



SHUR-FLO
Tubular Lining



About Moore Pipe

- Moore Pipe (2015) Inc. established September 2015
- Founder and CEO, Russel Moore and support staff migrated to MPI 2015 from previous tubular businesses - Moore Pipe Inc. and Bison Energy Services, originally established in 1997.
- Moore Pipe specializes in tubular services:
 - Shur-Flo Tubular Lining
 - Inspection
 - Tubular repair
 - Threading, Straightening, Bucking and Cleaning
 - New and Used Tubular sales
 - Accessories
 - Pup Joints
 - Couplings
 - Field Support
 - HDPE Flow Lines
 - Composite Drilling Accessories
 - Casing Centralizers
 - Soft Banding (patent pending)



What is Lined Tubing?

SHUR-FLO Tubular Lining

- Designed to reduce rod and tubing wear as well as corrosion
- The thermoplastic liner is mechanically bonded to the ID
- Comprised of standard and proprietary blend of resins
 - Can handle a wide range of well environments including higher temperatures and increased levels of H₂S and CO₂.
- New and used tubing can be lined
- Customer or Moore provided tubing can be lined



Why Lined Tubing?

Reduce Tubing Failures

- Less rod and tubing wear = longer run life
- Improved corrosion resistance = longer run life
- Longer run life = less workovers

Reduced Rod Failures

- Lower frictional load = reduced rod stress

Reduce Tubing Costs

- Prolong the life of your tube
- Utilize used tubing
- **Maximize your recovery potential**
 - Increase depth/angle of pump
 - Achieve higher SPM or RPM
- **Eliminate extra products**
 - Tubing rotator
 - Rod rotator
 - Centralizers/Scrapers

SHUR-FLO Tubular Lining



Benefits

SHUR-FLO Tubular Lining

- Thermoplastic lined tubing mitigates rod on tubing wear:
 - Beam or PCP pumped
 - Deviated and dog-legged holes
 - Minimize use of other standard solutions
- Thermoplastic lined tubing maximizes rod string life by:
 - Thermoplastic liners are more than 30 times smoother than steel pipe reducing fluid frictional flow losses as well as friction between the rod string and tubing wall
 - Reducing rod on tubing friction means reduced peak polished rod or torsional load
 - Reducing peak polished rod load means reduced stress on the rod string
 - Reducing stress on the rod string means **“increased rod string life”**
- Thermoplastic lined tubing mitigates corrosion:
 - “Holiday Free” corrosion barrier
 - Water injection and disposal wells
 - Flowing / pumping oil wells



Lining Process

SHUR-FLO Tubular Lining



1. New/Used tubing is inspected and threads are gauged and Magnetic-Particle Inspected (if required)
 - EMI and thread inspection done by MPI 2015
 - Tubing ID/ OD cleaned
 - Tubing straightened
2. Tubing enters facility
 - Liner is inserted inside of tube
 - Tube enters oven and is heated to allow for optimal expansion of liner
 - Tube exits oven and is transferred to end finishing station
 - Tube is drifted
 - Extended uncoated/coated coupling is installed
 - Tube is end-drifted
3. Tube exits facility and placed on rack for storage
4. [Moore Wyoming Operations.pptx](#)

SHUR-FLO SPECIFICATIONS

SHUR-FLO Tubular Lining

Product Trade Name	Material Description	Material Abbreviation	Maximum Operating Temperature	H2S Content	CO2 Content
Shur-Flo 1	High Density Polyethylene	HDPE	140F	5%	10%
Shur-Flo 2	Raised Temperature Polyethylene	PERT	200F	5%	10%
Shur-Flo 3	Cross Linked Polyethylene	PEX	250F	10%	30%
Shur-Flo 4	PolyKetone	PK	275F	20%	50%
Shur-Flo 5	Raised Temperature Polyketone	PKRT	310F	20%	50%

SHUR-FLO 1 (SF1)

SHUR-FLO Tubular Lining

This is our standard liner option (HDPE), good to 140F in standard operating conditions. Most water injection applications and disposal well applications are suitable for this liner. Many low to moderate temperature pumping applications are also suitable for Shur-Flo1 lined tubing. Working depths to about 5,300 feet is the limit for this liner option. This liner is **Black** in color.

Applications

- Low temperature product
- Best mechanical properties
 - PCP
 - Disposal
 - Plunger Lift
 - Beam Pump
- Submersible Pump Wells
 - Injection wells
- Low H₂S and CO₂ content
- Maximum side load of 475 lbs.



SHUR-FLO 2 (SF2)

SHUR-FLO Tubular Lining

This liner is a raised temperature HDPE (PERT) good to 200F in standard operating conditions. This liner is ideal for higher temperature Water Injection/Disposal Wells and Pumping Wells with extended well depths to 7,000 feet. This liner is **Orange** in color.

Applications

- Improved temperature rating over SF1
 - Similar mechanical properties
 - PCP
 - Disposal
 - Plunger Lift
 - Beam Pump
 - Submersible Pump Wells
 - Injection wells
 - Low H₂S and CO₂ content
 - Maximum Side Load of 500lbs.



SHUR-FLO 3 (SF3)

SHUR-FLO Tubular Lining

This liner is a Cross Linked HDPE (PEX) good to 250F in standard operating conditions. This liner is ideal for higher temperature Water Injection/Disposal Wells. This liner is **Red** in color.

Applications

- Improved temperature rating over SF2 and
 - lower permeation
 - lower mechanical properties
 - Submersible Pump Wells
 - Injection wells
- Moderate H₂S and CO₂ content

SHUR-FLO 4 (SF4)

SHUR-FLO Tubular Lining

Shur-Flo 4 is a proprietary blend of aliphatic Polyketone (PK) engineered polymer suitable for hydrocarbon applications. Our Shur-Flo 4 Lined Tubing maximum operation temperatures are 275°F. Excellent impact, hoop strength and ductility. Exceptional gas barrier properties combined with superb chemical resistance to aggressive chemicals and hydrocarbons. Also, this liner is highly resistant to abrasion and wear. This liner is **Beige** in color.

Applications

- Good temperature rating for deeper wells
 - Excellent mechanical properties
 - Disposal
 - Plunger Lift
 - Beam Pump
 - Submersible Pump Wells
 - Injection wells
- Increased H₂S and CO₂ resistance
- Maximum Side Load of 725lbs.



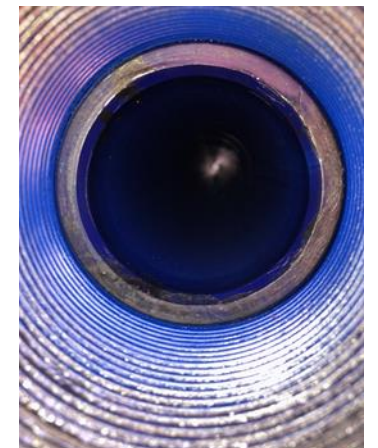
SHUR-FLO 5 (SF5)

SHUR-FLO Tubular Lining

Shur-Flo 5 is a proprietary blend of aliphatic Raised Temperature Polyketone (PKRT) engineered polymer suitable for hydrocarbon applications. Our Shur-Flo 5 Lined Tubing maximum operation temperatures are 310F. Excellent impact, hoop strength and ductility. Exceptional gas barrier properties combined with superb chemical resistance to aggressive chemicals and hydrocarbons. Also, this liner is highly resistant to abrasion and wear. This liner is **Blue** in color.

Applications

- Good temperature rating for deeper wells
 - Excellent mechanical properties
 - Disposal
 - Plunger Lift
 - Beam Pump
 - Submersible Pump Wells
 - Injection wells
- Increased H₂S and CO₂ resistance
- Maximum Side Load of 750lbs.



Why Polyketone?

SHUR-FLO Tubular Lining

Unique engineering plastic,
the polymer of
which backbone
consists of only Carbons.

Highly crystalline
with compact
crystal structure

Excellent impact resistance,
abrasion resistance,
chemical resistance,
fuel resistance,
gas barrier properties

- POKETONE is a tough semi-crystalline thermoplastic which has perfectly alternating structure of Carbon monoxide and Olefin.
- Its flexible chains together with the molecular symmetry enhances crystallization which results in many differentiated properties such as excellent chemical and impact resistance, exceptional wear resistance and barrier properties.

HDPE, Polyketone & PPS Comparisons

SHUR-FLO Tubular Lining



Comparison of Polyketone, HDPE and PPS Tribological Properties

Material	Specific Wear Rate, M ³ /N-M	Relative Wear	Wear Factor, K	Limiting PV value	Kinetic Coefficient of Friction	Taber Abrasion Weight loss, mg	Tensile Strength, psi
Polyketone (M630)	7.32 x 10 ⁻¹⁴	1.0	215	16,000	0.36	12	8,700
HDPE	1.8 x 10 ⁻¹³	2.46	-	-	0.25	-	3,600
40% Glass Filled PPS	-	-	350	32,000	0.44	57	22,500

1. Counter face material was un-lubricated steel (S45C, HRC 12-25, Surface roughness ~ 0.8µm)
2. Test conditions: Normal load = 1.3 MPa, Speed = 0.06 m/s, 23C, 50% RH
3. Wear factor & PV values generated per ASTM D-3702 Thrust Washer testing using 440C steel, surface hardness 55-60 R_c, 12-16 micro-inch surface finish for the counter face
4. Wear factor & PV values generated at 40 psi, 100 fpm
5. Taber Abrasion values correspond to 1000 cycles with 1 kg load and CS-17 grit wheels

HDPE, Polyketone & PPS Comparisons

SHUR-FLO Tubular Lining

Ketoprix PK vs PA, POM, PPS, PVDF – Impact Resistance

Notched Izod Impact at 23C & -40C

Resin	POM	PA66, dry	GF PPS	PVDF	Ketoprix™ EK63
Notched Izod Impact, J/m, 23C	64	53	91	160	240
Notched Izod Impact, j/m, -40C	43	27	N/A	N/A	50

PK has higher impact resistance than nylon & acetal at both 23C and -40C

As noted above the impact resistance at both 23C and -40C is far superior to the other Engineered polymers, especially PPS. Meaning that it can be handled without issue at cold temperatures. PPS has no impact resistance at -40C as shown.

Handling Procedures

SHUR-FLO Tubular Lining

1. End protectors should remain on tubing until the joints are tailed in and hanging in the tubing elevators.
2. Recommended torque is “not greater” than optimum torque:
 - I. Tubing
 - I. 2 3/8" Optimum Torque J55 -1290 ft.lbs. L80 – 1760 ft.lbs.
 - II. 2 7/8" Optimum Torque J55 - 1650 ft.lbs. L80 – 2250 ft.lbs.
 - III. 3 1/2" Optimum Torque J55 - 2280 ft.lbs. L80 – 3130 ft.lbs.
 - IV. 4 1/2" Optimum Torque J55 - 2860 ft.lbs. L80 – 3940 ft.lbs.
 - II. Casing
 - I. 4 1/2" Optimum Torque J55 - 1620 ft.lbs. L80 – 2230 ft.lbs.
 - II. 5 1/2" Optimum Torque J55 - 2470 ft.lbs. L80 – 3410 ft.lbs.
3. Progressive Cavity Pump Applications – Recommended running an 8 or 10 ft pup joint right above the stator, and then the first joint of Shur Flo Lined Tubing.
4. Rod Pump Applications – Recommended running 1 joint of Bare Tubing right above the Pump Seating Nipple (In the traveling area of the pump) and then Shur Flo Lined Tubing.
5. Electric Submersible Pump Applications – Recommended running Shur Flo Lined Tubing right above the pump or above the landing pup joint on the pump.
6. Water Injection/Disposal Applications – Recommended to run Shur Flo Lined Tubing right from the top of the tension, compression or inflatable packer assembly.
7. Thread lubricants are fine and should be used in the same manner as bare tubing.
8. Tubing end collision must be avoided in cold weather and stabbing guide is required during these conditions.

Handling Procedures, cont'd

SHUR-FLO Tubular Lining

9. Tension set packers can be set with no risk of damage to the Shur Flo Liner.
10. Weights of Tubing with Shur Flo Liner Installed are:
 - i. Tubing
 - i. 2 3/8" – 4.8 lbs/ft
 - ii. 2 7/8" – 7.06 lbs/ft
 - iii. 3 1/2" – 10.15 lbs/ft
 - iv. 4 1/2" – 13.81 lbs/ft
 - ii. Casing
 - i. 4 1/2" – 12.65 lbs ft
 - ii. 5 1/2" – 18.05 lbs/ft
11. Most tools etc. can be run inside of the Shur Flo lined tubing string with out risk of damage to the liner.
12. Drift diameters are as follows:
 - i. 2 3/8" – 1.60"
 - ii. 2 3/8" modified siphon string – 1.1"
 - iii. 2 7/8" – 2.00"
 - iv. 3 1/2" – 2.50"
 - v. 4 1/2" – 3.4"
 - vi. 5 1/2" – 4.30"
13. Wireline or coiled tubing can be run down Shur Flo lined tubing with no risk of damage to the liner. Recommend slower running and pulling speeds.
14. When pulling Shur Flo Lined Tubing from a well, it is recommended that end protectors be put on pins ends prior to standing the lined tubing in the derrick and recommend rubber matting be used as well.
15. In the event a Shur Flo Lined Tubing string shall become stuck in the hole, a chemical cutter system will not work. The chemical will not affect the liner at all, and therefore not get to the steel tubing wall. The use of an explosive tubing cutting device is the appropriate choice.

SHUR-FLO Tubular Lining

Case Studies

- 4,100 Coal Bed Methane wells
- 2,000' +/- setting depths, BHT- 80-120 Degree F, Production rates 20-500 BPD
- 90% of wells on ESP, with balance on PCP & SRP
- Averaging 130 interventions per month with 35% (45) due to hole in tubing
- Low BHP allowed to establish SOP to line tubing with as little as 40% wall thickness remaining
- Initially lined 59 wells with problems due to CO₂, rod wear and old tubing.
- Initial wells were being pulled every 90 days
- Since SHUR-FLO lining there have been no pulls in wells after 9 months
- Go forward plan is to line available used tubing vs buying new tubing and increase the number of wells being lined
- For the price difference, they are able to line tubing for 26 wells per month vs buying new that would equip 10 wells per month

Case Study – Alberta, Canada Arc Resources

- Arc at the time was operating over 480 injection wells.
- Running coating tubing with TK-99 coating and getting two year runtimes.
- Began lining 2 7/8” Blue Band tubing with SHUR-FLO 1
- Made the decision to replace all coated tubing with SHUR-FLO lined tubing in 2005
- Client now has over 1700 wells lined with 10 year run without interventions.
- Client continues to convert all injectors over to SHUR-FLO Lined tubing with 20 to 50 new wells every year

Case Study - Alberta, Canada CNRL

- CNRL initially installed bare steel tubing into wellbore
- Pulled after 23 day run due to severe wear and corrosion.
- Bottom Hole Temperature 115° F
- Inspected and lined all yellow band tubing with SHUR-FLO liner
- 3 year runtime prior to need for intervention.
- Client established SOP to line all tubing with SHUR-FLO
- Subsequently lined tubing in more than 361 wells.

Case Study - Alberta, Canada Crescent Point

- Operating 450 “heavy oil” wells. Tubing wear caused by rods for the progressive cavity pumps and erosion resulted in excessive interventions with run times under one year.
- Client lined all yellow and blue band tubing with SHUR-FLO, thus utilizing existing inventory.
- Run time exceeded the clients two year goal between interventions
- Client consequently lined tubing on 279 wells.


Case Study – Alberta, Canada Encana Pelican Lake

- Encana at the time were looking to convert 500 wells from producing to Injectors as field pressure and production were dropping off.
- Looked serious at running new coating tubing with TK-99 coating
- We approached them with the idea of pulling existing strings of tubing, sending to us to inspect, ID clean and insert SF-1 Liner.
- They made the decision to run SF-1 Lined Tubing in first 500 conversions saving almost 1.7 million dollars on this project
- Although property owner changed to Cenovus, they did over 1,400 Injection Well Conversions using SF-1 Lined Tubing


Accessibility

- Lining Plants
 - Nisku, AB
 - Casper Wyoming
 - Midland Texas
 - Bakersfield California
- Stocking Points
 - Nisku AB
 - Brooks, AB
 - Hayter, AB
 - Provost, AB
 - Drayton Valley, AB
 - Williston ND
 - Casper Wyoming
 - Midland Texas
 - Bakersfield California
- Flexible Stocking Options
 - Should a customer require stock in an area not in close proximity to Moore's current stocking locations, we would be more than happy to arrange alternate stocking areas based on anticipated:
 - Volume
 - Frequency
 - Moore also has the ability supply product direct to customer well locations and customer controlled stocking locations (i.e. battery).




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