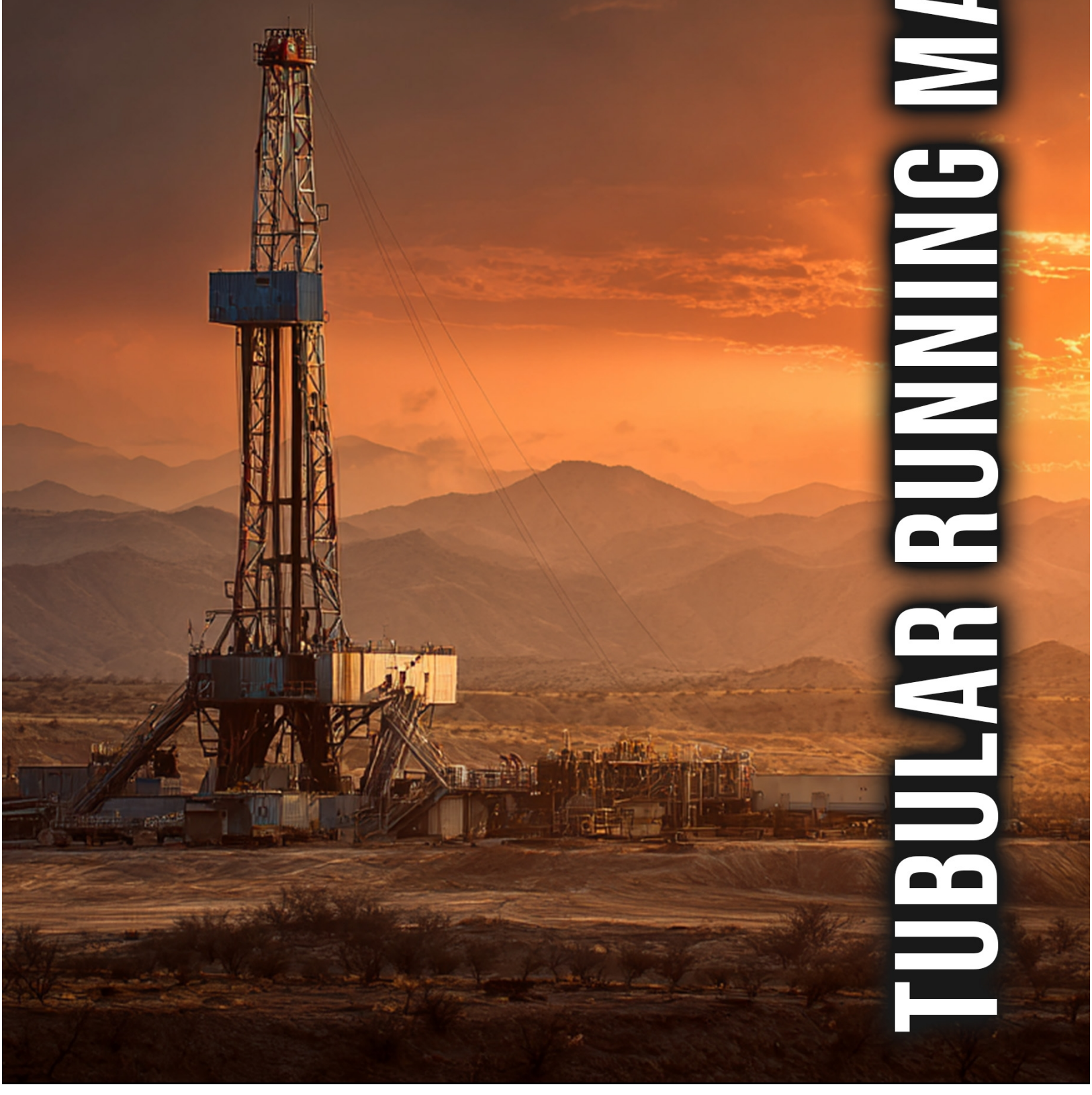
ArcelorMittal

Tubular Products Al-Jubail

TUBULAR RUNNING MANUAL



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Chapter 1:
Introduction to Connections and Field Services

This chapter presents ArcelorMittal Tubular Products Al-Jubail premium connections, engineered for demanding drilling environments and supported by a global manufacturing and service network. It stresses the importance of certified threading and repair facilities for maintaining connection integrity and explains the manual's purpose: to provide clear procedures that enhance performance, reduce failures, and support safe, efficient operations.

1.1 PRODUCT OVERVIEW AND GLOBAL EXPERTISE

ArcelorMittal Tubular Products Al-Jubail premium connections represent the result of years of engineering excellence and field experience. Designed for challenging environments, these connections are tailored to meet the demands of modern drilling and completion operations — from conventional oilfields to deepwater and unconventional plays.

Manufactured and supported by ArcelorMittal Tubular Products Al-Jubail, a world-renowned provider of seamless steel pipe solutions and integrated tubular services, ArcelorMittal TPJ products are backed by a robust infrastructure. This includes manufacturing plants, research and development center, field service team, and a fully integrated supply chain; enabling quick response, consistent quality, and customer-specific solutions.

These connections are engineered for well integrity, offering advanced sealing mechanisms, torque capacity, and fatigue resistance. Their proven track record spans operations across several countries, covering both onshore and offshore projects (see Appendices 1 & 2).

1.2 CERTIFIED THREADING AND REPAIR FACILITIES

To maintain the technical integrity and long-term performance of ArcelorMittal TPJ connections, ArcelorMittal TPJ operates an extensive network of licensed threading and repair facilities. These centers are equipped and audited to meet strict quality standards, ensuring that all re-threading and inspection services comply with ArcelorMittal TPJ specifications.

Only these authorized facilities are permitted to rework or re-thread ArcelorMittal TPJ connections. Using unauthorized services may lead to connection failure, invalidation of warranties, and increased HSE risk.

1.3 PURPOSE AND SCOPE OF THIS MANUAL

This manual serves as a comprehensive field reference for the proper care, preparation, and installation of ArcelorMittal TPJ premium connections. It consolidates globally validated procedures and incorporates lessons learned from multiple field jobs across diverse geographies and operating environments.

Whether you’re working with carbon steel or chrome alloys, these guidelines are designed to:

- Enhance connection integrity and reduce failure rates.
- Ensure consistent application of best practices across the field.
- Support HSE standards and mitigate environmental and operational risks.
- Extend the service life of each joint and reduce NPT (non-productive time).

While this manual does outlines key procedures, we strongly recommend the presence of ArcelorMittal TPJ field service representatives during running operations. These representatives are extensively trained, undergo continuous qualification programs, and are experienced in adapting procedures to variable rig conditions.

1.4 RIG-SITE FIELD SUPPORT: RUNNING ASSISTANCE

ArcelorMittal Tubular Products Al-Jubail offers direct technical support during live operations through on-site field service representatives. These professionals act as advisors and quality gatekeepers throughout the running process.

Rig-Site Running Support Includes:

- Coordination with the rig's operating company representatives and service providers.
- Application of procedures described in this manual and latest ArcelorMittal TPJ technical updates.
- Visual inspection of each joint and connection before running.
- Verification of tool and equipment readiness, including:
    - Drifts
    - Stabbing guides
    - Thread Compounds
    - Handling Plugs
    - Quick-fit protectors
    - Correctly sized elevators and tongs
- HSE compliance monitoring and awareness guidance.
- Ensuring correct compound selection and application per environment and connection type.
- Supervision of make-up parameters and torque-turn readings.

- Advising on pipe handling techniques, surplus preparation, and rejection identification.
- Performing minor connection repairs if conditions and approvals allow.
- Real-time adjustments and troubleshooting based on field observations.

1.5 OFF-SITE TECHNICAL SERVICES: YARD & FACILITY SUPPORT

In addition to rig-site involvement,ArcelorMittal TPJ offers support across various operational nodes — including pipe yards, bucking units, and preparation facilities. These services are crucial for ensuring readiness and compliance before material reaches the rig.

Technical Services Provided Include:

- Close collaboration with drilling engineers, completion teams, and logistics personnel.
- Validation of torque equipment calibration and readiness.
- Supervision of make-up for:
    - Couplings
    - Completion assemblies
    - Packers and hangers
    - Float shoes and casing accessories
- Inspection of components, seals, threads, and protectors prior to loadout.
- Stock and inventory traceability checks, including condition audits.
- Guidance on safe and efficient storage, transportation, and staging.
- Pre-job technical briefings and participation in drilling-on-paper sessions.
- Operator and crew training — both on-site and remote — on connection handling, torque monitoring, and damage prevention.
- Ongoing process optimization recommendations

1.6 REPORTING AND DOCUMENTATION

Upon completion of each job, the ArcelorMittal Tubular Products Al-Jubail field service representative prepares a service ticket, to be signed by the company representative at the rig or yard. This summary includes:

- • Work performed and results.
- • Notable deviations or non-conformances.
- • Connection behavior observations.
- • Technical issues encountered and corrective actions

A comprehensive post-job report may also be provided, offering graphs, photos, and conclusions. This is particularly valuable for future jobs or procedural reviews.

1.7 COMMITMENT TO HEALTH, SAFETY, AND ENVIRONMENTAL STEWARDSHIP

ArcelorMittal Tubular Products Al-Jubail upholds a firm commitment to sustainability, personal safety, and environmental protection. These values are deeply embedded in our operating philosophy and field service culture.

HSE Key Practices:

- All site-specific safety protocols must be fully implemented — including risk assessments, PPE use, and incident response plans.
- Only experienced and/or qualified personnel should handleArcelorMittal TPJ connections.
- Daily safety briefings (toolbox talks) should address pipe handling hazards, chemical exposure, fall risks, and equipment safety.
- Hazards such as H_2S exposure, heavy lifting, and rotational machinery must be managed with vigilance.

Environmental Considerations:

- Ensure all waste (thread compound, cleaning rags, protectors, wash fluids) is disposed of as per local regulations.
- Protect sensitive components (threads, seals) from exposure to water, mud, or debris to prevent corrosion and contamination.
- Apply proper compound containment measures to avoid spills on rig floor or yard surfaces.

1.8 PIPE

Tubing and casing are types of pipe used in oil and gas wells, but they serve different purposes and are installed at different stages of the drilling process. Connections are used to bring two pieces of pipe together.

1.8.1 TUBING

Tubing is used to transport fluids from a reservoir to the surface. Tubing is a smaller-diameter pipe installed inside the casing once the well has been drilled. It is used to transport the oil or gas to the surface.

1.8.2 CASING

Casing is for well integrity and isolation of well zones (underground layers). Casing is a large diameter pipe that is installed in the drilled well to stabilize the hole, prevent the well from collapsing, and isolate different underground layers (like oil, gas, water, or rock formations). It ensures that the drilling fluids, hydrocarbons, and other substances stay contained and don't mix with surrounding layers.

Chapter 2:
Quick Start Running Guidelines

This chapter outlines the essential steps for preparing and running connections. It highlights proper use of compounds, alignment checks, controlled rotation speeds, and correct torque application. Special care for chrome and CRA materials is emphasized, along with a checklist to confirm readiness before running operations.

2.1 PRE-OPERATION SETUP: PREPARING CONNECTIONS

Before any running activity begins, it's critical to prepare connections correctly. Proper preparation ensures structural integrity, reduces downtime, and prevents costly rework.

Follow these pre-running procedures carefully:

- Apply thread and running compounds precisely as recommended (see Section 7 for full application diagrams).
- Protect seal areas and threads with clean, dry protectors until the pipe is positioned for running.

2.2 ENSURING ALIGNMENT AND EQUIPMENT READINESS

Correct alignment prevents mechanical stress, misalignment, and premature wear of the connection threads and seals.

Checklist: Alignment Verification

Task	Description
Traveling Block	Must be aligned vertically above the rotary table.
Suspended Pin	Ensure it centers perfectly over the box connection. Adjust with stabbing guides if necessary.
Rotary Hole	Confirm concentricity to prevent stabbing issues.

SUGGESTION:

For challenging setups (e.g. floating rigs, narrow rotary tables), use precision laser alignment tools to reduce error margins.

2.3 ROTATION SPEEDS FOR CONNECTION MAKE-UP

Improper rotation speeds are a common cause of galling, seal deformation, and make-up failure. Use the following guidelines for safe and effective make-up:

Operation Phase	Recommended RPM
Spin-In	≤15RPM
Final Make-Up	≤5RPM (low gear only)

2.4 TORQUE APPLICATION: BEST PRACTICES

Always refer to the latest online ArcelorMittal TPJ torque specifications. Using incorrect torque risks seal failure, inadequate interference, and long-term fatigue damage.

Sources for updated torque info:

- Data Sheets:
- Torque Tables:

IMPORTANT:

Always calibrate your torque wrench system on- site before beginning operations. A 5%torque deviation can make or break sealing performance.

2.5 SPECIAL MATERIALS: CHROME AND CRA GUIDELINES

Connections made of chrome and corrosion-resistant alloys (CRAs) require special handling due to their reduced ductility and high surface hardness.

When handling Chrome or CRA pipes:

- Walk the connection in by hand until fully hand-tight before using tongs.
- Use compounds designed specifically for high-chrome materials.
- Avoid impacting the threads — even minor dings can cause cracks under load.

Quick Start Essentials Summary Checklist

Tasks

Tasks	Completed
Have you applied thread compounds?	
Have you checked alignment?	
Have you confirmed torque references?	
Have you set rotation speeds?	
Have you performed all material-specific checks?	

NOTE:

Most connection issues in the field occur due to skipping or rushing pre-running checks. A 10-minute preparation saves hours of fishing operations.

Chapter 3:
Running and Handling Guidelines

This chapter details best practices for running and handling connections, from lifting and protector use to compound application, stabbing, and make-up. It stresses the importance of torque-turn monitoring, proper inspection, and rejection criteria. Procedures for breakout, repair, surplus pipe management, and harsh environment operations are also included to protect connection integrity and extend service life.

3.1 CONNECTION CARE DURING RUNNING

Running premium connections is a critical phase where most field damage can occur if proper handling protocols aren't followed. This section provides step-by-step best practices for safely and effectively running ArcelorMittal TPJ connections, ensuring optimal performance and integrity throughout the operation.

IMPORTANT:

Most connection failures trace back to simple oversights during handling —like dropped joints, dirty threads, or excessive stabbing force. The aim here is prevention through precision.

3.2 PIPE HANDLING: GENERAL GUIDELINES

- Use properly rated slings, spreader bars, and lifting devices.
- Always lift pipes using the body, never by the threads or connection ends.
- Inspect slings and lifting gear before each use.
- Ensure thread protectors are in place until just before running.
- Store pipe on clean, flat racks with sufficient padding to avoid point loading.

CAUTION: Avoid the following handling mistakes.

- Never drag pipe along hard surfaces.
- Do not roll pipe joints on gravel or dirty rig floors.
- Do not remove protectors prematurely, as they prevent dust, fluid, and mechanical impact damage.

3.3 THREAD PROTECTOR MANAGEMENT

Thread protectors are often overlooked but are the first line of defense against environmental and impact damage.

Best Practices:

- Inspect protectors before removal. Discard if cracked, deformed, or contaminated.
- Replace protectors immediately after pulling out of hole (POOH), especially in extended operations.
- Store used protectors away from direct sunlight and contamination.

IMPORTANT:

Reusing protectors is allowed only if they are ArcelorMittal TPJ-approved and fully intact.

3.4 CLEANING PIPE BEFORE STABBING

Every connection should be thoroughly cleaned before stabbing. Even microscopic debris or residue can cause galling, cross-threading, or torque interference.

Cleaning Procedure:

1. Wipe the pin and box ends with a clean, lint-free cloth.
2. Use a mild solvent (if needed) to remove residual dope or shipping compound.
3. Use thread chasers or combs to dislodge dried particles in grooves.

CAUTION: Never use wire brushes or abrasive pads. These can scratch or deform sealing surfaces.

3.5 APPLYING COMPOUND

Apply a thin, even coat of thread compound to the entire pin and seal area using a clean brush.

Figure 3-1: Apply a thin coat to pin

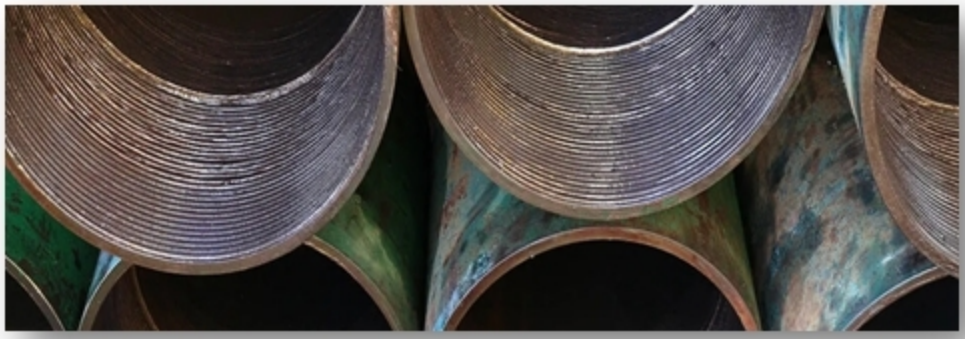


Figure 3-2: Apply a thin coat to seal area

Avoid over-applying — excess compound can increase torque and affect make-up.

NOTE:

Always refer to the compound compatibility matrix when running ArcelorMittal TPJ connections.

Manufacturer	Brand Name	JPC4 C1
	Thread Compound (FF=1.0)	
All	API Modified (API RP 5A3 Annex B compliant)	√
BestOLife	BoL 72733 (HPHT exceeds API RP 5A3)	√
BestOLife	BoL 2000 (Lead & Zinc Free)	√
Jet Lube	Jet-Lube API modified HP	√
Weatherford	Weatherford Lube Seal	√
	Storage Dope	
BestOLife	BESTOLIFE BSC STORAGE	√
ARGL	Kendex	√
ARGL	Kendex OCTG Orange	√
Jet Lube	Jet- Lube Korr-guard	√
Haughton	Rust Veto AS	√
Shell	Shell Showa Shell Storage	√
Total	Total Jet Marine 5271	√

Figure 3-3: Brands of Thread Compound

3.6 STABBING AND MAKE-UP: STEP-BY-STEP GUIDE

Proper stabbing and make-up are the foundation of a leak-proof connection.

Stabbing is the process of aligning and inserting the pin connection into the box connection. Make-up involves rotating the connections until the required torque is achieved to ensure proper seal and structural integrity.

3.6.1 STABBING

In most cases, connections are run with the pin end down, meaning stabbing occurs when the pin is lowered into the box. Proper alignment between the two pipe ends is critical to prevent cross-threading and ensure smooth make-up.

Always use a plastic or rubber stabbing guide over the box connection to protect the pin seal from damage during stabbing.

Stabbing Procedure

1. Use a non-metallic stabbing guide designed for the connection size.
2. Slowly lower the pin into the box until it contacts the shoulder.
3. Maintain vertical alignment — horizontal force causes shoulder galling.
4. Maintain a clear line of sight to monitor the stabbing process at all times

3.6.2 MAKE-UP

The required make-up torque for each connection is listed in this manual and on the connection data sheets. Torque values depend on several factors, including pipe diameter, weight, steel grade, and connection type.

Make-Up Procedure:

1. Rotate the joint by hand as far as possible before applying torque.
2. Engage tongs and rotate at low speed (≤15 RPM spin-in; ≤5 RPM final).
3. Monitor torque-turn graph in real time (see Section 4).
4. Stop once final torque is reached and the turn profile is consistent with manufacturer expectations.

NOTE:

Use a digital torque-turn system with memory logging to fulfill quality assurance / quality control requirements.

Before beginning make-up, verify the correct torque values for the specific connection being run.

Once the threads are properly engaged, the power tong can be applied to the pipe. If the tong features a single set of rotating jaws, position them just above the pin threads.

Ensure the back-up line is level and that the jaws will not strike the coupling (or box) face during operation.

For power tongs with integrated back-up jaws, the tool should be positioned so that the back-up jaws are below the coupling and the rotating jaws are above. In the case of integral joints, it's critical that the back-up jaws are placed below the box connection to prevent crushing the connection.

Do not lower the elevators over the pipe until the connection is fully made up. If the elevator is already positioned on the pipe, it must be released prior to make-up.

Power tongs typically operate with both high and low gear ratios. Begin make-up in high gear at low speed—this reduces the risk of damage in the event of cross-threading, as the

tong will stall before causing harm. Once the threads are fully engaged, the speed can be increased until resistance builds due to thread interference. At this point, switch to low gear and low speed to complete the make-up process with precise torque control.
An early increase in torque may indicate an issue such as cross-threading or galling. If such a condition occurs, stop rotation immediately, break out the connection completely, and inspect it. Typically, thread interference does not begin until approximately two-thirds of the pin threads are within the box.

Although not mandatory for all connections, the use of torque-turn monitoring equipment is recommended, as outlined in the following section. After make-up, verify the torque-turn monitoring system. Once confirmed, disengage the power tong.

If the casing string is not open to the bottom during run-in-hole operations, it must be filled from the top at regular intervals. Failure to do so can result in external pressure collapse. Care should be taken to ensure the casing fill-up tool does not damage box connections or introduce debris, drilling, or completion fluids onto the threads.

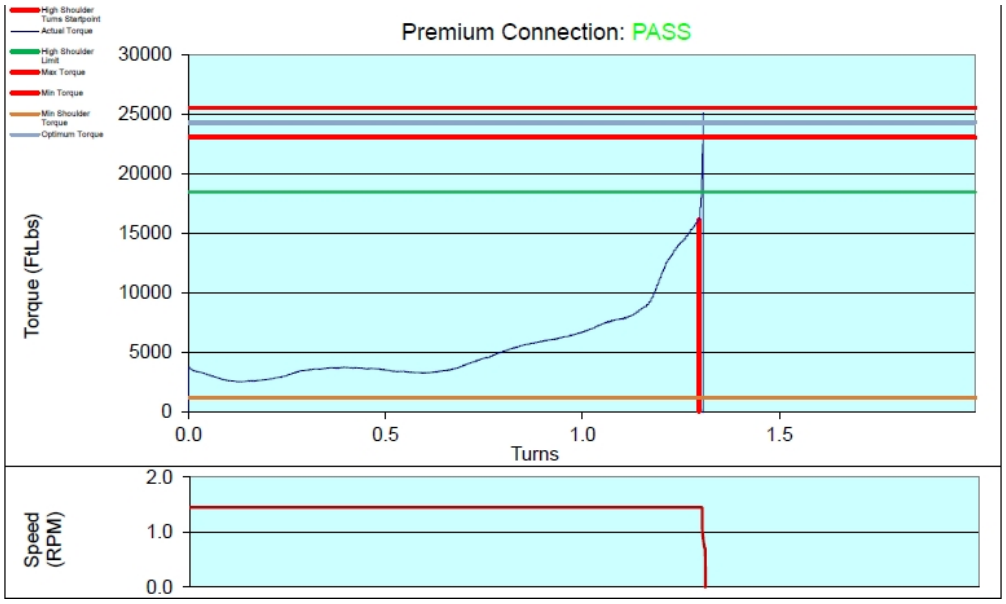


Figure 3-4: Acceptable Make-Up Torque

3.6.2.1 Unacceptable Make-up Verification

Since it is not possible to achieve exactly the same final torque for every connection make-up, an acceptable torque range—or acceptance window—is defined. This window is typically ±10% of the optimum torque. However, some connections may allow a wider or narrower window depending on the connection type.

Any final torque value within the minimum and maximum limits of this window is generally acceptable. However, some end users may require the final torque to fall specifically between the optimum and maximum values.

In addition, shoulder contact must occur when the torque is between 5% and 70% of the optimum torque. Given the ±10% tolerance on final torque, this ensures that at least 20% of optimum torque is applied after shoulder engagement.

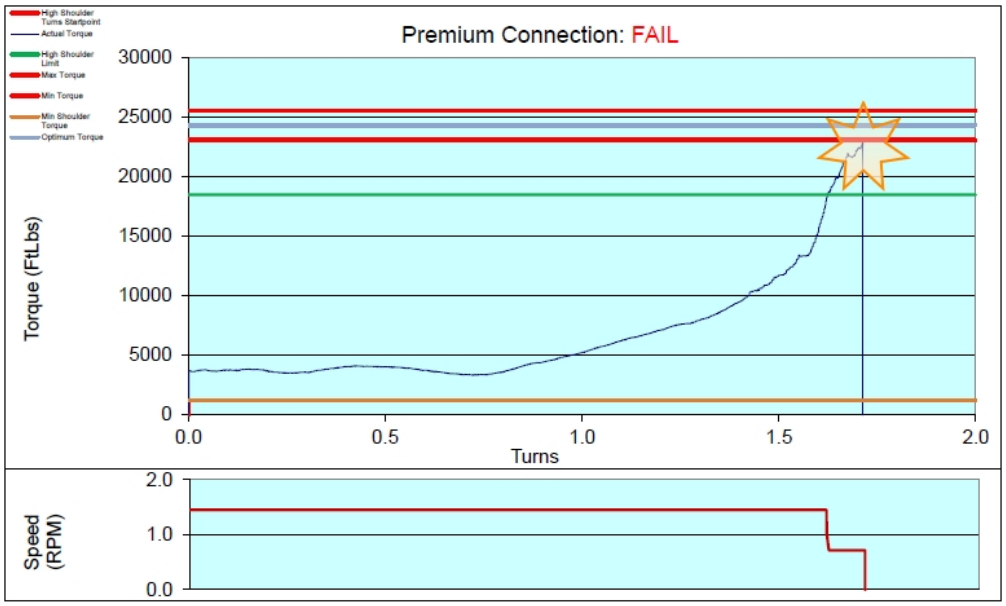


Figure 3-5: Unacceptable Make-Up Torque

3.6.2.2 Graph Interpretation And Resolution

Make-up graphs can appear very different depending on the scale and resolution used. A graph can look "stretched" or "compressed" depending on how the axes are configured. This makes it essential not only to assess the shape of the graph, but also to check the values on both the torque and turns axes.

Poor resolution may cause an unacceptable make-up to appear acceptable. To avoid misinterpretation:

- Display the graph as large as possible on the screen.
- Ensure the turns axis includes at least the final two turns.
- Use consistent scaling to maintain accurate profile recognition.

Each make-up graph must include the pipe tally number, date, and time. If a graph is rejected for any reason, it must still be stored with a clear explanation for rejection, for traceability and quality control.

3.6.2.3 Risk And Common Issues

By oilfield standards, running casing or tubing is considered a low-risk operation. Statistics indicate that 98% of connections are made up successfully on the first attempt. However, there is still a small chance of make-up errors, which can include:

- Final torque too low with no seal or shoulder contact
- Final torque too low with seal engagement but no shoulder contact
- Final torque too low after shoulder contact
- Short graph indicating no thread interference
- Plastic deformation or yielding
- Final torque too high
- Shoulder contact too low
- Excessive thread interference
- Humping (torque peak before shoulder contact)
- Humping (torque peak after shoulder contact)
- Irregular thread interference
- Too many turns after shoulder
- Step or torque drop during shouldering
- Graph step (abrupt change in torque)
- Torque spike
- Unusual or inconsistent torque profile

Proper monitoring, clear visual representation, and qualified interpretation of torque-turn graphs are essential to detect and prevent these issues before the connection is run downhole.

3.7 DAMAGE PREVENTION AND FIELD REPAIRS

Despite best practices, minor damage may occur. In most cases, ArcelorMittal TPJ-trained personnel can evaluate and perform on-site repair.

Field Repair Examples:

- Light galling or scratches: May be buffed and re-doped.
- Minor seal damage: Requires expert evaluation.
- Dents, deep scores, or bent pins: Reject the joint immediately.

CAUTION:

Never attempt makeshift repairs with files, sandpaper, or torch heating.

3.8 CONNECTION REJECTION CRITERIA

Reject a connection if:

- The thread form is visibly deformed or missing.
- Seal surfaces show signs of corrosion, pitting, or galling.
- Pipe body is bent or out of round.
- Make-up torque exceeds allowable limits without shoulder engagement.

Use ArcelorMittal Tubular Products Al-Jubail visual inspection guidelines and cross-check against digital torque-turn profiles (See Page 43).

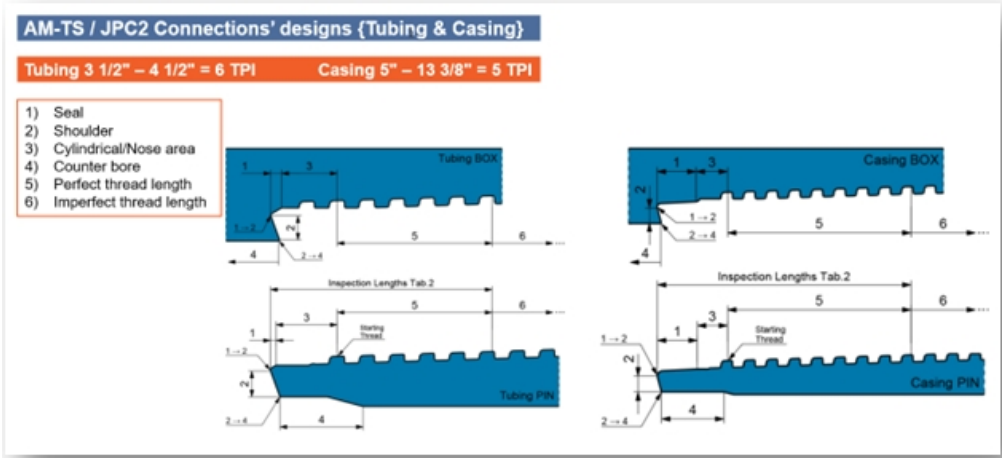
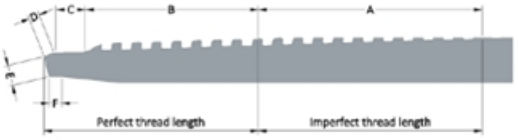


Figure 3-6: Visual Inspection Locations

Element	Corrosion		Mechanical Damage		
	Rust	Pitting[2]	Scratch[3]	Dent/Ding/Mashes/Tears	Galling
Seal (D)	Remove discoloration with Scotch Brite only	REJECT	REJECT	REJECT	REJECT
Shoulder (E)	Remove with Scotch Brite or emery paper	REJECT	Remove with Scotch Brite or emery paper	REJECT	REJECT
Nose area (C)	Remove with Scotch Brite or emery paper	REJECT	Remove with Scotch Brite or emery paper	Remove with Scotch Brite or emery paper	N/A
Counter Bore (F)	Remove with Scotch Brite or emery paper	Remove with Scotch Brite or emery paper	ACCEPTED	ACCEPTED	N/A
Perfect Thread[1] (B)	Remove with Scotch Brite or emery paper	REJECT	ACCEPTED	REJECT	REJECT
Imperfect Thread (A)	Remove with Scotch Brite or emery paper	Remove with Scotch Brite or emery paper	ACCEPTED	Remove with Scotch Brite, emery paper or file	Remove with Scotch Brite, emery paper or file

Notes:-
1. Up to 2 threads may be imperfect as long as no more than 25% of diameter (1/4 turn) is affected. However, all protruding metal outside of the thread form shall be removed to avoid galling.
2. Pitting is the localized accelerated dissolution of metal that occurs as a result of the breakdown of the passive protective film on the metal surface.
3. Scratch is rejectable if detectable by fingernail

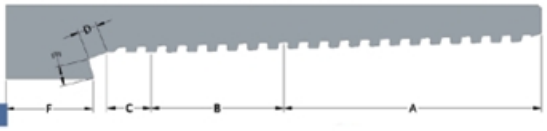


PIN VTI Guidelines

Figure 3-7: Pin Visual Inspection Guidelines

Element	Corrosion		Mechanical Damage		
	Rust	Pitting[3]	Scratch[4]	Dent/Ding/Mashes/Tears	Galling
Seal (D)	Remove discoloration with Scotch Brite only	REJECT	REJECT	REJECT	REJECT
Shoulder (E)	Remove with Scotch Brite or emery paper	REJECT	Remove with Scotch Brite or emery paper	REJECT	REJECT
Cylindrical Part (C)	Remove with Scotch Brite or emery paper	REJECT	ACCEPTED	Remove with Scotch Brite or emery paper	N/A
Internal Bore (F)	Remove with Scotch Brite or emery paper	Remove with Scotch Brite or emery paper	ACCEPTED	Remove with Scotch Brite or emery paper	N/A
Perfect Thread (B)	Remove with Scotch Brite or emery paper	REJECT	ACCEPTED	REJECT	REJECT
Imperfect Thread (A)	Remove with Scotch Brite or emery paper	Remove with Scotch Brite or emery paper	ACCEPTED	Remove with Scotch Brite, emery paper or file	Remove with Scotch Brite, emery paper or file
Coupling Face	ACCEPTED	REJECT	ACCEPTED	Remove with Scotch Brite, emery paper or file	N/A

Notes:-
1. Any couplings mashed on the outside diameter should be rejected
2. Imperfect threads for box/coupling are the threads corresponding to imperfect threads of pin ends
3. Pitting is the localized accelerated dissolution of metal that occurs as a result of the breakdown of the passive protective film on the metal surface.
4. Scratch is rejectable if detectable by fingernail



BOX VTI Guidelines

Figure 3-8: Box Visual Inspection Guidelines

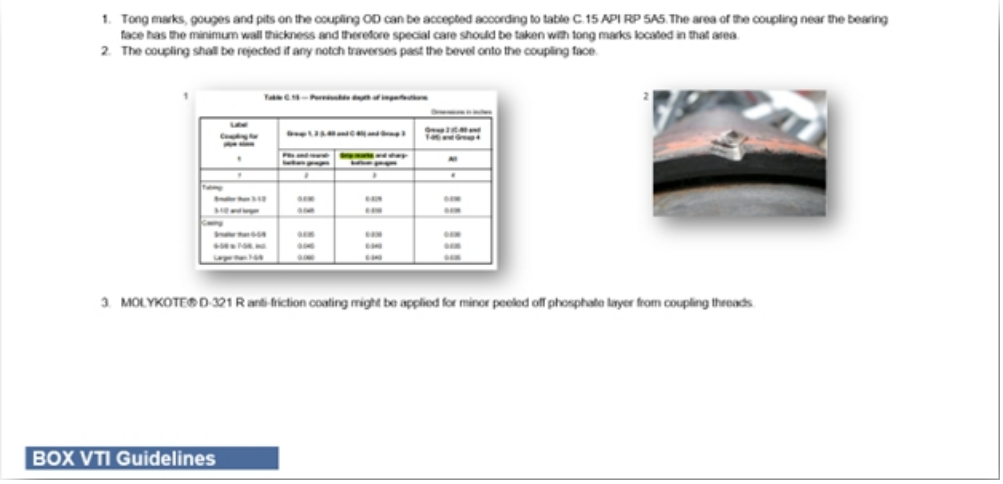


Figure 3-9: Box Visual Inspection Guidelines (Cont'd.)

3.9 BREAK OUT

A break-out becomes necessary when a connection doesn't meet acceptance criteria. Before beginning breakout, unlatch the elevators.

Position the connection to be broken out at a comfortable working height above the slips. Set the power tong and back-up tongs (or slips) as close together as possible to minimize bending and prevent damage during breakout.

Figure 3-10: Tongs in Use

Maintain vertical alignment and full control of the pipe at all times. This should be done using either a person on the stabbing board or a stabbing arm.

Apply torque slowly and steadily to break the connection. Never strike the connection with a hammer or any hard object, as this can cause damage. Be aware that break-out torque may be significantly higher than make-up torque, particularly if the pipe has been in the well for an extended period—though in some cases, the opposite may occur.

Continue turning at a controlled, consistent speed until the pin disengages and drops inside the box. Use a weight compensator if available to reduce the risk of thread galling during breakout. To prevent the pin from bouncing as it’s removed from the box, use a stabbing guide.

Once the connection is fully broken out, and if the joints are being returned for inspection or storage:

- Apply storage compound to the threads.
- Fit the correct thread protectors.
- Ensure the protectors are properly secured. Using the wrong type can result in the protector coming loose during transportation.

For tubing sizes 4 1/2" and below, a maximum of three break-out attempts is allowed. For casing sizes 5" and above, the limit is two break-outs. If the connection fails to make up properly after these attempts, the box connection (or coupling) must be replaced.

If the pin connection of the laid-out joint is undamaged, it may be reused later in the string. This limitation is in place to minimize rig time and prevent unnecessary delays during operations.

Pipes that are retrieved from the well carefully can be safely reused. Each pipe must be thoroughly cleaned using a high-pressure washdown gun with fresh water to remove all traces of completion fluids.

All connections must then be cleaned, dried, greased, and protected following the same procedures outlined below for handling surplus pipe.

Surplus Pipe

Operators typically bring 5% to 10% contingency pipes to the rig site in case of unexpected issues. These pipes retain value after running the string in hole and must not be treated as waste. An effective management system ensures that contingency pipes from Well #1 are used at the bottom of Well #2.

If rig personnel remove the protectors and grease from contingency pipes at the rig site, they must thoroughly clean and dry the connections. After cleaning, they should apply a thick coat of suitable compound to the entire threaded and sealing area to prevent water ingress and protect against corrosion. Finally, they must fit clean, undamaged protectors, ensuring they use the correct type for the connection to avoid contamination or damage.

3.10 HARSH ENVIRONMENT PROTOCOLS

Operations in challenging weather conditions or abrasive environments demand specific measures:

Sandy/Dusty Environments:

- Protect open connections from airborne grit using temporary caps or film covers.
- Increase frequency of thread inspections and compound re-application.

IMPORTANT:

When running, use stabbing guides. Be sure to clean connections thoroughly, and also monitor torque-turn in real time. Apply the recommended thread compound (avoid generic grease) and inspect after each make-up.

Avoid freehand stabbing or misaligned stabbing. Do not run dirty or wet threads. Never rely on visual torque or by "feel," and do not skip inspections between joints.

Chapter 4:

Torque- Turn Monitoring and Interpretation

This chapter highlights the importance of torque-turn monitoring to ensure connections are made up correctly and safely. It explains the phases of the torque-turn graph, how deviations indicate issues, and the use of digital systems for real-time monitoring and logging. Torque acceptance windows guide proper make-up, and post-job analysis of logs supports quality control, troubleshooting, and tool calibration.

4.1 TORQUE-TURN MONITORING

Torque-turn monitoring is essential to ensure each connection is made up to the correct specifications. It provides a graphical representation of the torque applied versus the turns during make-up, helping verify mechanical integrity, sealing performance, and identifying anomalies in real time.

Why It Matters: Incorrect torque or turn profiles can lead to connection leaks, galling, or mechanical failure — even if the final torque appears acceptable. The graph tells the full story.

4.2 UNDERSTANDING THE TORQUE-TURN GRAPH

A typical torque-turn graph is divided into three phases:

Phase 1: Thread Engagement

- Initial low resistance as threads engage.
- Smooth, gradual rise in torque.
- No sharp spikes or flat zones.

Phase 2: Interference/Shoulder Contact

- Torque begins to rise more steeply.
- The connection shoulder makes contact.
- A consistent, controlled increase is expected.

Phase 3: Final Make-Up (Yield Point)

- The slope increases sharply.
- Target torque is reached.
- A distinctive shoulder point (or break point) may appear, followed by stabilization or a plateau.

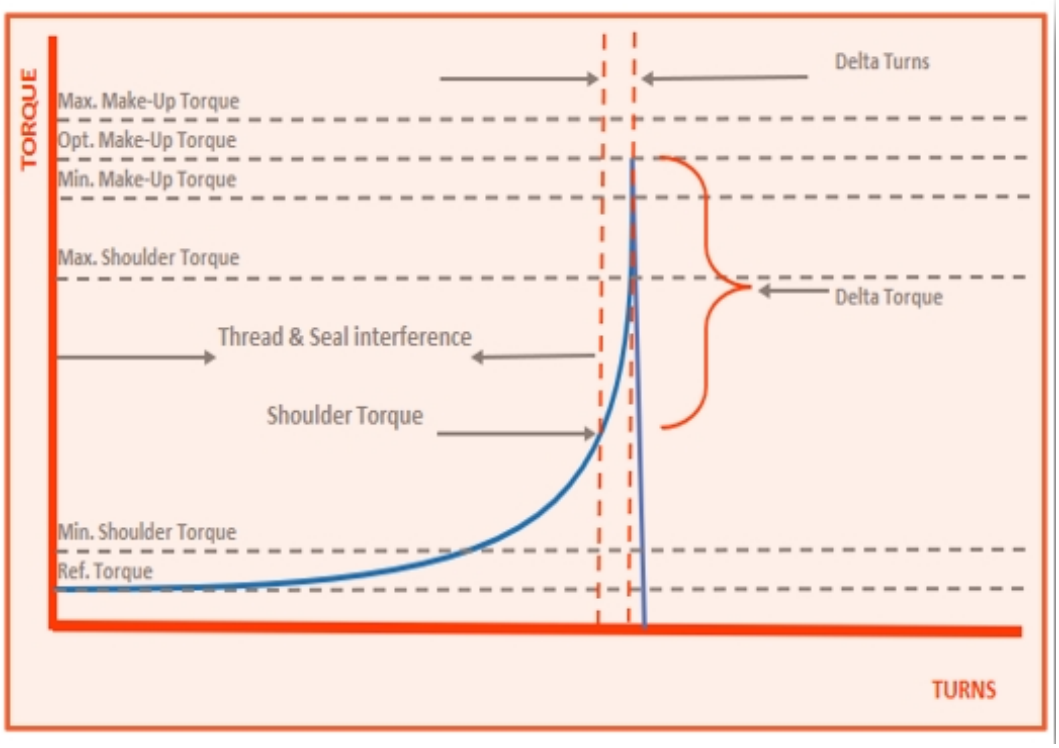


Figure 4-1: Typical Torque-Turn Graph

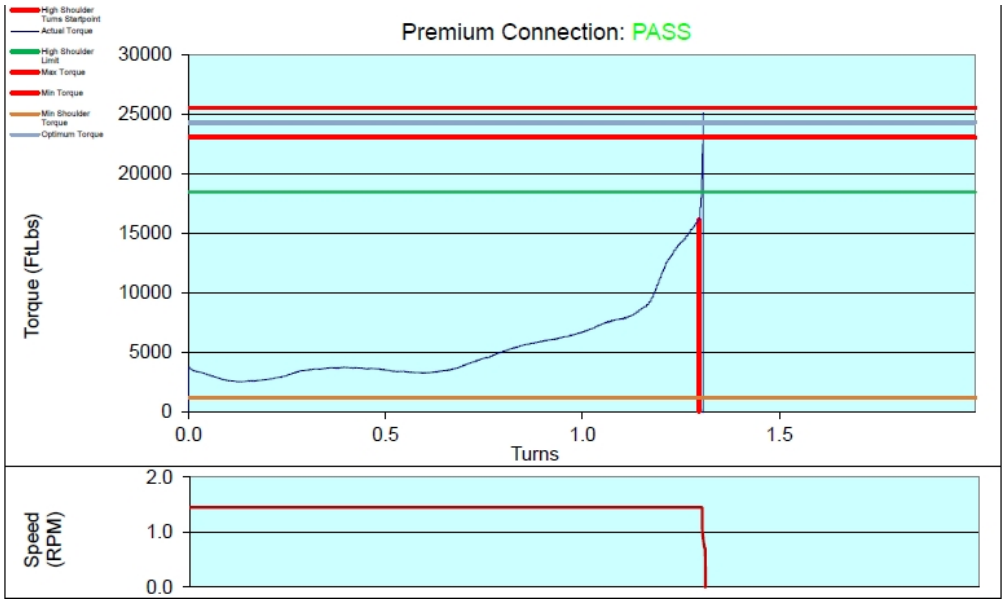


Figure 4-2: Acceptable Torque-Turn Graph

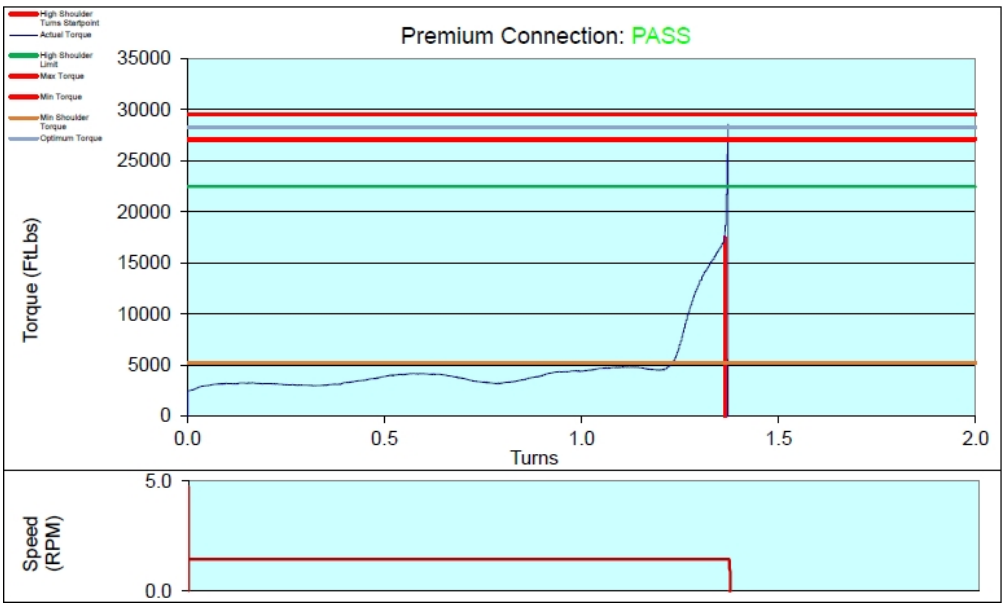


Figure 4-3: Acceptable Torque-Turn Graph

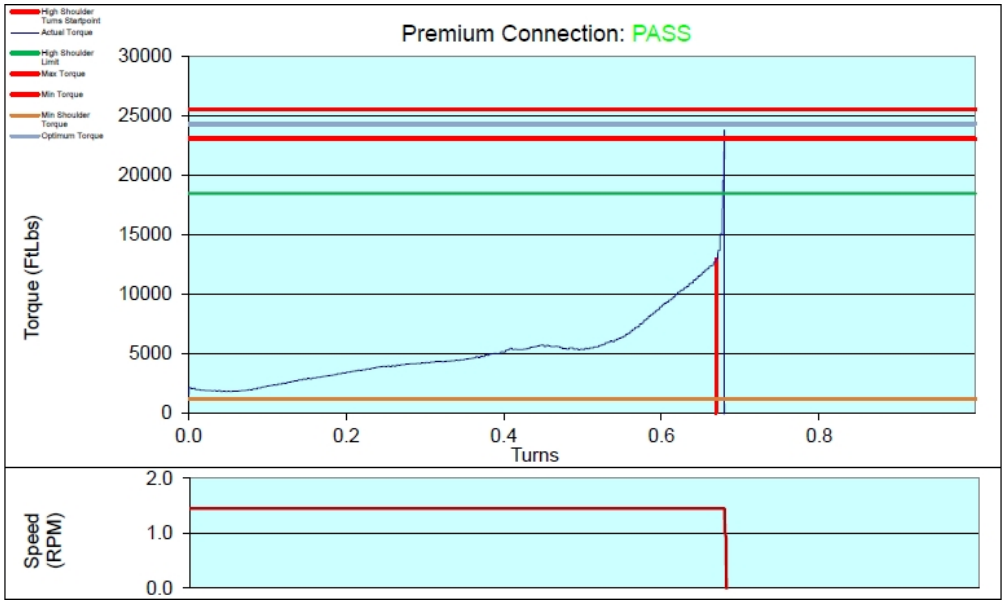


Figure 4-4: Acceptable Torque-Turn Graph

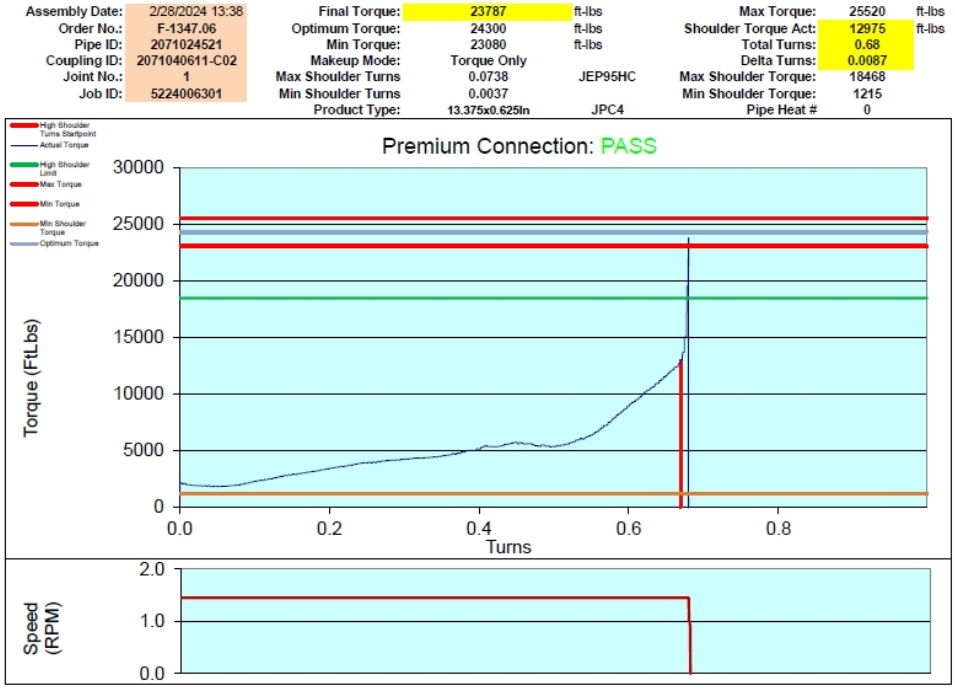


Figure 4-5: Make-Up Report

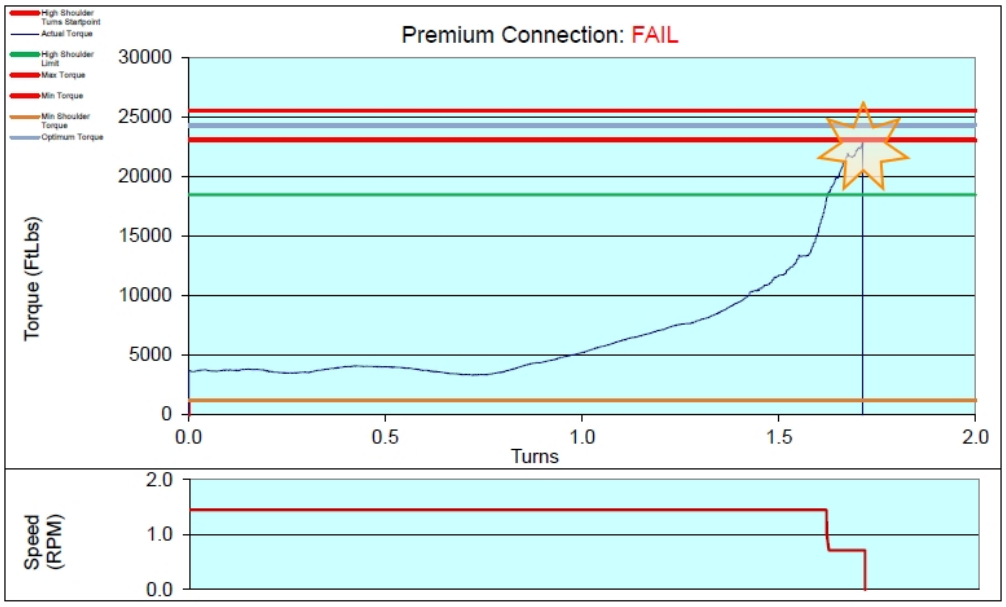


Figure 4-6: Unacceptable Torque-Turn Graph (Low Torque)

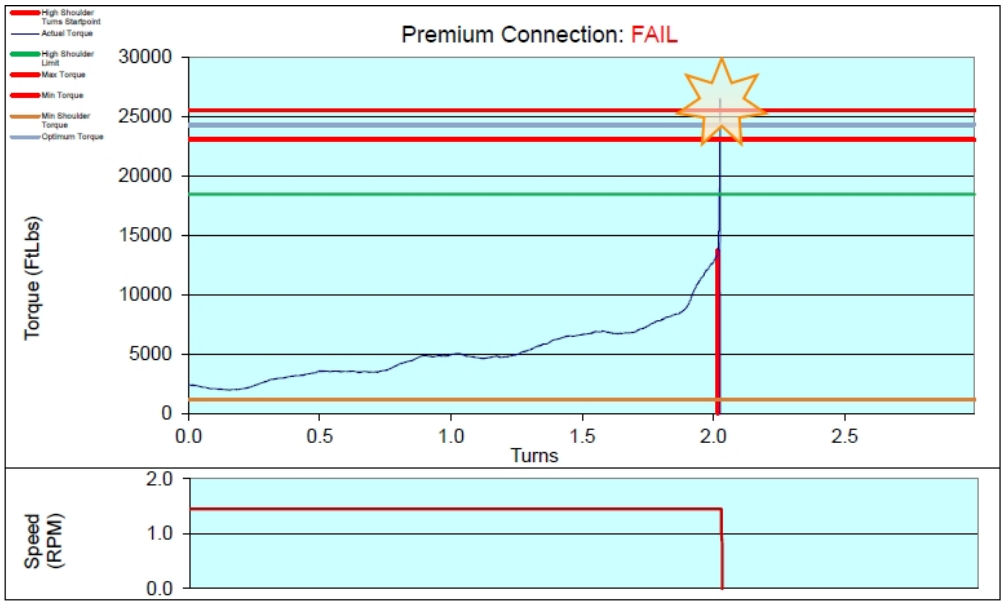


Figure 4-7: Unacceptable Torque-Turn Graph (Max Torque Exceeded)

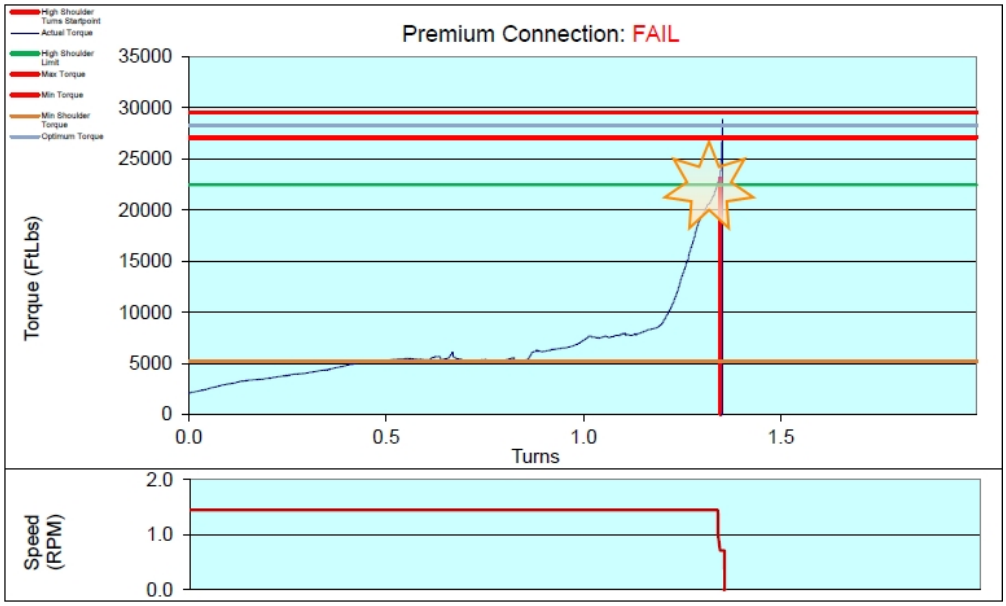


Figure 4-8: Unacceptable Torque-Turn Graph (High Shoulder Torque)

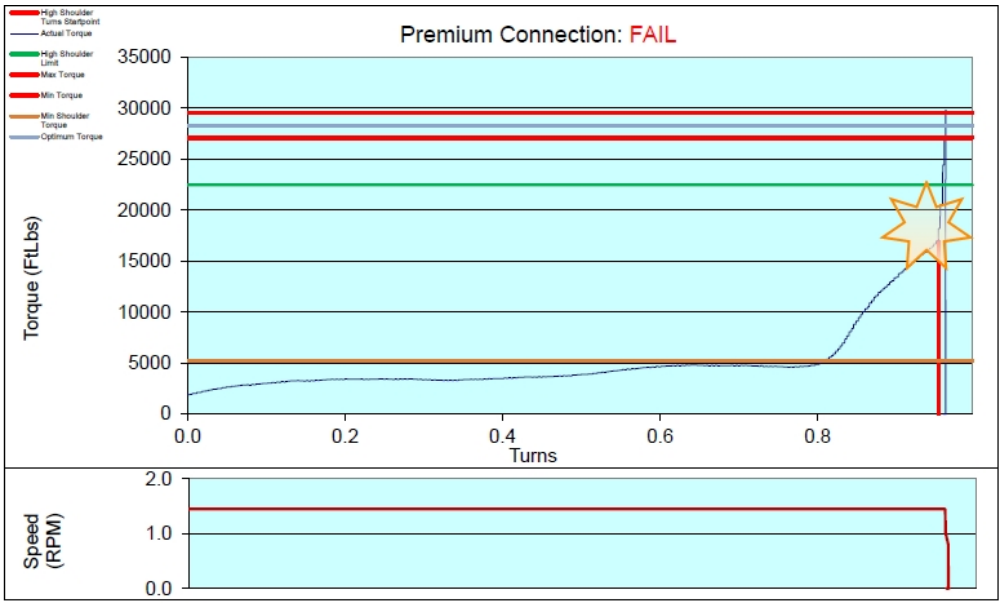


Figure 4-9: Unacceptable Torque-Turn Graph (High Shoulder Torque

4.3 INTERPRETING NORMAL GRAPHS

Identifying deviations from standard torque-turn behavior helps diagnose potential issues:

Graph Behavior	Possible Cause	Recommended Action
Flat initial segment	Damaged or contaminated threads	Inspect and clean threads thoroughly
Early torque spike	Cross-threading or galling	Stop immediately and evaluate connection
No sharp rise at final phase	Shoulder not fully engaged	Re-evaluate torque specs and reattempt make-up
Multiple dips in torque	Tong slippage or equipment issues	Inspect tongs and calibration

4.4 REAL-TIME MONITORING & TOOLS

Modern rigs should use digital torque-turn monitoring systems capable of:

- Capturing full graph data per joint.
- Logging and tagging torque-turn profiles.
- Providing alerts for abnormal trends.
- Syncing with QA/QC systems or cloud reporting.

IMPORTANT:

Maintain a torque-turn log with visual graphs and notes for each connection. This supports traceability and helps troubleshoot future failures.

4.5 TORQUE ACCEPTANCE WINDOWS

Each ArcelorMittal TPJ connection type has a recommended torque range, including:

- Minimum Make-Up Torque (MMT)
- Maximum Make-Up Torque (XMT)
- Optimum Torque (OT) — where sealing is most reliable
- Minimum Shoulder Torque (MST)
- Maximum Shoulder Torque (XST)

Always refer to the latest connection datasheet for updated torque values.

NOTE:

Torque specifications may vary by pipe grade, coating, compound, and application.

4.6 POST-JOB ANALYSIS AND TROUBLESHOOTING

After operations, torque-turn logs should be:

- Reviewed by ArcelorMittal TPJ field service representatives.
- Stored for QA audits.
- Used to generate insights into crew consistency and tool calibration.

NOTE:

Integrate torque- turn logs into daily reports or digital job summaries.

Chapter 5:
APPLYING THREAD COMPOUNDS

This chapter highlights the critical role of thread compounds in sealing, lubricating, and protecting connections. It covers selecting the correct compound for standard, premium, and CRA materials, proper application techniques, and storage requirements. Troubleshooting guidance ensures issues like galling, excessive torque, or sealing inconsistencies are identified and corrected to maintain reliable connection performance.

5.1 OVERVIEW: ROLE OF THREAD COMPOUNDS

Oil rigs use thread compounds, also known as pipe dope, to seal and lubricate threaded connections, preventing issues like galling and leaks. These compounds ensure smooth assembly and also protect against corrosion, which is crucial for maintaining the equipment integrity under harsh conditions.

Thread compounds are essential in ensuring the mechanical integrity and sealing performance of premium connections.

Thread compounds serve many purposes, including:

- Lubrication during make-up
- Corrosion protection
- Sealing thread interference areas

IMPORTANT:

Selecting or applying the wrong compound can result in galling, over-torque, leakage, or long-term connection failure.

5.2 TYPES OF THREAD COMPOUND

Compound Type	Application Context	Notes
API Modified	Standard steel connections (non-premium)	Basic performance, not suitable for high-end seals
Premium Compound	ArcelorMittal TPJ and other premium connection	High-pressure sealing, controlled friction
CRA-Compatible Compound	Chrome, duplex, or CRA materials	Non-metallic; avoids galvanic reactions

Always refer to the ArcelorMittal Tubular Products Al-Jubail Running Manual for the correct compound per material and application.

5.3 APPLICATION PROCEDURES

ArcelorMittal TPJ Connections:

- Use a clean, dry brush (natural or synthetic bristles).
- Apply a thin, uniform coating over the entire pin — threads, seal surfaces, and stabbing flank.
- Avoid applying to the box unless specifically instructed.
- Do not leave gaps or over-apply (which can increase torque).

CAUTION: Excess dope may mask misalignment or cause early shoulder contact —always apply evenly.

Manufacturer	Brand Name	JPC4 C1
	Thread Compound (FF=1.0)	
All	API Modified (API RP 5A3 Annex B compliant)	√
BestOLife	BoL 72733 (HPHT exceeds API RP 5A3)	√
BestOLife	BoL 2000 (Lead & Zinc Free)	√
Jet Lube	Jet-Lube API modified HP	√
Weatherford	Weatherford Lube Seal	√
	Storage Dope	
BestOLife	BESTOLIFE BSC STORAGE	√
ARGL	Kendex	√
ARGL	Kendex OCTG Orange	√
Jet Lube	Jet- Lube Korr-guard	√
Haughton	Rust Veto AS	√
Shell	Shell Showa Shell Storage	√
Total	Total Jet Marine 5271	√

Figure 5-1: Thread Compounds

Figure 5-2: Compound Application Brushes

See figures, "Apply a thin coat to pin" on page 14 and "Apply a thin coat to seal area" on page 14 for correct application.

5.3.1 APPLYING THREAD COMPOUND

Perform the following steps when applying thread compound:

1. Use the connection datasheet to select the correct compound.
2. Ensure that brushes are clean and the compound is not contaminated.
3. Apply a thin, even layer along the full pin length.
4. Ensure that box threads are clean and dry.

5.4 CRA AND HIGH-ALLOY CONNECTIONS

CRA materials (e.g., 13Cr, 25Cr, duplex) require special handling due to higher sensitivity to galling.

Key Guidelines:

- Use only ArcelorMittal TPJ-approved CRA compound.
- Never mix different compound types.
- Clean pin and box with solvent and lint-free cloth before dope application.
- Apply immediately prior to make-up to avoid evaporation or contamination.

IMPORTANT: Avoid moly- based compounds unless specifically certified for CRA use.

5.5 MANAGING AND STORING COMPOUNDS

Store thread compounds in a dry, shaded location that maintains a temperature between 5-40°C (41-104°F).

Keep the compound container sealed, and avoid exposure to dust, dirt, or liquids.

Follow manufacturer's shelf life expiration dates.

Replace applicator brushes on a regular maintenance scheduled basis.

IMPORTANT: Dirty compound is one of the most commonly- over-looked risks in thread failure analysis.

5.6 THREAD COMPOUND TROUBLESHOOTING

Issue	Probable Cause	Recommended Action
Excessive torque on make-up	Over-application or wrong compound	Remove and reapply correct amount
Thread galling or resistance	Contaminated or incom-patible compound	Clean and use approved material
Sealing inconsistency	Uneven coating or expired compound	Re-clean, reapply using fresh dope
Torque-turn curve distortion	Compound buildup in shoulder area	Clean and apply thin coat

Figure 5-3: Thread Compound Troubleshooting Table

Chapter 6:
Handling and Inspecting Connections

This chapter stresses that connection performance depends on proper handling long before running operations begin. It provides guidelines for safe storage, transport, and rig-site handling, along with inspection intervals to detect damage early. Environmental risks such as humidity, salt, dust, and freezing are addressed, with preventive measures to protect pipe integrity.

6.1 OVERVIEW: WHY HANDLING MATTERS

Connection performance begins before it ever reaches the rig floor. Mishandling in yards, during transport, or on-site can lead to damage that is not immediately visible — but becomes catastrophic during make-up or downhole use.

CAUTION:

A single dent, crushed thread, or missed contaminant can compromise seal integrity and lead to leaks, downtime, or total joint failure.

6.2 PIPE TRANSPORT AND STORAGE

Store pipe on padded, level racks away from direct contact with the ground. Use pipe chocks to prevent rolling. Stack pipe with proper dunnage spacing to prevent ovality and point loading. Avoid stacking too high without lateral support, as this increases the risk of collapse and deformation. Do not leave pipes exposed to harsh elements without adequate cover.

Be sure crew members are trained on proper lifting procedures. Use lifting slings or spreader bars to move pipes. Never use hooks or chains on pipe bodies. Do not lift pipe from the connection ends. Do not drag pipe along hard surfaces or gravel.

IMPORTANT:

Keep thread protectors installed at all times during storage and transit. Condensation inside protectors can freeze overnight in harsh weather conditions. Always warm pipe ends before inspecting or running.

Proper pipe storage is critical to maintain the integrity, cleanliness, and readiness of tubular goods prior to running operations. Store all pipe in accordance with industry best practices to prevent physical damage, corrosion, contamination, or distortion of the pipe body and threaded ends.

Storage Guidelines:

1. Surface Preparation:
   - Store pipes on a clean, level, and stable surface free of debris, sharp objects, or corrosive materials.
   - Avoid ground contact by using wooden sleepers, pipe racks, or steel stands with rubber or plastic padding.
2. Stacking:
   - Stack pipes in layers with uniform orientation and alignment.
   - Separate each layer by wooden dunnage or rubber spacers, placed at equal intervals to prevent bending or bowing.
   - Stack height must not exceed safe working limits, typically no more than 3 to 4 layers high, depending on pipe diameter and weight.
3. End Protection:
   - Fit all pipes with protectors (plastic, composite, or steel) on both ends to prevent thread or bevel damage.
   - End caps shall remain in place until the pipe is moved to the rig floor or prepared for cleaning and inspection.
4. Marking and Traceability:
   - Mark heat numbers, pipe grades, and sizes clearly and visibly on at least one end.
   - Maintain bundle tags and material identification throughout storage.
5. Environmental Protection:
   - Store pipes under cover or with a tarpaulin where possible, especially in corrosive environments (e.g., marine or humid conditions).
   - Ensure adequate ventilation to prevent condensation buildup under covers.
6. Handling Precautions:
   - Perform all lifting and handling using padded slings, cradles, or pipe hooks to avoid damaging the pipe surface or coating.
   - Never drop or drag a pipe.
7. Inspection and Housekeeping:
   - Inspect stored pipe periodically (per maintenance schedule) for signs of corrosion, damage, or displacement.
   - Keep storage areas clean and free of obstacles or spill hazards.

6.3 YARD HANDLING PROCEDURES

Perform the following tasks before shipping pipe to the rig site:

- Inspect threads and seals for dents, rust, or debris
- Check thread protectors for cracks or improper fit
- Verify heat numbers and tally list accuracy
- Apply drift tests for all pipes, especially after long storage
- Replace any damaged protectors immediately

6.4 RIG SITE HANDLING

6.4.1 PRE-STAGING

- Lay pipe on non-abrasive supports, with racks free of gravel or metal contact.
- Keep pipe ends elevated where possible to prevent water pooling inside protectors.

6.4.2 DURING RUNNING

- Only remove protectors just before stabbing.
- Use soft-handling tools (rubber-coated or lined) to prevent mechanical impact.
- Ensure stabbing guides are clean and matched to connection type.

6.5 INSPECTION INTERVALS AND DAMAGE MARKERS

When to Inspect pipes and connections:

- On arrival to pipe yard
- Before transport to rig
- Upon arrival at rig site
- Before every run

6.6 CLEANING AND RE-INSPECTION

If connections are found dirty or damaged:

- Use clean, lint-free rags and approved solvents (non-abrasive).
- Reinspect threads using profile gauges and magnifiers, if applicable.
- Never use steel brushes, files, or power tools on premium threads.

6.7 ENVIRONMENTAL EXPOSURE RISKS

The following table outlines the exposure risks pipe can experience in different environments.

Environment	Risks	Precautions
High Humidity	Rust/corrosion in protectors	Use desiccants and/or air-dry plugs
Coastal Sites	Salt damage to seals	Apply corrosion inhibitors, inspect daily
Dust / Dirt / Sand	Grit embedded in threads	Cover connections with breathable fabric
Freezing Temperatures	Cracking, dope hardening	Warm dope and inspect daily

6.8 PIPE HANDLING PRECAUTIONS

See "Pipe Handling: General Guidelines" on page 12 for infrormation about proper pipe handling.

Chapter 7:
Field Repairs and Rejection Guidelines

This chapter explains how to assess and manage connection damage in the field, distinguishing between repairable issues like light galling or minor scratches and rejectable conditions such as deformed threads, gouged seals, or bent pipe. It outlines approved repair steps, required tools, and documentation procedures to ensure traceability. Clear criteria are provided for when repairs can be done in the field, when shop intervention is needed, and when full rejection is required.

7.1 MANAGING CONNECTION DAMAGE IN THE FIELD

Field damage, whether from handling, transport, or running operations, can compromise connection integrity. This section outlines how to distinguish between reparable and rejectable damage, and how to handle each case using approved procedures.

NOTE:

Only ArcelorMittal TPJ- trained personnel or licensed service providers should perform any repair on ArcelorMittal TPJ connections.

7.2 COMMON DAMAGE TYPES AND ROOT CAUSES

Type of Damage	Typical Cause
Light galling	Excessive stabbing force, misalignment
Cross-threading	Improper stabbing, lack of guide use
Seal face nicks	Impact from foreign objects or tools
Thread corrosion	Poor storage, water or chemical exposure
Dents in pin / box	Dropping pipe, poor rig handling

7.3 FIELD REPAIR CRITERIA

The following defects can be repaired:

- Light galling that doesn't distort thread profile
- Minor seal scratches that don't breach plating or geometry
- Small amounts of thread corrosion that can be brushed and cleaned

The following defects must be rejected:

- Threads missing, flattened, or deformed
- Seal faces with gouges, deep pitting, or cracks
- Ovality or bent pipe body
- Recurrent make-up failure on torque-turn
- Any connection with unauthorized prior repairs

IMPORTANT:

Never attempt to “grind” or file ArcelorMittal TPJ connections. This voids warranty and compromises structural integrity.

7.4 FIELD REPAIR PROCESS

Perform the following steps to fix repairable pipe.

1. Clean the area thoroughly using lint-free rags and mild solvent.
2. Visually inspect using adequate lighting and magnification.
3. Buff minor damage with non-metallic pad (if approved by ArcelorMittal TPJ field service representative).
4. Reapply thread compound evenly across pin.
5. Re-inspect using profile gauges or approved templates.
6. Tag as “Field Repair Approved” if accepted. Log all actions.

7.5 TOOLS AND MATERIALS NEEDED FOR REPAIRS

Required Tool	Tool Purpose
Clean rags and solvent	Surface preparation
Flashlight and mirror	Deep visual inspection
Profile gauge	Thread geometry validation
Non-metallic buffing pad	Minor galling/scratch removal
Approved thread compound	Post-repair protection
Inspection tags / forms	Documentation and traceability

7.6 REJECTION DOCUMENTATION

When a connection is deemed irreparable:

- Tag the joint clearly with a red “Rejected” tag
- Record the serial/heat number and pipe tally location
- Photograph the damage for traceability
- Note the condition and cause (if known) in the field report
- Segregate the pipe away from running inventory

7.7 FIELD REPAIR VS. SHOP REPAIR VS. REWORK

Action	Who Can Perform	Scope
Field Repair	ArcelorMittal TPJ-certified field representative	Light galling, seal cleaning
Shop Repair	Licensed repair facility	Thread chasing, recutting, full inspection
Factory Rework	ArcelorMittal TPJ facility only	Major refurbishing, heat treatment, recertification

7.8 REPAIR OR REJECT CRITERIA

Damage	Action
Improper compound application	Clean and redo
Seal face nick < 0.5 mm depth	Field Repair
Corrosion visible on shoulder	Reject
Thread flattened or chipped	Reject
Bent pipe	Reject

Chapter 8:
After Running

This chapter explains post-running activities ensure that lessons are captured and performance is documented. The process includes inspecting backup connections, reviewing torque-turn data, debriefing the crew, and issuing a post-job report with findings and recommendations. Unused pipe must be cleaned, capped, and stored properly, while feedback from the job feeds into continuous improvement of procedures and training.

8.1 POST-RUNNING ACTIVITIES

Post-running activities are often overlooked, but they are just as critical as proper make-up. This stage ensures:

- Documentation of what occurred during running
- Issues or deviations from the plan are identified
- Lessons learned for future operations are preserved
- Field-level input into on-going ArcelorMittal TPJ procedures improvement

Remember, the job isn't done when the last joint is made up, but rather when the learning is captured and passed forward.

8.2 AFTER RUNNING INSPECTION AND TREND REVIEW

Once the string is landed and running tools are laid down:

- Conduct random spot-checks on backup joints (those not visible during make-up).
- Review all torque-turn graphs to identify:
  - Sudden variations in shoulder torque
  - Outliers in turn count
  - Inconsistent frictional profiles
- Look for repeatable patterns that could indicate equipment bias, crew variability, or material inconsistencies.

NOTE:

Reviewing a 10% sample of torque logs is often enough to identify systemic issues.

8.3 CREW DEBRIEF AND KNOWLEDGE CAPTURE

Conduct a structured debrief with:

- Rig supervisor or company representative
- ArcelorMittal TPJ field service representative
- Tong operator / torque technician
- Toolpusher or shift lead

Key Questions to Ask:

- What went well?
- Were there any rejected or repaired connections?
- Were any safety risks or near-misses encountered?
- Did the crew understand and follow the make-up parameters?
- Were there any equipment malfunctions or delays?

Document the responses objectively. Include specific recommendations for training or procedural updates. One honest conversation at the end of the job can save days of rework on the next one.

8.4 POST-JOB REPORT (BUILDING THE KNOWLEDGE CHAIN)

ArcelorMittal Tubular Products Al-Jubail field service representatives (or customer QC leads) shall issue a detailed report, typically within 24–48 hours following job completion.

Minimum report elements shall contain:

- Well and string identifiers
- A running summary (including any deviations from procedure)
- Make-up analysis with Torque-Turn graph highlights
- A list of rejected or field-repaired connections
- Connection performance notes
- Tool performance and feedback

- A crew evaluation (if applicable)
- Safety/HSE observations
- Photographic documentation (e.g., damaged threads, back-outs, Torque-Turn curves)
- Recommendations for the next run

These reports contribute to the ArcelorMittal TPJ feedback loop and support technical performance analytics across all fields.

8.5 HANDLING UNUSED OR RETURNED PIPE

Any joints that were doped but not run into the well must be cleaned, capped, and stored correctly to maintain future usability.

1. Thoroughly clean the threads and seal surfaces with solvent and dry cloths.
2. Re-apply storage compound if pipe is to be stored for more than 30 days.
3. Use new protectors (preferably with vent holes to avoid condensation).
4. Clearly label each joint: unused, previously doped, or rejected.
5. Store horizontally, off the ground, and under cover — ideally in a climate-protected pipe rack.

.

IMPORTANT:

Threads that were doped but exposed to the environment must be re-cleaned and re-lubricated before re-use.

8.6 FEEDBACK FOR CONTINUOUS IMPROVEMENT

The final (and most valuable) step is feedback. This closes the knowledge loop. ArcelorMittal TPJ actively collects:

- Field learnings
- Product behavior observations
- Connection handling challenges
- Suggestions for procedural updates

Feedback helps refine running manuals and quick guides, connection enhancements, and field training programs.

OBSERVATION:

Every rig run is a test. The more data we share, the better our connections become.

Post-Running and Reporting Summary

1. Backup connections spot-checked
2. Torque-turn graphs reviewed
3. Crew debrief completed
4. Post-job report submitted
5. Rejected joints documented with photos
6. Unused pipe cleaned, tagged, and stored
7. Feedback shared with ArcelorMittal Tubular Products Al-Jubail

Chapter 9:
Horizontal Assembly Technical Recommendations

This chapter explains horizontal assembly of ArcelorMittal Tubular Products Al-Jubail connections, used when vertical makeup isn't practical, such as during workshop pre-assemblies or limited-clearance rig setups. It emphasizes proper cleaning, alignment, controlled stabbing, and torque-turn monitoring to ensure correct engagement and prevent thread or seal damage. Post-make-up checks, correct handling, and secure storage protect connection integrity and maintain readiness for rig operations.

9.1 OVERVIEW: WHEN AND WHY TO USE HORIZONTAL MAKE-UP

Horizontal assembly is employed when vertical make-up is not practical — such as during yard preparation, pipe yard sub-assemblies, limited-clearance rig ups, completion assemblies preparation or inline float equipment integration.

It is standard practice to pre-make-up accessories at a workshop before shipping them to the rig site. This is because drilling rigs are optimized for handling long, uniformly sized, and weighted components, not short or irregularly shaped items.

To facilitate rig handling, pup joints—short sections of pipe—are typically installed above and below assemblies. These help maintain consistent dimensions and weight distribution, making the equipment easier to run.

Workshop make-up is typically performed horizontally, using equipment that differs from what's used at the rig site. These systems feature adjustable jaws capable of gripping a wide range of pipe sizes and accommodating components with offset connections.

IMPORTANT:

While vertical make- up is ideal, properly executed horizontal assembly ensures the same connection integrity when aligned, torqued, and inspected correctly.

9.2 RISKS IN HORIZONTAL ASSEMBLY

Risk	Consequences	Mitigation Strategy
Misalignment	Cross-threading, galling	Use full-length support and proper alignment tools
Impact stabbing	Seal damage, shoulder distortion	Manually stab and spin with controlled force
Incomplete cleaning	Seal leakage, torque irregularity	Make a thorough inspection before applying dope
Improper torque monitoring	Over / under torque, make-up failure	Use calibrated Torque-Turn systems and log graphs

9.3 PRE-ASSEMBLY PREPARATION

When performing cleaning and visual inspection:

- Remove protectors and wipe pin/box ends with lint-free cloths.
- Use approved solvent for ArcelorMittal TPJ connections.
- Visually inspect threads, seal face, stabbing lead, and ensure no corrosion, dents, or deformation.

Be sure to have the following equipment and information on hand:

- Calibrated bucking unit or powered makeup tool with torque-turn monitoring
- Alignment supports, stabbing guides, and OD-specific dies
- Verified torque spec from connection datasheet

9.4 PIPE ALIGNMENT AND SUPPORT

- Use padded V-blocks or adjustable roller stands.
- Ensure pipe ends are centered and level along the entire length.
- Avoid sagging. Even minor bending can lead to misaligned stabbing.
- Confirm axial alignment visually and by using gauges.

IMPORTANT:

Never proceed with stabbing if the pipe is offset or angled —this can destroy premium threads instantly.

9.5 CONTROLLED STABBING PROCEDURE

1. Align the pin end precisely with the box.
2. Lower or advance the pin slowly, by hand or low-speed hydraulic assist.
3. Spin in by hand until threads are fully engaged (≥2 full turns).
4. Watch for smooth engagement. Ensure there is no jerking, wobble, or resistance.
5. If binding occurs, stop immediately, retract, clean, and realign.

9.6 APPLYING COMPOUND

For Conventional Connections:

- Use approved premium compound per material type.
- Apply thin, uniform coat on pin threads, seal face, and lead-in.
- Avoid globbing or shoulder buildup — this distorts torque readings.

For CRA / Chrome:

- Only use CRA-compatible compound (non-metallic).
- Apply immediately prior to make-up to prevent oxidation or dirt adherence.

9.7 MAKE-UP AND TORQUE MONITORING

- Use a calibrated bucking unit with digital torque-turn output.
- Monitor the graph in real time to confirm thread engagement, shoulder contact, and final torque.

Parameter	Target
Spin-in Speed	≤15RPM
Final Make-Up	≤5RPM

Torque window per connection datasheet.

Save each torque-turn graph for traceability and quality audits.

9.8 POST-MAKE-UP QUALITY CHECKS

- Verify full shoulder contact visually.
- Look for signs of slippage or tong scarring.
- Reinstall clean protectors immediately after inspection.

Recommendation:

Paint stripe joints that pass inspection and log all make- up data.

9.9 HANDLING AND STORAGE AFTER ASSEMBLY

Use tarps or breathable pipe covers to prevent sun/dirt/dust exposure.

For long term storage, reclean and relubricate pipe, then inspect monthly.

- Use padded slings or pipe-handling tools only — never chain or fork the body.
- Stack horizontally with chocks or soft dunnage.
- Clearly label: “PRE-MADE CONNECTION – DO NOT OPEN.”

Horizontal Assembly Summary

1. Ensure all pipe is cleaned and protectors removed
2. Apply proper compound
3. Align and support pipe correctly
4. Apply torque within spec with graph saved
5. Complete the post-make-up inspection
6. Reinstall clean protectors
7. Ensure the joints are marked, tagged, and stored per guidelines

Chapter 10:
Connection Interchangeability Guidelines

This chapter explains that certain ArcelorMittal Tubular Products Al-Jubail connections of different weights and grades, such as 4½” L80.1 and JEP95HS, are fully interchangeable when the recommended torque values and approved procedures are followed. Minor steps may appear at the torque shoulders due to size differences, but proper make-up ensures connection integrity. Users should always refer to ArcelorMittal Tubular Products Al-Jubail specifications for torque values and other interchangeable connections.

10.1 MATERIAL

- 4 ½”, 12.6#, L80.1, JPC4-C1
- 4 ½”, 13.5#, JEP95HS, JPC4-C1

10.2 DESIGN FEATURES

Connection design for the aforementioned weights and grades is the same.

10.3 INTERCHANGEABILITY

Both connections are 100% interchangeable subject to application of the recommended make up torque values and approved buck-on process.

10.4 ASSEMBLY GEOMETRY

While assembling two different weights of an interchangeable connection, a resulting step may appear at the contact between both pin and box torque shoulders.

The step depth is approximately 50% of the difference between both connections’ IDs

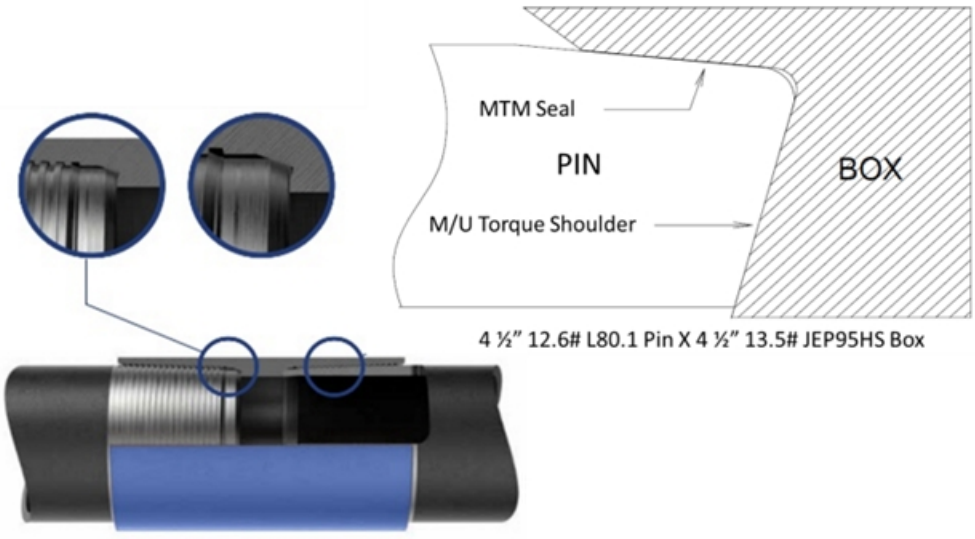


Figure 10-1: Assembly Geometry

10.5 RECOMMENDED MAKE-UP TORQUE VALUES

- 4 ½”, 12.6#, L80.1, JPC4-C1 X 4 ½”, 13.5#, JEP95HS, JPC4-C1

Minimum Make-up Torque	Optimum Make-up Torque	Maximum Make-up Torque	Minimum Shoulder Torque	Maximum Shoulder Torque
ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs
4690	4920	5170	246	3444

Please consult ArcelorMittal Tubular Products Al-Jubail for interchangeability of other sizes, weights, grades.

Chapter 11:
Manufacturing

This chapter explains the two main methods of pipeline manufacturing: seamless and ERW (Electric Resistance Welded) pipes. Seamless pipes are produced from heated steel billets pierced and rolled into hollow shells, then elongated, sized, straightened, cut, and finished with heat treatment, testing, and coating, providing high strength and reliability for critical applications. ERW pipes are made by cold-forming steel coils into cylindrical shapes and welding the seam using high-frequency electric current, followed by deburring, sizing, straightening, cutting, inspection, and finishing; both processes require specialized equipment to ensure precise dimensions, quality, and performance.

There are two methods of pipeline manufacture: Seamless and Electric Resistance Welded.

11.1 SEAMLESS PIPE

The seamless pipe manufacturing process is used to produce pipes without any welded joints, offering superior strength, pressure resistance, and reliability—especially for high-pressure, high-temperature, or critical applications.

A heated ingot is pierced with a mandrel and rolled into the proper pipe size.

1. Billet Heating:
   - Round steel billets (solid cylindrical bars) are heated to ~1200°C in a rotary hearth or induction furnace.
2. Piercing (Mannesmann Process):
   - The hot billet is pierced using a piercing mill with two skewed rollers and a piercing mandrel.
   - This creates a central hole, forming a rough shell (hollow).
3. Elongation:
   - The pierced shell is elongated using:
   - Mandrel Mill
   - Plug Mill
   - or Assel Mill
   - This reduces wall thickness and increases length.
4. Reheating (if necessary):
   - For temperature uniformity before sizing.
5. Sizing and Stretch Reducing:
   - Pipe is passed through a sizing mill or stretch reducing mill to achieve final diameter and wall thickness.
6. Cooling:
   - Pipes are cooled on a cooling bed.
7. Straightening:
   - Pipes are straightened using a straightening machine.
8. Cutting:

- Pipes are cut to desired lengths using flying saws or cutoff machines.
- Finishing:
- Includes:
    - End facing / beveling
    - Heat treatment (normalizing, quenching)
    - Non-destructive testing (ultrasonic, eddy current)
    - Hydrotesting
    - Coating or painting

Equipment Required

- Rotary hearth furnace
- Piercing mill
- Mandrel or plug mill
- Reheating furnace (optional)
- Stretch reducing/sizing mill
- Flying saw
- Straightener
- Heat treatment furnace
- NDT line
- Hydrotesting unit
- End-facing machine

11.2 ERW PIPE

ERW stands for the Electric Resistance Welded process. This process involves producing pipes by cold-forming generally low-carbon steel coil into a cylindrical shape and then welding the seam using electric resistance. The steel coil is cut into long strips. The strips are bent around sizing mandrels and welded into a tube.

1. Uncoiling:
   - Steel coil (hot rolled or cold rolled) is loaded onto an uncoiler.
   - The coil is fed into the forming line.
2. End Shearing and Welding:
   - The coil ends are trimmed and welded to allow continuous production.
3. Looping (Accumulator):
   - Stores strip temporarily so the mill can run continuously while new coils are being joined.
4. Forming:
   - The strip passes through a series of forming rollers that gradually shape it into a round tube.
5. Welding (ERW):
   - The edges of the tube are heated using high-frequency current (typically 100-800 kHz).
   - The heated edges are then squeezed together to form a weld.
6. Deburring:
   - Inside and outside weld beads are trimmed to ensure a smooth surface.
7. Sizing & Straightening:
   - The tube is passed through sizing rolls to get the precise diameter and straightness.
8. Cutting:
   - Pipes are cut to length using flying cutoff saws or other methods.
9. Inspection & Testing:
   - Pipes undergo non-destructive testing (NDT), such as ultrasonic or hydro testing, to ensure quality.

10. Finishing:
    - Includes end-facing, threading (if required), galvanizing, painting, or coating.

Key Equipment

- Uncoiler
- Shearing & end welding machine
- Strip accumulator
- Forming and welding mill
- High-frequency welder (solid-state or vacuum tube type)
- Bead trimmer
- Sizing mill
- Straightener
- Flying cutoff machine
- NDT equipment (UT, eddy current, etc.)
- Pipe bundling and stacking system

Chapter 12:
Products

This chapter explains the main ArcelorMittal Tubular Products Al-Jubail product lines and their features. The JPC2 and JPC4 connections are designed for oil and gas exploitation, with the JPC4 offering a conical metal-to-metal seal, anti-galling properties, and enhanced torque shoulder for precise makeup. The AM-HBC and AM-TS connections provide high-performance metal-to-metal seals, improved compression and bending resistance, and optimized threads for high-pressure, high-temperature, and deviated wells. The AM-C7S connection, based on API Buttress design, offers increased torsional strength, controlled make-up, and compatibility with standard BTC components, combining ease of running with robust sealing and mechanical performance.

12.1 JPC-2

- Size range: 5-1/2" to 13-3/8"
- Tolerances: API 5CT
- Extensive field proven premium connection technology
- Metal-to-Metal Seal
    - 30° Metal-to-Metal galling resistant pressure seal
    - Improved sealability compared to API connections
    - Used for higher temperature applications
- Torque Shoulder
    - 15°-20° reverse angle torque shoulder, enhancing connection sealability
    - Supports compression efficiency, and ensures precise make-up position control
- Thread Profile
    - Modified buttress thread profile reduces galling risk
    - OD 5-1/2" - 13-3/8" : 5 TPI
    - Thread taper 1:16
    - 3" load flank and 10" stab flank
    - Additional thread clearance for excess thread compound allocation.

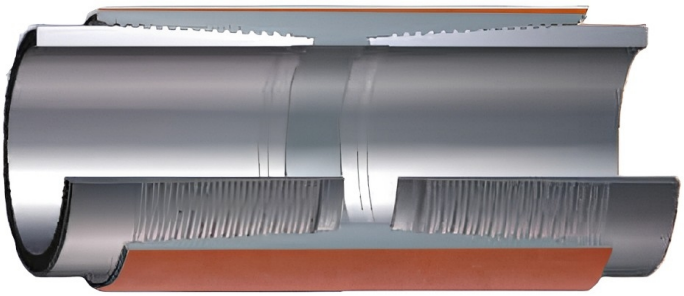


Figure 12-1: JPC-2, Cutaway View

12.2 JPC-4

- Size range: 3 ½” to 13 3/8”
- Successfully tested under ISO 13679:2002 CAL-IV and Major operator qualification test protocols
- Metal-to-Metal Seal
    - Conical seal design provides high performing gas tight sealability
    - Seal geometry provides excellent anti-galling properties
- Torque Shoulder
    - Negative angle torque shoulder to enhance sealability & compression resistance
    - Ensures precise make up position control
- Thread profile
    - Run out thread provides maximum pipe body area for tension and compression loads
    - Hooked thread profile for 100% tensile efficiency & preventing jump out
    - Steep stab flank angle and torque shoulder provide extra compression and bending resistance
    - Thread clearance for excellent anti-galling properties

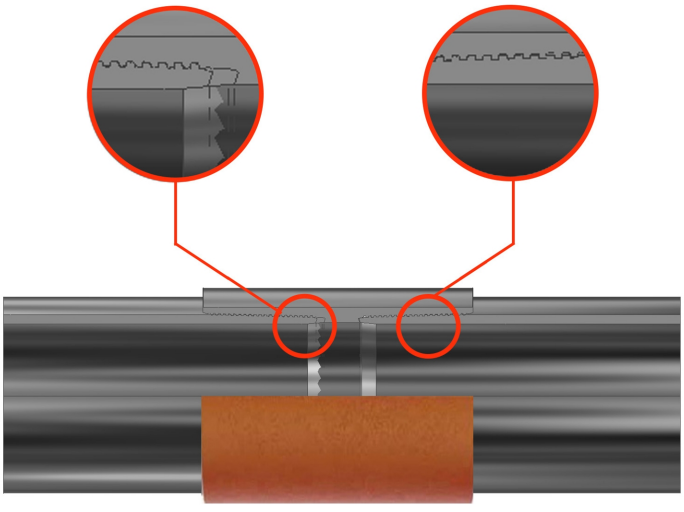


Figure 12-2: JPC-4 Connector, Cutaway View

12.3 FALCONTORQ

4 ½" to 13 5/8"

Built for the most challenging applications where well operations and economics are equally crucial.

Concept Design

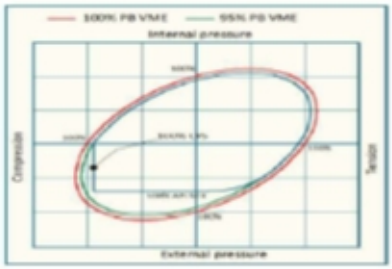
- Thread and Coupled Wedge thread profile guarantees 100% Tensile & Compression efficiencies under combined loads.
- Assures outstanding operational torque rating.
- Guarantees advanced bending performance.
- Offers 100% PBYS rating for Internal & External pressures (Burst & Collapse).
- Provides 100% internal and external gas tight sealability.
- Thread clearance enhances anti-galling properties.
- Deep stabbing for quick make up.

Options

- Special clearance coupling.

Qualification Testing

- Under API RP 5C5:2021 CAL-IV and Major operators' qualification test protocols.



12.4 AM-TS

- Size range: 4-1/2" to 9-5/8"
- Extensive field usage Metal-to-Metal seal
- Smooth bore for better fluid flow
- Modified BTC thread form
- Gap between the box root and the pin crest for the excess of thread compound
- Metal-to-Metal Seal
    - Galling resistant seal
    - Better sealability than API connections
    - Suitable for higher temperatures than API connections
- Torque Shoulder
    - Enhances the sealing
    - Enhanced compression resistance
    - Provides positive stop during make up
- Thread profile
    - Modified buttress thread profile reduces galling
    - Additional thread clearance allows for excess thread compound

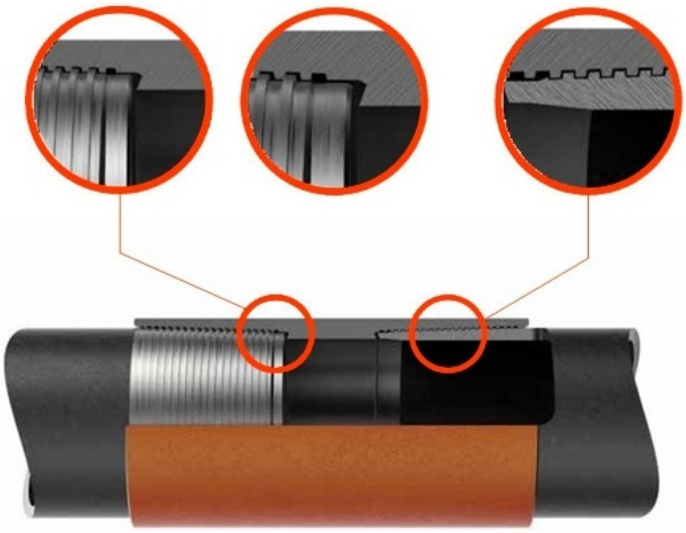


Figure 12-3: TS Connection, Cutaway View

12.5 AM-C7S

- Size Range: 4-1/2" to 13-3/8"
- Based on API Buttress design
- Coupling torque shoulder for increased torsional strength
- Designed for any application for API Buttress where greater torsional strength is required
- AM-C7S Couplings may be assembled with standard BTC pin (but torsional strength may be reduced)
- AM-C7S Pins may be assembled with standard BTC coupling
- BTC based thread design for easier operations
- Same ease of running as API BTC
- Torque Shoulder
    - Provides enhanced torsional strength
    - Allows controlled make up position for lower stresses
    - Make up connections to specified torque values
    - Better compression resistance than API BTC
    - High yield torque value
- Thread profile
    - Standard API BTC thread form on both pin and coupling
    - BTC thread seal
    - Pressure and tension performance properties are same as BTC

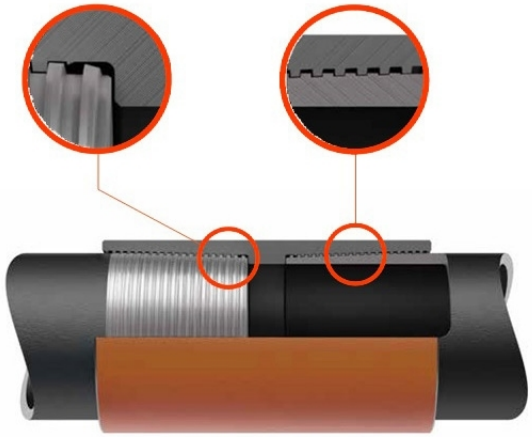


Figure 12-4: C7S Connection, Cutaway View

12.6 AM-HBC

- Size Range: 3-1/2” to 13-3/8”.
- Well-known Premium Connection: Connection design has been used for many years in the field
- Optimized Metal-to-Metal Seal: Optimized to improve Sealability while preventing galling to seal area and can withstand repeated make & breaks and combined loading
- Reverse angle Torque Shoulder: accurate makeup, hoop stress minimization
- Hook thread: high performances under external pressure, compression, bending
- Main Applications:
- High Pressures Wells, High Temperatures Wells
- Shales Drilling and Drilling with Casing
- Deviated, Horizontal, Extended Reach Wells

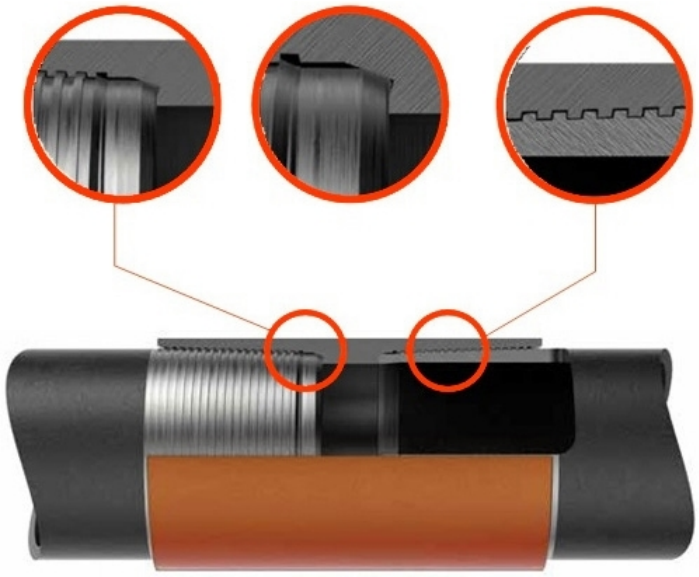


Figure 12-5: HBC Cutaway View

APPENDIX A - JPC-2

JPC-2 is a premium, proprietary, and interchangeable connection developed by Jubail Energy Services Company (JESCO) for Oil Country Tubular Goods (OCTG) applications in oil and natural gas extraction.

Designed for reliability and performance, JPC-2 is available in sizes ranging from 5.500" to 13.375", and is fully compliant with the API 5CT standard. It has improved sealability compared to API connections and is used for higher temperature applications. The modified thread profile reduces galling risk.

Successfully tested according to ISO 13679:2002 CAL-II with bending testing.

A.1 JPC-2 PERFORMANCE DATA

PIPE								PIN	COUPLING				
Nominal Outside Diameter	Nominal Weight	Nominal Wall Thickness		Nominal Inside Diameter	Drift Diameter		Nominal Section Area	Make up Loss Length	Coupling Outside Diameter	Coupling Inside Diameter	Finished Length	Critical Section Area	Tensile Efficiency
Inch (mm)	lbs/ft	inch	mm	Inch	Inch	mm	In²	Inch	Inch	Inch	Inch	In²	%
5-1/2 (139.7)	15.5	0.275	6.99	4.950	4.825	122.56	4.511	4.843	6.083	4.949	11.654	6.141	100%
	17.0	0.304	7.72	4.892	4.767	121.08	4.962	4.843	6.083	4.949	11.654	6.141	100%
	20.0	0.362	9.19	4.778	4.653	118.18	5.828	4.843	6.083	4.917	11.654	6.141	100%
	23.0	0.415	10.54	4.670	4.545	115.44	6.629	4.843	6.083	4.831	11.654	6.141	100%
	26.0	0.476	12.09	4.548	4.423	112.34	7.511	4.843	6.083	4.831	11.654	6.141	100%
7 (177.80)	23.0	.0317	8.05	6.366	6.241	158.52	6.653	5.197	7.697	6.437	12.402	9.405	100%
	26.0	0.362	9.19	6.276	6.151	156.24	7.549	5.197	7.697	6.388	12.402	9.405	100%
	29.0	0.408	10.36	6.184	6.059	153.90	8.449	5.197	7.697	6.339	12.402	9.405	100%
	32.0	0.454	11.53	6.094	5.969	151.61	9.317	5.197	7.697	6.339	12.402	9.405	100%
	35.0	0.499	12.67	6.004	5.879	149.33	10.173	5.197	7.697	6.339	12.402	9.405	100%
	38.0	0.541	13.74	5.920	4.795	147.19	10.960	5.197	7.697	6.339	12.402	9.405	100%
	41.0	0.590	14.99	5.820	5.695	144.65	11.875	5.197	7.697	6.339	12.402	9.405	100%
7-5/8 (193.68)	26.4	0.328	8.33	6.970	6.844	173.84	7.518	5.374	8.543	7.051	12.756	13.273	100%
	29.7	0.375	9.53	6.876	6.750	171.46	8.537	5.374	8.543	7.012	12.756	13.273	100%
	33.7	0.430	10.92	6.766	6.640	168.66	9.720	5.374	8.543	6.941	12.756	13.273	100%
	35.8	0.465	11.81	6.696	6.570	166.68	10.459	5.374	8.543	6.941	12.756	13.273	100%
	39.0	0.500	12.70	6.626	6.500	165.10	11.193	5.374	8.543	6.941	12.756	13.273	100%
	42.8	0.562	14.27	6.502	6.376	161.96	12.466	5.374	8.543	6.941	12.756	13.273	100%
	47.1	0.626	15.90	6.376	6.250	158.74	13.748	5.374	8.543	6.941	12.756	13.273	100%
9-5/8 (244.48)	36.0	0.352	8.94	8.922	8.765	222.63	10.253	5.433	10.630	9.047	12.874	18.096	100%
	40.0	0.395	10.03	8.836	8.679	220.45	11.455	5.433	10.630	8.992	12.874	18.096	100%
	43.5	0.436	11.07	8.756	8.599	218.41	12.560	5.433	10.630	8.949	12.874	18.096	100%
	47.0	0.473	12.01	8.682	8.525	216.54	13.572	5.433	10.630	8.949	12.874	18.096	100%
	53.5	0.545	13.84	8.536	8.379	212.83	15.547	5.433	10.630	8.949	12.874	18.096	100%
	58.4	0.595	15.11	8.436	8.279	210.29	16.880	5.433	10.630	8.949	12.874	18.096	100%
13-3/8 (339.72)	61.0	0.430	10.92	12.514	12.359	313.92	17.487	5.630	14.370	12.691	13.189	24.630	100%
	68.0	0.480	12.19	12.414	12.259	311.38	19.445	5.630	14.370	12.594	13.189	24.630	100%
	72.0	0.515	13.08	12.346	12.191	309.65	20.768	5.630	14.370	12.594	13.189	24.630	100%
	86.0	0.625	15.88	12.124	11.969	304.01	25.028	5.630	14.370	12.594	13.189	24.630	98%

A.2 JPC2 TORQUE DATA

			TORQUES											
			Makeup Loss	55 KSI		80 KSI		95 KSI		110 KSI		130 KSI	
OD	Weight	Wall		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
5.500"	17.0	0.304	4.843	4560	5560	4950	6050	5220	6360	5480	6680	6190	7550
	20.0	0.362	4.843	5340	6520	5860	7160	6120	7480	6450	7870	7170	8750
	23.0	0.415	4.843	6390	7790	7170	8750	7470	9130	7830	9570	9150	11150
7.000"	26.0	0.362	5.197	6510	7950	7470	9130	7830	9570	8460	10340	9150	11150
	29.0	0.408	5.197	7470	9130	8460	10340	9150	11150	9850	11850	10450	12600
	32.0	0.454	5.197	8150	9950	9150	11150	9850	11850	10450	12650	11100	13500
	35.0	0.499	5.197	8640	10300	9500	11500	10100	12300	10850	13050	11450	13850
7.625"	33.7	0.430	5.374	9150	11150	10450	12650	11100	13500	12100	14700	12700	15500
	35.8	0.465	5.374	9500	11500	10850	13050	11700	14300	12450	15050	13050	15850
	39.0	0.500	5.374	9850	11850	11100	13500	12100	14700	12700	15500	13700	16700
9.625"	40.0	0.395	5.433	9500	11500	11100	13500	12100	14700	13050	15850	14400	17400
	43.5	0.436	5.433	10850	13050	12700	15500	13700	16700	14400	17400	14400	17400
	47.0	0.473	5.433	11100	13500	13050	15850	14400	17400	14400	17400	14400	17400
	53.5	0.545	5.433	12100	14700	14400	17400	14400	17400	14400	17400	14400	17400
	58.4	0.595	5.433	12700	15500	14400	17400	14400	17400	14400	17400	14400	17400
13.375"	61.0	0.430	5.630	13700	16700	14400	17400	14400	17400	14400	17400	14400	17400
	68.0	0.480	5.630	14400	17400	14400	17400	14400	17400	14400	17400	14400	17400
	72.0	0.515	5.630	14400	17400	14400	17400	14400	17400	14400	17400	14400	17400

APPENDIX B - JPC-4

JPC-4 is JESCO's latest premium connection, engineered for high-performance and reliability in the most demanding operating conditions.

It is available in sizes 4-½", 5-½", 7", 9-5/8", and 13-3/8", each offered in a wide range of wall thicknesses and steel grades to suit diverse application requirements.

Extensive testing involving repeated makeup and breakout cycles—across varying torque levels and dope volumes—has demonstrated JPC-4's low galling tendency, ensuring gas-tight sealing even under the most critical conditions.

JPC-4 delivers 100% tensile and up to 100% compressive efficiency for sizes up to 7", and a minimum of 80% for 9-5/8" and 13-3/8" sizes.

Its superior performance under combined loads—including internal/external pressure, thermal cycling, bending, tension, and compression—has been fully validated through ISO 13679:2011 CAL IV testing. JPC-4 is among the few connections tested in accordance with the latest and most rigorous revision of this standard.

B.1 JPC4 PERFORMANCE DATA

PERFORMANCE DATA													
										Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Critical Section Area	Ten	Com	IP	EP
4.500"	10.50	0.224	10.50-15.10	4.052	4.862	3.992	7.480	3.222	3.882	100%	100%	100%	100%
	11.60	0.250	10.50-15.10	4.000	4.906	3.945	7.480	3.222	4.214	100%	100%	100%	100%
	12.60	0.271	10.50-15.10	3.958	4.937	3.906	7.480	3.222	4.458	100%	100%	100%	100%
	13.50	0.290	10.50-15.10	3.920	4.969	3.870	7.480	3.222	4.703	100%	100%	100%	100%
	15.10	0.337	10.50-15.10	3.826	5.043	3.791	7.480	3.222	5.291	100%	100%	100%	100%
5.500"	15.50	0.276	15.50-29.70	4.950	5.929	4.872	10.748	4.382	4.951	100%	100%	100%	100%
	17.00	0.304	15.50-29.70	4.892	5.978	4.815	10.748	4.382	5.411	100%	100%	100%	100%
	20.00	0.362	15.50-29.70	4.778	6.071	4.719	10.748	4.382	6.286	100%	100%	100%	100%
	23.00	0.415	15.50-29.70	4.670	6.156	4.611	10.748	4.382	7.099	100%	100%	100%	100%
	26.00	0.476	15.50-29.70	4.548	6.248	4.489	10.748	4.382	8.000	100%	100%	100%	100%
	26.80	0.500	15.50-29.70	4.500	6.283	4.442	10.748	4.382	8.349	100%	100%	100%	100%
	28.40	0.530	15.50-29.70	4.440	6.327	4.390	10.748	4.382	8.777	100%	100%	100%	100%
	29.70	0.562	15.50-29.70	4.376	6.372	4.339	10.748	4.382	9.229	100%	100%	100%	100%
7.000"	26.00	0.362	26.00-42.70	6.276	7.565	6.280	11.539	4.776	8.129	100%	100%	100%	100%
	29.00	0.408	26.00-42.70	6.184	7.644	6.280	11.539	4.776	9.072	100%	100%	100%	100%
	32.00	0.453	26.00-42.70	6.094	7.717	6.198	11.539	4.776	9.947	100%	100%	100%	100%
	35.00	0.498	26.00-42.70	6.004	7.788	6.118	11.539	4.776	10.817	100%	100%	100%	100%
	38.00	0.540	26.00-42.70	5.920	7.853	6.044	11.539	4.776	11.616	100%	100%	100%	100%
	41.00	0.590	26.00-42.70	5.820	7.930	5.954	11.539	4.776	12.570	100%	100%	100%	100%
	42.70	0.626	26.00-42.70	5.750	7.980	5.891	11.539	4.776	13.199	100%	100%	100%	100%
9.625"	36.00	0.352	36.00-58.40	8.922	10.188	8.927	13.228	5.589	11.235	100%	100%	100%	100%
	40.00	0.395	36.00-58.40	8.836	10.264	8.927	13.228	5.589	12.456	100%	100%	100%	100%
	43.50	0.435	36.00-58.40	8.756	10.333	8.855	13.228	5.589	13.572	100%	100%	100%	100%
	47.00	0.472	36.00-58.40	8.682	10.396	8.788	13.228	5.589	14.597	100%	100%	100%	100%
	53.50	0.545	36.00-58.40	8.536	10.520	8.657	13.228	5.589	16.634	100%	100%	100%	100%
	58.40	0.595	36.00-58.40	8.436	10.601	8.569	13.228	5.589	17.977	100%	100%	100%	100%
13.375"	61.00	0.430	61.00-92.00	12.514	14.088	12.617	13.425	5.698	18.970	100%	100%	100%	100%
	68.00	0.480	61.00-92.00	12.414	14.176	12.528	13.425	5.698	20.928	100%	100%	100%	100%
	72.00	0.514	61.00-92.00	12.346	14.236	12.467	13.425	5.698	22.263	100%	100%	100%	100%
	77.00	0.550	61.00-92.00	12.274	14.299	12.402	13.425	5.698	23.674	100%	100%	100%	100%
	80.70	0.580	61.00-92.00	12.214	14.350	12.348	13.425	5.698	24.826	100%	100%	100%	100%
	85.00	0.608	61.00-92.00	12.158	14.400	12.299	13.425	5.698	25.937	100%	100%	100%	100%
	86.00	0.625	61.00-92.00	12.124	14.429	12.268	13.425	5.698	26.605	100%	100%	100%	100%
	92.00	0.672	61.00-92.00	12.030	14.510	12.184	13.425	5.698	28.439	100%	100%	100%	100%

B.2 JPC4 TORQUE DATA

			MAKE-UP TORQUES							
			Makeup Loss	80000 KSI		95000 KSI		110000 KSI	
OD	Weight	Wall		Optimum (lb-ft)	Maximum (lb-ft)	Optimum (lb-ft)	Maximum (lb-ft)	Optimum (lb-ft)	Maximum (lb-ft)
4.500"	10.50	0.224	3.222	2840	3060	3130	3370	3490	3760
	11.60	0.250	3.222	3640	3920	4070	4380	4500	4840
	12.60	0.271	3.222	4120	4530	4580	4930	5080	5470
	13.50	0.290	3.222	4650	5000	5230	5630	5810	6250
	15.10	0.337	3.222	5810	6250	6530	7020	7180	7720
5.500"	15.50	0.276	4.382	5440	5850	6170	6640	6890	7410
	17.00	0.304	4.382	6600	7100	7250	7800	8320	8950
	20.00	0.361	4.382	8720	9380	9770	10510	10870	11690
	23.00	0.415	4.382	10870	11690	12320	13250	13770	14810
	26.00	0.476	4.382	13420	14430	15220	16370	16670	17930
	26.80	0.500	4.382	14470	15560	16270	17500	18120	19480
	28.40	0.530	4.382	15570	16740	17720	19050	19570	21040
	29.70	0.562	4.382	16670	17930	18820	20240	21020	22600
7.000	26.00	0.362	4.776	12000	12900	13800	14840	15250	16400
	29.00	0.408	4.776	14900	16020	17050	18330	17750	19090
	32.00	0.453	4.776	15600	16770	17700	19030	19600	21070
	35.00	0.498	4.776	18150	19520	20650	22200	22850	24570
	38.00	0.540	4.776	20650	22200	23200	24940	23200	24940
	41.00	0.590	4.776	23200	24940	23200	24940	23200	24940
	42.70	0.626	4.776	23200	24940	23200	24940	23200	24940
9.625"	36.00	0.352	5.589	9500	9980	11040	11600	11650	12240
	40.00	0.395	5.589	9500	9980	11040	11600	11650	12240
	43.50	0.435	5.589	13100	13760	15720	16510	16000	16800
	47.00	0.472	5.589	16000	16800	18870	19820	20350	21370
	53.50	0.545	5.589	23250	24420	25190	26450	23150	25450
	58.40	0.595	5.589	23250	24420	25180	26440	23250	24420
13.375"	61.00	0.430	5.698	16750	17590	19740	20730	21100	22160
	68.00	0.480	5.698	23250	24420	24300	25520	23250	24420
	72.00	0.514	5.698	23250	24420	24300	25520	23250	24420
	77.00	0.550	5.698	23250	24420	24300	25520	23250	24420
	80.70	0.580	5.698	23250	24420	24300	25520	23250	24420
	85.00	0.608	5.698	23250	24420	24300	25520	23250	24420
	86.00	0.625	5.698	23250	24420	24300	25520	23250	24420
	92.00	0.672	5.698	50100	52610	52500	55130	50100	52610

APPENDIX C DATA SHEETS

C.1 FALCONTORQ PERFORMANCE DATA

PERFORMANCE DATA														
											Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Matched Str OD	Cplg Bored ID	Coupling Length	Makeup Loss	Minimum Bore	Ten	Com	IP	EP
4.500	12.60	.271	12.6	3.877	5.200	4.866	3.950	11.788	4.460	1.319	100%	100%	100%	100%
4.500	13.50	.290	13.50-15.10	3.839	5.200	4.897	3.912	11.788	4.460	1.319	100%	100%	100%	100%
4.500	15.10	.337	13.50-15.10	3.745	5.200	4.971	3.818	15.470	6.310	1.593	100%	100%	100%	100%
4.500	17.00	.380	13.50-15.10	3.659	5.200	5.037	3.732	15.470	6.310	1.593	100%	100%	100%	100%
5.000	17.00	.304	15.50-20.00	.563	5.800	5.458	4.271	17.402	7.270	1.593	100%	100%	100%	100%
5.000	20.00	.361	15.50-20.00	.563	5.800	5.574	4.121	17.402	7.270	1.593	100%	100%	100%	100%
5.000	23.00	.415	23.00 26.00	.563	5.800	5.634	4.039	17.402	7.270	1.593	100%	100%	100%	100%
5.000	26.00	.476	23.00 26.00	.563	5.800	5.666	3.995	17.402	7.270	1.593	100%	100%	100%	100%
5.500	17.00	.304	15.50-20.00	4.818	6.300	5.887	4.891	14.818	5.980	1.395	100%	100%	100%	100%
5.500	20.00	.361	15.50-20.00	4.704	6.300	5.981	4.777	14.818	5.980	1.395	100%	100%	100%	100%
5.500	23.00	.415	23.00 26.00	4.596	6.300	6.054	4.669	14.818	5.980	1.395	100%	100%	100%	100%
5.500	26.00	.476	23.00 26.00	4.474	6.300	6.147	4.547	14.818	5.980	1.395	100%	100%	100%	100%
6.625	24.00	.352	24.00-32.00	5.853	7.250	7.108	5.926	17.394	7.270	1.591	100%	100%	100%	100%
6.625	28.00	.417	24.00-32.00	5.723	7.250	7.215	5.723	17.394	5.723	1.591	100%	100%	100%	100%
6.625	32.00	.475	24.00-32.00	5.607	7.375	7.308	5.607	17.394	5.607	1.591	100%	100%	100%	100%
7.000	23.00	.317	23.00-26.00	6.309	7.875	7.473	6.309	12.850	6.309	1.399	100%	100%	100%	100%
7.000	26.00	.362	23.00-26.00	6.210	7.875	7.507	6.210	17.402	6.210	1.593	100%	100%	100%	100%
7.000	29.00	.408	29.00-41.00	6.118	7.875	7.584	6.118	17.402	6.118	1.593	100%	100%	100%	100%
7.000	32.00	.453	29.00-41.00	6.059	7.875	7.657	6.059	17.402	6.059	1.593	100%	100%	100%	100%
7.000	35.00	.498	29.00-41.00	5.938	7.875	7.728	5.938	17.402	5.938	1.593	100%	100%	100%	100%
7.000	41.00	.590	29.00-41.00	5.754	7.875	7.869	5.754	17.402	5.754	1.593	100%	100%	100%	100%
9.625	36.00	.352	36.00-43.50	8.841	10.625	10.152	8.841	14.864	6.000	1.516	100%	100%	100%	100%
9.625	40.00	.395	36.00-43.50	8.826	10.625	10.228	8.826	14.864	6.000	1.516	100%	100%	100%	100%
9.625	43.50	.435	36.00-43.50	8.675	10.625	10.297	8.675	14.864	6.000	1.516	100%	100%	100%	100%
9.625	47.00	.472	47.00-58.40	8.601	10.625	10.360	8.601	14.864	6.000	1.516	100%	100%	100%	100%
9.625	53.50	.545	47.00-58.40	N/A	10.625	10.406	N/A	16.242	6.690	N/A	100%	100%	100%	100%
9.625	58.40	.595	47.00-58.40	N/A	10.625	10.488	N/A	16.242	6.690	N/A	100%	100%	100%	100%
13.375	54.50	.380	54.50-72.00	N/A	14.375	13.997	N/A	17.402	7.270	N/A	100%	100%	100%	100%
13.375	61.00	.430	54.50-72.00	N/A	14.375	14.088	N/A	17.402	7.270	N/A	100%	100%	100%	100%
13.375	68.00	.480	54.50-72.00	N/A	14.375	14.177	N/A	17.402	7.270	N/A	100%	100%	100%	100%
13.375	72.00	.514	54.50-72.00	N/A	14.375	14.237	N/A	17.402	7.270	N/A	100%	100%	100%	100%
13.375	77.00	.550	77.00-86.00	N/A	14.375	14.132	N/A	17.930	7.540	N/A	100%	100%	100%	100%
13.375	86.00	.625	77.00-86.00	N/A	14.375	14.262	N/A	17.930	7.540	N/A	100%	100%	100%	100%
13.625	88.25	.625	77.00-86.00	N/A	14.625	14.527	N/A	17.930	7.540	N/A	100%	100%	100%	100%

C.2 FALCONTORQ TORQUE DATA

			Torques													
			Makeup		55000		75000		80000		95000		110000		125000	
OD	Weight	Wall	Min	Max	Operanl	Yield	Operanl	Yield	Operanl	Yield	Operanl	Yield	Operanl	Yield	Operanl	Yield
4.500	12.60	.271	7100	8520	12000	15000	12800	16000	13600	17000	15200	19000	18400	23000	20000	25000
4.500	13.50	.290	7400	8880	12000	15000	12800	16000	13600	17000	15200	19000	18400	23000	20000	25000
4.500	15.10	.337	12000	14400	17600	22000	20000	25000	20800	26000	23200	29000	27200	34000	29600	37000
4.500	17.00	.380	13000	15600	17600	22000	20000	25000	20800	26000	23200	29000	27200	34000	29600	37000
5.000	17.00	.304	17000	20400	18400	23000	24800	31000	26400	33000	32000	40000	32000	40000	41600	52000
5.000	20.00	.361	19000	22800	18400	23000	24800	31000	26400	33000	32000	40000	32000	40000	41600	52000
5.000	23.00	.415	20000	24000	18400	23000	24800	31000	26400	33000	32000	40000	32000	40000	41600	52000
5.000	26.00	.476	21000	25200	18400	23000	24800	31000	26400	33000	32000	40000	32000	40000	41600	52000
5.500	17.00	.304	13000	15600	26400	33000	29600	37000	32000	40000	35200	44000	41600	52000	44800	56000
5.500	20.00	.361	14000	16800	26400	33000	29600	37000	32000	40000	35200	44000	41600	52000	44800	56000
5.500	23.00	.415	16000	19200	26400	33000	29600	37000	31200	39000	34400	43000	41600	52000	44800	56000
5.500	26.00	.476	17000	20400	26400	33000	29600	37000	31200	39000	34400	43000	41600	52000	44800	56000
6.625	24.00	.352	19000	22800	46400	58000	52000	65000	55200	69000	60800	76000	72000	90000	77600	97000
6.625	28.00	.417	21000	25200	46400	58000	52000	65000	55200	69000	60800	76000	72000	90000	77600	97000
6.625	32.00	.475	25000	30000	46400	58000	52000	65000	55200	69000	60800	76000	72000	90000	77600	97000
7.000	23.00	.317	10000	12000	22400	28000	30400	38000	32000	40000	38400	48000	44000	55000	50400	63000
7.000	26.00	.362	18000	21600	36800	46000	49600	62000	53600	67000	63200	79000	72800	91000	83200	104000
7.000	29.00	.408	19000	22800	36800	46000	49600	62000	53600	67000	63200	79000	72800	91000	83200	104000
7.000	32.00	.453	21000	25200	36800	46000	49600	62000	53600	67000	63200	79000	72800	91000	83200	104000
7.000	35.00	.498	22000	26400	36800	46000	49600	62000	53600	67000	63200	79000	72800	91000	83200	104000
7.000	41.00	.590	25000	30000	36800	46000	49600	62000	53600	67000	63200	79000	72800	91000	83200	104000
9.625	36.00	.352	18000	21600	54400	68000	73600	92000	78400	98000	93600	117000	108000	135000	123200	154000
9.625	40.00	.395	19000	22800	54400	68000	73600	92000	78400	98000	93600	117000	108000	135000	123200	154000
9.625	43.50	.435	21000	25200	54400	68000	73600	92000	78400	98000	93600	117000	108000	135000	123200	154000
9.625	47.00	.472	23000	27600	54400	68000	73600	92000	78400	98000	93600	117000	108000	135000	123200	154000
9.625	53.50	.545	27000	32400	59200	74000	80800	101000	86400	108000	102400	128000	118400	148000	134400	168000
9.625	58.40	.595	29000	34800	59200	74000	80800	101000	86400	108000	102400	128000	118400	148000	134400	168000
13.375	54.50	.380	28000	33600	136000	170000	184800	231000	197600	247000	234400	293000	271200	339000	308000	385000
13.375	61.00	.430	31000	37200	136000	170000	184800	231000	197600	247000	234400	293000	271200	339000	308000	385000
13.375	68.00	.480	34000	40800	136000	170000	184800	231000	197600	247000	234400	293000	271200	339000	308000	385000
13.375	72.00	.514	36000	43200	136000	170000	184800	231000	197600	247000	234400	293000	271200	339000	308000	385000
13.375	77.00	.550	39000	46800	138400	173000	188800	236000	200800	251000	239200	299000	276800	346000	314400	393000
13.375	86.00	.625	43000	51600	138400	173000	188800	236000	200800	251000	239200	299000	276800	346000	314400	393000
13.625	88.25	.625	44000	52800	144000	180000	196000	245000	208800	261000	248800	311000	288000	360000	327200	409000

C.3 AM-TS PERFORMANCE DATA

PERFORMANCE DATA												
									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
4.500"	10.500	0.224	10.500-24.600	4.010	4.862	3.994	9.331	3.661	100%	100%	100%	100%
	11.600	0.250	10.500-24.600	4.000	4.862	3.994	9.331	3.661	100%	100%	100%	100%
	12.600	0.271	10.500-24.600	3.958	4.892	3.958	9.331	3.661	100%	100%	100%	100%
	13.500	0.290	10.500-24.600	3.920	4.961	3.920	9.331	3.661	100%	100%	100%	100%
	15.100	0.337	10.500-24.600	3.826	5.010	3.826	9.331	3.661	100%	100%	100%	100%
	16.900	0.380	10.500-24.600	3.740	5.106	3.740	9.331	3.661	100%	100%	100%	100%
	18.800	0.430	10.500-24.600	3.640	5.146	3.640	9.331	3.661	100%	100%	100%	100%
	21.600	0.500	10.500-24.600	3.500	5.280	3.500	9.331	3.661	100%	100%	100%	100%
	24.600	0.560	10.500-24.600	3.380	5.333	3.380	9.331	3.661	100%	100%	100%	100%
5.000"	13.000	0.253	13.000-24.100	4.486	5.587	4.469	10.512	4.252	100%	100%	100%	100%
	15.000	0.296	13.000-24.100	4.408	5.587	4.408	10.512	4.252	100%	100%	100%	100%
	18.000	0.362	13.000-24.100	4.276	5.587	4.276	10.512	4.252	100%	100%	100%	100%
	20.300	0.408	13.000-24.100	4.184	5.587	4.184	10.512	4.252	100%	100%	100%	100%
	20.800	0.422	13.000-24.100	4.156	5.587	4.156	10.512	4.252	100%	100%	100%	100%
	21.400	0.437	13.000-24.100	4.126	5.587	4.126	10.512	4.252	100%	100%	100%	100%
	23.200	0.478	13.000-24.100	4.044	5.587	4.044	10.512	4.252	100%	100%	100%	100%
	24.100	0.500	13.000-24.100	4.950	6.075	4.000	10.512	4.252	100%	100%	100%	100%
5.500"	15.500	0.275	15.500-26.000	4.950	6.075	4.950	10.669	4.331	100%	100%	100%	100%
	17.000	0.304	15.500-26.000	4.892	6.075	4.892	10.669	4.331	100%	100%	100%	100%
	20.000	0.361	15.500-26.000	4.778	6.075	4.778	10.669	4.331	100%	100%	100%	100%
	23.000	0.415	15.500-26.000	4.670	6.075	4.670	10.669	4.331	100%	100%	100%	100%
	26.000	0.476	15.500-26.000	4.548	6.075				100%	100%	100%	100%
6.625"	20.000	0.288	20.000-35.000	6.049	7.413	6.049	11.063	5.528	100%	100%	100%	100%
	23.200	0.330	20.000-35.000	5.965	7.413	5.965	11.063	5.528	100%	100%	100%	100%
	24.000	0.352	20.000-35.000	5.921	7.413	5.921	11.063	5.528	100%	100%	100%	100%
	28.000	0.417	20.000-35.000	5.791	7.413	5.791	11.063	5.528	100%	100%	100%	100%
	32.000	0.475	20.000-35.000	5.675	7.413	5.675	11.063	5.528	100%	100%	100%	100%
	35.000	0.525	20.000-35.000	5.921	7.413	5.575	11.063	5.528	100%	100%	100%	100%
	23.000	0.317	23.000-46.000	6.366	7.681	6.366	11.457	4.724	100%	100%	100%	100%
	26.000	0.362	23.000-46.000	6.276	7.681	6.276	11.457	4.724	100%	100%	100%	100%
	29.000	0.408	23.000-46.000	6.184	7.681	6.184	11.457	4.724	100%	100%	100%	100%
	32.000	0.453	23.000-46.000	6.094	7.681	6.094	11.457	4.724	100%	100%	100%	100%
7.000"	35.000	0.498	23.000-46.000	6.004	7.681	6.004	11.457	4.724	100%	100%	100%	100%
	38.000	0.540	23.000-46.000	5.920	7.681	5.920	11.457	4.724	100%	100%	100%	100%
	41.000	0.590	23.000-46.000	5.820	7.681	5.820	11.457	4.724	100%	100%	100%	100%
	44.000	0.640	23.000-46.000	5.720	7.681	5.720	11.457	4.724	100%	100%	100%	100%
	46.000	0.670	23.000-46.000	5.660	7.681	5.660	11.457	4.724	100%	100%	100%	100%
7.625"	26.400	0.328	26.400-45.300	6.969	8.528	6.969	11.850	4.921	100%	100%	100%	100%
	29.700	0.375	26.400-45.300	6.875	8.528	6.875	11.850	4.921	100%	100%	100%	100%
	33.700	0.430	26.400-45.300	6.765	8.528	6.765	11.850	4.921	100%	100%	100%	100%
	35.800	0.465	26.400-45.300	6.695	8.528	6.695	11.850	4.921	100%	100%	100%	100%
	39.000	0.500	26.400-45.300	6.625	8.528	6.625	11.850	4.921	100%	100%	100%	100%
	42.800	0.562	26.400-45.300	6.501	8.528	6.501	11.850	4.921	100%	100%	100%	100%
	45.300	0.595	26.400-45.300	6.435	8.528	6.435	11.850	4.921	100%	100%	100%	100%

PERFORMANCE DATA												
									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
	28.000	0.304	28.000-62.000	8.017	9.650	8.017	12.087	5.039	100%	100%	100%	100%
	32.000	0.352	28.000-62.000	7.921	9.650	7.921	12.087	5.039	100%	100%	100%	100%
8.625"	36.000	0.400	28.000-62.000	7.825	9.650	7.825	12.087	5.039	100%	100%	100%	100%
	40.000	0.450	28.000-62.000	7.725	9.650	7.725	12.087	5.039	100%	100%	100%	100%
	44.000	0.500	28.000-62.000	7.625	9.650	7.625	12.087	5.039	100%	100%	100%	100%
	49.000	0.557	28.000-62.000	7.511	9.650	7.511	12.087	5.039	100%	100%	100%	100%
	52.000	0.595	28.000-62.000	7.435	9.650	7.435	12.087	5.039	100%	100%	100%	100%
9.625"	36.000	0.352	36.000-61.100	8.921	10.650	8.921	10.669	5.039	100%	100%	100%	100%
	40.000	0.395	36.000-61.100	8.835	10.650	8.835	10.669	5.039	100%	100%	100%	100%
	43.500	0.435	36.000-61.100	8.755	10.650	8.755	10.669	5.039	100%	100%	100%	100%
	47.000	0.472	36.000-61.100	8.681	10.650	8.681	10.669	5.039	100%	100%	100%	100%
	53.500	0.545	36.000-61.100	8.535	10.650	8.535	10.669	5.039	100%	100%	100%	100%
	58.400	0.595	36.000-61.100	8.435	10.650	8.435	10.669	5.039	100%	100%	100%	100%
	59.400	0.609	36.000-61.100	8.407	10.650	8.407	10.669	5.039	100%	100%	100%	100%
	61.1	0.625	36.000-61.100	8.375	10.650	8.375	10.669	5.039	100%	100%	100%	100%

C.4 AM-TS TORQUE DATA

			TORQUES													
			Makeup		55000		75000		80000		95000		110000		125000	
OD	Weight	Wall	Loss	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max
4.500"	10.5	0.224	3.661		3400	3740	4480	4920	4480	4920	5210	5730	5860	6440	5860	6440
	11.6	0.250	3.661		3470	3810	4630	5090	4630	5090	5350	5880	6000	6600	6000	6600
	12.6	0.271	3.661		3540	3890	4770	5240	4770	5240	5500	6050	6150	6760	6150	6760
	13.5	0.290	3.661		3690	4050	4920	5410	4920	5410	5640	6200	6370	7000	6370	7000
	15.1	0.337	3.661		4200	4620	5790	6360	5790	6360	6650	7310	7590	8340	7590	8340
	16.9	0.380	3.661		5060	5560	6940	7630	6940	7630	7960	8750	9050	9950	9050	9950
	18.8	0.430	3.661		5210	5730	7090	7790	7090	7790	8300	9130	9400	10340	9400	10340
	21.6	0.500	3.661		6150	6760	8700	9570	8700	9570	10150	11150	11950	13050	11950	13050
	24.6	0.56	3.661		6290	6910	9050	9950	9050	9950	10500	11500	11950	13050	11950	13050
5.000"	13.00	0.253	4.252"		4200	4620	4560	5010	4560	5010	4850	5330	5060	5560	5060	5560
	15.00	0.296	4.252"		4700	5170	5140	5650	5140	5650	5350	5880	5570	6120	5570	6120
	18.00	0.362	4.252"		5710	6280	6150	6760	6150	6760	6440	7080	6730	7400	6730	7400
	20.30	0.408	4.252"		6870	7550	7590	8340	7590	8340	7960	8750	8300	9130	8300	9130
	20.80	0.422	4.252"		7020	7720	7590	8340	7590	8340	7960	8750	8700	9570	8700	9570
	21.40	0.437	4.252"		7160	7870	7960	8750	7960	8750	8300	9130	8700	9570	8700	9570
	23.20	0.478	4.252"		7590	8340	8300	9130	8300	9130	8700	9570	9050	9950	9050	9950
	24.00	0.500	4.252"		7590	8340	8300	9130	8300	9130	8700	9570	9400	10340	9400	10340
5.500"	15.50	0.275	4.331"		4700	5170	5140	5650	5140	5650	5420	5960	5710	6280	5710	6280
	17.00	0.304	4.331"		5060	5560	5500	6050	5500	6050	5790	6360	6080	6680	6080	6680
	20.00	0.361	4.331"		5930	6520	6510	7160	6510	7160	6800	7480	7160	7870	7160	7870
	23.00	0.415	4.331"		7090	7790	7960	8750	7960	8750	8300	9130	8700	9570	8700	9570
	26.00	0.476	4.331"		7590	8340	8300	9130	8300	9130	9050	9950	9400	10340	9400	10340
6.625"	20.00	0.288	5.528"		5640	6200	6370	7000	6370	7000	6730	7400	7160	7870	7160	7870
	23.20	0.330	5.528"		6220	6840	6940	7630	6940	7630	7230	7950	7960	8750	7960	8750
	24.00	0.352	5.528"		6940	7630	7960	8750	7960	8750	8300	9130	8700	9570	8700	9570
	28.00	0.417	5.528"		8700	9570	9750	10720	9750	10720	10500	11500	11200	12300	11200	12300
	32.00	0.475	5.528"		9050	9950	10500	11500	10500	11500	11200	12300	11550	12650	11550	12650
	35.00	0.525	5.528"		9750	10720	10850	11850	10850	11850	11550	12650	12300	13500	12300	13500
7.000"	23.00	0.317	4.724"		6220	6840	7020	7720	7020	7720	7590	8340	7960	8750	7960	8750
	26.00	0.362	4.724"		7230	7950	8300	9130	8300	9130	8700	9570	9400	10340	9400	10340
	29.00	0.408	4.724"		8300	9130	9400	10340	9400	10340	10150	11150	10850	11850	10850	11850
	32.00	0.453	4.724"		9050	9950	10150	11150	10150	11150	10850	11850	11550	12650	11550	12650
	35.00	0.498	4.724"		9400	10340	10500	11500	10500	11500	11200	12300	11950	13050	11950	13050
	38.00	0.540	4.724"		9750	10720	11200	12300	11200	12300	11550	12650	12300	13500	12300	13500
	41.00	0.590	4.724"		10500	11500	11550	12650	11550	12650	12300	13500	13000	14300	13000	14300
	44.00	0.640	4.724"		12300	13500	13750	15050	13750	15050	14450	15850	15200	16700	15200	16700
	46.00	0.670	4.724"		13000	14300	14100	15500	14100	15500	14450	15850	15200	16700	15200	16700
7.625	26.00	0.328	4.921		7160	7870	7960	8750	7960	8750	8700	9570	9050	9950	9050	9950
	29.00	0.375	4.921		8300	9130	9400	10340	9400	10340	10150	11150	10850	11850	10850	11850
	33.00	0.430	4.921		10150	11150	11550	12650	11550	12650	12300	13500	13400	14700	13400	14700
	35.00	0.465	4.921		10500	11500	11950	13050	11950	13050	13000	14300	13750	15050	13750	15050
	39.00	0.500	4.921		10850	11850	12300	13500	12300	13500	13400	14700	14100	15500	14100	15500
	42800	0.562	4.921		11950	13050	13400	14700	13400	14700	14100	15500	15200	16700	15200	16700
	45300	0.595	4.921		12300	13500	13750	15050	13750	15050	14450	15850	15200	16700	15200	16700

			TORQUES													
			Makeup		55000		75000		80000		95000		110000		125000	
OD	Weight	Wall	Loss	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max
8.625	28.00	0.304	5.039"		7590	8340	8700	9570	8700	9570	9400	10340	10150	11150	10150	11150
	32.00	0.352	5.039"		8300	9130	9400	10340	9400	10340	10150	11150	10850	11850	10850	11850
	36.00	0.400	5.039"		10150	11150	11550	12650	11550	12650	12300	13500	13400	14700	13400	14700
	40.00	0.450	5.039"		10850	11850	12300	13500	12300	13500	13400	14700	14100	15500	14100	15500
	44.00	0.500	5.039"		11550	12650	13000	14300	13000	14300	14100	15500	15200	16700	15200	16700
	49.00	0.557	5.039"		12300	13500	13750	15050	13750	15050	15200	16700	15900	17400	15900	17400
	52.00	0.595	5.039"		13000	14300	14450	15850	14450	15850	15200	16700	15900	17400	15900	17400
9.625	36.00	0.352	5.039"		8700	9570	10150	11150	10150	11150	11200	12300	11950	13050	11950	13050
	40.00	0.395	5.039"		10500	11500	12300	13500	12300	13500	13400	14700	14450	15850	14450	15850
	43.00	0.435	5.039"		11950	13050	14100	15500	14100	15500	15200	16700	15900	17400	15900	17400
	47.00	0.472	5.039"		12300	13500	14450	15850	14450	15850	15900	17400	15900	17400	15900	17400
	53.50	0.545	5.039"		13400	14700	15900	17400	15900	17400	15900	17400	15900	17400	15900	17400
	58.40	0.595	5.039"		14100	15500	15900	17400	15900	17400	15900	17400	15900	17400	15900	17400
	59.40	0.609	5.039"		14450	15850	15900	17400	15900	17400	15900	17400	15900	17400	15900	17400
	61.10	0.625	5.039"		14450	15850	15900	17400	15900	17400	15900	17400	15900	17400	15900	17400

C.5 AM-C7 PERFORMANCE DATA

PERFORMANCE DATA												
									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
4.500"	10.500	0.224	10.500-15.100	4.052	5.2500	4.0520	8.8750	3.651	100%	100%	100%	100%
	11.600	0.250	10.500-15.100	4.000	5.2500	4.0000	8.8750	3.651	100%	100%	100%	100%
	13.500	0.290	10.500-15.100	3.920	5.2500	3.9200	8.8750	3.651	100%	100%	100%	100%
	15.100	0.337	10.500-15.100	3.826	5.2500	3.8260	8.8750	3.651	100%	100%	100%	100%
5.000"	13.000	0.253	13.000-24.100	4.494	5.8000	4.4940	9.1250	4.252	100%	100%	100%	100%
	15.000	0.296	13.000-24.100	4.408	5.8000	4.4080	9.1250	4.252	100%	100%	100%	100%
	18.000	0.362	13.000-24.100	4.276	5.8000	4.2760	9.1250	4.252	100%	100%	100%	100%
	21.400	0.437	13.000-24.100	4.126	5.8000	4.1260	9.1250	4.252	100%	100%	100%	100%
	23.200	0.478	13.000-24.100	4.044	5.8000	4.0440	9.1250	4.252	100%	100%	100%	100%
	24.100	0.500	13.000-24.100	4.000	5.8000	4.0000	9.1250	4.252	100%	100%	100%	100%
5.500"	15.500	0.275	15.500-26.000	4.950	6.300	4.950	9.2500	4.331	100%	100%	100%	100%
	17.000	0.304	15.500-26.000	4.892	6.050	4.892	9.2500	4.331	100%	100%	100%	100%
	20.000	0.361	15.500-26.000	4.778	6.050	4.778	9.2500	4.331	100%	100%	100%	100%
	23.000	0.415	15.500-26.000	4.670	6.050	4.670	9.2500	4.331	100%	100%	100%	100%
	26.000	0.476	15.500-26.000	4.548	6.300	4.548	9.2500	4.331	100%	100%	100%	100%
6.625"	20.000	0.288	20.000-32.000	6.049	7.390	6.049	9.6250	5.528	100%	100%	100%	100%
	24.000	0.352	20.000-32.000	5.921	7.390	5.921	9.6250	5.528	100%	100%	100%	100%
	28.000	0.417	20.000-32.000	5.791	7.390	5.791	9.6250	5.528	100%	100%	100%	100%
	32.000	0.475	20.000-32.000	5.675	7.390	5.675	9.6250	5.528	100%	100%	100%	100%
7.000"	23.000	0.317	23.000-46.000	6.366	7.8750	6.366	10.000	4.724	100%	100%	100%	100%
	26.000	0.362	23.000-46.000	6.276	7.8750	6.276	10.000	4.724	100%	100%	100%	100%
	29.000	0.408	23.000-46.000	6.184	7.8750	6.184	10.000	4.724	100%	100%	100%	100%
	32.000	0.453	23.000-46.000	6.094	7.8750	6.094	10.000	4.724	100%	100%	100%	100%
	35.000	0.498	23.000-46.000	6.004	7.8750	6.004	10.000	4.724	100%	100%	100%	100%
	38.000	0.540	23.000-46.000	5.920	7.8750	5.920	10.000	4.724	100%	100%	100%	100%
7.625"	26.200	0.328	26.400-47.100	6.969	8.500	6.969	10.3750	4.921	100%	100%	100%	100%
	29.700	0.375	26.400-47.100	6.875	8.500	6.875	10.3750	4.921	100%	100%	100%	100%
	33.700	0.430	26.400-47.100	6.765	8.500	6.765	10.3750	4.921	100%	100%	100%	100%
	39.000	0.500	26.400-47.100	6.625	8.500	6.625	10.3750	4.921	100%	100%	100%	100%
	42.800	0.562	26.400-47.100	6.501	8.500	6.501	10.3750	4.921	100%	100%	100%	100%
	45.300	0.595	26.400-47.100	6.435	8.500	6.435	10.3750	4.921	100%	100%	100%	100%
	47.100	0.625	26.400-47.100	6.375	8.500	6.375	10.3750	4.921	100%	100%	100%	100%
8.625"	32.000	0.352	32.000-49.000	7.921	9.625	7.921	10.625	5.039	100%	100%	100%	100%
	36.000	0.400	32.000-49.000	7.825	9.625	7.825	10.625	5.039	100%	100%	100%	100%
	40.000	0.450	32.000-49.000	7.725	9.625	7.725	10.625	5.039	100%	100%	100%	100%
	44.000	0.500	32.000-49.000	7.625	9.625	7.625	10.625	5.039	100%	100%	100%	100%
	49.000	0.557	32.000-49.000	7.511	9.625	7.511	10.625	5.039	100%	100%	100%	100%
9.625"	36.000	0.352	36.000-61.100	8.921	10.650	8.921	10.625	5.039	100%	100%	100%	100%
	40.000	0.395	36.000-61.100	8.835	10.650	8.835	10.625	5.039	100%	100%	100%	100%
	43.500	0.435	36.000-61.100	8.755	10.650	8.755	10.625	5.039	100%	100%	100%	100%
	47.000	0.472	36.000-61.100	8.681	10.650	8.681	10.625	5.039	100%	100%	100%	100%
	53.500	0.545	36.000-61.100	8.535	10.650	8.535	10.625	5.039	100%	100%	100%	100%
	58.400	0.595	36.000-61.100	8.435	10.650	8.435	10.625	5.039	100%	100%	100%	100%

C.6 AM-C7 TORQUE DATA

			TORQUES												
			Makeup Loss	55000		75000		90000		95000		110000		125000	
OD	Weight	Wall		Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max	Optimal	Max
4.500"	10.5	0.224	3.661	4,520	4,970	5,090	5,600	5,330	5,860	5,440	5,980	5,780	6,360	6,130	6,740
	11.6	0.250	3.661	5,250	5,780	6,030	6,630	6,330	5,250	6490	7140	6,960	7,660	7,350	8,090
	13.5	0.290	3.661	6,330	6,960	7,410	8,150	7,830	8,610	8050	8860	8,380	9,220	8,620	9,480
	15.1	0.337	3.661	7,510	8,260	8,910	9,800	9,240	10,160	9340	10270	9,660	10,630	9,660	10,630
5.500"	15.50	0.275	4.331"	7,830	8,610	9,250	10,180	9,540	10,490	9,640	10,600	9,960	10,960	10,270	11,300
	17.00	0.304	4.331"	8,960	9,860	10,330	11,360	10,590	11,650	10,720	11,790	11,110	12,220	11,500	12,650
	20.00	0.361	4.331"	11,060	12,170	12,160	13,380	12,520	13,770	12,690	13,960	13,230	14,550	13,760	15,140
	23.00	0.415	4.331"	12,600	13,860	13,700	15,070	14,140	15,550	14,360	15,800	15,020	16,520	15,690	17,260
7.000"	23.00	0.317	4.724"	12,590	13,850	13,640	15,000	14,060	15,470	14.270	15.700	14,900	16,390	15,530	17,080
	26.00	0.362	4.724"	14,300	15,730	15,670	17,240	16,220	17,840	16.490	18.140	17,310	19,040	18,140	19,950
	29.00	0.408	4.724"	15,920	17,510	17,610	19,370	18,280	20,110	18.620	20.480	19,630	21,590	20,640	22,700
	32.00	0.453	4.724"	17,410	19,150	19,410	21,350	20,200	22,220	20.600	22.660	21,800	23,980	23,000	25,300
	35.00	0.498	4.724"	18,780	20,660	21,070	23,180	21,980	24,180	22.440	24.680	23,810	26,190	25,190	27,710
	38.00	0.540	4.724"	20,000	22,000	22,550	24,810	23,580	25,940	24.090	26.500	25,620	28,180	27,160	29,880

C.7 AM-C7S PERFORMANCE DATA

PERFORMANCE DATA												
									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
4.500"	10.500	0.224	10.500-15.100	4.052	5.2500	4.0520	8.8750	3.651	100%	100%	100%	100%
	11.600	0.250	10.500-15.100	4.000	5.2500	4.0000	8.8750	3.651	100%	100%	100%	100%
	13.500	0.290	10.500-15.100	3.920	5.2500	3.9200	8.8750	3.651	100%	100%	100%	100%
	15.100	0.337	10.500-15.100	3.826	5.2500	3.8260	8.8750	3.651	100%	100%	100%	100%
5.000"	13.000	0.253	13.000-24.100	4.494	5.8000	4.4940	9.1250	4.252	100%	100%	100%	100%
	15.000	0.296	13.000-24.100	4.408	5.8000	4.4080	9.1250	4.252	100%	100%	100%	100%
	18.000	0.362	13.000-24.100	4.276	5.8000	4.2760	9.1250	4.252	100%	100%	100%	100%
	21.400	0.437	13.000-24.100	4.126	5.8000	4.1260	9.1250	4.252	100%	100%	100%	100%
	23.200	0.478	13.000-24.100	4.044	5.8000	4.0440	9.1250	4.252	100%	100%	100%	100%
	24.100	0.500	13.000-24.100	4.000	5.8000	4.0000	9.1250	4.252	100%	100%	100%	100%
5.500"	15.500	0.275	15.500-26.000	4.950	6.300	4.950	9.2500	4.331	100%	100%	100%	100%
	17.000	0.304	15.500-26.000	4.892	6.050	4.892	9.2500	4.331	100%	100%	100%	100%
	20.000	0.361	15.500-26.000	4.778	6.050	4.778	9.2500	4.331	100%	100%	100%	100%
	23.000	0.415	15.500-26.000	4.670	6.050	4.670	9.2500	4.331	100%	100%	100%	100%
	26.000	0.476	15.500-26.000	4.548	6.300	4.548	9.2500	4.331	100%	100%	100%	100%
6.625"	20.000	0.288	20.000-32.000	6.049	7.390	6.049	9.6250	5.528	100%	100%	100%	100%
	24.000	0.352	20.000-32.000	5.921	7.390	5.921	9.6250	5.528	100%	100%	100%	100%
	28.000	0.417	20.000-32.000	5.791	7.390	5.791	9.6250	5.528	100%	100%	100%	100%
	32.000	0.475	20.000-32.000	5.675	7.390	5.675	9.6250	5.528	100%	100%	100%	100%
7.000"	23.000	0.317	23.000-46.000	6.366	7.8750	6.366	10.000	4.724	100%	100%	100%	100%
	26.000	0.362	23.000-46.000	6.276	7.8750	6.276	10.000	4.724	100%	100%	100%	100%
	29.000	0.408	23.000-46.000	6.184	7.8750	6.184	10.000	4.724	100%	100%	100%	100%
	32.000	0.453	23.000-46.000	6.094	7.8750	6.094	10.000	4.724	100%	100%	100%	100%
	35.000	0.498	23.000-46.000	6.004	7.8750	6.004	10.000	4.724	100%	100%	100%	100%
	38.000	0.540	23.000-46.000	5.920	7.8750	5.920	10.000	4.724	100%	100%	100%	100%
7.625"	26.200	0.328	26.400-47.100	6.969	8.500	6.969	10.3750	4.921	100%	100%	100%	100%
	29.700	0.375	26.400-47.100	6.875	8.500	6.875	10.3750	4.921	100%	100%	100%	100%
	33.700	0.430	26.400-47.100	6.765	8.500	6.765	10.3750	4.921	100%	100%	100%	100%
	39.000	0.500	26.400-47.100	6.625	8.500	6.625	10.3750	4.921	100%	100%	100%	100%
	42.800	0.562	26.400-47.100	6.501	8.500	6.501	10.3750	4.921	100%	100%	100%	100%
	45.300	0.595	26.400-47.100	6.435	8.500	6.435	10.3750	4.921	100%	100%	100%	100%
	47.100	0.625	26.400-47.100	6.375	8.500	6.375	10.3750	4.921	100%	100%	100%	100%
8.625"	32.000	0.352	32.000-49.000	7.921	9.625	7.921	10.625	5.039	100%	100%	100%	100%
	36.000	0.400	32.000-49.000	7.825	9.625	7.825	10.625	5.039	100%	100%	100%	100%
	40.000	0.450	32.000-49.000	7.725	9.625	7.725	10.625	5.039	100%	100%	100%	100%
	44.000	0.500	32.000-49.000	7.625	9.625	7.625	10.625	5.039	100%	100%	100%	100%
	49.000	0.557	32.000-49.000	7.511	9.625	7.511	10.625	5.039	100%	100%	100%	100%
9.625"	36.000	0.352	36.000-61.100	8.921	10.650	8.921	10.625	5.039	100%	100%	100%	100%
	40.000	0.395	36.000-61.100	8.835	10.650	8.835	10.625	5.039	100%	100%	100%	100%
	43.500	0.435	36.000-61.100	8.755	10.650	8.755	10.625	5.039	100%	100%	100%	100%
	47.000	0.472	36.000-61.100	8.681	10.650	8.681	10.625	5.039	100%	100%	100%	100%
	53.500	0.545	36.000-61.100	8.535	10.650	8.535	10.625	5.039	100%	100%	100%	100%
	58.400	0.595	36.000-61.100	8.435	10.650	8.435	10.625	5.039	100%	100%	100%	100%

C.8 AM-C7S TORQUE DATA

			TORQUES													
			Makeup	55000		75000		90000		95000		110000		125000	
OD	Weight	Wall	Loss	Optimal	Maximum	Optimal	Maximum	Optimal	Maximum	Optimal	Maximum	Optimal	Maximum	Operanl	Maximum
4.500"	10.5	0.224	3.651	4,520	4,970	5,090	5,600	5,330	5,860	5,440	5,980	5,780	6,360	6,130	6,740
	11.6	0.250	3.651	5,250	5,780	6,030	6,630	6,330	5,250	6490	7140	6,960	7,660	7,350	8,090
	13.5	0.290	3.651	6,330	6,960	7,410	8,150	7,830	8,610	8050	8860	8,380	9,220	8,620	9,480
	15.1	0.337	3.651	7,510	8,260	8,910	9,800	9,240	10,160	9340	10270	9,660	10,630	9,660	10,630
5.500"	15.50	0.275	4.331"	7,830	8,610	9,250	10,180	9,540	10,490	9,640	10,600	9,960	10,960	10,270	11,300
	17.00	0.304	4.331"	8,960	9,860	10,330	11,360	10,590	11,650	10,720	11,790	11,110	12,220	11,500	12,650
	20.00	0.361	4.331"	11,060	12,170	12,160	13,380	12,520	13,770	12,690	13,960	13,230	14,550	13,760	15,140
	23.00	0.415	4.331"	12,600	13,860	13,700	15,070	14,140	15,550	14,360	15,800	15,020	16,520	15,690	17,260
7.000"	23.00	0.317	4.724"	12,590	13,850	13,640	15,000	14,060	15,470	14.270	15.700	14,900	16,390	15,530	17,080
	26.00	0.362	4.724"	14,300	15,730	15,670	17,240	16,220	17,840	16.490	18.140	17,310	19,040	18,140	19,950
	29.00	0.408	4.724"	15,920	17,510	17,610	19,370	18,280	20,110	18.620	20.480	19,630	21,590	20,640	22,700
	32.00	0.453	4.724"	17,410	19,150	19,410	21,350	20,200	22,220	20.600	22.660	21,800	23,980	23,000	25,300
	35.00	0.498	4.724"	18,780	20,660	21,070	23,180	21,980	24,180	22.440	24.680	23,810	26,190	25,190	27,710
	38.00	0.540	4.724"	20,000	22,000	22,550	24,810	23,580	25,940	24.090	26.500	25,620	28,180	27,160	29,880

C.9 AM-HBC PERFORMANCE DATA

PERFORMANCE DATA												
									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
2.375"	4.60	0.190	4.60-7.35	1.970	2.677	1.957	5.91	2.444	100%	100%	100%	100%
	5.10	0.218	4.60-7.35	1.926	2.719	1.913	5.91	2.444	100%	100%	100%	100%
	5.80	0.254	4.60-7.35	1.840	2.747	1.827	6.77	2.891	100%	100%	100%	100%
	6.30	0.280	4.60-7.35	1.796	2.782	1.783	6.77	2.891	100%	100%	100%	100%
	6.60	0.295	4.60-7.35	1.773	2.802	1.760	6.77	2.891	100%	100%	100%	100%
	7.35	0.336	4.60-7.35	1.706	2.853	1.693	6.77	2.891	100%	100%	100%	100%
2.875"	6.40	0.217	6.40-11.50	2.422	3.223	2.409	6.02	2.519	100%	100%	100%	100%
	7.80	0.276	6.40-11.50	2.284	3.275	2.271	7.36	3.180	100%	100%	100%	100%
	8.60	0.308	6.40-11.50	2.233	3.321	2.200	7.36	3.180	100%	100%	100%	100%
	9.35	0.340	6.40-11.50	2.182	3.364	2.169	7.36	3.180	100%	100%	100%	100%
	9.80	0.362	6.40-11.50	2.147	3.393	2.133	7.36	3.180	100%	100%	100%	100%
	10.50	0.392	6.40-11.50	2.099	3.431	2.086	7.36	3.180	100%	100%	100%	100%
	10.70	0.405	6.40-11.50	2.080	3.447	2.066	7.36	3.180	100%	100%	100%	100%
	11.50	0.440	6.40-11.50	2.000	3.470	1.987	8.11	3.558	100%	100%	100%	100%
3.500"	6.50	0.170	6.50-10.20	3.120	3.772	3.106	7.07	3.032	100%	100%	100%	100%
	7.70	0.216	6.50-10.20	3.037	3.850	3.024	7.07	3.032	100%	100%	100%	100%
	9.20	0.254	6.50-10.20	2.974	3.913	2.961	7.07	3.032	100%	100%	100%	100%
	10.20	0.289	6.50-10.20	2.911	3.965	2.898	7.07	3.032	100%	100%	100%	100%
4.000"	8.20	0.190	8.20-22.20	3.584	4.300	3.567	7.32	3.159	100%	100%	100%	100%
	9.50	0.226	8.20-22.20	3.517	4.362	3.500	7.32	3.159	100%	100%	100%	100%
	10.90	0.262	8.20-22.20	3.454	4.420	3.437	7.32	3.159	100%	100%	100%	100%
	11.60	0.286	8.20-22.20	3.414	4.458	3.398	7.32	3.159	100%	100%	100%	100%
	12.10	0.299	8.20-22.20	3.391	4.478	3.374	7.32	3.159	100%	100%	100%	100%
	13.20	0.330	8.20-22.20	3.344	4.526	3.327	7.32	3.159	100%	100%	100%	100%
	14.80	0.380	8.20-22.20	3.206	4.552	3.189	9.09	4.041	100%	100%	100%	100%
	16.10	0.415	8.20-22.20	3.147	4.602	3.130	9.09	4.041	100%	100%	100%	100%
	16.50	0.430	8.20-22.20	3.123	4.623	3.106	9.09	4.041	100%	100%	100%	100%
	18.90	0.500	8.20-22.20	2.985	4.691	2.969	10.08	4.545	100%	100%	100%	100%
	22.20	0.610	8.20-22.20	2.816	4.827	2.799	10.08	4.545	100%	100%	100%	100%
5.000"	13.00	0.253	13.00-24.10	4.457	5.400	4.438	10.39	4.181	100%	100%	100%	100%
	15.00	0.296	13.00-24.10	4.410	5.471	4.391	10.39	4.181	100%	100%	100%	100%
	18.00	0.362	13.00-24.10	4.410	5.577	4.391	10.39	4.181	100%	100%	100%	100%
	20.30	0.408	13.00-24.10	4.325	5.648	4.307	10.39	4.181	100%	100%	100%	100%
	20.80	0.422	13.00-24.10	4.302	5.670	4.283	10.39	4.181	100%	100%	100%	100%
	21.40	0.437	13.00-24.10	4.274	5.691	4.255	10.39	4.181	100%	100%	100%	100%
	23.20	0.478	13.00-24.10	4.199	5.750	4.181	10.39	4.181	100%	100%	100%	100%
	24.10	0.500	13.00-24.10	4.160	5.782	4.141	10.39	4.181	100%	100%	100%	100%
6.625"	20.00	0.288	20.00-36.70	6.069	7.081	6.049	10.87	4.418	100%	100%	100%	100%
	23.20	0.330	20.00-36.70	6.069	7.154	6.049	10.87	4.418	100%	100%	100%	100%
	24.00	0.352	20.00-36.70	6.069	7.191	6.049	10.87	4.418	100%	100%	100%	100%
	28.00	0.417	20.00-36.70	5.951	7.298	5.931	10.87	4.418	100%	100%	100%	100%
	32.00	0.475	20.00-36.70	5.845	7.390	5.824	10.87	4.418	100%	100%	100%	100%
	36.70	0.562	20.00-36.70	5.689	7.524	5.669	10.87	4.418	100%	100%	100%	100%

PERFORMANCE DATA

									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
7.000"	23.00	0.317	23.00-42.70	6.346	7.489	6.324	11.54	4.766	100%	100%	100%	100%
	42.70	0.625	23.00-42.70	5.954	7.981	5.933	11.54	4.766	100%	100%	100%	100%
7.625"	26.40	0.328	26.40-47.10	6.941	8.132	6.919	11.73	4.859	100%	100%	100%	100%
	29.70	0.375	26.40-47.10	6.941	8.213	6.919	11.73	4.859	100%	100%	100%	100%
	33.70	0.430	26.40-47.10	6.941	8.306	6.919	11.73	4.859	100%	100%	100%	100%
	35.80	0.465	26.40-47.10	6.878	8.363	6.856	11.73	4.859	100%	100%	100%	100%
	39.00	0.500	26.40-47.10	6.815	8.420	6.793	11.73	4.859	100%	100%	100%	100%
	42.80	0.562	26.40-47.10	6.705	8.518	6.683	11.73	4.859	100%	100%	100%	100%
	45.30	0.595	26.40-47.10	6.644	8.569	6.622	11.73	4.859	100%	100%	100%	100%
	47.10	0.625	26.40-47.10	6.589	8.615	6.566	11.73	4.859	100%	100%	100%	100%
8.625"	36.00	0.400	36.00-52.00	8.006	9.266	7.980	13.19	5.594	100%	100%	100%	100%
	40.00	0.450	36.00-52.00	7.916	9.351	7.889	13.19	5.594	100%	100%	100%	100%
	44.00	0.500	36.00-52.00	7.825	9.434	7.799	13.19	5.594	100%	100%	100%	100%
	49.00	0.557	36.00-52.00	7.724	9.526	7.696	13.19	5.594	100%	100%	100%	100%
	52.00	0.595	36.00-52.00	7.656	9.587	7.629	13.19	5.594	100%	100%	100%	100%
9.625"	36.00	0.352	36.00-58.40	9.019	10.194	8.990	13.19	5.589	100%	100%	100%	100%
	40.00	0.395	36.00-58.40	9.019	10.270	8.990	13.19	5.589	100%	100%	100%	100%
	43.50	0.435	36.00-58.40	8.946	10.339	8.917	13.19	5.589	100%	100%	100%	100%
	47.00	0.472	36.00-58.40	8.879	10.402	8.850	13.19	5.589	100%	100%	100%	100%
	53.50	0.545	36.00-58.40	8.747	10.526	8.718	13.19	5.589	100%	100%	100%	100%
	58.40	0.595	36.00-58.40	8.659	10.607	8.629	13.19	5.589	100%	100%	100%	100%
9.875"	62.80	0.625	62.80-72.00	8.863	10.908	8.834	12.95	5.475	100%	100%	100%	100%
	65.30	0.650	62.80-72.00	8.817	10.949	8.789	12.95	5.475	100%	100%	100%	100%
	66.40	0.661	62.80-72.00	8.798	10.965	8.769	12.95	5.475	100%	100%	100%	100%
	66.90	0.668	62.80-72.00	8.786	10.979	8.757	12.95	5.475	100%	100%	100%	100%
	67.50	0.678	62.80-72.00	8.768	10.993	8.740	12.95	5.475	100%	100%	100%	100%
	68.00	0.694	62.80-72.00	8.739	11.018	8.710	12.95	5.475	100%	100%	100%	100%
	68.90	0.700	62.80-72.00	8.729	11.028	8.700	12.95	5.475	100%	100%	100%	100%
	70.50	0.720	62.80-72.00	8.691	11.060	8.663	12.95	5.475	100%	100%	100%	100%
	72.00	0.725	62.80-72.00	8.684	11.067	8.655	12.95	5.475	100%	100%	100%	100%
10.750	45.50	0.400	45.50-73.20	10.152	11.400	10.122	13.27	5.625	100%	100%	100%	100%
	51.00	0.450	45.50-73.20	10.061	11.489	10.031	13.27	5.625	100%	100%	100%	100%
	55.50	0.495	45.50-73.20	9.981	11.565	9.950	13.27	5.625	100%	100%	100%	100%
	60.70	0.545	45.50-73.20	9.892	11.652	9.862	13.27	5.625	100%	100%	100%	100%
	65.70	0.595	45.50-73.20	9.802	11.735	9.771	13.27	5.625	100%	100%	100%	100%
	71.10	0.650	45.50-73.20	9.701	11.825	9.761	13.27	5.625	100%	100%	100%	100%
	73.20	0.672	45.50-73.20	9.662	11.863	9.631	13.27	5.625	100%	100%	100%	100%
11.750	54.00	0.435	54.00-71.80	11.099	12.463	11.066	13.43	5.703	100%	100%	100%	100%
	60.00	0.489	54.00-71.80	11.002	12.558	10.970	13.43	5.703	100%	100%	100%	100%
	65.00	0.534	54.00-71.80	10.922	12.636	10.889	13.43	5.703	100%	100%	100%	100%
	67.80	0.550	54.00-71.80	11.018	12.788	10.986	13.43	5.703	100%	100%	100%	100%
	71.00	0.582	54.00-71.80	10.835	12.719	10.803	13.43	5.703	100%	100%	100%	100%
	71.80	0.582	54.00-71.80	10.961	12.845	10.929	13.43	5.703	100%	100%	100%	100%

PERFORMANCE DATA												
									Design Efficiency			
OD	Weight	Wall	Interchangeable Weights	Pin Bored ID	Std Cplg OD	Cplg Bored ID	Coupling Length	Makeup Loss	Ten	Com	IP	EP
13.375	61.00	0.430	61.00-92.00	12.668	14.088	12.630	13.41	5.697	100%	100%	100%	100%
	68.00	0.480	61.00-92.00	12.578	14.176	12.540	13.41	5.697	100%	100%	100%	100%
	72.00	0.514	61.00-92.00	12.517	14.236	12.480	13.41	5.697	100%	100%	100%	100%
	77.00	0.550	61.00-92.00	12.452	14.299	12.415	13.41	5.697	100%	100%	100%	100%
	80.70	0.580	61.00-92.00	12.398	14.350	12.360	13.41	5.697	100%	100%	100%	100%
	85.00	0.608	61.00-92.00	12.349	14.400	12.311	13.41	5.697	100%	100%	100%	100%
	86.00	0.625	61.00-92.00	12.317	14.429	12.280	13.41	5.697	100%	100%	100%	100%
	92.00	0.672	61.00-92.00	12.233	14.510	12.196	13.41	5.697	100%	100%	100%	100%

C.10 AM-HBC TORQUE DATA

			TORQUES													
			Makeup Loss	60,000		70000		85000		100000		115000		130000	
OD	Weight	Wall		Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max
2.375"	4.60	0.190	2.444	N/A	N/A	1,010	1,060	1,160	1,210	1,290	1,410	1,370	1,500	1,450	1,590
	5.10	0.218	2.444	N/A	N/A	1,250	1,310	1,430	1,500	1,580	1,730	1,680	1,840	1,730	1,900
	5.80	0.254	2.891	N/A	N/A	1,640	1,720	1,760	1,840	1,990	2,180	2,160	2,370	2,270	2,490
	6.30	0.280	2.891	N/A	N/A	1,880	1,970	2,040	2,140	2,290	2,510	2,470	2,710	2,600	2,860
	6.60	0.295	2.891	N/A	N/A	2,000	2,100	2,190	2,290	2,450	2,690	2,650	2,910	2,790	3,060
	7.35	0.336	2.891	N/A	N/A	2,390	2,500	2,620	2,750	2,930	3,220	3,150	3,460	3,310	3,640
2.875"	6.40	0.217	2.519	N/A	N/A	1,610	1,690	1,850	2,030	1,990	2,180	2,060	2,260	2,130	2,340
	7.80	0.276	3.180	N/A	N/A	2,280	2,390	2,620	2,880	2,960	3,250	3,140	3,450	3,330	3,660
	8.60	0.308	3.180	N/A	N/A	2,640	2,770	3,050	3,350	3,430	3,770	3,650	4,010	3,860	4,240
	9.35	0.340	3.180	N/A	N/A	3,040	3,190	3,490	3,830	3,910	4,300	4,150	4,560	4,390	4,820
	9.80	0.362	3.180	N/A	N/A	3,280	3,440	3,800	4,180	4,250	4,670	4,510	4,960	4,760	5,230
	10.50	0.392	3.180	N/A	N/A	3,620	3,800	4,190	4,600	4,710	5,180	4,990	5,480	5,270	5,790
	10.70	0.405	3.180	N/A	N/A	3,700	3,880	4,330	4,760	4,900	5,390	5,190	5,700	5,480	6,020
	11.50	0.440	3.558	N/A	N/A	4,170	4,370	4,660	5,120	5,320	5,850	5,870	6,450	6,190	6,800
3.500"	6.50	0.170	3.032	N/A	N/A	1,350	1,410	1,530	1,680	1,590	1,740	1,660	1,820	1,710	1,880
	7.70	0.216	3.032	N/A	N/A	2,140	2,240	2,260	2,480	2,360	2,590	2,460	2,700	2,610	2,870
	9.20	0.254	3.032	N/A	N/A	2,760	2,890	2,900	3,190	3,020	3,320	3,170	3,480	3,360	3,690
	10.20	0.289	3.032	N/A	N/A	3,370	3,530	3,550	3,900	3,700	4,070	3,880	4,260	4,120	4,530
4.000"	8.20	0.190	3.159	N/A	N/A	2,040	2,140	2,240	2,460	2,340	2,570	2,430	2,670	2,510	2,760
	9.50	0.226	3.159	N/A	N/A	2,810	2,950	2,950	3,240	3,080	3,380	3,270	3,590	3,480	3,820
	10.90	0.262	3.159	N/A	N/A	3,560	3,730	3,750	4,120	3,910	4,300	4,150	4,560	4,420	4,860
	11.60	0.286	3.159	N/A	N/A	4,060	4,460	4,280	4,710	4,460	4,910	4,730	5,200	5,030	5,530
	12.10	0.299	3.159	N/A	N/A	4350	4560	4,580	5,030	4,780	5,250	5,070	5,570	5,400	5,940
	13.20	0.330	3.159	N/A	N/A	4,990	5,230	5,250	5,770	5,480	6,020	5,790	6,360	6,160	6,770
	14.80	0.380	4.041	N/A	N/A	6,220	6,530	6,940	7,630	7,250	7,970	7,520	8,270	7,770	8,540
	16.10	0.415	4.041	N/A	N/A	6,990	7,330	7,850	8,630	8,190	9,000	8,500	9,350	8,750	9,620
	16.50	0.430	4.041	N/A	N/A	7,280	7,640	8,220	9,040	8,600	9,460	8,900	9,790	9,200	10,120
	18.90	0.500	4.545	N/A	N/A	8,450	8,870	9,900	10,800	10,800	11,800	11,250	12,350	11,600	12,700
	22.20	0.610	4.545	N/A	N/A	10,400	10,900	12,200	13,400	13,600	14,900	14,500	15,900	14,950	16,350
4.500"	10.50	0.224	3.222	N/A	N/A	3,040	3,190	3,210	3,530	3,490	3,830	3,760	4,130	4,020	4,420
	11.60	0.250	3.222	N/A	N/A	3,620	3,800	3,880	4,260	4,220	4,640	4,540	4,990	4,860	5,340
	12.60	0.271	3.222	N/A	N/A	4,090	4,290	4,440	4,880	4,820	5,300	5,200	5,720	5,560	6,110
	13.50	0.290	3.222	N/A	N/A	4,600	4,830	4,940	5,430	5,360	5,890	5,770	6,340	6,170	6,780
	15.10	0.337	3.222	N/A	N/A	5,770	6,060	6,160	6,770	6,670	7,330	7,170	7,880	7,650	8,410
	17.00	0.380	4.041	N/A	N/A	7,240	7,600	7,350	8,080	7,930	8,720	8,500	9,350	9,050	9,950
	17.70	0.402	4.041	N/A	N/A	7,890	8,280	7,980	8,770	8,600	9,460	9,200	10,120	9,800	10,700
	18.90	0.430	4.041	N/A	N/A	8,700	9,140	8,800	9,680	9,500	10,450	10,200	11,200	10,850	11,850
	21.50	0.500	4.545	N/A	N/A	10,600	11,100	11,050	12,150	11,500	12,600	12,350	13,550	13,100	14,400
	23.70	0.560	4.545	N/A	N/A	11,900	12,450	12,650	13,850	13,050	14,350	14,000	15,400	14,850	16,250

			TORQUES													
			Makeup Loss	60,000		70000		85000		100000		115000		130000	
OD	Weight	Wall		Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max
5.000"	13.0	0.253	4.181	3,330	3,660	3,690	4,050	4,120	4,530	4,700	5,170	5,060	5,560	5,790	6,360
	15.0	0.296	4.181	4,340	4,770	4,700	5,170	5,060	5,560	5,790	6,360	6,510	7,160	7,230	7,950
	18.0	0.362	4.181	5,060	5,560	5,420	5,960	5,790	6,360	6,150	6,760	6,870	7,550	7,590	8,340
	20.3	0.408	4.181	6,150	6,760	6,510	7,160	7,230	7,950	7,960	8,750	9,050	9,950	9,750	10,720
	20.8	0.422	4.181	6,510	7,160	7,230	7,950	7,960	8,750	8,700	9,570	9,750	10,720	10,500	11,500
	21.4	0.437	4.181	6,870	7,550	7,590	8,340	8,300	9,130	9,400	10,340	10,150	11,150	10,850	11,850
	23.2	0.478	4.181	7,960	8,750	9,050	9,950	9,750	10,720	10,500	11,500	11,950	13,050	13,400	14,700
	24.1	0.500	4.181	8,900	9,790	9,700	10,670	11,000	12,100	12,250	13,450	13,600	14,900	14,900	16,300
6.625"	20.00	0.288	4.418	4,700	5,170	5,420	5,960	6,150	6,760	6,870	7,550	7,960	8,750	8,700	9,570
	23.20	0.330	4.418	5,060	5,560	5,790	6,360	6,510	7,160	7,230	7,950	8,30	9,130	9,050	9,950
	24.00	0.352	4.418	5,420	5,960	6,150	6,760	6,870	7,550	7,590	8,340	8,700	9,570	9,400	10,340
	28.00	0.417	4.418	7,960	8,750	8,700	9,570	9,400	10,340	10,150	11,150	11,200	12,300	12,300	13,500
	32.00	0.475	4.418	9,750	10,720	10,500	11,500	11,950	13,050	13,000	14,300	14,450	15,850	15,900	17,400
	36.70	0.562	4.418	13,000	14,300	14,100	15,500	15,900	17,400	17,700	19,400	19,550	21,450	21,700	23,800
7.000"	23.00	0.317	4.766	6,150	6,760	6,870	7,550	7,590	8,340	8,300	9,130	9,400	10,340	10,150	11,150
	42.70	0.625	4.766	16,650	18,250	18,100	19,900	20,250	22,250	23,150	25,450	23,150	25,450	23,150	25,450
7.625"	26.40	0.328	4.859	7,230	7,950	7,960	8,750	9,050	9,950	10,150	11,150	11,550	12,650	12,650	13,850
	29.70	0.375	4.859	7,960	8,750	8,700	9,570	9,400	10,340	10,850	11,850	12,300	13,500	13,000	14,300
	33.70	0.430	4.859	8,700	9,570	9,400	10,340	10,150	11,150	11,550	12,650	13,000	14,300	13,750	15,050
	35.80	0.465	4.859	10,150	11,150	11,200	12,300	12,300	13,500	13,750	15,050	15,200	16,700	16,650	18,250
	39.00	0.500	4.859	11,550	12,650	13,000	14,300	14,450	15,850	15,900	17,400	18,100	19,900	20,250	22,250
	42.80	0.562	4.859	15,200	16,700	16,250	17,850	18,800	20,600	21,000	23,100	23,150	25,450	23,150	25,450
	45.30	0.595	4.859	16,650	18,250	18,100	19,900	21,000	23,100	23,150	25,450	23,150	25,450	23,150	25,450
	47.10	0.625	4.859	18,100	19,900	19,900	21,800	22,400	24,600	23,150	25,450	23,150	25,450	23,150	25,450
8.625"	36.00	0.400	5.594	7,960	8,750	8,300	9,130	9,050	9,950	10,150	11,150	10,850	11,850	11,550	12,650
	40.00	0.450	5.594	10,150	11,150	11,550	12,650	12,300	13,500	13,750	15,050	15,200	16,700	16,650	18,250
	44.00	0.500	5.594	13,000	14,300	14,800	16,200	16,650	18,250	18,100	19,900	20,250	22,250	21,700	23,800
	49.00	0.557	5.594	16,650	18,250	18,800	20,600	21,000	23,100	22,400	24,600	23,150	25,450	23,150	25,450
	52.00	0.595	5.594	18,800	20,600	21,000	23,100	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
9.625"	36.00	0.352	5.589	7,960	8,750	8,700	9,570	9,400	10,340	10,150	11,150	11,550	12,650	12,300	13,500
	40.00	0.395	5.589	7,960	8,750	8,700	9,570	9,400	10,340	10,150	11,150	11,550	12,650	12,300	13,500
	43.50	0.435	5.589	10,850	11,850	11,550	12,650	13,000	14,300	14,450	15,850	15,900	17,400	17,350	19,050
	47.00	0.472	5.589	13,000	14,300	14,450	15,850	15,900	17,400	17,350	19,050	20,250	22,250	21,700	23,800
	53.50	0.545	5.589	18,100	19,900	20,250	22,250	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	58.40	0.595	5.589	21,700	23,800	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
9.875	62.80	0.625	5.475	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	65.30	0.650	5.475	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	66.40	0.661	5.475	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	66.90	0.668	5.475	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	67.50	0.678	5.475	25,300	27,800	25,300	27,800	25,300	27,800	25,300	27,800	25,300	27,800	25,300	27,800
	68.00	0.694	5.475	27,500	30,200	27,500	30,200	27,500	30,200	27,500	30,200	27,500	30,200	27,500	30,200
	68.90	0.700	5.475	27,500	30,200	27,500	30,200	27,500	30,200	27,500	30,200	27,500	30,200	27,500	30,200
	70.50	0.720	5.475	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000
	72.00	0.725	5.475	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000

			TORQUES											
			Makeup Loss	60,000		70000		85000		100000		115000		130000	
OD	Weight	Wall		Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max	Optimum	Max
10.750	45.50	0.400	5.625	8,700	9,570	9,750	10,720	10,850	11,850	11,550	12,650	13,000	14,300	14,450	15,850
	51.00	0.450	5.625	12,300	13,500	14,450	15,850	15,900	17,400	17,350	19,050	19,500	21,400	21,700	23,800
	55.50	0.495	5.625	15,900	17,400	18,100	19,900	20,250	22,250	23,150	25,450	23,150	25,450	23,150	25,450
	60.70	0.545	5.625	20,250	22,250	22,400	24,600	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	65.70	0.595	5.625	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	71.10	0.650	5.625	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	73.20	0.672	5.625	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000	30,000	33,000
11.750	54.00	0.435	5.703	12,300	13,500	13,750	15,050	15,200	16,700	16,650	18,250	18,800	20,600	21,000	23,100
	60.00	0.489	5.703	16,650	18,250	19,500	21,400	21,700	23,800	23,150	25,450	23,150	25,450	23,150	25,450
	65.00	0.534	5.703	21,000	23,100	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	67.80	0.550	5.703	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	71.00	0.582	5.703	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	71.80	0.582	5.703	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
13.375	61.00	0.430	5.697	13,000	14,300	14,450	15,850	16,650	18,250	18,800	20,600	21,000	23,100	23,150	25,450
	68.00	0.480	5.697	18,800	20,600	21,000	23,100	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	72.00	0.514	5.697	21,700	23,800	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	77.00	0.550	5.697	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	80.70	0.580	5.697	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	85.00	0.608	5.697	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	86.00	0.625	5.697	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450	23,150	25,450
	92.00	0.672	5.697	50,000	55,000	50,000	55,000	50,000	55,000	50,000	55,000	50,000	55,000	50,000	55,000