

REVISION LETTER	GE ALTERATION NOTICE NUMBER

INSTRUCTION MANUAL IM-152

**For Gas Turbine and Steam Turbine
Tensioned Studs and Nuts**

Fr. 9FA Gas Turbine to 330H Generator	GE 382A4341P005
	GE 382A4341P006
Fr. 9FB Gas Turbine to 330H Generator	GE 382A4341P001
	GE 382A4341P002
	GE 382A4341P003
	GE 382A4341P004
	GE 382A4341P005
	GE 382A4341P006
Fr. 9FB Gas Turbine to 450H Generator	GE 382A4341P005
	GE 382A4341P006
Steam Turbine to 330H Generator	GE 808L7424G001

GE Power Generation		GENERAL ELECTRIC COMPANY Schenectady, NY	
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**Instruction Manual IM-152
For Gas Turbine and Steam Turbine Tensioned Studs & Nuts**

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1.0 Cautions and Safety Warnings

CAUTION

Personal injury and equipment damage can occur if the puller screw is not securely engaged with the tapered thread of the stud. Proper engagement is achieved when the puller screw is tight in the stud and the Tensioner Assembly is free to rotate.

WARNING

The safety cage MUST be in place and hands kept out of designated areas at all times when the tensioner is pressurized otherwise personal injury can occur.

CAUTION

DO NOT EXCEED THE MAXIMUM PRESSURE VIBROSCRIBED ON THE PULLER BODY. Excessive pressure can damage the stud and the puller screw.

WARNING

Fire Hazard! DO NOT heat when the puller assembly is in place. Personal injury or equipment damage may occur. Use of an Oxy-Acetylene torch is not recommended.

NOTICE

Do not use more thread locking compound than specified or the nut may be VERY difficult to remove at disassembly.

CAUTION

DO NOT EXCEED THE MAXIMUM PRESSURE VIBROSCRIBED ON THE PULLER BODY. Excessive pressure can damage the stud and puller screw

Note: Before threading the puller screw into the stud, carefully check the cleanliness of both the stud's and the puller screw's conical threads. Apply a light coat of clean turbine oil or a spray lubricant to the puller screw. Do not use "Never Seize" on the conical threads. This procedure will ease assembly and assure positive mating of the threads before tightening.



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2.0 Scope

This document describes the procedure to be used to install studs and nuts supplied by Riverhawk Company in the flanges at the turbine/coupling and coupling/generator connections. This hardware is depicted on the following drawings. These drawings as well as Tooling drawings form a part of this manual.

HF-2019	HF-3447	HF-3794	HF-5379
HT-2287	HT-3795	HT-5380	



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3.0 Quick Checklist

The following checklist is intended as a summary of the steps needed to use the Riverhawk-supplied equipment. New personnel or those experienced personnel who have not used the Riverhawk equipment recently are encouraged to read the entire manual.

EQUIPMENT INSPECTION

- Check oil level in hydraulic pump.
- Check air pressure at 80 psi [5.5 bar] minimum. (For air-driven pumps)
- Check hydraulic hose for damage.
- Test pump.
- Inspect tensioner for any damage.

NUT AND STUD PREPARATION

- Inspect stud and nuts for any damage.
- Measure stud length.
- Clean the studs and nuts.
- Install studs and nuts (off-center) into the flange.
- Set stick-out dimension on the coupling side of the flange.
- Hand tighten all studs.
- Verify stick-out measurement (VERY IMPORTANT)



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Tensioning (Bolt installation)

- Match the tensioner setup to the flange joint.
- Apply a light coat of clean turbine oil or spray lubricant to the puller screw. **DO NOT USE "NEVER SEIZE" ON THE CONICAL THREADS.**
- Slide spanner ring over the puller screw.
- Mount the tensioner on the stud in flange.
- Install spanner ring onto nut.
- Insert 1/2" hex Allen wrench into the back side of the stud.
- Tighten the puller screw.
- Back off puller screw 1/2 turn.
- Retighten the puller screw and leave tight. **DO NOT BACK OFF PULLER SCREW.**
- Bleed the tensioner. **Do NOT bleed tensioner off of a stud! Damage to the tool will result!**
- Tension to 50%. Consult manual for correct pressure.
- Use the pin wrench in spanner ring to tighten nut.
- Release pressure, move to next stud in pattern.
- Repeat above steps at final pressure.
- Measure final stud length and record on stretch datasheets. Calculate stretch.
- Torque nuts' set screws.



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Detensioning (Stud removal)

- Loosen nuts' set screws
- Inspect and clean studs' conical threads. **Do not continue until ALL debris is removed from the threads! Do not try to use the tensioner to remove a damaged stud!**
- Apply a light coat of clean turbine oil or spray lubricant to the puller screw. **DO NOT USE "NEVER SEIZE" ON THE CONICAL THREADS.**
- Slide spanner ring over the puller screw.
- Mount the tensioner on the stud.
- Install spanner ring into nut.
- Tighten the puller screw.
- Back off puller screw 1/2 a turn.
- Retighten the puller screw and leave tight. **DO NOT BACK OFF PULLER SCREW.**
- Bleed the tensioner. **Do NOT bleed tensioner off of a stud! Damage to the tool will result!**
- Apply final pressure.
- Loosen nut with the spanner ring and pin wrench.
- Move to next stud in pattern



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4.0 General Preparations

Read and understand all instructions before installing and tensioning studs

This equipment produces very high hydraulic pressures and very high forces. Operators must exercise caution, wear safety glasses and hard hats when using this equipment.

High pressure fluid from the Hydraulic Pressure Kit system pressurizes the tensioner which generates a stretching force that actually stretches the stud. As the stud is stretched the nut lifts off the flange . The nut is then resealed into position on the flange by turning a nut driver by hand. When the nut is tight against the flange, the pressure in the tensioner is released leaving the stud loaded to its predetermined value.

4.1 Hardware - Balance

- Hardware is supplied as weight balanced sets
- Studs and nuts are interchangeable within sets
- Do not intermix with other sets
- Save weight certification supplied with each set for the purchase of spare parts

4.2 Machine Preparation

The flange to be tensioned must be fully closed prior to positioning the studs in the flanges. There must be provisions for turning the shafts of the turbine, coupling, gearbox and generator. Also, it will be advantageous to remove as many obstructions as possible from the flange area, such as speed probes and conduit.



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5.0 Preparation of Hardware

5.1 Nut Preparation

For new installations, the nuts should come sealed from the factory and will need no cleaning.

Previously installed nuts require cleaning: Wire brush using a petroleum based solvent to remove any foreign material on the external surfaces and threads.

Do not apply thread lubricants to the threads.

Finish the cleaning process by rinsing in a volatile solvent such as acetone and allow to dry.

5.2 Stud Preparation

For new installations, the studs should come sealed from the factory and will need no cleaning.



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5.2.1 Stud Cleaning - Old Installations

Previously installed studs may require cleaning. Clean conical threads should have a bright and shiny appearance.

If cleaning is required, follow these steps:

1. Blow out the threads with compressed air to remove loose debris and dry conical threads. Do not apply a solvent or other cleaning solution to the threads as this may chemically attack the stud.
2. Use Stud Cleaning Kit, GT-4253 or a similar 1" diameter Brass power brush.



Picture of Brass Power Brush

3. Insert the brush into an electric drill and set drill to run in a counterclockwise direction at high speed.
4. Work the drill in a circular motion while moving the brush in and out to clean all of the threads. Try not to hold the brush in one place too long, so as not to remove the stud's protective coating.
5. Blow out the threads with compressed air to remove loosened debris.
6. Visually inspect threads for cleanliness. Threads should be bright and shiny.
7. Repeat if any dirt can be seen in the threads.
8. Inspect threads for any damage that may have been caused by previous installation.

Do not apply thread lubricants to the threads.

Finish the cleaning process by rinsing in a volatile solvent such as acetone and allow to dry.



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5.3 Stud Length Measurement

Stud measurement will require a micrometer or caliper which will measure 12 to 13 inches [305 to 330 mm].

Measure and record the initial length of the studs. The following suggestions will improve your results:

- Plan to start and finish any flange in the same day.
- Studs and flange must be at the same temperature.
- Number each stud with a marker.
- Mark the location of measurement on stud end with a permanent marker.
- Measure each stud to nearest 0.001 inch.
- Record each measurement on the supplied charts.
- Do not allow the micrometer to set in the sun

6.0 Stud and Nut Assembly

Refer to Hardware Assembly Drawing (HF-) listed in Section 2.0 of this manual. Assemble cylindrical nut to the tapered thread end (Pull End) of the stud. Slide the stud and cylindrical nut assembly into the flange from the coupling side as shown in Figures 1 & 2, then install the other nut on the back side. **Adjust the nut/stud assembly so that the stud protrudes from the face of the cylindrical nut by the amount depicted on the hardware drawing (HF-) and also shown in Figures 1 & 2. SETTING THIS PROTRUSION OF STUD TO NUT IS CRITICAL FOR PROPER TENSIONER OPERATION. A metal stickout gage is provided with the tensioner to assist the operator in setting the protrusion dimension (See Fig. 6). Hand tighten the assembly to a snug fit. See Photos 1 & 2 for a view of the assembly of studs and nuts in the flange prior to tensioning.**

7.0 Assembly of Hydraulic Tensioner Equipment

7.1 Kit Assembly

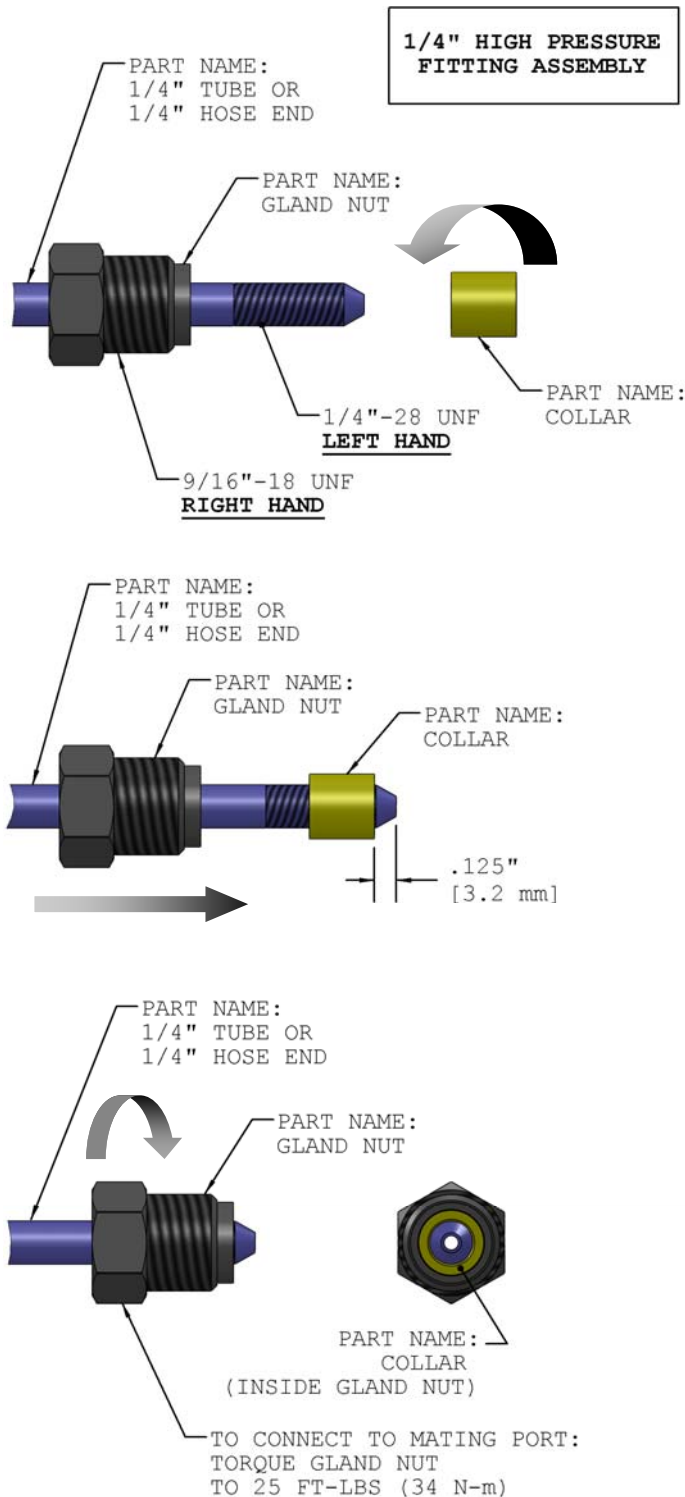
Assemble the hydraulic pump with its hose to the puller tool and bleed the system of air per following instructions.



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7.1.1 Hydraulic Fittings



Riverhawk tensioners use a 1/4" High Pressure port to connect its hydraulic hoses. The hose connector is made from a three piece assembly: a gland nut, a collar, and a 1/4" tube or 1/4" hose end.

To assembly the fitting, slide the gland nut over the 1/4" tube or 1/4" hose end. Turn the collar counter-clockwise (**left hand** thread) on to the tube or hose end.

The collar should be placed .125" (3.2 mm) from the tip of the cone. It may be necessary to adjust this collar with a set of vise-grip pliers. Be careful to not strip the threads off the tube or hose end.

Slide the gland nut down over the collar. Insert the 1/4" tube or 1/4" hose end into tensioner or hydraulic pump. While firmly holding the tube or hose end to stop it from rotating, turn the gland nut clockwise (**right hand** thread) and torque the gland nut to 25 FT-LBS (34 N-m).

Tips:

- Make sure all parts are clean and free from debris.
- Protect the cone from scratches as this is the sealing surface.

Replace red plastic caps when finished to protect the threads and cone.



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7.2 Pump

Pump kit is shipped full of hydraulic oil. The pump reservoir cap is sealed for shipment. To use turn cap to the vent position. To prevent oil spillage close cap when not in use, during storage and shipment. Lost oil should be replaced with Enerpac Hydraulic Oil. ISO 32. Mineral Oil may be substituted if necessary.

7.3 Bleeding Hydraulic System

Follow the tensioner assembly instructions of Section 8.0.

TO AVOID A FAILURE, ENSURE SAFETY AND PROPER OPERATION THE TENSIONER ASSEMBLY MUST BE MOUNTED ON THE STUD BEFORE BLEEDING THE SYSTEM AND TENSIONING BEGINS

The tensioner has four ports see Fig. 5, one for pressurizing, two for bleeding the system and a fourth pressure relief port.

To facilitate bleeding, start by first mounting the tensioner at either the 3 o'clock or 9 o'clock stud position depending on which will critically place the bleed ports in their uppermost position. In addition, make sure that the pump is situated below the tensioner assembly.

The puller tool is equipped with 5/8 in. [16 mm] Hex coned stem bleeder fittings installed in the bleeder ports. With these two fittings loosened simultaneously, stroke the pump repeatedly until streams of oil exiting the tool from each port are free of air, then retighten the fittings.

Providing the hose is not disconnected or loosened in the process of tensioning all the studs, bleeding the assembly once at the first position should suffice to fill the assembly and preclude the need to repeat the bleeding.

Note: The hose is stiff; use of this tooling can be simplified by temporarily mounting the puller tool on one stud prior to final tightening of fittings. This will reduce the tendency for the fittings to loosen during use.



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8.0 Assembly of Tensioner on Stud

All tensioning will be performed from the tapered thread end of the stud with orientation of the stud to the flange as shown in Figures 1 & 2.

Clean puller screw and check for any debris and dents.

Puller screw should be free to rotate and move back and forth.

Seam between cylinders closed tightly.

Inspect tensioner guard for any signs of damage. Bent guards should be replaced. Also, be sure the rubber pad is in place on the end of the guard, if missing, replace.

Refer to Tensioner assembly drawing and Figure 5 for tensioner to flange mounting. This assembly has the following features, which should make stud tensioning safe and easy.

- The safety cage is integral (bolted) to the puller tool.
- The hydraulic piston is spring loaded to retract.



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Assembly sequence is as follows:

- Place the spanner ring over the puller screw on the tensioner.
- Apply a light coat of clean turbine oil or a spray lubricant to the puller screw. Do not use "Never Seize" on the conical threads.
- Place and hold the tensioner assembly over the end of the stud to be tightened. See Photos 3, 4, & 5.
- Slide the puller screw into the tapered thread of the stud and hand tighten. **Be sure not to cross thread the assembly at the same time,** Hold the stud steady with a ½ in. hex key wrench and lightly tighten the puller screw into the thread with a wrench.
- Place the spanner ring on the cylindrical nut located on the stud.
- At this point the Tensioner Assembly **MUST BE FREE TO ROTATE,** the puller screw must be tight in the stud.

Note: If the tool is not free to rotate it is most likely that the tensioner foot has bottomed out on the flange and the nuts must be repositioned so that the stud can be shifted slightly to the puller tool side of the flange.

Note: Do not over extend the stud. Over extension can cause the piston to loose its seal and leak oil.

CAUTION

Personal injury and equipment damage can occur if the puller screw is not securely engaged with the tapered threads of the stud. Proper engagement is achieved when the puller screw is tight in the stud and the tensioner is free to rotate.



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9.0 Stud Pulling and Tensioning

The studs will be tensioned in two steps, at approximately 50% pressure and at final pressure. Follow the tensioning sequence for each flange joint as defined on the data sheets supplied at the end of this manual.

WARNING

The safety cage must be in place at all times. Keep hands out of designated areas at all times when the puller tool is pressurized otherwise personal injury can occur.

Note: Before threading the puller screw into the stud, carefully check the cleanliness of both the stud's and the puller screw's conical threads. Apply a light coat of clean turbine oil or a spray lubricant to the puller screw. Do not use "Never Seize" on the conical threads. This procedure will ease assembly and assure positive mating of the threads before tightening.

9.1 Tensioning at 50% pressure

After the tensioner is properly installed apply hydraulic pressure to the tool. Bring the pressure to the 50% level in accordance with the following table.

<u>Flange Position</u>	<u>Stud Size</u>	<u>50% Pressure</u>	<u>50% Stretch</u>
Turbine to Coupling	3" [76 mm]	10000 psi [690 bar]	Do not measure Do not use
Coupling to Generator	3" [76 mm]	10000 psi [690 bar]	Do not measure Do not use
Steam Turbine to Generator	3" [76 mm]	10000 psi [690 bar]	Do not measure Do not use

9.1.1 Tightening of Turbine/Coupling and Coupling/Generator Nuts

Tighten the cylindrical nuts hand tight using the pinwrench and spanner ring as depicted in Figure 5. Turn the nut until it bottoms on the flange.



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Caution

Do not tighten the nut or insert the pinwrench until the pump has reached pressure. If the puller screw were to pull out from improper installation INJURY could occur if operator were holding the pin wrench at time of the "jump".

9.1.2 Removing the Tensioner from an Installed Stud

The tensioner removal is to accomplished by the follows steps:

1. Release the puller tool pressure by opening the valve on the pump. Leave the valve open. (This is automatic on the air-operated hydraulic pump)
2. Unscrew the puller tool using a wrench.
3. Tapping the wrench with a hammer may be necessary to loosen the puller screw
4. Move the tool to the next stud/nut assembly to be tensioned following the sequence/pattern as defined on the supplied data sheets.

9.3 Tensioning at Final Pressure

Repeat the pulling and tightening procedure stated above at full pressure. Measures the length of the studs after all have been tensioned. The final pressure and required stretch values are listed in the following table

<u>Flange Position</u>	<u>Stud Size</u>	<u>Final Pressure</u>	<u>Final Stretch</u>
Turbine to Coupling	3" [76 mm]	18000 psi [1240 bar]	0.020" - 0.022" [0.51 mm - 0.56 mm]
Coupling to Generator	3" [76 mm]	18000 psi [1240 bar]	0.020" - 0.022" [0.51 mm - 0.56 mm]
Steam Turbine to Generator	3" [76 mm]	18000 psi [1240 bar]	0.020" - 0.022" [0.51 mm - 0.56 mm]

CAUTION

DO NOT EXCEED THE MAXIMUM PRESSURE VIBROSCRIBED ON THE PULLER BODY. Excessive pressure can damage the stud and the puller screw.



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10.0 Retensioning

For the procedures of Section 9.3 excessive stretch variations or low stretch values can be corrected by retensioning all or selected studs to the pressure value stated in the above table. Have final stretch values approved by the supervisor responsible for the installation.

11.0 Thread Locking

Once pulling and tensioning is complete all studs and nuts must be locked in position.

11.1 Thread Locking Using a Mechanical Locking Device

Mechanical lock nuts have two set screws located in the top face, see Figure 4. Before threading the nut onto the stud check to be certain that the set screws are free to turn. Once the nut is seated torque the set screws to the values specified in the following table. When seated and torqued to the values specified the load created by the set screw displaces the thread of the nut in the area of the web creating the desired locking action.

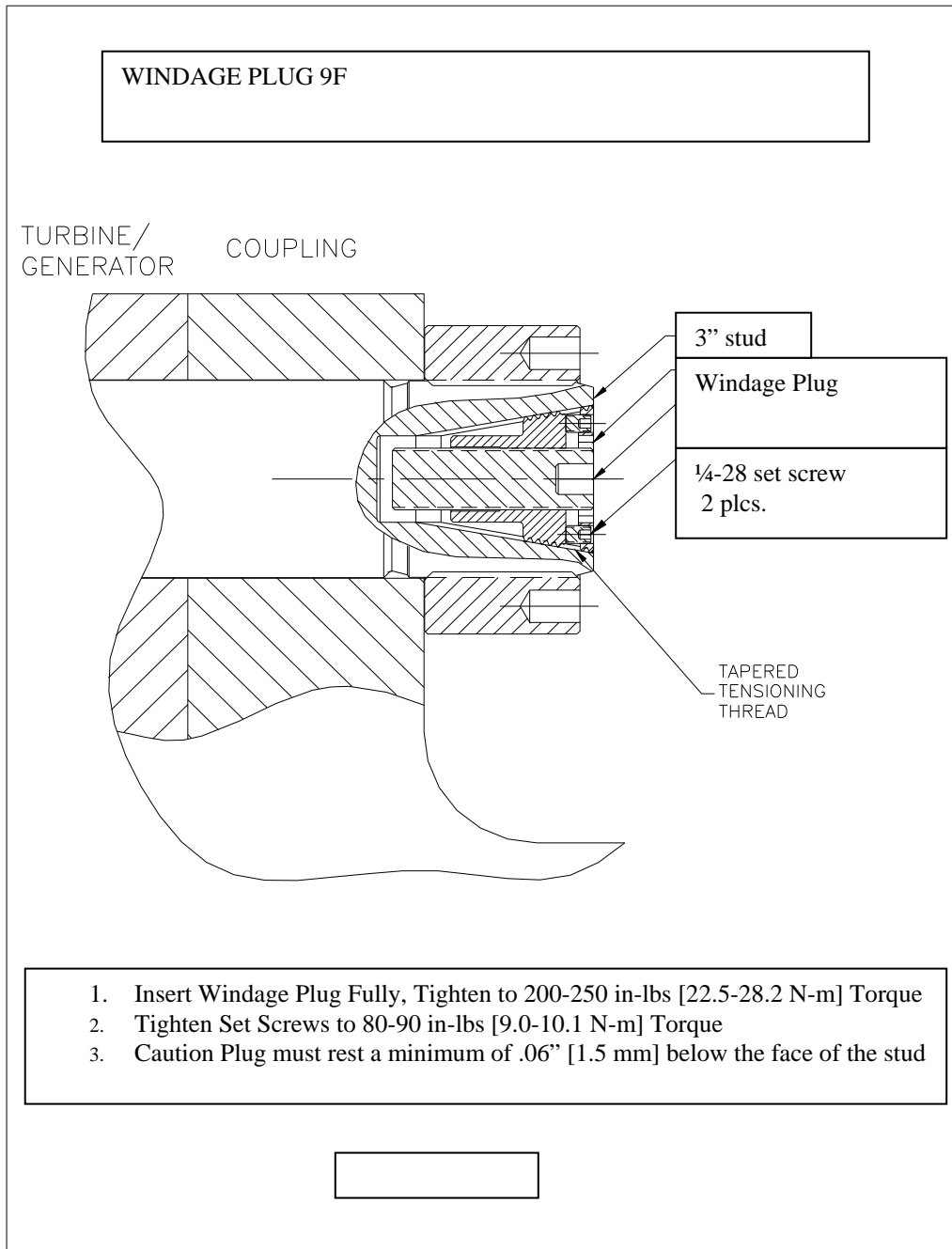
<u>Stud Size</u>	<u>Set Screw Size</u>	<u>Torque</u>
3" [76 mm]	3/8"-24 UN	200 in·lbs - 250 in·lbs [22.6 N·m - 28.2 N·m]



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12.0 Windage Plug Installation



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13.0 Stud/Nut Removal

13.1 Removal of Assemblies Mechanical Locknut

- Using a wire brush and shop air clean the internal tapered thread of the stud to remove any debris/deposits that may have accumulated during service. (see section 5.2.1)
- With an Allen wrench loosen the two locking set screws but do not remove from nut see Figure 4.
- Install the appropriate puller tool to the stud as described in Section 7.0
- Apply hydraulic pressure per the following table and without using unreasonable force attempt to loosen the nut using the spanner ring and spanner wrench as shown in Figure 5.

<u>Flange Position</u>	<u>Stud Size</u>	<u>Removal Pressure</u>
Turbine to Coupling	3" [76 mm]	18000 psi [1240 bar]
Coupling to Generator	3" [76 mm]	18000 psi [1240 bar]
Steam Turbine to Generator	3" [76 mm]	18000 psi [1240 bar]



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14.0 Frequently Asked Questions

This section contains some frequently asked questions and problems. If the steps listed here do not solve your problem, contact the Riverhawk Company thru our website, email, or phone call.

- Q:** A tensioner has pulled itself out of the stud's conical threads. Can I continue using a tensioner on this stud?
- A:** No. Both the tensioner and the stud may have been damaged. If the stud is tensioned, a Nut Buster repair kit, from Riverhawk, must be used to remove the damaged stud by drilling out the nut. Riverhawk can supply a replacement stud and nut based on the initial weight certification supplied with the hardware set (see section 4.2). The damaged tensioner should also be returned to Riverhawk for inspection and repair.
- Q:** The hydraulic tensioner has been taken up to its final pressure. The final stretch length is short of the final stretch target. What is the next step?
- A:** Do not increase the hydraulic pressure. Check if the hydraulic pump is set to the right pressure. Install the tensioner and re-pressurize the tensioner to the final pressure then recheck the stretch measurement. If the stretch value is still short, remove the stud from the hole and re-measure the stud's initial length then try to install the stud again.
- Q:** The hydraulic tensioner has been taken up to its final pressure. The final stretch length is larger than the final stretch target. What is the next step?
- A:** Remove the stud from the bolt hole. Check if the hydraulic pump is set to the right pressure. Re-measure the stud's initial length then try to install the stud again.



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- Q:** Is there an easier way to support or move the tensioner around the coupling shaft?
- A:** Use two straps. One around the coupling shaft and the other attach to any overhead support. Straps must be slack during mounting tensioner to stud and during tensioning.
- Q:** The tensioner is at its final pressure, but the nut cannot be loosen.
- A:** If the nuts cannot be loosened at the final pressure, continually increasing the pressure will not help and can be dangerous and in some cases make it harder to remove the nut. Check the nut to see if its set screws have been loosened. Check for and remove any corrosion around the nut's threads.
- Q:** How do I clean the conical threads on a stud?
- A:** The conical threads are best cleaned using a spiral wound brass brush in a drill as described in section 5.2.1
- Q:** During the initial steps of removing a tensioned stud, the stick-out length is found to be wrong.
- A:** Do not proceed. Contact Riverhawk for assistance. With the wrong stick-out length, the hydraulic tensioner has a limited stroke and may not work properly and can be damaged.
- Q:** The hydraulic pump appears to be leaking.
- A:** Check the hose connection to the hydraulic pump. If the 1/4" high pressure fitting is not assembled, it may look like the pump is leaking. If the problem continues, it may be necessary to open the pump kit. Contact Riverhawk for guidance.



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- Q:** The hydraulic hose has a collar on it that can't be moved by hand
- A:** The collar is sometimes held in place with a thread locking compound. This prevents the collar from moving too easily. It may be necessary to adjust this collar with a set of vise-grip pliers. Be careful to not strip the threads off the tube or hose end.



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15.0 Revision History

Revision Letter	Effective Date	Description
H	Nov 7, 2011	Added HF-5379 and HT-5380 to section 2, Added HT-5380 to section 4.5
G	Sept 12, 2011	Corrected spelling error on figure 1, Revised section 7.1.1, Removed figure 3, Revised stretch record sheets
F	Nov 29, 2010	Added 9FA Gas Turbine to 330H Generator to title page (page 1), Added 382A4341P005 and 382A4341 P006 to Fr. 9FB to 330H Generator
E	Aug 04, 2010	Added 450H Generator and Steam Turbine to title page (page 1)
D	Jun 10, 2009	Added turbine oil and removed "Never Seize" from sections 1.0, 3.0, 8.0, and 9.0
C	Mar 25, 2009	Added sections 3 and 14
B	Jun 23, 2008	
A	Feb 22, 2007	
-	Jan 09, 2004	Released



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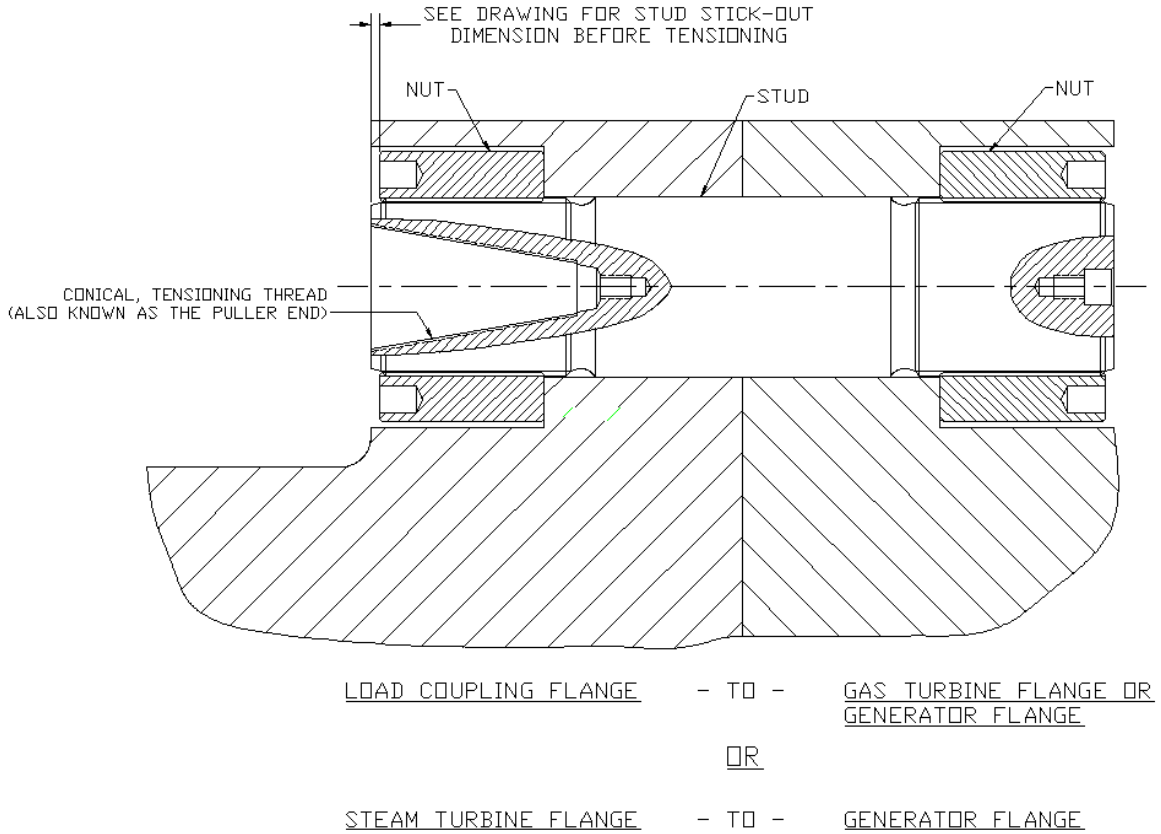


Figure 1
**Cross Section View of the Tensioned Hardware
in the Load Coupling to Generator Bolted Joint**

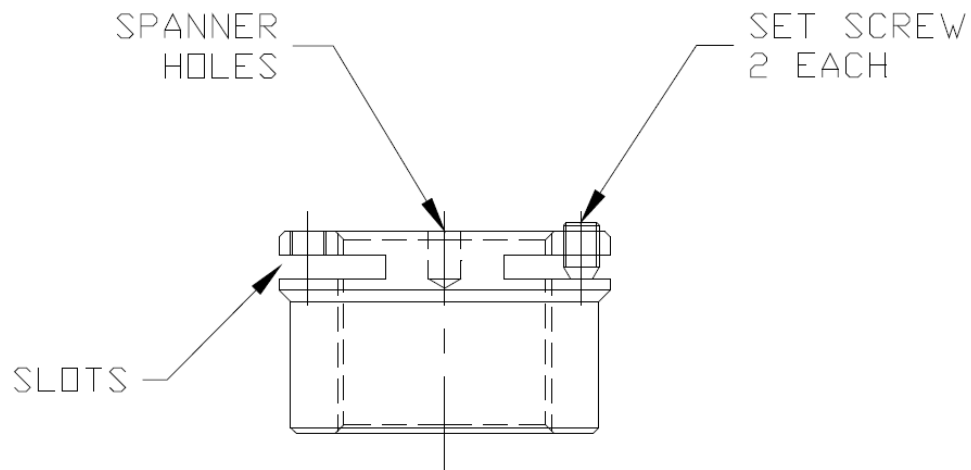
Figure 2
Not applicable to 9FB



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Figure 3
Not applicable



TYPICAL STUD LOCKNUT
FIGURE 4



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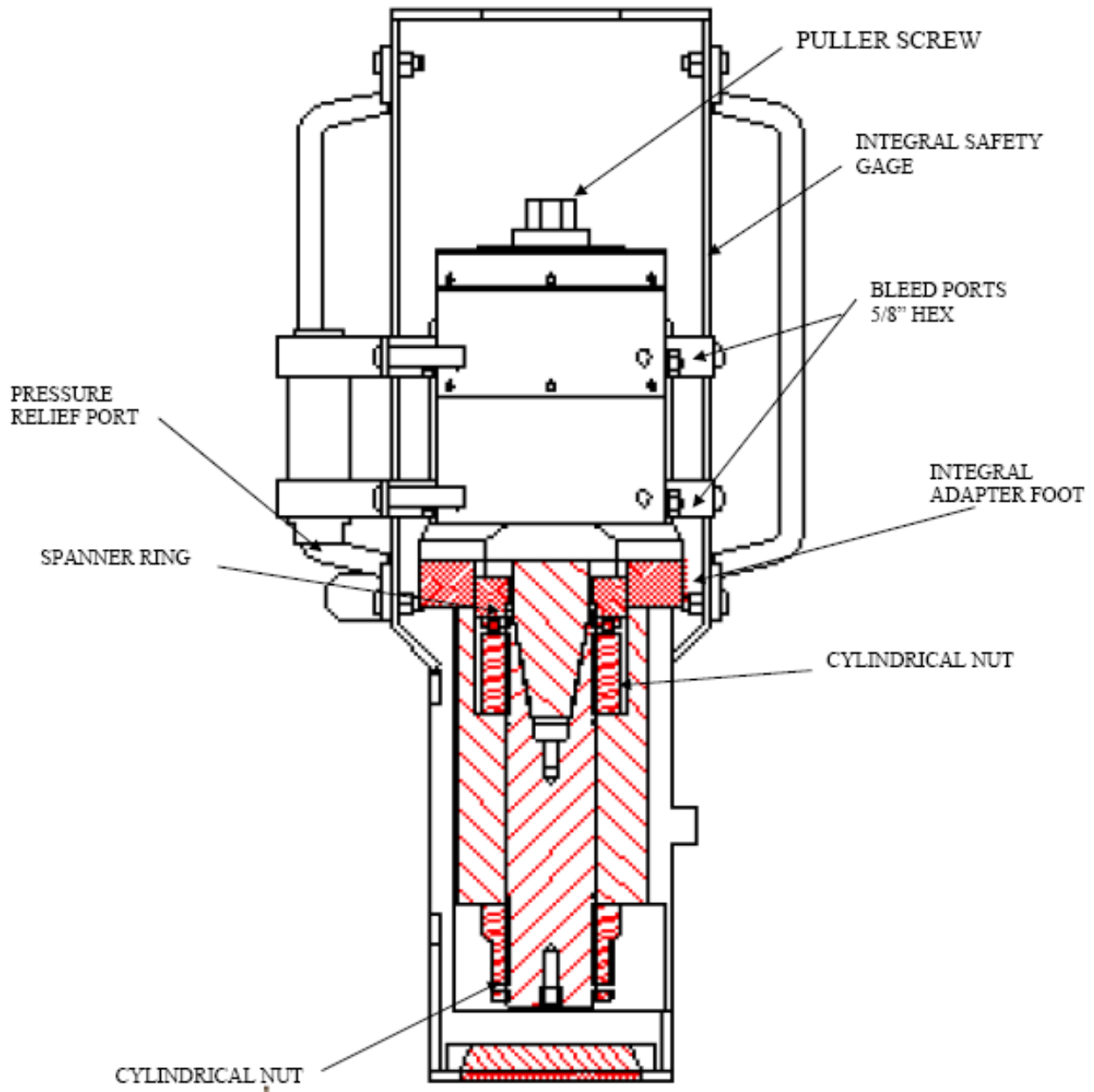


FIGURE 5



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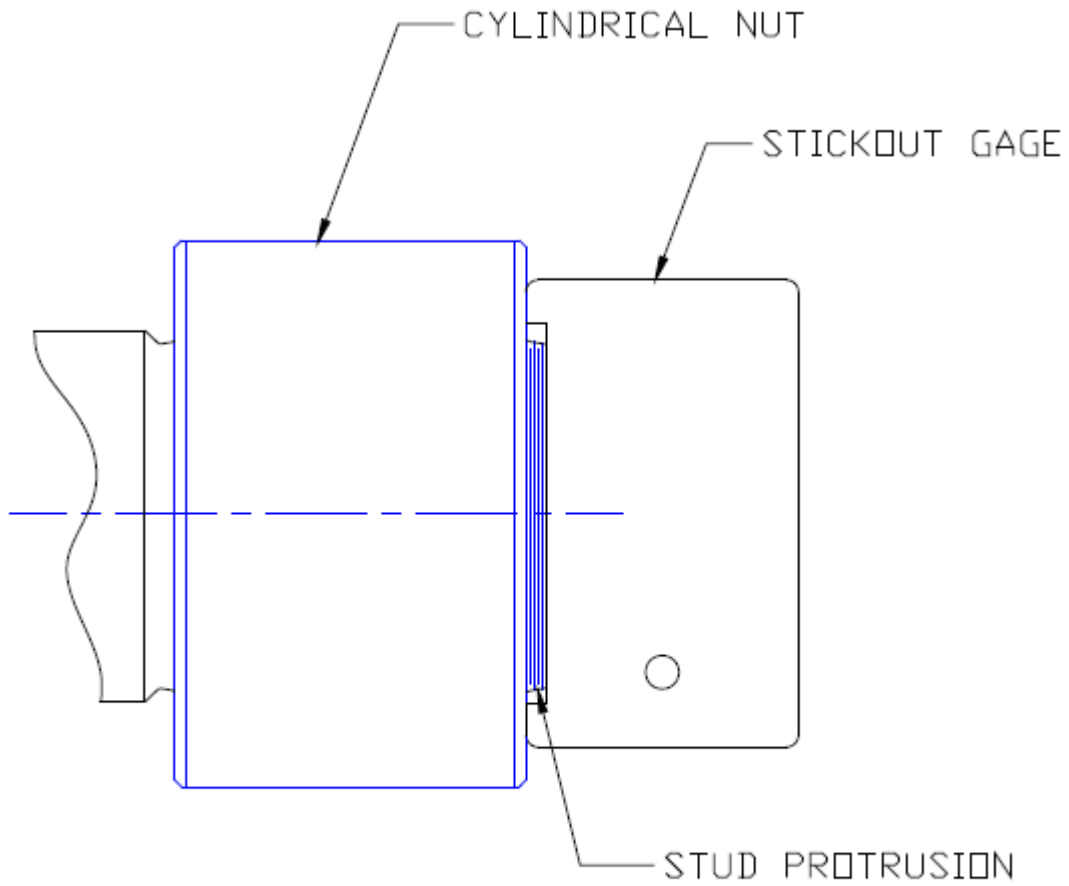


FIGURE 6



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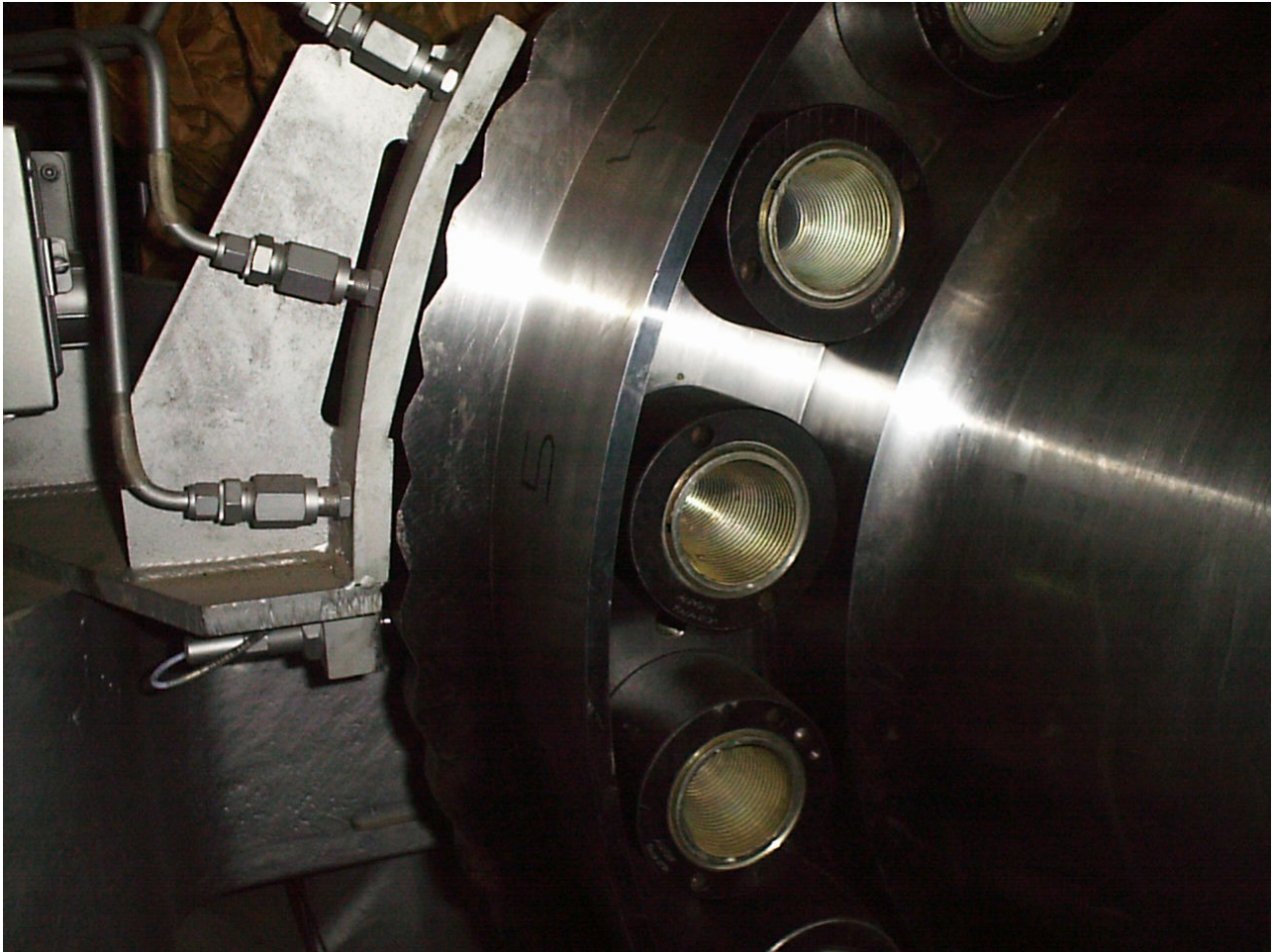


Photo 1
Section of 9FA turbine flange
with studs in place prior to
tensioning.



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Photo 2
Back Side of 9FA turbine
flange showing studs and nuts
in place



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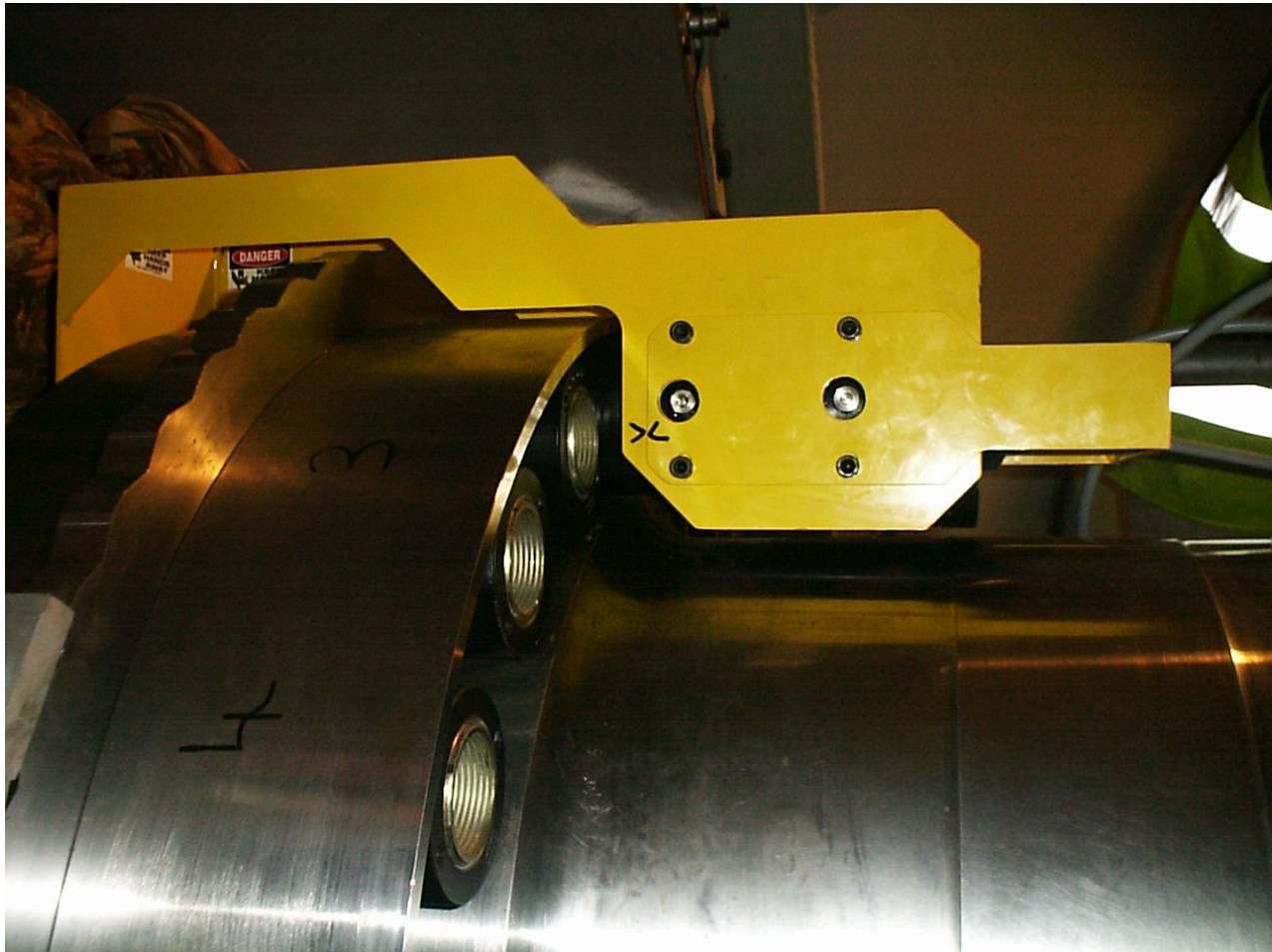


Photo 3
Side view of tensioner
mounted on 9FA turbine
flange.



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Photo 4
Tensioner in operation while
mounted on 9FA turbine
flange.



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Photo 5
Tensioner during operation.
Note pin wrench and control
handle of pressure kit.



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STRETCH RECORD SHEET

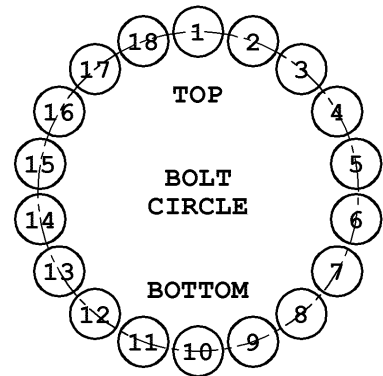
TURBINE NUMBER:

BOLTED JOINT NAME:

DATE:

TECHNICIAN:

SUPERVISOR:



NOTE: FINAL STRETCH = FINAL LENGTH - STARTING LENGTH
(EXAMPLE: FINAL STRETCH = 12.421" - 12.400" = .021" STRETCH)

HOLE NUMBER	STARTING LENGTH	FINAL LENGTH	FINAL STRETCH
1			
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STETCH RECORD SHEET

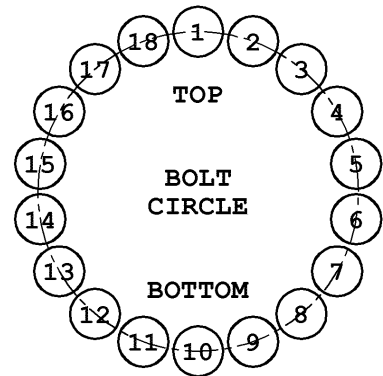
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