Blue® Series and Legacy Series Make up Acceptance

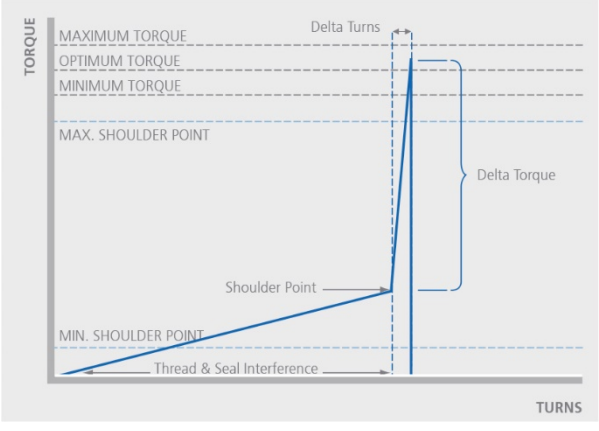
1. Computer graph interpretation is exactly as described, ‘interpretation’ which means it is not an exact science. Many things should be considered before accepting a graph; condition of pipe, weather, alignment, thread compound, pipe or rig movement, temperature and most importantly the behavior exhibited by the graphs of the connections previously made up during the run. There are however some basic rules and tenets which, if understood along with specific connection mechanics, allow the area of interpretation to remain within anticipated parameters. The following examples are indicative and are only for guidance as to the acceptance of any given connection assembly. Many variables can produce graphs which differ to the ones depicted, which with the correct understanding and knowledge can still be acceptable make up profiles.

2. The reliability of any make up graph depends on the accuracy of both the equipment used and the data input. Therefore, it is imperative that all equipment used is well maintained, calibrated, set up and operated correctly. Data input should be cross checked to ensure accuracy and saved.

3. A computer graph for a shouldered connection can essentially be broken down into four component parts:

- Thread and seal interference build slope.
- Shoulder point.
- Linear delta torque build.
- Delta turns.

4. The above four components are analyzed in conjunction with the characteristics for the given connection design (such as presence or absence of metal seal, low or high thread interference, etc.) in order for the make up graph to be interpreted accurately.



TYPICAL GRAPH PROFILE

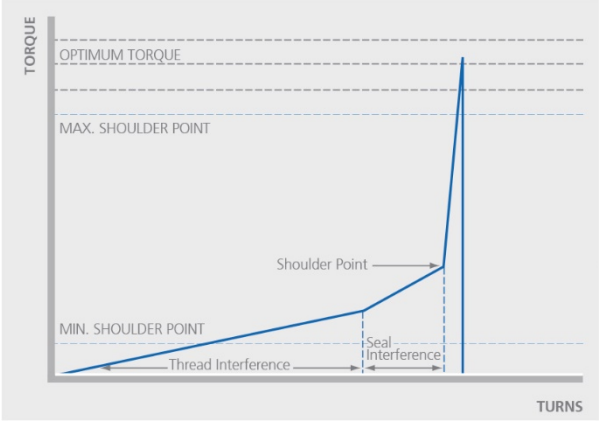
5. The four basic component parts of a graph should exhibit the following characteristics to be acceptable:

- Smooth, continuous thread and seal interference build exhibiting no unusual discontinuities.
- A distinct, identifiable shoulder point within set shoulder parameters.
- An exponential delta torque build after shoulder point exhibiting no discontinuities.
- Delta turns within acceptable parameters.

6. Encountering high torque at the commencement of rotation or soon after can indicate cross threading of the connections. Immediately stop rotation, back out and inspect the connections for damage.

7. Best practice is to spin the connection in without the back up tong gripping the pipe.

8. Occasionally some connections can exhibit a change in angle during seal engagement, this is perfectly acceptable. This profile may be evident on every make up of a particular string or may occur sporadically throughout the run.



9. While a shouldered connection will display the four key components previously described, the specific make up profile can vary significantly. Various factors influence the shape of a computer-generated graph, including weather conditions, rig movement, pipe sway, traveling block alignment or sway, pipe bending, tong slip, rotation speed, snub line whip, elevator or equipment contact with the pipe, material grade, temperature, accuracy of the make-up equipment, thread compound type, its temperature, consistency, application method, contamination, friction factor, and the quantity applied. Any or all these factors can contribute to the final graph profile.

10. It is imperative data is accurately input to the computer and stored correctly. Shoulder points should be accurately pinpointed whether automatically or manually in order to accurately determine delta turns.

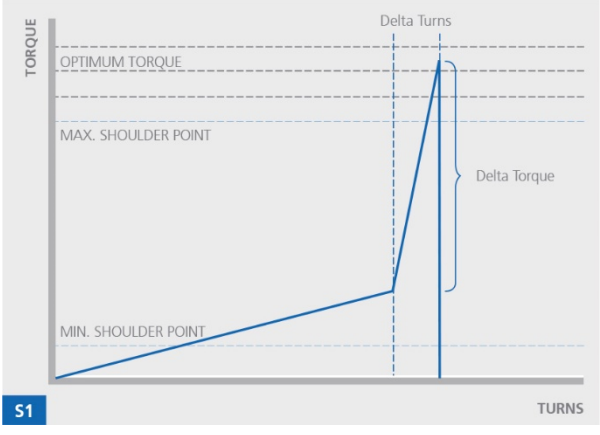
11. There are many reasons for not accepting a make up graph and therefore breaking out the connection, priority among these is doubt with the integrity of the assembly leading to the connections leaking down hole. Unacceptable graphs require the connections to be fully disassembled with both pin and box connections cleaned and inspected for damage. Only when this process has been completed and no damage found, can the connections then be re-assembled. Partial break out is inadvisable. All graphs should be kept for post job analysis including unacceptable make up graphs.

12. The following series of graphs, which are by no means exhaustive, are indicative of the many different profiles witnessed, both acceptable and unacceptable. In certain circumstances an anomalous graph profile can be accepted after investigation by a qualified Tenaris Field Service Representative but only within the context of the particular run of pipe in which it occurs. This would only be the case if the cause has been identified and is deemed by the representative as non-detrimental to connection integrity. If no remedy can be found further graphs of a similar type can be accepted during that particular run.

13. These graphs are applicable to Blue® Series and Legacy Series shouldered connections, in doped and Dopeless® versions, with the following additional considerations:

- TXP® BTC, TenarisHydril SLX®, TenarisHydril MACII™, TenarisHydril PH6™, TenarisHydril PH4™ and TenarisHydril CS® shouldered connections have no defined shoulder point criteria. However, it is still essential to see a clear shoulder to confirm proper make up.
- Certain anomalies in the make up graphs are acceptable on semi-premium connection (without metal seal), but cannot be accepted on premium connections (with metal seal).

COMPUTER GRAPH BLUE® SERIES AND LEGACY SERIES

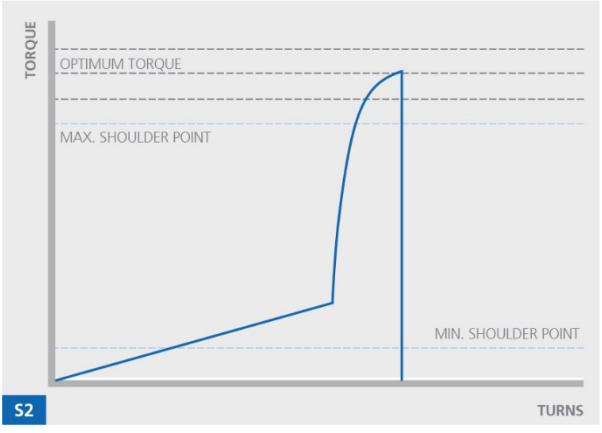


S1 - TYPICAL GRAPH

The acceptance criteria for Blue® Series or Legacy Series threaded and coupled connections are as follows:

- A final torque above minimum and below maximum.
- Shoulder point within limits, when applicable.

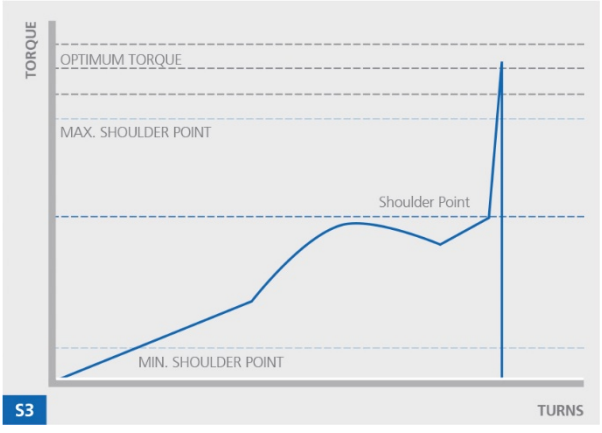
- The maximum delta turn can be no more than:
  - 0.12 turns for sizes 5 1/2" and below
  - 0.10 turns for sizes above 5 1/2"



S2 - CURVED GRAPH POST SHOULDER

Recommendations

- Verify final torque is above minimum and below maximum.
- Expand the graph and ensure the shoulder point is accurately indicated, adjust if necessary.
- If the delta turn limit value is not exceeded accept the make up
- If the delta turn limit value is exceeded, proceed according to connection type.
- Connections with metal seal: reject the graph and lay down both connections.
- Connections without metal seal: break out and inspect for damage. If no damage found, connections can be re-run. If this behavior persists during the run, accept further similar graphs.



S3 - HUMP BELOW SHOULDER POINT

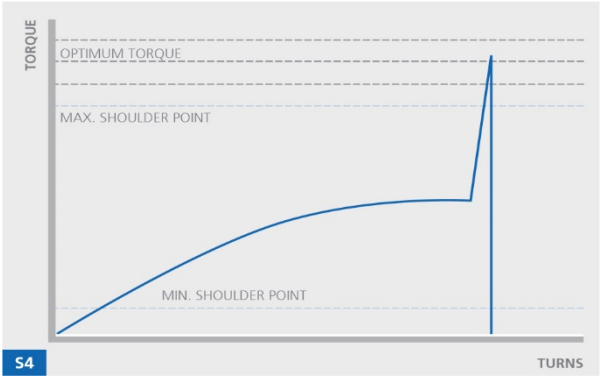
Thread and seal build profile with smooth hump effect not exceeding shoulder point.

Possible Causes

- Excessive running compound
- High friction factor running compound
- Slight misalignment
- Pipe sway
- Rig movement
- Pipe bend
- Contact on pipe by other equipment

Recommendations

- If no obvious reason is evident break out the first make up and inspect both connections for damage, if no damage found continue to accept similar graph profiles.



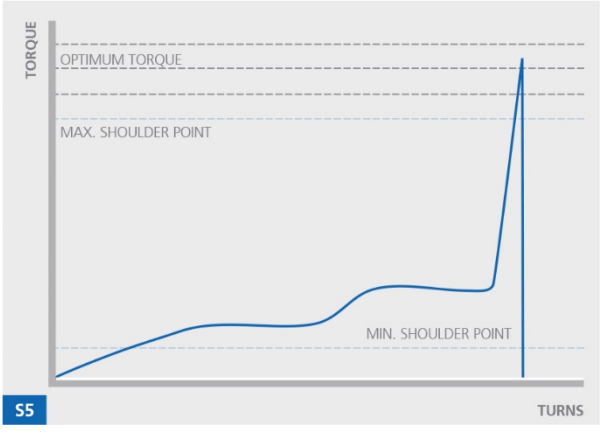
S4 - CURVED TORQUE BUILD SECTION

Possible Causes

- Excess thread compound
- High friction factor thread compound
- Low temperature thread compound
- Pipe sway
- Rig movement
- Pipe bend
- Contact on pipe body by other equipment

Recommendations

- If thread and seal interference build section displays a smooth profile, the graph is acceptable.
- If compound is thought to be the cause ensure it is fully stirred and warm if possible.
- Eradicate any contact by other equipment during make up.



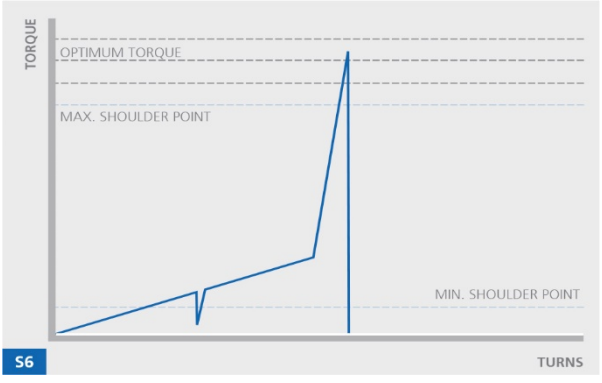
S5 - MINOR OSCILATIONS PRIOR TO SHOULDER

Possible Causes

- Pipe sway
- Pipe bend
- Rig movement
- Contact on pipe body by other equipment
- Excessive spin in speed

Recommendations

- Minor, smooth oscillations during thread and seal interference build profile can be accepted.
- Reduce rotation speed if pipe sway, rig movement or pipe bend is the reason.
- Stabilize pipe during make up.
- Eradicate any contact by other equipment.



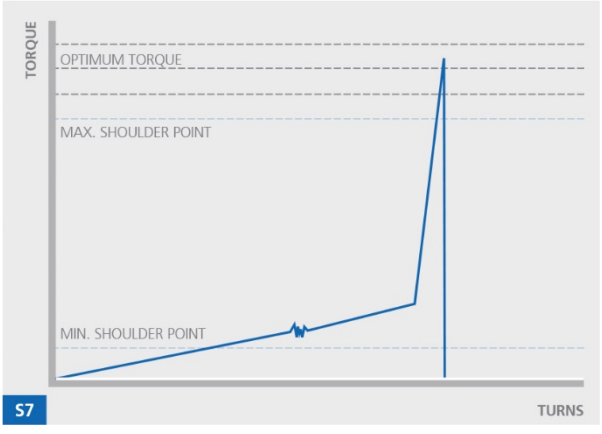
S6 - TONG SLIP DURING THREAD AND SEAL BUILD

Possible Causes

- Clogged tong dies
- Worn tong dies
- Incorrect dies or tong jaws
- Tong not level
- Snub line movement
- Wet or oil covered pipe OD.

Recommendations

- Accept if the tong slip is momentary and the torque build returns to previous build slope.
- Clean or replace tong dies
- Ensure tong and back up are level and dies contact pipe OD evenly.



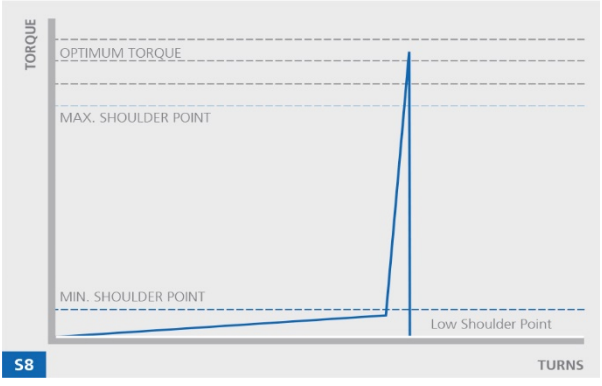
S7 - MINOR THREAD INTERFERENCE

Possible Causes

- Electrical interference
- Momentary contact on pipe, elevators, etc.

Recommendations

- Minor interference during thread interference build can be accepted.
- Identify cause and eradicate if possible



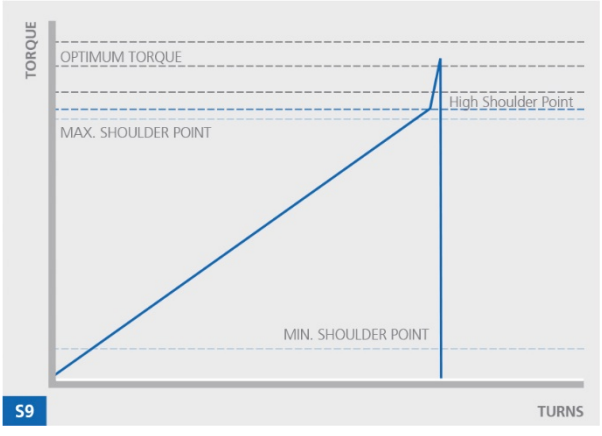
S8 - LOW SHOULDER

Possible Causes

- Incorrect torque applied
- Incorrect thread compound friction factor
- Contaminated thread compound
- Substance contamination of connections
- Storage compound not cleaned off prior to application of thread compound
- Other friction reducer
- Incorrect load cell / data reading
- Low thread interference

Recommendations

- The make up graph is unacceptable, except for TXP®, SLX®, MACII™, PH6™, PH4™ and CS® (which only require a visible shoulder point).
- Break out, clean and inspect both connections for damage.
- Ensure connections are cleaned using methods recommended in cleaning section of this document.
- Ensure connections are dry whenever possible.



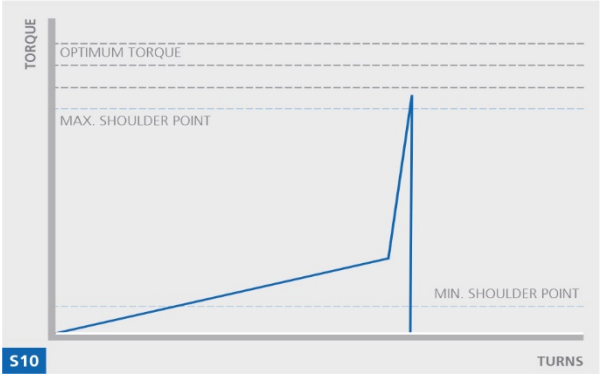
S9 - HIGH SHOULDER

Possible Causes

- Incorrect torque
- Incorrect running compound
- Contaminated or lack of running compound
- High thread interference
- Incorrect friction factor
- Load cell problem
- Misalignment

Recommendations

- The make up graph is unacceptable, except for TXP® BTC, TenarisHydril SLX®, TenarisHydril MACII™, TenarisHydril PH6™, TenarisHydril PH4™ and TenarisHydril CS® (which only require a visible shoulder point)
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound increasing the amount applied while maintaining the recommended distribution, then re-make up connection.



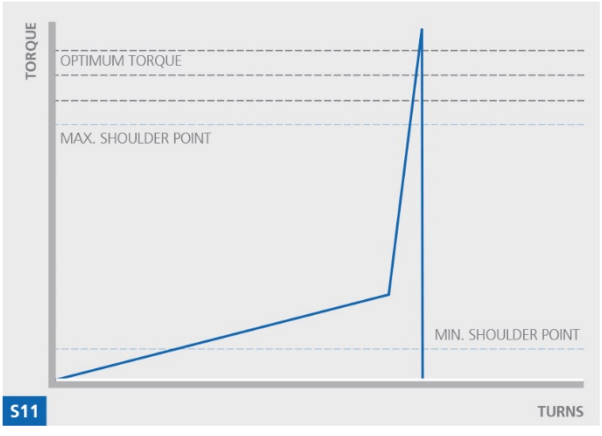
S10 - LOW FINAL TORQUE

Possible Causes

- Incorrect torque input
- Incorrect dump valve function
- Load cell error
- Operator error

Recommendations

- The make up graph is unacceptable.
- Break out clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.



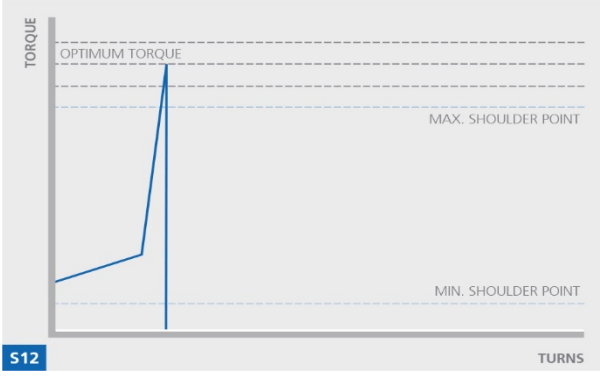
S11 - HIGH FINAL TORQUE

Possible Causes

- Incorrect torque
- Incorrect dump valve function
- Load cell error
- Operator error
- Excessive RPM at final torque

Recommendations

- If the final torque is below operating torque and all other parameters are within limits, a smooth make up graph can be accepted.
- Take actions to avoid exceeding torque in subsequent make ups.



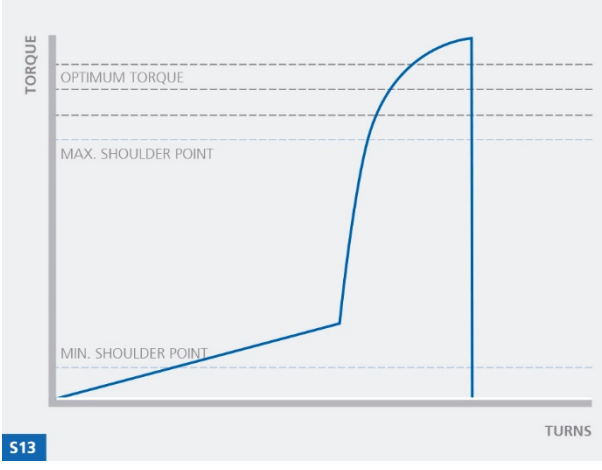
S12 –SHORT / INCOMPLETE GRAPH

Possible Causes

- Reference torque set too high
- Late gear change
- High initial interference
- Cross-threading
- Computer operator started the graph late

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.
- Lower reference torque.
- Stabilize pipe during stabbing and make up.



S13

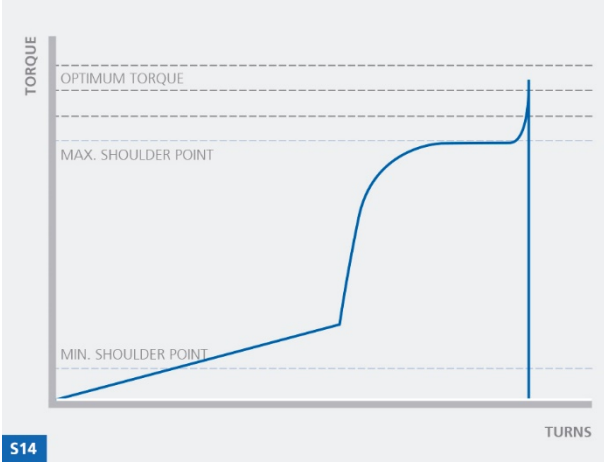
S13 - OVERTORQUE WITH YIELD

Possible Causes

- Incorrect torque
- Incorrect thread compound
- Contaminated thread compound
- Storage compound not cleaned off correctly
- Incorrect friction factor
- Disparity of connection grade / weight
- Load cell error
- Equipment malfunction
- Incorrect tong arm length
- Operator error

Recommendations

- The make up graph is unacceptable.
- If delta turns and/or torque applied exceed the acceptable limit reject both pin and box connections.



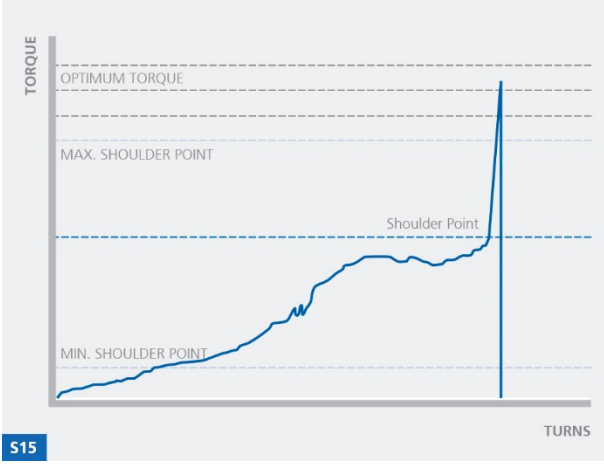
S14 – YIELDED CONNECTION

Possible Causes

- Incorrect torque
- Incorrect thread compound
- Contaminated thread compound
- Storage compound not cleaned off correctly
- Incorrect friction factor
- Disparity of connection grade / weight
- Load cell error
- Equipment malfunction
- Incorrect tong arm length
- Operator error

Recommendations

- The make up graph is unacceptable.
- Reject both pin and box connections.



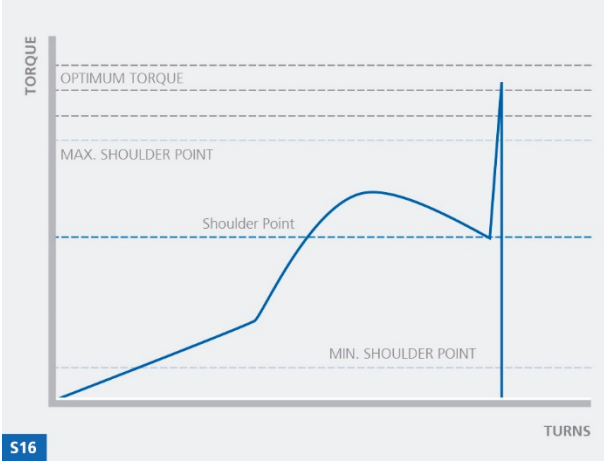
S15 - ERRATIC THREAD INTERFERENCE

Possible Causes

- Incorrect thread compound
- Contaminated thread compound
- Misalignment
- High rotation speed
- Pipe movement during spin in
- Damaged threads
- Debris on connections

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.



S16

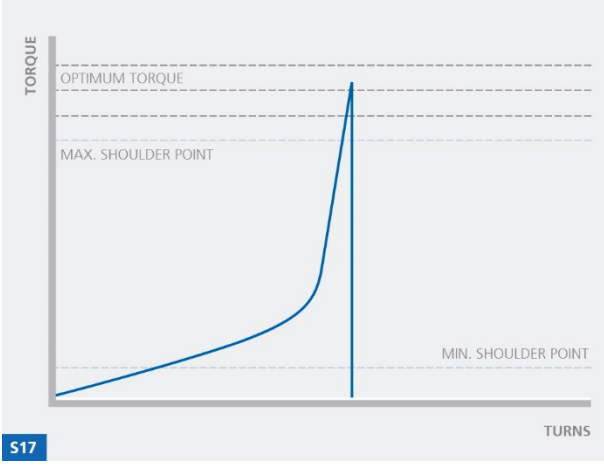
S16 - HUMP EXCEEDING SHOULDER POINT

Possible Causes

- Excessive thread compound application
- Contaminated thread compound
- Debris on connections
- High friction factor thread compound
- Pipe movement during spin in
- External contact on pipe from other equipment
- Misalignment

Recommendations

- Connections without metal seal: The make up graph is acceptable.
- Connections with metal seal: Break out connections, clean and inspect both connections for damage. If no damage found re-apply thread compound, reducing quantity then re-make up connection.
- Eradicate any other external influence causing this effect



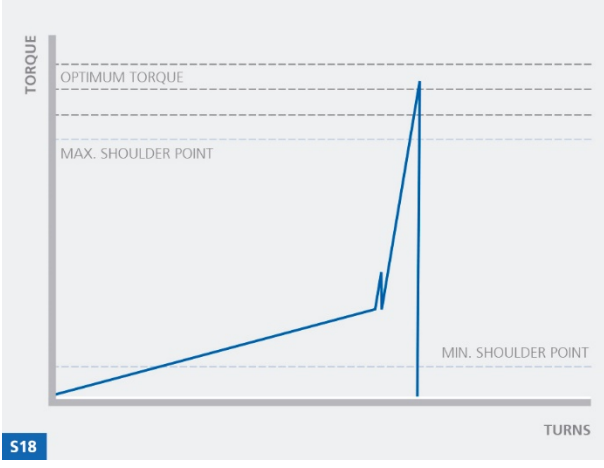
S17 - NON-DEFINED SHOULDER POINT

Possible Causes

- Incorrect torque
- Misalignment
- Pipe movement during spin in
- Debris on threads
- High friction factor thread compound
- Excessive thread compound application
- Slow final rotation speed
- False shoulder encountered

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.
- Increase RPM during final make up if possible



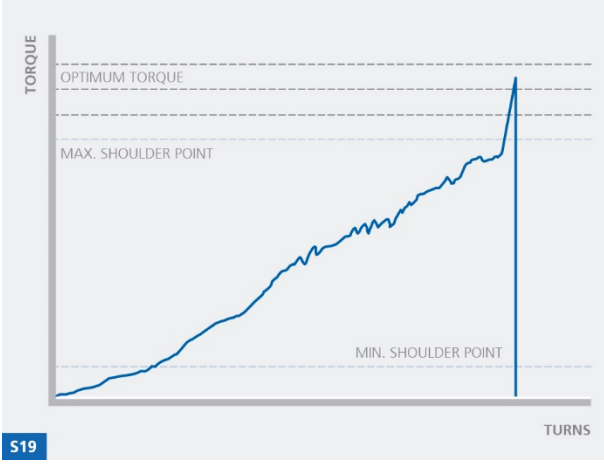
S18 – SPIKE PRIOR TO SHOULDER POINT

Possible Causes

- Galling of threads or seal
- Contaminated thread compound
- Debris on threads / seals
- Sudden pipe movement prior to shoulder
- Contact on pipe from external equipment
- Misalignment

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.
- If the anomaly persists during the run, check for external equipment contact on pipe.
- If the issue cannot be eradicated and no detrimental effect found on connection, accept further similar graphs.



S19

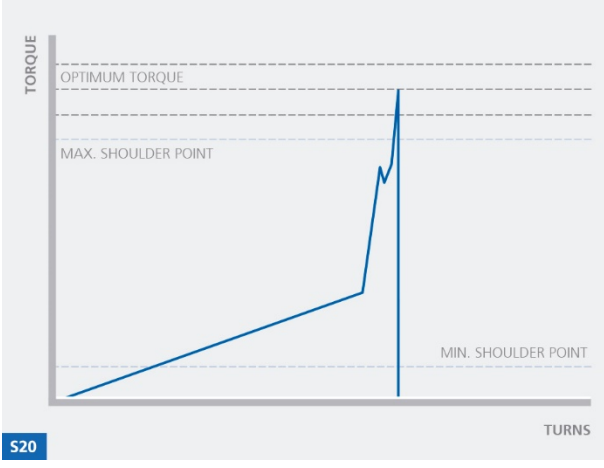
S19 – HIGH AND ERRATIC THREAD INTERFERENCE

Possible Causes

- Galled threads
- Contaminated thread compound
- Incorrect thread compound
- Debris on threads
- Damaged threads
- Misalignment
- Crossed threads
- High spin in speed
- Pipe movement during spin in
- Electrical interference

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.



S20

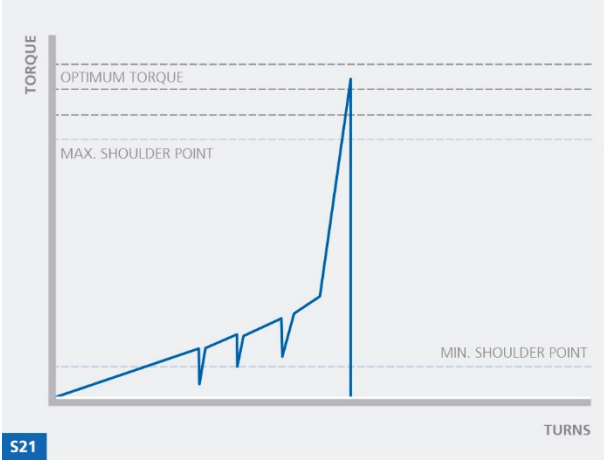
S20 – DISCONTINUOUS DELTA TORQUE BUILD

Possible Causes

- Galled threads
- Damaged threads
- Misalignment
- Crossed threads
- Tong slip
- Rotary turning during make up

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.
- If tong slip is the cause clean or replace dies.
- Lock the rotary table.



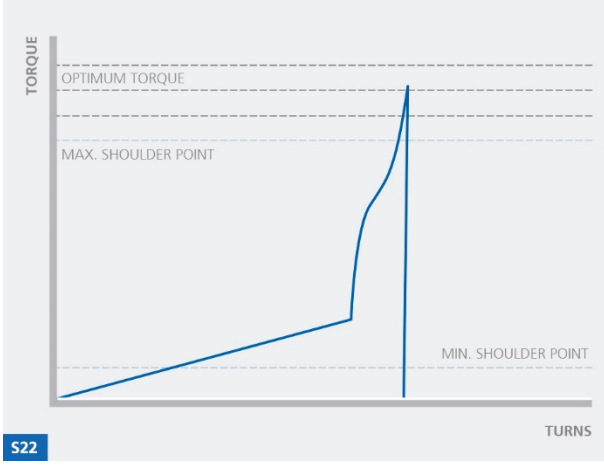
S21 – MULTIPLE TONG SLIPS

Possible Causes

- Clogged tong dies
- Worn tong dies
- Incorrect dies or tong jaws
- Tong not level
- Snub line movement
- Wet or oil covered pipe OD

Recommendations

- The make up graph is unacceptable.
- Break out clean and inspect both connections and pipe body for damage.
- If no damage found re-apply thread compound, then re-make up connection
- Clean or replace tong dies.
- Ensure tong and back up is level and dies contact pipe OD evenly.



S22

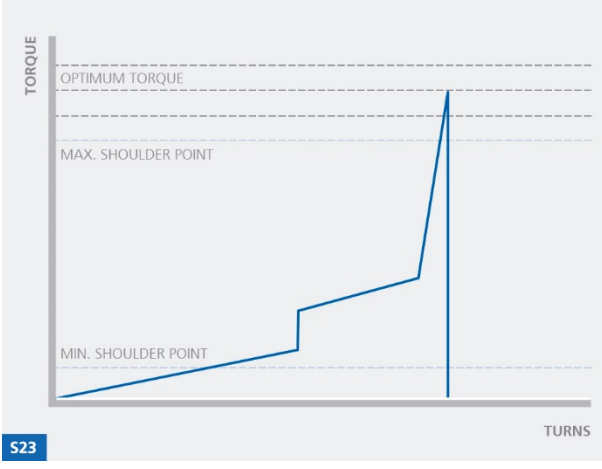
S22 – NON-LINEAR DELTA TORQUE BUILD

Possible Causes

- Coupling turn
- Minor yield
- External contact on pipe from other equipment
- Compression load cell restriction

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.
- Eradicate any contact from external equipment.
- Check for obstructions within the load cell bracket.



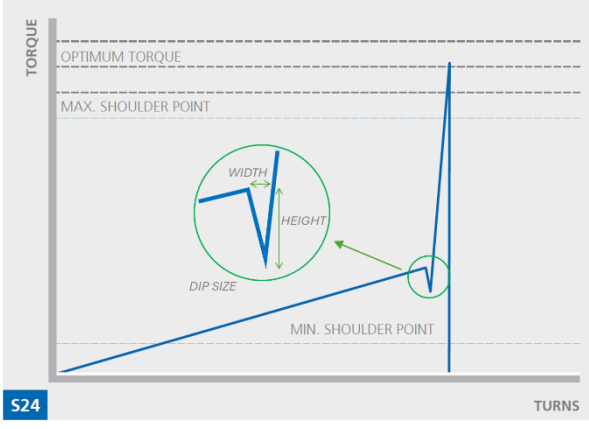
S23 –TORQUE STEP

Possible Causes

- Turns counter malfunction

Recommendations

- The make up graph is unacceptable.
- Break out, clean and inspect both connections for damage.
- If no damage found re-apply thread compound then re-make up connection.



S24 –DIP PRIOR TO SHOULDER

Possible Causes

- Minor back up tong movement just prior to shoulder
- Back up tong not completely level
- Dope squeeze

Recommendations

- Connections without metal seal: The make up graph is acceptable
- Connections with metal seal: Analize the size of the dip and proceed as indicated below.
  - If the dip width is 0.015 turns or below and dip height is 5% of optimum torque maximum, accept the make up graph.
  - If the dip width and/or height is larger than indicated above, the make up graph is unacceptable. Break out, clean and inspect both connections for damage. If no damage found re-make connections.
  - Adjust back up tong to prevent re-occurrence.
  - If the anomaly persists during the run and the issue cannot be eradicated, open and check the first connection, and if no damage is found accept further similar graphs.