UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Procedure for Assembly and Test:

API 6A
ISO 10423

LICENSED UNDER 6A

WELLHEAD & CHRISTMAS TREE EQUIPMENT

Description

Mechanical testing performed in test labs at various UWS facilities for pressure and temperature, inspection for defects.

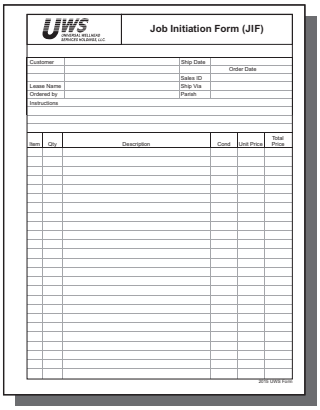
Purpose: in-house procedures for specific tasks to accompany the Management System Process Manual.

Scope: Shop Assembly and Testing of New Products.
New Products to include all chokes, crosses, tees, valves, hangers, spools, casing heads, all associated Christmas tree equipment under API 6A.

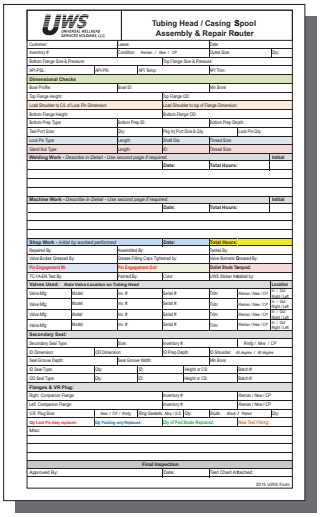
Responsibility: Shop Foreman of each facility.

This procedure will refer only to new UWS equipment.

Required Forms:



JIF

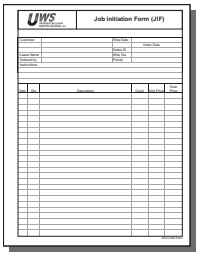


Router

Special Instructions:

See API Procedures
-
Cross Reference

Job Initiation Form (JIF)



Click to view form

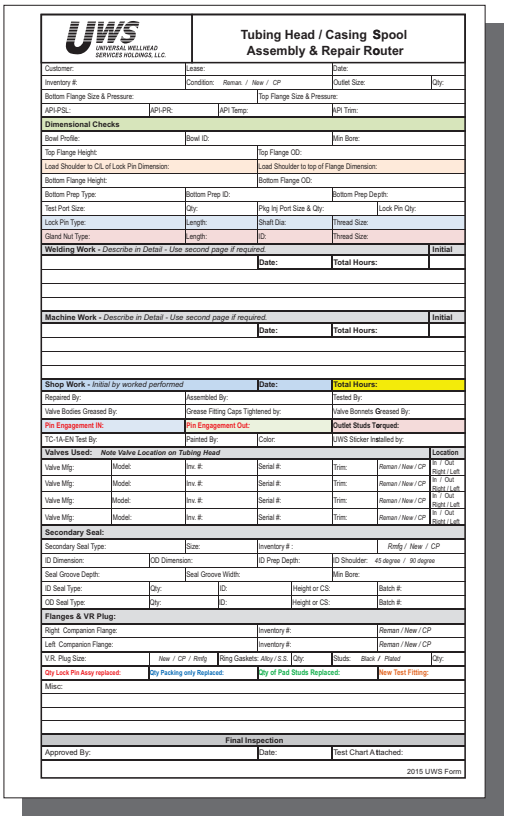
1) ☐ Start with a completed UWS Job Initiation Form (JIF). This form will spec the proper equipment to use and may be accompanied with a schematic showing proper location of components.

2) ☐ Pull all associated Routers for each component in the assembly job, and attach to the JIF. *Click to view complete list of Routers*

3) ☐ Pull all equipment necessary to assemble the wellhead components on the JIF.

4) ☐ Record all information on the Routers…including but not limited to:

- ☐ **a.** Item Description
- ☐ **b.** Manufacturer
- ☐ **c.** Model number
- ☐ **d.** Part number
- ☐ **e.** Inventory numbers
- ☐ **f.** Serial numbers
- ☐ **g.** Elastomer material and durometer
- ☐ **h.** All API specifications
  - ☐ i. Product Specification Level (PSL)
  - ☐ ii. Performance Requirements (PR)
  - ☐ iii. Trim Level
  - ☐ iv. Temperature Rating



Click to view form

Visual Inspection

5) ☐ Before beginning the assembly process,
perform a visual inspection on each part.
Verify that there are no defects or damaged components.

IMPORTANT

In preparing for the assembly process it is VERY important that all parts are clean and free of shavings. Please ensure that all sharp edges are broken and de-burred.

6) ☐ During the assembly process,
ensure that all ring grooves and
ring gaskets are clean and dry.
Paint, oil and grease are not allowed
on either the groove or the ring.

☐ **a.** Place a ring gasket in each flange
ring groove and paint each flange face
with aerosol primer to help prevent corrosion.
Remove the ring and ensure the ring groove
is clean before proceeding.

7) ☐ Inspect all test flanges and verify that
they are in good condition.
Pay close attention to the ring grooves.

Note: Rubber coated or Petromec rings
are not allowed for testing.
Use only new, clean, Alloy Steel
ring gaskets under test flanges.

Drift Each Component Independently

8) ☐ Drift each gave valve and wellhead component *independently* prior to assembly.
Valves must drift when
in the full open position – DO NOT back off the valve to obtain a drift.

9) ☐ Use the bolting specified on the JIF, and follow API requirements for installation, tightening sequence, and torque values.

click to view
API Flange Bolt Torque Procedures

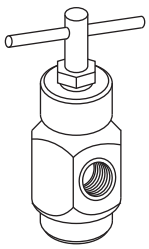
- ☐ **a.** Use proper lubricant on all studs and nuts prior to installation.
- ☐ **b.** Ensure all nuts are equal as far as exposed threads.
- ☐ **c.** Ensure there is a minimum of 2 complete threads visible above each nut after tightening.

10) ☐ Visually inspect the assembly after installing each component to assure proper alignment and flange spacing.

WARNING
Never remove any fitting from a valve when there is the possibility of pressure inside the valve.

Drift the Assembly as a Unit

11) ☐ After completing the assembly and all connections are properly torqued, drift the assembly as a unit with approved drift bar.


Bleeder Tool

12) ☐ Inspect the elastomers and verify that they are in good condition.

13) ☐ Ensure that all threaded connections (tree caps, chokes, etc.) are assembled with proper anti-seize compound.

14) ☐ Move the assembly to the test bunker – **DO NOT grease any valves before testing.**

15) ☐ Attach test hose and fill the assembly with cold water.

16) ☐ Make every effort to remove all trapped air by operating valves using bleeder tools on body grease fittings, etc.
Remove all bleeder tools prior to testing.

Test Procedures

17) ☐ After ensuring the test bunker is secured and unoccupied, proceed with the test.

18) ☐ ** see API procedures for next steps. *click to view* **API Hydrostatic Test Procedures**

19) ☐ After a successful test and securing an unblemished chart, bleed off all pressure. Mark the chart with the appropriate JOB number and attach to the Router.

20) ☐ Remove test flanges and inspect the ring groove on the assembly.

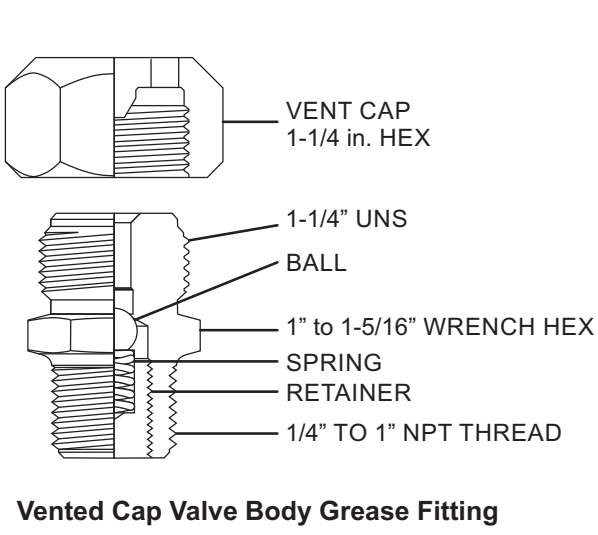
21) ☐ At this time re-torque every nut on every connection, and record the torque value on the JIF.

CAUTION
Precaution should be taken to bleed off any retained pressure by opening the vent fitting, or using a pressure relief tool (see below) on one of the valve body grease fittings.

Grease

22) ☐ Grease all valves with appropriate valve lubricant for the job (check the JIF for specifications). Ensure that all water is flushed from each valve body and that each valve is full of grease.

- ☐ **a.** Grease all valves in the Full Open position.
- ☐ **b.** Grease all bearings via the Alemite fittings, and install a protective cap over the fitting.
- ☐ **c.** Re-install the grease fitting caps and tighten securely.
- ☐ **d.** Operate the valve through one complete cycle, leaving the valve in the full open position.



Vented Cap Valve Body Grease Fitting

1 ☐ ***DE-PRESSURIZE THE VALVE***

2 ☐ ***REMOVE THE VENT CAP FROM THE FITTING***

3 ☐ ***CONNECT THE GREASE GUN***

NEVER EXCEED THE WORKING PRESSURE OF THE VALVE WHEN PUMPING GREASE INTO THE BODY

4 ☐ ***PUMP THE LUBRICANT INTO THE VALVE BODY***

5 ☐ ***REMOVE THE GREASE GUN***

6 ☐ ***REPLACE VENT CAP ON FITTING, TIGHTEN***

Re-Drift the Assembly

23) ☐ Re-drift the assembly at this time, ensure that the bore is clean and free from excess grease. All valves must be in the full open position – DO NOT partially close a valve to obtain a drift.

Clean and Paint

24) ☐ Clean the assembly and prepare for painting.

- ☐ **a.** Tape all tags and name plates, grease all exposed threads, seal bores and ring grooves prior to painting.
- ☐ **b.** Ensure the assembly is clean and dry before painting.

25) ☐ After painting, remove all tape and verify that there is no paint on exposed threads, seal bores or ring grooves. Ensure they are protected from the elements with a light coat of grease.

Tag the Assembly

26) ☐ Place a UWS sticker on the assembly and tag the assembly with the Customer's name and Lease information.

Revision Log

LIST OF FORMS

Revision	Details
0	Rev. 0 Dec. 1, 2014 Updated logo header / footer Added list of forms Added indexed electronic forms Added API cross reference

JIF
Casing Head Router
Choke Router
Misc. Router
Safety Valve Router
Tubing Head Casing Spool Assembly Repair Router
Second Sheet (Page 2)
Tree Router
Gate Valve Router
Coupling Style Adapter Router
Cross-Over Spool Router

API CROSS REFERENCE

Revision	Details
0	Rev. 0 Dec. 1, 2014

API Flange Bolt Torque Procedures
API Hydrostatic Test Procedures

ENGINEERING

Approval Log

Approved By: _____
SIGNATURE

_____
PRINT NAME

Revision	*REVIEWER* NAME	*REVIEWER* TITLE	DATE
0	Bob Allen	Managing Partner	December 1, 2014

FIELD

Date of Printing ***2:35 pm, 11/30/2014*** *Please ensure the latest revision is in use.*

INDEX

PRINT

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Job Initiation Form (JIF)

Customer		Ship Date	
		Order Date	
		Sales ID	
Lease Name		Ship Via	
Ordered by		Parish	
Instructions			

Item	Qty	Description	Cond.	Unit Price	Total Price

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Casing Head Router

Customer:		Lease:		Date:
Inventory #:		Condition: *Rmfg / New / CP*	Bowl Profile:	
Flange Size:		Flange Pressure:	Outlet Size:	Qty:
API-PSL:	API-PR:	API Temp:		API Trim:

Dimensional Checks

Bottom Prep Size:	Type: *SOW / 8rd box / 8rd pin*		Min. Bore:	Qty of Lock-Pins:
Lock-Pin Type:		Length:	Shaft Dia:	Threrad Size:
Gland Nut Type:		Length:	ID:	Threrad Size:
Pin Engagement IN:		Pin Engagement OUT:		
Load Shoulder to top of Flange Dimension:		Load Shoulder to C/L of Pin Dimension:		
Bowl ID:	Flange OD:	Flange Height:		Test Port Size:
SOW prep ID:	SOW Prep Depth:		O-Ring groove ID:	O-Ring Cross Section:
Bushing in SOW prep: *Yes - No*	Bushing OD:	Bushing ID:	Bushing Length:	
Base Plate OD:	Thickness:	Base Plate ID :	Qty of Gussets :	Thickness:

Welding Work - *Describe in detail*

	Total Hours:	Date:	By:

Machine Work - *Describe in detail*

	Total Hours:	Date:	By:

Shop Work - *Initial by work performed*

Repaired by :	Assembled by:	Date:	**Total Hours:**
Bushing Tested by:	Tested to:	Test Port Drilled Through by:	Date:
Outlet Studs Torqued to:		Valve Bonnet Studs Torqued to:	
SOW prep O-ring Size:		O-Ring Installed by:	
Painted:	Color:	Date:	

Parts Used

Valve Mfg:	Model:	Pres:	Cond: *Rmfg / New /CP*	Inventory #:	S/N:
Valve Mfg:	Model:	Pres:	Cond: *Rmfg / New /CP*	Inventory #:	S/N:
Bull Plugs:		Nipples:		V.R. Plug:	
Studs: *Black / Plated*		Companion Flanges:			*Rmfg / New / CP*
SOW prep O-ring:		Ring Gaskets:		Studs:	
Other Parts Used:					

Final Inspection

Approved by:	Date:	Test Chart Attached :

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Choke Router

Customer:	Lease:		Date:
Inventory #:	Condition: *Reman. / New / C/P*		
Inlet Side:	Outlet Side:		
Manufacturer:	Model:		Body: *Alloy / SS*
Trim: *HS / TC / FL-TC*	Orafice Size: *3/4" / 1"*	Working Pressure:	
API-PSL:	API-PR:	API Temp:	API Trim:

Shop Work - *Initial by work performed*

Repaired by:	**Total Hours:**	
Painted by:	Color:	Bonnet Greased by:
Indicator Zero'd by:	Tested by:	
Other:		

Welding Work Performed	**Total Hours:**	Date:	By:

Machine Work Performed	**Total Hours:**	Date:	By:

Parts Used:

Stem: *3/4" or 1"*	Trim: *HS / TC*	Seat: *3/4" / 1"*	Trim: *HS / TC / FL-TC*
Flow Bean Size: /64"	Trim: *Ceramic / FL-TC*	Pos. Cap Assy: *Solid / Tapped*	
Packing: *Nitrile / Aflas / HSN*	Junk Ring: *Alloy / SS*	Spiralox Ring: *Alloy / SS*	
Grease Fitting:	Cage Nipple:	O-Ring: *HSN-80 / Aflas / Other*	
Indicator Drum: *3/4" / 1"*	Thumb Screw:	Teflon Ball:	Handwheel:
New Bonnet Assy:	Size: *3/4" / 1"*		Trim: *HS / TC*
Misc Parts Used:			

Final Inspection

Approved by:	Date:	Test Chart Attached :

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Misc. Router

Customer:	Lease:	Date:
Part Description:	Size & Pressure:	
Inventory #:	Condition: *New / Reman / C/P*	

API-PSL:	API-PR:	API Temp:	API Trim:	

Welding Work Performed	**Total Hours:**	**Date:**	**By:**

Machine Work Performed - in Detail	**Total Hours:**	**Date:**	**By:**

Shop Work - In Detail	**Total Hours:**	**Date:**	**By:**

Parts Used

Quantity	**Description**

Final Inspection

Approved By:	Date:	Test Chart Attached:

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Safety Valve Router

Customer:	Lease:		Date:
Inventory #:	Condition: *Rmfg. / New / CP*		
Size:	Pressure:	S/N:	Seat #:
Trim:	Valve Manufacturer:		Model:
API-PSL:	API-PR:	API Temp:	API Trim:
Actuator Manufacturer:		Model:	
Type: *Piston / Diaphram / Hydraulic*		Piston or Diaphram Size:	

Shop Work - *Initial by work performed*

Valve Repaired by:	Date:	**Total Hours:**	
Actuator Repaired by:	Drifted by:	Painted by:	Color:
Shell Tested by:	Gate Tested by:	Actuator tested with shop air by:	
O-Ring or Diaphram visually Inspected by:		Greased by:	
Bonnet Studs Torqued to:		Grease Fitting Caps tightened by:	

Welding Work Performed - *in Detail*	**Total Hours:**	Date:	By:

Machine Work Performed - *in Detail*	**Total Hours:**	Date:	By:

Valve Parts Used:

Gate: *Resurfaced / New / Original*	If Resurfaced - Letter Size: *A / B / C / D / E*		Trim:
Seats: *Resurfaced / New / Original*	Body Bushings: *Resurfaced / New / Original*		Trim:
Gate Guides: *New / Original*	Trim: *Alloy / SS*	Bonnet Seal: *Alloy / SS*	
Body Grease Fittings: *Alloy / SS*		Stem Packing Set: *Orange / Purple / Black*	
Lower Stem: *New / Original*		Upper Stem: *New / Original*	

Actuator Parts Used:
*

Change Piston O-ring on all Used Piston Actuators!
Inspect Diaphrams on all Used Diaphram Actuators!

Piston Housing: *New / Original / Rmfg*	Piston: *New / Original / Rmfg*	O-Ring & Seal Kit:	
Diaphram Condition: Original / Replaced with New / Good Condition		O-Ring & Seal Kit:	
Manual Over-Ride: *Rmfg / New / CP*		Hand Wheel: *Rmfg / New / CP*	
Pressure Relief Ftg: *New / Original*		Pressure Rating:	Thread size:
Springs: *New / Original*	Gate Nut: *New / Original*	Seat Retainer Plates: *New / Original*	
Misc:			

Final Inspection

Approved By:	Date:	Test Chart Attached:

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Tubing Head / Casing Spool Assembly & Repair Router

Customer:	Lease:	Date:	
Inventory #:	Condition: *Reman. / New / CP*	Outlet Size:	Qty:
Bottom Flange Size & Pressure:		Top Flange Size & Pressure:	
API-PSL:	API-PR:	API Temp:	API Trim:

Dimensional Checks

Bowl Profile:	Bowl ID:	Min Bore:	
Top Flange Height:		Top Flange OD:	
Load Shoulder to C/L of Lock Pin Dimension:		Load Shoulder to top of Flange Dimension:	
Bottom Flange Height:		Bottom Flange OD:	
Bottom Prep Type:	Bottom Prep ID:	Bottom Prep Depth:	
Test Port Size:	Qty:	Pkg Inj Port Size & Qty:	Lock Pin Qty:
Lock Pin Type:	Length:	Shaft Dia:	Thread Size:
Gland Nut Type:	Length:	ID:	Thread Size:

Welding Work - *Describe in Detail - Use second page if required.*			**Initial**
	Date:	**Total Hours:**	

Machine Work - *Describe in Detail - Use second page if required.*			**Initial**
	Date:	**Total Hours:**	

Shop Work - *Initial by worked performed*	**Date:**	**Total Hours:**
Repaired By:	Assembled By:	Tested By:
Valve Bodies Greased By:	Grease Fitting Caps Tightened by:	Valve Bonnets Greased By:
Pin Engagement IN:	**Pin Engagement Out:**	**Outlet Studs Torqued:**
TC-1A-EN Test By:	Painted By:	Color: UWS Sticker Installed by:

Valves Used: ***Note Valve Location on Tubing Head***						**Location**
Valve Mfg:	Model:	Inv. #:	Serial #:	Trim:	*Reman / New / CP*	In / Out Right / Left
Valve Mfg:	Model:	Inv. #:	Serial #:	Trim:	*Reman / New / CP*	In / Out Right / Left
Valve Mfg:	Model:	Inv. #:	Serial #:	Trim:	*Reman / New / CP*	In / Out Right / Left
Valve Mfg:	Model:	Inv. #:	Serial #:	Trim:	*Reman / New / CP*	In / Out Right / Left

Secondary Seal:

Secondary Seal Type:	Size:	Inventory # :		*Rmfg / New / CP*
ID Dimension:	OD Dimension:	ID Prep Depth:	ID Shoulder: *45 degree / 90 degree*	
Seal Groove Depth:	Seal Groove Width:	Min Bore:		
ID Seal Type:	Qty:	ID:	Height or CS:	Batch #:
OD Seal Type:	Qty:	ID:	Height or CS:	Batch #:

Flanges & VR Plug:

Right Companion Flange:		Inventory #:		*Reman / New / CP*	
Left Companion Flange:		Inventory #:		*Reman / New / CP*	
V.R. Plug Size:	*New / CP / Rmfg*	Ring Gaskets: *Alloy / S.S.*	Qty:	Studs: *Black / Plated*	Qty:
Qty Lock Pin Assy replaced:	**Qty Packing only Replaced:**	**Qty of Pad Studs Replaced:**		**New Test Fitting:**	

Misc:

Final Inspection

Approved By:	Date:	Test Chart Attached:

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Tubing Head / Casing Spool Assembly & Repair Router *(cont'd.)*

Work - *Describe in Detail - Second page.*			**Initial**
	Date:	**Total Hours:**	

Final Inspection		
Approved By:	Date:	Test Chart Attached:

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Tree Router

Customer:	**R/R#:**	**Lease:**	**Date:**
Assembled by:	Shell Tested by:	Gate Tested by:	
Studs in Run Torqued after testing to:		Studs in WingTorqued after testing to:	
Valves Greased by:	Caps tightened by:	Bonnets Greased by:	Alemite caps installed by:
Drifted by:	Painted by:	Color:	Indicator cleaned by:	Indicator Zero'd by:
Tubing Hanger Dry Fit by:	Tree Cap lift Threads Tested to:	Safety Valve Supply Ports Capped by:	
Ring Grooves cleaned & greased by:	Seal areas cleaned & greased by:	Threads cleaned & greased by:	
Total Shop Hours:	Cap installed on choke cage nipple by:	Sticker Installed by:	

Adapter:	Size:	Inventory #:
Parts Used:		
Lower Master:	Size:	Inventory #:
Parts Used:		
Upper Master:	Size:	Inventory #:
Parts Used:		
Tee / Cross:	Size:	Inventory #:
Parts Used:		
Swab Valve:	Size:	Inventory #:
Parts Used:		
Tree Cap:	Size:	Inventory #:
Parts Used:		
Wing Valve:	Size:	Inventory #:
Parts Used:		
Safety Valve:	Size:	Inventory #:
Parts Used:		
Choke:	Size:	Inventory #:
Parts Used:		
Hanger Coupling:	Size:	Inventory #:
Parts Used:		
Tubing Hanger:	Size:	Inventory #:
Parts Used:		
Studs Used:		
Ring Gaskets Used:		
Misc:		

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Gate Valve Router

Customer:	Lease:	Date:
Inventory #:	Condition: *Rmfg / New / CP*	Position in tree:
Size:	Pressure:	Trim:
Mfg:	Model:	S/N:
API-PSL: API-PR:	API Temp:	API Trim:

Shop Work - *Initial by task performed*

Repaired by:	Bonnet Repaired by:	***Total Hours:***
Tested by:	Drifted by:	Bonnet studs torqued to:
Painted by:	Color:	Bonnet Greased by:
Body Greased by:	Grease Fitting Caps Tightened by:	
Misc:		

Dimensional Checks

Right Flange OD:	Height:	Bore:	Ring Groove:
Left Flange OD:	Height:	Bore:	Ring Groove:
Valve End to End:	Number of Turns open to close:		Valve Height:

Welding Work Performed	**Total Hours:**	Date:	By:

Machine Work Performed - in Detail	**Total Hours:**	Date:	By:

Parts Used:

Gate: *Resurfaced / New / Original* <> *Alloy / SS*	*If Resurfaced - Letter Size:* A / B / C / D / E	
Seats: *Resurfaced / New / Original* <> *Alloy / SS*	**Body Bushings (FC):** *Resurfaced / New / Original* <> *Alloy / SS*	
Gate Guides: *New / Original* <> *Alloy / SS*	**Stem:** *New / Original* <> *Alloy / SS*	**Stem Packing:** *White / Black*
Body Grease Fittings: *Alloy / SS* QTY-_____	**Packing Inj Fitting:** *Alloy / SS*	**Alemite Fitting:** *New / Original*
Bearings: *New / Original*	**Bearing Spacer Sleeve:** *New / Original*	**Bonnet Seal:** *Alloy / SS*
Packing Retainer Bushing: *New / Original*	**Bearing Retainer Nuts:** *New / Original* QTY-_____	
Handwheel: *New / Used / Original*	**Seat Retainer Plate (FC):** *New / Original* <> *Alloy / SS*	

Misc or Parts not listed above:

Final Inspection

Approved by:	Date:	Test Chart Attached:

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Coupling Style Adapter Router

Customer:	Lease:	Date:
Bottom Flange Size & Pres:	Top Flange Size & Pres:	
Inventory #:	Condition: *New / Reman / C/P*	
Profile: *BO-2 / HB / WBU / HT / B8-M / Other -*		

Welding Work Performed	**Total Hours:**	**Date:**	**By:**

Machine Work Performed - in Detail	**Total Hours:**	**Date:**	**By:**

Shop Work - In Detail	**Total Hours:**	**Date:**	**By:**
Replaced Seals:			

Replaced Test Port Ftg:	Replaced Pad Studs:
Coupling tried in Adapter:	Coupling Inventory Number:

Dimensional Inspection

Bottom Ring Groove:	Flange Thickness:	Top Ring Groove:
Seal area Inspected:	Suspension Threads Inspected:	Threads Clipped:

Parts Used

Quantity	**Description**

Final Inspection

Approved by:	Date:	Test Chart Attached:

UNIVERSAL WELLHEAD SERVICES HOLDINGS, LLC.

Cross-Over Spool Router

Part Description:				
Customer:			Lease:	Date:
API PSL:	API PR:	API Temp:		API Trim:
Inventory #:			Condition: *New / Rmfg / C/P*	
Bottom Flange Size & WP:			Top Flange Size & WP:	
Bottom Flange Height:			Top Flange Height:	
Bottom Flange OD:			Top Flange OD:	
Bottom Flange Prep ID:			Top Flange Bore:	
Bottom Prep Depth:				
Bottom Prep Seal Type:	Qty:		Seal Groove Depth:	Height:

Welding Work Performed	**Total Hours:**	**Date:**	**By:**

Machine Work Performed - in Detail	**Total Hours:**	**Date:**	**By:**

Shop Work - In Detail	**Total Hours:**	**Date:**	**By:**

Parts Used

Quantity	***Description***				
	Bottom Studs:	Dia:	Length:	Material: *Black / Plated*	
	Top Studs:	Dia:	Length:	Material: *Black / Plated*	
	Internal Seals:	ID:	Height or CS:	Material:	Batch:

Final Inspection

Approved By:	Date:	Test Chart Attached:

I. Recommended Flange Bolt Torque

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Abbreviations and Definitions

Equations are expressed where:

D is the thread major diameter, expressed in millimeters (inches);

E is the pitch diameter, of thread, expressed in millimeters (inches);

f is the friction coefficient;

H is the hex size (nut), equal to 1,5 D + 3,175 mm (0,125 in);

K is the nut internal chamfer, equal to 3,175 mm (0,125 in);

P is the thread pitch, equal to $\frac{1}{\text{number of threads per unit length}}$, experssed in millimeters (inches)

σ is the stress in stud;

A_S is the stress area, expressed in square millimeters (square inches);

F is the force per stud, expressed in newtons (pound-force).

t is the torque.

SI units is the International System of Units

USC units is the United States Customary Units

Nm The torque obtained using units of millimeters and newtons is in units of newton-millimeters and can be divided by 1,000 to obtain newton-meters (Nm).

ft-lbf The torque obtained using units of inches and pounds is in units of inches-pounds-force and can be divided by 12 to obtain foot-pound-force (ft-lbf).

NOTE: The stresses in these calculations are based on stress area, and not thread root area as required for stress calculations in 4.3.4.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Recommended flange bolt torque

UWS Cross Reference

D.1 **General** **page 4** EQUATION D.1

It has been shown that the torque values given in the tables of API Annex D are acceptable values for use in type 6B and 6BX flanges in some services.

The user should refer to API TR 6AF, API TR 6A F1, API TR 6AF2 and API Spec 6FA for data on the effects on flange performance of bolt pre-load stress and other factors.

It should be recognized that torque applied to a nut is only one of several ways to approximate the tension and stress in a fastener.

$$A_S = \frac{\pi}{4}[D - (0{,}9743 \times P)]^2$$

See Table D.1

D.2 **Basis for tables** **page 4** EQUATION D.2

- The tables in API Annex D are for the convenience of the user only, and are based on calculations that assume certain friction coefficients for the friction between the studs and nuts, and between the nuts and flange face.

- Some factors that affect the relationship between nut torque and stud stress are:

  - thread dimensions and form;
  - surface finish of studs, nuts, and flange face;
  - degree of parallelism between nut face and flange face;
  - type of lubrication and coatings of the threads and nut bearing surface areas.

$$F = \sigma A_S$$

- Two coefficients of friction are used in the tables.

  A coefficient of friction of 0,13 approximates the friction with threads and nut bearing surfaces being bare metal well lubricated with thread compound tested in accordance with ISO 13678.

  A coefficient of friction of 0,07 approximates threads and nut face coated with fluoro-polymer material.

See Table D.2

NOTE: The stresses in these calculations are based on stress area, and not thread root area.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Recommended flange bolt torque

UWS Cross Reference

D.3 **Equations** **page 4** EQUATION D.3

The stress area, A_s, expressed in square millimeters (square inches), is calculated as given in Equation D.1

The force per stud, F, expressed in newtons (pound-force), is calculated as given in equation D.2

The torque, t, is calculated as given in Equation D.3

$$t = \frac{F \cdot E\left[P + \frac{\pi f \cdot E}{\cos(\pi/6)}\right]}{2\left[\pi E - \frac{P \cdot f}{\cos(\pi/6)}\right]} + F \cdot f\left[\frac{H + D + K}{4}\right]$$

Table D.3 not shown

D.4 **Recommendation for specific flanges**

The following flanges should not be made up beyond 275 MPa (40,000 psi) bolt stress, due to potentially high flange stresses.

346 mm (13-5/8 in.): 13,8 MPa (2,000 psi)

425 mm (16-3/4 in.): 13,8 MPa (2,000 psi)

540 mm (21-1/4 in.): 13,8 MPa (2,000 psi)

346 mm (13-5/8 in.): 20,7 MPa (3,000 psi)

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Recommended flange bolt torque

Table D.1 – Recommended torques for flange bolting (SI units)

Stud Diameter		Thread pitch	Studs with S_y = 550 MPa Bolt stress equal to 275 MPa			Studs with S_y = 720 MPa Bolt stress equal to 360 MPa			Studs with S_y = 655 MPa Bolt Stress equal to 327,5 MPa		
			Tension	Torque	Torque	Tension	Torque	Torque	Tension	Torque	Torque
D		*P*	*F*	*f* =0,07	*f* =0,13	*F*	*f* =0,07	*f* =0,13	*F*	*f* =0,07	*f* =0,13
mm	(in.)	mm	kN	Nm	Nm	kN	Nm	Nm	kN	Nm	Nm
12,70	0.500	1,954	25	36	61	33	48	80	—	—	—
15,88	0.625	2,309	40	70	118	52	92	155	—	—	—
19,05	0.750	2,540	59	122	206	78	160	270	—	—	—
22,23	0.875	2,822	82	193	328	107	253	429	—	—	—
25,40	1.000	3,175	107	288	488	141	376	639	—	—	—
28,58	1.125	3,175	140	413	706	184	540	925	—	—	—
31,75	1.250	3,175	177	569	981	232	745	1285	—	—	—
34,93	1.375	3,175	219	761	1320	286	996	1727	—	—	—
38,10	1.500	3,175	265	991	1727	346	1297	2261	—	—	—
41,28	1.625	3,175	315	1263	2211	412	1653	2894	—	—	—
44,45	1.750	3,175	369	1581	2777	484	2069	3636	—	—	—
47,63	1.875	3,175	428	1947	3433	561	2549	4493	—	—	—
50,80	2.000	3,175	492	2366	4183	644	3097	5476	—	—	—
57,15	2.250	3,175	631	3375	5997	826	4418	7851	—	—	—
63,50	2.500	3,175	788	4635	8271	1032	6068	10828	—	—	—
66,68	2.625	3,175	—	—	—	—	—	—	1040	6394	11429
69,85	2.750	3,175	—	—	—	—	—	—	1146	7354	13168
76,20	3.000	3,175	—	—	—	—	—	—	1375	9555	17156
82,55	3.250	3,175	—	—	—	—	—	—	1624	12154	21878
95,25	3.750	3,175	—	—	—	—	—	—	2185	18685	33766
98,43	3.875	3,175	—	—	—	—	—	—	2338	20620	37293
101,6	4.000	3,175	—	—	—	—	—	—	2496	22683	41057

The tables show material properties equivalent to ASTM A193 / A193M Grades B7 and B7M, which are the most commonly used.

Values of torque for materials having other strength levels may be obtained by multiplying the tabulated torque value by the ratio of the new material's yield strength to the tabulated material's yield strength.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Recommended flange bolt torque

Table D.2 – Recommended torques for flange bolting (USC units)

Stud Dia.	Threads per in.	Studs with S_y = 80 ksi Bolt stress equal to 40 ksi			Studs with S_y = 105 ksi Bolt stress equal to 52,5 ksi			Studs with S_y = 95 ksi Bolt stress equal to 47,5 ksi		
		Tension	Torque	Torque	Tension	Torque	Torque	Tension	Torque	Torque
D	N	F	f=0,07	f=0,13	F	f=0,07	f=0,13	F	f=0,07	f=0,13
in.	1 / in.	lbf	ft-lbf	ft-lbf	lbf	ft-lbf	ft-lbf	lbf	ft-lbf	ft-lbf
0.500	13	5676	27	45	7450	35	59	—	—	—
0.625	11	9040	52	88	11865	68	115	—	—	—
0.750	10	13378	90	153	17559	118	200	—	—	—
0.875	9	18469	143	243	24241	188	319	—	—	—
1.000	8	24230	213	361	31802	279	474	—	—	—
1.125	8	31618	305	523	41499	401	686	—	—	—
1.250	8	39988	421	726	52484	553	953	—	—	—
1.375	8	49340	563	976	64759	739	1281	—	—	—
1.500	8	59674	733	1278	78322	962	1677	—	—	—
1.625	8	70989	934	1635	93173	1226	2146	—	—	—
1.750	8	83286	1169	2054	109313	1534	2696	—	—	—
1.875	8	96565	1140	2539	126741	1890	3332	—	—	—
2.000	8	110825	1750	3094	145458	2297	4061	—	—	—
2.250	8	142292	2496	4436	186758	3276	5822	—	—	—
2.500	8	177685	3429	6118	233212	4500	8030	—	—	—
2.625	8	—	—	—	—	—	—	233765	4716	8430
2.750	8	—	—	—	—	—	—	257694	5424	9712
3.000	8	—	—	—	—	—	—	309050	7047	12654
3.250	8	—	—	—	—	—	—	365070	8965	16136
3.750	8	—	—	—	—	—	—	491099	13782	24905
3.875	8	—	—	—	—	—	—	525521	15208	27506
4.000	8	—	—	—	—	—	—	561108	16730	30282

The tables show material properties equivalent to ASTM A193 / A193M Grades B7 and B7M, which are the most commonly used.

Values of torque for materials having other strength levels may be obtained by multiplying the tabulated torque value by the ratio of the new material's yield strength to the tabulated material's yield strength.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

II. Hydrostatic body pressure test

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Hydrostatic body test pressure

Working pressure rating		End and outlet connections											
		Nominal size of flange *mm* **in.**				Line pipe and tubing threads		Casing threads *mm* **in.**					
		346 **13-5/8** and smaller		*425* **16-3/4** and larger				*114,3 to 273,1* **4-1/2** to **10-3/4**		*298,5 to 339,7* **11-3/4** to **13-3/8**		*406,5 to 508,0* **16** to **20**	
MPa	**psi**	MPa	**psi**	MPa	**psi**	MPa	**psi**	MPa	**psi**	MPa	**psi**	MPa	**psi**
13,8	2,000	27,6	4,000	20,7	3,000	27,6	4,000	27,6	4,000	27,6	4,000	15,5	2,250
20,7	3,000	41,5	6,000	31,0	4,500	41,5	6,000	41,5	6,000	31,0	4,500	—	—
34,5	5,000	51,7	7,500	51,7	7,500	51,7	7,500	51,7	7,500	—	—	—	—
69,0	10,000	103,5	15,000	103,5	15,000	103,5	15,000	—	—	—	—	—	—
103,5	15,000	155,0	22,500	155,0	22,500	—	—	—	—	—	—	—	—
138,0	20,000	207,0	30,000	—	—	—	—	—	—	—	—	—	—

Special considerations

UWS Cross Reference **page 5**

For equipment with end or outlet connections having different working pressures, use the lowest working pressure rating to determine the body test pressure (except for cross-over connectors and chokes).

Cross-over connectors and Chokes

Test a cross-over connector at a test pressure based on the pressure rating for the upper connection. Apply test pressure inside and above the restricted area pack-off of the lower connection. The lower connection shall be tested below the restricted area pack-off to a level based on its pressure rating.

For chokes having an inlet connection with a higher pressure rating than the outlet connection, test the body hydrostatically, from the inlet connection to the body-to-bean seal point of the replaceable seat or flow bean, to the appropriate pressure for the inlet connection.

Chokes

Test the remainder of the body, downstream from the seal point, to the appropriate pressure for the inlet connection. Temporary seat seals may be used to facilitate testing.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

Special considerations	UWS Cross Reference	page 5
Valves and chokes shall be in the partially open position during testing.		Valves and Chokes
Test each bore of multiple-bore equipment individually.		Multi-bore equipment

Acceptance criteria

The equipment shall show no visible leakage under the test pressure.

Leakage by the thread during the hydrostatic testing of a threaded wellhead member when joined with a threaded test fixture is permissible above the working pressure of the thread.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

	UWS Cross Reference page 5
Christmas trees	
The same requirements are applicable as in the special considerations section, except that for trees assembled entirely with equipment that, other than loose connectors, has been previously hydrostatically tested, only testing to rated working pressure is necessary.	Trees as a unit

Test method

Valves	
For bidirectional valves, apply hydrostatic seat test pressure, equal to the rated working pressure, to each side of the gate or plug with the other side open to the atmosphere.	Bi-Directional Valves
For unidirectional valves, apply pressure in the direction indicated on the body, except for check valves, which shall be tested on the downstream side.	Uni-Directional Valves and Check valves
Holding periods for tests shall be a minimum of 3 minutes.	3 minute Test
Reduce the pressure to zero between all holding periods.	Bleed Pressure
Test valves a minimum of two times on each side of the gate or plug.	Repeat Test

Acceptance criteria

No visible leakage shall occur during each holding period.

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

PSL 2 testing	UWS Cross Reference page 5
Drift test requirements for PSL 2 shall be identical to the requirements for PSL 1	Drift test Full bore Valves
Drift test requirements for PSL 2 shall be identical to the requirements for PSL 1	Drift test Christmas trees
Hydrostatic body test requirements for PSL 2 shall be identical to the requirements for PSL 1	Single equipment Units
Hydrostatic body test requirements for PSL 2 shall be identical to the requirements for PSL 1	Christmas trees
Test method	Valves
For hydrostatic seat test requirements for PSL 2, the following shall apply: **1)** Apply the hydrostatic seat test pressure, which is equal to the rated working pressure, to each side of the gate or plug with the other side open to the atmosphere. - Test bidirectional valves in both directions. - Test unidirectional valves in the direction indicated on the body.	Valve seat test
After the pressure has been applied to one side of the gate or plug, hold the pressure and monitor for a minimum of 3 minutes. **2)** Then, open the valve, except for check valves, while under full differential pressure. Repeat the above two steps. Then, pressurize one side of the gate or plug, hold, and monitor a third time for a minimum of three minutes. Next, test bidirectional valves on the other side of the gate or plug using the same procedure outlined above. Split-gate valves may have both seats tested simultaneously.	3 minute Test
Acceptance criteria for the seat test	
Valves shall show no visible leakage during each holding period.	

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*

PSL 3 testing	**UWS Cross Reference**	**page 5**
Drift test requirements for PSL 3 shall be identical to the requirements for PSL 1		Drift test Full bore Valves
Drift test requirements for PSL 3 shall be identical to the requirements for PSL 1		Drift test Christmas trees

Records of pressure tests	**UWS Cross Reference**	**listed on page 7, Routers (all)**
A chart recorder shall be used on all hydrostatic tests. The record shall identify the recording device, it shall be dated and signed.		
Chart recording of gas testing is not required. Records of gas testing shall document test parameters and acceptance.		
If the chart recorder is not qualified as a pressure-measuring device in accordance with PSL 1, it shall be used in parallel with a calibrated pressure-measuring device, and the pressure-measuring device readings at the start and stop of each hold period shall be written on the chart as part of the record.		

Extended pressure tests	**UWS Cross Reference**	**page 5**
Hydrostatic body test requirements for PSL 3 shall be identical to the requirements of PSL 1, with the addition that this hydrostatic body test requires an extension of the secondary pressure-holding period to a minimum of **15 minutes**.		Single equipment Units
Hydrostatic body test requirements for PSL 3 shall be identical to the requirements of PSL 1, with the addition that this hydrostatic body test requires an extension of the secondary pressure-holding period to a minimum of **15 minutes**.		Christmas trees

Ref.: *API 6A, Specification for Wellhead and Christmas Tree Equipment, Annex D (informative)*