






HIGH PRESSURE ISOLATED HYDRAULIC POWER UNIT (15K I-HPU) INSTALLATION & MAINTENANCE MANUAL DOCUMENT No. DSS-TL-MAN-007

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1 PURPOSE AND SCOPE

This manual describes the installation, operation and maintenance of the Delta Subsea, LLC – High Pressure Isolated Hydraulic Power Unit, also called a 15K i-HPU. The scope is limited to generic installation and operation on work class ROV's with sufficient hydraulic power and controls to safely operate this unit. For specific application and integration technical support, please contact the Delta Subsea, LLC Tooling Solutions Group.

This manual is intended for qualified personnel. It is important that this manual be read and understood fully before execution of any task related to the 15K i-HPU. This unit is capable of generating and capturing very high pressure. This potential and kinetic energy can cause severe injury or death if this unit is improperly, installed, applied, operated, serviced or maintained.

2 ABBREVIATIONS AND DEFINITIONS

ABBREVIATION	DEFINITION
CCW	Counter-clockwise
CW	Clockwise
DCV	Directional Control Valve
GPM	Gallons Per Minute
HPU	Hydraulic Power Unit
JIC	Joint Industry Council
JSA	Job Safety Analysis
LBS	Pounds
PSI	Pounds Square Inch
PTW	Permit To Work
ROV	Remotely Operated Vehicle
TBT	Toolbox Talk

3 REFERENCES

- /1./ DSS-028-TL-SCHH-01000-00, High Pressure i-HPU Hydraulic Schematic
- /2./ Dynaset OY, HPW Hydraulic High Pressure Water Pumps, Operating Instructions (November 2012)
- /3./ Dynaset OY, High Pressure Pump HPW 1600/15-140, Engineering Data (September 2012)
- /4./ Dynaset OY, HPW High Pressure Pumps, Dis- & Re-Assembly Instructions Changing the Seals

4 RESPONSIBILITIES

It is the responsibility of the Delta Subsea, LLC Tooling Solutions Group and/or the Tooling Asset Manager to make any changes to this document.

5 BODY TEXT (ARIAL FONT, SIZE 12, ALL CAPS, INDENT 0 AND .5)

- Hydraulic Input:
 - 12 GPM
 - 2200 PSI

- Hydraulic Output:
 - 1.5 GPM
 - 15000 PSI
- Weight in Air 158 lbs.
- Weight in Water 118 lbs.
- Fluid Medias
- Water
- Glycol and other water based media
- Methanol (subsea pressurization only)
- Petroleum based medias
- Seawater (with post use flushing)

6 THEORY OF OPERATION

The Delta Subsea High Pressure i-HPU utilizes hydraulic energy from the ROV tooling circuit to power an isolated high pressure pumping system. The tooling circuit provides flow to a reciprocating pump with a differential ratio of 7.87:1. Net differential pressure across the high pressure pump produces an outlet pressure 7.87 times greater. Thus a 2000 psi input will provide just over 15,000 psi output. The flow is divided by the differential ratio, thus with an input flow from the ROV of 12 gpm, the output from the i-HPU will be 1.525 gpm.

The i-HPU is turned on or off with the "Pump-On Pilot" signal applied to the 2-way logic element on the hydraulic pressure line. The flow rate (and thus pump speed) is limited by a fixed orifice, pressure compensated flow control. The adjustment on this flow control is 10% of the fixed orifice setting of 12 gpm. This valve does not normally require field adjustment.

The high pressure i-HPU incorporates a pilot operated directional control valve. The "A" and "B" ports are independently operated, thus both ports can be piloted at the same time. When the pilots are not engaged, the "A" and "B" ports are vented to tank. The pilot chambers are fully isolated from the media being controlled.

The i-HPU is equipped with an isolation ball valve on the "A" side of the output downstream of the DCV. This valve is intended to provide zero-leak isolation for execution of testing protocols.

Also included in the i-HPU is a relief valve to limit the maximum output pressure. It is the user's responsibility that the relief is not set higher than any component rating.

7 I-HPU INTEGRATION

Before any work is executed, complete all safety actions and documentation, included but not limited to JSA, Lift Plan, PTW and TBT.

The High Pressure i-HPU integrates to the ROV tooling circuit. While the maximum flow consumption is limited to 12 gpm, the unit can be run with less. A minimum of 2 gpm input is recommended. All connections excluding the gauges are located on the bulkhead. Available pressure to the 15K i-HPU should never exceed 2100 psi.

Pilot lines for the Pilot – Pump On, DCV A and B pilots, and isolation ball valve open and close pilots, will interface at Hydraulic Valve Pack. Please note that the cross-piloted check valves must be removed from the ROV DCV's when being used as a pilot. If the cross piloted checks are not removed, pressurized fluid may become trapped between the i-HPU and the check, causing a false pilot signal.

<input checked="" type="checkbox"/>	FUNCTION	SIZE	ROV INTERFACE
	PRESSURE	8 JIC	TOOLING CIRCUIT CAPABLE OF 2-12 GPM – WITH PRESSURE CONTROL IF AVAILABLE
	RETURN	8 JIC	TOOLING CIRCUIT RETURN UPSTREAM OF FILTRATION
	PILOT PUMP ON	4 JIC	ROV TOOLING DVC
	PUMP PRESSURE GAUGE	9/16 TYPE M (AT TEE)	PROVIDED GAUGE PANEL
	DVC PILOT A	4 JIC	ROV TOOLING DVC – ON SAME VALVE AS PILOT B (REMOVE CHECKS)
	DVC PILOT B	4 JIC	ROV TOOLING DVC PACK – ON SAME VALVE AS PILOT A (REMOVE CHECKS)
	ISOLTATED PRESSURE	9/16 TYPE M (AT TEE)	PROVIDED GAUGE PANEL
	PILOT ISOLATION BALL VALVE - ON	4 JIC	ROV TOOLING DVC – ON SAME VALVE AS PILOT OFF (REMOVE CHECKS)
	PILOT ISOLATION BALL VALVE - OFF	4 JIC	ROV TOOLING DVC – ON SAME VALVE AS PILOT OFF (REMOVE CHECKS)
	HOT STAB “A”	9/16 TYPE M	HOT STAB – PORT A
	HOT STAB “B”	9/16 TYPE M	HOT STAB – PORT B
	MEDIA SUCTION	8 JIC	MEDIA BLADDER

8 SETTING THE RELIEF

Before any work is executed, complete all safety actions and documentation, included but not limited to JSA, Lift Plan, PTW and TBT.

<input checked="" type="checkbox"/>	ACTION
	Secure hot stab in pressure rated receptacle with plugged ports or cap hot stab bulkheads with pressure rated caps
	Provide hydraulic power source (ROV or Deck HPU)
	Pilot Isolation ball valve to the closed position
	Pilot DCV valve pilot A
	Pilot logic element – initiating the high pressure pump
	Inspect for leaks
	Note gauge pressure compared to relief setting to quantify adjustment required
	Open Isolation ball valve and de-energize DVC pilot to relieve pressure

	De-energize DVC pilot
	De-energize logic element to shut down high pressure pump
	Adjust relief – CW will increase pressure, CCW will decrease pressure NOTE: relief and pump are capable of up to 20,000 psi – never set relief to maximum – it may exceed the rating of the DVC and hot stab
	Repeat steps above until relief valve actuates at required setting
	Open Isolation ball valve
	De-energize DVC pilot
	Confirm system is de-pressurized
	Shutdown hydraulic power source
	Restore 15K i-HPU to deployable condition

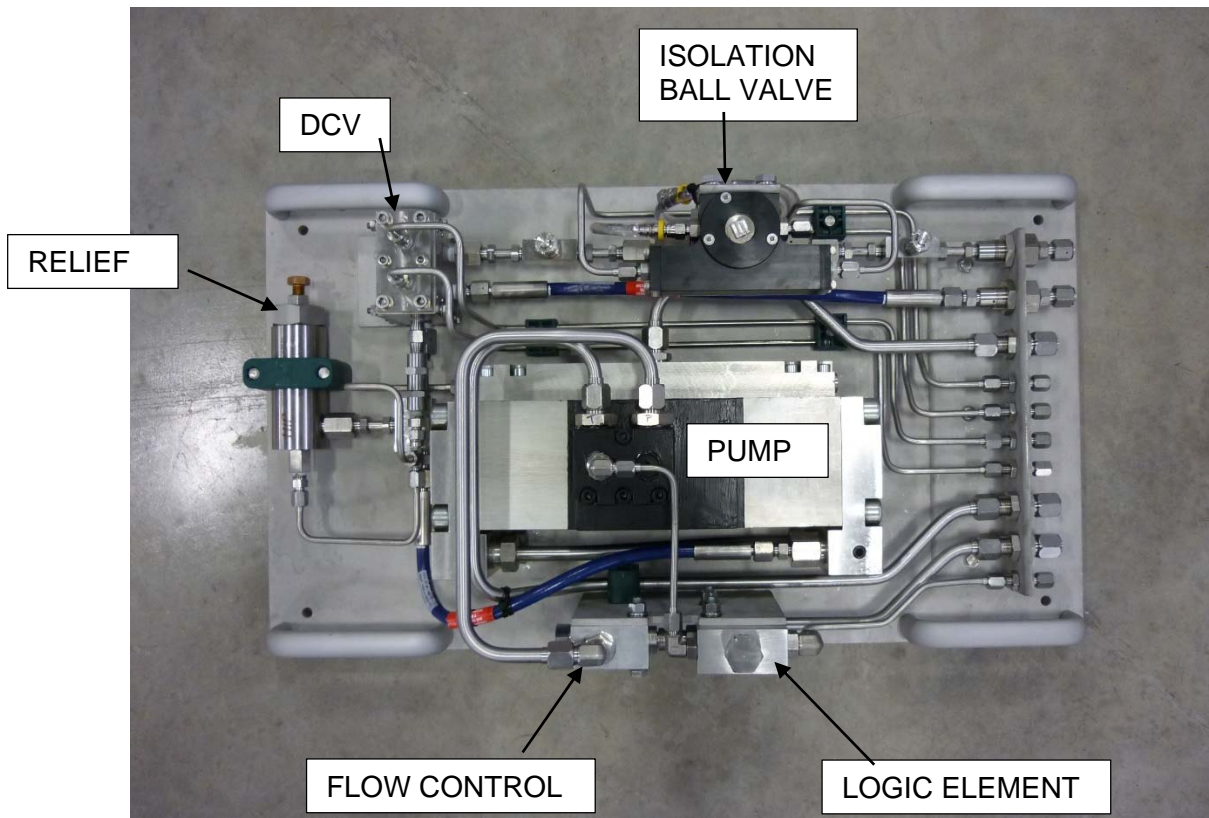


Figure 1 - MAJOR COMPONENTS

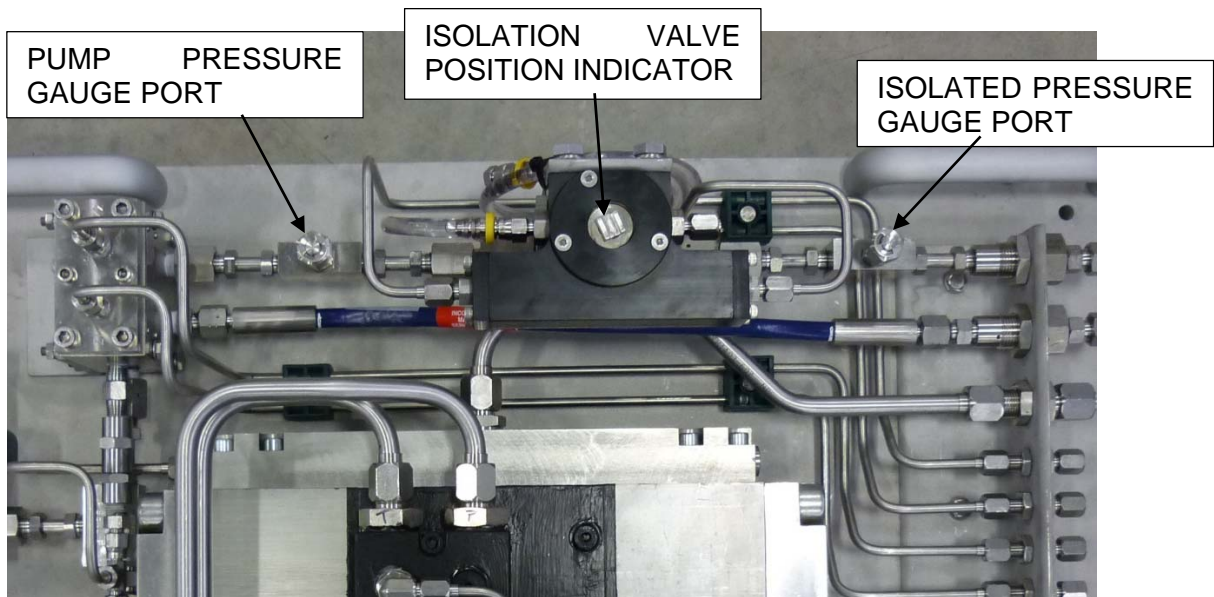


Figure 2-INDICATOR AND GAUGE PORTS

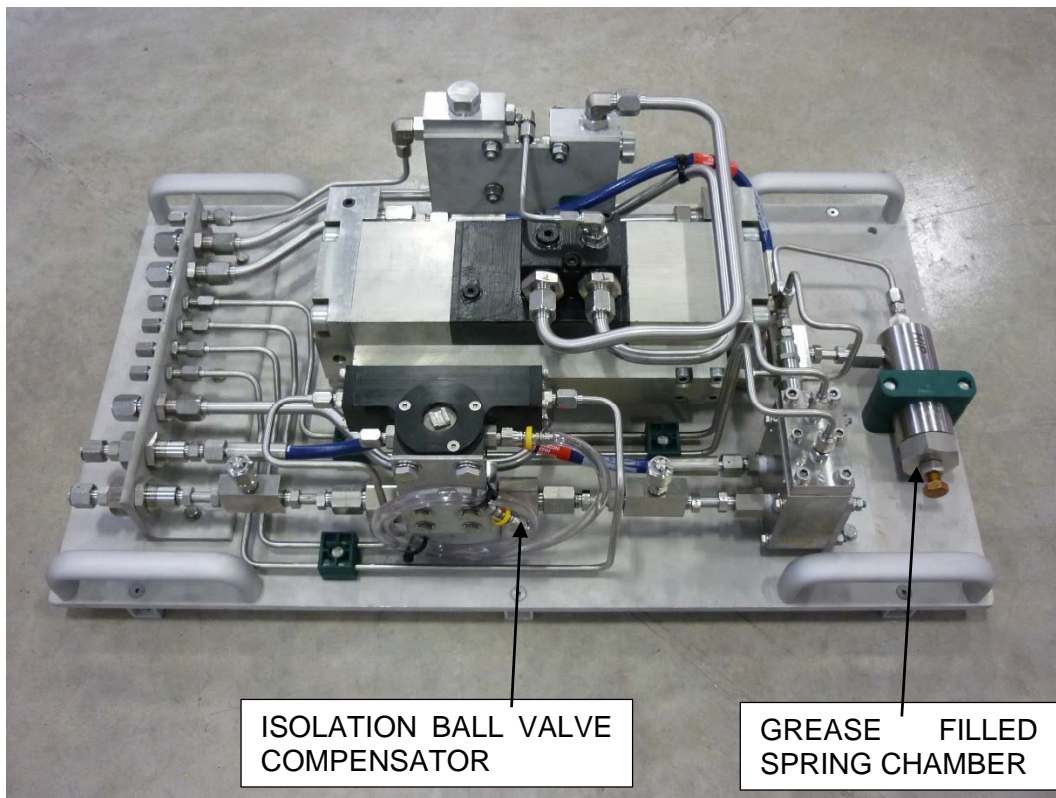


Figure 3 - SERVICE POINTS

9 OUTPUT PRESSURE (DEAD HEAD) TEST

The output pressure test is intended as a pre-dive test to verify the output pressure of the media pump (as controlled by the supply pressure and relief valve setting) is correct, and appropriate for the operation to be executed. The pressure setting is provided by the client and/or Subsea Engineer.

The media pump can be deadheaded at the isolation ball valve for verification of pump pressure setting as displayed on gauge (quick test). Alternately the hot stab hoses can be plugged with a pressure rated plug and secured.

<input checked="" type="checkbox"/>	ACTION
	Secure hot stab in pressure rated receptacle or cap hot stab bulkheads with pressure rated cap (20,000 psi rating)
	Provide hydraulic power source (ROV or Deck HPU)
	Pilot Isolation ball valve to the closed position
	Pilot DCV valve pilot A
	Pilot logic element – initiating the high pressure pump
	Inspect for leaks
	Note gauge pressure compared to mission requirement
	Open Isolation ball valve and de-energize DVC pilot to relieve pressure
	De-energize DVC pilot
	De-energize logic element to shut down high pressure pump
	Restore 15K i-HPU to deployable condition

10 ADJUSTING OUTPUT PRESSURE

Two devices limit the available output pressure of the skid, the available pressure from the ROV and the relief valve. If the 15K i-HPU is integrated to a tooling circuit with proportional pressure control, the output pressure can be dynamically set while diving. As stated in Section 6, the pressure output available is the input pressure from the ROV multiplied times the pump ratio of 7.87.

11 MAINTENANCE

11.1 PRE-DIVE

<input checked="" type="checkbox"/>	ACTION ITEM
	RESERVOIR FULL AND VALVES OPEN
	ALL PLUMBING AND CONNECTIONS SECURE
	ISOLATION BALL VALVE ACTUATOR COMPENSATOR FULL AND CONTAMINANT FREE
	HOSES DAMAGE AND KINK FREE
	PRESSURE VERIFIED (OUTPUT PRESSURE TEST)
	PUMP COATING INTACT

11.2 POST-DIVE

<input checked="" type="checkbox"/>	ACTION ITEM
	SYSTEM DE-PRESSURIZED
	THOROUGH FRESH WATER RINSE
	DAMAGE INSPECTION AND REPAIR
	HOSES DAMAGE AND KINK FREE
	MEDIA RESERVOIR FULL
	PUMP COATING INTACT

11.3 MONTHLY

<input checked="" type="checkbox"/>	ACTION ITEM
	THOROUGHLY FLUSH PUMP AT LOW FLOW AND PRESSURE
	RUN ON DECK – CHECK SEAL WEEP HOLES FOR LEAKAGE
	FILL RELIEF VALVE CAVITY WITH GREASE

11.4 ANNUALLY

<input checked="" type="checkbox"/>	ACTION ITEM
	SERVICE PUMP SEALS PER MANUFACTURER DIRECTIONS PROVIDED

12 TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSES
DOES NOT BUILD/HOLD PRESSURE	NO FLOW FROM ROV RESERVOIR(S) EMPTY LOGIC ELEMENT CLOSED CONTAMINATION LEAK ISOLATION BALL VALVE DAMAGED PUMP FAILURE
PRESSURE BLEEDS OFF	ISOLATION VALVE NOT FULLY ACTUATED SYSTEM IMPROPERLY BLED
ISOLATION VALVE NOT FULLY ACTUATED	CROSS PILOT CHECKS NOT REMOVED FROM VALVE IN ROV VALVE PACK VALVE ACTUATOR NOT PROPERLY COMPENSATED OR BLED

UNIT WILL NOT TURN OFF	CROSS PILOT CHECKS NOT REMOVED FROM VALVE IN ROV VALVE PACK
DVC WILL NOT RETURN TO CENTER (HOT STAB FLOW PRESENT WITHOUT PILOT)	CROSS PILOT CHECKS NOT REMOVED FROM VALVE IN ROV VALVE PACK
PRESSURE INADEQUATE	RELIEF SETTING TOO LOW RELIEF TRAPPED OPEN WITH CONTAMINATION SUPPLY PRESSURE TOO LOW LEAK
FLOW AND OR PRESSURE OSCILLATES	SYSTEM IMPROPERLY BLED SUCTION RESTRICTED/OBSTRUCTED PUMP DAMAGED
MEDIA PUMP NOISY ON DECK	SYSTEM IMPROPERLY BLED SUCTION OR SUCTION VALVES RESTRICTED/OBSTRUCTED PUMP DAMAGED