Pressure Control Equipment

• NXT BOP
• NXT-M BOP
• Corrosion Resistant Enhancement Package - sheet 1 & 2
• Low Force Shear Rams - LFS-5
• RCX multiplex pod
• RCX low shock valves - sheet 1 & 2
• EHBS Adjustable Timing Circuit Actuator
• RCX emergency hydraulic backup system acoustic pod
• Depth compensated bottles - sheet 1 & 2
• Hands free gooseneck
• Riser
• Wellhead connectors - sheet 1 & 2
• CMX 1527 LMRP wellhead connector
• Shuttle stack tool
Hydraulic System

Hydraulic power to operate a Mod-X ram BOP can be furnished by any standard oil field accumulator system. Hydraulic passages drilled through the body eliminate the need for external manifold pipes between the hinges. Each of these rams requires only one opening and one-closing line. There are two openings and two closing hydraulic ports, clearly marked, on the back side of the BOP. The extra hydraulic ports facilitate connecting the control system to the Preventer. A standard hydraulic accumulator unit will close any Model Mod-X ram with rated working pressure in the well bore.

Ultra-Temp™

The conservative Shaffer™ testing procedures call for maintaining pressure and temperature for the duration of the test. Even with these stringent demands, the Ultra-Temp ram holds in witnessed testing. Shaffer™ Ultra-temp ram assemblies are designed to safely withstand wellbore pressures up to 15,000 psi and some temperatures up to 300°F (177°C) for prolonged periods. This translates into rigsite capability to safely evacuate personnel and equipment at the event of a major high temperature, high pressure kick.

Low Force Blind Shear (LFS) Rams

The force required to shear casing is reduced by at least 50%. The LFS Ram server 14”, 113/4”, Q-125 casing at 2700 psi with a 22” operator. Multiple shear and seal sequences can be performed with the same assembly, including conditions where the drill pipe is hung-off the shear ram cavity, enhancing reliability and extending the length of the BOP stack deployment.

- Less pressure required to shear
- Capable of centering pipe before sharing
- Shearing range
- Wellline to 14”
- Temperature Range: 30°F to 300°F (-2°C to 149°C)

Wellhead Cavity

The introduction of no weld cavities in previous Shaffer™ BOP designs is carried on in the Mod-X models. This feature introduces replaceable parts to the cavity to eliminate extensive in-shop repairs and post wellbore treatments. The seal, skid plate and side pads can be replaced using the BOP cavity tolerance to as new condition.
Hydraulic System
Hydraulic power to operate a Model NXT-M ram BOP can be furnished by any standard oil field accumulator system. Hydraulic passages drilled through the body eliminate the need for external manifold pipes between the hinges. Each set of rams requires only one opening and one closing line. There are two opening and two closing hydraulic ports, clearly marked, on the back side of the BOP. The extra hydraulic ports facilitate connecting the control system to the preventer. A standard hydraulic accumulator unit will close any Model NXT-M ram with rated working pressure in the well bore.

Ultra-Temp™
The conservative Shaffer™ testing procedures call for maintaining pressure and temperature for the duration of the test. Even with these stringent demands, the Ultra-temp rams hold in witnessed testing. Shaffer™ Ultra-temp ram assemblies are designed to safely withstand wellbore pressures up to 15,000 psi and extreme temperatures up to 392°F (200°C) for prolonged periods. This translates into rig site capability to safely evacuate personnel and equipment in the event of a major high temperature, high pressure kick.

Low Force Blind Shear (LFS) Rams
The force required to shear casing is reduced by at least 50%. The LFS Rams save 14", 113psf, Q-125 casing at 2700 psi with a 22" operator. Multiple shear and seal sequences can be performed with the same assembly, including conditions where the drill pipe is hanging off the shear ram cavity, enhancing reliability and extending the length of the BOP stack deployment.

- Less pressure required to shear
- Capable of centering pipe before sharing
- Shearing range
- Wireline to 14”
- Temperature Range: 30°F to 300°F (-1°C to 149°C)

Wellhead Cavity
The introduction of weld cavities in previous Shaffer™ BOP designs is carried over in the NXT-M models. This feature introduces replaceable parts to the cavity to eliminate extensive in-shop repairs and post weld heat treatments. The seal, skirt plate and side pads can be replaced using the BOP cavity tolerances as new conditions.

BOP Body - CREP Overview

*For reference only, please contact your local sales contact for more information.

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**CREP Purpose and Definition**

In an effort to reduce corrosion in the critical sealing areas of the BOP’s, NOV provides a Corrosion Resistant Enhancement Package (CREP) on all of the 18-3/4” NXT and SLX BOPs. This CREP package is designed to reduce down time and extend the useful life of the BOP assembly prior to the need for field machining on the BOPs. On the BOP bodies, NOV only provides the maximum level of protection. Customers can choose the level of protection they desire for the BOP doors. This sheet describes the different CREP options available. Coating and inlay locations are indicated by the shaded areas on the included graphics. Inconel is inlaid, while chrome, ever-silk®, and phosphate are applied as coatings. The information provided is derived from NOV Engineering Specification AX070224.

### NXT Body View

<table>
<thead>
<tr>
<th>BODY AREA</th>
<th>CREP LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door Seal</td>
<td>Inconel</td>
</tr>
<tr>
<td>Top Seat</td>
<td>Inconel</td>
</tr>
<tr>
<td>Bottom Seat</td>
<td>Inconel</td>
</tr>
<tr>
<td>Hydraulic Ports</td>
<td>Inconel</td>
</tr>
<tr>
<td>Ring Grooves</td>
<td>Inconel</td>
</tr>
</tbody>
</table>

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### 22” PosLock Door
- Cylinder Head Cylinder Seal
- Manifold Ports
- Cylinder Bore
- Packing Bore
- Door Seal Race Track
- Lock Bar Grooves (Top and Bottom)
- Hinge Pin Holes
- Manifold Ports
- Door Cylinder Seal

### 14” PosLock Booster Door
- Cylinder Head Cylinder Seal
- Booster Cylinder Bore
- Middle Head Cylinder Seal (Front and Rear)
- Middle Head Manifold Ports

### 14” UltraLock II(B) Door
- Cylinder Head Cylinder Seal
- Manifold Port
- Door Cylinder Seal
- Cylinder Bore
- Door Cylinder Seal
- Middle Head Manifold Ports
- Door Seal Race Track
- Hydraulic Port

---

**NX Door CREP Levels - 22” PosLock Door**

<table>
<thead>
<tr>
<th>Door Area</th>
<th>CREP Level H</th>
<th>CREP Level J</th>
<th>CREP Level K</th>
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</thead>
<tbody>
<tr>
<td>Cylinder Head Cylinder Seal</td>
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<td>Ever-slik®</td>
<td>Inconel</td>
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<tr>
<td>Manifold Ports</td>
<td>Ever-slik®</td>
<td>Ever-slik®</td>
<td>Inconel</td>
</tr>
<tr>
<td>Cylinder Bore</td>
<td>Phosphate</td>
<td>Chrome</td>
<td>Chrome</td>
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<tr>
<td>Packing Bore</td>
<td>Incconel</td>
<td>Incconel</td>
<td>Incconel</td>
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<tr>
<td>Lock Bar Grooves</td>
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<td>Phosphate</td>
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<tr>
<td>Hinge Pin Holes</td>
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<td>Ever-slik®</td>
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<tr>
<td>Tail Shaft Bore</td>
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<td>Incconel</td>
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</table>

**NX Door CREP Levels - 14” PosLock Booster Door**

<table>
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<tr>
<td>Cylinder Head Cylinder Seal</td>
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<td>Inconel</td>
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<tr>
<td>Booster Cylinder Bore</td>
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<td>Chrome</td>
<td>Chrome</td>
</tr>
<tr>
<td>Middle Head Cylinder Seal</td>
<td>Phosphate</td>
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<td>Inconel</td>
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<tr>
<td>Middle Head Manifold Ports</td>
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<td>Phosphate</td>
<td>Inconel</td>
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**NX Door CREP Levels - 14” UltraLock II(B) Door**

<table>
<thead>
<tr>
<th>Door Area</th>
<th>CREP Level H</th>
<th>CREP Level J</th>
<th>CREP Level K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock Bar Groove</td>
<td>Phosphate</td>
<td>Phosphate</td>
<td>Inconel</td>
</tr>
<tr>
<td>Manifold Ports</td>
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<td>Phosphate</td>
<td>Inconel</td>
</tr>
<tr>
<td>Cylinder Bore</td>
<td>Phosphate</td>
<td>Chrome</td>
<td>Chrome</td>
</tr>
<tr>
<td>Cylinder Head Cylinder Seal</td>
<td>Phosphate</td>
<td>Phosphate</td>
<td>Inconel</td>
</tr>
<tr>
<td>Packing Bore</td>
<td>Incconel</td>
<td>Incconel</td>
<td>Incconel</td>
</tr>
<tr>
<td>Hydraulic Ports</td>
<td>Phosphate</td>
<td>Phosphate</td>
<td>Inconel</td>
</tr>
<tr>
<td>Door Seal Race Track</td>
<td>Incconel</td>
<td>Incconel</td>
<td>Incconel</td>
</tr>
</tbody>
</table>

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Low Force Shear Rams - LFS-5

Features

- Shear efficiencies improved by up to 40%
- Automatically centers pipe by sweeping the entire throughbore to accommodate off center wire line
- Centers pipe with 10,000 lbs side pull
- Designed to shear and seal landing string and work string consecutively
- Passed API 16A qualification testing
- Rated ED (20°F to 250°F)
- Will retrofit to current LFS capable doors
- Improved seal design with increased cycle life

Proven Performance Results

| DESCRIPTION PIPE OD LB/FT GRADE OPERATOR LF S-5 ACTUAL SHEAR PRESSURE |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Drill Pipe      | 5.875           | 27              | S-135           | 22": 14 x 14": 1189 |
| Thrust          | 0.36            | 10.45           | S-135           | 22": 1009 |
| Thrust          | 0.34            | 10.45           | S-135           | 22": 1009 |
| Landing String  | 0.36            | 10.45           | V-150           | 15": 10.4": 4086 |
| Casing          | 6.625           | 0.96            | Q-125           | 22": 1050 |
| Casing          | 5.575           | 0.96            | Q-125           | 16": 14": 2004 |

LFS-5 Shear Performance

| DESCRIPTION PIPE OD LA/FT GRADE OPERATOR LFS-5 ACTUAL SHEAR PRESSURE |
|-----------------|-----------------|-----------------|-----------------|
| Drill Pipe      | 5.875           | 27              | S-135           | 16": 14": 1189 |
| Thrust          | 0.36            | 10.45           | S-135           | 16": 1009 |
| Thrust          | 0.34            | 10.45           | S-135           | 16": 1009 |
| Landing String  | 0.36            | 10.45           | V-150           | 15": 10.4": 4086 |
| Casing          | 6.625           | 0.96            | Q-125           | 22": 1050 |
| Casing          | 5.575           | 0.96            | Q-125           | 16": 14": 2004 |

Successful Shear and Seal

- 6 7/8", 50ppf, S-135 followed by 5 7/8", 27ppf, S-135
- 6 7/8", 57ppf, UD-165 followed by 5 7/8", 27ppf, S-135
- 6 7/8", 64ppf, V-150 followed by 5 7/8", 27ppf, S-135
- 7 1/4", 5 7/8", MT, CR-115 followed by 5 7/8", 27ppf, S-135
- THR A followed by 5 7/8", 27ppf, S-135
- 7 3/4", 54ppf, V-150 followed by 5 7/8", 27ppf, S-135
- 10 3/4", 104ppf, P-110 followed by 10 3/4", 104ppf, P-110
- 14", 115ppf, Q-125 followed by 14", 115ppf, Q-125

*All of the above shear and seal tests (and more) were performed using the same set of shear rams.

Shear and Seal Wireline

- Schlumberger 7-48A SUS
- Rochester 7-H-490K
- Rochester 1-H-334K

*All with no tension on wireline

For reference only, please contact your local sales contact for more information.
The RCX Multiplex (MU X) Pod is NOV’s next generation control system. Components from Sub-plate Mounted Valves (SPM) to the full electronics package were targeted to improve quality. Combining high reliability achieved through meticulous component redesign with retrievability, the RCX system was built to keep you drilling.

The pod takes in hydraulic supply, electrical power, and control data from the rig and distributes pressure via a network of valves to individual stack-mounted functions. Each valve is controlled by a pilot valve which is solenoid operated and controlled by the Subsea Electronics Assembly (SEA).

**Description**

- Retrievable
- RCX Low Shock SPM Valves
- Dual pod design with independent retrieval for both BOP and LMRP sections
- Improved packer seal design
- Pod-mounted conduit manifold for directing fluid from either conduit to either pod
- Manifold-to-manifold connections use dual seal, seal subs
- Streamlined footprint
- Ergonomically designed user interface & HMI
- Unique pod ID - function counting capability even on test stand

**Features**

<table>
<thead>
<tr>
<th>Technical Specifications</th>
<th></th>
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<tbody>
<tr>
<td>Operating pressure</td>
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<tr>
<td>Condensed length</td>
<td>48.5” (123 cm)</td>
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<tr>
<td>Operating Fluid</td>
<td>Water / Glycol / Soluble oil mix</td>
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<tr>
<td>Max Allowable working depth</td>
<td>12,000 ft</td>
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<tr>
<td>Functions</td>
<td>140</td>
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<tr>
<td>Voltage rating</td>
<td>480 VAC</td>
</tr>
<tr>
<td>Temperature rating</td>
<td>-20°C to 50°C</td>
</tr>
</tbody>
</table>

**Other Specifications**

- Piping of 1/2” and larger functions use schedule pipe with socket welded connections; terminating at SAE Code 62, dual seal connections
- Pilot lines are 1/4” tubing using Swagelok connections and SAE O-ring boss connections
- Corrosion resistant stainless steel (SS316)
Rig Technologies

**RigX Low-Shock SPM Valves**

Sub Plate Mounted (SPM) valves are 3-way, 2-position fluid control valves. SPM valves are used throughout National Oilwell Varco (NOV) control systems to direct hydraulic fluid within hydraulic circuits.

- Created to address industry requests for a more robust and reliable valve.
- Direct circuit replacements with matched flow rates. Closing times are not affected.
- Utilize improved materials and are designed to reduce hydraulic shock (water hammer). Test data provided on sheet 2.
- Must be used with RCX Low-Shock SPM valve blocks. RCX Low-Shock SPM valve blocks may be re-machined to NOV specifications. Non-RCX Low-Shock blocks cannot be re-machined.

RigX Low-Shock SPM Valve Components

- SPM valve engraved with identification
- SPM valve block stamped with identification
- Assembly tag stamped with SPM + valve block assembly ID
- SPM valve block re-machinable
- Purge fitting available - Circulates pilot fluid and bleeds air from the control chamber
- SAE-4 port only (O-ring boss style)
- Nord-Lock washer retains assembly bolt
- Spring chamber filled with control fluid to prevent corrosion
- Cap threads made from high-strength copper alloy for anti-galling properties
- Seawater chamber drains through milled slot
- Keyhole assembly of actuator rod and spool eliminates retainer nut (see Detail View - B)
- Improved cage seals (H-vap) designed to accommodate cavity rework and larger extrusion gaps
- Improved cage designed to prevent “crushing” Cage flow areas designed to gradually open and close the supply and vent chambers as the spool shifts
- Spool support improved by moving wear bands further apart (see Detail View - A)
- Spool clearances and line-on-line spool timing (opening/closing) of vent and supply port used to minimize interflow

**Block Styles**

- FRS Block
- Non-FRS Block

*For reference only, please contact your local sales contact for more information.*
### Pod Select

**Pod Select Legend**
- Supply Port - Standard SPM: Yellow pod
- Supply Port - Low-Shock SPM: Blue pod
- Work Port - Standard SPM: Yellow pod
- Work Port - Low-Shock SPM: Blue pod

### Shear Accumulator Charge

**High Pressure Shear Accumulator Legend**
- Work Port: Supply
- HP Upper Shear Close @ SPM Work Port
- HP Upper Shear Close @ Accumulator

### Shear Accumulator Block

**High Pressure Shear Accumulator Legend**
- Work Port: Supply
- HP Upper Shear Close @ SPM Work Port
- HP Upper Shear Close @ Accumulator

### Shear Close

**High Pressure Upper Shear Legend**
- Work Port: Supply
- HP Upper Shear Close @ SPM Work Port
- HP Upper Shear Close @ Operator Door
- LMRP Accumulator Supply @ Accumulator

### Shear Block

**High Pressure Upper Shear Legend**
- Work Port: Supply
- HP Upper Shear Close @ SPM Work Port
- HP Upper Shear Close @ Operator Door
- LMRP Accumulator Supply @ Accumulator

---

**RCX Low-Shock SPM Assemblies - Part Number and Description**

<table>
<thead>
<tr>
<th>Value Size</th>
<th>Value Configuration</th>
<th>Value &amp; Block Assembly P/N</th>
<th>Value Application</th>
<th>Value Only P/N</th>
<th>Shear Kit P/N</th>
<th>Shear Kit Only P/N</th>
<th><strong>Block Only P/N</strong></th>
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<tbody>
<tr>
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<td>FR S</td>
<td>11448758-001</td>
<td>11446049-001</td>
<td>11446070-001</td>
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<td>1&quot; NC</td>
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<td>1&quot; NO</td>
<td>Normally Open</td>
<td>11449450-001</td>
<td>Pod Select</td>
<td>11395270-001</td>
<td>11444594-001</td>
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<td>Stack Mounted</td>
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<td>11450588-001</td>
<td>16607805-001</td>
<td>16607868-001</td>
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</table>

*For reference only, please contact your local sales contact for more information.*

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*rig@nov.com*
The National Oilwell Varco (NOV) Koomey® Emergency Hydraulic Back-up System (EHBS) is an independent hydraulic control pod mounted on the lower BOP stack. When armed, the EHBS pod performs automatically in the event main conduit hydraulic pressure and electric power to the BOP control system 112-line MUX pod are disconnected or lost. The EHBS is a reliable safety system that activates customer-specified functions in the event of power failure, riser string disconnect or Lower Marine Riser Package disconnect.

Adjustable Timing Circuit Actuator

The Adjustable Timing Circuit Actuator provides a mechanical method for providing a time delay between two hydraulic functions on an EHBS. The Adjustable Timing Circuit Actuator is easily adjusted to provide a time delay range of 18 to 52 seconds (when supplied with 5,000 psi [345 bar]).

Key Benefits:
- No nitrogen pre-charging for time delay.
- No temperature or depth variables or pre-charge calculations.
- Rugged and reliable.
- Easily adjustable.
- Corrosion resistant.
- Existing timing circuits are easily upgraded.

Operating Principles:
Previous time delay circuits required an accumulator pre-charged for specific depth and water temperature variables. With the Adjustable Timing Circuit Actuator, a timing circuit accumulator and variable dependent precharges are no longer necessary. The timing setting used for surface testing is the same timing setting used for subsea operation.

The system can be deployed as tested.

Adjustable Actuator Properties

- Height: 50.2" (127.51 cm)
- Width: 9.9" (25.15 cm)
- Depth: 9.9" (25.15 cm)
- Weight: 410 lb (185.0 kg)

Stack Mounted Timing Circuit Properties

- Height: 50.64" (128.63 cm)
- Width: 20.8" (52.83 cm)
- Depth: 10.96" (27.84 cm)
- Weight: 1,720 lb (780.2 kg)

Adjustment Range

- Min: 18 - 22 Seconds
- Max: 48 - 52 Seconds

Adjustment

1 inch of adjustment = ± 5 seconds

Adjustment Procedure

1. Remove the timing adjustment thread cover.
2. Using a socket wrench, thread the adjustment screw inward (shorter delay) or outward (longer delay).
3. Replace the timing adjustment thread cover.

Reference: 10874976-ASM

*For reference only, please contact your local sales contact for more information.
RCX A-HB Pod

The RCX A-HB Pod combines both acoustic and EHBS functionality. Those two circuits are completely isolated hydraulically, however, they share a structural package. Acoustic emergency backup control system provides remote closure of certain BOP stack functions.

- Acoustic emergency back-up consists of two (2) sections of control, acoustic and electrohydraulic
- System is sized for 12,000 feet water depth
- Acoustic Functions will be as listed in later in this document
- System will include HIPAP
- Cables for the connectors to have test ports

Acoustic Electronic Section

- Portable Surface Acoustic Command and Control Unit for two way communication and operation of the control system. Splash proof design, with easy operation for critical BOP functions.
- Dunking Transceiver, with 70M cable
- Full redundant subsea container, with built in dual lithium, two year operating, batteries and electronics. Each electronic section has interface to dedicated transducer connectors (one for each). The electronics/transducers can operate individually or as a system.
- 2 Subsea Transceivers. Inclusive of 15 meter cable and Gisma connectors
- Simulator for testing of ACS Tool for on-deck testing of the ACS before the BOP enters the sea. Connector and interface cable simulating solenoid drivers and read-backs are standard. The connector mates directly to the ACS interface cable (solenoid end).

EHBS

Emergency Hydraulic Backup System (EHBS) (also referred to as Auto Shear Circuit), commonly called a “Deadman System” is an independent hydraulic control pod circuit mounted on the BOP stack which performs the following stack functions automatically if main conduit and electrical power to the BOP control system are disconnected or otherwise lost.

The EHBS is hydraulically powered from the stack-mounted Shear Accumulator Bank. The EHBS system consists of the following major components:

- EHBS Assembly, housed in a steel frame attached to the BOP stack. All inputs, outputs and manual valves are labeled. All manifold valve functions are stamped on the manifold.
- On screen activation for simulation of the Deadman Circuits; “Normal Operation / Test” function for simulation of loss of emergency power before stack deployment.
- Two (2) Functions: Close Casing Shear and after 20 second, close the upper blind shear rams.
- Will include one additional valve, 3 valves total.
- Timing Circuit included will be mechanical. No pre-charged bottle.

Electrohydraulic Control Section

Electrohydraulic mini pod to interface between acoustic system and desired functions. The modularly constructed pod will consist of the following:

- One (1) Stainless steel pressure compensated chamber. The chamber is filled with dielectric insulating fluid and compensated by a pressure compensator complete with a relief valve. The chamber is to contain CCSV environmentally protected solenoid actuators.
- One (1) 3m absolute filtration assembly
- One (1) piston type accumulator for supply pressure storage to the CCSV valves.
Today’s designed operating environment for stack mounted accumulators is challenging. Design criteria include 12,000 ft water depths, temperatures as low as 12°F with surface temperatures of 120°F, rapid discharge (adiabatic), as well as higher minimum system pressures. All of these things add up to a large number of bottles on a lower BOP stack. It is not uncommon to see as many as 126 accumulator bottles on a lower BOP stack, 98 of which are dedicated to the shear system alone. This adds weight to the overall assembly, increases maintenance requirements, and decreases stack equipment access. By using the water column pressure and mechanically boosting the hydraulic pressure, a Depth Compensated Accumulator has reduced the total number of stack mounted shear circuit bottles dramatically.

**Functionality**

This system is comprised of a double-piston accumulator. The two pistons are connected by a piston rod. This creates five separate chambers within the DCB, plus the transfer barrier:

- The first two chambers (V1 and V2) contain a Nitrogen pre-charge acting against one piston.
- The third chamber (V3) is a vacuum that acts against the other piston.
- The fourth chamber (V4) is filled with BOP fluid from the transfer barrier. The transfer barrier is open to ambient seawater pressure on one end and forces more fluid into V4 as depth increases.
- The fifth chamber (V5) contains the hydraulic fluid.
- The result is 100% usable hydraulic fluid while subsea.

**Estimating the number of bottles required:**

1. On the vertical axis, find the required Shear Pressure (including the effects of Mud Weight and Water Depth) and intersect with the curve for DCB bottle type. (Example: 3900 psi, 7.9 Gal DCB)
2. Draw a line down from the point of intersection to the horizontal axis of the chart and read usable volume for one bottle. (Example: 3.6 gal)
3. Multiply the required operator volume by 1.1 (API 16D Volume Design factor) to obtain the total required volume. (Example: 18’-15M NXT 22” Operator, closing volume = 37.3 gal, required volume = 37.3 x 1.1 = 41.03 gal)
4. Divide the required volume by the usable volume for one bottle to obtain the required number of bottles. (Round up to the next whole number.) (Example: 41.03/3.6 = 11.4, round up to 12 bottles)

**Equation**

\[
\text{Number of Bottles Required} = \frac{\text{Required Operational Volume} \times 1.1}{\text{Volume Used Per Bottle}}
\]

Note: This is only an estimate. Contact NOV Pressure Control Engineering for certified calculations.
P/N 20090035 configuration

- Nitrogen Pressure Chamber - V2
- Nitrogen Pressure Chamber - V2
- Connectors
- Anti-extrusion Rod
- Shell
- Hydraulic Pressure Chamber - V5
- Hydraulic Connection
- Bladder
- Seawater Chamber - V4
  Note: Seawater Chamber is filled with BOP fluid from transfer barrier
- Poppet Valve
- Seawater Port
- Vacuum Chamber - V3
- Vacuum Chamber Gas Valve - V3

Specifications:

<table>
<thead>
<tr>
<th>P/N</th>
<th>V1 VOLUME</th>
<th>V2 VOLUME</th>
<th>V2 VOLUME (MIN)</th>
<th>HEIGHT</th>
<th>WIDTH</th>
<th>DEPTH</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20090035</td>
<td>7.4 Gal</td>
<td>41.6 Gal</td>
<td>15 Gal</td>
<td>15.5&quot;</td>
<td>30.5&quot;</td>
<td>11.9&quot;</td>
<td>1,955 lb</td>
</tr>
<tr>
<td></td>
<td>(30 liters)</td>
<td>(156.8 liters)</td>
<td>(58.4 liters)</td>
<td>(394.4 mm)</td>
<td>(774.2 mm)</td>
<td>(302.3 mm)</td>
<td>(3,495 kg)</td>
</tr>
</tbody>
</table>

(Trigger barrier can be installed separately if desired)

P/N 10641709-003 configuration

- Nitrogen Pressure Chamber Gas Valve - V2
- Nitrogen Pressure Chamber - V2
- Connectors
- Anti-extrusion Rod
- Shell
- Hydraulic Pressure Chamber - V5
- Hydraulic Connection
- Bladder
- Seawater Chamber - V4
  Note: Seawater Chamber is filled with BOP fluid from transfer barrier
- Poppet Valve
- Seawater Port
- Vacuum Chamber - V3
- Vacuum Chamber Gas Valve - V3

Specifications:

<table>
<thead>
<tr>
<th>P/N</th>
<th>V1 VOLUME</th>
<th>V2 VOLUME</th>
<th>V2 VOLUME (MIN)</th>
<th>HEIGHT</th>
<th>WIDTH</th>
<th>DEPTH</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10641709-001</td>
<td>17 Gal</td>
<td>52 Gal</td>
<td>20.6 Gal</td>
<td>15&quot;</td>
<td>34&quot;</td>
<td>19.5&quot;</td>
<td>7,208 lb</td>
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<tr>
<td></td>
<td>(64.35 liters)</td>
<td>(196.3 liters)</td>
<td>(77.98 liters)</td>
<td>(380 mm)</td>
<td>(863.6 mm)</td>
<td>(495.3 mm)</td>
<td>(3,269 kg)</td>
</tr>
<tr>
<td>10641709-002</td>
<td>25.8 Gal</td>
<td>90 Gal</td>
<td>25.8 Gal</td>
<td>19.5&quot;</td>
<td>34&quot;</td>
<td>19.5&quot;</td>
<td>9,545 lb</td>
</tr>
<tr>
<td></td>
<td>(97.66 liters)</td>
<td>(354.8 liters)</td>
<td>(97.66 liters)</td>
<td>(500 mm)</td>
<td>(863.6 mm)</td>
<td>(495.3 mm)</td>
<td>(4,329 kg)</td>
</tr>
<tr>
<td>10641709-004</td>
<td>28 Gal</td>
<td>105.99 Gal</td>
<td>28 Gal</td>
<td>19.5&quot;</td>
<td>34&quot;</td>
<td>19.5&quot;</td>
<td>9,077 lb</td>
</tr>
<tr>
<td></td>
<td>(105.99 liters)</td>
<td>(396.5 liters)</td>
<td>(105.99 liters)</td>
<td>(500 mm)</td>
<td>(863.6 mm)</td>
<td>(495.3 mm)</td>
<td>(4,117 kg)</td>
</tr>
<tr>
<td>10641709-003</td>
<td>28 Gal</td>
<td>105.99 Gal</td>
<td>28 Gal</td>
<td>19.5&quot;</td>
<td>34&quot;</td>
<td>19.5&quot;</td>
<td>9,545 lb</td>
</tr>
<tr>
<td></td>
<td>(105.99 liters)</td>
<td>(396.5 liters)</td>
<td>(105.99 liters)</td>
<td>(500 mm)</td>
<td>(863.6 mm)</td>
<td>(495.3 mm)</td>
<td>(4,329 kg)</td>
</tr>
</tbody>
</table>

*For reference only, please contact your local sales contact for more information.
Hands Free Gooseneck Overview

NOV understands the oil and gas industry, and with it, the inherent dangers of rig personnel working inside the moon pool area. Manual goosenecks have a tendency to have long connection times and are difficult to manage, leaving an opportunity for both equipment damage as well as exposing rig personal to potentially harmful situations.

With an eye ever towards the needs of our customer, NOV is proud to introduce the Hands Free Gooseneck System (HFGN). NOV's HFGN eliminates the need to have rig personnel in potentially hazardous environments and with the addition of rotating stabs, the BOP stack has easy access beneath the drill floor.

Manual Swivel Gooseneck

The hands free gooseneck stabs are designed such that they may swivel in the clockwise and counterclockwise directions by manually pulling the hose in the desired plane of rotation, making way for any equipment which must find its way to well center. The unit is available in 75 1/2" and 60 1/2" diverter sizes.

1. Visual Position Rod to verify successful stab with the telescopic joint
2. Secondary locking to prevent unintentional un-stabbing of the gooseneck with the telescopic joint
3. Emergency packing element to temporarily seal potential leaks.
4. API Flange or Hub moon pool hose connections, customizable to customer preference.

Manual Swivel Gooseneck Features

- Simple connection process
- Improved Safety
- No manual intervention required
- Rotating cartridge assemblies
- Modular Components
- Quick disconnects to facilitate connection of control hoses
- Safety interlocks to prevent unintended operation of HFGN functions

Manual Swivel Gooseneck Benefits

- Removes personnel from working over water in a riding belt
- Connection process is reduced from hours to minutes
- Can be retrofitted to existing NOV riser systems with minimal modifications
- Eliminates damage from manually stabbing individual goosenecks using snatch blocks and tuggers
- Modular configuration provides for common spare parts

Testing

- Designed and tested to API 16F Specifications
- Each Hands Free Gooseneck is stab tested with a Telescoping Joint prior to shipment

Perspective View

Top View

Front View

*For reference only, please contact your local sales contact for more information.*
The CHX model connector is an industry leader in bending load capacity. Mechanical engagement of the unlocking piston to the finger segments, a 27% higher unlocking force to locking force, and a secondary unlocking piston ensures full release of the connector segments from the wellhead. A wide variety of option features including top connection, gasket control features, porting types, and corrosion prevention measures, provide flexibility to meet customer satisfaction.

Standard Features
- Industry leading bending and tension capacity
- Unlock force 27% greater than locking force
- Load path directly through self-locking segments
- Secondary unlocking piston for increased detachment reliability
- Two visual piston position indicator rods that engage with the annular piston to ensure an accurate reading. Both with life cycle grooves for easy connector life wear inspections
- Hydraulic and spring operated gasket retention pins
- Hydraulic gasket nudgers
- Inconel inlay on all sealing surfaces
- Weep hole porting for quick testing validation
- ID running tool alignment slot
- Molded, bi-directional T seals with dual polyurethane back up extrusion protection
- Wear band protection against piston cylinder galling

Available Options
- CREP level packages
- Detachable WLHD funnel down assembly
- Various API top flange connections
- Multiple gasket control feature configurations
- Various hydraulic porting connection types
- Adapter kit which allows for a 27” H4 locking profile

Other Benefits
- 92% Surface coverage on locking profile allows for higher pre-load without damaging wellhead / mandrel
- Lead in alignment that eliminates potential gasket contact when landing on the wellhead
- Design flexibility with integrated stack controls

Design Validation Testing
- Sealing Mechanism (Wellbore Shell)
- Tension / Bending Capacity
- Seal Life Cycle Fatigue
- Piston Displacement
- Hub Separation
- Stack Pull (Gimbal) Simulation
- Vibration Simulation
- Locking Relationship Validation
- High & Low Temperature Testing
- Function Life Cycle Fatigue
- Friction Validation

All values are preliminary and are subject to change. Full capacity values are based on FEA and will be confirmed with testing.

CHX WLHD Connector Overview

For reference only, please contact your local sales contact for more information.
The CMX-1527 connector includes a patented floating floating hydrate seal that allows for extreme angle SRs while maintaining hydrate prevention during operation. Mechanical engagement of the unlocking piston to the finger segments, a 43% higher unlocking force to locking force, and a secondary unlocking piston ensures full release of the connector segments from the mandrel or wellhead.

A wide variety of options features including top connection, gasket control features, porting types, and corrosion prevention measures, provide flexibility to meet customer satisfaction.

**Standard Features:**
- High angle release capability
- Stationary upper support (patent pending)
- Competitive bending and tension capacity
- Unlock force 43% greater than locking force
- Load path directly through seal locking segments
- Two visual piston position indicator rods that engage with the annular piston to ensure an accurate reading. Both with life cycle grooves for easy connector life wear inspections.
- Hydraulic and spring operated gasket retention pins
- Weep hole porting for quick testing validation
- ID running tool alignment slot

**Available Options:**
- CERP level packages
- Detachable LMRP alignment / WLHD funnel down assembly
- Various API top range connections
- Multiple gasket control feature configurations
- Various hydraulic porting connection types

**Benefits:**
- Added HAR capability with floating hydrate seal design
- 92% Surface coverage on locking profile allows for higher pre-load without damaging wellhead/mandrel
- Lead in alignment that eliminates potential gasket contact when landing
- Design flexibility with integrated stack controls
- Improved delivery times

**Design Validation Testing:**
- Sealing Mechanism (Wellbore Shell)
- Tension/Bending Capacity
- Seal Life Cycle Fatigue
- Piston Displacement
- Hub Separation
- Stack Pull (Gimbal) Simulation
- Vibration Simulation
- Locking Relationship Validation
- High & Low Temperature Testing
- Function Life Cycle Fatigue
- High Angle Release

---

**Technical Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Bending Load Capacity</td>
<td>7.0 mili-tons</td>
</tr>
<tr>
<td>Pure Tension Load Capacity</td>
<td>6.75 mili-tons</td>
</tr>
<tr>
<td>Preload</td>
<td>4.9 mili-tons</td>
</tr>
<tr>
<td>Locking Volume</td>
<td>10.6 gallons</td>
</tr>
<tr>
<td>Unlocking Volume</td>
<td>15.4 gallons</td>
</tr>
<tr>
<td>Max Bending Pressure</td>
<td>30,000 psi</td>
</tr>
<tr>
<td>Max Tension Pressure</td>
<td>2,000 psi</td>
</tr>
<tr>
<td>Max Hydraulic Operating Pressure</td>
<td>3,000 psi</td>
</tr>
<tr>
<td>Stack Up Height</td>
<td>13.5 in.</td>
</tr>
<tr>
<td>Swallow Height</td>
<td>25.50 in.</td>
</tr>
<tr>
<td>Weight</td>
<td>20,300 lbs</td>
</tr>
</tbody>
</table>

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**Low Temperature Test**

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**Locking Segment Coverage Shown in Unloaded Position**

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**Bending Test Fixture**

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*For reference only, please contact your local sales contact for more information*
**Type FT-H/FT-HB**

The shuttle stack tool is used as a lifting tool for the riser sitting and BOP stack when the vessel needs to move a short distance. The shuttle stack tool is comprised of two main parts, the riser shuttle joint and the shuttle tool assembly. The riser shuttle joint is installed beneath the telescopic joint and functions as another joint of rear during normal operations. However, the riser shuttle joint has a large locking area in which the shuttle tool assembly’s six lock dogs can engage.

**Hydraulic Locking System**

The Shuttle Tool hydraulic circuit is equipped with a pilot operated check valve. This allows the operator to first activate the pilot operated check valve before functioning the tool to the unlock position. This procedure prevents the Shuttle Tool from being inadvertently unlocked:

- Stab the shuttle tool pin into the riser shuttle joint box connection
- Apply 1500 psi hydraulic pressure to the shuttle tool’s lock side hydraulic circuit

**Shuttle Tool Uses**

The Shuttle Tool does not carry over 500 T.

- Re-landing the LMRP/BOP
- Move or reorient the BOP Stack
- Location Hopping for Short Distances
- Perhaps fully utilizing the Dual Activity Rigs

### Technical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Working Load</td>
<td>500 Tons (454 Tonne)</td>
</tr>
<tr>
<td>Extended Height</td>
<td>11,945 ft (3686 m)</td>
</tr>
<tr>
<td>Weight: Riser Shuttle Joint Only</td>
<td>11,136 lb. (5,045 kg)</td>
</tr>
<tr>
<td>Weight: Riser Shuttle Tool Only</td>
<td>5,916 lb. (2,683 kg)</td>
</tr>
<tr>
<td>Length: Vehicle Mounting</td>
<td>234 ft (70.4 m)</td>
</tr>
<tr>
<td>Length: Riser Shuttle Joint Only</td>
<td>16 ft (4.9 m)</td>
</tr>
<tr>
<td>Length: Shuttle Tool Only</td>
<td>80 ft (24.3 m)</td>
</tr>
<tr>
<td>Hydraulic Fluid Contact</td>
<td>Operating Fluid is Hydraulic Oil</td>
</tr>
<tr>
<td>Operating Fluid</td>
<td>Hydraulic Oil</td>
</tr>
</tbody>
</table>

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*For reference only, please contact your local sales contact for more information.*

rig@nov.com

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