Make-up Acceptance Criteria

These guidelines indicate acceptance and rejection criteria to be used when making up TenarisHydril connections at the well site. Should you have any questions, please contact your local field services contact (running.assistance@tenaris.com).

Connections nomenclature

TenarisHydril Premium connections are divided into three types: Blue™ Series, Wedge Series 500™ and Legacy Series. For clarity, our premium connections series are organized in the following manner:

<table>
<thead>
<tr>
<th>CONNECTIONS</th>
<th>GROUP 1</th>
<th>GROUP 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue™</td>
<td>Wedge Series 500™</td>
<td></td>
</tr>
<tr>
<td>Blue™ Near Flush</td>
<td>MACII™</td>
<td></td>
</tr>
<tr>
<td>Blue™ Thermal Liner</td>
<td>SLX™</td>
<td></td>
</tr>
<tr>
<td>MS™</td>
<td>PH4™, PH6™ and CS®</td>
<td></td>
</tr>
<tr>
<td>3SB™</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW™</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PJD™</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ER™</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The use of a torque-turn monitoring system is highly recommended for Group 1 connections.

The use of a torque-turn Monitoring System is not necessary for Group 2 connections.

If torque-turn equipment is used, verify calibration dates on load cells.

Unless clearly stated, torque values published in TenarisHydril Data Sheets are for make-up with a running compound having a friction factor of 1. Use of other compounds may result in higher or lower torque values.

Group 1 Connections

Recommended make-up equipment

TURN MEASUREMENT RECOMMENDATIONS

1. Use a turn transducer device independent of the power tongs.

2. Perform a test to ensure that one turn of the transducer device indicates one turn on the graph.

3. Use a turn transducer that can deliver preferably 1000 pulses per turn for an accurate reading.

TIME MEASUREMENTS

Time measurement is useful but not necessary for monitoring the make-up of TenarisHydril premium connections.

DUMP VALVE RECOMMENDATIONS

1. Check the dump valve opening time before the first make-up.

2. Test the dump valve by applying the torque-turn system to the pipe body.

3. Fix or replace the dump valve if the real make-up torque does not match the optimum make-up torque.

FRICTION FACTOR CORRECTION

For all Group I connections, torque values should be adjusted by multiplying by the corresponding friction factor. This applies for running compound and for thread lock compound as well.
The following data should be loaded into the computer:

- Reference torque (1)
- Minimum shoulder torque
- Maximum shoulder torque
- Minimum make-up torque (2)
- Optimum make-up torque (2,3)
- Maximum make-up torque (3)
- Calibration value of the load cell
- Dump valve sensitivity
- Turn transducer sensitivity

(1) The initial recommended value for the reference torque is 5% of the optimum torque.
While running, the reference torque can be adjusted to display at least the last two turns.

(2) Look up values on the connection data sheets: www.tenaris.com/tenarishydril
For TenarisHydril dopeless® connections torque values, please consult the Tenaris Field Service Group.

(3) Optimum torque is the same as target torque.

Shoulder torque parameters are given as a percentage of optimum torque as follows:

### Shoulder Torque

<table>
<thead>
<tr>
<th>Shoulder Torque</th>
<th>Minimum Shoulder Torque</th>
<th>Maximum Shoulder Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(% Optimum Torque)</td>
<td>(% Optimum Torque)</td>
</tr>
<tr>
<td>Blue™ / Blue™ Thermal Liner</td>
<td>15</td>
<td>85</td>
</tr>
<tr>
<td>Blue™ Near Flush (2)</td>
<td>10</td>
<td>85</td>
</tr>
<tr>
<td>3SB™ (1)</td>
<td>5</td>
<td>80</td>
</tr>
<tr>
<td>HW™ (1)</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>MS™ (1)</td>
<td>10</td>
<td>75</td>
</tr>
<tr>
<td>MS XT/XC™ (1)</td>
<td>10</td>
<td>75</td>
</tr>
<tr>
<td>PJD™</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>ER™ (1)</td>
<td>15</td>
<td>75</td>
</tr>
</tbody>
</table>

(1) For special clearance option, torque values are different to those used in regular connections.
Please refer to the connections data sheet, or contact Tenaris office.

(2) For shoulder torque values above maximum limit and up to 90% of optimum torque, the make-up can be accepted provided a Delta torque higher than 5% is obtained.

Delta torque = (Final torque - Shoulder torque) * 100 / Optimum torque
Make-up acceptance criteria

Group 1 Connections
Graph interpretation

Make-up curves shown throughout this Section are schematic. Some variations may be observed in real make-up graphs.

For a correct interpretation of make-up graphs, it is important to consider the behavior exhibited by the joints that were previously run into hole.

Any graph reflecting anomalies should be investigated (i.e., back out and inspect joint).

MAIN FEATURES OF THE TORQUE VS. TURN GRAPH

TYPICAL GRAPH PROFILE

The graph pattern will indicate at least the following:

- The shoulder torque value will be within the specified shoulder torque range.
- Automatic shouldering torque determination on each graph should show a value close to that determined visually.

ACCEPTABLE CURVE

This result will be achieved if the recommended guidelines for running and thread lock compound application are followed.
**ACCEPTABLE CURVE**

This result will be achieved if the recommended guidelines for running and thread lock compound application are followed.

---

**ACCEPTABLE CURVE WITH SLIGHT OSCILLATIONS**

Slight oscillations in the thread interference section are allowed.

---

**ACCEPTABLE CURVE WITH HUMP EFFECT NOT EXCEEDING THE MAXIMUM SHOULDER LIMIT**

Possible causes:
- Running compound excess
- Dirt between threads
- Decanted running compound
- Running compound not homogenized
- High friction running compound
- Running compound contamination

Recommendations:
In this case it is recommended to break out the first two connections to verify that the hump effect is produced by an excess of running compound thus ensuring no damage has been caused.
Make-up acceptance criteria

GROUP 1 CONNECTIONS TORQUE VS. TURN
REJECTION CRITERIA

NON-ACCEPTABLE CURVE WITH HIGH FINAL TORQUE
Possible causes
- Over torque
- Load cell problem
- Dump valve problem
- Tong operator error
- Inertia high RPM

Possible effects
- Too much stress
- Galling on thread and/or seal

Recommendations
- Break out, clean and perform visual inspection (drift if possible)
- If the results from the inspection are acceptable, re-apply running compound and make-up again.

NON-ACCEPTABLE CURVE WITH LOW FINAL TORQUE
Possible causes
- Torque interruption
- Load cell problem
- Dump valve problem
- Tong operator error
- Back-off slip + dump delay

Possible effects
- Connection leak
- Poor energization
- Back-off

Recommendations
- Break out, clean and perform visual inspection (drift if possible)
- If the results from the inspection are acceptable, re-apply running compound and make-up again.

NON-ACCEPTABLE CURVE WITH YELLED CONNECTION
Possible causes
- Over torque
- Wrong box and/or pin grade
- Load cell problem
- Dump valve problem
- Tong operator error
- Low friction running compound
- Running compound contamination

Possible effects
- No drift after make-up
- Pin plastic deformation
- Special clearance box plastic deformation
- Tools could not pass
- Connection could fail due to:
  - Tension
  - Compression
  - Collapse
  - Burst

Recommendations
- Reject pin and box joints
Non-Acceptable Curve with High Shoulder Torque

Possible causes:
- Wrong torque
- Wrong running compound
- Running compound contamination
- Presence of storage compound
- Other friction reducer
- Load cell problem
- Low thread interference

Possible effects:
- Thread damage
- Seal damage
- Shoulder damage
- Connection leak

Recommendations:
- Break out, clean and perform visual inspection (drift if possible). If the results from the inspection are acceptable, re-apply running compound increasing the amount respecting the recommended distribution and make-up again.

Non-Acceptable Curve with Low Shoulder Torque

Possible causes:
- Wrong torque
- Wrong running compound (low friction)
- Running compound contamination
- Presence of storage compound
- Other friction reducer
- Load cell problem
- Low thread interference

Possible effects:
- Back-off
- High localized stress

Recommendations:
- Break out, clean and perform visual inspection (drift if possible). If the results from the inspection are acceptable, re-apply running compound decreasing the amount of it respecting the recommended distribution and make-up again.
Make-up acceptance criteria

**Non-Acceptable Curve with Non-Defined Torque Shoulder**

- **Possible causes**
  - Cross threads
  - Misalignment
  - Damaged threads
  - Dirty threads
  - Wrong torque
  - Incorrect running compound amount
  - Incorrect running compound
  - Load cell problem

- **Possible effects**
  - Leak
  - Galling
  - Back-off
  - Jump-out

- **Recommendations**
  - Break out, clean and perform visual inspection (drift if possible).
  - If the results from the inspection are acceptable, re-apply running compound and make-up again.

**Non-Acceptable Curve with Abnormal Thread Interference**

- **Possible causes**
  - Cross-threads
  - Dings or cut threads
  - Galled threads
  - Threads with burs
  - Threads with razor edges
  - Running compound contamination
  - Spider or slip turns during make-up
  - Back-up tong dies slip during make-up
  - Mechanical interference of pipes during rotation

- **Possible effects**
  - Severe thread damages
  - Thread galling
  - Connection leak
  - Connection back-off
  - Connection jump-out

- **Recommendations**
  - Break out, clean and perform visual inspection (drift if possible).
  - If the results from the inspection are acceptable, re-apply running compound and make-up again.

**Non-Acceptable Curve with Excessive Jaw Slips**

- **Possible causes**
  - Jaw dies poor grip
  - Dirty or worn tong dies
  - Dirty or worn slips dies
  - Dirty or worn spider dies
  - Spider movement
  - Not enough string weight for proper slips grip

- **Possible effects**
  - Pipe body damage

- **Recommendations**
  - Break out, clean and perform visual inspection (drift if possible).
  - If the results from the inspection are acceptable, re-apply running compound and make-up again.
  - Minor jaw slip can be accepted.
Group 2 Connections

The primary make-up criteria for Group 2 connections is the attainment of target torque. As a secondary visual aid the following guide is applicable:

**WEDGE SERIES 500™**

**Friction Factor Correction**

When running compound is employed it is recommended not to apply any friction factor correction, regardless of the recommendations made by compound’s manufacturer. Use TenarisHydril published make-up torque.

For thread lock compounds apply the following recommendations:

- Wedge Series 500™: Torque applied should be 15-20% over target torque regardless of the recommendations made by thread lock compound’s manufacturers. Do not exceed 1.75 times minimum torque.
- TSH SLX™ and TSH MAC® use maximum torque value from Data Sheet.

**Variants 521, 561, 563, 551 and 553**

These connections have a make-up band stencilled round the circumference of the pin OD. The face of the coupling should be within the range of the band.

- If the face of the coupling ends pass the maximum limits of the band, mark the pin and coupling and set both aside.
- If the face falls short of the band, breakout the coupling, clean pin and box, and inspect for damage.
- Repair any damage. Reapply running compound and buckle coupling. If face still fails to reach the band, mark the pin and coupling and set aside.

**Variants 533 and 503**

These connections have a wear indicator gap between the pin and box shoulders after make-up. This gap should always be visible.

- When the gap is closed it is an indication that the connection is worn, and both pin and box should be marked and sent for re-cut.

**Variants 511, 513 and 523**

These connections have no make-up band on pin end. Correct make-up has been attained if no pin threads are visible after make-up.
Make-up acceptance criteria

**LEGACY SERIES**

**MACII™**
This connection should have the external seal in contact after make-up.

**PH4™, PH6™ AND CS®**
These connections will make-up to the external seal with no gap visible.

**SLX™**
This connection should have no pin threads visible after make-up.