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PLIDCO® SPLIT REPAIR FITTING (1) INSTALLATION INSTRUCTIONS

(1) PLIDCO Split Repair Fittings include Split+RepairElls, Split+RepairTees, Split+RepairCrosses, FlangeRepair+SplitSleeves, Domed Split Bolt-On Tap+Enclosures, and other split repair fittings not covered under separate installation instructions. These instructions are applicable to Split Repair Fittings with or without clamping ends.

!! WARNING!!

IMPROPER SELECTION OR USE OF THIS PRODUCT CAN RESULT IN EXPLOSION, FIRE, DEATH, PERSONAL INJURY, PROPERTY DAMAGE AND/OR HARM TO THE ENVIRONMENT.

Do not use or select a PLIDCO Split Repair Fitting until all aspects of the application are thoroughly analyzed. Do not use the PLIDCO Split Repair Fitting until you read and understand these installation instructions. If you have any questions, or encounter any difficulties using this product, please contact:

**PLIDCO “DEPARTMENT 100” at 440-871-5700
 toll free U.S. & Canada at 800-848-3333**

READ CAREFULLY

The person in charge of the repair must be familiar with these instructions and communicate them to all personnel involved in the repair crew.

Safety Check List

Pipeline repairs can be made with the pipeline in operation or shutdown.

- 1. Read and follow these instructions carefully. Follow your company’s safety policy and applicable codes and standards. If the PLIDCO Split Repair Fitting is to be installed underwater, be sure to read the *Underwater Installation* section.
- 2. The PLIDCO Split Repair Fitting should never be used to couple pipe unless sufficient end restraint is provided for with clamping ends. Without clamping ends the PLIDCO Split Repair Fitting has no end restraint rating in its unwelded condition, and if so utilized could result in EXPLOSION, FIRE, DEATH, PERSONAL INJURY, PROPERTY DAMAGE, AND/OR HARM TO THE ENVIRONMENT.

- ❑ 3. Observe the working pressure and temperature on the label of the PLIDCO Split Repair Fitting. Do not exceed the maximum working pressure or temperature as indicated on the fitting.
- ❑ 4. When repairing an active leak, extreme care must be taken to guard personnel. Severe injury or death could result.
- ❑ 5. If the pipeline has been shut down, repressuring should be done with extreme caution. Repressuring should be accomplished slowly and steadily without surges that could vibrate the pipeline and fitting. Industry codes and standards are a good source of information on this subject. Except for testing purposes, do not exceed the design pressure of the PLIDCO Repair Fitting. Personnel should not be allowed near the repair until the seal has been proven.

Pipe Preparation

1. Remove all coatings, rust and scale from the pipe surface where the circumferential seals of the PLIDCO Split Repair Fitting will contact the pipe. A near-white finish, as noted in SSPC-SP10 / NACE No.2, is preferred. The cleaner the pipe the more positive the seal.
2. Where the circumferential seals will contact any pipe welds, the welds in this vicinity must be ground flush with the outside diameter of the pipe.
3. Circumferential pipe welds within the circumferential seals do not need to be ground flush as long as the weld height does not exceed 3/16 inch (4.7 mm).
4. Pipe outside diameter tolerance is $\pm 1\%$ for 6-inch nominal pipe size and smaller. For pipe sizes larger than 6-inch nominal the tolerance is ± 0.06 inch (± 1.5 mm).
5. The seal can tolerate minor surface irregularities up to $\pm 1/32$ inch (0.8 mm).
6. A PLIDCO Split Repair Fitting is capable of sealing on out-of-round pipe up to approximately 5% ovality. This is based on the ability of the bolting to reshape the pipe. For very thick wall pipe the bolting may not be able to reshape the pipe. Badly out-of-round pipe may require a different length PLIDCO Split Repair Fitting to ensure the circumferential seal are positioned on round pipe.
7. A PLIDCO Split Repair Fitting is not capable of reshaping flatten or dented pipe.

Installation

Careless handling can damage the seals and GirderRings. Lifting devices such as chains, cables or lift truck forks should not be allowed to contact the seals or GirderRings. Contact can result in the seals being pulled from their grooves. (See Figure 1)

1. If the two sleeve halves were shipped as an assembled unit it would have been shipped with spacers between the two halves to prevent damage to the longitudinal seals and ends of the circumferential seals. Typically small diameter nuts are used for the spacers. The spacers must be removed and discarded before installing the PLIDCO Split Repair Fitting. Failure to remove the spacers will prevent proper compression of the seals.

- Coat all exposed surfaces of the seals with a lubricant. The chart below lists the lubricants that are recommended for the various seals. The customer must determine if the lubricant is compatible with the product in the pipeline.

Petroleum based lubricants	= A	
Silicone based lubricants	= B	
Glycerin based lubricants	= C	
Super Lube® Grease (1)	= D	
		Temperature (2)
Buna-N	A, B, C, D	225°F (107°C)
Viton	A, B, C, D	250°F (121°C)
Silicone	C, D	300°F (149°C)
Neoprene	B, C, D	250°F (121°C)
Aflas	A, B, C, D	225°F (107°C)
Hycar	A, B, C, D	180°F (82°C)
Teflon	A, B, C, D	500°F (260°C)
Kevlar	A, B, C, D	750°F (399°C)

- Super Lube® Grease is a product of Synco Chemical Corporation. (www.super-lube.com)
- Temperature limit is for the seal material only and does not imply the pressure rating is necessarily applicable at this limit.

- Clean and lubricate all studbolts and nuts, and prove free and easy nut running prior to the installation.
- Assemble the PLIDCO Split Repair Fitting around the pipe making sure the yellow painted ends are matched.
- All studbolts and nuts should be uniformly torqued as indicated by the *PLIDCO Torque Chart* located on the back cover. The best results are obtained by maintaining an equal gap all around, between side bars, while tightening the studbolts. Ensure a minimum of 1/4 inch (6.4 mm) of studbolt extends beyond the nut. Different torque values are required for clamping ends, if so equipped. Refer to the section on clamping ends if applicable.
- To complete assembly, ALL studbolts should be rechecked at the recommended torque. Keep in mind; an increase in torque on one studbolt can cause a decrease in torque on neighboring studbolts.
- The sidebars are gapped approximately 1/8 inch (3.2 mm) when the PLIDCO Split Repair Fitting is fully tightened. Different sidebar gaps are applicable for clamping ends, if so equipped. Refer to the section on clamping ends if applicable.

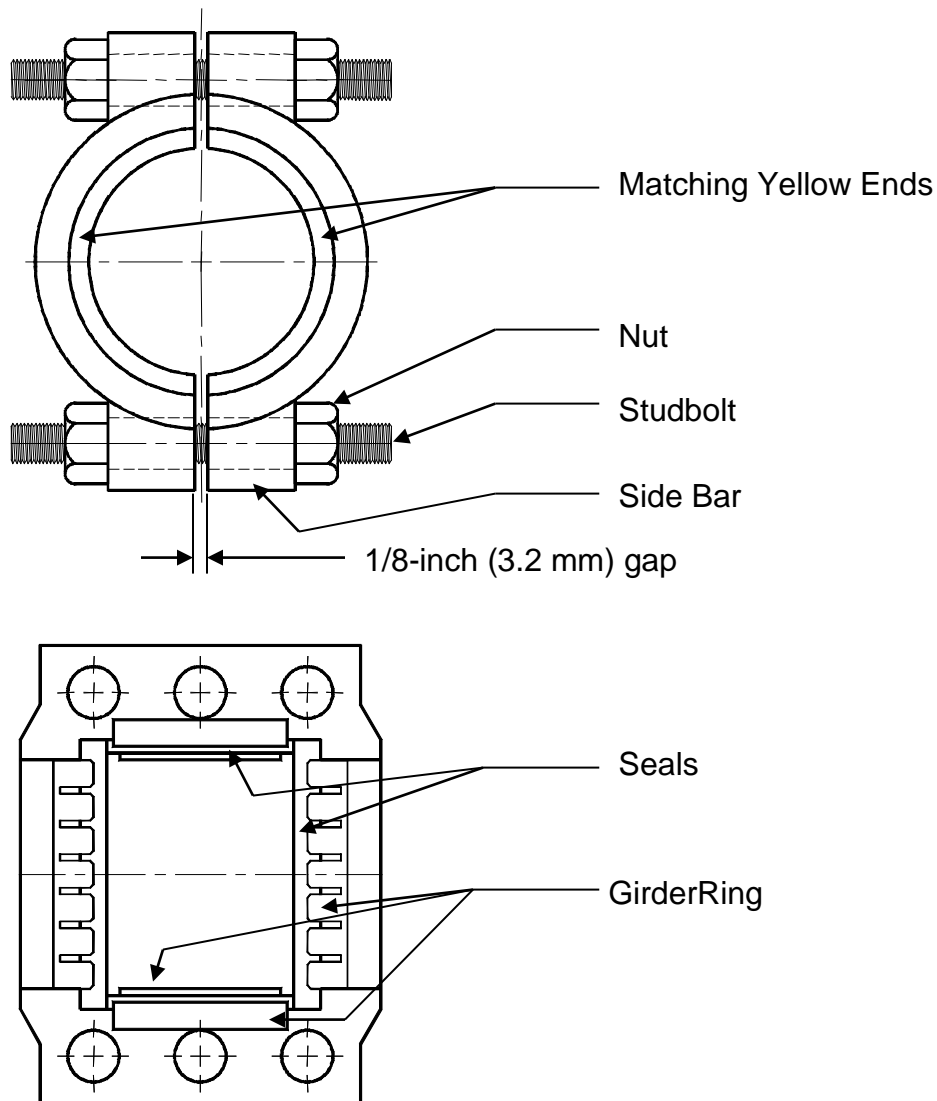


Figure 1

Re-pressuring and Field Testing

If the pipeline has been shut down, repressuring should be done with extreme caution. Repressuring should be accomplished slowly and steadily without surges that could vibrate the pipeline and fitting. Industry codes and standards are a good source of information on this subject. Except for testing purposes, do not exceed the design pressure of the PLIDCO Split Repair Fitting. The PLIDCO Split Repair Fitting can be field tested up to 1½ times its design pressure. Personnel should not be allowed near the repair until the seal has been proven.

Field Welding Instructions

Welding is not a requirement for the pressure sealing ability of the PLIDCO Split Repair Fitting. The issue of welding is dependent on your company's requirements, applicable codes, and if longitudinal loads need to be carried by the PLIDCO Split Repair Fitting. Refer to the section on Clamping Ends if so equipped.

Failure to follow field welding instructions could result in explosion, fire, death, personal injury, property damage and/or harm to the environment.

PIPELINE SHOULD BE FULL AND UNDER FLOW

Use weld material with equal or greater tensile strength than the pipe. Carefully control the size and shape of the circumferential fillet welds. The size of the fillet weld should be at least 1.4 times the wall thickness of the pipe. This assumes a 1.0 joint efficiency. You may need to select a different joint efficiency based on your level of inspection. Strive for a concave faced fillet weld, with streamlined blending into both members; avoid notches and undercuts. The smoother and more streamlined the weld, the greater the resistance to fatigue failure. The worst possible shape would be a heavy reinforced convex weld with an undercut. Improper weld shape can lead to rapid fatigue failure, which can cause leakage, rupture or an explosion with attendant serious consequences.

Welders and weld procedures should be qualified in accordance with API Standard 1104, *Welding of Pipelines and Related Facilities*, Appendix B, *In-Service Welding*. We strongly recommend the use of a low hydrogen welding process such as GMAW or SMAW using low hydrogen electrodes (E-XX18) because of their high resistance to moisture pick-up and hydrogen cracking. These are also the preferred welding process for seal welding the studbolts and nuts. SMAW electrodes must be absolutely dry.

It is very important that the field welding procedure closely follow the essential variables of the qualified procedure so that the quality of the field weld is represented by the mechanical tests performed for the procedure qualification.

We do not recommend the use of thermal blankets for pre-heating. Thermal blankets can generate hot spots and reduce the ability of the PLIDCO Split Repair Fitting to dissipate welding heat in the vicinity of the seals. We recommend a small torch, such as a cutting torch, being careful not to aim the flame directly into the gap between the PLIDCO Split Repair Fitting and the pipe towards the seals. The flame from a preheat torch is helpful in burning off oils and other contaminants. Do not use a large torch, commonly called a rosebud, because of the difficulty controlling the size of the area being preheated.

Monitor the heat generated by welding or preheating, particularly near the area of the seals, by using temperature crayons or probe thermometers. If the heat generated approaches the temperature limit of the seal material, which is indicated on the label, welding should be discontinued or sequenced to another part of the fitting so that the affected area has a chance to cool.

Seal welding the grade B-7 studbolts of the PLIDCO Split Repair Fitting is the most difficult phase of field welding. They are made of AISI 4140 steel with a high carbon equivalence. By using a low hydrogen welding process with preheat, the problem of hydrogen cracking and pinholes can be reduced. The preheat will dry out any moisture, oil dampness or thread lubricant that may be present in the weld area. If the studbolt lengths need to be cut back, allow at least 1/4 inch (6.4 mm) of studbolt beyond the nut for the fillet weld. Preheat the studbolt and nut and then weld the nut to the studbolt. Check the preheat and weld the nut to the sidebar.

WELDING AFTER A CONSIDERABLE TIME LAPSE AFTER THE INITIAL INTALLATION

PLIDCO recommends that if the PLIDCO Split Repair Fitting is to be welded, the welding be completed as soon as possible after the installation; as conditions permit. Welding at a significantly later date relies heavily on whether proper installation procedures were followed and the compatibility of the elastomeric gaskets with the product in the pipeline.

After the installation of the PLIDCO Split Repair Fitting there is no meaningful test that can be performed to determine the condition of the gaskets or the remaining service life the gaskets. There are many variables that can affect the condition of the gaskets over which PLIDCO has no control.

If the PLIDCO Split Repair Fitting is to be welded at a significant time lapse from the installation, the follow precautions should be followed:

1. The PLIDCO Split Repair Fitting must be closely inspected for any leakage that may have developed.
2. The studs and nuts should be retightened per the recommended torque value.
3. If possible, the pressure in the line should be reduced.
4. Some flow in the line is still required to dissipate the welding heat to prevent damage to the elastomeric seals.
5. Following the recommended welding practices as listed under Field Welding Instructions.

Welding Sequence

1. Caution should be observed so that welding does not overheat the seals. Sequence the welding so that the heat is not concentrated in one area. It will be necessary to re-torque the studbolts and nuts periodically during field welding because weld contraction causes them to loosen.
2. Fillet weld ends to pipe. (See Figure 2)
3. Seal Weld side openings.
4. Re-torque studbolts and nuts.
5. Seal weld nuts to studbolts.
6. Seal weld nuts to side bars.
7. Seal weld vent plugs, if applicable.

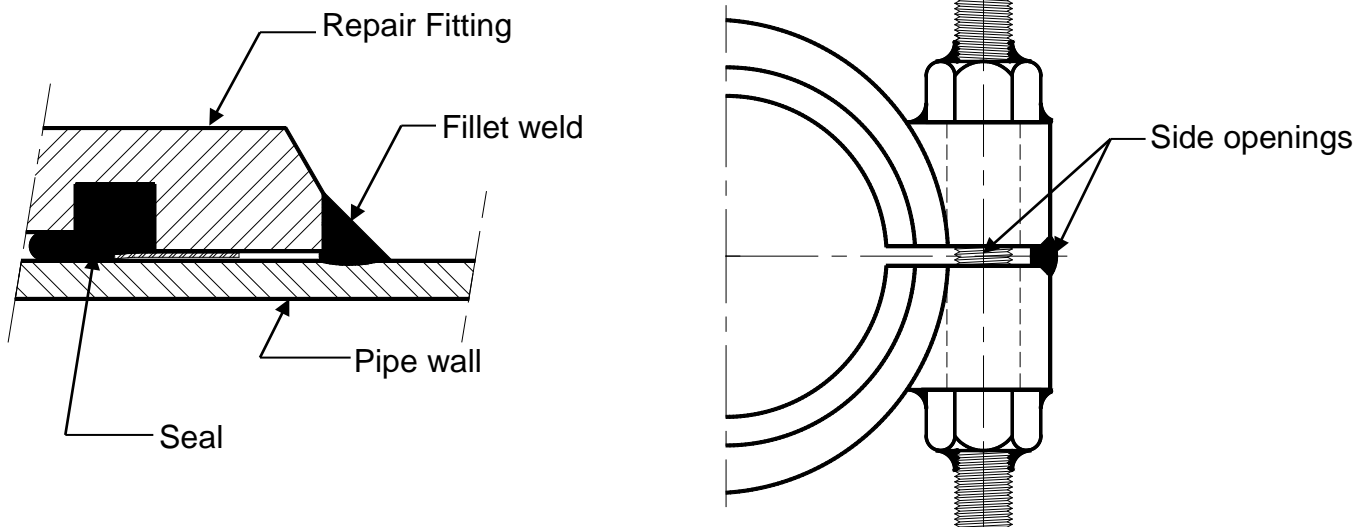


Figure 2

Storage Instructions

PLIDCO Split Repair Fittings should be stored in a dry environment to prevent the unpainted surfaces from rusting. Storage temperatures should not exceed 120°F (49°C). Cover with dark polyethylene to keep the direct sunlight from the packing. It is best to exclude contamination, light, ozones and radiation. Improperly stored PLIDCO Split Repair Fittings can cause the seal material to become cracked and brittle and lose its ability to seal.

Traceability

PLIDCO Split Repair Fittings, as most PLIDCO products, have a unique serial number by which the fitting is fully traceable. Additionally, all elastomer seals have a unique batch number by which the seal material is traceable.

Underwater Installation

WARNING!

This warning is only applicable to a non-leaking, underwater installation. When assembling a PLIDCO Split Repair Fitting under water (or under any liquid) it is possible to build up thousands of pounds of pressure in the annulus between the fitting and the pipe. The pressure is caused by compressing the fluid trapped in the annulus as the two fitting halves are closed and tightened. For installations over a leak, pressure in the annulus equalizes with the pressure in the pipe. The pressure trapped in the annulus may have the following effects:

- The pressure rating of the split product is exceeded causing leakage or damage to the fitting.
- The pipe on which the fitting is installed is damaged.
- Personal injury or death due to subsequent removal of a vent plug.

RECOMMENDATIONS

The Pipe Line Development Company strongly recommends the following for non-leaking, underwater installations:

1. All fittings are supplied with vents.
2. Vents are open during installation.

Additionally, the Pipe Line Development Company recommends not using a lubricant on the seals or on the studbolt and nut threads. This is to prevent sand, gravel, or debris from sticking to the lubricant and possibly interfering with sealing and/or obtaining accurate torque reading on the stud bolts. It is recommended that the torque value listed under the 0.15 C_f (coefficient of friction) be used for non-lubricated studs installed underwater.

PLIDCO Torque Chart

Nominal Diameter of Studbolt (inches) (see Note 2)	Wrench Opening Across Flats (inches)	Torque Values (see Note 1)			
		0.08 C _f		0.15 C _f	
		ft-lbs	Nm	ft-lbs	Nm
		25,000 psi pre-stress			
5/8--11	1-1/16	33	45	56	76
3/4--10	1-1/4	57	77	98	133
7/8--9	1-7/16	91	123	156	212
1--8	1-5/8	135	183	233	316
1-1/8--8	1-13/16	197	267	342	464
1-1/4--8	2	274	372	480	651
1-3/8--8	2-3/16	370	502	651	883
1-1/2--8	2-3/8	485	658	857	1162
1-5/8--8	2-9/16	617	837	1096	1486
1-3/4--8	2-3/4	782	1060	1394	1890
1-7/8--8	2-15/16	968	1313	1730	2346
2--8	3-1/8	1180	1600	2116	2869
2-1/4--8	3-1/2	1695	2298	3053	4140
2-1/2--8	3-7/8	2340	3173	4231	5737
		23,000 psi pre-stress			
2-3/4--8	4-1/4	2880	3904	5224	7083
3--8	4-5/8	3785	5133	6885	9336
3-1/4--8	5	4826	6545	8799	11931
3-1/2--8	5-3/8	6043	8194	11037	14967
3-3/4--8	5-3/4	7447	10099	13626	18477
4--8	6-1/8	9055	12278	16590	22497
		18,800 psi pre-stress			
4-1/4--8	6-1/2	8891	12057	16313	22120
4-1/2--8	6-7/8	10569	14331	19413	26324
4-3/4--8	7-1/4	12444	16874	22882	31028
5--8	7-5/8	14530	19703	26743	36263
5-1/4--8	8	16837	22830	31014	42055
5-1/2--8	8-3/8	19375	26272	35717	48433
5-3/4--8	8-3/4	22156	30044	40873	55425
6--8	9-1/8	25191	34160	46504	63059

Studs: ASTM A193 Grade B7 - Nuts: ASTM A194 Grade 2H

Note 1: Torque values shown in the table represent two different coefficients of friction (C_f); 0.08 and 0.15. When C_f equals 0.08, it is assumed the studs and nuts are clean, free running, free of obvious flaws and lubricated with a high-grade graphite-oil thread lubricant. When C_f equals 0.15, it is assumed the studs and nuts are clean, free running, free of obvious flaws and lubricated with a light weight machine oil. The torque values are safe minimums and represent approximately the bolt pre-stress values.

Note 2: The second number is the pitch, which is shown in number of threads per inch.

Note 3: Use the pre-stress value shown for the applicable studbolt size if bolt tensioners are to be used and follow the bolt tensioner manufacturer's instructions.

Clamping Ends

Due to the unsymmetrical nature of many PLIDCO Split Repair Fittings there is an unbalanced force generated by the internal pressure. This unbalanced force can cause movement of the PLIDCO Split Repair Fitting relative to the pipeline resulting in an increase in the seal compression on one side of the fitting and a decrease in the seal compression on the other side, which can cause leakage. For small, low pressure fittings this difference in the seal compression is insignificant. However, for larger, higher pressure fittings the unbalanced force has to be counteracted by clamping ends. Clamping ends are designed to grip the pipe and prevent movement of the PLIDCO Split Repair Fitting. Additionally, some customers require clamping ends when there is concern about total separation of the pipe.

The two additional concerns when installing a PLIDCO Split Repair Fitting with clamping ends are:

1. The torque value requirements are different for the studbolts in the clamping ends than the studbolts in the central sealing section. Refer to the Clamping Ends Torque Chart at the end of these installation instructions.
2. The gap between the two fitting halves is not necessarily the same for the clamping ends as it is for the sealing section. The sealing section gap is always 1/8 inch, whereas the clamping end gap can be between 1/8 and 1/4 inch, depending on pipe diameter. Consult PLIDCO if this dimension is required.

PLIDCO Clamping End Torque Chart

Nominal Diameter of Studbolt (inches) (see Note 2)	Wrench Opening Across Flats (inches)	Torque Values (see Note 1)			
		0.08 C _f		0.15 C _f	
		ft-lbs	Nm	ft-lbs	Nm
		52,500 psi pre-stress			
5/8--11	1-1/16	70	95	118	160
3/4--10	1-1/4	120	162	206	280
7/8--9	1-7/16	192	259	328	446
1--8	1-5/8	284	385	490	664
1-1/8--8	1-13/16	414	561	719	975
1-1/4--8	2	576	782	1008	1368
1-3/8--8	2-3/16	777	1055	1368	1855
1-1/2--8	2-3/8	1019	1382	1800	2441
1-5/8--8	2-9/16	1296	1758	2302	3121
1-3/4--8	2-3/4	1643	2226	2929	3969
1-7/8--8	2-15/16	2033	2758	3633	4927
2--8	3-1/8	2478	3360	4444	6025
2-1/4--8	3-1/2	3560	4826	6412	8694
2-1/2--8	3-7/8	4914	6664	8886	12048
		47,500 psi pre-stress			
2-3/4--8	4-1/4	5947	8064	10787	14628
3--8	4-5/8	7816	10598	14218	19280
3-1/4--8	5	9966	13514	18170	24639
3-1/2--8	5-3/8	12478	16921	22794	30908
3-3/4--8	5-3/4	15380	20856	28140	38157
4--8	6-1/8	18699	25355	34262	46460
		37,500 psi pre-stress			
4-1/4--8	6-1/2	17735	24050	32540	44123
4-1/2--8	6-7/8	21082	28586	38723	52508
4-3/4--8	7-1/4	24822	33659	45643	61891
5--8	7-5/8	28983	39302	53344	72334
5-1/4--8	8	33585	45539	61864	83887
5-1/2--8	8-3/8	38647	52405	71245	96609
5-3/4--8	8-3/4	44195	59929	81529	110556
6--8	9-1/8	50249	68139	92761	125783

Studs: ASTM A193 Grade B7 - Nuts: ASTM A194 Grade 2H

Note 1: Torque values shown in the table represent two different coefficients of friction (C_f); 0.08 and 0.15. When C_f equals 0.08, it is assumed the studs and nuts are clean, free running, free of obvious flaws and lubricated with a high-grade graphite-oil thread lubricant. When C_f equals 0.15, it is assumed the studs and nuts are clean, free running, free of obvious flaws and lubricated with a light weight machine oil. The torque values are safe minimums and represent approximately the bolt pre-stress values.

Note 2: The second number is the pitch, which is shown in number of threads per inch.

Note 3: Use the pre-stress value shown for the applicable studbolt size if bolt tensioners are to be used and follow the bolt tensioner manufacturer's instructions.