// RECOMMENDED PRACTICE

THERMOPLASTIC LINED TUBING CARE & HANDLING

Recommended practice for running, handling, testing, and pulling WFES Thermoplastic Lined (TPL) Tubing with API 8 Round Connections.

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// TPL RECOMMENDED PRACTICE

FIELD RUNNING & HANDLING PROCEDURES

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1.0 SCOPE

1.1 This document sets forth the recommended practice for the field running and handling procedures that should be utilized in conjunction with Western Falcon Energy Services (WFES) Thermoplastic Lined Tubing.

2.0 REFERENCES

2.1 The following documents were used for reference in the preparation of this document and should be followed unless otherwise specified:

2.1.1 API Recommended Practice 5C1

2.1.2 API Bulletin 5A2

3.0 EQUIPMENT

3.1 The following list of equipment is recommended for the installation of WFES Thermoplastic Lined Tubing (TPL):

3.1.1 Ample supply of thread compound.

> NOTE Western Falcon recommends spreading thread lubricant evenly around the entire surface of the pin and box thread to ensure ample lubrication and seal ability.

3.1.2 Appropriate product data sheet and WFES field reference card.

3.1.3 Drift assembly.

3.1.4 Stabbing guide recommended for all liners and required for Enertube™, Ultratube™, and Extremetube™ as well as during cold weather installation/handling.

4.0 FIELD RUNNING AND HANDLING PROCEDURES

4.1 Precautions

4.1.1 Consult appropriate product data sheet to ensure well conditions are within allowable limits of the thermoplastic liner being installed.

4.1.2 Consult appropriate product data sheet and/or the WFES field reference card for the dimensions of thermoplastic liners before running tools or equipment. Pumps, rod boxes, and any other downhole equipment should be inspected and free of sharp edges, excessive corrosion, or other abnormalities that could damage or shave the plastic liner.

4.1.3 Thread protectors should always remain in place when moving or handling tubulars.

4.1.4 Do not use a high temperature heating device or welding torch to remove thread protectors.

4.1.5 Avoid rough handling. Do not drop the pipe during unloading or while moving the pipe around on location. Minimize impacts by maintaining safe handling practices and using a lay-down machine or pipe wrangler to lift or lay down the pipe when possible.

4.1.6 **Never** use end hooks or other tools inside the end of pipe. Handle with slings only.

4.1.7 **Cold Weather Handling.** When moving, installing or pulling Enertube™ or Ultratube™ lined tubulars at temperatures below 5°C (41°F), the following special procedures must be implemented to avoid significant shock or impact loads against the liner or pipe body that can fracture the liner in cold conditions. Cold temperatures increase the vulnerability of the liner to impact damage and its sensitivity to suddenly applied stress.

a. A trained Field Service Technician is recommended during installation of WFES Thermoplastic Lined Tubing (TPL).

b. During transport, tubulars lined with either Enertube or Ultratube should always be stripped between each layer and have heavy-duty protectors on every pin end. There should be a minimum of five strips per layer. All layers should be stripped with the strips in each layer being vertically aligned with the strips in all other layers.

c. Do NOT drop pipe or allow pipe to free fall from trucks, lifts, or racks at either the storage yard or on location. Experienced operators should be used to minimize the impact between joints while the pipe is being picked up, released, or during movement. At fixed locations the use of specialized equipment may be warranted.

d. Do NOT strike or side impact the tubing with handling equipment, tools, or other objects.

e. Do NOT drag tubing as this could cause impact and damage the liner.

f. Heavy-duty pin end protectors are to always remain on lined tubing during all phases of handling and storage. The protectors should only be removed as the last step, immediately prior to stabbing the connection into the collar, and reinstalled as the first step immediately after breaking the connection during pulling.

g. Plastic stabbing guides are required during installation.

h. Minimum API torque is recommended for makeup with WFES Thermoplastic Lined Tubing (TPL). The position should be checked after makeup. Makeup is considered satisfactory if the face of the coupling is flush with the vanishing thread or within two thread turns of the thread vanish point (per API 5C1 section 4.4.1). If the satisfactory condition isn't met or there is a preference to cover the threads to the vanish point, torque can be increased up to but not to exceed API optimum torque. It is important to drift the connection after makeup as described in Appendix C to ensure that the increased torque didn't cause compression of the liner anchors (on the pin faces) which could result in a drift issue.

i. Couplings installed during manufacturing are torqued to API minimum torque. API minimum field makeup torque can be verified on new, unused TPL tubing by marking the coupling and tubing with a chalk or paint stick on the mill end side of the coupling and seeing if the coupling spins during makeup. With API minimum torque, the coupling shouldn't spin. If API minimum torque is exceeded, coupling turn/spin would be expected.

j. Hydrostatic testing procedures can be found in Appendix D.

k. The Field Service Technician will make the determination if the conditions worsen to the point that it is no longer advised to continue handling the lined tubing.

4.2 Preparation

4.2.1 By visual inspection, ensure that all necessary running equipment and accessories (subs, crossovers, nipples, hangers, pup joints, etc.) are available and in good condition.

> **NOTE** Following visual inspection of the running and accessory equipment, discuss field running procedures with the Rig Supervisor.

4.2.2 **Slip type elevators must be utilized for special clearance / slim hole coupling applications.**

4.2.3 All WFES TPL pipe shipped from lining plants will have protectors installed and Best of Life 2000 thread compound applied (in some cases Artic thread compound will be applied).

4.2.4 Lined pipe shipping from WFES plants will have had couplings bucked on to API specified torque and standoff verified.

4.2.5 If field thread inspection is required, be certain that thread compound and protectors are reapplied.

4.2.6 Do NOT remove pin end thread protectors until joint is hanging in the derrick. Moving unprotected pin threads can result in liner damage as well as pin thread damage.

4.2.7 Do NOT use hooks or any other device inserted into the coupling or end of the pipe for material handling as this could result in damaged liner and pipe.

4.3 Running Thermoplastic Lined Tubulars into the Well

4.3.1 Use of stabbing guides are recommended for all liner materials. Stabbing guides are required when installing Enertube™, Ultratube™, and Extremetube™, and during any "Cold Weather Handling" (Section 4.1.7) installation.

4.3.2 WFES recommends that all thermoplastic lined pipe (TPL) be made up to API minimum torque (see Torque Table in Appendix A). If minimum torque is to be exceeded during make-up, WFES would recommend the use of extended length couplings and not to exceed optimum torque during make-up (see Torque Table in Appendix A). Over-torquing the connection can damage both threads and liner.

4.3.3 When properly calibrated torque gauges reading in foot-pounds are not available, apply back-ups to tube body below the coupling and make-up the connection without significantly turning the coupling. This can be monitored by marking a vertical line with a chalk stick down the coupling and onto the tube; after make-up is complete check to see that the line remains unbroken. Lower this joint down in the well. Then lower the drift down through the connection to check make-up (see Appendix C).

> **NOTE** The method described in Section 4.3.3 is only applicable when installing a string of API threaded and coupled thermoplastic lined tubing into a well for the very first time as the make-up on the mill end can be verified when received from the plant.

4.3.4 Do NOT make-up past the last scratch or vanishing point of the pin thread.

4.3.5 After following this procedure for 10 or more joints, the tongs should be set and regular installation can proceed (drifting each connection). Once the tongs are set, begin recheck every tenth joint for coupling movement upon make-up.

4.3.6 It is recommended that all downhole pipe should be drifted during installation (see Appendix C for drift procedure). Steel drifts of the proper size are acceptable (see Appendix B for drift dimensions).

4.3.7 Dropping a rabbit through the pipe as it is being picked up is NOT a suitable substitute for downhole drifting after making up a connection. WFES suggests only using a rabbit with the Polycore™, Modified Polycore™, or COTube™ liners. The higher temperature liners (e.g. Enertube™, Ultratube™, and Extremetube™) can be damaged with rabbit-style drifting with a steel drift.

4.4 Operation

4.4.1 **No Rod Guides.** It is not necessary, nor recommended, to use rod guides. Most rod guides will damage the liner.

4.4.2 The use of "top hold down pumps" is recommended in some highly deviated wells. Contact your representative for further information.

4.4.3 Pumps, rod boxes, and any other downhole equipment should be inspected and free of sharp edges, excessive corrosion, or other abnormalities that could damage the integrity of the liner.

a. It may be necessary to bevel the bottom of the pump if the lower edge seems sharp.

b. Sharp edges or corrosion on the rod boxes can shave the liner, jeopardizing its integrity.

c. Rods and downhole equipment can be inspected with a clean dry cotton cloth rubbed over them looking for snags.

4.4.4 Coiled tubing or wirelines can be run inside WFES liners. First check the leading edge for sharp edges and burrs using the cotton cloth. Check any wireline tools for sharp edges and file away any sharp edges found. It is best practice to use a rounded centralizing tool at the end of coiled tubing to keep the opening of the coiled tubing string from gouging, cutting, or shaving the thermoplastic liner material.

4.4.5 **Hot Oiling or Hot Water Flushes:** Use caution not to exceed the temperature limits of the liner (consult Product Data Sheet). Higher temperature resistant liners can be installed in the appropriate areas of the string to accommodate wells that require hot liquid treatments. Please reach out to a WFES representative before hot oil or hot water treatments to discuss the proper procedure and temperature for the given well specifics.

4.4.6 **Swabbing:** The use of rubber cups (not wire cups) and keeping line speeds as slow as possible to accomplish the job are recommended when swabbing inside of WFES thermoplastic lined tubing (TPL).

4.4.7 **Hydrostatic Testing** or pressure testing is common practice with thermoplastic liners to proof check the pipe connection for leaks and structural integrity. The preferred method would be to test against a plug or standing valve either in intervals or after the full string has been installed. The pressure test duration could take up to 1 hour to obtain a stabilized test pressure when testing the full string. In some cases, the thermoplastic liner can stretch slightly during pressure testing. See **Appendix D** for specific pressure testing procedures.

4.4.8 **Cutting Tubing:** Thermoplastic lined tubing can be cut downhole. The recommended method is to use a jet cutter that is properly sized for the drift ID of the specific size, weight, and liner type. There are also mechanical cutting tools that can be used. Please reach out to a WFES representative before cutting tubing to discuss options.

4.5 Pulling Pipe and Standing Back

4.5.1 If it is necessary to remove the pipe from the well and stand back in the derrick, installing pin protectors before standing back is the preferred method to protect the liner and pin threads. Proper protection of pin ends is required before standing back. A rubber mat is NOT an acceptable alternative to the use of pin protectors when standing back WFES TPL tubing.

4.5.2 **Best Practice:** Always install pin protectors if the pipe is to be moved, stood back, or laid down.

4.5.3 WFES recommends referring to Section 4.3, adhering to API minimum torque, and drifting all connections after make-up when reinstalling pipe into the well.

HELPFUL ITEMS AVAILABLE FROM WFES

- Field Service Technician (In-House or Third-Party Affiliates)
- Replacement and Coated Cross-Over Couplings
- Drift Kits
- Stabbing Guides (polyurethane)
- Thermoplastic Lined Pup Joints (individual or sets)

A APPENDIX A – API TORQUE

API Torque (*foot-pounds*)								
Thread	Pipe Size	Weight lb/ft	J-55		L-80		P-110	
			Min	Opt	Min	Opt	Min	Opt
EUE 10rd	1.900" Tbg	2.90	660	880	900	1,190	*NA*	*NA*
EUE 8rd	2 3/8" Tbg	4.70	970	1,290	1,320	1,760	1,785	2,380
	2 7/8" Tbg	6.50	1,240	1,650	1,690	2,250	2,280	3,040
	3 1/2" Tbg	9.30	1,710	2,280	2,270	3,030	3,170	4,230
	4 1/2" Tbg	12.75	2,150	2,860	2,960	3,940	*NA*	*NA*
NUE 10rd	1.900" Tbg	2.75	310	410	420	560	*NA*	*NA*
	2 3/8" Tbg	4.60	550	730	740	990	1,010	1,340
	2 7/8" Tbg	6.40	790	1,050	1,070	1,430	1,460	1,940
	3 1/2" Tbg	9.20	1,110	1,480	1,520	2,030	2,060	2,740
NUE 8rd	4 1/2" Tbg	12.60	1,310	1,740	1,800	2,400	*NA*	*NA*
LTC	4 1/2" Csg	11.60	1,220	1,620	1,670	2,230	2,270	3,020
		13.50	*NA*	*NA*	2,030	2,710	2,750	3,660
	5" Csg	15.00	1,670	2,230	2,310	3,080	3,130	4,170
		18.00	*NA*	*NA*	2,960	3,930	3,980	5,310
	5 1/2" Csg	15.50	1,630	2,170	*NA*	*NA*	*NA*	*NA*
		17.00	1,850	2,470	2,560	3,410	3,470	4,620
		20.00	*NA*	*NA*	3,150	4,200	4,270	5,690
		23.00	*NA*	*NA*	3,700	4,930	5,010	6,680
	7" Csg	23.00	2,350	3,130	3,270	4,350	*NA*	*NA*
		26.00	2,760	3,670	3,840	5,110	5,200	6,930
		29.00	*NA*	*NA*	4,400	5,870	5,980	7,970
BTC	4 1/2" Csg	11.60	Position Make-Up. As per API 5C1: "makeup torque values should be determined by carefully noting the torque required to make up each of several connections to the base of the triangle; then using the torque value thus established, make up the balance of the pipe of that particular weight and grade in the string."					
	5" Csg	15.00						
		18.00						
	5 1/2" Csg	15.50						
		17.00						
		20.00						
		23.00						
	7" Csg	23.00						
		26.00						
		29.00						
API Minimum Torque Recommended; Do Not Exceed Optimum Torque								

B APPENDIX B – DRIFT DIMENSIONS

Western Falcon Thermoplastic Lined Pipe Drift Dimensions							
Pipe Size		Polycore™	Modified Polycore™	COTube™	Enertube™	Ultratube™	Extremetube™
OD	WT	Drift	Drift	Drift	Drift	Drift	Drift
1.9	2.90	1.250	1.184	*Well Specific*	1.184	1.250	1.250
2 3/8	4.70	1.600	1.516	*Well Specific*	1.516	1.600	1.600
2 7/8	6.50	2.000	1.901	*Well Specific*	1.901	2.000	2.000
3 1/2	9.30	2.500	2.347	*Well Specific*	2.347	2.500	2.500
4 1/2	12.75	3.400	3.215	*Well Specific*	3.350	3.400	3.400
4 1/2	11.60	3.400	3.215	*Well Specific*	3.350	3.400	3.400
	13.50	3.350	3.165	*Well Specific*	3.300	3.350	3.350
5	15.00	3.785	3.540	*Well Specific*	3.685	3.785	3.785
	18.00	3.660	3.430	*Well Specific*	3.560	3.660	3.660
5 1/2	15.50	4.300	4.050	*Well Specific*	4.200	4.300	4.300
	17.00	4.300	4.050	*Well Specific*	4.200	4.300	4.300
	20.00	4.200	3.927	*Well Specific*	4.050	4.200	4.200
	23.00	3.950	3.800	*Well Specific*	3.850	3.950	3.950
7	23.00	5.600	5.300	*Well Specific*	5.500	5.600	5.600
	26.00	5.500	5.200	*Well Specific*	5.400	5.500	5.500
	29.00	5.400	5.100	*Well Specific*	5.300	5.400	5.400

C APPENDIX C – WFES DRIFTING PROCEDURE FOR THERMOPLASTIC LINED TUBULARS

01 Inspect rope for tears, frays, and damage. SECURELY attach rope to eye on drift.

02 Tie a knot in the rope at a distance approximately six feet longer than the longest joint (or stand) in the tubing string away from the drift. This knot will act as a "stop" to keep the line from falling through the pulley into the wellbore and as a reference point to verify that the drift has cleared through the connection.

03 Tie off the pulley at one of three locations (tong chain - Point A; on the winch line after you secure it to the rig floor - Point B; or the winch line after you secure it to the floor chain - Point C). See sketch below.

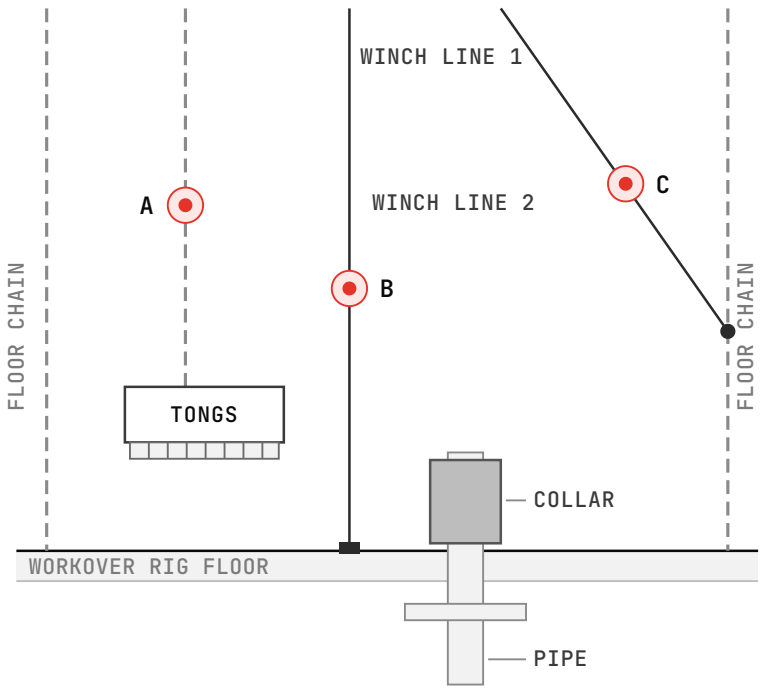
04 Run rope with the drift tied on the end through the pulley. Hold onto the drift line and secure it on rig floor to keep line from falling into wellbore. Drop drift into tubing below rig floor and store coiled drift line on rig floor.

05 When drifting the first joint, be careful and check for nipples, swages or other attachments that the drift will not pass through.

06 In the event that the drift gets stuck, tie off the rope on the elevators, pull up the joint or stand, then breakout that connection and pull the drift out through the bottom of the joint.

07 See Appendix B for Drift Diameters.

NOTE Tubing can be drifted in singles or doubles (stands). Set location of knot on rope accordingly.



D APPENDIX D – WFES LINED TUBING PRESSURE TESTING PROCEDURE

When pressure testing lined tubing, Western Falcon recommends seating a standing valve to test when possible. This is always safer than testing with bar equipment. You can test a full string or in intervals.

PROHIBITED Bar testing WFES Enertube™, Ultratube™, and Extremetube™ is strictly prohibited. Damage (cracking and breakage) is likely to occur from the testing bar cups (mechanical damage due to pressure), sudden pressure changes, and/or abrupt temperature fluctuations.

Our standard Polycore™ and Modified Polycore™ liners can be pressure tested with bar equipment (still preferring the use of a standing valve when possible) in 2-3/8", 2-7/8", and 3-1/2" tubing. We recommend using a two-hole stinger (if possible). Visually inspect the bar prior to running into the tubing. Do not use if testing bar is damaged or has sharp, exposed edges. It is best to use only enough pressure to seal cups (do not overpressure). Also, it is important to fully deflate the cups before removing the bar. DO NOT bar test if the testing bars will be submerged in a column of fluid. When the bars are submerged in fluid, there is a possibility that the testing bars will rise with displacement when pressured up which could stretch and damage the liner.

CUP SIZES ASSOCIATED WITH DIFFERENT SIZES OF WFES LINED TUBING

- 2-3/8" Polycore™ - 1.600"
- 2-7/8" Polycore™ - 2.000"
- 2-7/8" Modified Polycore™ - 1.901" (Same size as cups used for bare 4.70# 2-3/8" tubing)
- 3-1/2" Polycore™ - 2.500"
- 3-1/2" Modified Polycore™ - 2.347" (Same size as cups used for bare 6.50# 2-7/8" tubing)