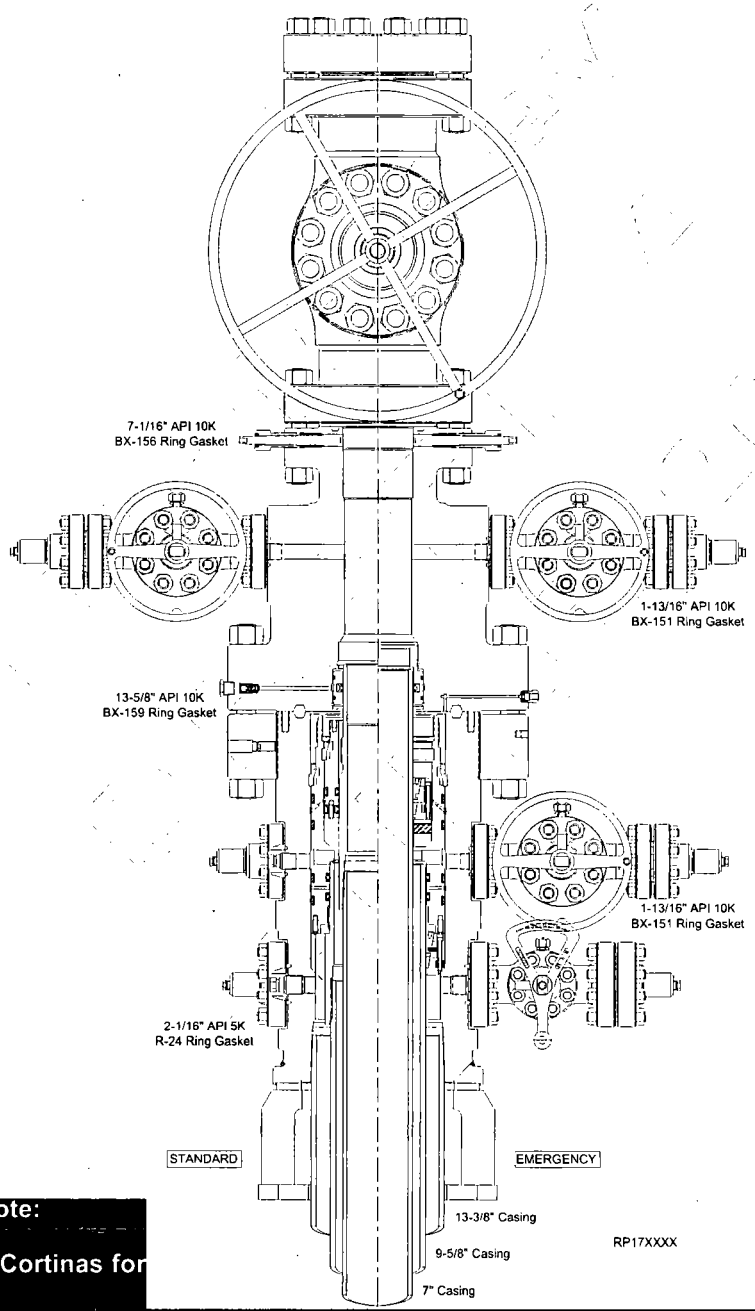
RUNNING PROCEDURE

Mewbourne Oil Co



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Surface Systems Publication

CAMERON A Schlumberger Company	**13-5/8" 10K MN-DS System** **13-3/8" x 9-5/8" x 7" Casing Program**	**RP-003815** **Rev 01 Draft A**

Safety Hazard Indicators

The Safety Hazard Indicators listed below will be used throughout this procedure to indicate potentially hazardous and/or personnel risks that may be encountered during the performance of the tasks outlined in this procedure.

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury
⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
NOTICE	Preferred to address practices not related to personal injury

ES-000175-02

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To confirm the correct version is in use, make sure the revision and release date match those on the controlled version of the document in SAP. Refer to the Document Control page for the document revision history.

NOTE This document alone does not qualify an individual to Install/Run the Equipment. This document is created and provided as a reference for Qualified Cameron Service Personnel and does not cover all scenarios that may occur.

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RUNNING PROCEDURE GENERAL WARNING

READ AND UNDERSTAND ALL INSTRUCTIONS. Failure to follow may result in serious personal injury and damage not only to the equipment but also the environment.

1. Safety is a combination of staying alert, common sense, and experience with the oil field equipment and environment. Read this Running Procedure prior to operating and installing the equipment. Be familiar with the operation terminologies of oil field equipment.
2. This document includes basic installation guidance. **The field service personnel shall be fully trained in all aspects of handling pressure control equipment as well as of the job that they are going to perform.** If any of the procedures and policies listed in this procedure cannot be followed, contact a Cameron Representative for the best course of action.
3. Proper **Personal Protective Equipment (PPE)** shall be utilized according to Company policies. Always use proper tools when servicing the equipment.
4. A **Job Hazard Analysis (JHA)** must be performed prior to beginning any service on a well location. A JHA review meeting will be held with all affected rig personnel PRIOR to the commencement of work to review the results of the JHA, evacuation routes, emergency contacts, etc. All meeting attendees and a Company Representative will sign-off on the JHA to acknowledge this meeting has taken place
5. **Be aware of unexpected circumstances** that may arise when operating or servicing the equipment. Utilize the **Step Back 5X5 Process** in order to assess the hazards posed before, during, and after the servicing of equipment under pressure or with the potential of hazardous chemicals present. Be familiar with the company's and facility's Lockout/Tagout program in order to ensure all sources of energy (i.e. electrical, pneumatic, pressure) are isolated and/or de-energized prior to beginning work.
6. All **governmental or Company safety requirements** shall be met before working on the equipment. **Requirements of fully tested pressure barriers prior to servicing the equipment shall be observed. Cameron recommends that two mechanical pressure barriers is the preferred practice.** Additional precautions should be taken to ensure that the mechanical pressure barriers are functioning correctly prior to any work being carried out on this particular equipment.
7. Always check for any **trapped pressure** before servicing the equipment. All valves downstream of the pressure barriers must be cycled several times to release any trapped pressure.
8. Ensure the chemical and physical properties of the fluid flow product inside the equipment are known. Obtain applicable **Material Safety Data Sheets (MSDS)** for commonly encountered chemicals such as hydrogen sulfide, cements, etc. in order to identify appropriate PPE to use, emergencies, procedures, and methods or exposure control.
9. Always use **correct lifting devices** and follow safety rules in handling heavy products. The actual weight can vary for the system configurations. Never attempt to lift the equipment by hand.
10. Cameron manufactures a variety of oil field equipment with different features and operating requirements. Be certain of the equipment model and refer to the appropriate procedure, before attempting any operation or service on the equipment. **This procedure is to assist field personnel in the operation and installation of the equipment that is listed in this document. Different procedures are available for other oil field products.**

SD-045055-01 Rev 01 - RP General Warning M.Contreras 25/OCT/2010

HSE Hand Safety Rules

1. **No Hands on Loads**
   Select the appropriate device to control the load
2. **Hands on Handles Only**
   Use manufacturers handles or safe alternatives
3. **Permission to Touch**
   Use lifting assistance/technology for loads > 20kg or 44 lbs
4. **Hands Off...Energy On**
   Remove hands from load BEFORE setting in motion
5. **Safe Cargo Handling**
   Use pallets & crates designed to prevent tip over or loss of load
6. **Use the Correct PPE**
   Use the right glove for the job (chemical, hot work, impact, etc.)

HSE VISION: NO ONE GETS HURT; NOTHING GETS HARMED — HEALTH, SAFETY & ENVIRONMENT

HSE Tenets of Operation

Stop Work
Stop work immediately until unsafe behaviors and conditions are addressed.

Leadership & Accountability
Hold each other accountable for working safely and complying with applicable regulations.

Follow Procedures
Maintain all training and follow established HSE policies and practices.

PPE
Always wear the correct Personal Protective Equipment for the task.

Report ALL Incidents
Immediately report incidents, including injuries, illnesses, property damage, near misses, and environmental releases.

Equipment Operations
Always operate equipment and vehicles with safety devices enabled, and never beyond their capabilities, environmental limits, or designed purposes.

HSE Observations
Recognize safe behaviors and conditions, and address those at-risk.

Ask
Ask questions when in doubt, and for assistance when dealing with new or unusual situations.

HSE VISION: NO ONE GETS HURT; NOTHING GETS HARMED — HEALTH, SAFETY & ENVIRONMENT

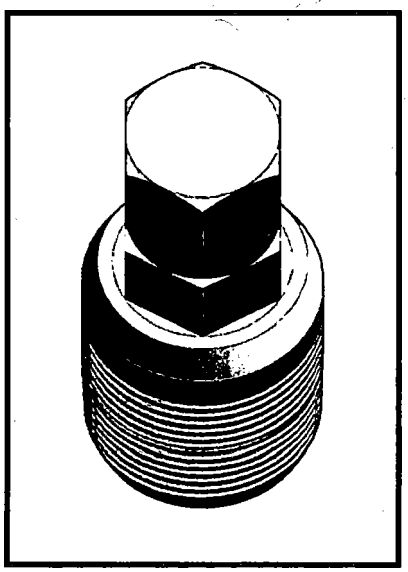
Valve Removal Plugs

STOP

For Installation and Removal of Valve Removal Plugs Refer to:

Publication: RP-001558

(Assembly Procedure for VR Plugs and Recommended Torque Values)

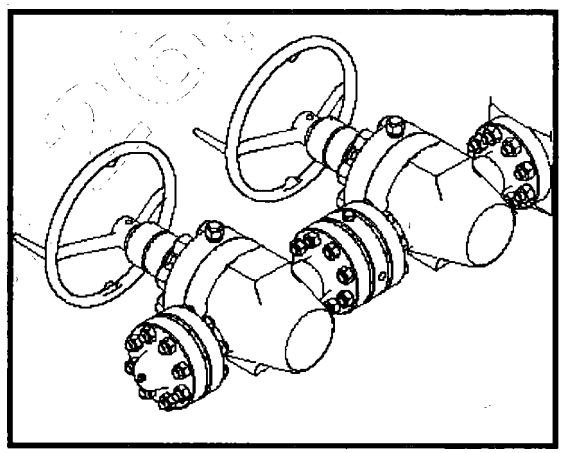


Make-up Requirements for API Flange Connections

STOP

For Make-up Requirements for API Flange Connections Refer to:

Publication: RP-002153



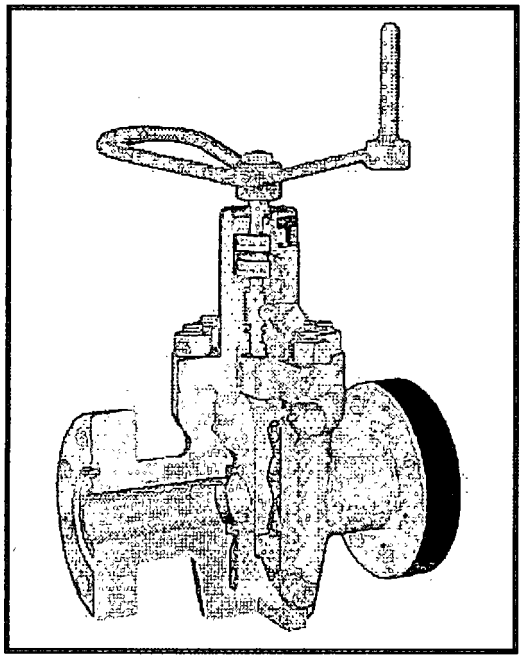
WKM Model M Power R- Seal Gate Valves

STOP

For Operation and Maintenance refer to:

Publication: TC9084-2

(Operation and Maintenance Manual)



TC9084-2

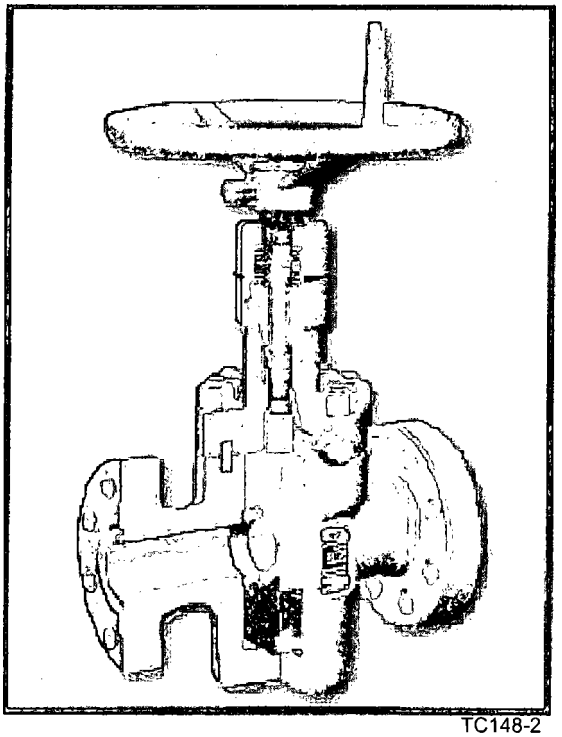
Cameron Type FL & FLS Gate Valves

STOP

For Operation and Maintenance refer to:

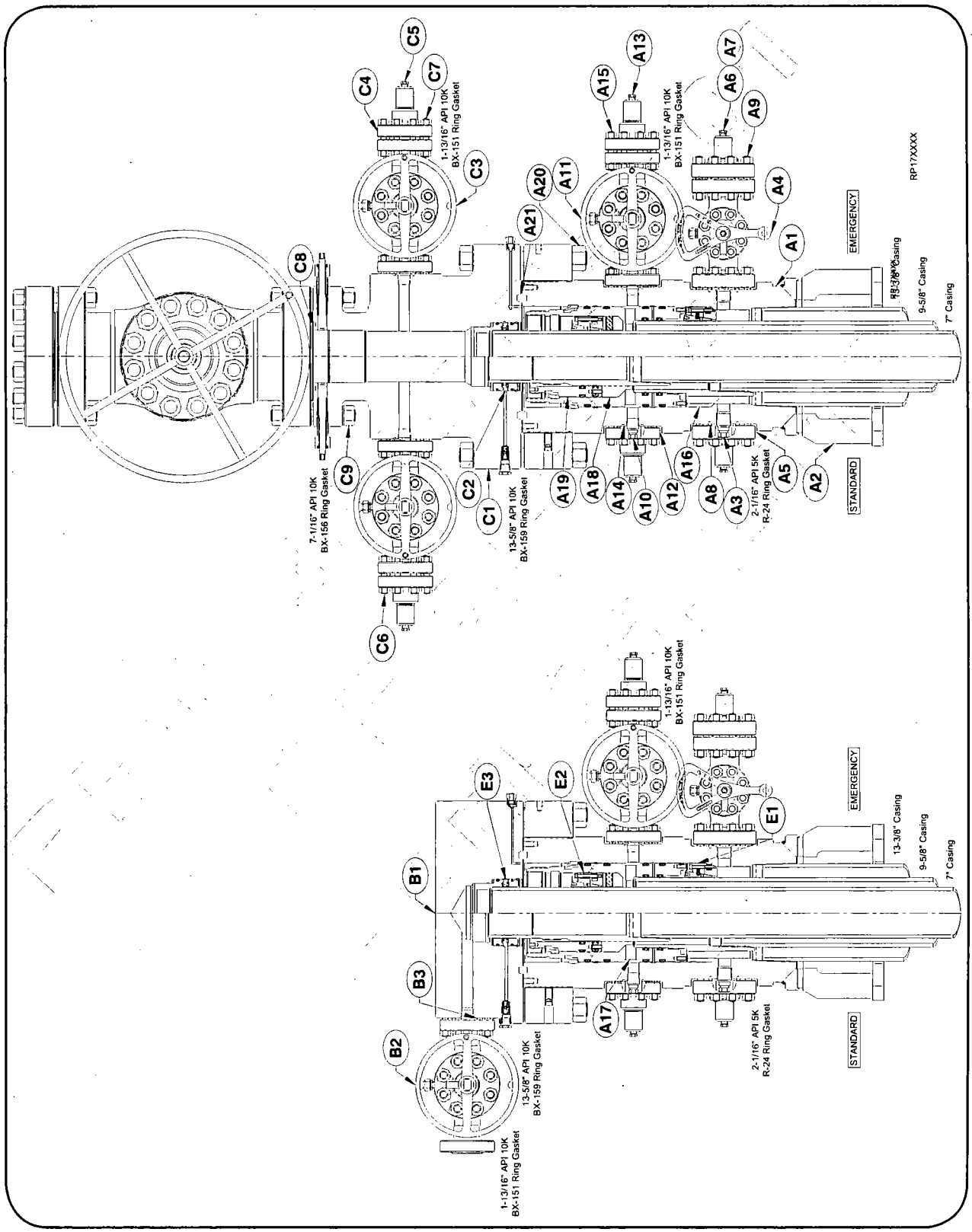
Publication: TC148-2

(FL & FLS Gate Valves Operation and Maintenance Manual)



TC148-2

System Drawing



Bill of Materials

NOTE Contact your Cameron representative for replacement part inquiries. Cameron personnel can check the latest revision of the assembly bill-of-material to obtain the appropriate and current replacement part number.

MN-DS HOUSING

Item	Qty	Description
A1	1	Assy; Casing Head Housing, MN-DS 10K,13-5/8" Nom 10K OEC BX-159 w/ 20.500"-4TPI LH Stub Acme Top f/ Thd'd Flg andPrep f/ Internal Snap Ring x 13-3/8" BC Box Thd Btm, w/ (2) Upper 1-13/16" API 10K BX-151 Outlets w/1-13/16" API VR Thds and(2) Lower 2-1/16" API 5K R-24 Outlets w/ 2-1/16" API VR Thds, w/ 4 Grout Ports, Min Bore: 12.615" Part# 2345472-10-01
A2	1	Assy, Landing Base f/ 'MN-DS' Thd'd Housings 13-5/8" Csg, 24" OD Base Plate w/ 3" Flow-by Slots, 850K Lbs Capacity Part# 2057661-06-01
A3	1	VR Plug 1-1/2" 11-1/2 TPI-3/4 TPF 'Vee' Tubing Thd, 2-1/16" 2K - 10K Part# 2222164-02-01
A4	1	Gate Valve, Manual, Model Aop Distributed, 2-1/16" Bore, 5K Psi, 2-1/16" API Flg x Flg Part# 2737400-01-01
A5	2	Companion Flange, 2-1/16" API 5K x 2" API LP Part# 142362-01-03-02
A6	2	Bull Plug 2" LP w/1/2" NPT x 3-3/4" Lg Part# 007481-01
A7	2	Bleeder Fitting, Plug 1/2" NPT, 10K Psi Max Part# 2738068-02
A8	3	Ring Gasket, R-24 Part# 702001-24-02
A9	8	Stud W /(2) Nuts, 7/8" x 6" Lg Part# Y51201-20220301

MN-DS HOUSING

Item	Qty	Description
A10	1	VR Plug 1-1/4" LP Thd,1-13/16" 2K - 10K Part# 2222164-01-01
A11	1	Gate Valve, Manual, Model FLS, 1-13/16" Bore, 10K Psi,1-13/16" API Flg x Flg Part# 141510-41-91-01
A12	2	Companion Flange, 1-13/16" API 10K w/ 2" API LP, 5K Psi WP Part# 142359-01-03-02
A13	1	Nipple, API 2" LP x 6" Lg Part# 021013-12
A14	3	Ring Gasket, BX-151 Part# 702003-15-12
A15	8	Stud w/ (2) Nuts, 3/4" x 5-1/4" Lg Part# Y51201-20120201
A16	1	Casing Hanger, Mandrel, Type 'MN-DS', 13-5/8" Nom x 9-5/8" API LC Box Thd Btmx 10.000"-4TPI LH Stub Acme Running Thd, Min Bore: 8.835", Max WP: 8K Psi, Max Hanging Load: 800KLbs Part# 2345509-04
A17	1	Assy; Packoff Support Bushing, Type 'MN-DS', 13-5/8" 10K, w/ 13-5/8" Nom Dovetail Seal, and 9-5/8" Nom 'T' Seal and w/ Internal and External-lock Ring Prep, Min Bore: 8.835" Part# 2161673-01-01
A18	1	Mandrel Hanger, Type 'MN-DS', 11" Nom x 7" 29 Lb/Ft API Buttress Thd Btm x 7.500"-4TPI LH Stub Acme Running Thdw/ 7" Nom Slick Neck Top w/ Flow-by Slots, Min Bore: 6.169" Part# 2345649-36-01

MN-DS HOUSING

Item	Qty	Description
A19	1	Assy; Seal Packoff f/ 11" Nom Type 'MN-DS', w/ 9.875"-4TPI LH Stub Acme Thd w/ 7-3/4" Dbl 'T' Seals At ID and Dovetails At OD Part# 2217588-05-03
A20	20	Stud w/ (2) Nuts, 1-7/8" x 17-3/4" Lg Part# 621650-15
A21	1	Ring Gasket, BX-159 Part# 702003-15-92

ABANDONMENT CAP

Item	Qty	Description
B1	1	Assy; Capping Flg, 7-1/16" API 10K BX-156 Std'd Blind Top x 13-5/8" API10K BX-159 Std'd Btm, w/ (1) 1-13/16" API 10K BX-151 SSO, w/ 1-13/16" API VR Thd, w/ 11" 'NX' Btm Prep, Oal: 12" Part# 2392883-03-01
B2	1	Gate Valve, Manual, Model FLS, 1-13/16" Bore, 10K Psi,1-13/16" API Flg x Flg Part# 141510-41-91-01
B3	1	Ring Gasket, BX-151 Part# 702003-15-12

TUBING SPOOL

Item	Qty	Description
C1	1	Assy; Tbg Spl, Type 'C', 13-5/8" API 10K Flg Btm x 7-1/16" API 10K Flg Top, w/ (2) 1-13/16" API 10K SSO's w/ 1-13/16" API VR, w/ Spcl 11" 'NX' Btm Prep Part# 2329584-01-02
C2	1	Assy; 'NX' Bushing Nom 11" w/ 7" OD Csg Part# 608783-17

Bill of Materials

NOTE **Contact your Cameron representative for replacement part inquiries. Cameron personnel can check the latest revision of the assembly bill-of-material to obtain the appropriate and current replacement part number.**

TUBING SPOOL

Item	Qty	Description
C3	2	Gate Valve, Manual, Model FLS, 1-13/16" Bore, 10K Psi, 1-13/16" API Flg x Flg Part# 141510-41-91-01
C4	2	Companion Flange, 1-13/16" API 10K w/ 2" API LP, 5K Psi WP Part# 142359-01-03-02
C5	1	Nipple, API 2" LP x 6" Lg Part# 021013-12
C6	3	Ring Gasket, BX-151 Part# 702003-15-12
C7	16	Stud w/ (2) Nuts, 3/4" x 5-1/4" Lg Part# Y51201-20120201
C8	1	Ring Gasket, BX-156 Part# 702003-15-64
C9	12	Stud w/ (2) Nuts, 1-1/2" x 11-1/4" Lg Part# 621650-07

EMERGENCY EQUIPMENT

Item	Qty	Description
E1	1	Assy; Type MN-DS-IC-1, Casing Slip, 13-5/8" Nom x 9-5/8" Csg, w/ Holes f/ Anti-Rotation Pins Part# 2161741-08-01
E2	1	Casing Hanger, IC-2, 11" x 7" Part# Y15001-21303801
E3	1	Assy; 'NX' Bushing, 11" Nom x 7" Csg w/ Integral Bit Guide Part# 2161829-01-01

SERVICE TOOLS

Item	Qty	Description
ST1	1	Conversion Assy; Casing Head Torque Tool, f/ 'Mn-Ds' w/ Lift Plate, 13-3/8" API 8Rnd Short Thd Casing Box Thd Top x .750"-10Unc (16) Bolt Pattern Btm (8) Torque Pins, Min Bore: 12.605" Safe Hanging Load: 290K Lbf Max Rated Torque: 20K Lbf-Ft Max Rated Pressure: 3K Psi Part# 2143701-75
ST2	1	Assy; Test Plug, Type 'C', 13-5/8" Nom f/ Use In Cactus Head w/ 'WQ' Seal 4-1/2" IF Box X 4-1/2" IF Pin Btm, w/ Weep Hole On Top Portion Of Test Plug Part# 2247044-01-01
ST3	1	Running Tool, 13-5/8" Nom, w/ Dbl Lead Pin Thd Btm x 4-1/2" IF Box Thd Top, w/ 6-1/2" OD Ext'D Neck Part# 608536-19
ST4	1	Assy; Wear Bushing, f/ 13-5/8" Nom MN-DS, w/ 4 O-Rings f/ Use w/ Thd'D Running Tool, Min Bore: 12.615" Part# 2394103-01-01
ST5	1	Assy; Running Tool, 13-5/8" Nom, w/ 9-5/8" API 8Rd LC Box Thd Top x 10.000"-4TPI LH Stub Acme Running Thd Btm, w/ Single O-Ring and (3) Centralizing Ribs, Min Bore: 8.73" Part# 2161757-69-01
ST6	1	Assy; Jetting Tool, 13-5/8" Nom Compact Housing, Type 'SSMC' Part# 2125914-01

SERVICE TOOLS

Item	Qty	Description
ST7	1	Running Tool, Type 'MN-DS' f/ 13-5/8" Nom Packoff Support Bushing w/ 4-1/2" API IF Thd Top x 4-1/2" API IF Thd Btm and 12.375" 4-TPI LH Stub Acme Thd, Working Load: 275K Lbf Part# 2017712-10-01
ST8	1	Assy; Test Plug, Type 'IC', 11" Nom, 4-1/2" IF Box Top x Pin Btm, w/ Weep Hole On Top Portion of Test Plug, w/ (2) Dovetail Seal Grooves Part# 2247042-10-01
ST9	1	Tool f/ Running & Retrieving Wear Bushing 11" Nom x 4-1/2" API IF Thd w/ Dbl Lead Thd Part# 661822-06
ST10	1	Assy; Wear Bushing, f/ 11" Nom Type 'MN-DS', Dbl Lead Thd, Min Bore: 8.910" Part# 2125720-10-01
ST11	1	Assy; Running Tool f/ Fluted Mandrel Hanger, 'MN-DS', 11" Nom x 7.500"-4 TPI LH Stub Acme Thd Btm x 7" API Buttress Box Thd Top, Min Bore: 6.66", Max Lifting Load Capacity: 500K Lbs Part# 2161757-87-01
ST12	1	Assy; Weldment, Wash-Tool, 11" Nom x 23.00" Lgw/ NC50 (4-1/2" If) Box Thd Top Part# 2017726-05-01
ST13	1	Running Tool, f/ 11" Nom Seal Assembly w/ 4-1/2" API IF Thd Top x 2-7/8" API IF Thd Btm and 9.875"-4TPI LH Stub Acme Thd, Oal: 21.60" Part# 2017712-07-01

Bill of Materials

NOTE **Contact your Cameron representative for replacement part inquiries. Cameron personnel can check the latest revision of the assembly bill-of-material to obtain the appropriate and current replacement part number.**

MN-DS HOUSING

Item	Qty	Description
ST14	1	Lockring Installation Tool Part# 2360305-48
ST15	1	Assy; 13-5/8" Nom Combo Tool, Running & Testing, 3-1/2" IF API Box Thd Top & Btm w/ 2.485" OD 4-TPI LH Type 'H' BPV Thd Part# 2247068-03-01
ST16	1	Assy; 13-5/8" Nom MN-DS Bit Guide, f/ 7" Csg w/ (4) Communication/ Weep Holes, (4) Welded Stop Lugs, Min Bore: 6.34" Part# 2254334-06

Stage 1.0 — 13-3/8" Casing

SAFETY NOTE: Always wear proper PPE (Personal Protective Equipment) such as safety shoes, safety glasses, hard hat, gloves, etc. to handle and install equipment.

⚠ CAUTION Threaded Devices should *NEVER* be routinely tightened under pressure. This includes: Flange Bolting, Pipe Plugs, Bull Plugs, Union Nuts, Tiedown/Lockscrew Glands.

⚠ CAUTION Use of Teflon tape is prohibited. Use appropriate thread compound/sealant only. TS-73; PN: 687950-38-31-26, TF-15; PN: 687950-39-31-26, Liquid O-Ring 104G or any other thread sealant approved by Cameron Engineering.

1.1. Install the Casing Head Housing

1.1.1. Run the 13-3/8" casing and space out as required. Retrieve the landing joint.

NOTE Lift plate, Running Tool, Landing Joint, Casing Head Housing, and Lower Pup Joint (Steps 1.1.2. - 1.1.9.) will be made up offline and shipped to location as one assembly.

OFFLINE

1.1.2. Examine the ***MN-DS Housing (Item A1).*** Verify the following:

- bore is clean and free of debris
- ring groove and seal areas are clean and undamaged
- all threads are clean and undamaged
- pup joint and all outlet equipment are properly installed, clean and undamaged
- outlet equipment removed and flush plugs are installed
- ***Landing Base (Item A2)*** is properly installed, clean and undamaged

1.1.3. Orient the assembly as illustrated on page 14.

1.1.4. Examine the ***Casing Head Torque Tool assembly (Item ST1).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- o-rings are properly installed, clean and undamaged
- all torque pins are properly installed, retracted, clean and undamaged

1.1.5. Make up a landing joint to the top of the Torque Tool assembly.

NOTE Landing joint may be made up to the Running Tool in advance.

1.1.6. Lubricate the o-rings of the Lift Plate and the ID of the Housing with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

1.1.7. Lift and suspend the Torque Tool assembly over the Housing.

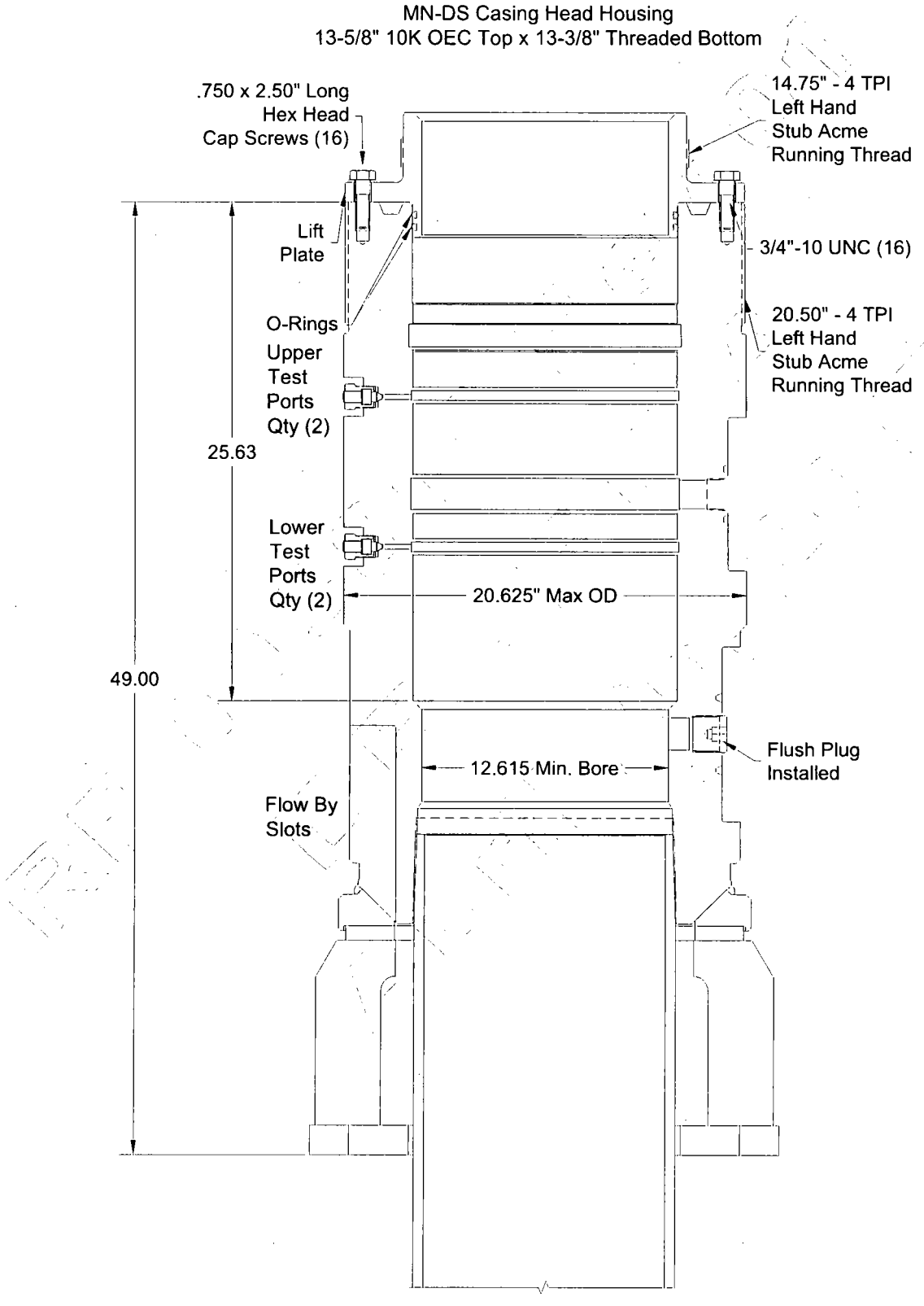
1.1.8. Lower the Torque Tool assembly into the Housing and align the capscrew holes on the Lift Plate and the threaded holes on the Housing.

1.1.9. Run in all (16) capscrews to a positive stop to hold the Torque Tool assembly and the Housing together.

NOTE Capscrews will be made up and torqued offline per API 6A (referenced in the torque chart at the back of this manual).

OFFLINE

Stage 1.0 — 13-3/8" Casing



Stage 1.0 — 13-3/8" Casing

1.1.10. Carefully lower the Housing assembly until the mating threads of the 13-3/8" casing and the pin threads of the pup joint make contact. Make up the connection to the thread manufacturer's recommended optimum torque.

NOTE Max torque 20,000 ft/lbs.

1.1.11. Pick up and release Casing from floor slips. Turn and orient outlets as required.

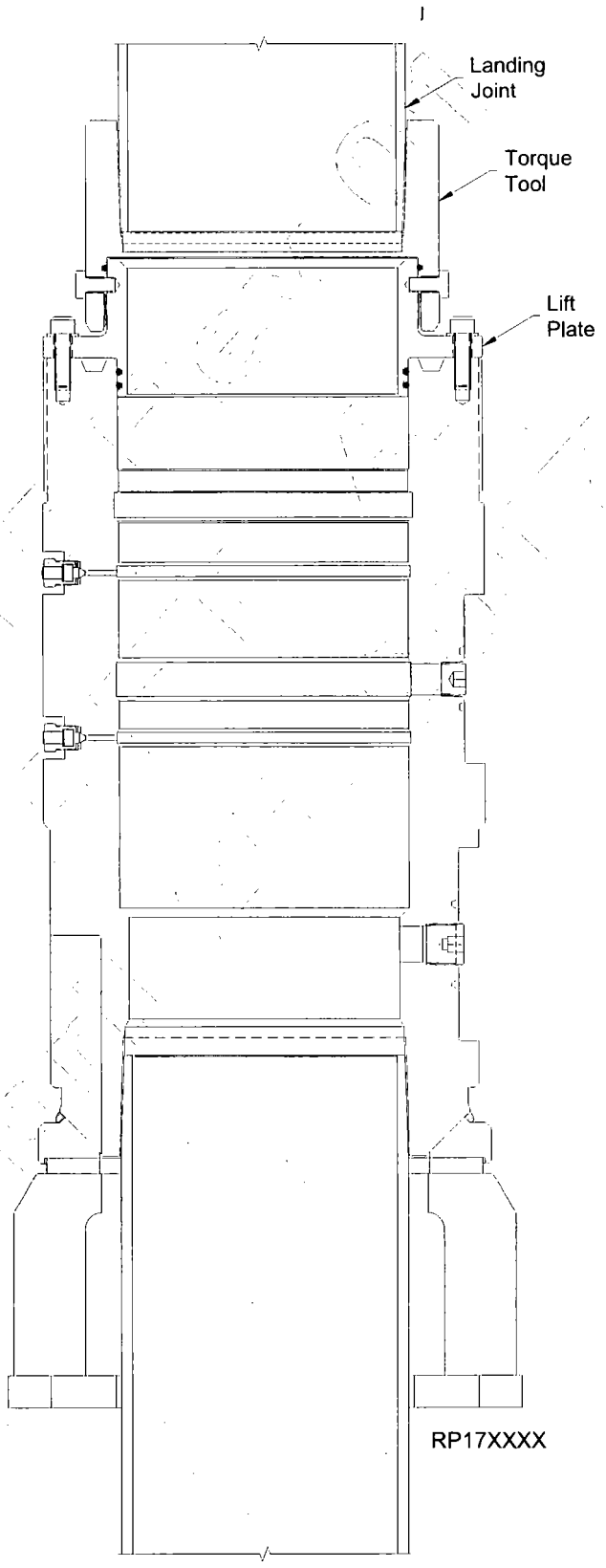
1.1.12. Carefully lower the Housing assembly and land as required.

1.1.13. Rig should chain down landing joint during cement to prevent the Housing from rising during the cement operations.

NOTE Make sure landing joint remains level after it is chained down.

1.1.14. With the Housing properly landed and oriented, cement the casing as required.

NOTE Cement returns may be taken through the Flow-by Slots of the Housing.



Stage 1.0 — 13-3/8" Casing

1.1.15. With cementing complete, remove the Torque Tool assembly from the top of the Housing by removing the capscrews and washers of the Lift Plate and lifting straight up.

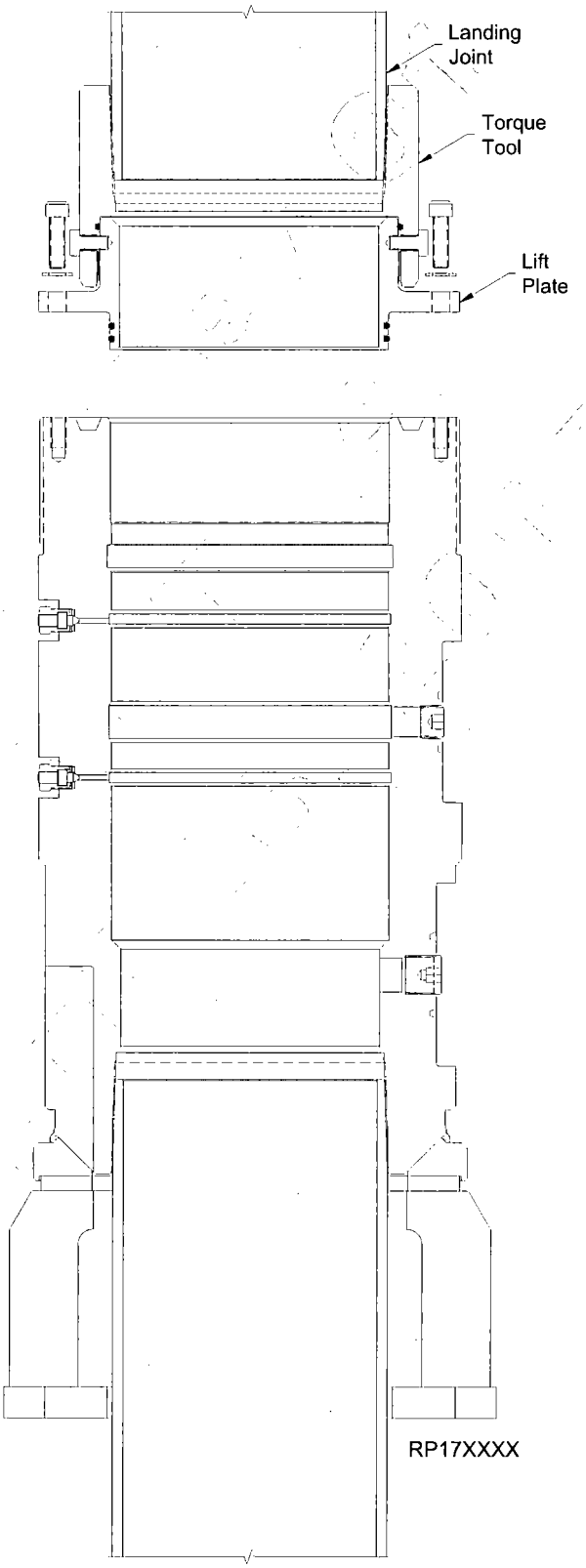
1.1.16. Retrieve the Torque Tool assembly to the rig floor.

1.1.17. Remove all (8) Torque Pins from the Torque Tool.

1.1.18. Turn the landing joint clockwise to remove the Torque Tool from the Lift Plate, approximately 6-1/2 to 7 turns.

NOTE: Running Tool may be made up to landing joint permanently.

1.1.19. Clean, grease and store the Lift Plate and Torque Tool as required.



Stage 1.0 — 13-3/8" Casing

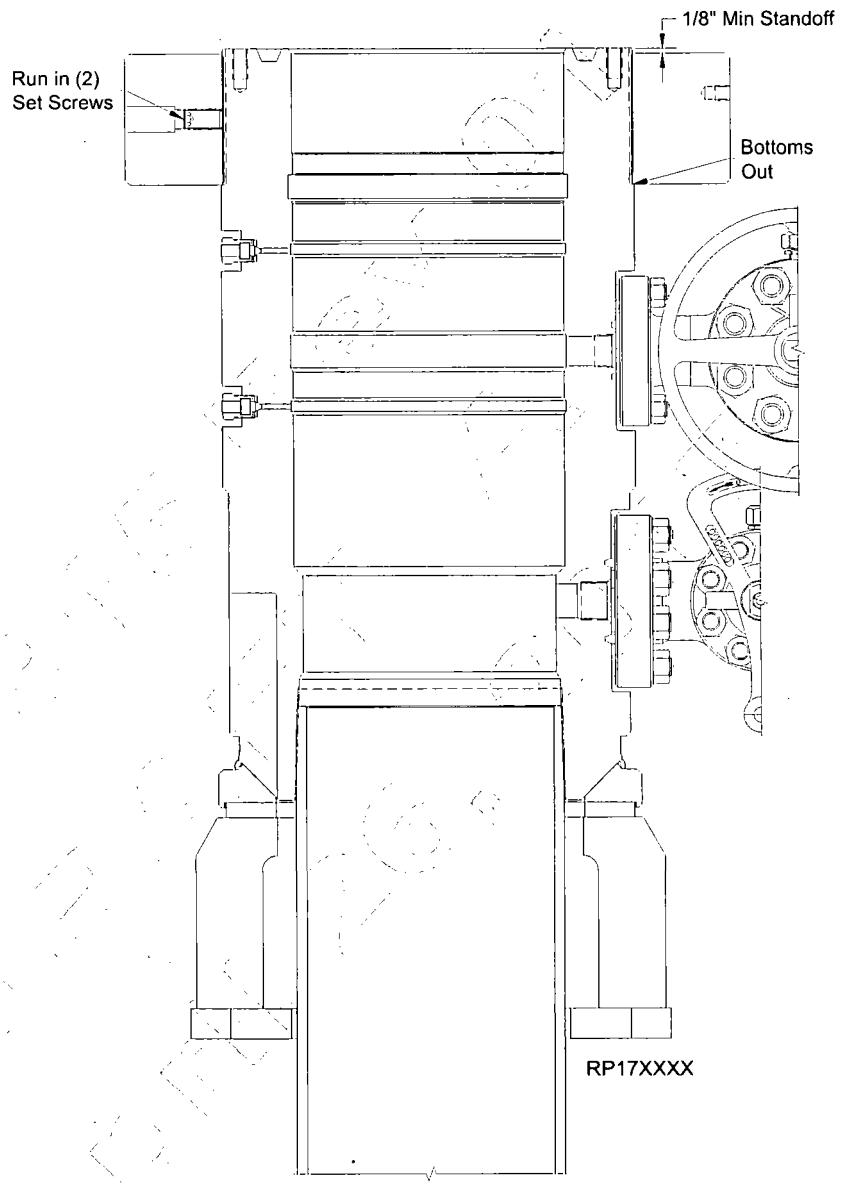
1.1.20. Install the Threaded Flange to the top of the Casing Head Housing.

⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.



1.1.21. Remove Flush Plugs and install upper and lower Housing outlet equipment.

1.1.22. Install VR Plugs, and test the outlet valves to:

- Lower Valves to 5,000 psi
- Upper Valves to 10,000 psi

1.1.23. Remove VR Plugs, and close Upper and Lower outlet valves.

Stage 2.0 — 9-5/8" Casing

2.1. Test the BOP Stack

NOTE Immediately after making up the BOP Stack and periodically during the drilling of the hole for the next casing string, the BOP Stack (connections and rams) must be tested.

WARNING Previously used BOP Test Plug must be inspected for damage due to wear. Where warranted such as highly deviated wells the Test Plug must be checked periodically to insure integrity.

2.1.1. Make up the BOP Stack using a spare ***BX-159 ring gasket.***

⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counter-clockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.

2.1.2. Examine the ***Test Plug (Item ST2).*** Verify the following:

- seal is in place and undamaged
- 1/2" pipe plug is installed, if required
- all threads are clean and undamaged

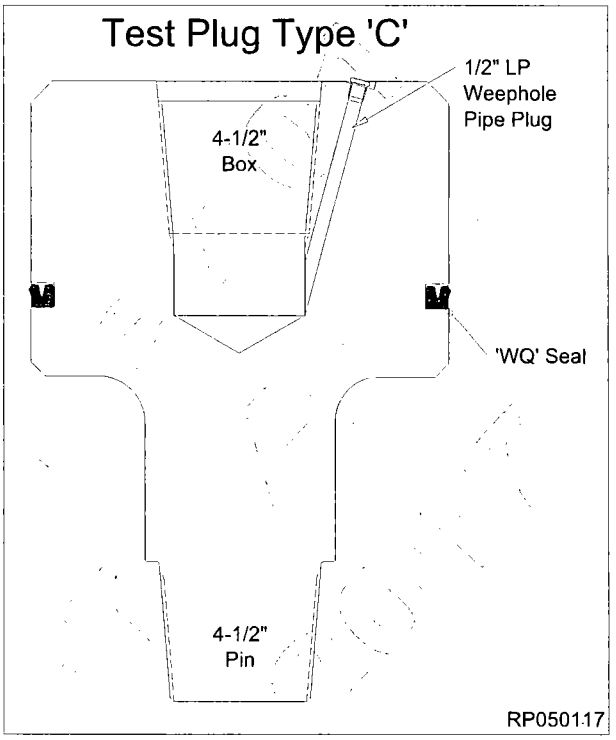
2.1.3. Orient the Tool as illustrated.

2.1.4. Make up a joint of drill pipe to the top of the Tool.

WARNING A minimum of one joint of Drill Pipe is required on the bottom of the BOP Test Plug to ensure BOP Test plug remains centralized.

2.1.5. Lubricate the seal of the Tool with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.



Stage 2.0 — 9-5/8" Casing

2.1.6. Open the lowermost annulus valve of the Housing and drain fluid to land the Test Plug. Leave valve open.

2.1.7. Slowly lower the Tool through the BOP Stack, measure and record, until it lands on the load shoulder in the Housing.

NOTE Distance from the Housing load shoulder to the face of the BOP flange is 25.63".

2.1.8. Close the BOP rams on the drill pipe and test to ***10,000 psi maximum***.

2.1.9. Monitor the annulus valve for signs of pressure.

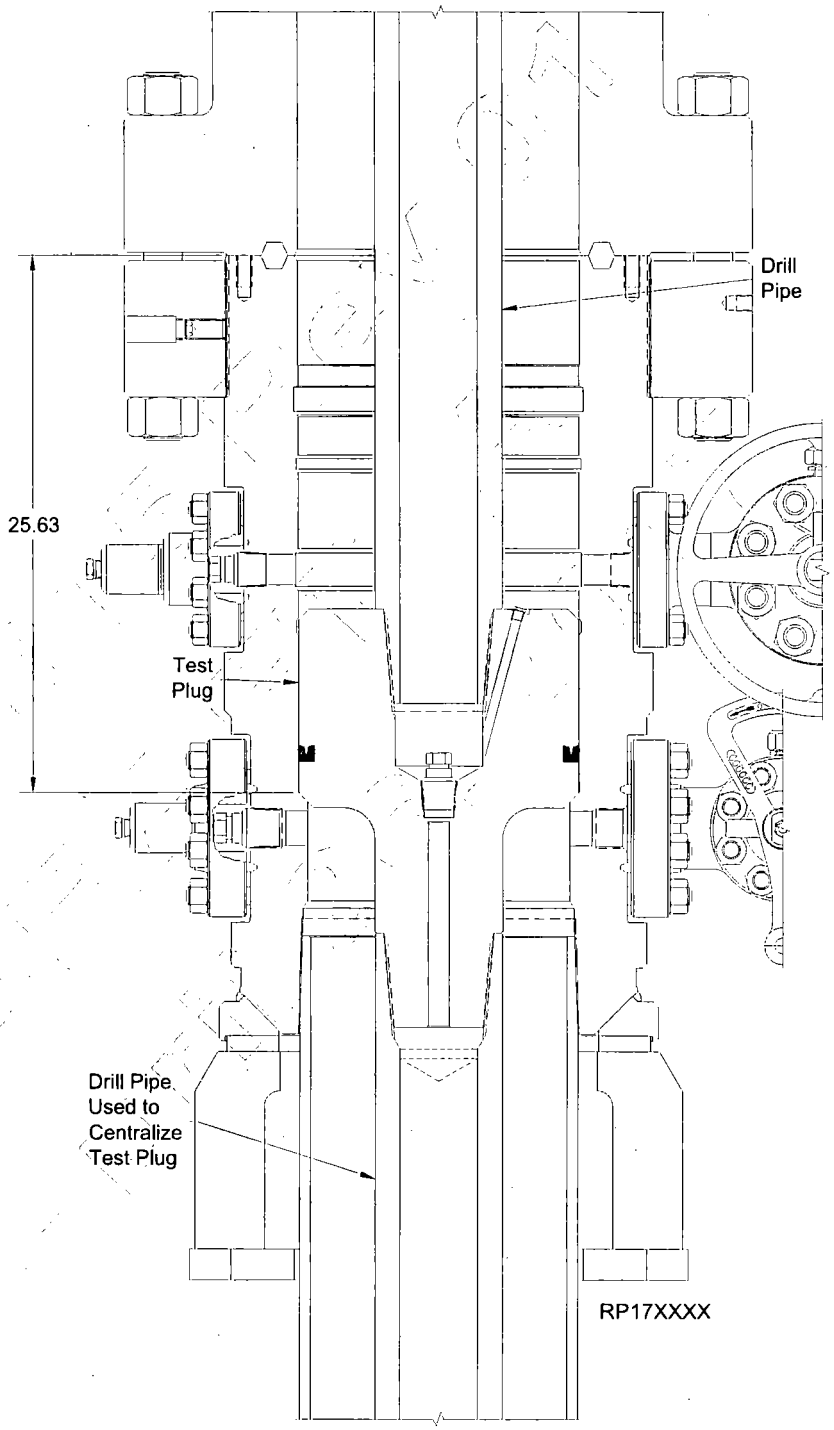
2.1.10. After a satisfactory test is achieved, release pressure, close the annulus valve and open the rams.

2.1.11. Remove as much fluid from the BOP as possible.

2.1.12. Retrieve the Test Plug slowly to avoid damage to the seal.

NOTE It may be necessary to open the annulus valve when starting to retrieve the Test Plug to relieve any vacuum that may occur. Leaving annulus valve open during testing insures safety of surface casing.

2.1.13. Close lower annulus valve.



Stage 2.0 — 9-5/8" Casing

NOTE Always use a Wear Bushing while drilling to protect the load shoulder from damage by the drill bit or rotating drill pipe. The Wear Bushing must be retrieved prior to running the casing.

WARNING Previously used Wear Bushings must be inspected for damage and significant reduction in wall thickness due to wear. Where warranted such as highly deviated wells the Wear Bushing must be checked periodically to insure integrity.

2.2. Run the Wear Bushing Before Drilling

2.2.1. Examine the ***Wear Bushing Running Tool (Item ST3).*** Verify the following:

- all threads are clean and undamaged
- bore is clean and free of debris
- pup joint is properly installed for tonging

2.2.2. Orient the Tool as illustrated.

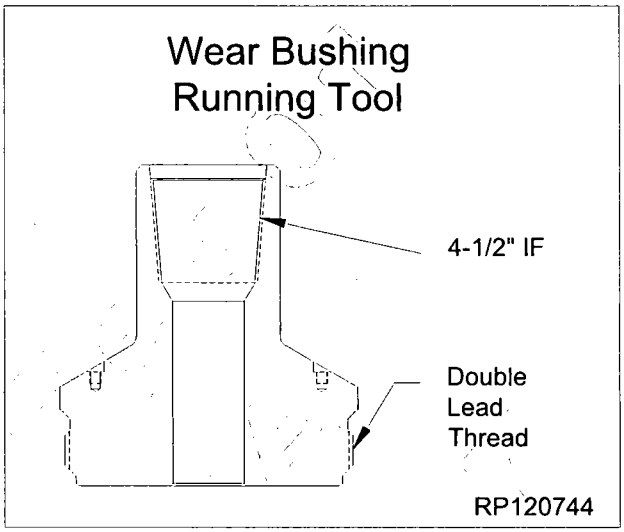
2.2.3. Examine the ***Wear Bushing (Item ST4).*** Verify the following:

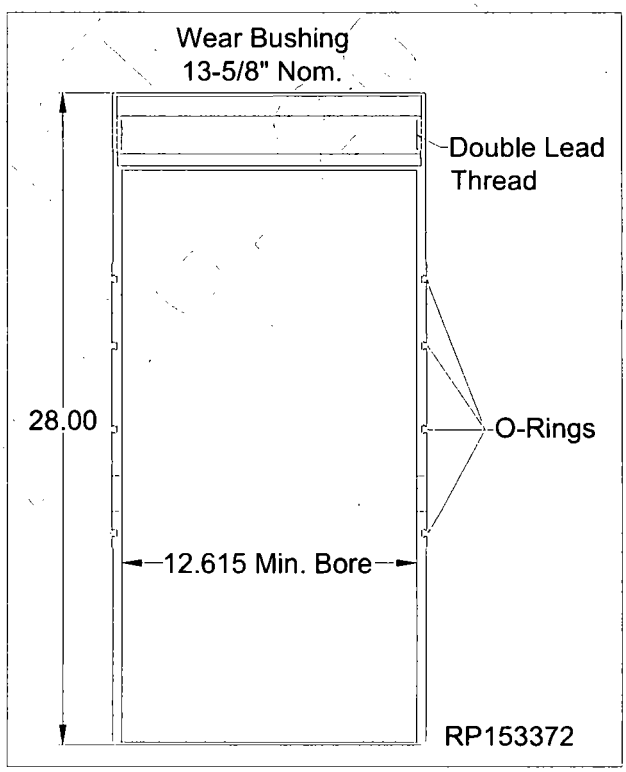
- bore is clean and free of debris
- threads are clean and free of debris
- o-ring seals are in place, clean and undamaged

2.2.4. Orient the Wear Bushing as illustrated.

WARNING Do NOT cut o-rings.

CAUTION This Wear Bushing has no mechanical retention device. Care must be exercised when tripping out the hole to avoid dislodging the Wear Bushing which could compromise safety if it becomes lodged in the BOP.





Stage 2.0 — 9-5/8" Casing

2.2.5. Lubricate the o-ring seals of the Wear Bushing with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

2.2.6. Make up a joint of drill pipe to the top of the Tool.

2.2.7. Lower the Tool into the Wear Bushing and turn the drill pipe counterclockwise until thread 'jump' can be felt, then clockwise to a positive stop to thread the Tool into the Wear Bushing.

WARNING Do NOT overtighten the Tool/ Wear Bushing connection.

2.2.8. Carefully lower the Tool/ Wear Bushing assembly through the BOP, measure and record, until it lands on the load shoulder of the Housing.

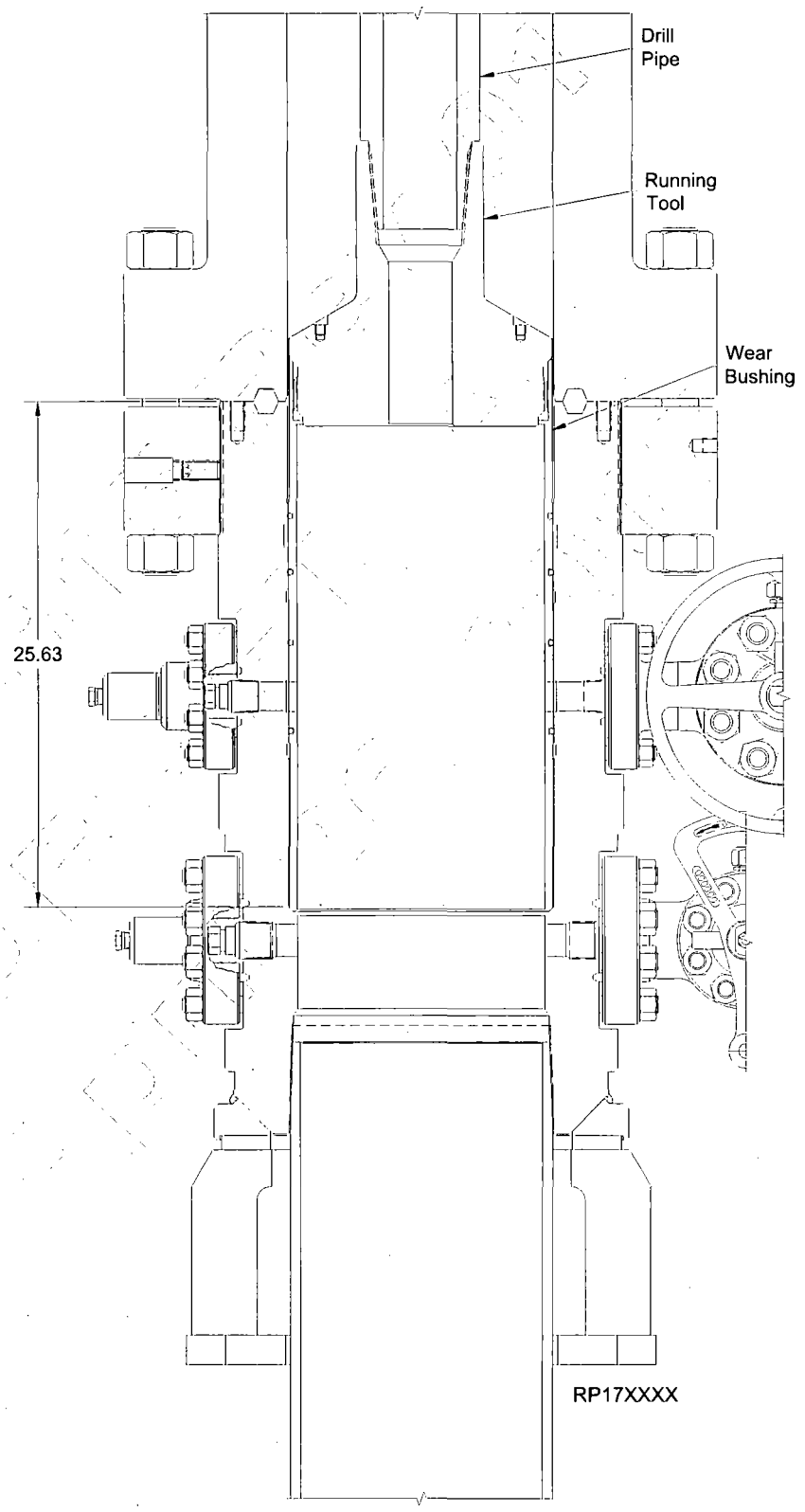
NOTE Distance from the Housing load shoulder to the face of the BOP flange is 25.63".

2.2.9. Disengage the Tool from the Wear Bushing by turning the drill pipe counterclockwise and lifting straight up.

2.2.10. Remove the Tool from the drill string.

2.2.11. Clean, grease, and store the Tool as required.

2.2.12. Drill as required.



2.3. Retrieve the Wear Bushing After Drilling

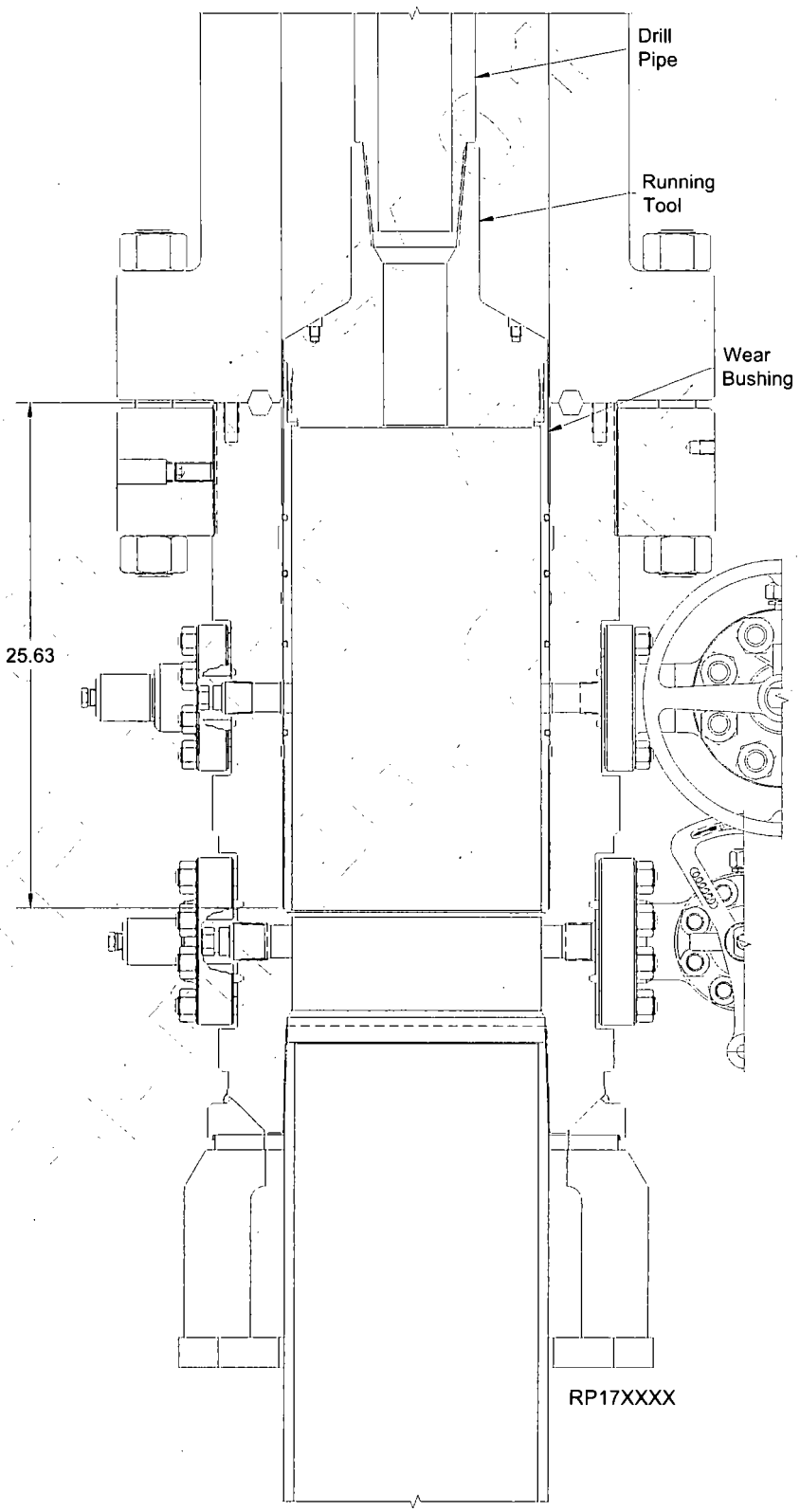
2.3.1. Make up the Tool to the drill pipe with the threads down.

2.3.2. Slowly lower the Tool into the Wear Bushing.

2.3.3. Turn the Tool counter clockwise until thread jump can be felt. Slack off all weight to make sure the Tool is down. Then turn clockwise to a positive stop.

2.3.4. Slowly retrieve the Wear Bushing to the rig floor and remove it and the Tool from the drill string.

2.3.5. Clean, grease and store the Tool and Wear Bushing as required.



Landing of Mandrel Hangers

Cameron service personnel must verify that the mandrel hanger is landed properly on the load shoulder in the wellhead. This can be accomplished by one of three methods.

- Visually observe the scribe line mark around mandrel hanger running tool through upper side outlet valve.
- Conduct a dry run and mark the dedicated landing joint prior to running the casing or tubing.
- Calculate the distance from the rig floor to the landing shoulder and confirm that the hanger has traveled the required distance.

2.4. Hang Off the Casing

NOTE In the event the 9-5/8" casing should become stuck, and the Mandrel Hanger is unable to be used, refer to Section 2.5.

2.4.1. Run the 9-5/8" casing and space out appropriately.

2.4.2. Hang off the last joint of casing to be run in the floor slips at height that will enable easy handling and make up of the Hanger and landing joint.

2.4.3. Examine the ***Casing Hanger Running Tool (Item ST5).*** Verify the following:

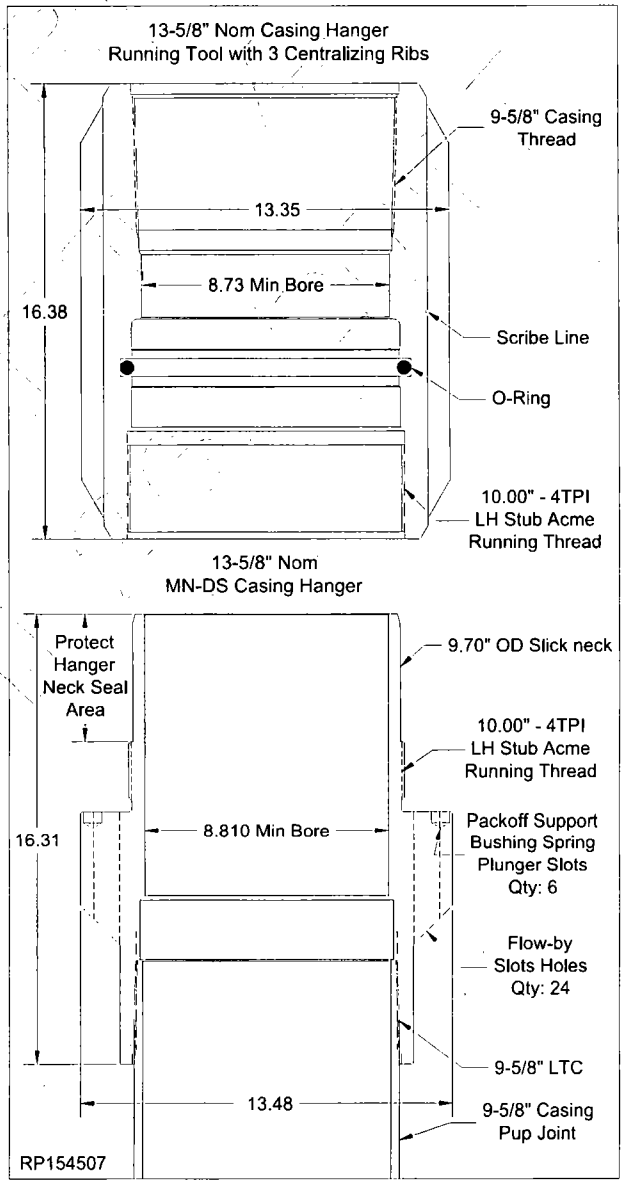
- bore is clean and free of debris
- all threads are clean and undamaged
- internal seal is properly installed, clean and undamaged
- scribe line is properly identified with paint as required

2.4.4. Orient the Tool as illustrated.

2.4.5. Examine the ***Casing Hanger (Item A16).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- neck seal area is clean and undamaged
- casing pup joint is properly installed
- flow-by slots are clean and free of debris

2.4.6. Orient the Hanger as illustrated.



Stage 2.0 — 9-5/8" Casing

2.4.7. Make up a landing joint to the top of the Running Tool.

2.4.8. Lubricate the running threads of both the Tool and the Hanger and the seal of the Tool with a light coat of oil or grease.

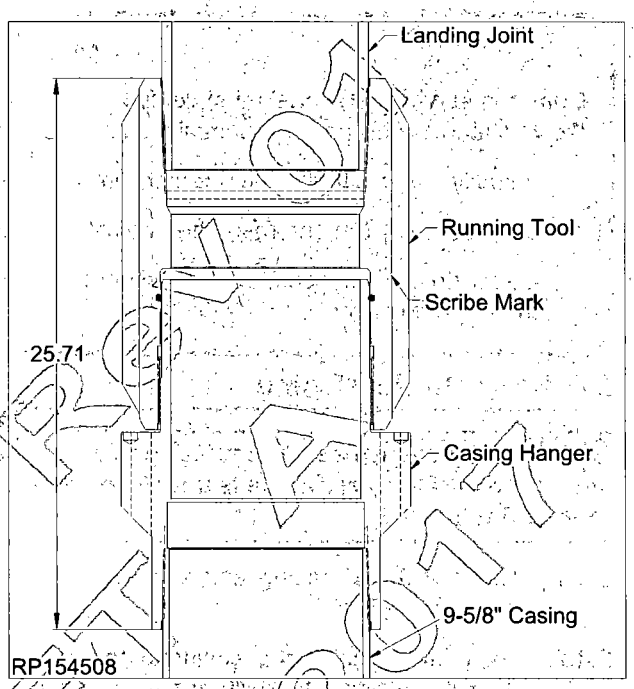
WARNING Excessive oil or grease may prevent a positive seal from forming.

2.4.9. Lift and suspend the Tool over the Hanger.

2.4.10. Lower the Tool onto the Hanger until the mating threads make contact.

2.4.11. While balancing the weight, turn the Tool clockwise until the thread 'jump' can be felt then counterclockwise to a positive stop. Approximately 8-1/2 turns.

WARNING Do NOT torque the connection.



⚠ CAUTION

Do not use Top Drive to engage/ disengage the Running Tool. Using Top Drive will permanently damage the equipment running threads and will require damaged part to be replaced.

2.4.12. Back the Tool off 1/2 a turn clockwise to keep the threads from binding up.

2.4.13. Lift the Hanger above the casing hung off in the floor.

2.4.14. Lower the Hanger assembly until the mating threads of the casing and the pin threads of the pup joint make contact.

NOTE: When making up the Hanger to the casing do not use the seal neck area for back up.

2.4.15. While balancing the weight, turn the Hanger assembly counterclockwise until the thread 'jump' can be felt then clockwise to the thread manufacturer's recommended optimum torque.

Stage 2.0 — 9-5/8" Casing

2.4.16. Open the lowermost side outlet valve of the Housing.

2.4.17. Release the casing from the floor slips and lower it into the well, measure and record, until the Hanger lands on the load shoulder in the Housing.

NOTE Distance from the Housing load shoulder to the face of the BOP flange is 25.63".

2.4.18. Ensure Hanger is centered in well bore.

2.4.19. Slack off all weight on the casing.

2.4.20. Verify through the open outlet on the MN-DS Housing that the Hanger has landed properly. Ensure the scribe line on the Tool is in the middle of the uppermost outlet of the MN-DS Housing.

2.4.21. Cement as required.

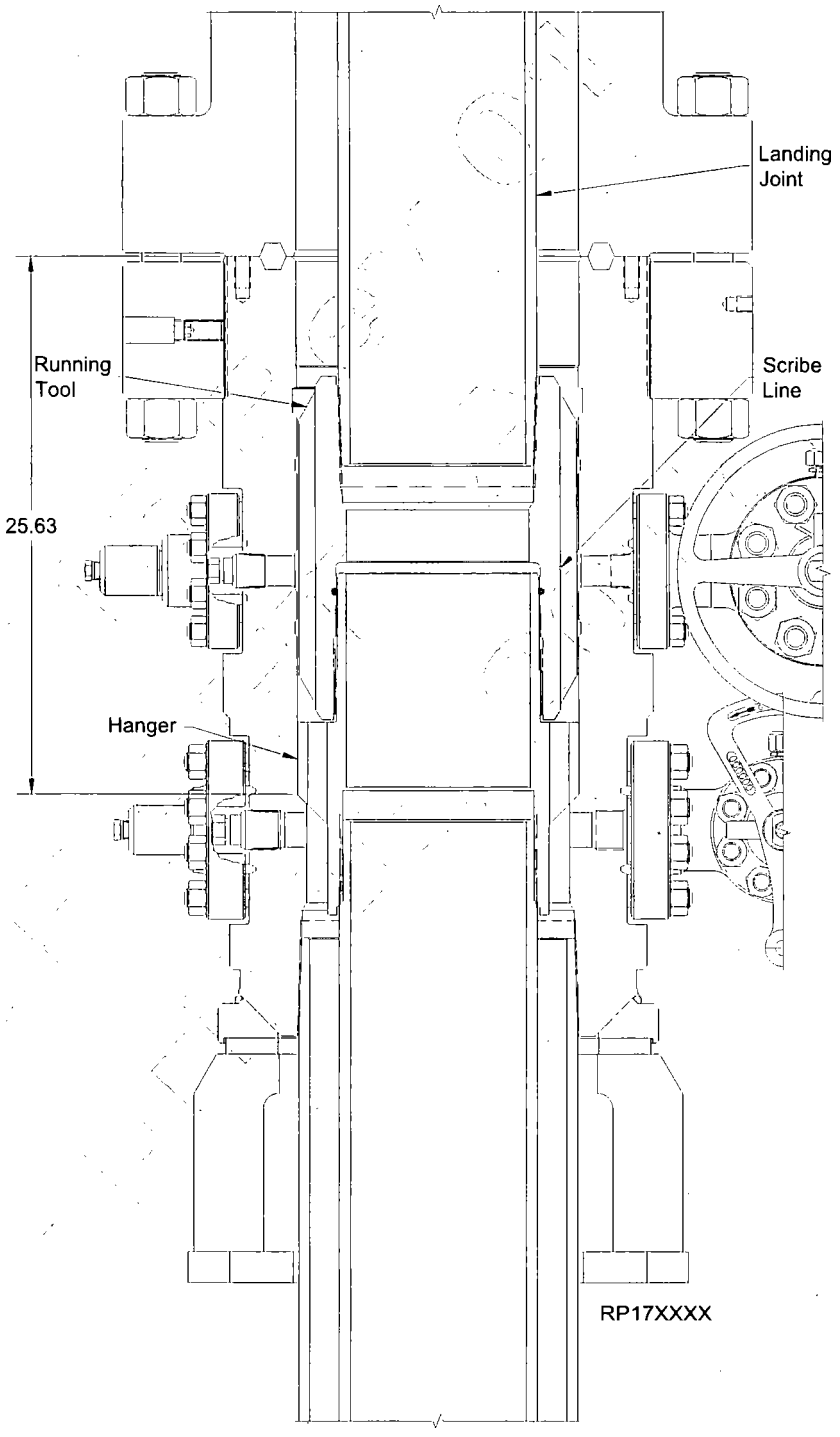
NOTE Cement returns may be taken through the flow-by slots of the Hanger and out of the BOP Stack.

2.4.22. With cementing completed, turn the landing joint clockwise 8-1/2 turns to release the Tool from the Hanger.

NOTE Only use chain tongs to turn the landing joint. Do NOT use top drive or CRT as this will damage the Hanger and Tool threads.

2.4.23. Retrieve the Tool to the rig floor.

2.4.24. Clean, grease and store the Tool as required.



Stage 2.0 — 9-5/8" Casing

SAFETY NOTE: Always wear proper PPE (Personal Protective Equipment) such as safety shoes, safety glasses, hard hat, gloves, etc. to handle and install equipment.

NOTE

1. **Reconfirm the Casing OD and grade. Remove and clean loose scale from Casing OD.**
2. **Verify Slip Bowl taper is smooth, clean with no corrosion and damage free.**
3. **Disassembly of the Hanger to re-orient the slips is not required.**

2.5. Hang Off the Casing (Emergency)

NOTE The following procedure should be followed ONLY if the casing should become stuck. If the Mandrel Casing Hanger was used, skip this stage.

2.5.1. Run the Casing and cement as required.

NOTE Ensure that the Casing is centralized. Hanger clearances are small and centering must be accurate.

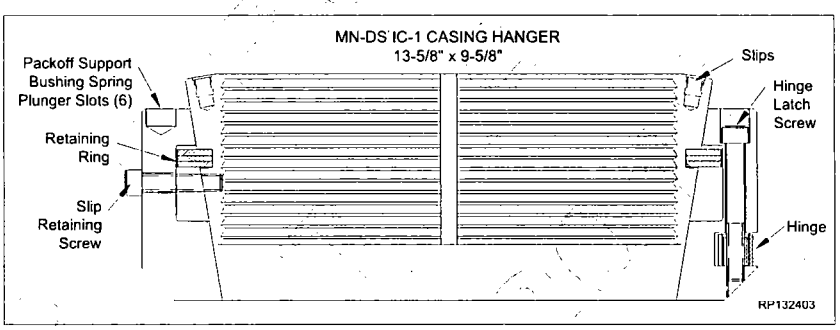
2.5.2. Drain the BOP and Housing bowl through the lowermost valve of the Housing. Leave the valve open until the Casing Hanger is set.

2.5.3. Ensure the well is safe and under control.

NOTE Ensure hang off weight desired is picked up before installing slips around casing.

2.5.4. Separate the BOP Stack from Housing and suspend it above the Housing high enough to facilitate installation of the Slip Casing Hanger.

2.5.5. Washout as required.



2.5.6. Examine the ***MN-DS-IC-1 Slip Type Casing Hanger (Item E1).*** Verify the following:

- segments are clean, undamaged and secure
- all screws are in place and snug

Stage 2.0 — 9-5/8" Casing

2.5.7. Remove the latch screw and separate the Hanger halves.

2.5.8. Place a slip plate on the Housing flange against the casing to support the Hanger.

2.5.9. Ensure the casing is centered in well bore.

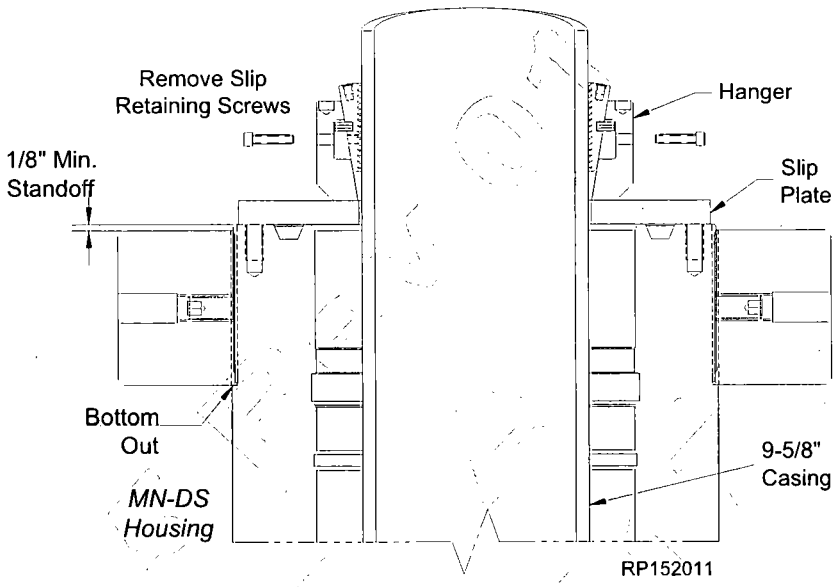
2.5.10. Wrap the Hanger around the casing and replace the latch screw.

2.5.11. Remove the four slip retainer screws on the OD of the slip bowl. These screws hold the slips in retracted position. Slips will **NOT** set unless these screws are removed before Hanger is placed in the Housing.

2.5.12. Grease the Hanger's body.

2.5.13. Remove the slip plate and carefully lower the Hanger into the Housing bowl, using a cat-line to center the casing, if necessary. Measure and record.

WARNING Do NOT drop the Casing Hanger!



2.5.14. When the Hanger is down pull tension on the casing to the desired hanging weight (no minimum weight is required).

2.5.15. Slack off the casing.

NOTE A sharp decrease on the weight indicator will signify that the Hanger has taken weight and is supporting the Casing.

2.5.16. Rough cut the casing approximately 5-1/2" above the top flange of the Housing and move the BOP and excess casing out of the way.

2.5.17. Using an internal cutter, final cut the casing at 15-1/4" +/-1/8" below the Housing flange.

2.5.18. Place a 3/8" x 3/16" bevel on the casing stub and remove all burrs and sharp edges.

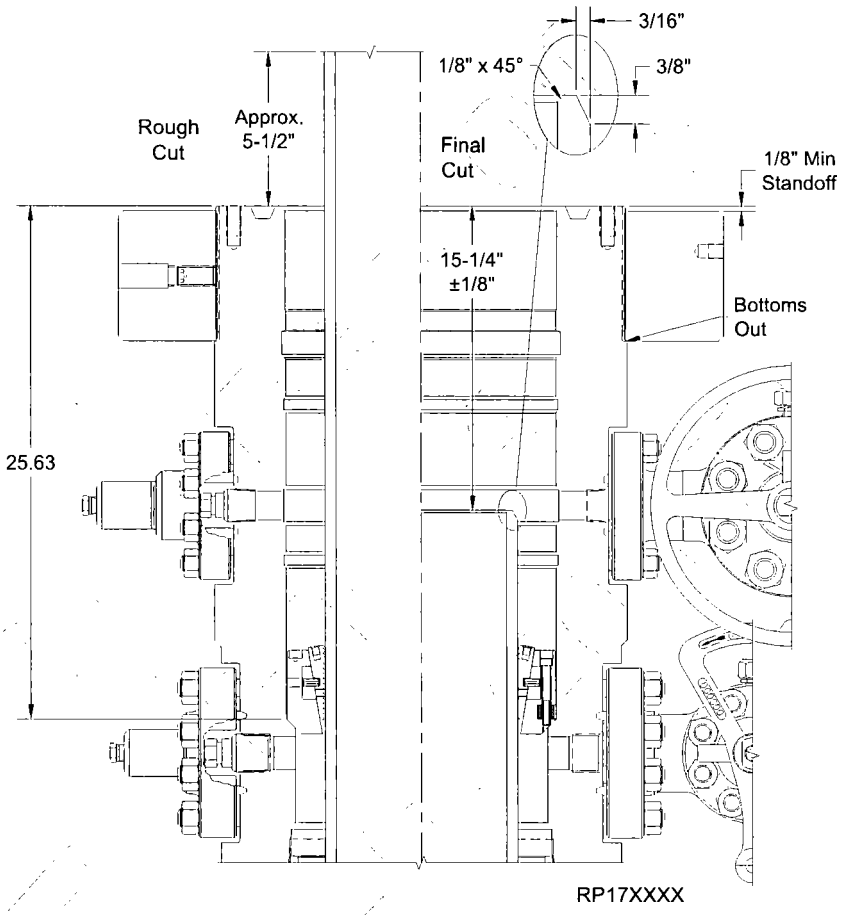
NOTE There must not be any rough edges on the casing or the seals of the Packoff will be damaged.

2.5.19. Remove and discard the used ring gasket from the Housing flange.

2.5.20. Clean the mating ring grooves of the Housing and BOP Stack.

2.5.21. Install the spare ***BX-159 Ring Gasket*** in the Housing ring groove.

2.5.22. Reconnect the BOP Stack to the Housing using the ***Studs and Nuts (Item A20)*** and tightening the studs and nuts in an alternating cross pattern to the torque referenced in the chart in the back of this manual.



⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.

Stage 2.0 — 9-5/8" Casing

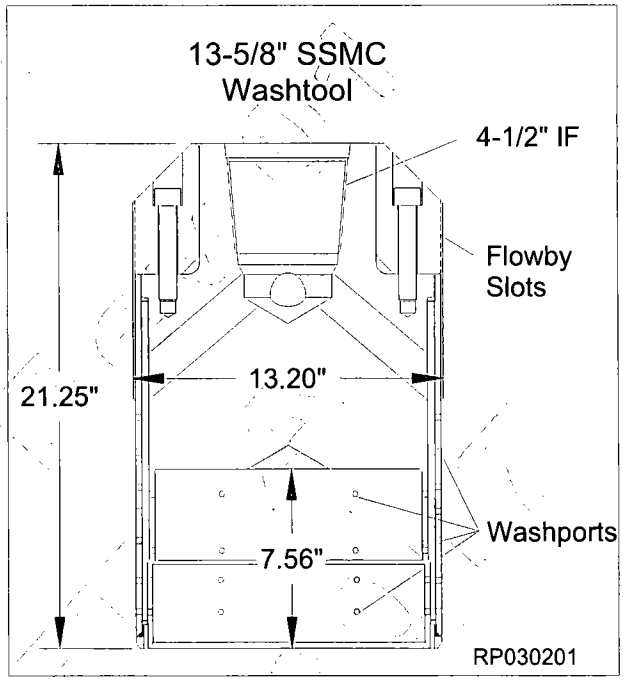
2.6. Washout the Housing

2.6.1. Examine the ***Wash Tool (Item ST6).*** Verify the following:

- bore is clean and free of debris
- threads are clean and undamaged
- washports are clean and unobstructed

2.6.2. Orient the wash tool with the box connection up.

2.6.3. Make up a joint of drill pipe to the top of the Tool.



Stage 2.0 — 9-5/8" Casing

2.6.4. Ensure lowermost outlet valve or Housing is open.

2.6.5. Carefully lower the Tool into the well until it lands on the top of the 9-5/8" Casing Hanger. Measure and Record.

2.6.6. Lift the Tool approximately 2" and supply pressure through the drill pipe. At the same time the pressure is being supplied, turn the Tool.

NOTE The maximum pressure rating for the Wash Tool is 1,000 PSI, at the flow rate of 75 GPM.

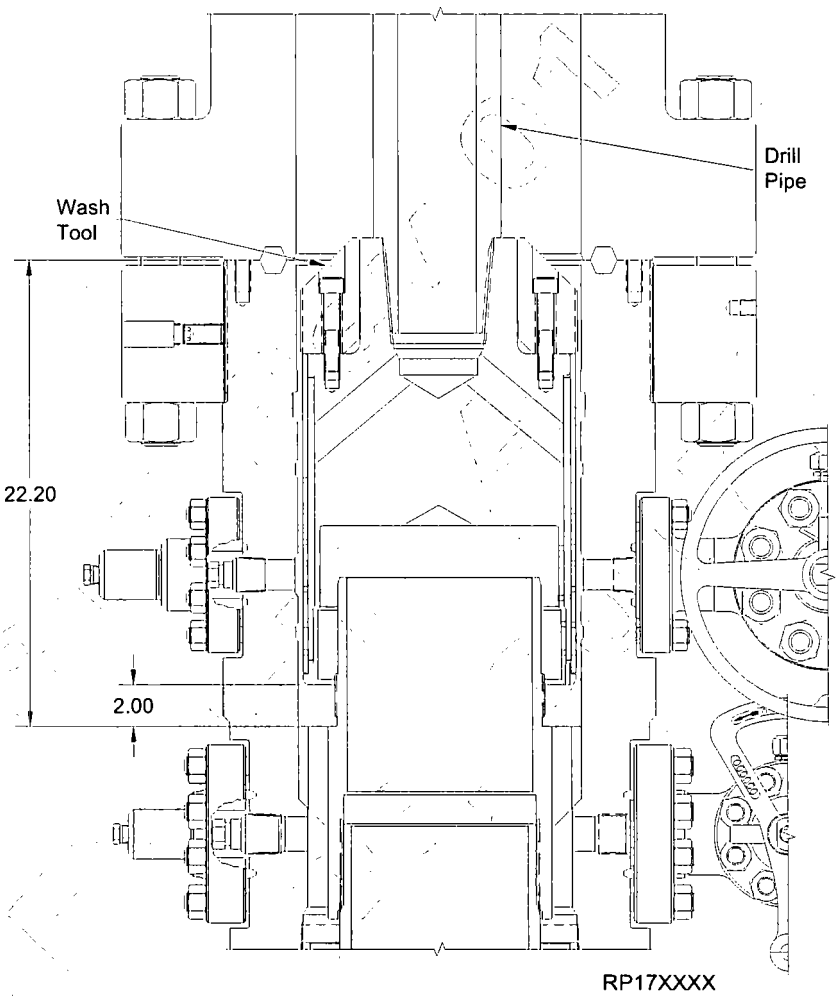
NOTE Do NOT reciprocate the Wash Tool.

2.6.7. Monitor the outlet valve for returns.

2.6.8. Once the returns are clean and free of debris, stop the rotation and the pump.

2.6.9. Retrieve the Tool to the rig floor.

2.6.10. Clean, grease and store the Tool as required.



Stage 2.0 — 9-5/8" Casing

2.7. Install the Packoff Support Bushing

2.7.1. Examine the ***Packoff Support Bushing Running Tool (Item ST7).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- required pin x pin crossover stub is properly installed

2.7.2. Orient the Running Tool as illustrated.

2.7.3. Examine the ***Packoff Support Bushing (Item A17)***. Verify the following:

- bore is clean and free of debris
- all elastomer seals are in place, clean and undamaged
- all threads are clean and undamaged
- lockring is in place
- scribe line is properly identified with paint as required
- ensure spring plunger pins on the inside of the Packoff Support Bushing are properly installed and spring loaded pins retract properly.

2.7.4. Orient the Packoff Support Bushing as illustrated.

2.7.5. Lubricate the external running threads of the Packoff Support Bushing and threads of the Running Tool with a light coat of oil or grease.

⚠WARNING Excessive oil or grease may prevent a positive seal from forming.

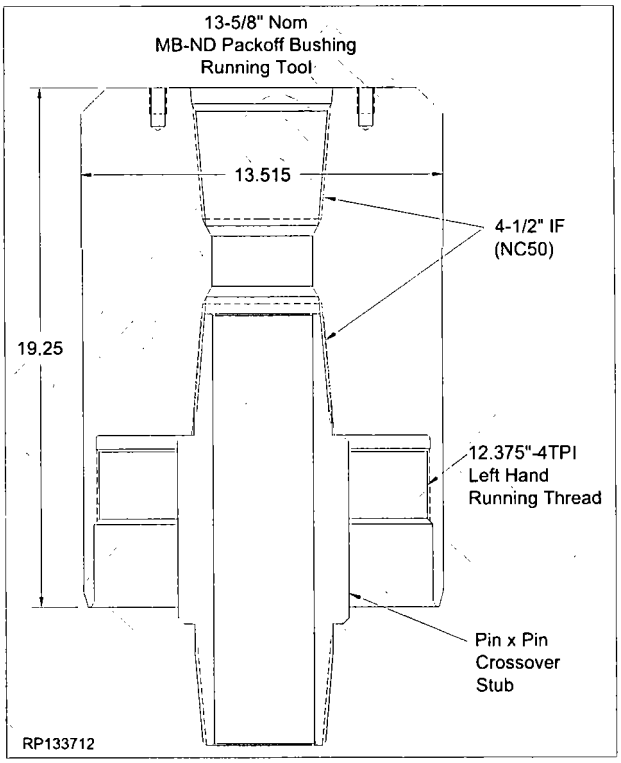
2.7.6. Run drill pipe or heavy weight collars through the rotary table and hang off in the floor slips. This will be used for weight to set the Packoff Support Bushing into position.

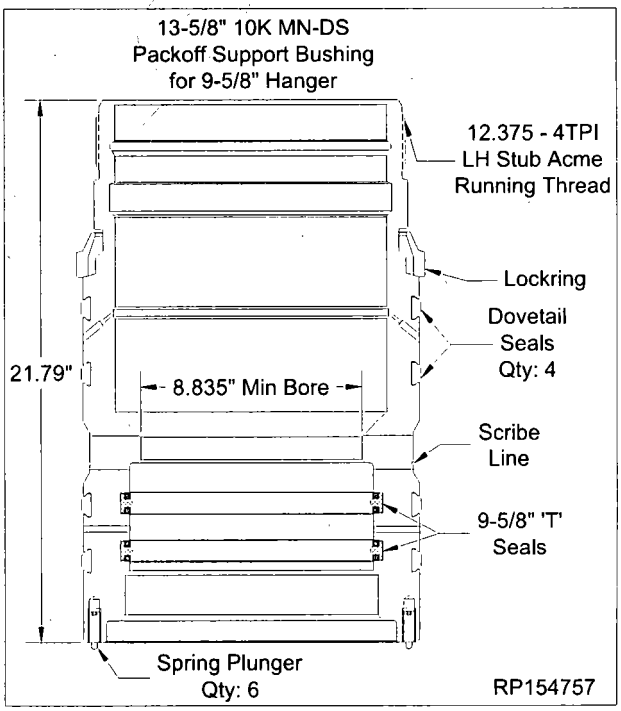
NOTE Heavy weight drill pipe or drill collars are used to aid in landing the Packoff Support Bushing. Weight required to run the Packoff Support Bushing into the Housing is approximately 10,000 lbs.

2.7.7. Make up a stand of drill pipe to the top of the Tool.

2.7.8. Install a ***Lockring Installation Tool (Item ST14)*** onto the lockring of the Support Bushing.

NOTE See APPENDIX 1 for Optional Lock ring Installation Tool on the back of this procedure.

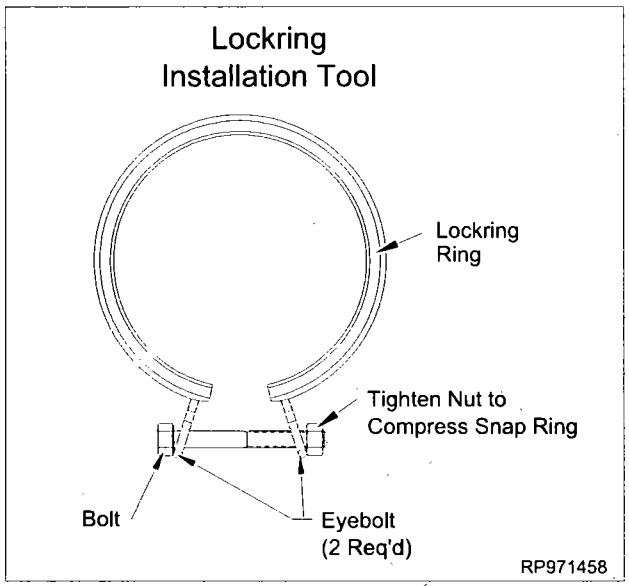




Stage 2.0 — 9-5/8" Casing

2.7.9. Fully compress the lockring.

NOTE The Lockring Installation Tool will assist in minimizing the length of time that the lockring is compressed.



2.7.10. Carefully lower the Running Tool onto the Packoff Support Bushing Assembly until the threads make contact.

2.7.11. Make up the connection by first turning the Tool clockwise to align the threads then counterclockwise until the Tool engages the lockring.

NOTE Approximately 8 turns are required for full make-up. Write down the number of turns to make up the Tool to the Packoff Support Bushing in the Field Service Report.

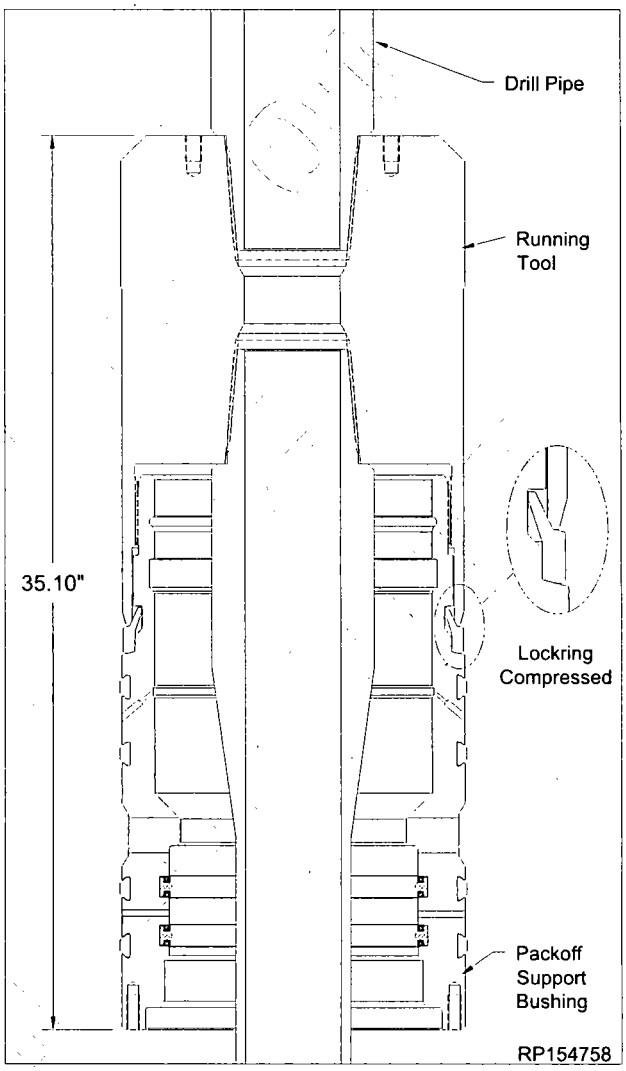
2.7.12. Once the lockring is engaged remove the Lockring Installation Tool.

NOTE Ensure the Lockring is flush or below of the OD of the Packoff Support Bushing.

2.7.13. Lift and suspend the assembly over the drill pipe hung off in the rig floor.

2.7.14. Lower the assembly onto the threads of the drill pipe and make up the connection.

WARNING Do NOT damage the internal seals of the Packoff Support Bushing!



2.7.15. Lubricate the ID of the 'T' seals and the OD of the dovetail seals with a light coat of oil or grease. Do NOT use pipe dope.

WARNING Excessive oil or grease may prevent a positive seal from forming.

2.7.16. Open the uppermost and lowermost valves of the Housing.

NOTE The uppermost valve is to remain open during the setting of the Seal Assembly.

Stage 2.0 — 9-5/8" Casing

2.7.17. Center and lower assembly through the BOP Stack, measure and record, until the Support Bushing lands on the Hanger. Mark the landing joint.

NOTE Distance from the Mandrel Casing Hanger landing shoulder or the top of the Emergency Casing Hanger to the face of the BOP flange is 22.20".

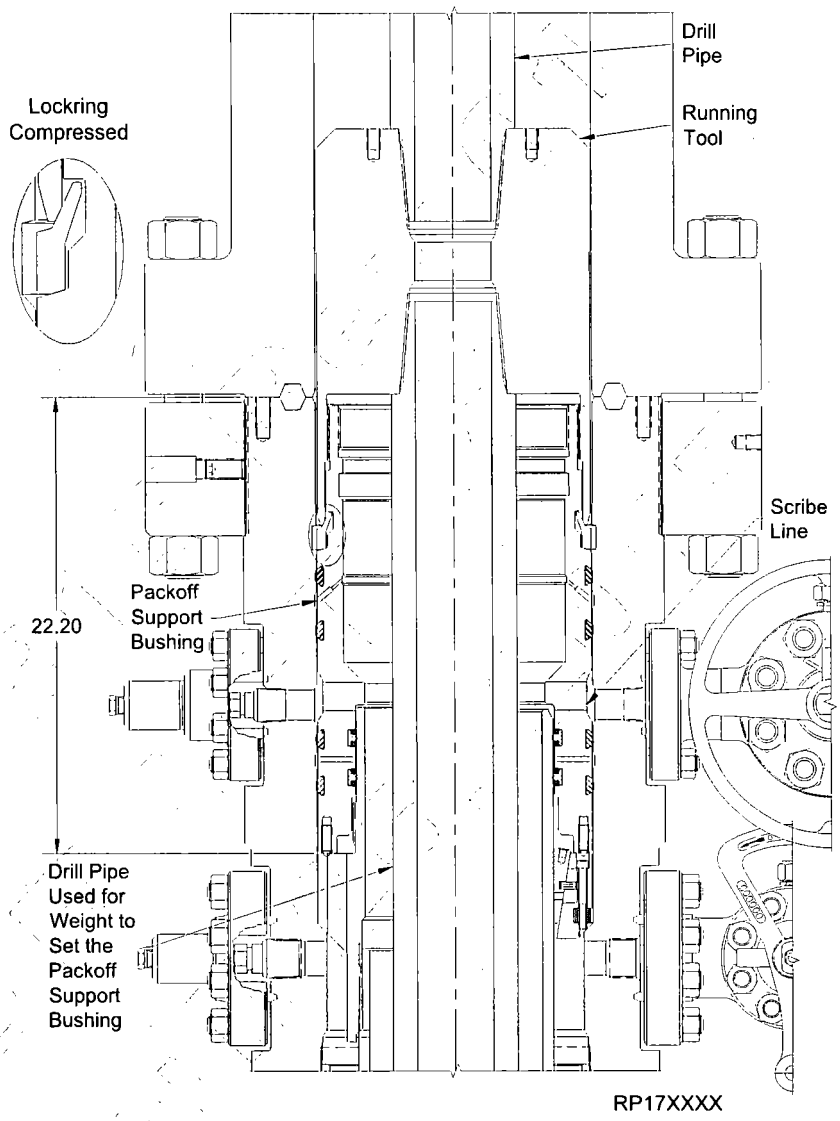
2.7.18. Compare and confirm dimension against BOP stack drilling adapter and Housing.

2.7.19. Verify the Packoff Support Bushing has landed properly through the uppermost outlet valve of the Housing:

- using a flash light, verify the scribe line is visible in the center of the port

2.7.20. Turn the landing joint counterclockwise until the (6) Spring Plunger pins engage the Hanger mating slots. When the pins engage the Hanger, STOP turning when a positive stop is felt.

NOTE Test between the lower seals of the Packoff Support Bushing will be conducted after the Lockdown Ring has been properly engaged/ set into the Housing.



2.8. Set the Packoff Support Bushing Lockdown Ring

NOTE ***Confirm the Packoff Support Bushing has properly landed on Mandrel or Emergency Casing Hanger by (1) confirming dimension (2) viewing through the upper open annulus valve of the Housing. The scribe line should be in the center of the outlet bore.***

2.8.1. Make a horizontal mark on the landing joint to monitor the number of turns.

2.8.2. Using chain tongs, back out the Tool 3-1/2 turns clockwise to allow the Locking ring to expand into its mating groove in the Housing.

NOTE **Horizontal mark should raise no more than .875".**

WARNING **Do NOT attempt to back out more than 3 tuns.**

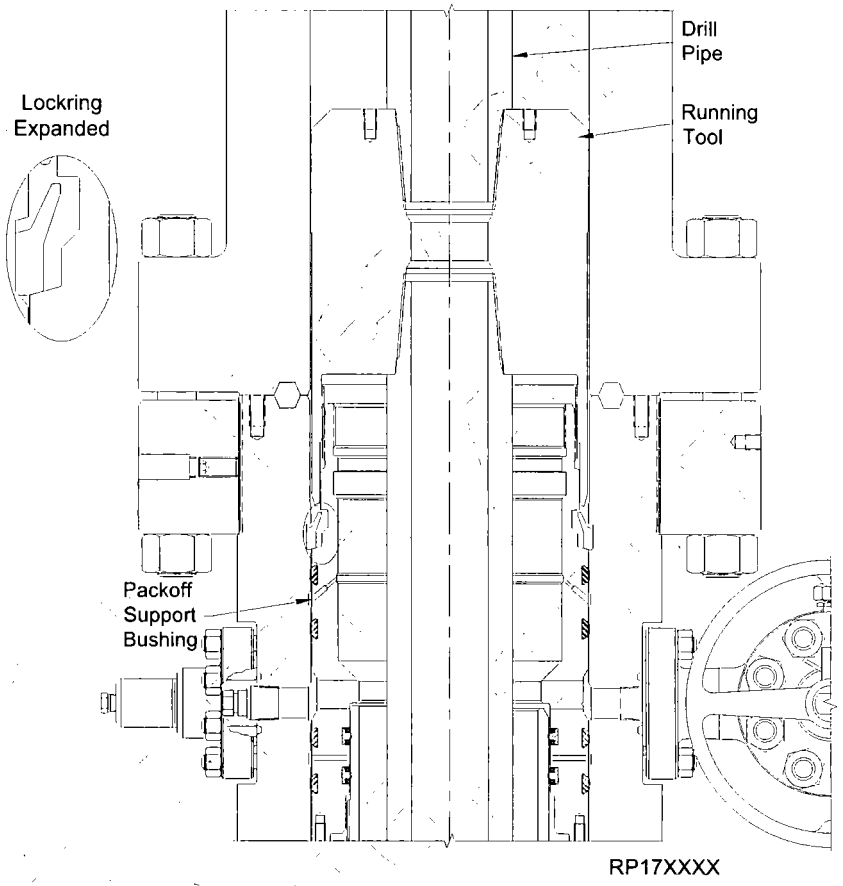
⚠ CAUTION

Clear out personnel from rig floor during over pull test. Precaution must be taken for personnel verifying the over pull.

⚠ CAUTION

There should be maximum of 1/8" vertical movement during over pull. If vertical movement is greater than 1/8" verify the position of the Packoff Support Bushing by checking the location of the scribe line relative to the upper side outlets. If the scribe line has risen more than 1/8", drive the Packoff Support Bushing back down until it lands as per step 2.7.17.

2.8.3. Perform an over pull 50,000 lbs over block weight to confirm the lockring has properly engaged.



2.8.4. Once a successful over pull has been achieved, slack off over pull and ensure elevators are well clear of the drill pipe tool joint.

NOTE If initial over pull test is unsuccessful, do not immediately collapse the lockring for a second installation attempt. Conduct the following steps prior to Support Bushing retrieval:

- Ensure Packoff Support Bushing Running Tool is backed off 3-1/2 turns.
- Re-apply the installation load (10,000 - 20,000 lbs) to force the Packoff and Lockring down into the groove of the housing.
- Re-attempt 50,000 lbs over pull test.

⚠ CAUTION

If a successful over pull test is not achieved after three installation attempts, follow steps 2.11.3 and 2.11.4. to fully retract the lockring and remove the Packoff Support Bushing. Retrieve the Packoff Support Bushing and lockring to the rig floor for trouble shooting.

NOTE **Dovetail seals must be replaced prior to re-installing the Packoff Support Bushing.**

2.9. Test Between the Lower Seals of the Packoff Support Bushing

2.9.1. Locate the lowermost test port on the OD of the Housing and remove the fitting.

2.9.2. Attach a hydraulic test pump to the open test port and inject test fluid into the Packoff Support Bushing to ***5,000 psi or 80% of casing collapse—whichever is less.***

NOTE ***If Emergency Hanger was installed do not exceed 80% of casing collapse.***

NOTE **Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.**

WARNING **Do NOT over pressurize!**

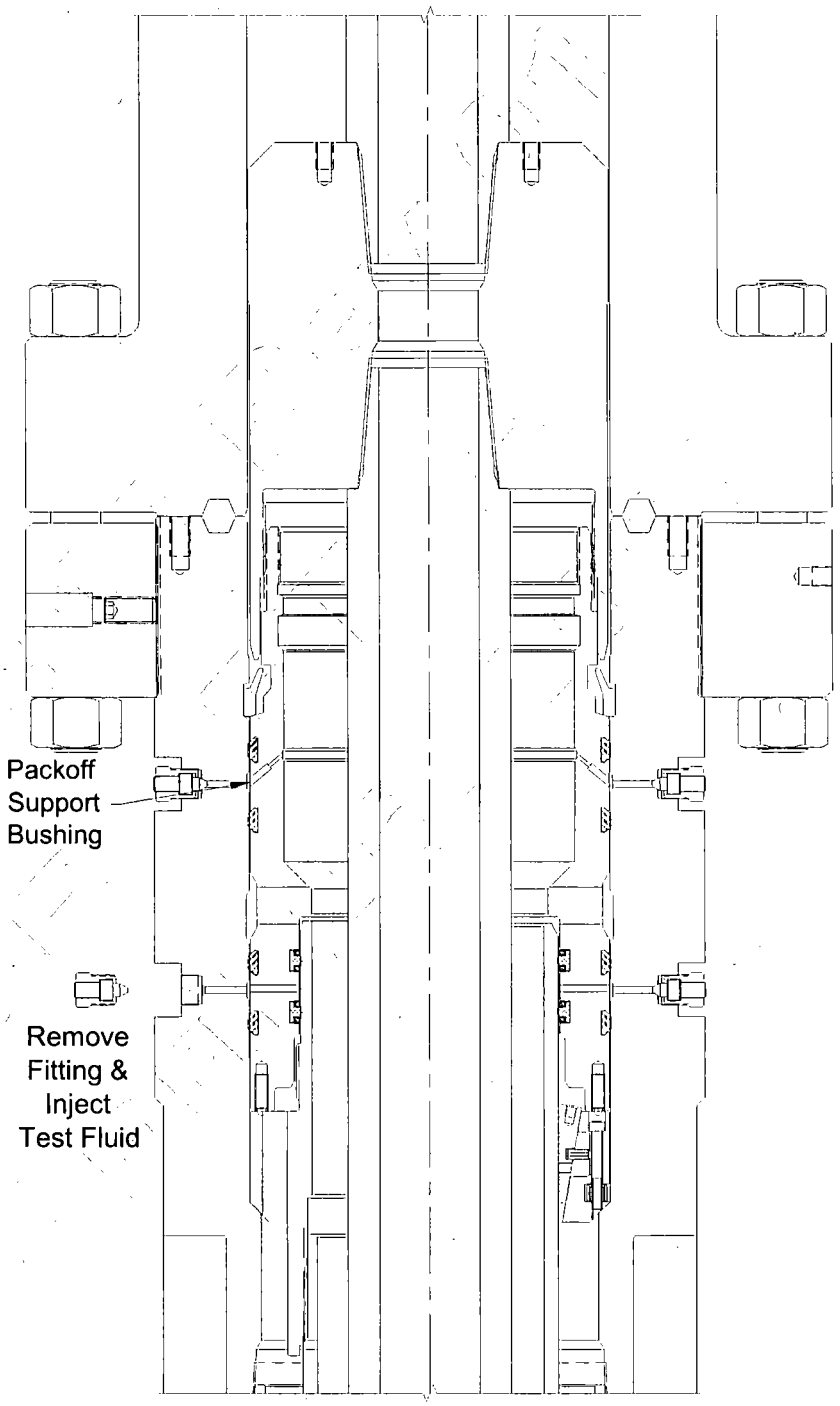
2.9.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

2.9.4. Once a satisfactory test is achieved, carefully bleed off all test pressure, remove the test pump and re-install the fitting.

2.9.5. Release the Tool from the Packoff Support Bushing by turning the drill pipe (with chain tongs) clockwise approximately 4-1/2 turns or until it comes free from the Seal Assembly.

2.9.6. Retrieve the Tool to the rig floor and remove it from landing joint.

2.9.7. Clean, grease and store the Tool as required.



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Stage 2.0 — 9-5/8" Casing

2.10. Test Between the Upper Seals of the Packoff Support Bushing

WARNING ***Previously used BOP Test Plugs must be inspected for damage due to wear. Where warranted such as highly deviated wells the Test Plugs must be checked periodically to insure integrity.***

2.10.1. Examine the ***Test Plug (Item ST8).*** Verify the following:

- both upper and lower seals are in place and undamaged
- 1/2" pipe plug is removed
- all threads are clean and undamaged

NOTE **Ensure the 1/2" LP pipe plug is removed**

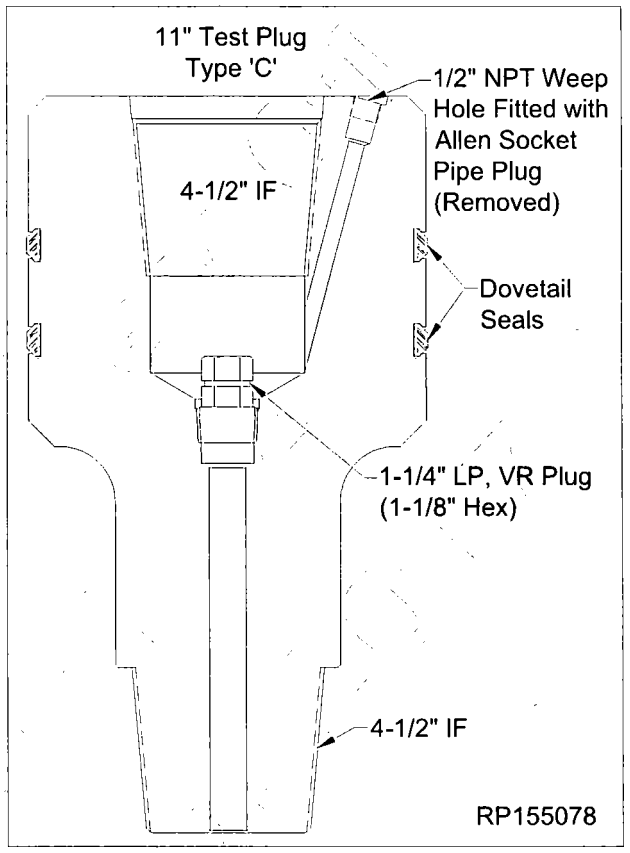
2.10.2. Orient the Tool as illustrated.

2.10.3. Make up a joint of drill pipe to the top of the Tool.

WARNING **A minimum of one joint of Drill Pipe is required on the bottom of the BOP Test Plug to ensure BOP Test plug remains centralized.**

NOTE **A minimum weight of 1,500 lbs is required per dovetail seal to land the Test Plug.**

2.10.4. Lubricate the dovetail seal of the Tool with a coat of light oil or grease.



2.10.5. Open the upper annulus valve of the Housing, and drain fluid to land the Test Plug. Leave valve open.

2.10.6. Slowly lower the Tool through the BOP Stack, measure and record, until it lands on the load shoulder in the Packoff.

NOTE Distance from the Pack-off Support Bushing load shoulder to the face of the BOP Flange is 12.90".

2.10.7. Locate the uppermost test port on the OD of the Housing and remove the fitting.

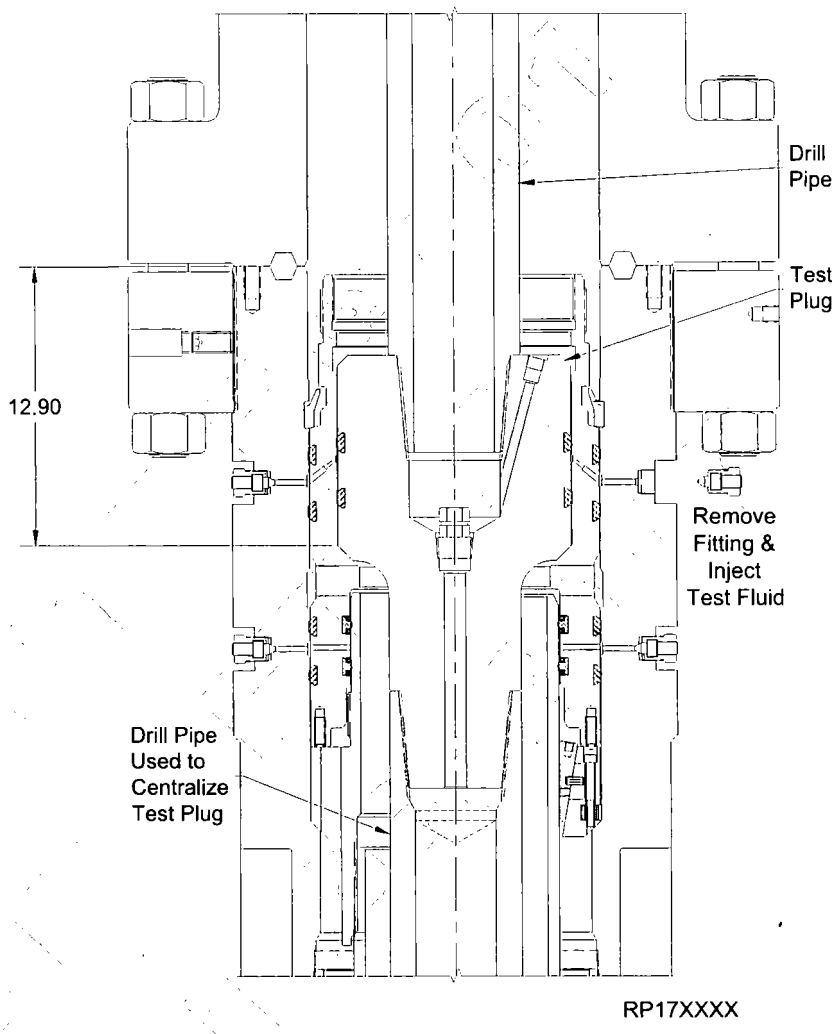
2.10.8. Attach a hydraulic test pump to the open test port and inject test fluid into the Packoff Support Bushing to ***10,000 psi maximum***.

2.10.9. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

2.10.10. Once a satisfactory test is achieved, carefully bleed off all test pressure, remove the test pump and re-install the fitting.

2.10.11. Retrieve the Test Plug slowly to avoid damage to the seal.

2.10.12. Drain BOP stack.



⚠ CAUTION

The following procedure should be followed **ONLY** in the event Retrieval of the Packoff Support Bushing is necessary. If the Packoff Support Bushing Assembly was properly landed, skip this procedure.

2.11. Retrieval of Packoff Support Bushing Assembly

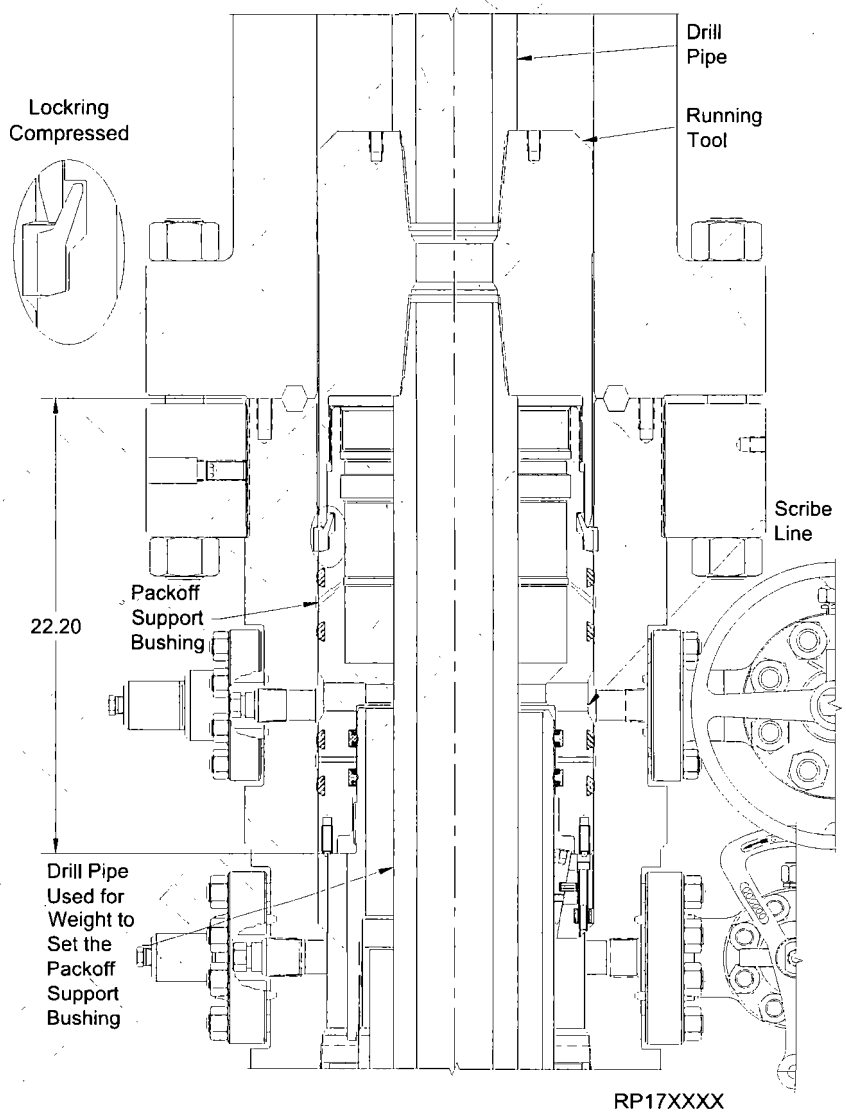
2.11.1. Make up a joint of drill pipe to the top of the ***Packoff Support Bushing Running Tool (Item ST7).***

2.11.2. Lower the Tool through BOP stack and land on top of Packoff Support Bushing.

2.11.3. Turn the Tool counterclockwise approximately 8 turns or the number of turns documented per Section 2.7, until the Tool fully engages the lockring and a firm stop is encountered. Back off from this point a maximum 1/8 of a turn.

⚠ CAUTION

Do not use Top Drive to engage/ disengage the Running Tool. Using Top Drive will permanently damage the equipment running threads and will require damaged part to be replaced.



2.11.5. Retrieve the Packoff Support Bushing by pulling vertically (approximately 15,000 to 20,000 lbs).

⚠WARNING If overpull exceeds this value, repeat counter-clockwise rotation until a firm stop is encountered and repeat overpull.

2.11.6. To remove Packoff Support Bushing from the Tool, install the ***Lockring Tool (Item ST14)*** and fully compress the lockring.

NOTE Dovetail seals must be replaced prior to re-installing the Packoff Support Bushing.

Stage 3.0 — 7" Casing

3.1. Test the BOP Stack

NOTE Immediately after making up the BOP stack and periodically during the drilling of the hole for the next casing string, the BOP stack (connections and rams) must be tested.

WARNING Previously used BOP Test Plugs must be inspected for damage due to wear. Where warranted such as highly deviated wells the Test Plugs must be checked periodically to insure integrity.

3.1.1. Examine the ***Test Plug (Item ST8).*** Verify the following:

- both upper and lower seals are in place and undamaged
- 1/2" pipe plug is removed
- all threads are clean and undamaged

NOTE Ensure the 1/2" LP pipe plug is removed

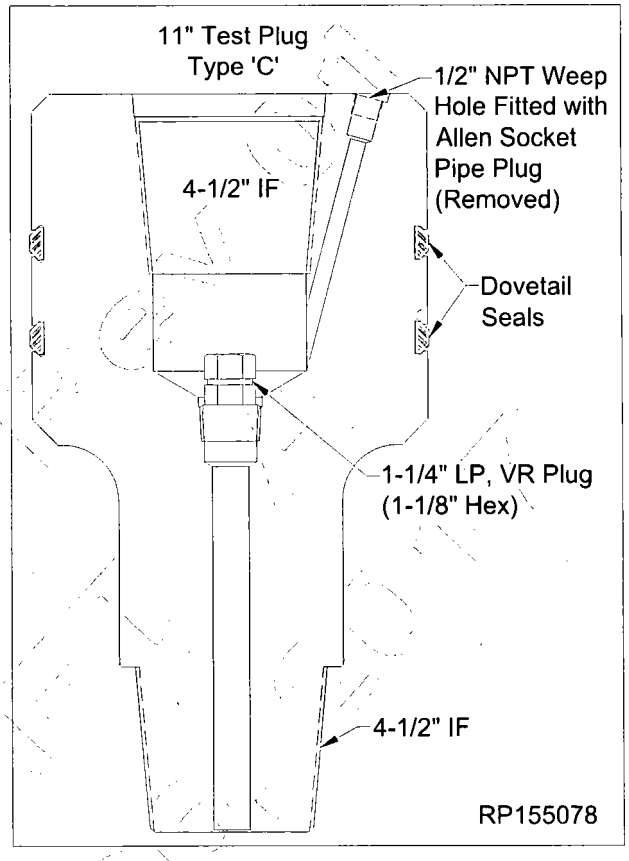
3.1.2. Orient the Tool as illustrated.

3.1.3. Make up a joint of drill pipe to the top of the Tool.

WARNING A minimum of one joint of Drill Pipe is required on the bottom of the BOP Test Plug to ensure BOP Test plug remains centralized.

NOTE A minimum weight of 1,500 lbs is required per dovetail seal to land the Test Plug.

3.1.4. Lubricate the dovetail seal of the Tool with a coat of light oil or grease.



Stage 3.0 — 7" Casing

3.1.5. Open the upper annulus valve of the Housing, and drain fluid to land the Test Plug. Leave valve open.

3.1.6. Slowly lower the Tool through the BOP Stack, measure and record, until it lands on the load shoulder in the Packoff.

NOTE Distance from the Pack-off Support Bushing load shoulder to the face of the BOP Flange is 12.90".

3.1.7. Close the BOP rams on the drill pipe and test to ***10,000 psi maximum.***

3.1.8. Monitor the annulus valve for signs of pressure.

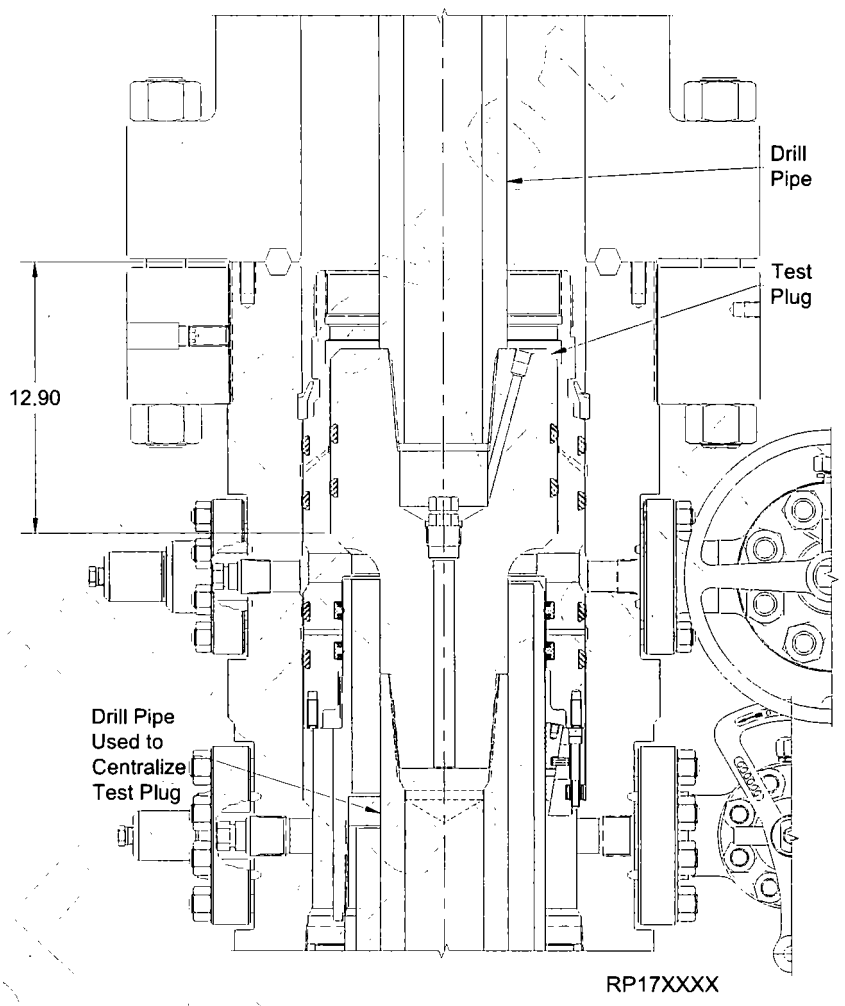
3.1.9. After a satisfactory test is achieved, release pressure and open the annulus valve.

3.1.10. Retrieve the Test Plug slowly to avoid damage to the seal.

NOTE It may be necessary to open the annulus valve when starting to retrieve the Test Plug to relieve any vacuum that may occur. Leaving annulus valve open during testing insures safety of surface casing.

3.1.11. Drain BOP stack.

3.1.12. Close upper annulus valve.



Stage 3.0 — 7" Casing

NOTE Always use a Wear Bushing while drilling to protect the load shoulder from damage by the drill bit or rotating drill pipe. The Wear Bushing must be retrieved prior to running the casing.

WARNING *Previously used Wear Bushings must be inspected for damage and significant reduction in wall thickness due to wear. Where warranted such as highly deviated wells the Wear Bushing must be checked periodically to insure integrity.*

3.2. Run the Wear Bushing Before Drilling

3.2.1. Examine the ***Running Tool (Item ST9).*** Verify the following:

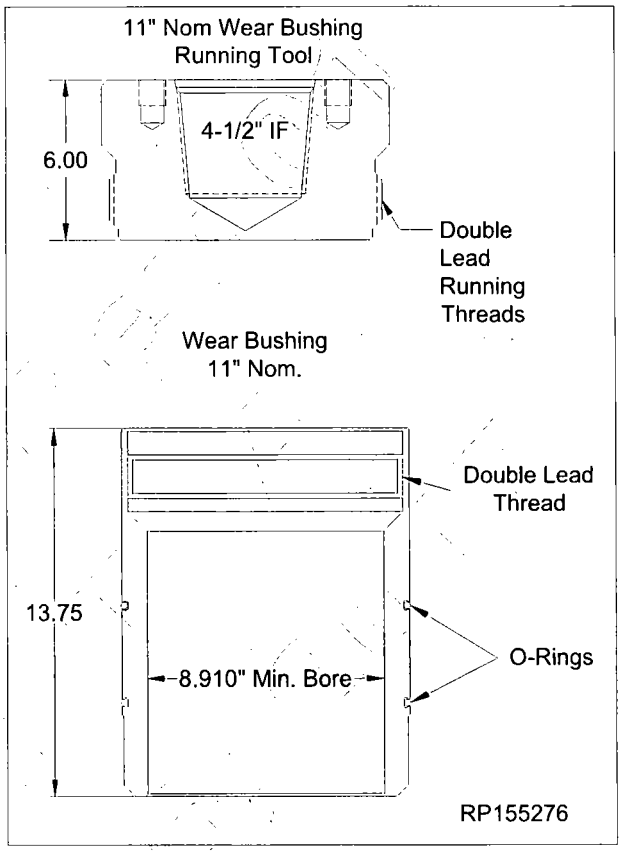
- all threads are clean and undamaged

3.2.2. Orient the Tool with the lift lugs down.

3.2.3. Examine the ***Wear Bushing (Item ST10).*** Verify the following:

- bore is clean and free of debris
- o-rings are properly installed, clean and undamaged

3.2.4. Orient the Wear Bushing as illustrated.



WARNING Do NOT cut o-rings.

CAUTION This Wear Bushing has no mechanical retention device. Care must be exercised when tripping out the hole to avoid dislodging the Wear Bushing which could compromise safety if it becomes lodged in the BOP.

3.2.5. Lubricate the o-ring seals of the wear bushing with a light coat of oil or grease.

3.2.6. Make up a joint of drill pipe to the top of the Tool.

3.2.7. Lower the Tool into the Wear Bushing and turn the drill pipe counterclockwise until thread 'jump' can be felt, then clockwise to a positive stop, to thread the Tool into the Wear Bushing.

WARNING Do NOT overtighten the Tool/ Wear Bushing connection.

3.2.8. Carefully lower the Tool/ Wear Bushing assembly through the BOP, measure and record, until it lands on the load shoulder of the Packoff Support Bushing.

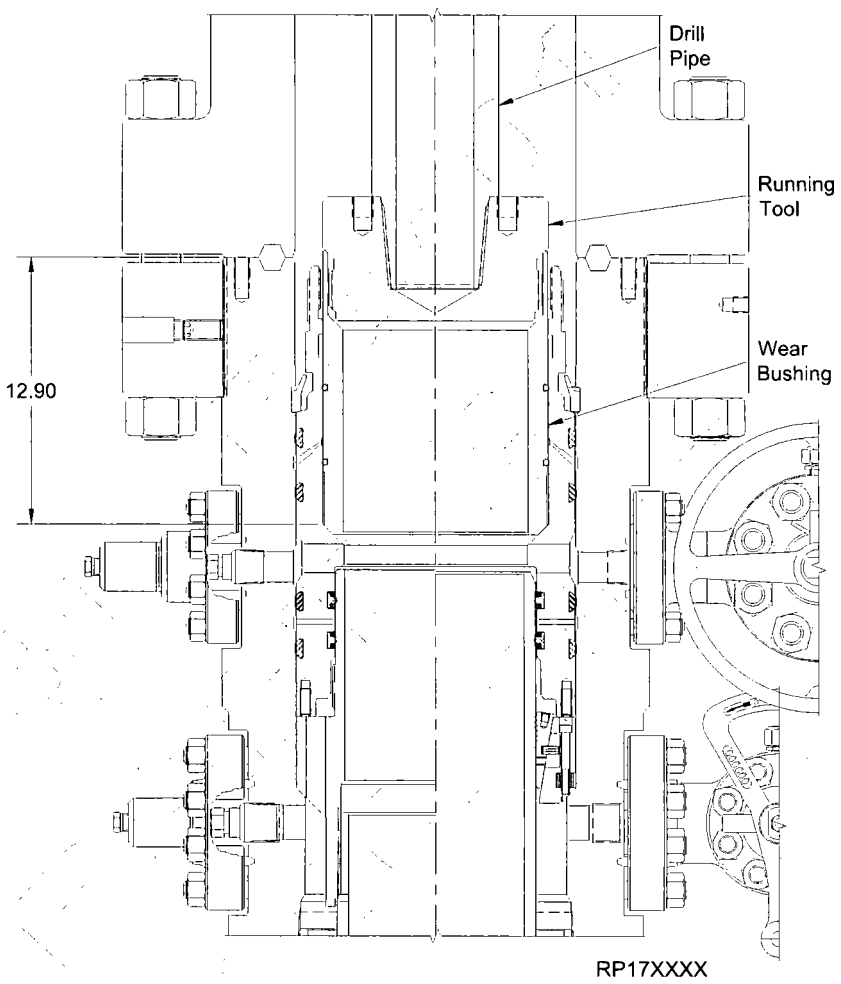
NOTE Distance from the Packoff Support Bushing load shoulder to the face of the BOP flange is 12.90".

3.2.9. Remove the Tool from the Wear Bushing by turning the drill pipe counterclockwise and lift straight up.

3.2.10. Remove the Tool from the drill string.

3.2.11. Clean, grease, and store the Tool as required.

3.2.12. Drill as required.



3.3. Retrieve the Wear Bushing After Drilling

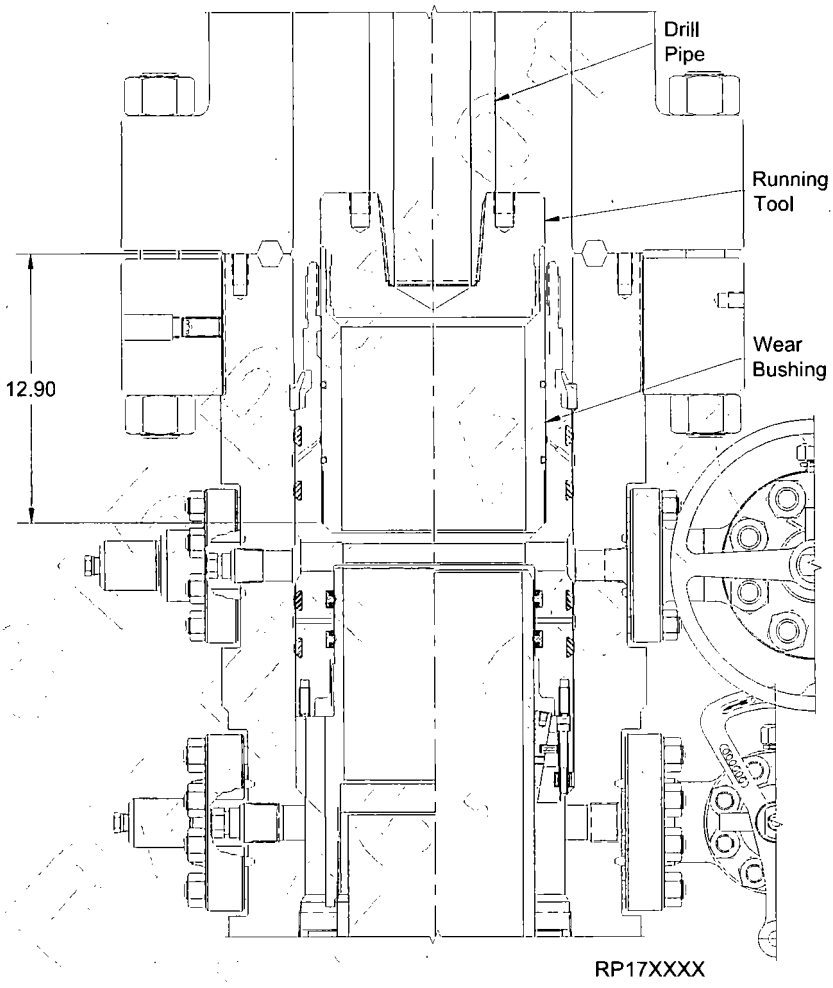
3.3.1. Make up the Tool to the drill pipe.

3.3.2. Slowly lower the Tool into the Wear Bushing.

3.3.3. Turn the Tool counterclockwise until thread 'jump' can be felt, slack off all weight then turn clockwise to a positive stop.

3.3.4. Slowly retrieve the Wear Bushing to the rig floor and remove it and the Tool from the drill string.

3.3.5. Clean, grease and store the Tool and Wear Bushing.



Landing of Mandrel Hangers

Cameron service personnel must verify that the mandrel hanger is landed properly on the load shoulder in the wellhead. This can be accomplished by one of three methods.

- Visually observe the scribe line mark around mandrel hanger running tool through upper side outlet valve.
- Conduct a dry run and mark the dedicated landing joint prior to running the casing or tubing.
- Calculate the distance from the rig floor to the landing shoulder and confirm that the hanger has traveled the required distance.

3.4. Hang Off the Casing

NOTE In the event the 7" casing should become stuck, and the Mandrel Hanger is unable to be used, refer to Section 3.13.

3.4.1. Run the 7" casing and space out appropriately.

3.4.2. Hang off the last joint of casing to be run in the floor slips at height that will enable easy handling and make up of the hanger and landing joint.

NOTE Steps 3.4.3-3.4.12 may be conducted offline in the shop and shipped to location as one assembly.

3.4.3. Examine the ***Running Tool (Item ST11).*** Verify the following:

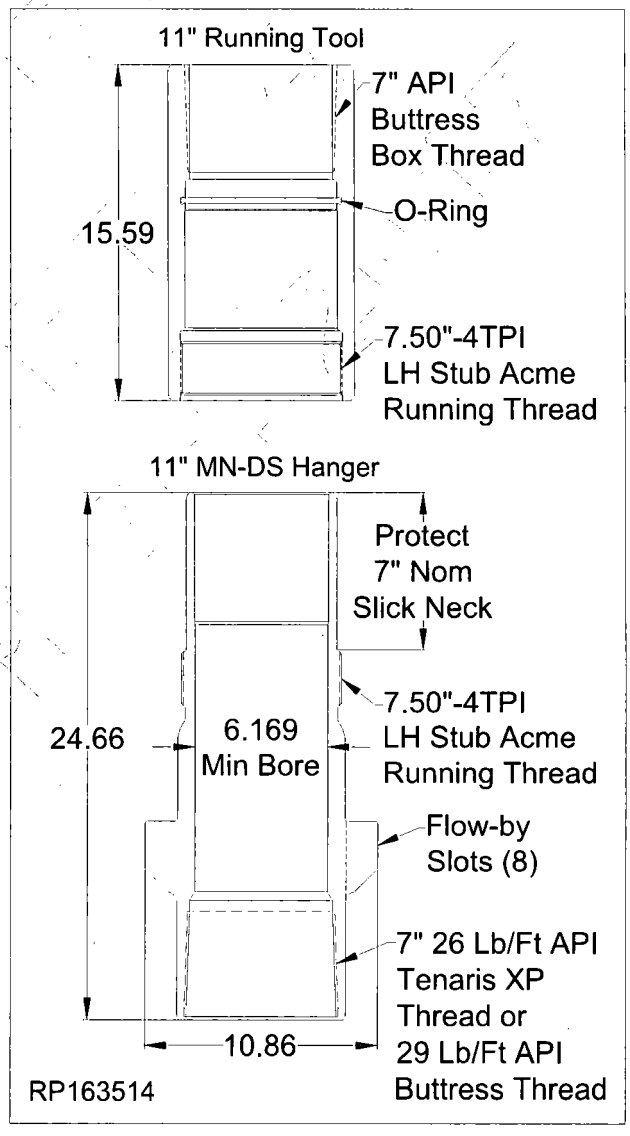
- bore is clean and free of debris
- all threads are clean and undamaged
- o-ring is properly installed and undamaged

3.4.4. Orient the Running Tool as illustrated.

3.4.5. Examine the ***Casing Hanger (Item A18).*** Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged
- flow-by slots are clean and free of debris
- casing pup joint is properly installed.

3.4.6. Orient the Hanger as illustrated.



Stage 3.0 — 7" Casing

3.4.7. Make up a landing joint to the top of the Running Tool.

3.4.8. Lubricate the running threads of both the Tool and the Hanger and also the seal of the Tool with a coat of light oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

3.4.9. Lift and suspend the Tool over the Hanger.

3.4.10. Lower the Tool onto the Hanger until the mating threads make contact.

3.4.11. While balancing the weight, turn the Tool clockwise until the thread 'jump' can be felt then counterclockwise to a positive stop (approximately 10 turns) then back off the Tool clockwise 1/2 turn.

WARNING DO NOT torque the connection.

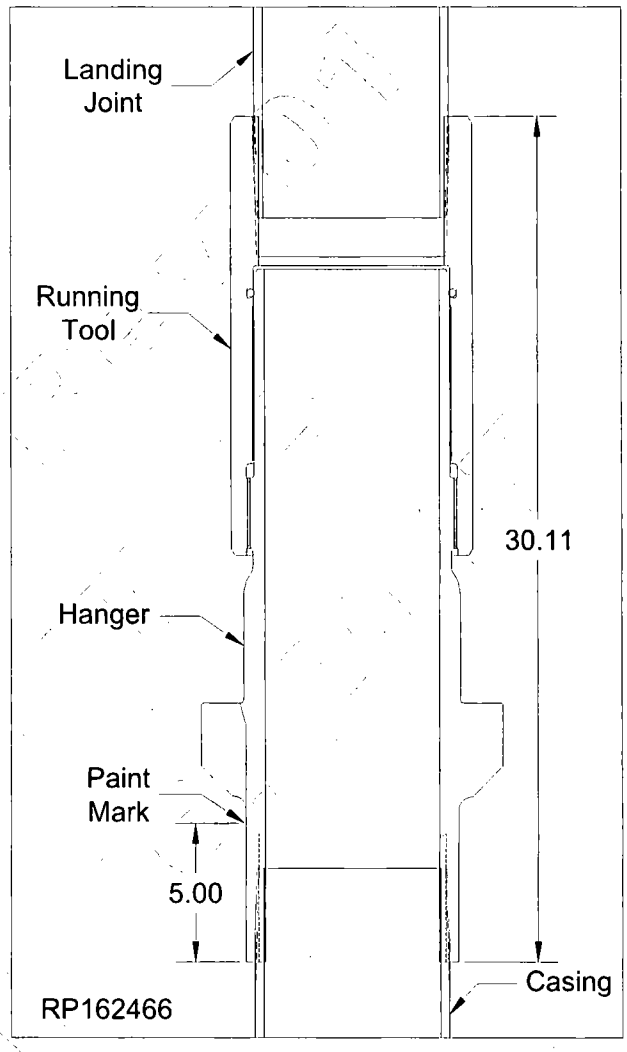
3.4.12. Lift the Hanger above the casing hung off in the floor.

3.4.13. Lower the Hanger assembly until the mating threads of the 7" casing and the pin threads of the pup joint make contact.

NOTE When making up the Hanger to the casing do not use the seal neck area for back up.

3.4.14. While balancing the weight, turn the assembly counterclockwise until the thread 'jump' can be felt then clockwise to the thread manufacturer's recommended optimum torque.

3.4.15. Make a paint mark all the way around the Hanger at 5.00" from the bottom of the Hanger for landing verification.



3.4.16. Open the uppermost side outlet valve of the Housing.

3.4.17. Release the casing from the floor slips and lower it into the well, measure and record, until the Hanger lands on the load shoulder of the Packoff.

NOTE Distance from the Pack-off Support Bushing load shoulder to the face of the BOP flange is 12.90".

3.4.18. Make sure Hanger is centered in well bore.

3.4.19. Slack off all weight on the casing.

3.4.20. Verify the through the open outlet the Hanger has landed properly.

NOTE Scribed line on the Hanger should be just above the middle of the uppermost outlet of the MN-DS Housing.

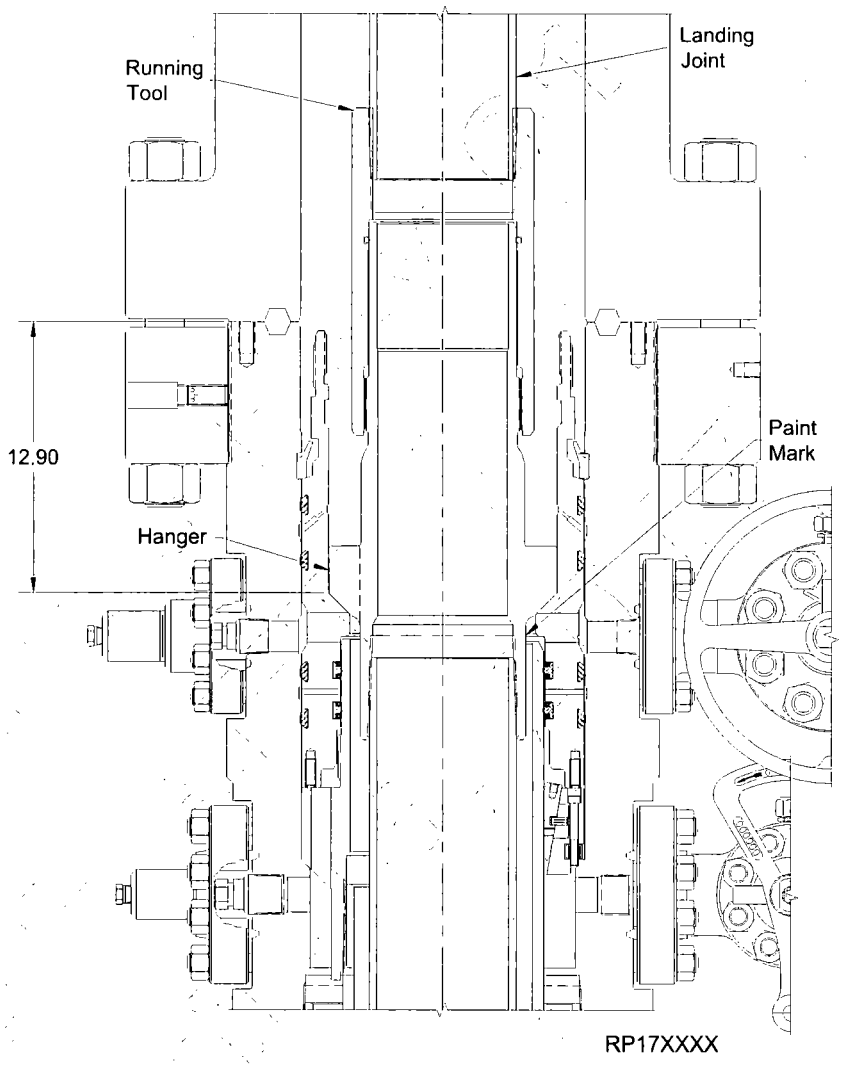
3.4.21. Cement the casing as required.

NOTE Cement returns may be taken through the flow-by slots of the Hanger/Running Tool and out of the BOP Stack.

3.4.22. With cementing completed, turn the landing joint clockwise to release the Tool from the Hanger, approximately 10 turns.

3.4.23. Retrieve the Tool to the rig floor.

3.4.24. Clean, grease and store the Tool as required.



Stage 3.0 — 7" Casing

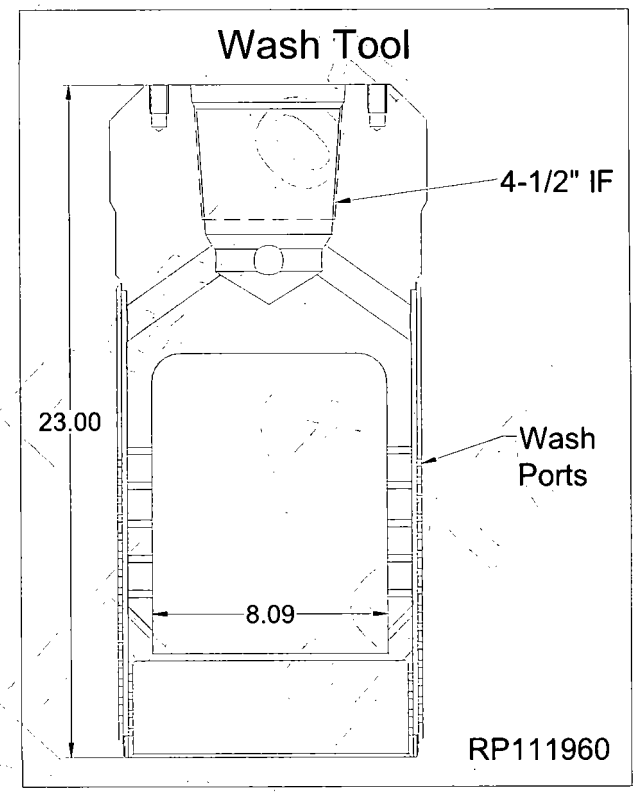
3.5. Washout the Housing

3.5.1. Examine the ***Wash Tool (Item ST12)***. Verify the following:

- bore is clean and free of debris
- threads are clean and undamaged
- washports are clean and unobstructed

3.5.2. Orient the wash tool as illustrated.

3.5.3. Make up a joint of drill pipe to the top of the Tool.



3.5.4. Ensure uppermost outlet valve on the Housing is open.

3.5.5. Carefully lower the Tool into the well, measure and record, until it lands on the top of the 7" Casing Hanger.

3.5.6. Lift the Tool approximately 2" and supply pressure through the drill pipe. At the same time the pressure is being supplied, turn the Tool.

NOTE The maximum pressure rating for the Wash Tool is 1,000 PSI at the flow rate of 75GPM.

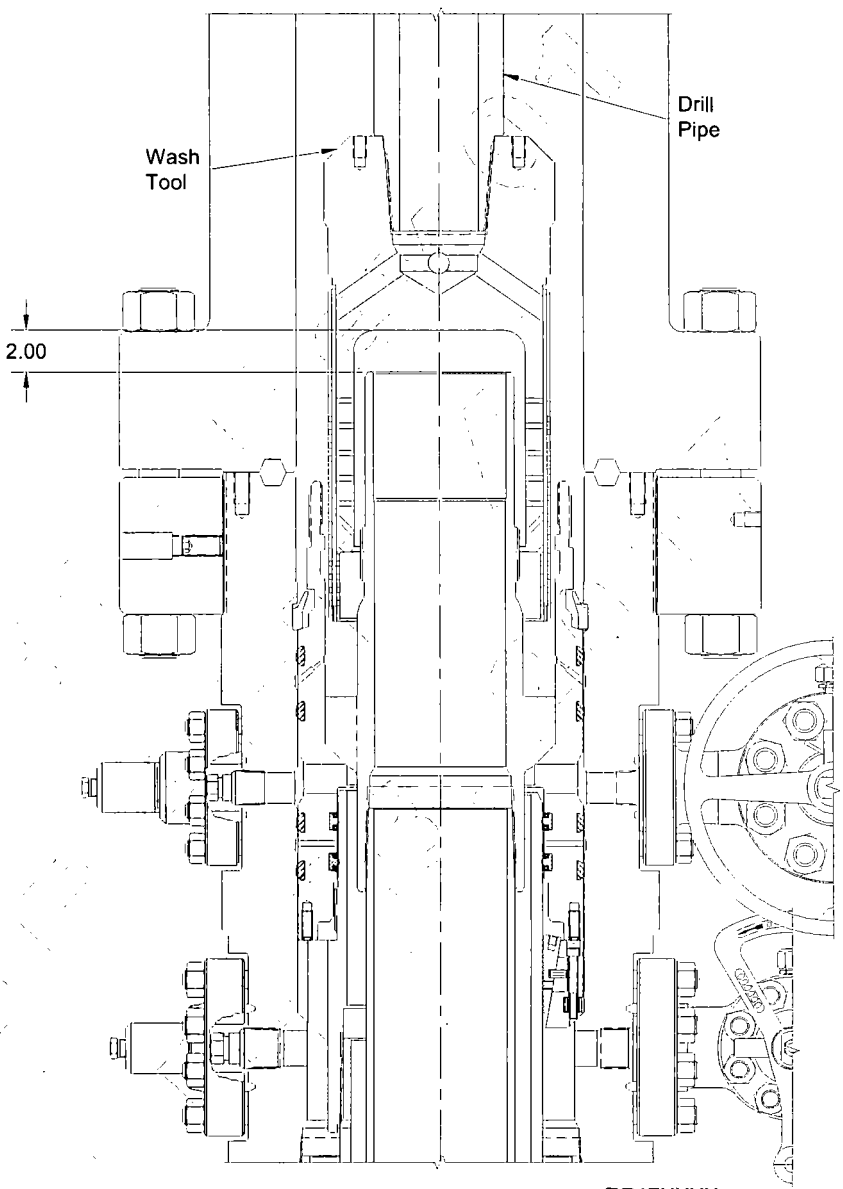
NOTE Do NOT reciprocate the Wash Tool.

3.5.7. Monitor the outlet valve for returns.

3.5.8. Once the returns are clean and free of debris, stop the rotation and the pump.

3.5.9. Retrieve the Tool to the rig floor.

3.5.10. Clean, grease and store the Tool as required.



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3.6. Install the Seal Assembly

3.6.1. Examine the ***Seal Assembly Running Tool (Item ST13)***. Verify the following:

- bore is clean and free of debris
- all threads are clean and undamaged

3.6.2. Orient the Running Tool as illustrated.

3.6.3. Examine the ***Seal Assembly (Item A19)***. Verify the following:

- bore is clean and free of debris
- all elastomer seals are in place, clean and undamaged
- all threads are clean and undamaged
- lockring is in place
- ensure spring plunger pins on the inside of the Seal Assembly are properly installed and spring loaded pins retract properly.

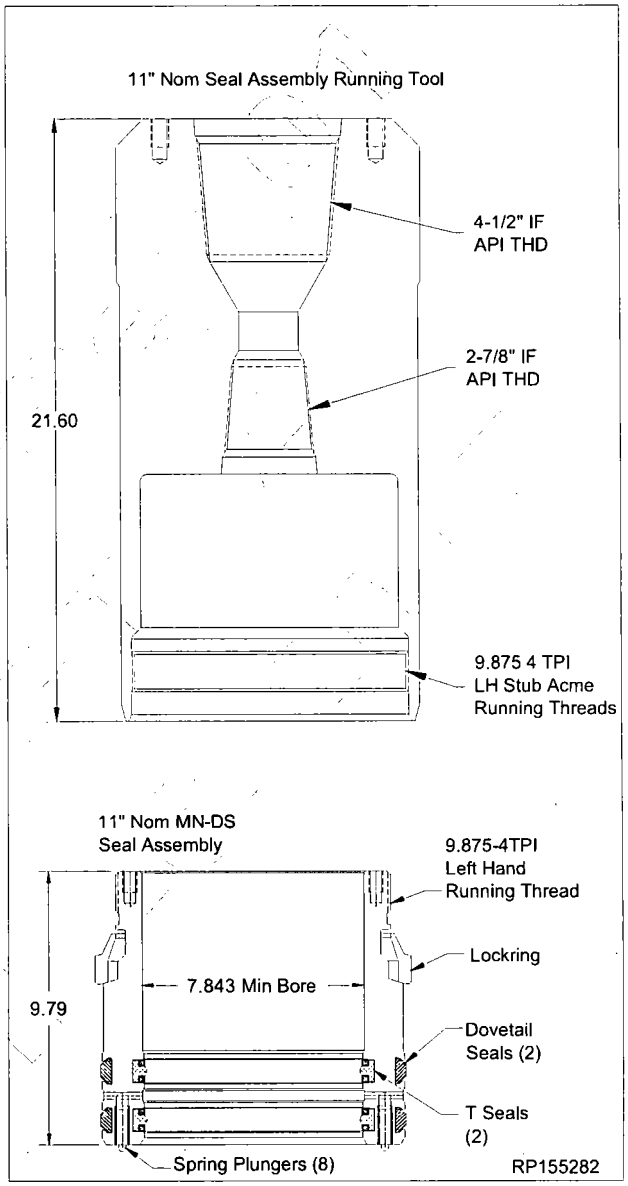
3.6.4. Orient the Seal Assembly as illustrated.

3.6.5. Lubricate the running threads of the Seal Assembly and threads of the Running Tool with a light coat of oil or grease.

3.6.6. Run drill pipe or heavy weight collars through the rotary table and hang off in the floor slips. This will be used for weight to set the Seal assembly into position. If running heavy weight pipe, measure OD of all pipe and connection to make sure pipe will drift casing.

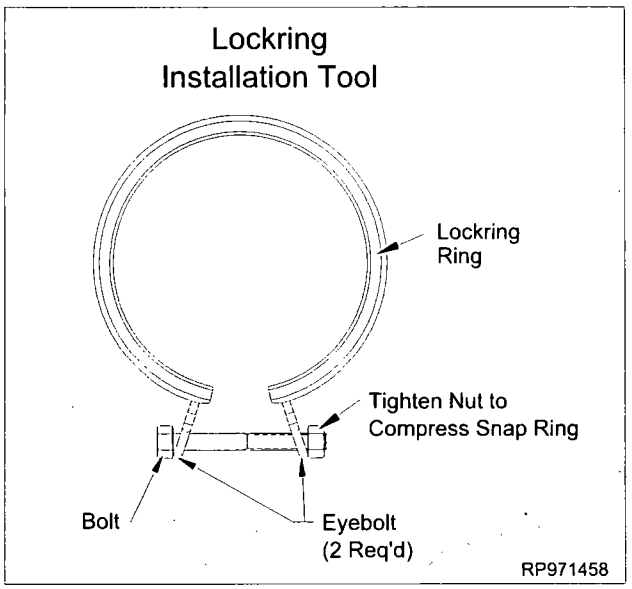
NOTE Heavy weight drill pipe or drill collars are used to aid in landing the Seal Assembly. Weight required to run the Seal Assembly into the Housing is approximately 3,000 lbs.

3.6.7. Make up a joint of drill pipe to the top of the Running Tool.



Stage 3.0 — 7" Casing

3.6.8. Install a ***Lockring Installation Tool (Item ST14)*** onto the lockring of the Seal Assembly.



NOTE See APPENDIX 1 for optional Lockring Installation Tool on the back of this procedure.

3.6.9. Fully compress the lockring.

NOTE The Lockring Installation Tool will assist in minimizing the length of time that the lockring is compressed.

3.6.10. Carefully lower the Running Tool onto the Seal Assembly until the threads make contact.

3.6.11. Make up the connection by first turning the Tool clockwise to align the threads then counterclockwise until the Tool engages the lockring.

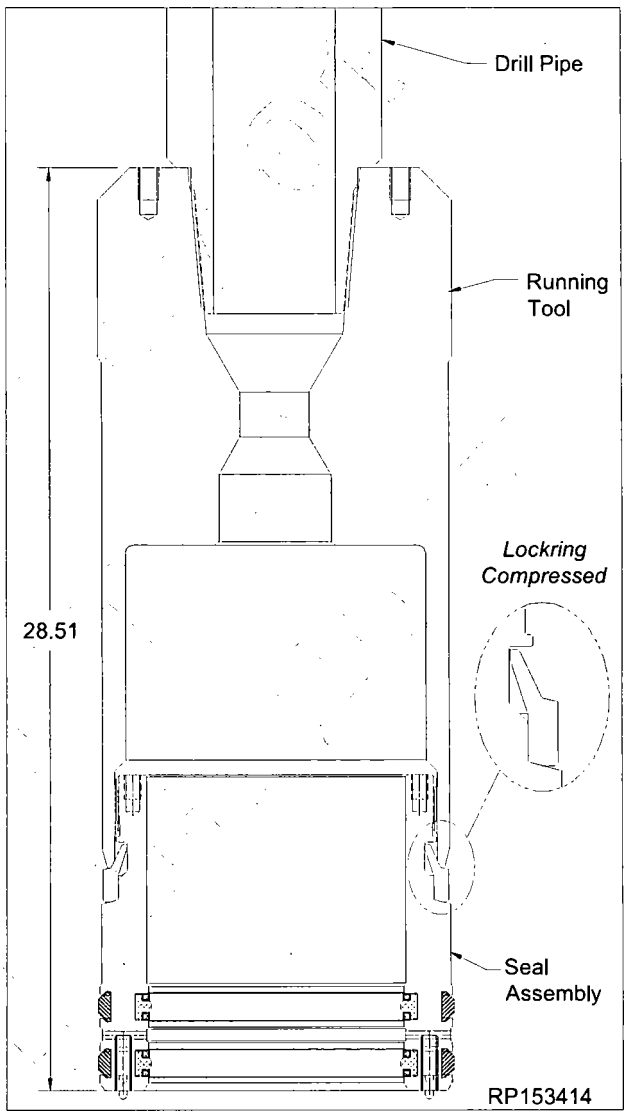
NOTE Approximate 6-1/2 turns are required for full make-up. Write down the number of turns to make up the Tool to the Seal Assembly in the Field Service Report.

3.6.12. Once the lockring is engaged remove the Lockring Installation Tool.

NOTE Ensure the lockring is flush or below the OD of the Seal Assembly.

3.6.13. Lubricate the ID of the 'T' seals and the OD of the dovetail seals with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.



3.6.14. Lift and suspend the Seal Assembly over the drill pipe hung off in the rig floor.

3.6.15. Lower the Seal Assembly onto the threads of the drill pipe and make up the connection.

WARNING Do NOT damage the internal seals of the Packoff Support Bushing assembly.

3.6.16. Open the uppermost side outlet valves on the Housing.

NOTE The uppermost side outlet valve is to remain open during the setting of the Seal Assembly.

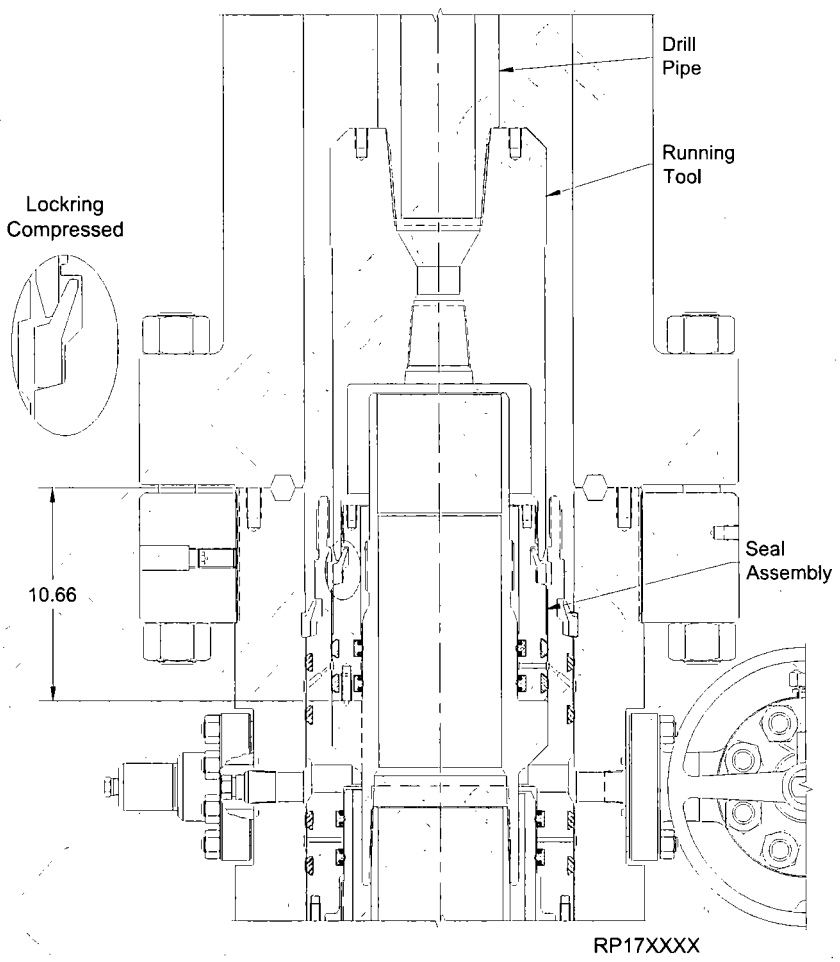
Stage 3.0 — 7" Casing

3.6.17. Center and lower the assembly through the BOP Stack and Housing, measure and record, until the Seal Assembly lands on the Casing Hanger.

NOTE Distance from the Mandrel Casing Hanger landing shoulder to the face of the BOP flange is 10.66".

3.6.18. Turn the landing joint counterclockwise until the (8) Spring Plunger pins engage the Hanger mating slots. When the pins engage the Hanger, STOP turning when a positive stop is felt.

NOTE Test between the seals of the Seal Assembly will be conducted after the Lockdown Ring has been properly engaged/ set into the Packoff Support Bushing.



3.7. Set the Seal Assembly Lockdown Ring

NOTE ***Confirm the Seal Assembly has properly landed on Mandrel Casing Hanger.***

3.7.1. Make a vertical mark on the landing joint to monitor the number of turns.

3.7.2. Using chain tongs, back out the Tool 3 turns clockwise to allow the Locking ring to expand into its mating groove in the Packoff Support Bushing.

NOTE **Horizontal mark should raise no more than .75".**

WARNING DO NOT ATTEMPT TO BACK OUT MORE THAN 3 TURNS.

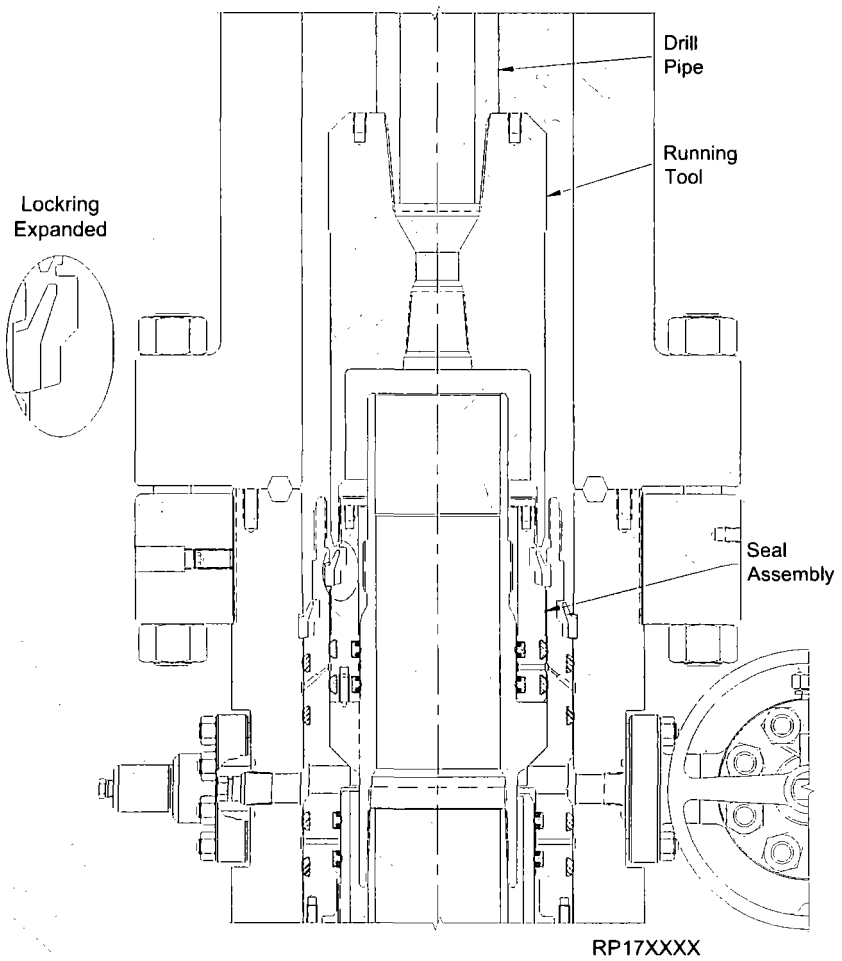
3.7.3. Perform an over pull 50,000 lbs to confirm the lockring has properly engaged.

⚠ CAUTION

Clear out personnel from rig floor during overpull test. Precautions must be taken for personnel verifying the overpull.

⚠ CAUTION

There should be minimum upper movement on the landing joint at any point during the overpull. Actual nominal lockring clearance is 1/8". If vertical movement is greater, check and verify if Seal Assembly has been lifted off from its land off position. If such situation arises, collapse lockring and retrieve Seal Assembly to rig floor to troubleshoot.



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NOTE If initial over pull test is unsuccessful, do not immediately collapse the lockring for a second installation attempt. Conduct the following steps prior to Support Bushing retrieval:

- Ensure Packoff Support Bushing Running Tool is backed off 3-1/2 turns.
- Re-apply the installation load (10,000 - 20,000 lbs) to force the Packoff and Lockring down into the groove of the housing.
- Re-attempt 50,000 lbs over pull test.

⚠ CAUTION

If a successful over pull test is not achieved after three installation attempts, follow steps 4.6.3 and 4.6.4 to fully retract the lockring and remove the Packoff Support Bushing. Retrieve the Packoff Support Bushing and lockring to the rig floor for trouble shooting.

NOTE **Dovetail seals must be replaced prior to re-installing the Packoff Support Bushing.**

3.8. Testing Between the 9-5/8" Packoff Upper Seals & 7" Packoff Seals (ID & OD)

3.8.1. Locate the upper test port on the Housing and remove fitting from the port.

3.8.2. Attach a hydraulic test pump to the open test port and inject fluid into the seal assembly to the ***10,000 psi maximum.***

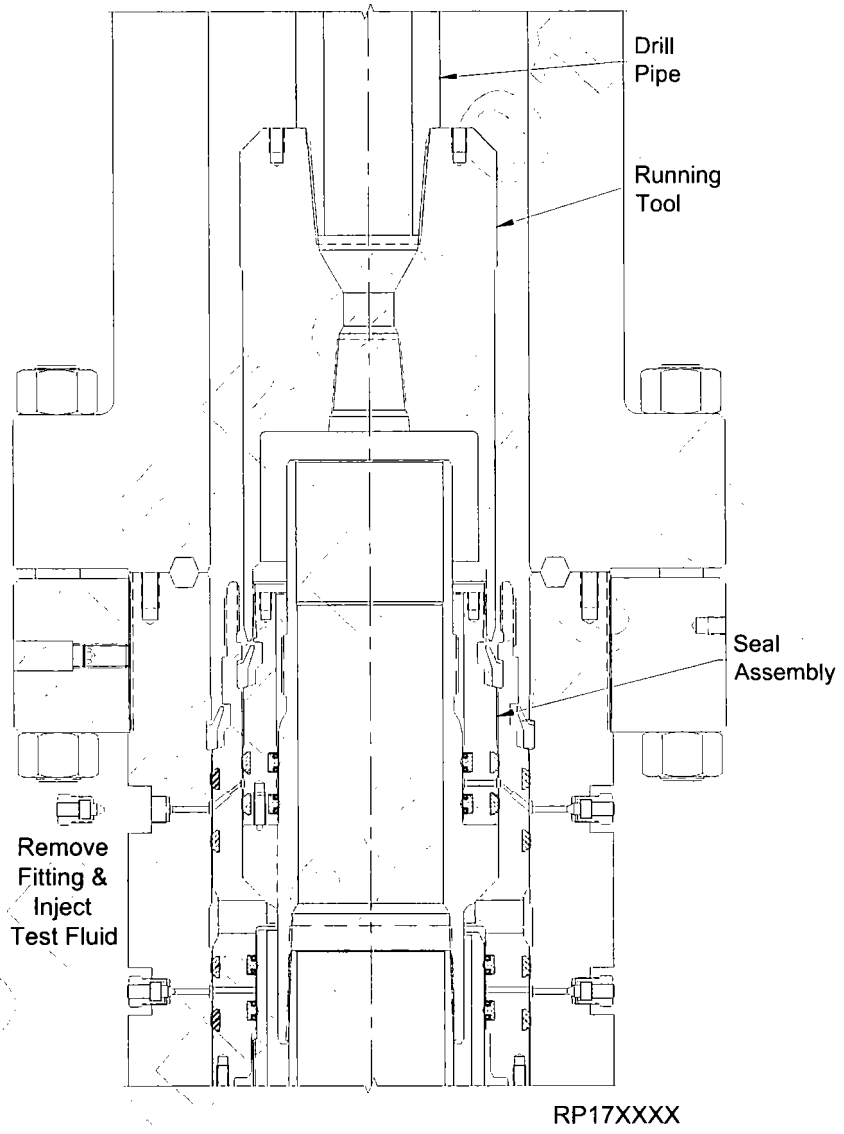
WARNING Do NOT over pressurize!

3.8.3. Hold and monitor the test pressure for 15 minutes or as required by the Drilling Supervisor.

3.8.4. After a satisfactory test is achieved, carefully bleed off the test pressure, remove the test pump, re-install fitting in the open port.

3.8.5. Retrieve the Tool by turning the drill pipe (with chain tongs) clockwise approximately 3-1/2 turns or until it comes free from the Seal Assembly. A straight lift will retrieve the Tool.

3.8.6. Remove the Tool from the drill string. Clean, grease, and store the Tool as required.



⚠ CAUTION

The following procedure should be followed **ONLY** in the event Retrieval of the Seal Assembly is necessary. If the Seal Assembly was properly landed, skip this procedure.

3.9. Retrieval of Seal Assembly

3.9.1. Make up a joint of drill pipe to the top of the ***Seal Assembly Running Tool (Item ST13).***

3.9.2. Lower the Running Tool through BOP stack and land on top of Seal Assembly.

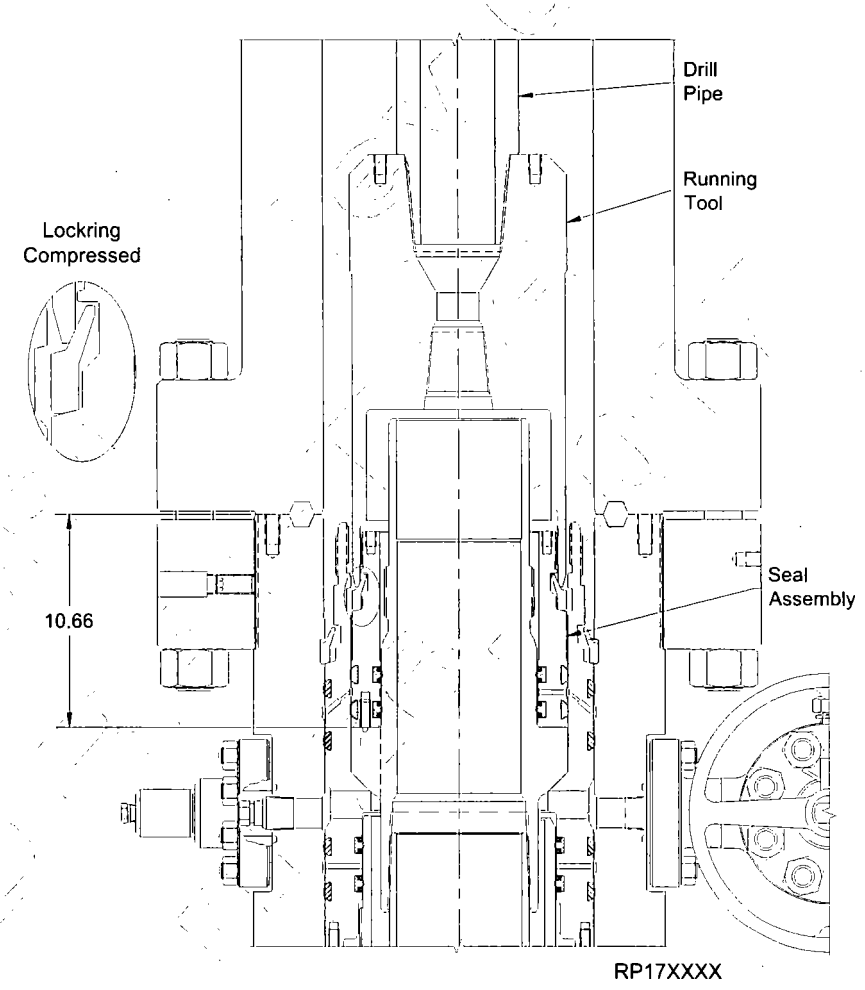
3.9.3. Turn the Tool counterclockwise approximately 6-1/2 turns or the number of turns documented per section 4.3, until the tool fully engages the lockring and a firm stop is encountered. Back off from this point a maximum 1/8 of a turn.

3.9.4. Retrieve the Seal Assembly by pulling vertically (approximately 3,000 lbs).

⚠WARNING If overpull exceeds this value, repeat counter-clockwise rotation until a firm stop is encountered and repeat overpull.

3.9.5. To remove Seal Assembly from the running tool, install ***Lockring Installation Tool (Item ST14)*** and fully compress the Lockring.

NOTE Dovetail seals must be replaced prior to re-installing the Seal assembly.



3.10. Install the Bit Guide

3.10.1. Examine the ***Combination Tool (Item ST15)***. Verify the following:

- lift lugs are intact and undamaged
- all threads are clean and undamaged
- o-ring seals are in place and undamaged

3.10.2. Orient the Tool as illustrated.

3.10.3. Make up a joint of drill pipe to the top of the Tool.

WARNING Make sure the lift lugs are down and the elastomer is up when latching into the Bit Guide.

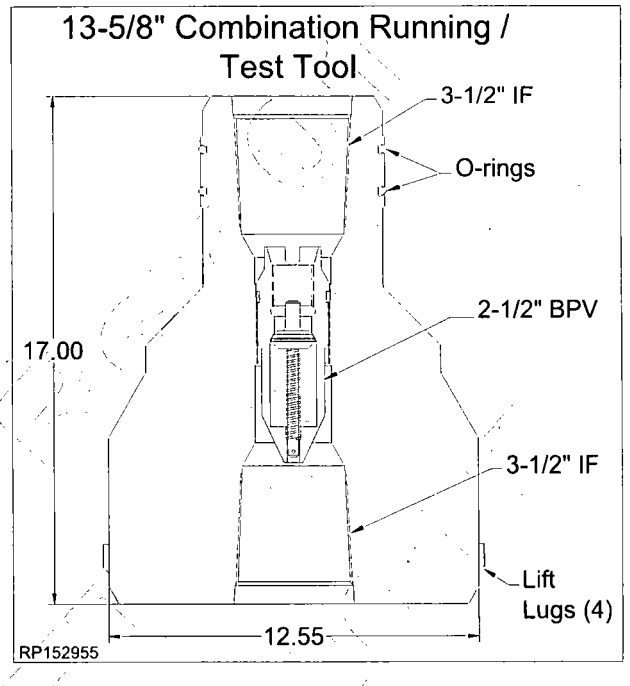
3.10.4. Examine the ***Bit Guide (Item ST16)***. Verify the following:

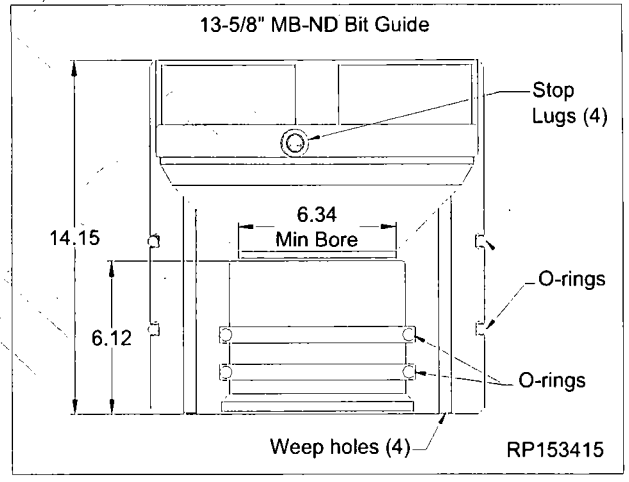
- bore is clean and free of debris
- stop lugs are properly installed
- j-slots are clean and free of debris
- o-ring seals are in place and undamaged

3.10.5. Orient the Bit Guide as illustrated.

3.10.6. Lubricate OD of Bit Guide and O-ring seals with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.



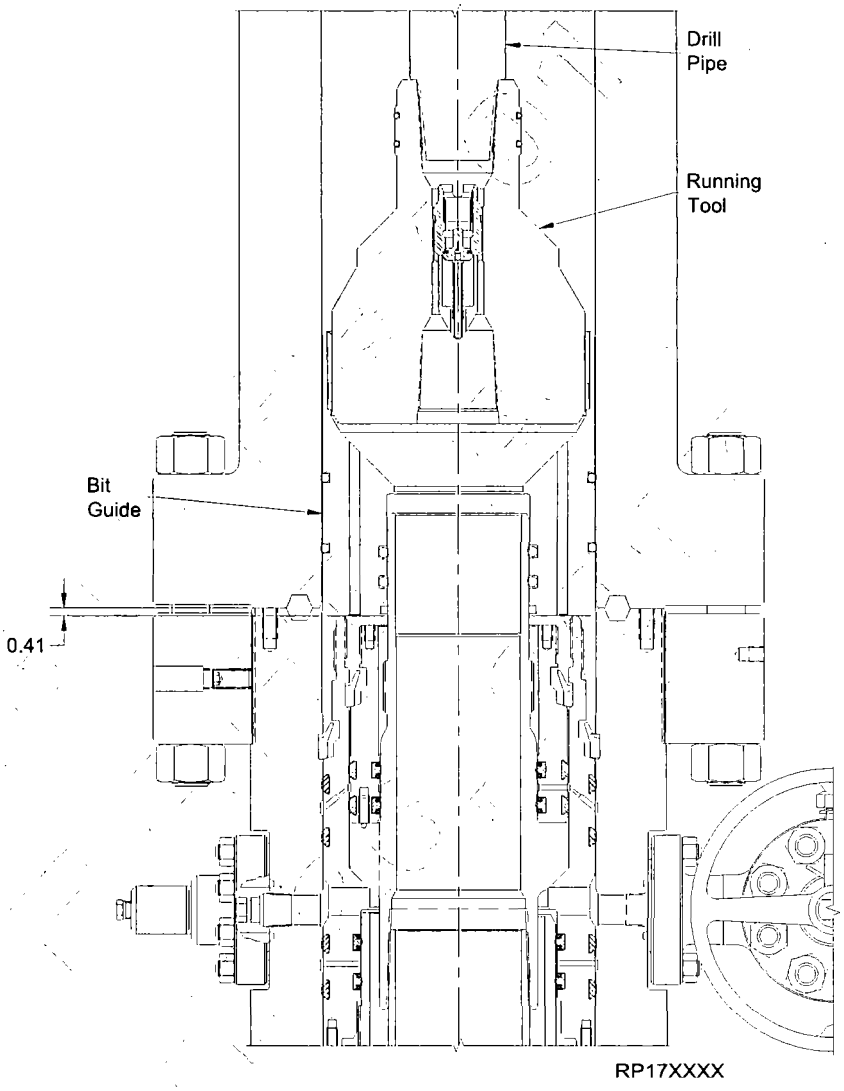


Stage 3.0 — 7" Casing

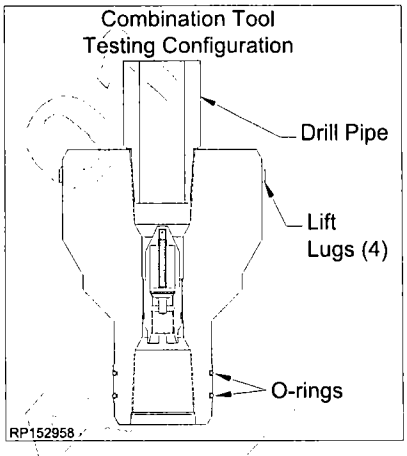
3.10.7. Lower the Tool into the Bit Guide and turn the drill pipe 1/4 turn clockwise.

3.10.8. Slowly lower the Bit Guide assembly through the BOP stack, measure and record, until it lands on top of the Packoff Support Bushing.

3.10.9. Disengage the Tool from the Bit Guide by turning the drill pipe counterclockwise 1/4 turn and lifting straight up.



3.11. Test the Seal Assembly



3.11.1. After retrieving the Tool, remove the drill pipe out of the Tool.

3.11.2. Position the ***Combination Tool (Item ST15)*** with the lift lugs up and make up the drill pipe to the top of the Tool to the thread manufacturer's recommended shoulder torque.

NOTE Verify Combination Tool seal neck will drift ID bore of casing or Hanger prior to install. Major downtime will occur if Tool will not drift.

3.11.3. Open the uppermost annulus valve of the Housing.

3.11.4. Lower the Tool through the BOP stack, measure and record, until it lands on the Bit Guide and into the Casing Hanger.

3.11.5. Close the BOP rams on the drill pipe and test to ***10,000 psi maximum.***

⚠WARNING Do NOT over pressurize!

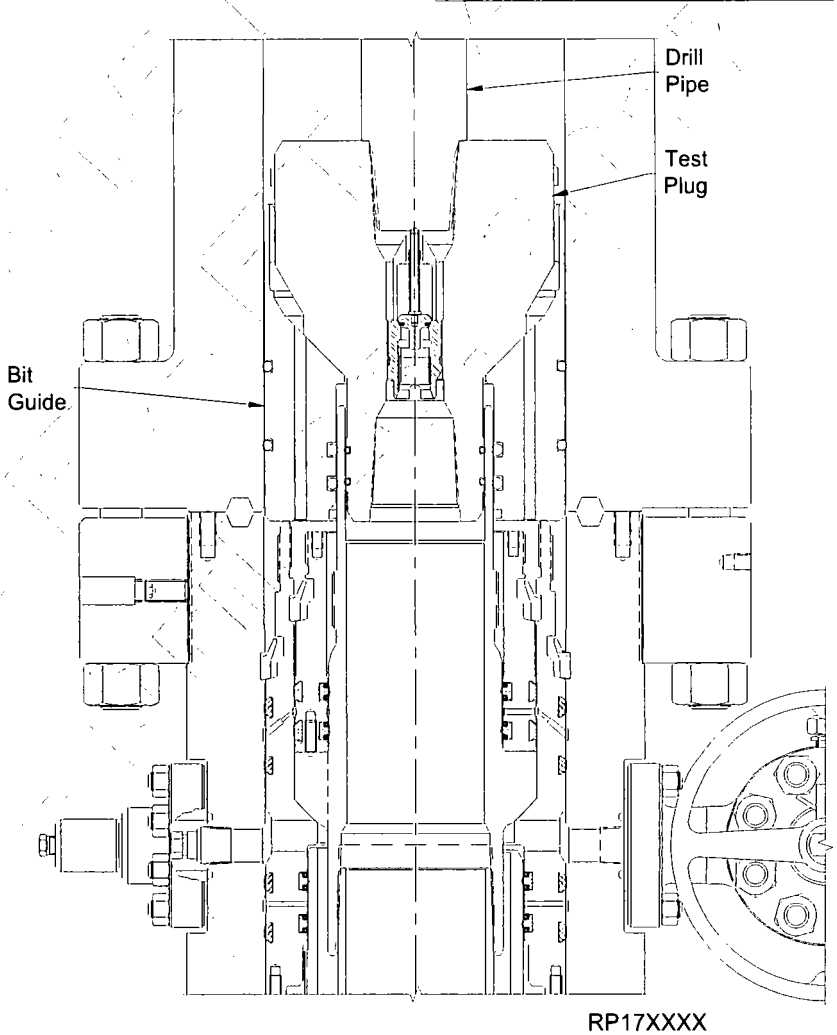
3.11.6. Monitor the open outlet for signs of leakage past the Seal Assembly.

3.11.7. After a satisfactory test is achieved, release pressure, and open the rams.

3.11.8. Slowly retrieve the Tool to the rig floor.

3.11.9. Close upper annulus valve.

3.11.10. Drill as required.



3.12. Retrieve the Bit Guide After Drilling

3.12.1. Remove the drill pipe out of the Tool.

3.12.2. Make up the Tool to the drill pipe with the lift lugs down and the elastomer up.

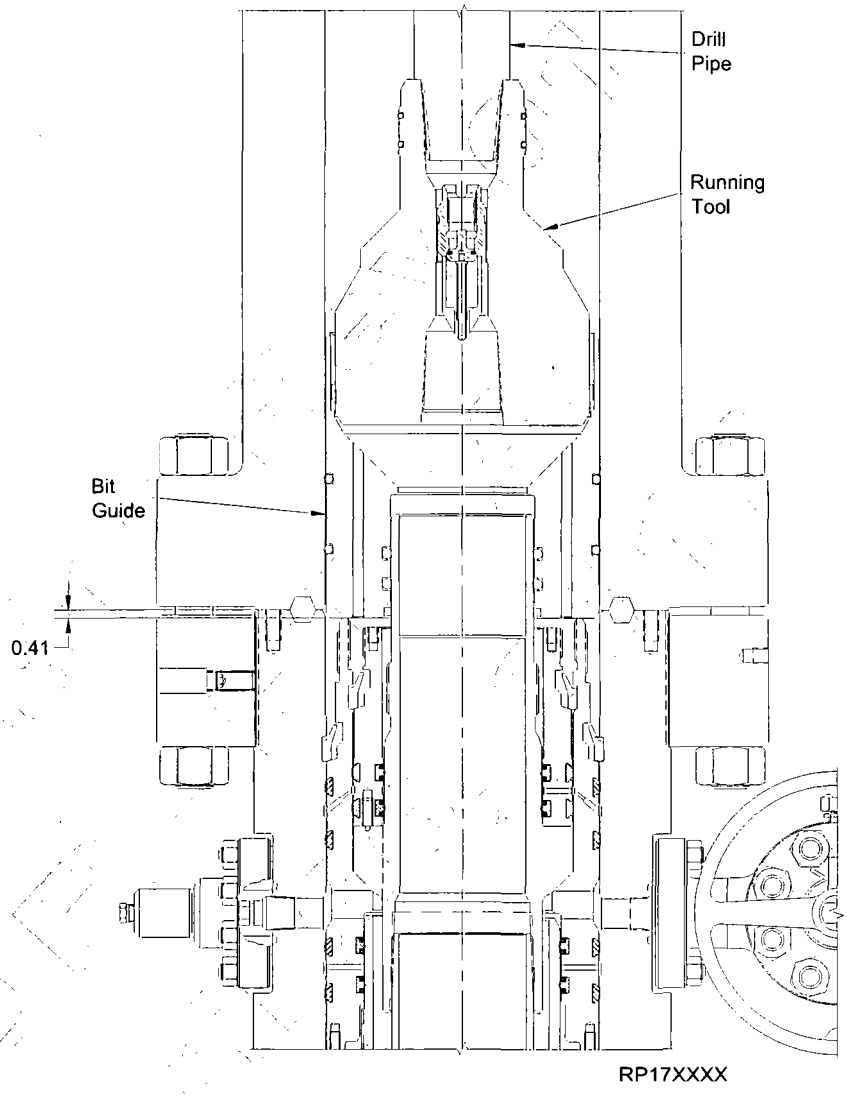
3.12.3. Slowly lower the Tool into the Bit Guide.

3.12.4. Turn the Tool clockwise until the drill pipe drops approximately 2". This indicates the lugs have aligned with the Bit Guide slots.

3.12.5. Turn clockwise 1/4 turn to fully engage the lugs in the Bit Guide.

3.12.6. Slowly retrieve the Bit Guide and remove it and the Tool from the drill string.

3.12.7. Clean, grease and store the Tool and Bit Guide as required.



Stage 3.0 — 7" Casing

3.12.8. With the well safe and secure, nipple down the BOP stack.

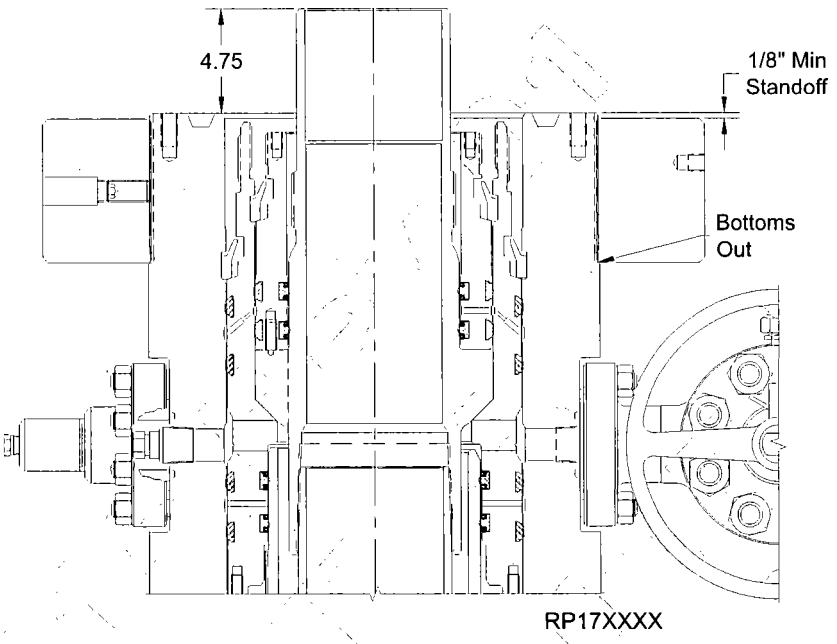
3.12.9. Masure and record Hanger neck/ standoff height.

⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.



SAFETY NOTE: Always wear proper PPE (Personal Protective Equipment) such as safety shoes, safety glasses, hard hat, gloves, etc. to handle and install equipment.

NOTE

1. **Reconfirm the Casing OD and grade. Remove and clean loose scale from Casing OD.**
2. **Verify Slip Bowl taper is smooth, clean with no corrosion and damage free.**
3. **Disassembly of the Hanger to re-orient the slips is not required.**

3.13. Hang Off the Casing (Emergency)

NOTE The following procedure should be followed ONLY if the casing should become stuck. If the Mandrel Casing Hanger was used, skip this stage.

NOTE Since the IC-2 Casing Hanger is an automatic, weight energized Hanger, it is necessary to ensure there is adequate casing weight to create an annular seal.

3.13.1. Run the casing through the BOP to the required depth and cement the hole as required.

3.13.2. Drain the Casing Head bowl through its side outlet.

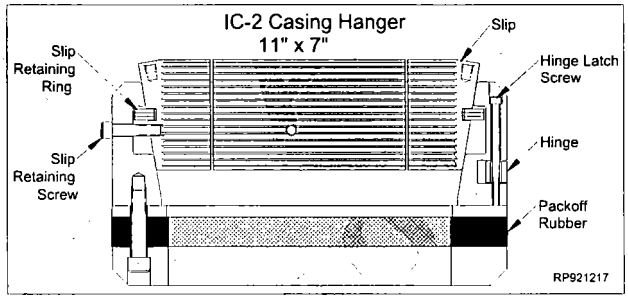
3.13.3. Measure Slip Bowl from load shoulder to top of Housing and record.

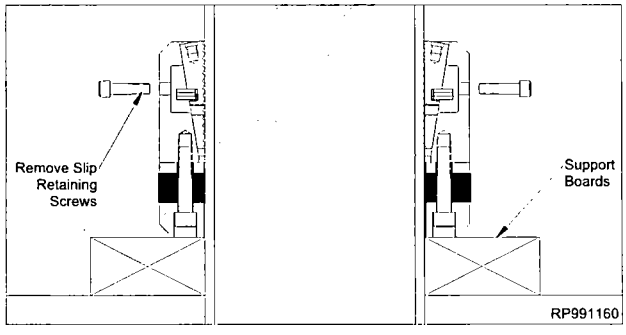
3.13.4. There are two methods used to install the Casing Hanger:

- from the rig floor through a full opening BOP stack, provided no casing collars are between the rig floor and the Head
- underneath the BOP stack, provided the well is safe and under control. This option allows the Hanger bowl to be inspected and thoroughly washed prior to the Hanger Installation.

3.13.5. Examine the ***Casing Hanger (Item E2).*** Verify the following:

- the packoff rubber is clean and undamaged
- all screws are in place and intact
- slips are intact, clean, and undamaged
- seal element is not compressed beyond the OD of the Hanger





3.13.6. Remove the latch screw to open the Hanger.

WARNING Do NOT over open the Hanger. This can damage the Packoff Rubber.

3.13.7. Place two boards of equal size against the casing to support the Hanger.

3.13.8. Wrap the Hanger around the casing and replace the latch screws.

3.13.9. Verify that the seal element is not compressed beyond the OD of the Hanger. If it is, loosen the cap screws in the bottom of the Hanger. The seal **MUST NOT BE COMPRESSED** prior to slacking off casing weight onto the Hanger.

3.13.10. Remove the slip retaining screws.

3.13.11. Grease the Hanger body and packoff rubber.

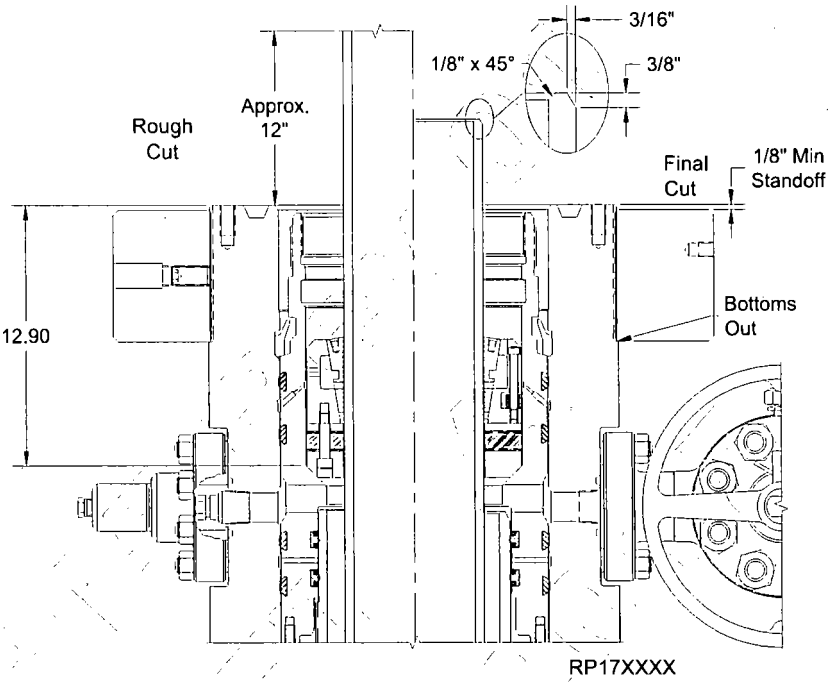
Stage 3.0 — 7" Casing

3.13.12. Remove the boards and carefully lower the Hanger into the Housing, using a cat-line to center the casing, if necessary. Measure and record.

3.13.13. Once slips are landed, measure from top of Housing to verify that slip bowl is on the load shoulder prior to putting weight on the slips.

3.13.14. When the Hanger is down, pull tension on the casing to the desired hanging weight + 1-1/2" then slack off.

NOTE A sharp decrease on the weight indicator will signify that the Hanger has taken weight and at what point.



3.13.15. Rough cut the casing at approximately 12" above the flange of the Housing.

3.13.16. Move the BOP and excess casing out of the way.

NOTE Always physically measure the exact cutoff height by measuring the bottom bore of the next component to be installed and subtract 1/4" from this dimension, prior to making the final cutoff.

3.13.17. Final cut the casing at 4-1/4" ±1/8" above the top of the Housing flange. Place a 3/8" x 3/16" bevel on the casing stub and remove all burrs and sharp edges.

NOTE The ID edge of the casing may be ground slightly to allow drill pipe and casing collars to pass smoothly.

3.14. Install the TA Cap

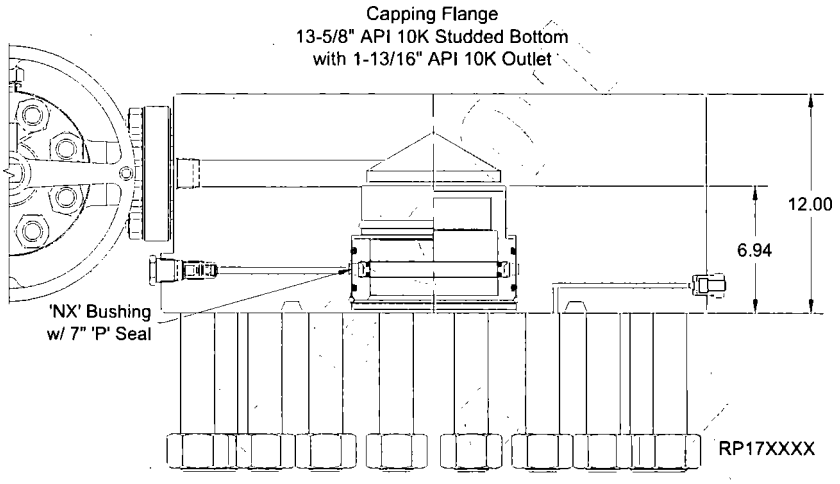
3.14.1. Examine the ***TA Cap (Item B1)***. Verify the following:

- bore is clean and free of debris
- seal areas are clean and undamaged
- all peripheral equipment is intact and undamaged
- ***'NX' Bushing (Item C2 or E3)*** is properly installed, clean and undamaged

3.14.2. Orient the TA Cap as illustrated.

3.14.3. Clean the mating ring grooves of the Housing and TA Cap. Lubricate each groove, the ID of the TA Cap and the OD of the Hanger neck/ casing stub with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

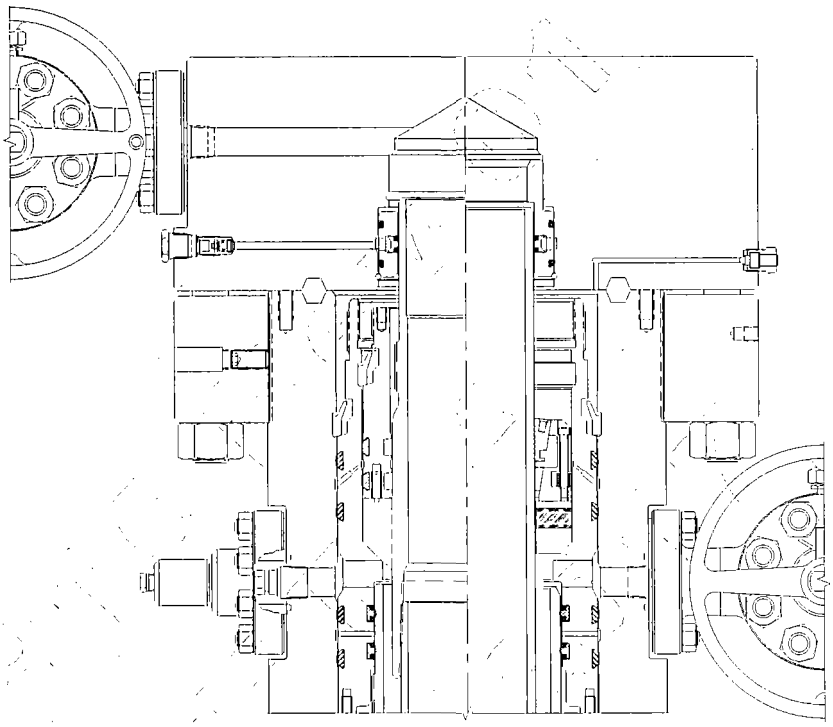


Stage 3.0 — 7" Casing

3.14.4. Install a new ***BX-159 Ring Gasket (Item A20)*** into the ring groove of the Housing.

3.14.5. Orient the TA Cap per customer's requirements and carefully lower the TA Cap over the casing stub until it lands on the ring gasket.

3.14.6. Make up the connection using the ***studs and nuts provided with the TA Cap*** and tighten the connection in an alternating cross fashion to the torque referenced in the chart in the back of this manual.



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⚠ CAUTION

Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counterclockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.

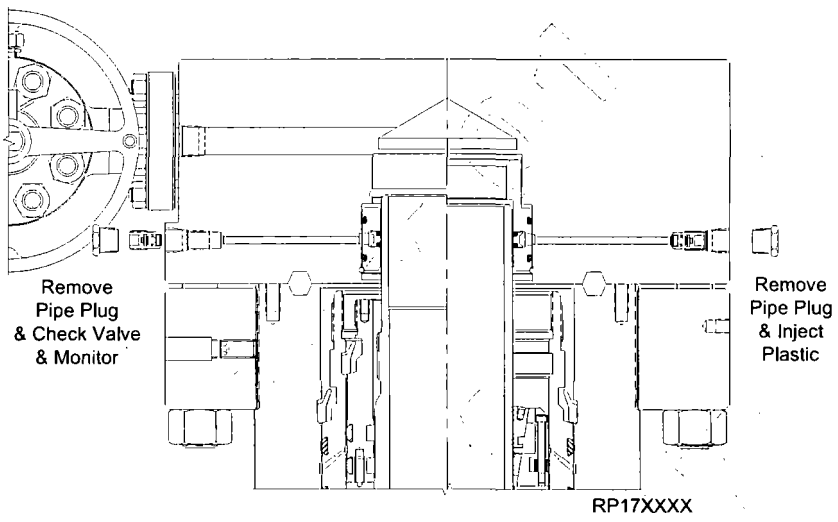
Stage 3.0 — 7" Casing

3.15. Energize the 'NX' Bushing 'P' Seal

⚠ CAUTION Extreme care and time must be used when injecting plastic packing into 'NX' Bushing with thin-walled cross-sections. Pump plastic packing slowly and allow additional time for pressure to stabilize between pump iterations on the hydraulic pump.

⚠WARNING

SEE RP-000589 PROCEDURE FOR PACKING INJECTION AND ENERGIZING THE 'P' SEALS

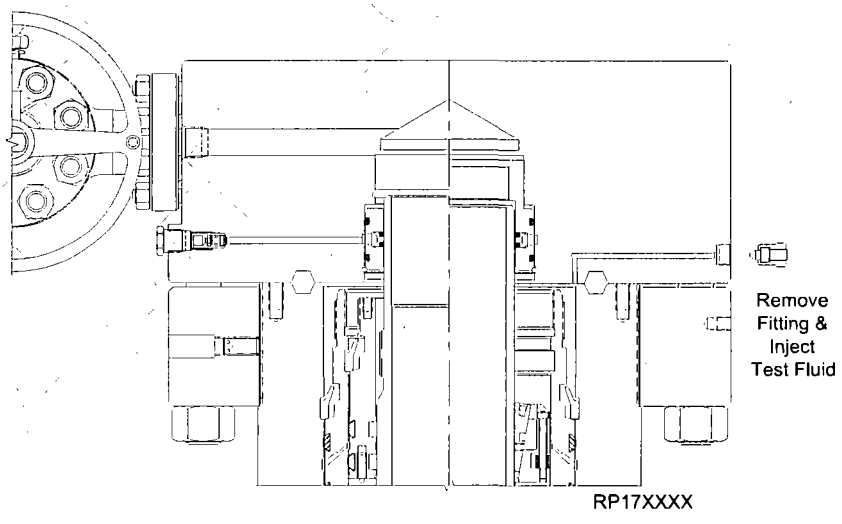


3.16. Test the Connection

3.16.1. Locate the port on the OD of the TA Cap for testing the connection and remove the fitting.

3.16.2. Install a test pump to the open port and inject test fluid to ***10,000 psi or 80% of casing collapse—whichever is less.***

NOTE If Emergency Hanger was installed, do not exceed 80% of casing collapse.



NOTE Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.

⚠WARNING Do NOT over pressurize.

3.16.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

3.16.4. Once a satisfactory test is achieved, carefully bleed off all test pressure and remove the test pump.

3.16.5. Re-install the fitting.

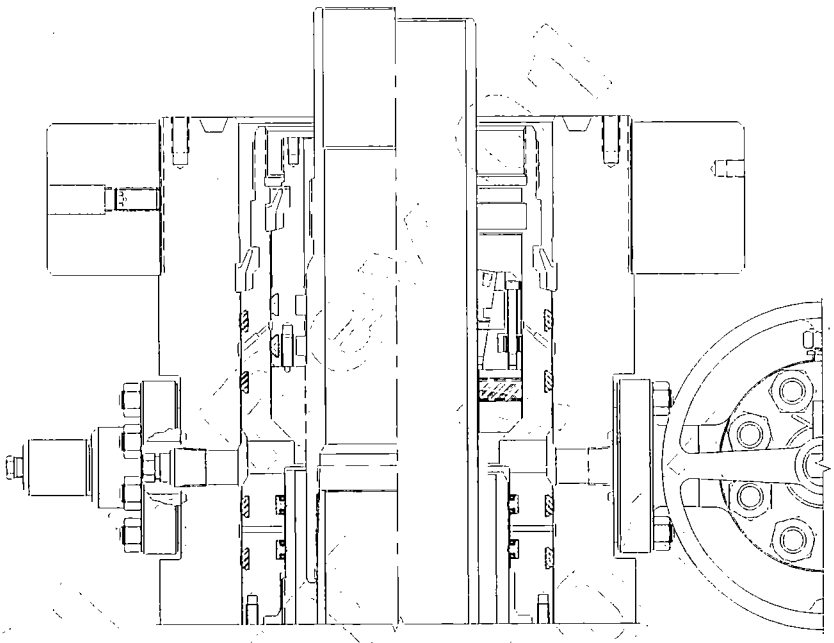
3.17. Remove the TA Cap

NOTE Verify the well is safe and secure and that there is no trapped pressure in the well.

3.17.1. With the well safe and secure, nipple down the TA Cap.

3.17.2. With the appropriate lifting device, lift the TA Cap straight up and retrieve to the rig floor.

3.17.3. Inspect the Hanger neck/ casing stub for signs of damage and report immediately.



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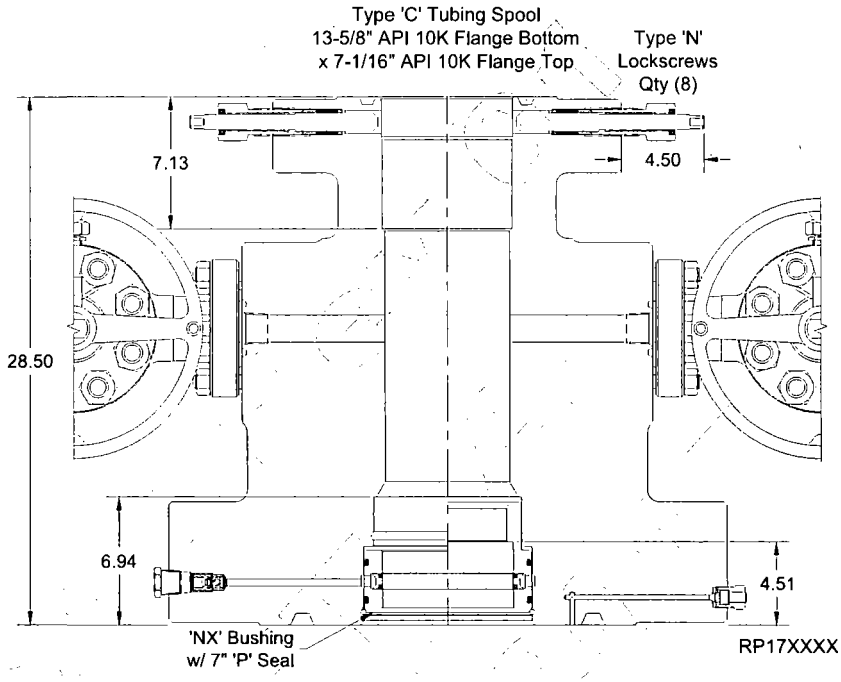
Stage 3.0 — 7" Casing

3.18. Install the Tubing Spool

3.18.1. Examine the ***Tubing Spool (Item C1).*** Verify the following:

- bore is clean and free of debris
- ***'NX' Bushing (Item C2 or E3)*** is properly installed and undamaged
- ring grooves and seal areas are clean and undamaged
- peripheral equipment is intact and undamaged
- all lockscrews are retracted from the bore as indicated



WARNING All Lockscrews *MUST* achieve positions as indicated. Otherwise contact Surface Engineering for guidance.

3.18.2. Lubricate the ID of the 'P' seal or 'T' seals (depending on the Bushing installed) and the OD of the casing stub with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

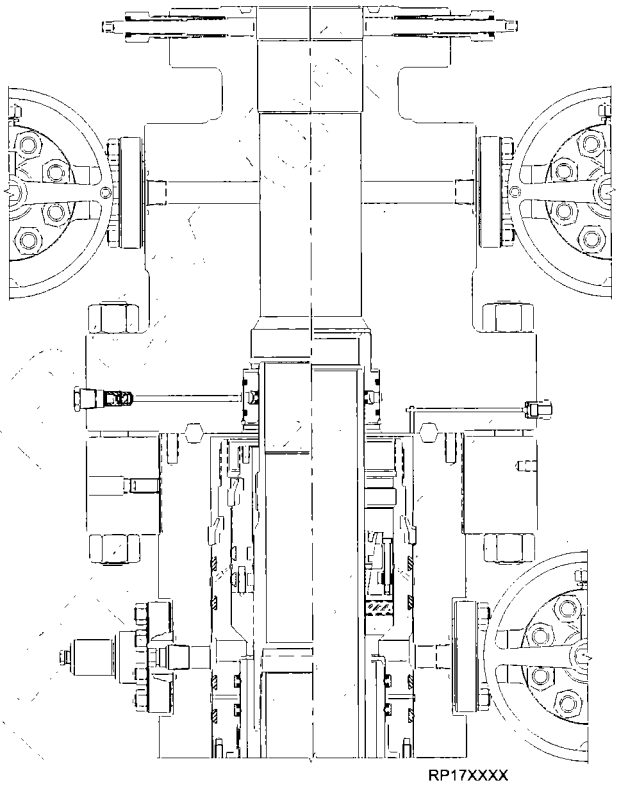
3.18.3. Install a new ***Ring Gasket BX-159 (Item A21)*** into the ring groove of the MN-DS Housing.

3.18.4. Lift and suspend the Tubing Spool over the casing stub, ensuring it is level. Align the spool outlets as required. Align the bolts of the Spool as required (two hole).

3.18.5. Carefully lower the Tubing Spool and land it on the Housing flange.

WARNING Do NOT damage the 'P' seal or its sealing ability will be impaired.

3.18.6. Make up the connection using the ***studs and nuts (Item A20)*** in an alternating cross fashion to the torque referenced in the chart in the back of this manual.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⚠ CAUTION

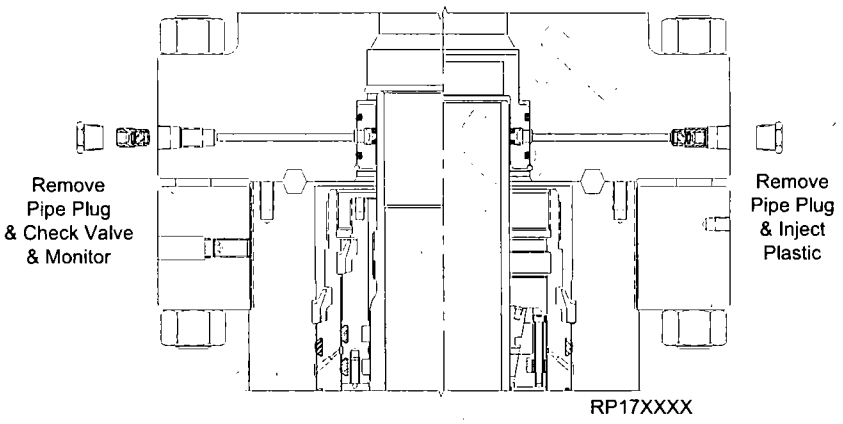
Ensure and verify Threaded Flange is properly installed to the Casing Head.

1. **Rotate the threaded flange counter-clockwise (left hand thread) to a positive stop and bottom out threaded flange on Casing Head flange shoulder.**
2. **Verify make up dimension. Dimension from the top of the threaded flange to the top of the casing head must be 1/8" or greater.**

Threaded flange must remain shouldered out during installation.

3.19. Energize the 'NX' Bushing 'P' Seal

⚠ CAUTION Extreme care and time must be used when injecting plastic packing into 'NX' Bushing with thin-walled cross-sections. Pump plastic packing slowly and allow additional time for pressure to stabilize between pump iterations on the hydraulic pump.



⚠WARNING

SEE RP-000589

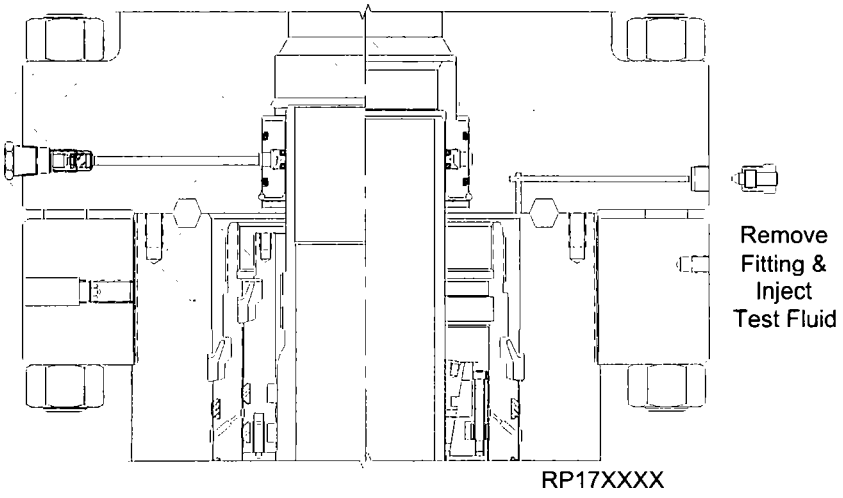
PROCEDURE FOR PACKING INJECTION AND ENERGIZING THE 'P' SEALS

3.20. Test the Connection

3.20.1. Locate the port on the bottom flange of the Tubing Spool for testing the connection and remove the fitting.

3.20.2. Install a test pump into the port and inject test fluid to ***10,000 psi or 80% of casing collapse—whichever is less.***

***NOTE** If Emergency Hanger was installed, do not exceed 80% of casing collapse.*



NOTE Contact the Drilling Supervisor to determine the collapse pressure of the specific grade and weight of the casing used.

⚠WARNING Do NOT over pressurize.

3.20.3. Hold and monitor the test pressure for fifteen minutes or as required by the Drilling Supervisor.

3.20.4. Once a satisfactory test is achieved, carefully bleed off the test pressure and remove the test pump.

3.20.5. Re-install the fitting.

NOTE Not all injection and testing port configurations are the same and should be handled accordingly.

3.21. Install the Lower Master Valve

3.21.1. Examine the ***Lower Master Valve.*** Verify the following:

- bore is clean and free of debris
- ring groove are clean and undamaged
- drift diameter

3.21.2. Orient the Lower Master Valve as required.

3.21.3. Clean the mating ring grooves of the Tubing Spool and the Lower Master Valve. Lubricate each groove with a light coat of oil or grease.

WARNING Excessive oil or grease may prevent a positive seal from forming.

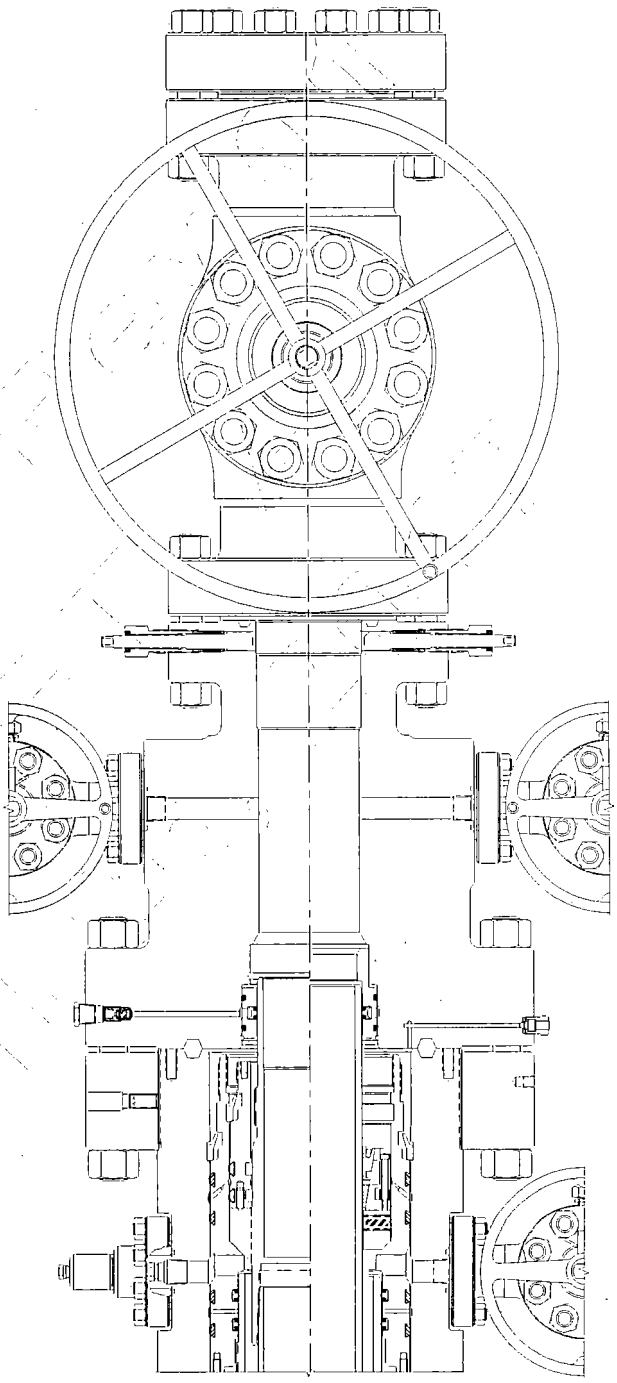
3.21.4. Install a new ***Ring Gasket BX-156 (Item C8)*** into the ring groove of the Tubing Spool.

3.21.5. With the appropriate lifting device, lift and suspend the Lower Master Valve over the Tubing Spool, ensuring assembly is level. Align the bolts as required (two hole).

3.21.6. Slowly and carefully lower the Lower Master Valve until it lands on the Tubing Spool ring gasket.

3.21.7. Make up the connection using the ***studs and nuts (Item C9)*** in an alternating cross fashion to the torque referenced in the chart in the back of this manual.

3.21.8. Test as required.



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Recommended Procedure for Field Welding Pipe to Wellhead Parts for Pressure Seal

The following procedure is a direct extraction (except for the numeric footnote designators) from the Fourteenth Edition of API 6A[1]. Editorial footnotes have been added to provide additional information that may be of benefit when developing procedures for specific field welding applications. The recommended procedure and footnotes are for general information purposes and it should be mentioned that Cameron is not responsible for determining or administering any field welding practices. The organization performing the welding should qualify their welding procedure(s) and welder(s) in accordance with applicable codes and standards[2]. The success of any field weld should be verified by subsequent hydrostatic test at the direction of the customer.

B.1 Introduction and Scope. - The following recommended procedure has been prepared with particular regard to attaining pressure-tight welds when attaching casing heads, flanges, etc., to casing. Although most of the high strength casing used (such as P-110) is not normally considered field weldable, some success may be obtained by using the following or similar procedures[3].

⚠ CAUTION In some wellheads, the seal weld is also a structural weld and can be subjected to high tensile stresses. Consideration must therefore be given by competent authority to the mechanical properties of the weld and its heat affected zone.

1. The steels used in wellhead parts and in casing are high strength steels that are susceptible to cracking when welded. It is imperative that the finished weld and adjacent metal. be free from cracks, The heat from welding also affects the mechanical properties. This is especially serious if the weld is subjected to service tension stresses.

2. **This procedure is offered only as a recommendation. The responsibility for welding lies with the user and results are largely governed by the welder's skill. Weldability of the several makes and grades of casing varies widely, thus placing added responsibility on the welder.** Transporting a qualified welder to the job, rather than using a less-skilled man who may be at hand, will, in most cases, prove economical. The responsible operating representative should ascertain the welder's qualifications and if necessary, assure himself by instruction or demonstration, that the welder is able to perform the work satisfactorily.

B.2 Welding conditions. - Unfavorable welding conditions must be avoided or minimized in every way possible, as even the most skilled welder cannot successfully weld steels that are susceptible to cracking under adverse working conditions, or when the work is rushed. Work above the welder on the drilling floor should be avoided. The weld should be protected from dripping mud, water, and oil and from wind, rain, or other adverse weather conditions. The drilling mud, water, or other fluids must be lowered in the casing and kept at a low level until the weld has properly cooled. It is the responsibility of the user to provide supervision that will assure favorable working conditions, adequate time, and the necessary cooperation of the rig personnel.

B.3 Welding. - The welding should be done by the shielded metal-arc[4] or other approved process.

B.4 Filler Metal. - After the root pass, low hydrogen electrodes or filler wires of a yield strength equal to the casing yield strength should be used[5]. The low hydrogen electrodes include classes EXX15, EXX16, EXX18, EXX28 of AWS A5.1 (latest edition): *Mild Steel Covered Arc- Welding Electrodes** and AWS A5.5 (latest edition): *Low Alloy Steel Covered Arc-Welding Electrodes**. Low hydrogen electrodes should not be exposed to the atmosphere until ready for use. Electrodes exposed to atmosphere should be dried 1 to 2 hours at 500 to 600°F *(260 to 316°C)* just before use[6].

*Available from the American Society for Testing and Materials, 1916 Race street, Philadelphia, Pa. 19103.

B.5 Preparation of Base Metal. - The area to be welded should be dry and free of any paint, grease, scale, rust or dirt.

B.6 Preheating. - Both the casing and the wellhead member should be preheated to 250-400°F *(121 to 204°C)* for a distance of at least 3 inches *(76.2 mm)* on either side of the weld location, using a suitable preheating torch. Before applying preheat, the fluid should be bailed out of the casing to a point several inches *(mm)* below the weld location. The preheat temperature should be checked by the use of heat sensitive crayons. Special attention must be given to preheating the thick sections of wellhead parts to be welded, to insure uniform heating and expansion with respect to the relatively thin casing[7].

NOTE Preheating may have to modified because of the effect of temperature on adjacent packing elements which may be damaged by exposure to temperatures 200°F ***(93°C)*** and higher. Temperature limitations of the packing materials should be determined before the application of preheat.

⚠WARNING If Casing Head is designed with an internal o-ring bottom prep and the internal o-ring is installed, ensure the o-ring preheat temperature does not exceed 300°F

Recommended Procedure for Field Welding Pipe to Wellhead Parts for Pressure Seal

B7. Welding technique. - Use a 1/8 or 5/32 inch *(3.2 or 4.0 mm)* E6010 electrode[8] and step weld the first bead (root pass); that is, weld approximately 2 to 4 inches *(50 to 100 mm)* and then move diametrically opposite this point and weld 2 to 4 inches (50 to 100 mm). Then weld 2 to 4 inches *(50 to 100 mm)* halfway between the first two welds, move diametrically opposite this weld, and so on until the first pass is completed. The second pass should be made with a 5/32 *(4.0 mm)* low hydrogen electrode of the proper strength and may be continuous. The balance of the welding groove may then be filled with continuous passes without back stepping or lacing, using a 3/16-inch *(4.8 mm)* low hydrogen electrode. All beads should be stringer beads with good penetration, and each bead after the root pass should be thoroughly peened before applying the next bead. There should be no undercutting and welds shall be workmanlike in appearance.

NOTE ***E7018 RODS HAVE BEEN SUCCESSFULLY USED FOR ROOT PASS.***

1. Test ports should be open when welding is performed to prevent pressure build-up within the test cavity.
2. During welding the temperature of the base metal on either side of the weld should be maintained at 250°F *(121°C)* minimum.
3. Care should be taken to insure that the welding cable is properly grounded to the casing, but ground wire should not be welded to the casing or the wellhead. Ground wire should be firmly clamped to the casing, the wellhead, or fixed in position between pipe slips. Bad contact may cause sparking, with resultant hard spots beneath which incipient cracks may develop; The welding cable should not be grounded to the steel derrick, nor to the rotary-table base.

B.8 Cleaning. - All slag or flux remaining on any welding bead should be removed before laying the next bead. This also applies to the completed weld.

B.9 Defects. - Any cracks or blow holes that appear on any bead should be removed to sound metal by chipping or grinding before depositing the next bead.

B.10 Postheating. - For the removal of all brittle areas on high strength steel casing, a post heat temperature of 1050-1100°F *(566 to 593°C)*[9] is desirable. It is recognized, however, that this temperature is difficult or impossible to obtain in the field, and that the mechanical properties of the wellhead parts and the pipe may be considerably reduced by these temperatures. As a practical matter, the temperature range of 500-900°F *(260 to 482°C)* has been used with satisfactory results.

B.11 Cooling. - Rapid cooling must be avoided. To assure slow cooling, welds should be protected from extreme weather conditions (cold, rain, high winds, etc.) By the use of a blanket of asbestos[10] or other suitable insulating material. Particular attention should be given to maintaining uniform cooling of the thick sections of the wellhead parts and the relatively thin casing, as the relatively thin casing will pull away from the head or hanger if allowed to cool more rapidly. The welds should cool in air to 250°F *(121°C)* (measured with a heat sensitive crayon) prior to permitting the mud to rise in the casing.

NOTE The above procedure is presented for the convenience of our customers. Please Contact Cameron's Land Wellhead engineering Group in Houston, Texas if any additional assistance is required.

Recommended Procedure for Field Welding Pipe to Wellhead Parts for Pressure Seal

[1]API SPECIFICATION 6A - Fourteenth Edition, March 1983, Appendix B, Page 109

[2]ASME Section IX is one such code that provides guidelines for the qualification of welding procedures and welders. It specifically assigns the responsibility of qualification of welding procedures and welders to the organization with "responsible operational control" over the production welding.

[3]Many of the high strength casing grades are weldable but weldability will vary from one casing manufacturer to another even within a given casing grade. The weldability of any base metal is determined largely by its chemical composition. Casing materials, even within a given grade vary widely in their chemical makeup. This necessitates the qualification of welding procedures, not just for a particular grade but also for each different chemical makeup. When qualifying welding procedures intended for field application, it is recommended that field welding conditions be simulated as much as is possible. It is very important that the welding parameters and techniques qualified are duplicated in the field.

[4]American Welding Society designation SMAW (Shielded Metal Arc Welding), commonly referred to as "stick welding."

[5]Finding filler metals that will match the strength of the high strength casings will be very difficult if not impossible to do. For instance, E12018M is the highest strength electrode classified by AWS A5.5. It has a minimum specified yield strength of 108 ksi. That does not meet the minimum specified yield strength for P-110 or Q-125 casing. When joining carbon and low alloy materials of different strengths, it is standard practice to use a carbon steel or low alloy filler metal that will match, as a minimum, the strength of the weaker of the two materials being joined. When dealing with the high strength casings such as N-80, P-110 and Q-125, the material to which any one of these is to be joined will probably be the weaker of the two. In such cases, filler metals should be selected based on the minimum specified strength of the weaker material. It is the responsibility of the user to specify the size of weld required based on anticipated loads and strength of weld metal being used.

[6]The reason for maintaining low moisture in the electrodes is to minimize the amount of hydrogen that is liberated at the arc during welding. When welding high strength low alloy steels, hydrogen can promote delayed cold cracking in hardened weld metals and heat affected zones. One of the ways to reduce the chance of cold cracking is to minimize the hydrogen potential of the electrodes through moisture control.

[7]Internal pre-heaters for preheating the casing and wellhead member from the inside are available from Cameron and are highly recommended.

[8]E6010 electrodes contain high levels of moisture in their coating. Hydrogen which is liberated from moisture under the intense heat of the electric arc, migrates into the weld metal and heat affected zone and can promote hydrogen induced cold cracking as the weld cools down. For this reason, some companies elect not to use E6010 electrodes for the first pass, even though there are benefits from the standpoint of operator appeal and penetration. If they are used, precautions must be taken to get rid of the diffusible hydrogen before the weld cools from preheating temperatures. Given enough time at elevated temperatures, the hydrogen will diffuse out of the metal. The rate of diffusion is time and temperature dependant. Therefore, the diffusion process can be promoted through the use of high preheats, post weld stress relief, post weld soaks at or above preheat temperatures and slow cooling.

NOTE ***E7018 RODS HAVE BEEN SUCCESSFULLY USED FOR ROOT PASS***

[9]Low alloy welds that are required to meet NACE MR0175 specification must be stress relieved at 1150°F *(621°C)* minimum.

[10]For health reasons, Cameron strongly recommends **against** the use of asbestos insulating blankets . There are many good non-asbestos materials that can be used as an acceptable substitute.

Torque Chart

Recommended Makeup Torques for Flange Bolting Ft•Lbf Per API 6A: preload = .50Sy				
Bolt Size Nom OD - TPI	B7M, L7M (Sy=80 ksi)		B7, L7, 660 (Sy=105 ksi)	
	cf=0.07	cf=0.13	cf=0.07	cf=0.13
.500-13	27	45	35	59
.625-11	52	88	68	115
.750-10	90	153	118	200
.875-9	143	243	188	319
1.000-8	213	361	279	474
1.125-8	305	523	401	686
1.250-8	421	726	553	953
1.375-8	563	976	739	1280
1.500-8	733	1280	962	1680
1.625-8	934	1640	1230	2150
1.750-8	1170	2050	1530	2700
1.875-8	1440	2540	1890	3330
2.000-8	1750	3090	2300	4060
2.250-8	2500	4440	3280	5820
2.500-8	3430	6120	4500	8030
2.625-8	3970	7100	4720	8430
2.750-8	4570	8180	5420	9700
3.000-8	5930	10700	7050	12700
3.250-8	7550	13600	8970	16100
3.500-8	9430	17000	11200	20200
3.750-8	11600	21000	13800	24900
3.875-8	12800	23200	15200	27500
4.000-8	14100	25500	16700	30300

NOTE

- The information in this table is based on API-6A's recommended torque for a given bolt size. The information is presented for the convenience of the user and is based on assumptions of certain coefficients of friction (cf). The coefficients of friction are based on approximations of the friction between the studs and nuts, as well as the nuts and flange face. A coefficient friction of 0.13 assumes the threads and nut bearing surfaces are bare metal and are well lubricated with thread compound. A coefficient of friction of 0.07 assumes the thread and nuts are coated with a fluoropolymer material.

- Lubrication

  It is essential that threads and nut faces be well lubricated with an appropriate grease prior to assembly. Cameron clamps and fast clamps require lubrication on the hub-clamp contact area. Acceptable lubricants include thread joint compounds which meet the formulation, evaluation and testing requirements specified in API Recommended Practice 5A3/ISO13678. (Reference - Jet Lube Grease, 1 lb can PN: 2737980-02).

  Studs and nuts coated with Xylan/PTFE compound in accordance with a Cameron procedure do not require lubrication. However, a light coat of API Recommended Practice 5A3/ISO13678 thread compound is recommended for Xyland-coated bolting as an aid to assembly.

  Material gaskets should be lightly coated with lubricant prior to assembly. Acceptable lubricants include motor oil or Cameron gate valve greases.

IC Test Plug Load Chart

IC Test Plug Maximum Load							
Bowl		Maximum Hanging Load (in 1000s lbs) at Test Pressure					
Size	Pressure	0 psi	2,000 psi	3,000 psi	5,000 psi	10,000 psi	15,000 psi
7-1/16"	2,000 to 5,000 psi	213	135	96	19	N/A	N/A
	10,000 psi	253	175	136	59	0	N/A
	15,000 psi	477	399	360	282	88	0
9"	2,000 to 10,000 psi	600	479	419	299	0	N/A
	15,000 psi	751	630	570	450	149	0
11"	2,000 to 10,000 psi	1277	1091	998	812	348	N/A
	15,000 psi	1596	1410	1317	1131	667	202
13-5/8"	2,000 to 10,000 psi	1713	1426	1283	997	281	N/A
	15,000 psi	2142	1855	1712	1426	710	5
16-3/4"	2,000 to 5,000 psi	3076	2641	2424	1990	N/A	N/A
20"	2,000 to 5,000 psi	2733	2096	1778	1142	N/A	N/A

Minimum Casing Load Chart for IC Type Hangers

Minimum Casing Load for IC-2 & IC-6 Casing Hangers		
Hanger Nom. Size	Casing Size	Load (Pounds)
11"	4-1/2"	78,000
	5"	74,000
	5-1/2"	70,000
	6-5/8"	59,000
	7"	55,000
	7-5/8"	48,000
13-5/8"	5-1/2"	120,000
	7"	106,000
	7-5/8"	99,000
	8-5/8"	86,000
	9-5/8"	72,000
	10-3/4"	54,000

Minimum Casing Load for IC-2 & IC-6 Casing Hangers		
Hanger Nom. Size	Casing Size	Load (Pounds)
16-3/4"	9-5/8"	146,000
	10-3/4"	128,000
	11-3/4"	110,000
	11-7/8"	109,000
	13-3/8"	79,000
20-3/4" 21-1/4"	10-3/4"	228,000
	13-3/8"	180,000
	13-5/8"	175,000
	16"	120,000

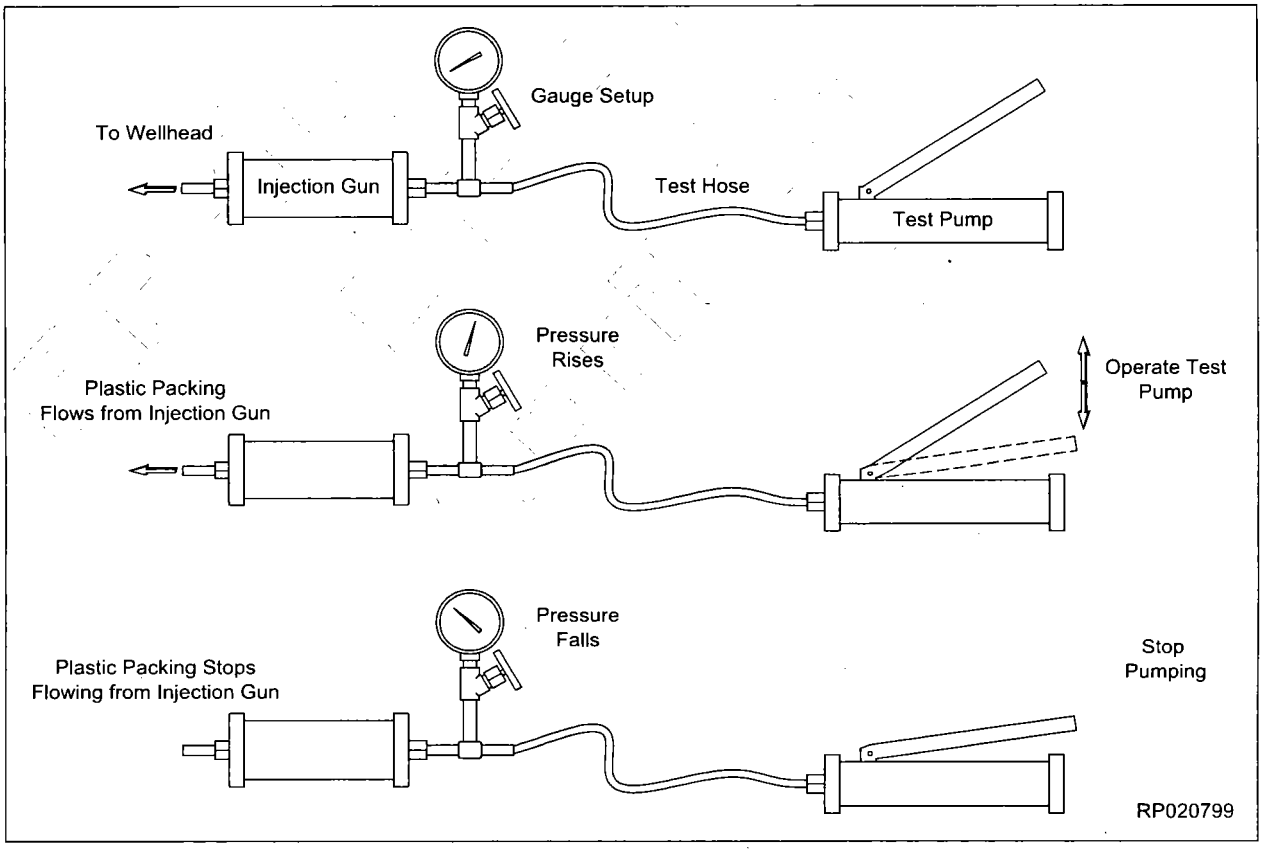
Injection Gun Preparation

1. Maintaining the Injection Gun at ambient temperatures, prepare Test Pump and Injection Gun for injecting P seals.
2. Operate Test Pump to inject fluid into Injection gun.
3. Monitor open end of Injection Gun for signs of plastic packing.
4. After plastic packing begins to flow from open end of Injection Gun continue to inject fluid from Test Pump increasing pressure an additional 200 to 400 psi.
5. Stop pumping Test Pump and monitor plastic packing movement and pressure on the pressure gauge.
6. Once packing has stopped flowing and the pressure gauge has stabilized observe the reading on gauge and record the pressure. **This will be your P1 pressure.**

Screw Type Injection Gun	
Applied Torque (ft-lb)	**Packing Pressure (psi)**
25	1,600
50	5,000
75	7,000
100	8,800
150	14,100
200	17,700
220	20,000

NOTE The pressure recorded will become "0". This is the pressure required to move the plastic packing and is not included in the actual injection pressure.

NOTE The amount of pressure required to force plastic packing to flow from the Injection Gun is dependent on several factors including outside temperature and the plastic injection gun itself. The example given above is for illustration purposes only.



Fraction to Decimal Conversion Chart

FRACTION TO DECIMAL CONVERSION CHART

4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES	4THS	8THS	16THS	32NDS	64THS	TO 3 PLACES	TO 2 PLACES
				1/64	.016	.02					33/64	.516	.52
			1/32		.031	.03				17/32		.531	.53
				3/64	.047	.05					35/64	.547	.55
		1/16			.062	.06			9/16			.562	.56
				5/64	.078	.08					37/64	.578	.58
			3/32		.094	.09				19/32		.594	.59
				7/64	.109	.11					39/64	.609	.61
	1/8				.125	.12		5/8				.625	.62
				9/64	.141	.14					41/64	.641	.64
			5/32		.156	.16				21/32		.656	.66
				11/64	.172	.17					43/64	.672	.67
		3/16			.188	.19			11/16			.688	.69
				13/64	.203	.20					45/64	.703	.70
			7/32		.219	.22				23/32		.719	.72
				15/64	.234	.23					47/64	.734	.73
1/4					.250	.25	3/4					.750	.75
				17/64	.266	.27					49/64	.766	.77
			9/32		.281	.28				25/32		.781	.78
				19/64	.297	.30					51/64	.797	.80
		5/16			.312	.31			13/16			.812	.81
				21/64	.328	.33					53/64	.828	.83
			11/32		.344	.34				27/32		.844	.84
				23/64	.359	.36					55/64	.859	.86
	3/8				.375	.38		7/8				.875	.88
				25/64	.391	.39					57/64	.891	.89
			13/32		.406	.41				29/32		.906	.91
				27/64	.422	.42					59/64	.922	.92
		7/16			.438	.44			15/16			.938	.94
				29/64	.453	.45					61/64	.953	.95
			15/32		.469	.47				31/32		.969	.97
				31/64	.484	.48					63/64	.984	.98
1/2					.500	.50	1					1.000	1.00

Appendix 1

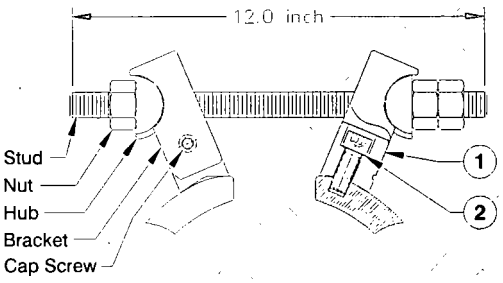
CAMERON SINGAPORE	DRAWN BY	DATE	REVISION	DOCUMENT
	Jacob Yuan	1 Mar 2010		RP-001601
	APPROVED BY	DATE	01	PAGE
	Tony Poh	1 Mar 2010		1 / 3

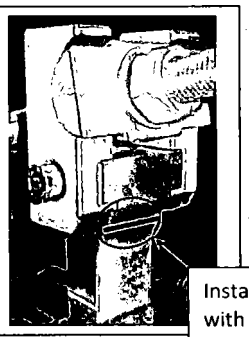
RECOMMENDED LOCKDOWN RING (COLLAPSING/EXPANDING) TOOL FOR SSMC AND E-LOCK

Scope

Recommended tool Top level assembly **2273869-05** contains common assembly parts with optional interchangeable adaptors and associated cap screws for specific lockdown ring size.

Table 1 lists recommended and existing tool Part numbers.



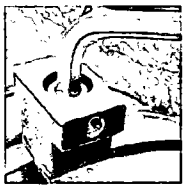


Install adaptor with Undercut Facing out

Figure 1 – Components in recommended tool top level assembly 2273869-05 (optional Item 1 – adaptor; comes with associated Item 2 – cap screw)

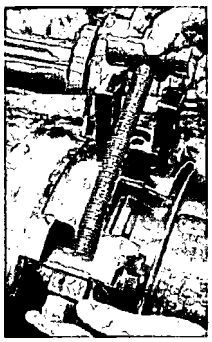
Procedure to use recommended tool 2273869-05

(A) Collapsing lockdown ring



Step 1
Power tight dedicated adaptor and cap screw to the specific lockdown ring size.

⚠ **Adaptor "Legs" must rest fully on ring profile to prevent loading stress on cap screw.**

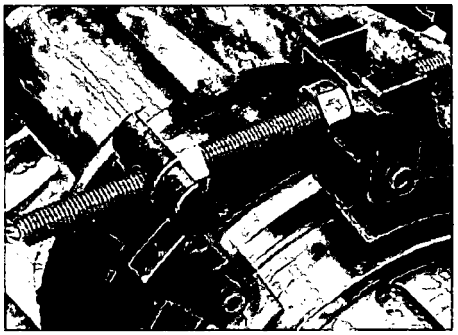


Step 2
Make up brackets to receive Hub.

Step 3
Torque nut sufficiently to collapse ring.

⚠ **Torque should not exceed 10ft-lbs. Verify collapse interference by wiggling lock ring.**

(B) Expanding lockdown ring



Step 1
Power tight dedicated adaptor and cap screw to specific lockdown ring size.

Step 2
Make up bracket to receive Hub.

Step 3
Torque nut sufficiently to expand ring.

⚠ **Similar checks as collapsing the ring.**

Appendix 1

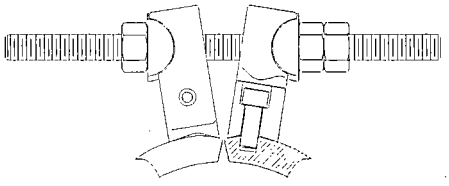
Table 1
Recommended and Existing Tool PN

Type	Size	Recommended* and Existing Tools	Tool Model (Table 2)	Adaptor (Fig 1 - Item 1)	Cap Screw (Fig 1 - Item 2)	Use on Lock Down Ring PN
SSMC	7-1/16	2273869-05*	A	2309218-05	702550-05-00-12	2017505-01
		2017561-06	D	NA		
	9	2273869-05*	A	2309218-06	702550-05-00-12	2202370-01 2236286-01
		2017561-06	D	NA		
		2017561-14	D			
	11	2273869-05*	A	2309218-07	702550-05-00-14	2094484-02 2094484-02-01 2094484-05 2094484-06
		2209192-01	D	NA		
		2017561-06	D			
		2017561-14	D			
	13-5/8	2273869-05*	A	2309218-02	702550-06-00-12	2062967-02 2062967-02-13 2062967-06
		2017561-02	D	NA		
		2017561-15	D			
		2273869-02	E			
		2230761-02	C			
		2230761-05	C			
	18-3/4	2273869-05*	A	2309218-08	702550-06-00-14	2125281-01 2125281-02 2125281-04
		2017561-15	D	NA		
		2230761-01	C			
		2209898-01	D			
	21-1/4	2273869-05*	A	2309218-08	702550-06-00-14	2125281-03
		2230761-01	C	NA		
E-LOCK	9	2273869-05*	A	2309218-11**	702503-16-00-40	2236573-01
	11	2273869-05*	A	2309218-01	702550-05-00-22	2216464-01 2216464-03
		2017561-13	D	NA		
		2273869-04	B			

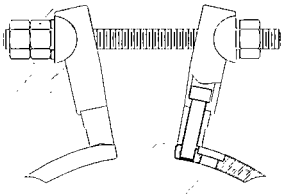
** Only to use on E-lock Union Connector with Enlarged Window (PN 2236288-03)

Appendix 1

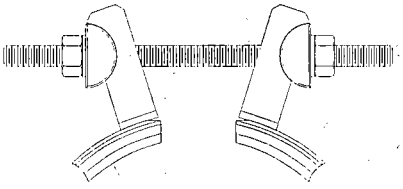
Table 2
Tool Models



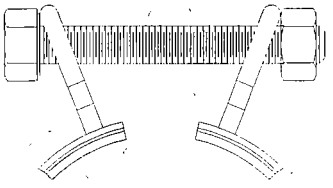
Model A - PN: 2273869-05
- **Recommended tool** for SSMC and E-lock
- Common assembly component
- Interchangeable adaptor and cap screw for specific lock ring size



Model B - PN: 2273869-04
- Specifically designed for 11" E-lock
- Adaptor not interchangeable for other lock ring sizes.

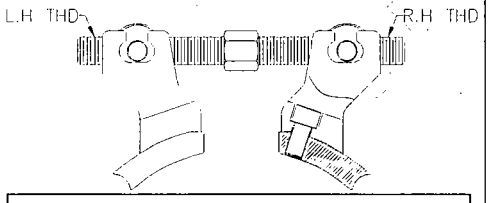


Model C - PN: 2230761
- Historically used on SSMC
- Various body components per ring size.
- Comes with extension pin for E-lock

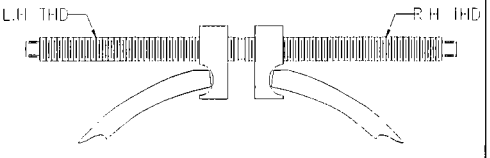


Model D - PN: 2017561 / 2209192 / 2209898
- Most common tool for SSMC and E-lock
- High occurrence to replace eyebolt

⚠ **Potential hazard due to shearing of eyebolt.**



Model E - PN: 2273869-02
- Specifically designed for 13-5/8" SSMC
- Opposite direction threaded ends to facilitate quick collapsing/expansion.



Model F - PN: 2273869-03
- Specifically designed for expanding process

Appendix 2

MAKE-UP AND BREAK OUT PROCEDURE FOR TYPE N LOCKSCREW ASSEMBLIES

1.0 SCOPE

This document provides recommended tools, assembly, make up and break out procedures for Type N lockscrew assemblies.

2.0 RECOMMENDED GREASE

All lockscrew assemblies require grease application at each threaded interface. Grease used on lockscrew assemblies must have a coefficient of friction within the range of 0.11 - 0.13. Table 1 provides recommended part numbers for grease to be used in lockscrew assemblies. Similar grease may be used if it has an acceptable coefficient of friction, as listed in this section.

Cameron PN	Description
708503	NeverSeez Regular Grade
700670	TF-41 Valve Grease

Table 1 - Standard Grease Part Numbers

3.0 LOCKSCREW ASSEMBLY

The standard lockscrew assembly is the type N lockscrew assembly (reference ES-000115-01). This consists of a lockscrew, gland, graphite packing, and spacer rings. Reference Figure 1 for the standard lockscrew assembly configuration.

CAUTION:
New gland PN 2165861-02-04 listed in ES-000115-01 rev 05 will not work with respective old N type lockscrew PNs on the following flange sizes because the old lockscrews will not retract all the way to clear the bore. The lockscrews listed on ES-000115-01 rev 05 must be used with this gland part number for the following flange sizes.

4-1/16 10K	5-1/8 10K	11 3K
4-1/16 15K	5-1/8 15K	13-5/8 2K
		13-5/8 3K

Contact local or regional engineering support for questions and/or additional support.

Appendix 2

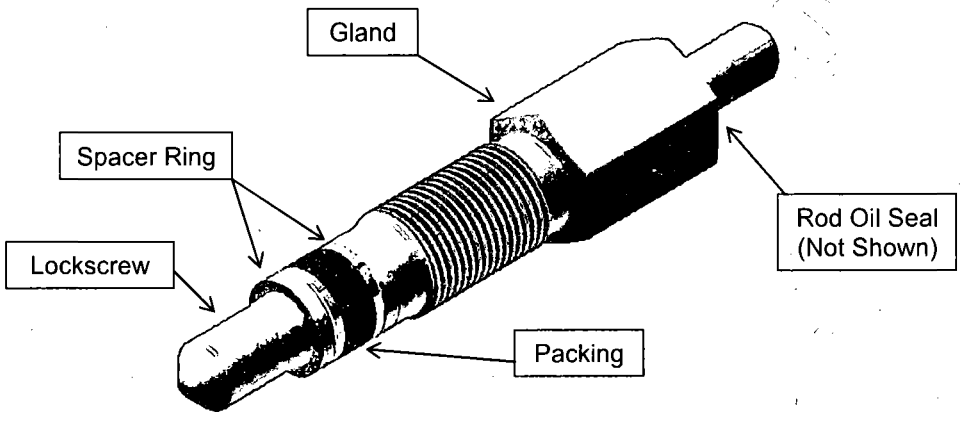


Figure 1 - Standard Type N Lockscrew Assembly

Spacer rings are placed on each side of the graphite packing, and this sub-assembly is then placed along the lockscrew shaft. The lockscrew external threads, along with the gland external and internal threads, must be fully coated with a layer of the recommended grease from Section 2.0, or a grease with a coefficient of friction within the range specified. Reference Figure 2 and Figure 3 for required grease locations.

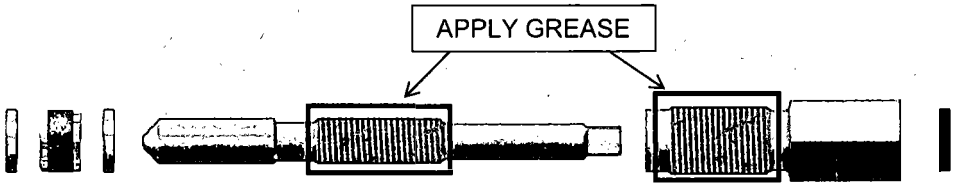


Figure 2 - Grease Locations (External)

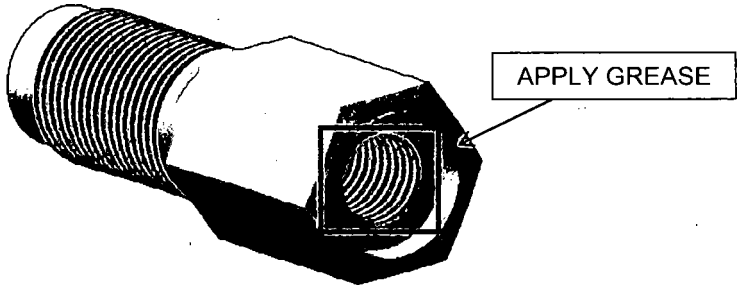


Figure 3 - Grease Location (Internal)

Appendix 2

The lockscrew gland must then be made up to the lockscrew. Once the gland is in place, insert the rod oil seal (Note: groove on rod oil seal must face out towards square drive on lockscrew). Lockscrew ports in housings must also be coated with a layer of grease. The lockscrew assembly may then be made up to the housing. It is acceptable for the graphite packing and junk rings to come in contact with grease, but not required.

4.0 LOCKSCREW ASSEMBLY MAKE UP PROCEDURE

The geometry and quantity of each assembly require all lockscrew assemblies to be fully engaged to be able to retain the casing or tubing hanger. Lockscrews should never be operated under pressure.

4.1 TORQUE TOOLS

Part numbers have been created for torque wrenches, sockets, and open ended torque wrench adapters required to achieve setting torques for Type N lockscrew assemblies.

Description	Drive	Length	Part Number
Torque Wrench (120-600 ft-lb)	3/4"	41.19"	2824392-01
Torque Wrench (200-1,000 ft-lb)	1"	69"	2824392-02
Torque Wrench (400-2,000 ft-lb)	1"	107.5"	2824392-03

Table 2 - Torque Wrench Part Numbers

Description	Drive	Size	Part Number
Socket	1/2"	9/16" - 8 pt	2824402-01
Socket	1/2"	5/8" - 8 pt	2824402-02
Socket	1/2"	11/16" - 8 pt	2824402-03
Socket	1/2"	3/4" - 8 pt	2824402-04
Socket	1/2"	1" - 8 pt	2824402-05
Socket Adapter (3/4" drive to 1/2" drive)	-	-	2824403-01

Table 3 - Lockscrew Socket Part Numbers

Description	Drive	Size	Part Number
Gland Adapter	3/4"	1-3/4" - 12 pt	2379114-01-03
Gland Adapter	1"	1-3/4" - 12 pt	2379114-01-02
Gland Adapter	3/4"	2-1/4" - 12 pt	2379114-01-05
Gland Adapter	1"	2-1/4" - 12 pt	2379114-01-04

Table 4 - Gland Nut Wrench Adapters

4.2 GENERAL OPERATIONAL SEQUENCE

- Ensure the lockscrew void is free of pressure
- Loosen gland to relive packing compression on lockscrew
- Retighten gland to 50 ft-lb
- Torque lockscrews in alternating cross pattern to the required torque listed in Section 4.3 and Section 4.4.
- Retighten gland to the required torque listed in Section 4.5.
  Note: Ensure the lockscrew is held stationary while torque is applied to the gland.

Appendix 2

4.3 LOCKSCREW TORQUE ON SOLID SHOULDER

All mandrel hangers or packoff assemblies that do not have compression style seals are to be considered to have a solid shoulder. When making up lockscrews to solid shoulders, **150 ft-lb** of torque must be applied to each lockscrew. This is to ensure that the lockscrew has fully engaged the shoulder to be retained without providing excessive preload throughout the lockscrew assembly.

4.4 LOCKSCREW TORQUE FOR ELASTOMER SEAL COMPRESSION

Table 5 displays the torque range required for all applications other than solid shoulder.
The minimum torque values are derived from load required to set an slip hanger elastomer seal (1,500 – 3,000 psi) , using either zinc coated or Xylan coated lockscrews, or 150 ft-lbs for cases where the derived torques is less than 150 ft-lbs.
The maximum torque values listed are based on allowable stress limits of the lockscrew assembly presented in the Design Files. See ES-000115-01 for further information.

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Size and Pressure	4140 Lockscrew - Zinc		718 Lockscrew - Xylan		4140 Lockscrew - Xylan	
Size	Min	Max	Min	Max	Min	Max
4-1/16 10K	150	300	150	240	-	-
4-1/16 15K	150	300	150	240	-	-
5-1/8 10K	150	300	150	240	-	-
5-1/8 15K	150	300	150	240	-	-
7-1/16 2K	150	250	150	185	-	-
7-1/16 3K	150	250	150	185	-	-
7-1/16 5K	150	250	150	185	150	250
7-1/16 10K	150	450	150	340	150	300
7-1/16 15K	150	450	150	300	150	300
7-1/16 20K	150	550	150	440	150	550
9 2K	200	300	150	240	-	-
9 3K	200	300	150	240	-	-
9 5K	175	450	150	340	175	450
9 10K	150	450	150	340	150	450
9 15K	150	550	150	440	150	550
9 20K	150	1350	150	440	150	550
11 2K	200	300	150	240	-	-
11 3K	200	300	150	240	-	-
11 5K	175	450	150	340	175	450
11 10K	150	450	150	340	150	450
11 15K	150	450	150	340	150	450
11 20K	300	1350	300	440	300	550
13-5/8 2K	200	300	150	240	-	-
13-5/8 3K	200	300	150	240	150	250
13-5/8 5K	150	450	150	340	150	450
13-5/8 10K	150	450	150	340	150	450
13-5/8 15K	150	1350	150	440	150	550
16-3/4 2K	350	450	200	250	-	-
16-3/4 3K	300	450	200	340	-	-
16-3/4 5K	200	450	200	340	-	-
16-3/4 10K	150	450	150	340	-	-
18-3/4 5K	250	450	200	340	-	-
18-3/4 10K	250	1350	200	440	-	-
20-3/4 3K	250	450	200	340	-	-
21-1/4 2K	375	450	200	340	-	-
21-1/4 5K	200	550	200	440	-	-
21-1/4 10K	175	1350	150	440	-	-
26-3/4 5K	500	1350	150	440	-	-

Table 5 - Torque Ranges for Lockscrews

Appendix 2

4.5 PACKING GLAND MAKE UP PROCEDURE

The recommended manufacturing gland torque is **200 ft-lb** (ER-4542) for factory assembly. The manufacturing torque assumes there is no torque on the lockscrew prior to making up the gland. The recommended manufacturing packing gland torque is the expected value to hold hydraulic pressure at ambient temperature for the one time proof test.

Table 6 lists the torque range for the Type N packing gland for field installation. The packing gland field torque is the torque required to maintain pressure for the life of the well, and is from Annex F testing experience. The field gland torque also assumes the worst case loading combination between working pressure of the well and torque applied on the lockscrew.
The maximum torque values listed are based on allowable stress limits of the lockscrew assembly presented in the Design Files. See ES-000115-01 for further information.
In manufacturing applications, lab test applications and in field applications when possible, the packing gland should not be adjusted while under pressure (Reference Section 4.2).

Flange Pressure	Torque	
Size	Min	Max
2K	400	500
3K	400	500
5K	500	600
10K	600	700
15K	800	850
20K	1000	1300

Table 6 - Torque Ranges for Glands

CAUTION: Do NOT use the Table 6 values to set or read torque wrench values when using a Gland Nut Wrench Adapter. Doing so would result in applying more torque than intended.

When using a Gland Nut Wrench Adapter included in section 4.1 the torque setting and/or reading on the torque wrench will be lower than the values listed in Table 6 to compensate for the length of the Gland Nut Wrench Adapter since the Gland Nut Wrench Adapter effectively makes the torque wrench longer.

Table 7 shows the torque wrench setting for the Type N packing gland for field installation for each of the torque wrenches in Table 2.

Torque on Gland Nut (From Table 6)	Torque Wrench Setting/Reading When Using Gland Nut Wrench Adapter from Table 4		
	Wrench p/n 2824392-01	Wrench p/n 2824392-02	Wrench p/n 2824392-03
200 (factory use only)	188	192	196
400	376	384	392
500	470	480	490
600	564	576	588
700	658	672	686
800	752	768	784
850	799	816	833
1,000	940	960	980
1,300	1,222	1,248	1,274

Table 7 - Torque Wrench Setting/Reading When Using Gland Nut Wrench Adapter from Table 4

Appendix 2

Example: Using Torque Wrench p/n 2824392-02 and the Gland Nut Wrench Adapter listed on Table 4 to make up a Gland Nut on a 11" 10,000 psi flange the required minimum torque for the Gland Nut is 600 ft-lbs so the Torque Wrench setting or reading will be 576 ft-lbs using the above table.

Torque on Gland Nut (From Table 6)	Torque Wrench Setting/Reading When Using Gland Nut Wrench Adapter from Table 4		
	Wrench p/n 2824392-01	Wrench p/n 2824392-02	Wrench p/n 2824392-03
200 (factory use only)	188	192	196
400	376	384	392
500	470	480	490
600	564	576	588
700	658	672	686
800	752	768	784
850	799	816	833
1,000	940	960	980
1,300	1,222	1,248	1,274

CAUTION: Do NOT use Table 7 torque values when using a Gland Nut Adapter with any torque wrench not listed in Table 2. Contact Engineering prior to using a Gland Nut Wrench Adapter in Table 4 with any torque wrench other than the part numbers listed in Table 2 to determine the setting / reading for the torque wrench being used.

5.0 Break Out Procedure

All test port plugs and check valves shall be removed prior to removing lockscrews and packing glands in a made up connection to verify there is no pressure behind the screw. Also, the annulus below the retained equipment must be checked to verify absence of pressure. Failure to verify and bleed down pressure prior to disassembly could lead to personal injury.

The lockscrew cannot be retrieved though the packing gland, so the gland must be completely removed upon disassembly. The break out torque of the gland is approximately equal to the makeup torque. However, higher than expected break out torque can be caused from poor thread conditions, old lubrication or trapped pressure. If higher than expected break out torque is encountered, try removing other glands. If the other glands can be removed, the high torque is a result of thread conditions, and not trapped pressure.

Appendix

Calculation of torque wrench setting/reading when using Gland Nut Wrench Adapter

When using a Gland Nut Wrench Adapter in Table 4, a torque factor (TF) must be derived to determine the adjustment required to the torque wrench setting.
This torque factor is derived as follows:

- Determine wrench length: W_len in feet.
- TF = W_len / (W_len +.25')
  [Note: for the gland nut wrench adapters listed in Table 4, the length from center of square drive to center of socket is 0.25 ft]
- The torque factor must then be multiplied to the gland torque listed in Table 6 to determine the torque reading/setting required on the wrench: $T = TF * T_{table\ 6}$

Note: When the torque wrench being used is one of the part numbers listed in Table 7, the wrench setting in Table 7 shall be used. The calculation in this appendix is required when the torque wrench being used is not one of the wrenches listed in Table 7.

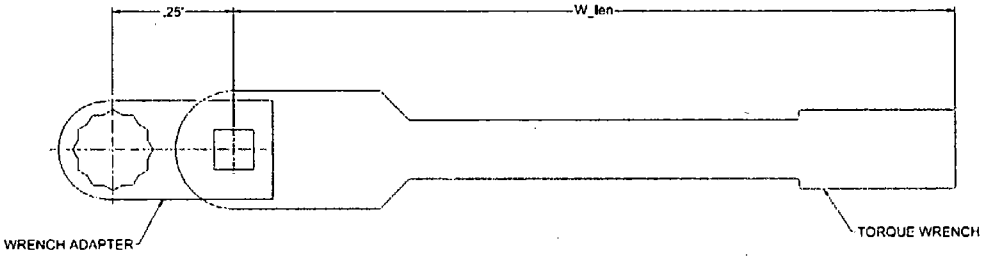

Figure 4 - Wrench Adapter and Wrench Torque Arm Dimensions

Document Control

Revision History

Revision	Date	Description	Prepared by:
01		Initial Release per ZE 650265717	Rodrigo Araujo

About this Revision

Owner: **Surface Systems Engineering - Running Procedures Department, Houston, TX**

Author: **Rodrigo Araujo**

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Released by: **Name, SAP**