

**CASE IIIA
BOLTING PROCEDURE
USING STUD TENSIONERS - 25% COVERAGE**

THIS PROCEDURE IS TO BE USED IN THE FOLLOWING SITUATIONS:

1. Joints with large bolts which are subject to galling.
2. Joints where bolt tensioning can reduce critical path timing.

THE FOLLOWING DATA, TO BE RECORDED ON THE JOB DATA SHEET.

1. Customer
2. Job Number
3. Unit
4. Joint Identification and Alignment Check
5. Bolt Material
6. Bolt Diameter
7. Number of Bolts
8. Nut Size ATF
9. Gasket Type
10. Gasket Material
11. Condition of Bolts
12. Condition of Washers
13. Lubricant
14. Stud Tensioner Data
15. Flange Make-Up Data
16. Completed Alignment Check
17. Supervisor's Signature
18. Notes

JOINT PREPARATION

1. Thoroughly clean the flange faces and check for scars.
2. Check studs and nuts for proper size, piping material specifications and cleanliness; and any rust, paint or corrosion to be removed by wire brushing or bead blasting.
3. Remove burrs from all threads.
4. If one stud is replaced, all must be replaced.
5. Gaskets are to be checked for proper size and specifications. Metal gaskets to be free of grease, rust or burrs.
6. Check flange spot face where nut makes contact. This area must be clean and smooth. Use 1/4" thick hardened steel washers on both ends of studs when installing new bolts.
7. Check flange alignment: alignment of parallelism tolerance shall be limited to 3/32" per foot of pipe diameter measured at any point on the flange circumference.
8. Number the studs and nuts for identification and control during bolting procedure.
9. Lubricate the thread area of both stud and nut. Also lubricate the face of the nut in contact with the flange (use only anti-seize paste lubricant). Apply lubricant thoroughly to all surfaces.
10. Where applicable, the flanges will be pulled together and snugged with hand wrenches. When working with heavier flanges that have not support, it is acceptable to use an impact to lightly snug a maximum of 8 bolts beginning with bolt #1 and following the bolt pattern.

NOTE: When using an impact wrench, only enough pressure shall be applied to hold the flange stable.

TENSIONING PROCEDURE

1. Fill in the job data sheet and job work sheet showing the: Load Loss Factor, Bolt Stress Area, Residual Load Required, and Pump Pressure Settings. Label bolts in flange according to the appropriate bolt tensioning pattern for 25% coverage.
2. Assemble stud tensioners on the first set of bolts in the pattern (set "A"). Use the **first pass pump setting** to pressurize the tensioners.
3. Pressurize the tensioners. Turn the nuts down against the flange face. **CAUTION:** If maximum piston extension is reached before required pressure is reached; stop pressurizing, turn the nuts down onto the tensioned joint face and slowly release pressure. Screw down the puller bar onto the load cell, ensuring that the puller bar is turned all the way down. If necessary, pressurize again.
4. Release the pressure after the required pressure is reached and the nuts have been turned down against the joint face.
5. Transfer stud tensioners to the second set of bolts (set "C") in the pattern and repeat steps 3 and 4 at the **first pass pump setting**.
6. Transfer stud tensioners to the third set of bolts (set "B") in the pattern and repeat steps 3 and 4 at the **second pass pump setting**.
7. Transfer stud tensioners to the fourth set of bolts (set "D") in the pattern and repeat steps 3 and 4 at the **second pass pump setting**.
8. Transfer stud tensioners to the first set of bolts (set "A") in the pattern and repeat steps 3 and 4 at the **second pass pump setting**.
9. Transfer stud tensioners to the second set of bolts (set "C") in the pattern and repeat steps 3 and 4 at the **second pass pump setting**.
10. For joints with spiral wound or double jacketed gaskets, repeat step 8 twenty-four hours after completion of the second pass.

**CASE III
JOB WORK SHEET**

1. Bolt Diameter _____ 2. Bolt Material _____
3. TPI _____ 4. Joint Grip Length _____
5. Load Loss Factor (F) _____ (See Exhibit V)

To find the Load Loss Factor (F):

- a. Divide the joint grip length (G) by the bolt diameter (D)

$$\frac{G}{D} = R(\text{Ratio})$$

- b. Locate (R) on the horizontal axis (See Exhibit V)
c. Extend a vertical line from (R) to intersect the curve at normal surfaces
d. Extend a horizontal line from the intersection to the vertical axis and read the Load Loss Factor (F)

6. First Pass Load (FPL) required _____ Lbs.

$$FPL = RL \times F$$

Residual Load (RL) required (See Exhibit IV)

NOTE: First pass load required must not exceed maximum allowable applied load (See Exhibit IV)

7. First Pass Pressure (FPP) required _____ PSI

First Pass Pressure = First Pass Load (FPL) required divided by Tensioner Piston Area (TPA) (See Job Data Sheet)

$$FPP = \frac{FPL}{TPA}$$

8. Second Pass Pressure (SPP) required _____ PSI

$$SPP = \frac{RL}{TPA}$$

**CASE IIIA
JOB DATA SHEET
FOR USE WITH STUD TENSIONERS
25% COVERAGE**

1. Customer _____ 2. Job Number _____
3. Unit _____ 4. Flange _____
Starting Alignment Checked _____
5. Bolt Diameter _____ 6. Bolt Material _____
7. Number of Bolts _____ 8. Nut Size ATF _____
9. Gasket Type _____ 10. Gasket Material _____
11. Bolt Condition _____ 12. Washer Condition _____
13. Lubricant:
Manufacturer _____
Lubricant Name or Number _____
(Must be ANTI-SEIZE PASTE with appropriate temperature rating)
14. Stud Tensioner Data:
Manufacturer _____ Model _____
Load Limit _____ Piston Area _____
15. Flange Make-Up Data
First Pull Load Required (FP): _____ Lbs.
First Pull Pump Pressure (P1): _____ PSI.
Second Pull Pump Pressure (P2): _____ PSI.
Residual Load (Second Pull Load): _____ Lbs.
Second Pull Completed: Date ____ / ____ / ____ Time _____
Approximate Time to Complete: _____ Number of People in Crew: _____
24 Hour Pull Completed: Date ____ / ____ / ____ Time _____
16. Completed Flange Alignment Checked _____
17. Supervisor's Signature _____
18. Notes:

EXHIBIT IV

LOAD & TORQUE CHART

NEW, ASTM A193, GRADE B7 STUDS
 NEW HARDENED STEEL WASHERS
 RESIDUAL STRESS AT 50% OF MINIMUM YIELD.
 MAXIMUM ALLOWABLE APPLIED STRESS AT 70% OF MINIMUM YIELD.
 LUBRICANT: ANTI-SEIZE PASTE ON ALL MATING SURFACES
 K-FACTOR = 0.18

BOLT LOAD = STRESS AREA (INCHES²) X BOLT STRESS (PSI)

$T = K \text{ (Nut Factor)} \times \text{Clamp Load (LBS)} \times D \text{ (Bolt Diameter) Inches}$

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BOLT DIAMETER (INCHES)	STRESS AREA (INCHES ²)	MINIMUM YIELD (PSI)	RESIDUAL LOAD REQUIRED (LBS)	TORQUE REQUIRED (FT-LBS)	MAXIMUM ALLOWABLE APPLIED LOAD
3/4	0.334	105,000	17,535	197	24,549
7/8	0.462	105,000	24,255	318	33,957
1	0.606	105,000	31,815	477	44,541
1-1/8	0.790	105,000	41,475	700	58,065
1-1/4	1.000	105,000	52,500	984	73,500
1-3/8	1.233	105,000	64,732	1,335	90,625
1-1/2	1.492	105,000	78,330	1,762	109,662
1-5/8	1.780	105,000	93,450	2,278	130,830
1-3/4	2.080	105,000	109,200	2,867	152,880
1-7/8	2.410	105,000	126,525	3,559	177,135
2	2.770	105,000	145,425	4,090	203,595
2-1/8	3.150	105,000	165,375	5,271	231,525
2-1/4	3.560	105,000	186,900	6,308	261,660
2-3/8	3.990	105,000	209,475	7,463	293,265
2-1/2	4.440	95,000	188,700	7,909	295,260
2-3/4	5.430	95,000	230,775	10,639	361,095
3	6.510	95,000	276,675	13,915	432,915
3-1/4	7.690	95,000	326,825	17,807	511,385
3-1/2	8.960	95,000	380,800	22,344	595,840
3-3/4	10.340	95,000	439,450	27,627	687,610
4	11.810	95,000	501,925	33,659	785,365

EXHIBIT V

HYDRAULIC STUD TENSIONERS LOAD LOSS FACTOR

