



INTERLOCK Semi Flush Description:

The *INTERLOCK* Semi Flush is a threaded semi flush joint connection that relies on leak resistant and torque energized dovetail flank locking threads to obtain maximum liquid tight performance. The *INTERLOCK* Semi Flush uses a unique dovetail thread form for strength and sealing. The threads are formed on plain end pipe after compression swaging the pin ends and expansion swaging the box ends. Torque ratings vary by size, weight and grade because torque is affected by the pipe cross sectional area and the strength of the steel.



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Thread Compound Application

A moustache brush is recommended because of its ability to evenly apply thread compounds and its unique angle which aids fully coating internal threads and seal. The brush should be kept free and clean of debris and liquids that would adversely affect the thread compound. Likewise, the container with the thread compound shall remain free of contaminants. Oil based muds can thin out the grease in the thread compound which can cause galling or premature connection yielding.

A light coat should be applied to the threads of the box when using traditional thread compound. When using an anaerobic thread compound such as SealLube or FlexLube 100 the pin only shall be doped. The coating should be light and cover no more than 1/3 of the thread height.

Best of Life 2000, Best of Life 72733, JET-LUBE® RUN-N-SEAL®, Klüberlub OCTG LF HT are the recommended running compounds. Other proprietary thread compounds may be used that are API Bulletin 5A2 compliant or equivalent. Artic grades are recommended for cold weather applications.



Thread compound on box only with tradition thread compounds such as BOL 2000 or similiar



Thread compound on pin only with FlexLube 100, SealLube, or other anaerobic Precision approved compounds



Supplemental Thread Compound Information

Thread Compounds

- Thread compounds meant for casing must be utilized since they have very fine particle size additives when compared to drill collar or drill pipe compounds. The compound will reference API Bulletin 5A2 compliance on the container. ISO 13678 and API RP 5A3 compounds are also authorized.
- It is recommended that a specified dropping point of 150°F (66°C) or higher than the well temperature be chosen. For elevated temperature wells a dropping point of 450°F (230°F) is recommended.
- Arctic grades are suggested when the outdoor temperature is 40°F or lower because the thickness and adherence for non arctic grades is very poor. The thread compound has to stick and be evenly applied to be effective as a sealant and to prevent galling.
- Confirm that the thread compound has not expired by checking the container documentation.
- Always stir the thread compound before use because generally the grease and solids separate during storage. Not stirring the whole container can make the connection too slick and cause low shoulders.
- Keep the container covered to prevent contamination from water, rain, and drilling fluids. Especially oil based drilling fluids which act like paint thinner.



Thread Compound Application

Approximate weights and volumes for application are listed below for reference. Roughly equal amounts are applied to the box and pin. Too little results in a high shoulder torque and too much can give an odd graph.

Pipe OD (in)	Dope Volume (cm ³)	(in ³)	Dope Weight Approximate		
			Weight (lbs)	Weight (Ounce)	Weight (grams)
2 7/8	6	.39	0.027	0.43	12
3 1/2	9	0.58	0.039	0.63	18
4	12	0.75	0.052	0.83	23
4 1/2	13	0.81	0.055	0.89	25
5	15	0.93	0.063	1.01	29
5 1/2	17	1.02	0.070	1.12	32
6 5/8	34	2.07	0.141	2.26	64
7	38	2.31	0.158	2.53	72
7 5/8	45	2.74	0.187	3.00	85
8 5/8	57	3.51	0.240	3.84	109
9 5/8	72	4.37	0.299	4.78	135



Representative Torque Graphs

The following torque graphs are supplied to aid in the running of the *INTERLOCK*. The values provided in the technical data sheets are determined by laboratory testing at standard room temperature in a clean environment with perfectly made pipe and perfectly aligned and calibrated tongs. Your conditions will vary, but these guidelines can help to troubleshoot common problems. The graphs depict the full torque profile past yield.

INTERLOCK/Shoulder Torque: Point on the graph where the torque spikes dramatically when the wedge threads lock up.

Yield Torque: Torque that crushes the pin noses and deforms the wedge threads. Generates a lot of heat due to friction.

Optimum Make Up Torque: Recommended torque to ensure pressure integrity, breakout capability and structural stability. The value is between Minimum and Maximum Make Up Torque.

Minimum Make Up Torque: Lowest recommended assembly torque.

Maximum Make Up Torque: Highest recommended assembly torque. Exceeding this value can make it difficult to re-run the connection if the casing string must be tripped out. It is best to leave the connection together if this value is only slightly exceeded.

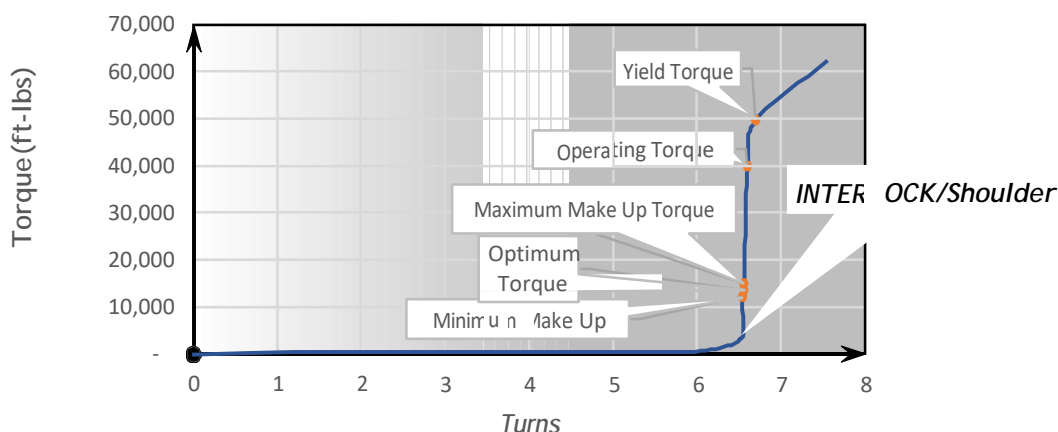
Operating Torque: Maximum torque when rotating a casing string under load. Represents a percentage close to yield torque and great care should be taken before making a decision to approach this value. It will be difficult or impossible to break out connections that are run to extreme torques. Breaking out connections run at high torque can cause galling of the threads. Making up pipe at this torque could crush the pipe because of the tongs (It may also leave deep tong marks).

Maximum Make Up Speed: 10 RPM for all sizes.

Make up start speed: Begin make up at no more than 10 RPM

Make up end speed: 5 RPM or less to get a good shoulder & graph recommended.

INTERLOCK Semi Flush
Representative Torque Graph



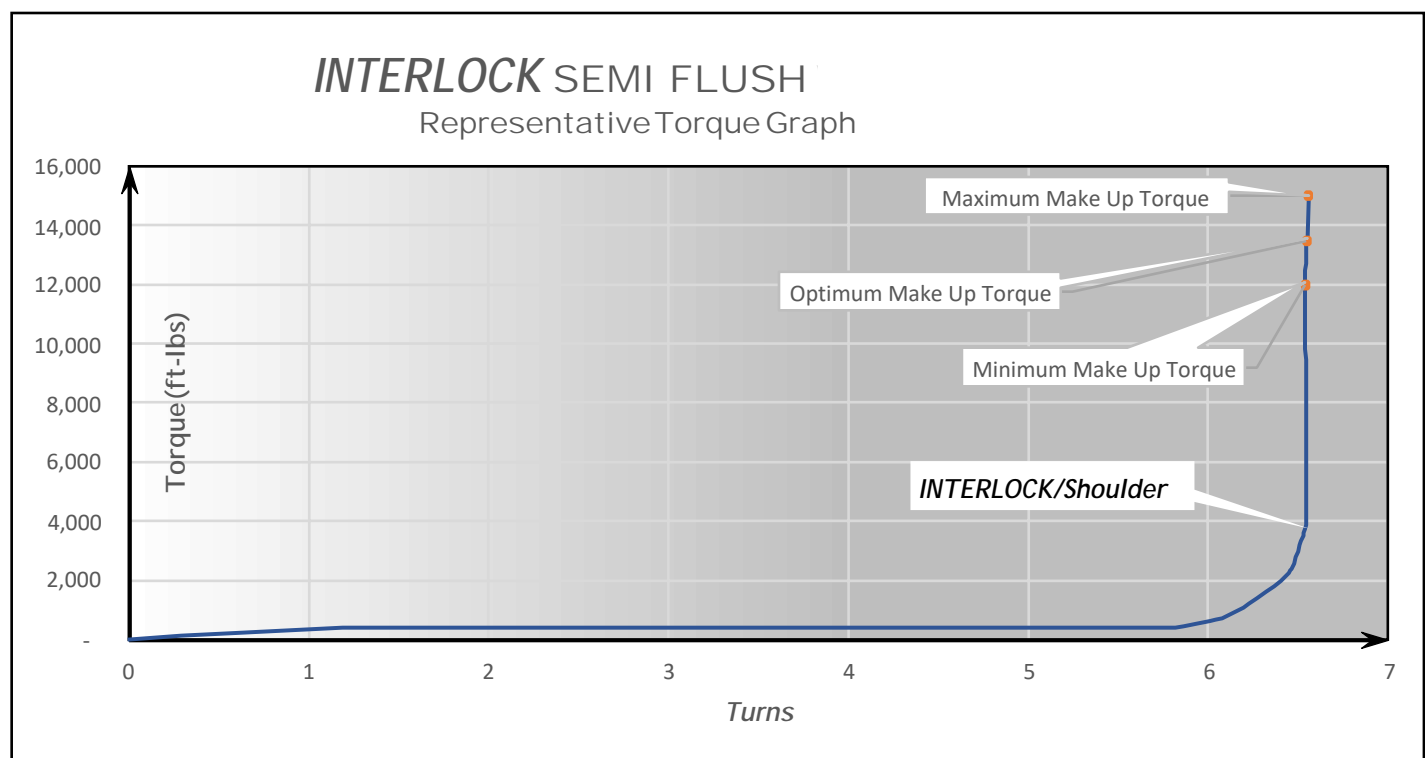


Representative Make Up Graphs

The following torque graphs are supplied to aid in the running of the *INTERLOCK*. The values provided in the technical data sheets are determined by laboratory testing at standard room temperature in a clean environment with perfectly made pipe and perfectly aligned tongs with perfectly calibrated tongs. Your conditions will vary, but these guidelines can help to troubleshoot common problems. The graphs depict different make up conditions.

Normal Make Up Graph

The shoulder is expected to occur before the minimum make up torque. Adhering to the minimum, optimum and maximum makeup torques will give the best sealing and ability to trip out the connection easily.





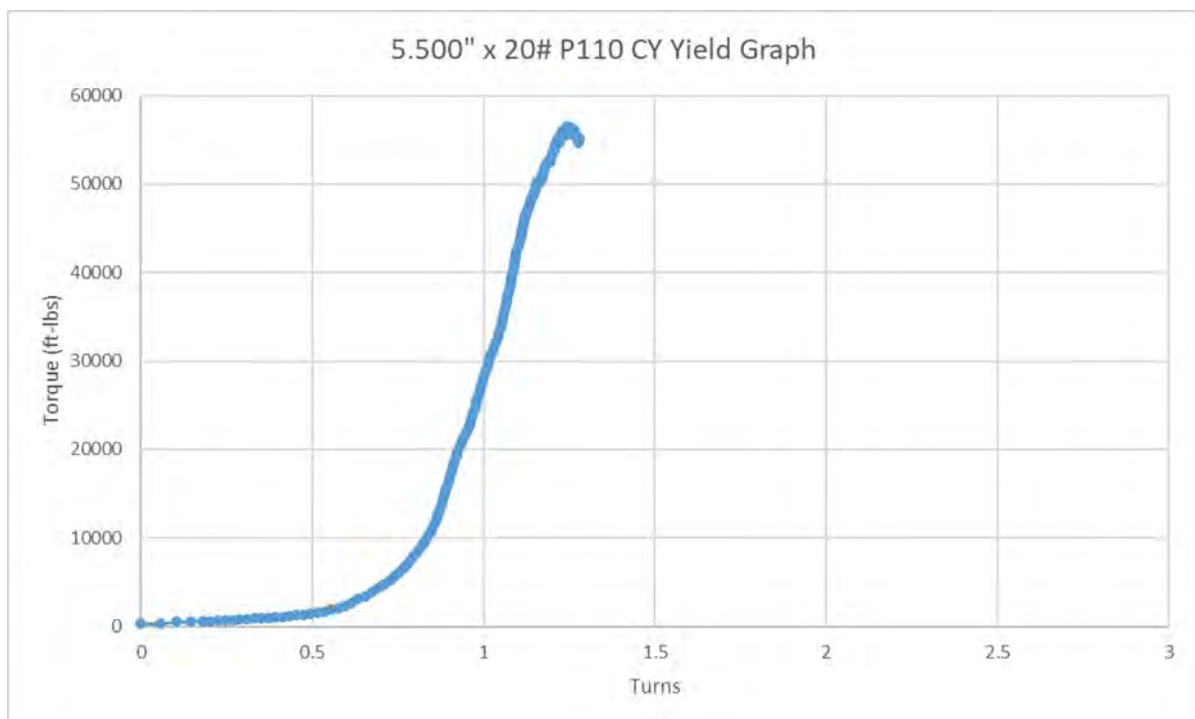
Cross Threading

When cross threading occurs the torque graph can have the appearance of a sloped line. The graph lacks a definitive shoulder at the expected shoulder and can exceed the max makeup torque.

Possible Causes:

- Pipe to coupling alignment
- Too much pipe weight on threads when stabbing
- Connection rocking from: high rpm make up, bent pipe, pipe alignment or rig alignment.

Representative Torque Graphs





Make-Up

- A stabbing guide shall be used to align the pin and box.
- The power tong jaws should be 8" above the pin end and 8" or more below the box end.
- Initial rotation should begin in high gear with a low torque. Ensure the make up is not biting into the thread.
- Shift to low gear after the thread interference but before the shoulder engagement.
- The last turn should be done in low gear so the interlock/shoulder engagement appears in the torque turn graph. This also allows a good graph of the interlock/shoulder.
- Once the seal engages the tongs should remain in low gear and at a constant RPM. Recommended RPM's are listed in the table below. They may be modified to achieve a better graph (generally slower).
- The joint should be laid out if it fails 3 make-up attempts. Sometimes the joint can be made to another joint just fine if the connections checks out after inspection.

Buck On RPM

Pipe OD	Initial	Final RPM
2 7/8	10	5
3 1/2	10	5
4	10	5
4 1/2	10	5
5	10	5
5 1/2	10	5
6 5/8	10	5
7 3/4	10	5
8 5/8	10	5
9 5/8	10	5

- The interlock/shoulder torque shall be clear and defined. The shoulder is expected to occur before minimum make up torque. It should shoulder before it reaches 80% of the minimum make up torque to achieve proper delta torque. **Under no circumstances should the shoulder occur above the minimum makeup torque.**
- Abnormally high shoulder torques are usually caused by casing alignment over the rotary table. Particularly on shorter length segments such as frack sleeves, marker joints and specialty tools. This is due to side loading of the thread during assembly.
- For shoulder torques that are not within spec break out the connections and inspect.
- Rig alignment can cause higher than expected shoulders, especially on shorter joints.
- Any large torque increase before reaching the shoulder may indicate cross threading or galling.
- Abnormal Spikes in the torque graph may indicate over-doping.
- Break out and inspect connections that have failing graphs.



Break Out, Re-makes and Repairs

- After break out, the pin and box must be thoroughly cleaned and inspected for any damage.
- Some connection repair is allowable using scotch brite, a fine file, stone or sand paper. Remove all sharps, raised edges or burrs from the threaded areas.
- Trained technicians may make decisions regarding the serviceability.
- The imperfect threads should have no edges sharps burrs or bent edges that will cause or start galling since they receive the most abrasion on make up.
- Check the Box OD and pin nose for signs of over-torque before deciding to re-run. The small width pin and box threads will show signs of pullout shearing or buckling.
- Once repaired the connection should be sprayed with an even coat of "dry moly" and allowed to dry.





Running Torque & Rotation

RPM Limitation. It is recommended that 30 RPM be the upper limit especially for doglegs greater than 25° / 100ft. This will keep the fatigue low enough to finish a well in the shale plays. For drilling with casing in vertical wells (Less than 6° /100ft) this limit does not apply. Fatigue is your worst enemy and it comes from the stress reversals through the bend. It's better to be advancing slowly under high RPM and low torque than low RPM and high torque. The RPM limitation rules apply generally for 4.5" to 7" pipe. Pipe larger than 7" is not typically used in doglegs in the shale plays.

Torque Application & Downhole Makeup. It is not recommended to apply the maximum operating torque during buck on. Downhole makeup is better for several reasons. The pipe is not marred or swaged by the tongs. Torque generates heat and the coupling is generally surrounded by fluid which keeps the connection cool. Downhole make up is more gradual and only the connections at the surface will see the highest torque (torque dissipates the further away you are from the source.) The connections going through the bend will have lower makeup stress and flexibility. Instead of stressing every connection you only stress a few. Staying within the min and max makeup torques allows the connections to be broken apart (tripped out) and run again. When applying a higher torque at makeup the connection threads can be damaged on break out. Higher torque forces the grease out so that when you back out there is little lubrication. The direction of the galling usually indicates this is the case. The final reason is that it is easier to trip out without a powerful tong (logistical nightmare).

Torque Application & RPM. It is recommended that torque be applied gradually as well as RPM. A gradual downhole makeup is preferred versus the impact type forces that result from rapid torque applications or rotational acceleration. There is little advantage and a whole lot of downside. The speed and torque to be applied will differ with the depth of the well since you would be winding up a lot more pipe. The torsion will twist the pipe and it's better to let it wind and unwind slowly downhole.

Reciprocation. Reciprocating the pipe is recommended to aid advancement as long as the pull is below the connection minimum yield. Reciprocating, Rotating and Circulating are the best ways to make bottom. Reciprocation should be gradual to minimize impulse / shock loads. The INTERLOCK SEMI FLUSH utilizes the wedge thread profile and can take larger compressive and tension loads than the typical flush. One word of warning though; Do not exceed the connection yield in pull, some people use the API Joint strength or thread strength. That is the tensile value and you may get one good pull before the joint parts. In any case pulling to this number permanently deforms and weakens the steel. A piece of steel that has been pulled past yield will experience accelerated corrosion downhole.



Handling Plugs

Handling Plugs are designed for lifting and/or protecting your box end threads. They are engineered products designed to accommodate lifting a joint of pipe from the rack to position over the rotary table. They can withstand the load of singles or doubles. They are designed to be free running and can be installed without tongs. Because of this there are limitations on their pull strength. They are not good for supporting the load of the entire string.



Warning! Handling plugs shall be obtained from an authorized provider. Sawing off an Interlock pin and welding it to another piece of steel is not authorized. Using an un-authorized handling plug can result in death, injury and property loss. A sawed off pin will not provide enough thread contact to support much weight since they are designed to be press fit into the box with thousands of pounds of torque.

Authorized handling plugs are integral pieces of steel with 2 to 4 holes drilled in the collar portion. They are labelled and serialized. The labelling will denote the size and wall thickness (weight) of the pipe the plug was designed for. They are made from high grade steel and phosphate coated to extend the useful life.

Safety:

- Ensure that elevators are slacked off and disengaged when rotating the connection to prevent backoff. Falling handling plugs can be lethal.
- Use setting plates on slip type elevators to ensure the slips do not grip on the box connection. Refer to the make-up loss to choose the right plate. Generally 8" from the box face/edge of handling plug is a good minimum distance.
- Handling plugs shall be installed to a hand tight position to ensure full thread engagement with manual tightening with a steel bar or wrench through the provided holes.
- Ensure the handling plug is free of debris clean and in good running condition since it will be installed on every joint.



Stabbing Guides

A stabbing guide is required for the proper make-up of the *INTERLOCK* Semi Flush.



Stabbing Guide:

- The stabbing guide centers the pin with the box and prevents the pin face and seals from denting or scraping on the box face. Protecting the seals on the box face and the pin nose is very important for most flush joint connections.
- Stabbing guides also minimize the chance of a cross thread by centering the joints with one another.
- Stabbing guides are sized with the pipe size and connection type. Generally, the stabbing guide will work for all wall thicknesses of the same connection. Some other proprietary flush connection stabbing guides may work, but it is best to find an *INTERLOCK* Semi Flush specific stabbing guide.
- Stabbing guides are kept with our *INTERLOCK* Semi Flush authorized field service companies (Thread Reps). The *INTERLOCK* Semi Flush authorized field service companies may differ from our BK and HOSS product lines.

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Quick Reference Guide

***To be used with connection data sheet**

Make Up Torque

The Torque should be between the Min Make Up and Max Make Up Torque.

Makeup RPM.

Begin at 10 RPM or less.

Last turn at 5 RPM or less.

Max: 10 RPM for all sizes

INTERLOCK/Shoulder Torque

Occurs after both flanks of the thread profile come into contact, should be equivalent to minimum torque

Running RPM

Recommended: 30 or lower

Time at Max: 12 hours or less in high dogleg.

Operating torque depends on CRT limits.

Running Torque

Min: As low as possible to get the job done

Max: Max Operating Torque (80% Yield Torque)

Thread Compound

Jet Lube Run N Seal ECF & Kluberlub OCTG LF HT

highly recommended (Good for temperatures exceeding 150°F). *BOL 2000* also works well. Use artic grades below 50°F.

Recommended Equipment

Stabbing Guide

Recommended for running and pulling to prevent thread damage

Handling Plug

Handling Plugs are designed for lifting and/or protecting your box end threads. They are engineered products designed to accommodate lifting a joint of pipe from the rack to position over the rotary table. They can withstand the load of singles or doubles. Because of this there are limitations on their pull strength. They are not good for supporting the load of the entire string.

Weight Compensator

Recommended to prevent thread damage by neutralizing tool and joint weight.



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