# DRILL PIPE
# CARE AND HANDLING

CG.ENG.223_0



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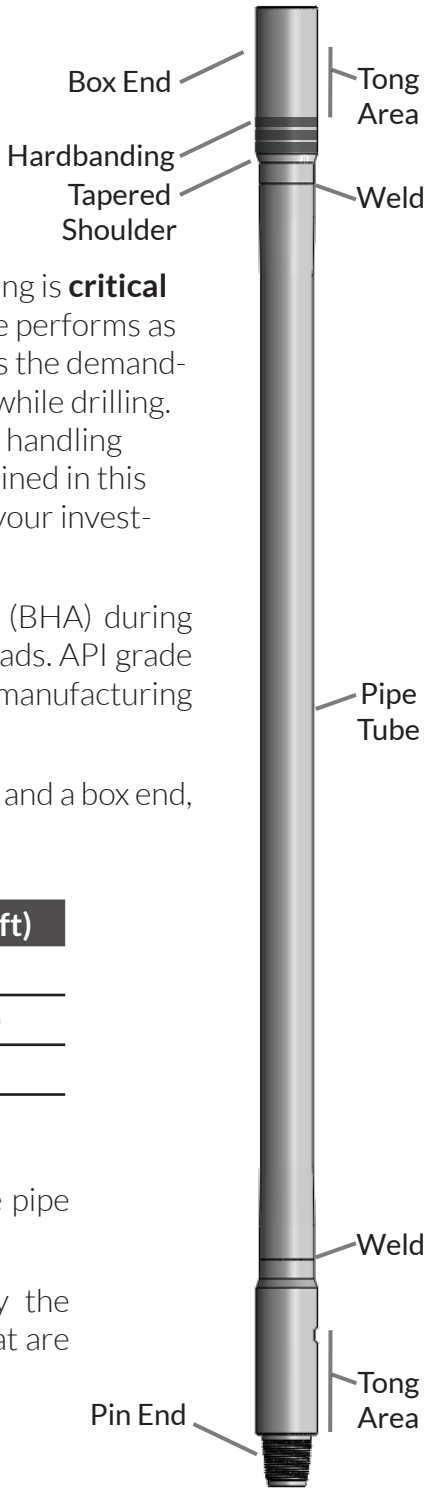
# DRILL PIPE INTRODUCTION




## DEFINITION

The drillpipe connects the rig surface equipment with the bottomhole assembly and the bit, both to pump drilling fluid to the bit and to be able to raise, lower and rotate the bottomhole assembly and bit.

***Source:*** *Schlumberger Oilfield Glossary*

Proper care and handling is **critical** to ensure that drill pipe performs as desired and withstands the demanding conditions it faces while drilling. Following the care and handling recommendations outlined in this document will ensure your investment is protected.

Drill pipe is designed to both rotate and lift the bottom hole assembly (BHA) during drilling, and must withstand high torque, tension, bending and pressure loads. API grade drill pipe is typically controlled by API Spec 5DP, defining the materials, manufacturing and dimensions.

Drill pipe is most commonly manufactured by welding two tool joints, a pin and a box end, to either end of a seamless upset tube.

| API Grade | Min. Yield Strength (ksi) |
|---|---|
| E-75 | 75 |
| X-95 | 95 |
| G-105 | 105 |
| S-135 | 135 |

| API Range | Length (ft) |
|---|---|
| 1 | 18-22 |
| 2 | 27-30 |
| 3 | 38-45 |

**API Grades** are used to classify the strength of the material used in the pipe tube body. **API Ranges** define the seal to seal length of the tubular.

Additional proprietary material grades may be utilized if required by the customer. This includes grades specially designed for Sour Service use that are sulphide corrosion cracking (SSC) resistant.







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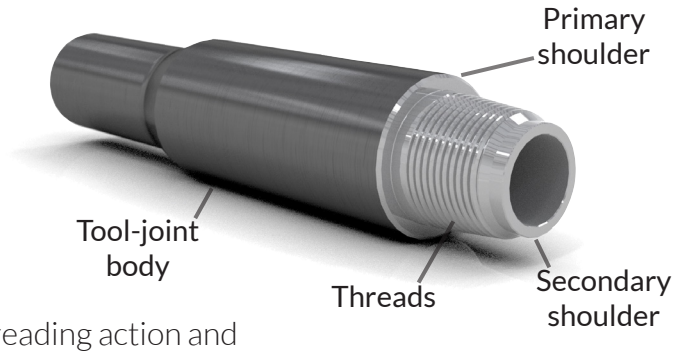
# ROTARY SHOULDERED CONNECTIONS

## DEFINITION

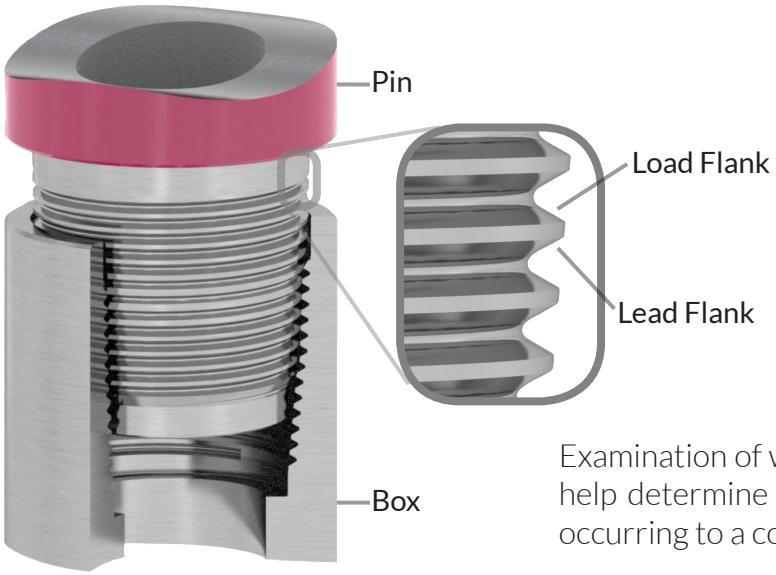
A connection used on drill string elements which has coarse, tapered threads and sealing shoulders

***Source:*** *API RP 7G, Recommended Practice for Drill Stem Design and Operating Limits*




A connection's **primary shoulder** acts as a stop for threading action and seals the connection.

Modern rotary shouldered connections utilize a **double shoulder** design. The **secondary shoulder** makes contact when connection is torqued to minimum makeup torque and gives enhanced load distribution across the threads, as well as increased the torsional capacity.




### Connection Threadform

The **load flank** of the thread is on the uphole side of the pin and is subjected to load stresses **upon makeup.**

The **lead flank** of the thread is on the downhole side of the pin and is subjected to stress and impact during the **stabbing** of the connection.

Examination of where damage occurs on a threadform can help determine the mechanisms and reasons for damage occurring to a connection.







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# ARRIVAL INSPECTION

Upon arrival of new or refurbished pipe, rig crew should check **pipe quantity** and **marking** against documentation.

Thread protectors should be checked for damage and debris which could result in thread damage. Any unknown compounds present on threads or protectors shall be removed.

Spare protectors should be held on hand to replace any that are damaged.

Operations should be provided with **DP** and **HWDP Performance Data Sheets**, and ensure data sheet parameters match drill pipe. Data sheets may be obtained through contacting Complete Group or visiting our website Resources page.







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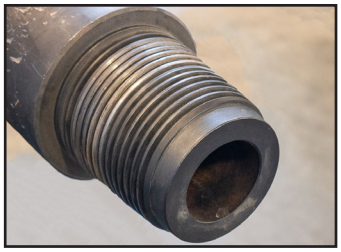
# THREAD COMPOUND

A high quality **copper based thread compound** (dope) should be applied prior to all makeups. Connection must be **clean, dry and free of contaminants** before applying.

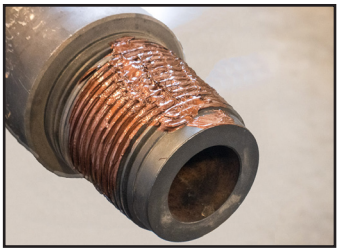
Thread compound should be **thoroughly mixed** before use to ensure solids and lubricants are distributed evenly throughout the grease base.

Apply an even, **thin layer** of compound to **all** contacting surfaces, including primary and secondary shoulders. Thread rotation is not sufficient for uniform application- the connection will not spread compound during threading.

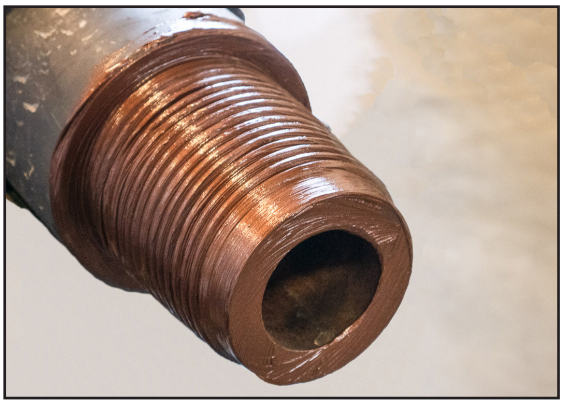
**DEFINITION: THREAD COMPOUND**
Substance that is applied to threaded oilfield pipe connections prior to make-up to assist in their lubrication during assembly and disassembly and in their sealing against high internal and external pressures in service
***Source:*** *API RP 5A3, Recommended Practice on Thread Compounds for Casing, Tubing, and Line Pipe*



**Cleaned connection**



**Poor application**



**Correct application of compound**

All CTP data sheets are calculated for a compound **friction factor of 1.0.** Compounds with higher friction factors (1.10 or 1.15) may be used at operator's discretion.







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# THREAD PROTECTORS

Thread protectors are designed to protect both **threads** and **seals** from damage on the pin and box connections of drill pipe.

Thread protectors must be in use as pipe is moved or stored. Only remove pin protectors after the pipe is pulled out of the mouse hole and a connection is to be made up.

If a protector is damaged, remove and visually inspect the connection for damage or debris.

**Box protector**

**Pin protector**

**Severely damaged thread protector**







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# STABBING PIPE

**Stabbing guides** should be used whenever double shouldered connections are made up.

Guides ensure **proper alignment** of pin and box tool joints, and reduce damage to seal faces and connection threads.

Use of a stabbing guide also **reduces time** spent aligning connections and minimizes finger **pinch points** when stabbing and spinning up.

Do not rotate with weight on **partially stabbed connection**, as this induces impact and grinding on thread flanks.

Lead flanks damaged on stabbing threads

**Minimizing the amount of weight** applied to the connection during stabbing will reduce damage to the lead flanks of the tool joint threads.

**Verify** counterbalance systems are functioning, to mitigate excessive stabbing forces.







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# PIPE MAKEUP


**DEFINITION: TRIPPING**
The act of pulling the drillstring out of the hole or replacing it in the hole. A pipe trip is usually done because the bit has dulled or has otherwise ceased to drill efficiently and must be replaced.
*Source: Schlumberger Oilfield Glossary*

### Tripping

When tripping out, **alternate breaks** to ensure that joint makeup cycles and wear is even throughout string.

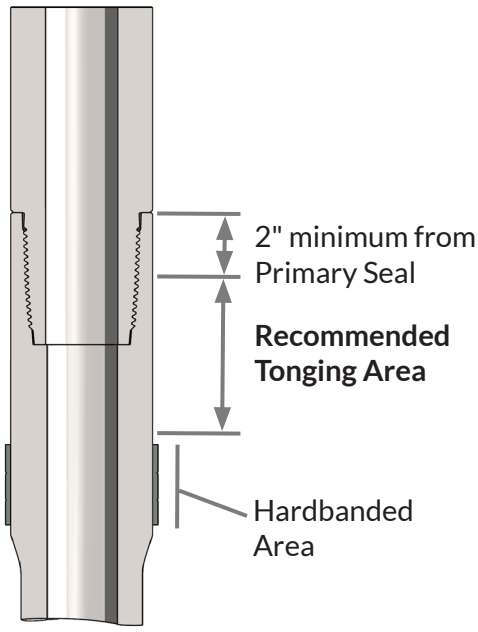
Monitor break-out torques when tripping out: high breakout torques can indicate **down-hole makeup** and/or **thread damage.**

### Connection Makeup

Starting threads should be spun-in using a **slow speed spinner** or by hand with **chain tongs**. High speed spinners should only be used once the threads have been engaged.

Use rig tongs or the iron roughneck to makeup each connection to 100% of **recommended makeup torque**. Multiple connections should not be made-up simultaneously.

Ensure tongs are not placed on hardband or within 2" of primary shoulder seal on box.







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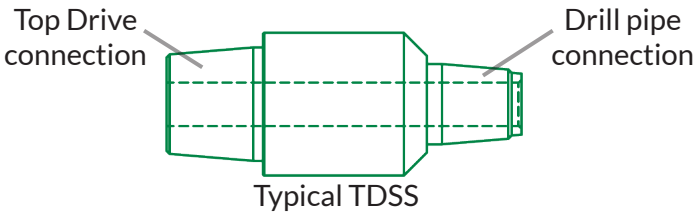
# TOP DRIVE SAVER SUB

Thread damage can **propagate** from any damaged thread, but proper attention must be given to monitor damage to the **Top Drive Saver Sub** (TDSS).

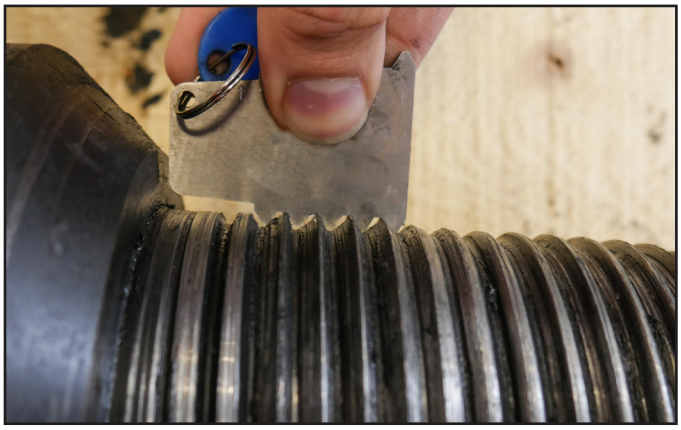
As the most made up connection on a rig, damage to the TDSS will propagate throughout the entire drill string during makeup.

TDSS must be **inspected regularly for damage,** and repaired or replaced immediately before irreversible damage is induced on drill string.

**DEFINITION: SAVER SUB**
A sacrificial substitute device made up in the drill stem to absorb much of the wear of frequently broken joints (such as between the kelly or top drive and the drill pipe)
*Source: Adapted from Dictionary of Petroleum Terms*



Typical TDSS


Thread damage on TDSS requiring repair


Extremely damaged TDSS sent for "repair"

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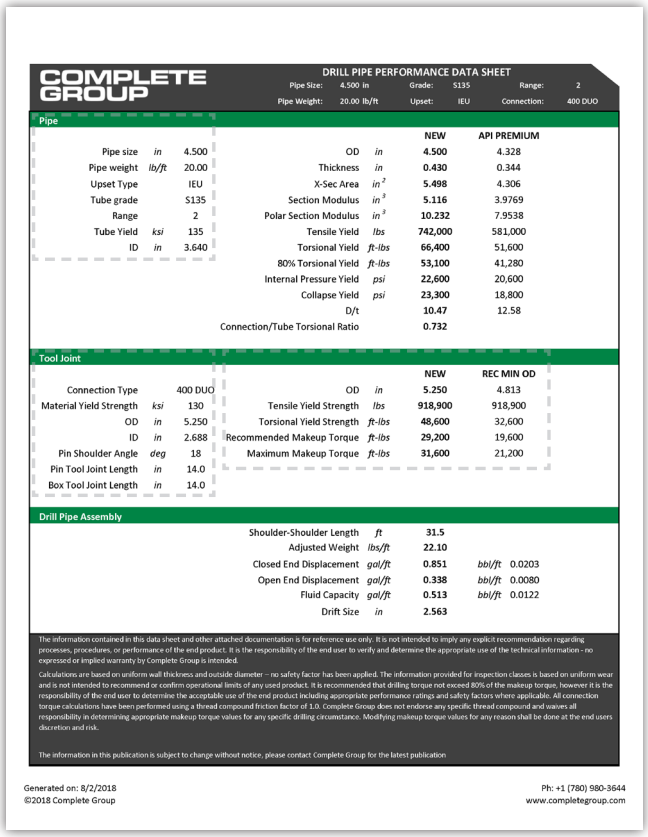
# READING DATA SHEET



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DRILL PIPE PERFORMANCE DATA SHEET

Pipe Size: 4.500 in | Grade: S135 | Range: 2
Pipe Weight: 20.00 lb/ft | Upset: IEU | Connection: 400 DUO

**Pipe**

| | | | | | NEW | API PREMIUM |
|---|---|---|---|---|---|---|
| Pipe size | in | 4.500 | OD | in | 4.500 | 4.328 |
| Pipe weight | lb/ft | 20.00 | Thickness | in | 0.430 | 0.344 |
| Upset Type | | IEU | X-Sec Area | $in^2$ | 5.498 | 4.306 |
| Tube grade | | S135 | Section Modulus | $in^3$ | 5.116 | 3.9769 |
| Range | | 2 | Polar Section Modulus | $in^3$ | 10.232 | 7.9538 |
| Tube Yield | ksi | 135 | Tensile Yield | lbs | 742,000 | 581,000 |
| ID | in | 3.640 | Torsional Yield | ft-lbs | 66,400 | 51,600 |
| | | | 80% Torsional Yield | ft-lbs | 53,100 | 41,280 |
| | | | Internal Pressure Yield | psi | 22,600 | 20,600 |
| | | | Collapse Yield | psi | 23,300 | 18,800 |
| | | | D/t | | 10.47 | 12.58 |
| | | | Connection/Tube Torsional Ratio | | 0.732 | |

**Tool Joint**

| | | | | | NEW | REC MIN OD |
|---|---|---|---|---|---|---|
| Connection Type | | 400 DUO | OD | in | 5.250 | 4.813 |
| Material Yield Strength | ksi | 130 | Tensile Yield Strength | lbs | 918,900 | 918,900 |
| OD | in | 5.250 | Torsional Yield Strength | ft-lbs | 48,600 | 32,600 |
| ID | in | 2.688 | Recommended Makeup Torque | ft-lbs | 29,200 | 19,600 |
| Pin Shoulder Angle | deg | 18 | Maximum Makeup Torque | ft-lbs | 31,600 | 21,200 |
| Pin Tool Joint Length | in | 14.0 | | | | |
| Box Tool Joint Length | in | 14.0 | | | | |

**Drill Pipe Assembly**

| | | | | | |
|---|---|---|---|---|---|
| Shoulder-Shoulder Length | ft | 31.5 | | | |
| Adjusted Weight | lbs/ft | 22.10 | | | |
| Closed End Displacement | gal/ft | 0.851 | bbl/ft | 0.0203 | |
| Open End Displacement | gal/ft | 0.338 | bbl/ft | 0.0080 | |
| Fluid Capacity | gal/ft | 0.513 | bbl/ft | 0.0122 | |
| Drift Size | in | 2.563 | | | |

The information contained in this data sheet and other attached documentation is for reference use only. It is not intended to imply any explicit recommendation regarding processes, procedures, or performance of the end product. It is the responsibility of the end user to verify and determine the appropriate use of the technical information - no expressed or implied warranty by Complete Group is intended.

Calculations are based on uniform wall thickness and outside diameter – no safety factor has been applied. The information provided for inspection classes is based on uniform wear and is not intended to recommend or confirm operational limits of any used product. It is recommended that drilling torque not exceed 80% of the makeup torque, however it is the responsibility of the end user to determine the acceptable use of the end product including appropriate performance ratings and safety factors where applicable. All connection torque calculations have been performed using a thread compound friction factor of 1.0. Complete Group does not endorse any specific thread compound and waives all responsibility in determining appropriate makeup torque values for any specific drilling circumstance. Modifying makeup torque values for any reason shall be done at the end users discretion and risk.

The information in this publication is subject to change without notice, please contact Complete Group for the latest publication

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**Drill Pipe Performance Data Sheets** act as a reference for drilling operations. It is up to the end user to determine its use in specific drilling circumstances.

Metric and imperial unit sheets are available with all CTP products.

API specifications classify pipe based on inspection results of wall thickness, as pipe that has been worn in the well is capable of withstanding lower loads.

Drill strings with an inspected wall thickness not less than 80% are classified as **API Premium** and have reduced operating limits. Wall thickness not less than 70% results in a classification of Class 2.

| | | NEW | REC MIN OD |
|---|---|---|---|
| OD | in | 5.250 | 4.813 |
| Tensile Yield Strength | lbs | 918,900 | 918,900 |
| Torsional Yield Strength | ft-lbs | 48,600 | 32,600 |
| Recommended Makeup Torque | ft-lbs | 29,200 | 19,600 |
| Maximum Makeup Torque | ft-lbs | 31,600 | 21,200 |

**Pipe**

| | | |
|---|---|---|
| Pipe size | in | 4.500 |
| Pipe weight | lb/ft | 20.00 |
| Upset Type | | IEU |
| Tube grade | | S135 |
| Range | | 2 |
| Tube Yield | ksi | 135 |
| ID | in | 3.640 |

**Pipe** configuration section lists tube design parameters, including material selection and geometry.

**Tool Joint**

| | | |
|---|---|---|
| Connection Type | | 400 DUO |
| Material Yield Strength | ksi | 130 |
| OD | in | 5.250 |
| ID | in | 2.688 |
| Pin Shoulder Angle | deg | 18 |
| Pin Tool Joint Length | in | 14.0 |
| Box Tool Joint Length | in | 14.0 |

**Tool joint** configuration section lists key tool joint parameters such as connection, size and material strength.

**Tensile yield strength** is limit of the connection when pure tension is applied, without torque applied.

**Recommended makeup torque** is the calculated amount of torque that can be applied to connection during makeup.

**Maximum makeup torque** is the calculated maximum amount of torque that can be applied to connection during makeup. It is applicable and shown for **Complete Group DUO** connections only.







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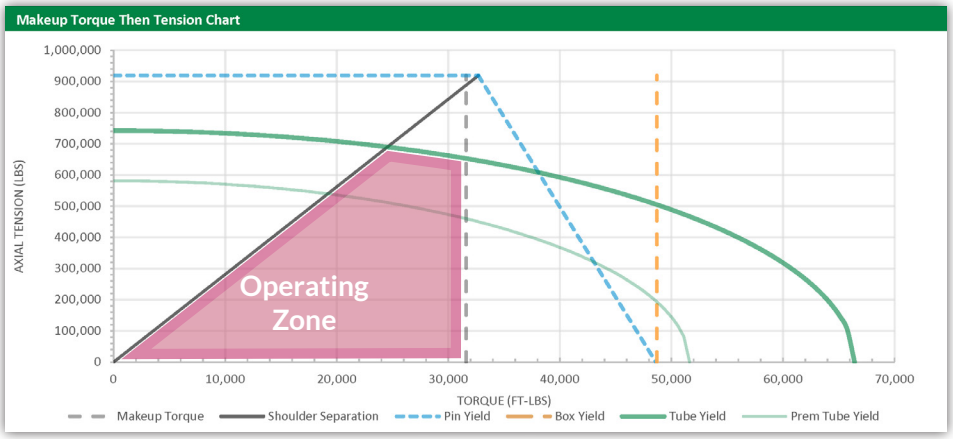
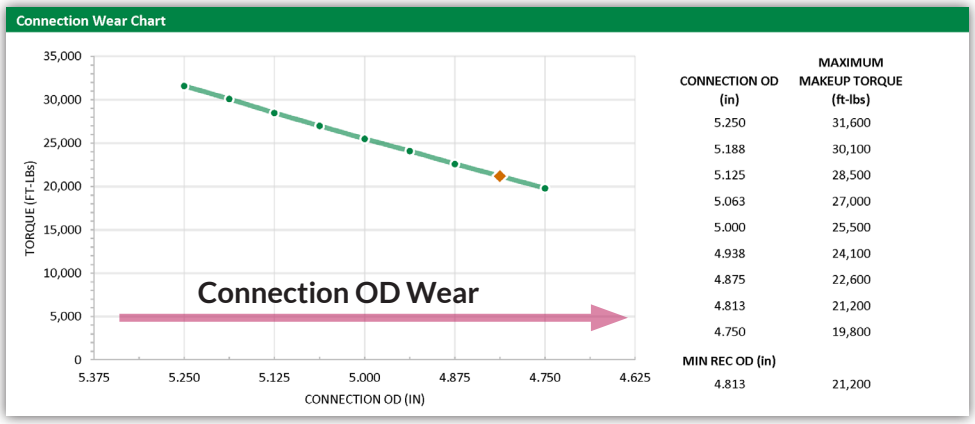
## Makeup Torque Then Tension Chart

Provides a reference for the safe operation tension and torque parameters under combined loading.

The zone highlighted in **magenta** represents the conditions that do not exceed recommended tool joint torque, pin/box yield, shoulder separation, or tube yield.




| CONNECTION OD (in) | MAXIMUM MAKEUP TORQUE (ft-lbs) |
|---|---|
| 5.250 | 31,600 |
| 5.188 | 30,100 |
| 5.125 | 28,500 |
| 5.063 | 27,000 |
| 5.000 | 25,500 |
| 4.938 | 24,100 |
| 4.875 | 22,600 |
| 4.813 | 21,200 |
| 4.750 | 19,800 |
| MIN REC OD (in) | |
| 4.813 | 21,200 |

## Connection Wear Chart

As a drill string is used, wear on the outside of the tool joint box will occur, limiting the **recommended makeup torque** that the connection can safely handle.

Measured connection OD's may be operated at the corresponding recommended makeup torques given in this chart, however operation should not continue once connection OD wears below minimum recommended OD due to overly **thin box counterbore**.







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# TROUBLESHOOTING

### Thread Damage/Galling

Ensure all connections are receiving proper application of ***thread compound***, and are free of contaminants and debris. Ensure thread compound is well mixed. Ensure no compatibility issues with compound and drilling fluid.

Check condition of ***saver sub.*** Damage and wear can easily propagate through entire drill string.

Check ***rig alignment***, to ensure threads of drill string in table align with connection in the head and are not placing additional stress on threads.

### Breakout Torque

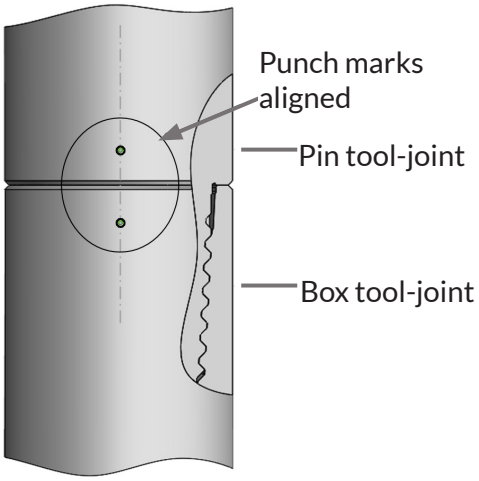
Ensure torque measurement equipment is ***calibrated***. Ensure ***correct makeup torque*** is applied to connection (including friction factor correction when applicable).

Ensure ***tongs*** are gripping in ***proper location***, away from seal and hardbanding. Gripping over thin box connection can distort and damage connection.

Ensure connections are not being overtorqued due to downhole makeup.

### Downhole Makeup

Ensure connection is not subjected to excess makeup torque due to downhole dynamics. Downhole makeup can contribute to connection damage and/or high breakout torques. To ***verify downhole*** makeup is occuring, mark pin and box once sealed and monitor for rotation (marking should not rotate >0.5").




### Pipe Damage

Ensure slips are not set too hard to minimize deep mechanical damage. Slips, dies and bushings should be inspected and replaced frequently.

Ensure corrosion of pipe is monitored, using oil-based drilling fluids whenever possible. Water-based or brine fluids should have pH carefully monitored and corrosion inhibitors used appropriately to minimize tube deterioration.







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