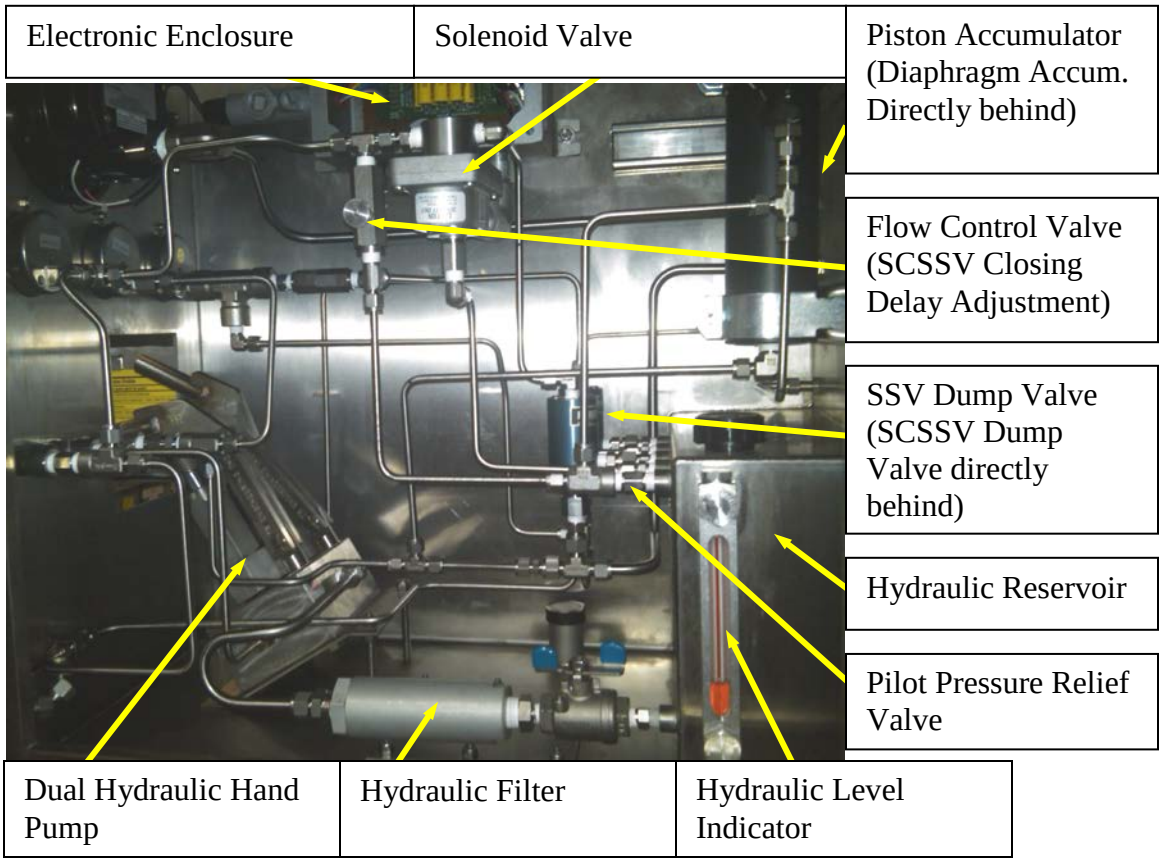


**Fig. 2 – XH3D Enclosure's Interior**

## INSTALLATION – PRELIMINARY STEPS AND TESTS

The XH3D is sent with the battery module mounted backwards to prevent the system from operating while in transit. Also, as needed to meet shipping regulations, the device is typically shipped without hydraulic fluid in the reservoir and without Nitrogen pre-charge in the accumulators.

Before installing the system is to be inspected to confirm that there is no external damage or indication of rough handling during shipment.

In case of overseas shipments it is recommended that the XH3D is tested in a work shop near the final destination to facilitate the commissioning and allow the operators to become familiar with the unit.

**NOTE**

**It is recommended that the operator becomes familiar with the Hydraulic Schematic (Appendix "B") and have a copy handy during the tests described below to better understand the system's behavior.**

To commission the system follow with the steps listed below:

i. Pre-charge 15 CU IN piston accumulator with 1,000 PSI of Nitrogen
ii. Pre-charge 5 CU IN diaphragm accumulator with 50 PSI of Nitrogen.
iii. Add hydraulic fluid to the reservoir, approximately one gallon if reservoir is empty. Filling is to be done with care not to about 2/3$^{rd}$ of capacity.
iv. Open Explosion Proof Box mounted inside the stainless steel box, remove battery module and re-install after rotating 180$^{o}$ as indicated in Appendix "A". By doing this the electronic circuit becomes energized and the green LED blinks every second (Heartbeat) to indicate the electronic circuit is operating without problem.
v. Before applying pressure it is recommended that hydraulic fluid is circulated throughout the system to flush any particle and contaminants that could be present within the hydraulic lines. With this purpose proceed as follows:

    a) Set valve "In Service – ESD" to "ESD".
    b) Set valve "SSV - Pilot" to "Pilot"
    c) Pump "Pilot/ SSV"(right side pump) in a fast mode for approximately one minute while observing the "Pilot" pressure gage. This gauge should display "0" PSI but the needle oscillates with each pump strike.
    d) Set valve "SSV – Pilot" to "SSV"
    e) Again, pump "Pilot/ SSV"(right side pump) in a fast mode for approximately one minute while observing the "SSV SSV" pressure gauge. This gauge should stay in "0" PSI
    f) Pump "SCSSV"(left side pump) in a fast mode for approximately one minute while observing the "SCSSV" pressure gage. This gauge should stay in "0" PSI.

vi. Confirm that the plugs on the bulkhead connectors are tight before proceeding with the following steps.
vii. Set valve "In Service – ESD" to "In Service".
viii. Set valve "SSV - Pilot" to "Pilot"
ix. Press "Reset" on switch "Test – Reset".
x. Pump "Pilot/ SSV" (right side pump) while observing the "Pilot" pressure gauge. Pump until reaching 100 PSI. Inspect hydraulic lines to confirm that there is no leakage.
xi. Pump "SCSSV" pump (left side pump) while observing the "SCSSV" pressure gauge. Pump until reaching about 10,000 PSI. Inspect hydraulic lines to confirm that there is no leakage. As this test is being done with the SCSSV output blocked the pressure will rise quickly and the pressure will decrease in about 20 to 30% in a few seconds after the pumping stops. This is normal; however, after the initial pressure decrease the pressure should remain stable except for the effects of temperature changes.
xii. Set valve "SSV - Pilot" into "SSV"
xiii. Pump "SSV - Pilot" pump (right side pump) while observing the "SSV" pressure gauge. Pump until reaching 3,000 PSI. Inspect hydraulic lines to confirm that there is no leakage. It is normal for the pressure to fall about 10% after finishing the pumping.
xiv. Set valve "In Service – ESD" to "ESD" to return all pressures to cero before moving the XH3D to the field for installation.

## FIELD INSTALLATION

Typically the XH3D is mounted on one or two poles made of 3" pipe. Using two poles is preferred as it would insure safe mounting even if one of the pipe brackets used for fastening the panel to the poles would fail. The two poles should have a separation of 10" to 15" (25cm to 38cm) center to center. The pipe brackets connect to the unistrut channel mounted on the left side of the panel

**Fig. 3 – XH3 Mounting**

With the panel firmly mounted, proceed to connect the field devices as shown on Fig. 4.

**-1-**
Flow-line Sensing Pressure

**-2-**
Hydraulic pressure to SCSSV

**-3-**
Hydraulic pressure to SSV

**-4-**
Hydraulic pressure to Manual ESD/Fire Sensor

**-5-**
Hydraulic return from Manual ESD/Fire Sensor.


**Fig. 4 – Rear view, hydraulic lines connections.**

The connection to the ESD station (Connection No. 4) can be also connected to a fire plug. If the fire plug used does not have a return line, some means are to be used to prevent hydraulic fluid from reaching the ground. A small amount of hydraulic fluid (approximately 3 CU IN or 50 CC) will be released in the event of a fire.

## OPERATION AND ADJUSTMENTS

The operation of the installed panel is as follows:

**Starting Production:**

**1-** Set valve "In Service – ESD" to "In Service"
**2-** Set valve "SSV - Pilot" to "Pilot".
**3-** Press "Reset" on switch "Test – Reset".
**4-** Pump "Pilot/ SSV" (right side pump) while observing the "Pilot" pressure gauge until reaching 100 PSI.
**5-** Pump "SCSSV" pump (left side pump) while observing the "SCSSV" pressure gauge. Pump until reaching the pressure necessary to open SCSSV. Do not exceed 10,000 PSI.
**6-** Set valve "SSV - Pilot" into "SSV".
**7-** Pump "SSV - Pilot" pump (right side pump) while observing the "SSV" pressure gauge. Pump until reaching 3,000 PSI. It is normal for the pressure to fall about 10% after finishing the pumping. Do not exceed 3,000 PSI.
**8-** Check all hydraulic connections (internal and external to the panel) to confirm that there is no leakage.
**9-** Adjust High and Low Alarm set point on switch-gage.

**Closing SSV:**

**10-** Move High or Low Alarm Set-Point until it touches the gage's needle. The system responds closing the SSV. The corresponding LED (High or Low Pressure Alarm) blinks and the green LED stops blinking. There is no change on pilot pressure but the SSV pressure goes to cero.

**Re-opening the SSV:**

**11-** Press "Reset". The Alarm LED stops blinking while the green LED (Heartbeat) blinks every second. Also, as the solenoid trips, the pilot pressure goes momentarily to cero and slowly returns to approximately 80 PSI.
**12-** Pump "Pilot/ SSV" (right side pump) while observing the "Pilot" pressure gauge until reaching 100 PSI.
**13-** Set valve "SSV - Pilot" into "SSV".
**14-** Pump "SSV - Pilot" pump (right side pump) while observing the "SSV" pressure gauge. Pump until reaching 3,000 PSI. It is normal for the pressure to fall about 10% after finishing the pumping. Do not exceed 3,000 PSI.

**Initiating ESD:**

**15-** Set valve "In Service – ESD" to "ESD".

**Shutdown Delay adjustment for SCSSV:**

**16-** Turn knob a small fraction of a turn in the direction of the clock's pointers to increase time delay and in the opposite direction to reduce it.

**Re-opening the well after ESD:**

**17-** Repeat steps 1 through 9 of this list.

**Adjusting High and Low Pressure Alarms:**

**18-** Turn red knob to adjust High pressure Alarm to the desired High Pressure Alarm. Repeat the same with the black knob to set the Low Pressure Alarm.

## HYDRAULIC CIRCUITS

The hydraulic circuits are shown on appendix "B".

## ELECTRONIC SYSTEM

By replacing most of the hydraulic logic with electronic circuits, the most failure prone components are removed and the hydraulic circuit greatly simplified to a few reliable components. In this way, by having self diagnostic in the electronics and a simplified hydraulic system, the XH3D offers a reliability level not seen on any of the typical self-contained wellhead control panel. Furthermore, if a failure would occur, the diagnostic and correction of the problem is much simpler because of the simplicity of the hydraulics.

The electronic circuit and battery module are enclosed in an explosion proof box that makes the system suitable for Class 1 hazardous areas, where ignitable mixtures of combustible gases may exist.

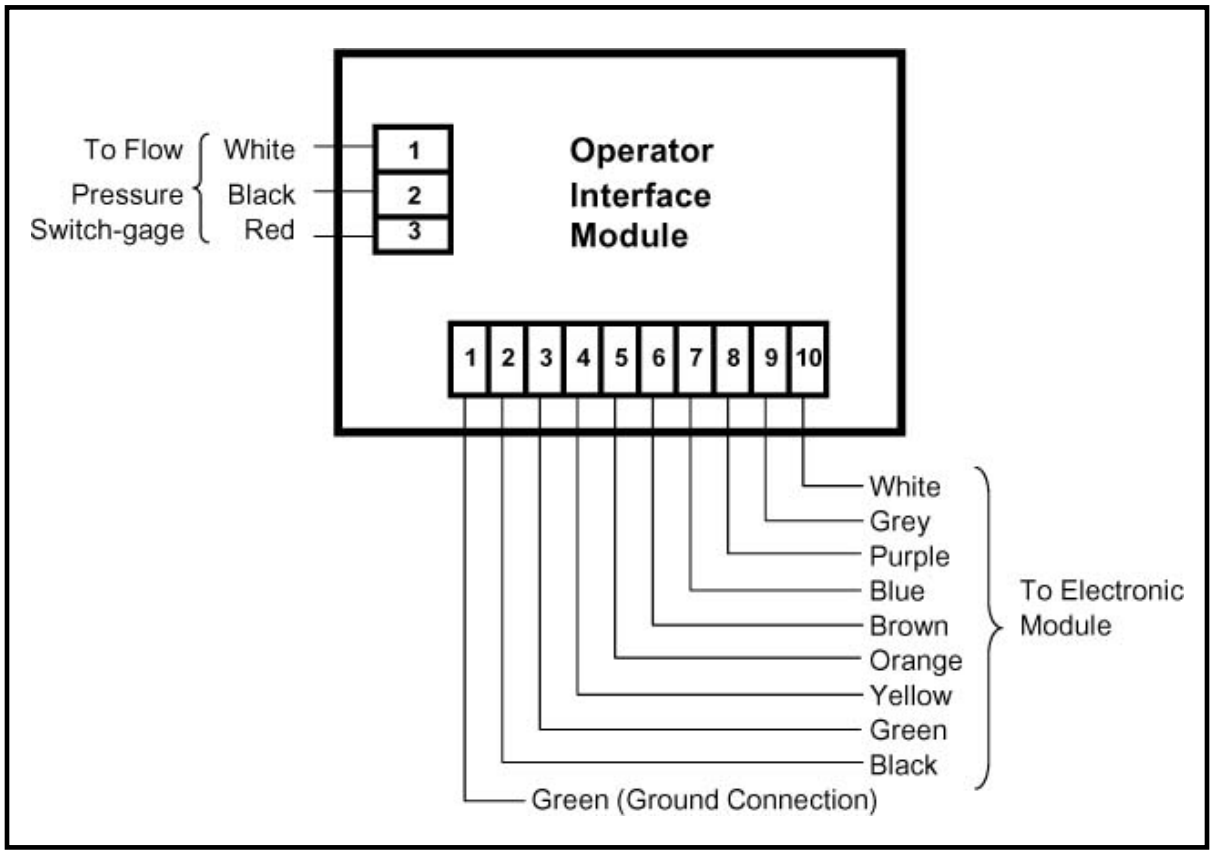


**Fig. 4 – Alambrado del módulo de interfase**

The wiring from the Pressure Switch-Gage to the Interface Module as well as the wiring from the Interface Module to the Electronic Module is color coded as shown in Fig. 4

The interface module includes the indicator LEDs, the "Test –Reset". The circuits connecting to the Interface Module use energy level so low that they are incapable of igniting the type of combustible mixtures found in the oil industry and the circuits have been designed to meet the "Intrinsically Safe" criteria.

When operating under normal conditions (no alarms) the electronic system flashes the green LED every second (heartbeat) to indicate that the electronic system is operating without problems.

**If a High Pressure or Low Pressure alarm is detected the green LED stops flashing, the solenoid valve is tripped to initiate shutdown of the SSV only** and the red LED corresponding to the detected alarm starts flashing. Once detected, the detected alarm is latched in such way that even if the alarm would go away or a new alarm would be detected; the first alarm detected will continue to flash to hold the information for the operator to see the cause of the shutdown. For example, if a High Pressure Alarm would occur the corresponding High Pressure Alarm LED will flash and keep on flashing even if the high pressure alarm would go away and now the needle is touching the Low Pressure contact. The first detected alarm will keep displaying until the operator presses "Reset".

A total shutdown (closing of the SSV and SCSSV) would be executed only in the case of Fire Alarm (fusible plug) and/or Manual Shutdown.

Once the operator presses "Reset" while the alarm still present, the system resets the solenoid valve to allow the re-opening of the well and alternatively flashes the green LED and corresponding alarm red LED, even if the alarm still present. However, the system tolerates the existing alarm for only 30 minutes before re-initiating the shutdown to prevent the system from being left in production while operating in an abnormal condition. Once the pressure alarm clears, only the green LED remain flashing.

The "Test" function allows the operator to see the last alarm and also to confirm that all the indicator LEDs are working properly. This is, when pressing "Test", the system respond by flashing the last detected alarm for about second and then it flashes the three LEDs in sequence.

The battery module provides two separate voltages, 3.6 VDC to feed the microcontroller circuits and 14.4 VDC to operate the solenoid valve. Both voltages are periodically monitored to confirm the system has the proper battery supply to operate reliably.

If the system detects a low voltage, the green LED and the "Low Battery" red LED will alternates flashing but the system remains in operation. However, if a voltage falls too far down for insuring reliable operation, then a shutdown is executed.

Given the low power consumption of the system it is expected that the operator will be able to detect the warning signs of low battery and should be able to replace the battery module before it gets to the point where the system causes shutdown because low battery.

The battery module is to be replaced as soon as the system shows signs of low voltage to insure the system continues operating reliably. The battery module has an expected life of five years

# WARNING!

**Do not attempt to recharge the batteries on the battery module as this may cause an instable condition that may result in a violent explosion.**

**Return the spent battery modules to Axiom Technologies or to any lithium battery recycling facility.**

See the instructions shown on Appendix "A" for replacing the battery module.