

**INSTRUCTION MANUAL IM-117**

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

REVISION LETTER	GE ALTERATION NOTICE NUMBER

Fr. 9E to Elin 9A4/9A5 Generator	GE 137A3350P001, 137A3350P002 358A7202P011, 358A7202P015
Fr. 9E to Brush/Alstom Generator	GE 137A3350P011, 137A3350P012
Fr. 9E to 9H2 Generator	GE 358A7202P005, 358A7202P006 358A7202P009, 358A7202P014
Load Coupling to 9A4 Generator	GE 358A7202P023, 815L1876G001
Steam Turbine to 9A4 Generator	GE 358A7202P023, 358A7202P024 358A7202P030, 815L1876G001
Steam Turbine to 9A5 Generator	GE 365A5262P001, 382A6121P001 382A6121P002, 382A6121P005
A15 Steam Turbine to 9A5 Generator	Cost Code U230

GE Power Generation		GENERAL ELECTRIC COMPANY Schenectady, NY	
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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 the tooling drawings form a part of this manual.

GE Purchasing Ordering Part Number	GE Hardware Set Drawing Number	Riverhawk Hardware Set Part Number	Description
137A3350P001 137A3350P002# 358A7202P011 358A7202P015#	359B2516	HF-1785	2-3/4" Hardware Set for Fr. 9E to Elin 9A4/9A5 Generator (both ends of load coupling)
137A3350P011 137A3350P012#		HF-0800	2-3/4" Hardware Set for Fr. 9E to Brush/Alstom Generator (both ends of load coupling)
358A7202P005 358A7202P014#		HF-0339 (OBSOLETE) See HF-0800	2-3/4" Hardware Set for Fr. 9E to 9H2 Generator (both ends of load coupling)
358A7202P006		HF-0340 HF-0801 (OBSOLETE) See HF-0800	2-3/4" Hardware Set for Fr. 9E to 9H2 Generator (both ends of load coupling)
358A7202P005 358A7202P006 358A7202P009# 358A7202P014#		HF-0800	2-3/4" Hardware Set for Fr. 9E to 9H2 Generator (both ends of load coupling)
358A7202P023# 815L1876G001#	359B2525	HF-1093	2-3/4" Hardware Set for load coupling to 9A4 Generator
358A7202P024#		HF-1098 (OBSOLETE) See HF-1093	2-3/4" Hardware Set for Steam Turbine to 9A4 Generator
358A7202P023# 358A7202P024# 358A7202P030# 815L1876G001#	359B2525	HF-1093	2-3/4" Hardware Set for Steam Turbine to 9A4 Generator
365A5262P001# 382A6121P001 382A6121P002# 382A6121P005#	359B2525	HF-1093	2-3/4" Hardware Set for Steam Turbine to 9A5 Generator
		HF-2848	2-3/4" Hardware Set (2 flanges)
		HF-3171	2-3/4" Hardware Set (1 flange)

# denotes part numbers that include installation tooling



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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 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 reseated 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 Machine Preparation

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

### 4.2 Hardware - Balance

- Hardware is supplied as weight balanced sets
- Studs and Nuts are interchangeable within sets
- Do not mix with other sets
- Save the weight certification supplied with each set for the purchase of spares

### 4.3 Tensioner - Care and Handling

- When not in use, the tensioner shall be maintained in a clean environment and all caps and plugs for hydraulic openings and fittings must be in place.
- When in use, the tensioner shall be protected from sand and grit
- Long term storage - coat tensioner with oil, return to original container, seal container and protect from moisture
- Shipment - coat tensioner with oil and ship in original container



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## 5.0 Hardware Set Preparations

### 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 as follows: Wire brush using a petroleum based solvent to remove any foreign material on the external surfaces and threads.

If previous installations employed a thread-locking compound, which will be visible as a grayish-green residue, remove as much of this compound as possible.

**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

Measure and record the initial lengths of the studs. The following recommendations 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 measuring instruments to set in the sun.

### 6.0 Stud and Nut Assembly

Refer to hardware assembly drawing (HF-xxxx) 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. Refer to the hardware assembly drawing (HF-xxxx) for the correct placement of the hardware into the flange. An example is shown in Figure 1.

Install the other nut on the backside.

Adjust the nut/stud assembly so that the stud's Pull End protrudes from the face of the cylindrical nut the amount as depicted on the hardware drawing (HF-xxxx). **SETTING THIS PROTRUSION OF STUD TO NUT IS CRITICAL FOR PROPER TENSIONER OPERATION.** A metal stickout gage may be 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 view of studs in flange prior to tensioning.



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## 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. Photo 4 shows hose connected to manifold of tensioner.

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.

#### 7.1.1 Fittings

Make sure both male and female parts are clean and free of debris; see Figure 3 for fitting configuration. Hold female part securely when tightening so as to prevent damage to adjacent tubing. If fitting leaks first try retightening as needed. If leaking continues then disassemble and check for scratches or debris on the seating conical surfaces. Clean as required. Replace plastic caps when finished with tooling.

### 7.2 Pump

The 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.



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### 7.3 Bleeding Hydraulic System

Follow the tensioner assembly instructions of Section 8.0

**TO AVOID 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 always 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 the streams of oil exiting the tool from each port are free of air, then retighten the fittings.

Providing that 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 process.

**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. Refer to the hardware assembly drawing (HF-xxxx) for the correct placement of the hardware into the flange. An example is shown in Figure 1.

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.

**NOTE:** The HT-1786 tensioner model is supplied with two adapter feet. The short foot marked "Turbine" is used on the turbine end of the load coupling. The tall foot marked "Generator" is used on the generator end of the load coupling. Mount the appropriate foot before attempting use of the tensioner.

Assembly sequence is as follows:

1. Open the hydraulic return valve on the hand pump to allow hydraulic fluid to be pushed back from the puller tool into the pump reservoir (this is automatic with the air-operated hydraulic pump).
2. Place the spanner ring on the puller side cylindrical nut
3. 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.
4. Place and hold the tensioner assembly over the end of the stud to be tightened. See photos 3,4 &5.
5. Slide the puller screw in to the tapered thread of the stud and hand tighten. **Be sure not to cross thread assembly.**
6. Tighten the puller screw using Allen wrenches on the puller screw and the stud. DO NOT wrench on the nut opposite the puller tool.
7. At this point the Tensioner Assembly MUST BE FREE TO ROTATE and the puller screw must be tight in the stud.



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If the puller tool is not free to rotate when the puller screw is tight, then the stud is not properly positioned in the flange and the nuts must be repositioned so that the stud is shifted slightly more on the puller tool side. This can be done as follows.

1. Slightly loosen the puller screw
2. Back the nut opposite the puller tool off about 1/2 turn
3. Tighten the puller screw side nut to take up the slack.
4. Retighten the puller screw per above and check for looseness of tool

**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 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.

## 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 found at the end of this manual.

**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.

**WARNING**

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



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**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	2-3/4" [71 mm]	8000 psi [550 bar]	Do not measure Do not use
Coupling/Steam Turbine to Generator	2-3/4" [71 mm]	8000 psi [550 bar]	Do not measure Do not use

**9.1.1 Tightening Turbine/Coupling and Coupling/Steam  
Turbine/Generator Nuts**

Turn the cylindrical nut using the spanner ring and pin wrench as depicted in Figure 5 until it bottoms on the flange.

**9.2 Removing the Tensioner from an Installed Stud**

Puller tool removal is to accomplished as follows:

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 screw 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 sheet.



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### 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	2-3/4" [71 mm]	16000 psi [1100 bar]	0.011" - 0.013" [0.28 mm - 0.33 mm]
Coupling to Generator	2-3/4" [71 mm]	16000 psi [1100 bar]	0.011" - 0.013" [0.28 mm - 0.33 mm]

#### CAUTION

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

### 10.0 Retensioning

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



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## 11.0 Thread Locking

Once pulling and tensioning is complete all studs and nuts must be locked in position. The lock nuts used in the turbine/coupling and coupling/generator connections employ a mechanical locking feature. These mechanical lock nuts have two set screws located on 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>
2-3/4" [71 mm]	3/8"-24 UN	200 in·lbs - 200 in·lbs [22.6 N·m - 28.2 N·m]

## 12.0 Stud/Nut Removal

Removal is accomplished as follows:

1. Using a wire brush and shop air clean the internal tapered thread of the stud to remove any debris/deposits, which may have accumulated during service. (see section 5.2.1)
2. With an Allen-wrench loosen the two locking set screws but do not remove from the nut see Figure 4.
3. Install the appropriate puller tool to the stud as described in Section 8.0.
4. Apply the appropriate hydraulic pressure per the following Table and using the spanner ring and spanner/pin wrenches shown in Figure 5 loosen the nut, then release the pressure and remove the puller tool.

<u>Flange Position</u>	<u>Stud Size</u>	<u>Removal Pressure</u>
Turbine to Coupling	2-3/4" [71 mm]	16000 psi [1100 bar]
Coupling/Steam Coupling to Generator	2-3/4" [71 mm]	16000 psi [1100 bar]



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### **13.0 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 correctly, 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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**14.0 Revision History**

Revision Letter	Effective Date	Description
P	Nov 22, 2010	Revised application list on page 1, Added chart to page 4, Added HT-1786 note to page 15
N	Jun 10, 2009	Added turbine oil and removed "Never Seize" from sections 1.0, 3.0, 8.0, and 9.0
M	Mar 25, 2009	Added sections 3.0 and 13.0
L	Sept 02, 2005	Added A15 reference
K	Jun 02, 2005	Page 3 revised, moved caution notes
J	Nov 29, 2004	Page 1 revised
H	Apr 19, 2002	Page 1 revised, Page 4 para 4.0, Page 8 para 11.0 deleted, Page 18 removed Photo 6
G	Oct 17, 2001	Added GE title block to all pages
F	Oct 16, 2000	Page 2 para 1.0, Page 3 para 2.5
E	Jun 23, 2000	Page 2 para 2.0, Page 4 para 4.0, Page 5 para 5.3, Page 7 para 7.3
D	Jan 07, 2000	Page 1, Figures 1 and 2
C	Jul 19, 1999	
B	Jul 02, 1999	
A	May 12, 1999	
-	Apr 1, 1999	Released



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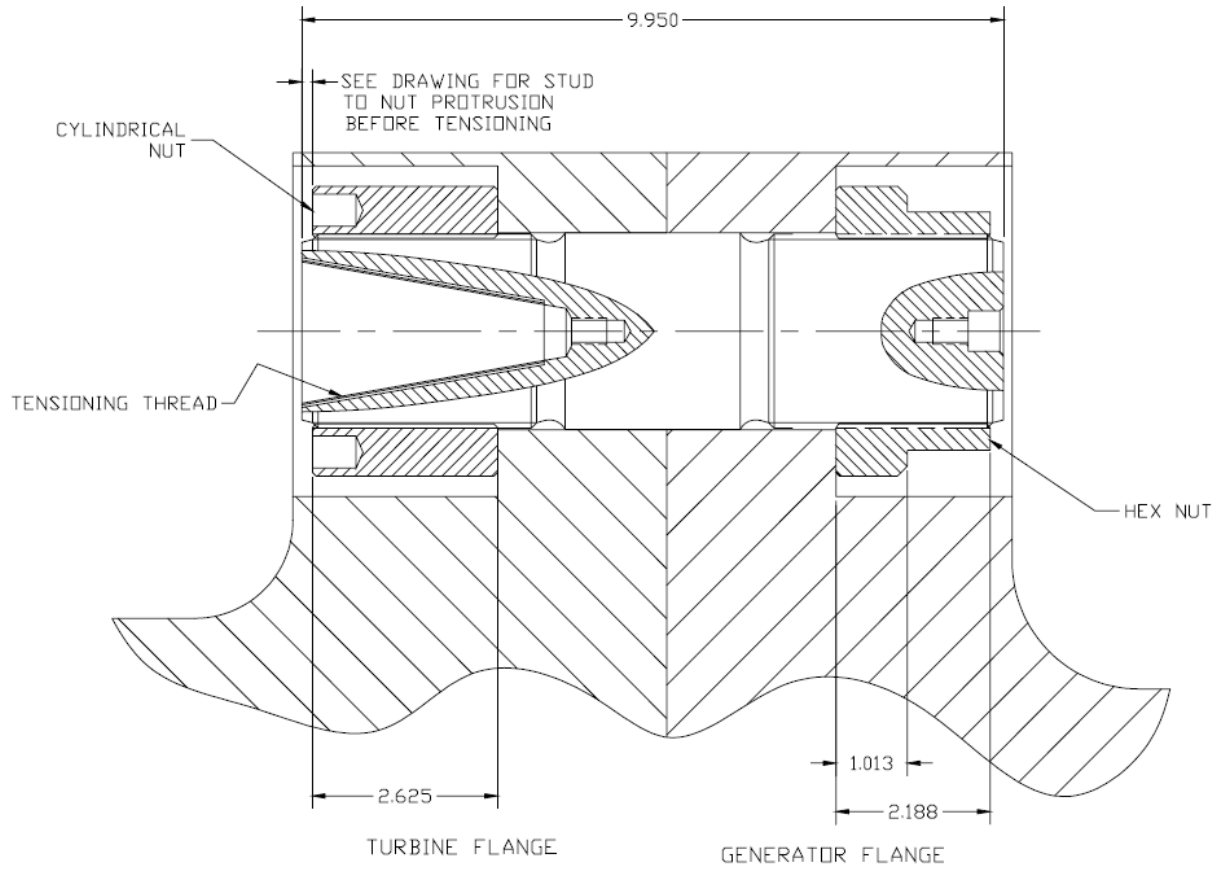


Figure 1 depicts Stud/Nut Assembly

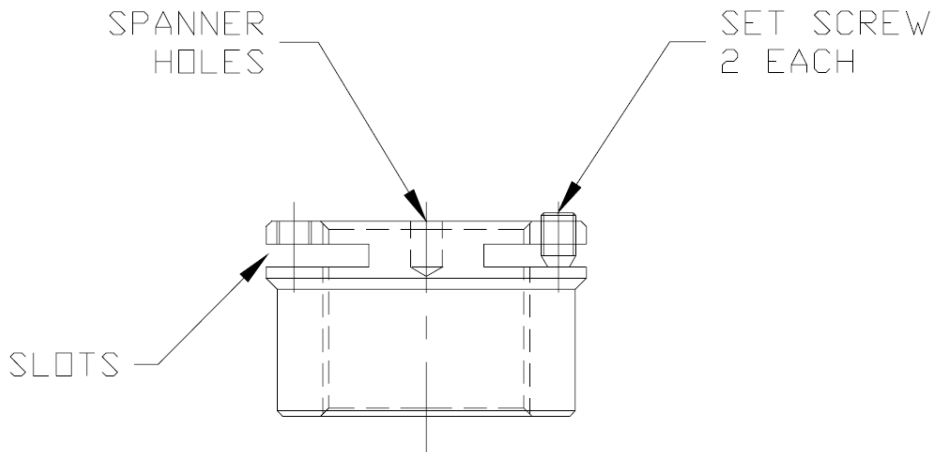


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FIGURE 3 PRESURE PORT



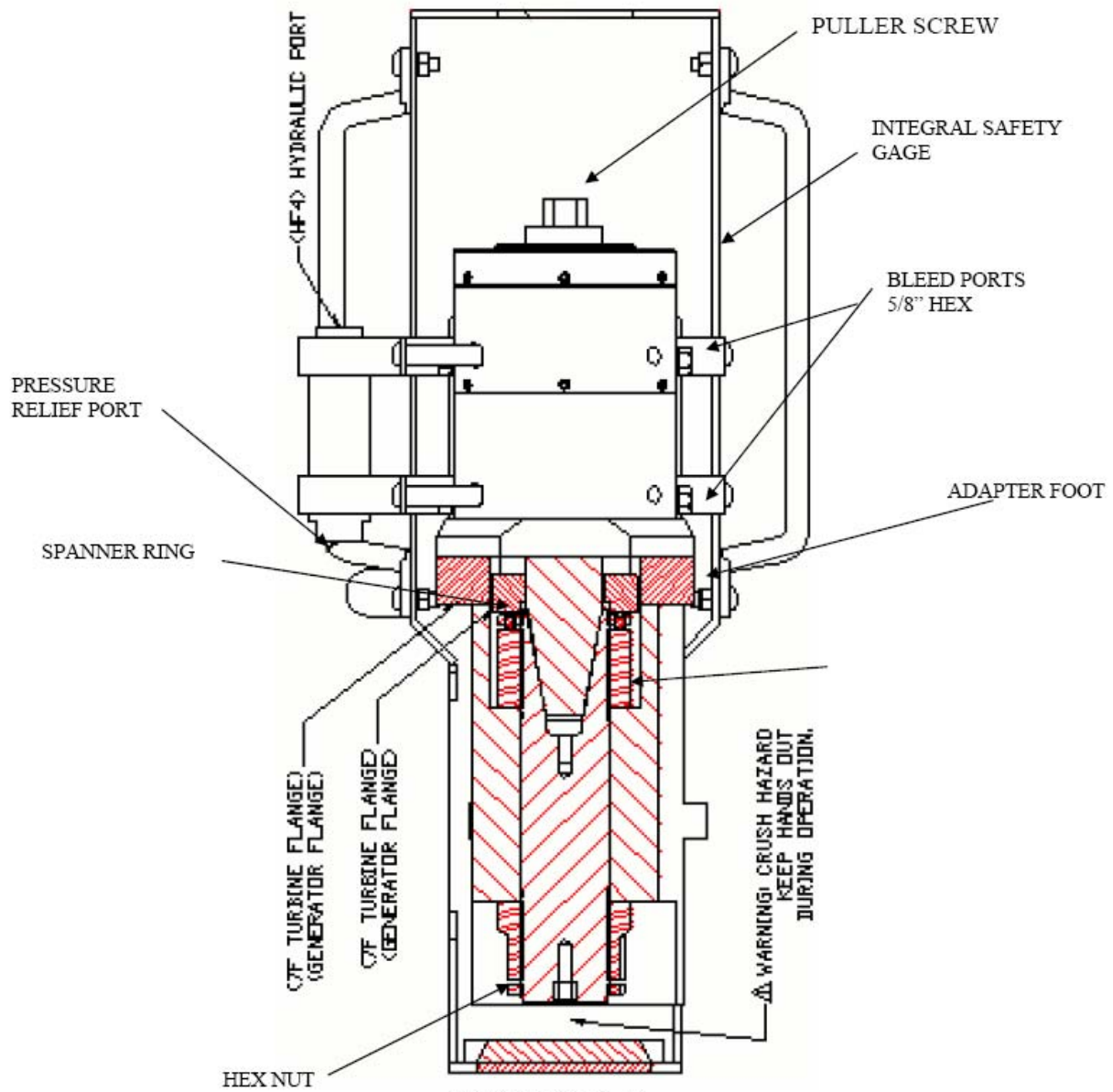
TYPICAL STUD LOCKNUT  
 FIGURE 4



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**FIGURE 5**



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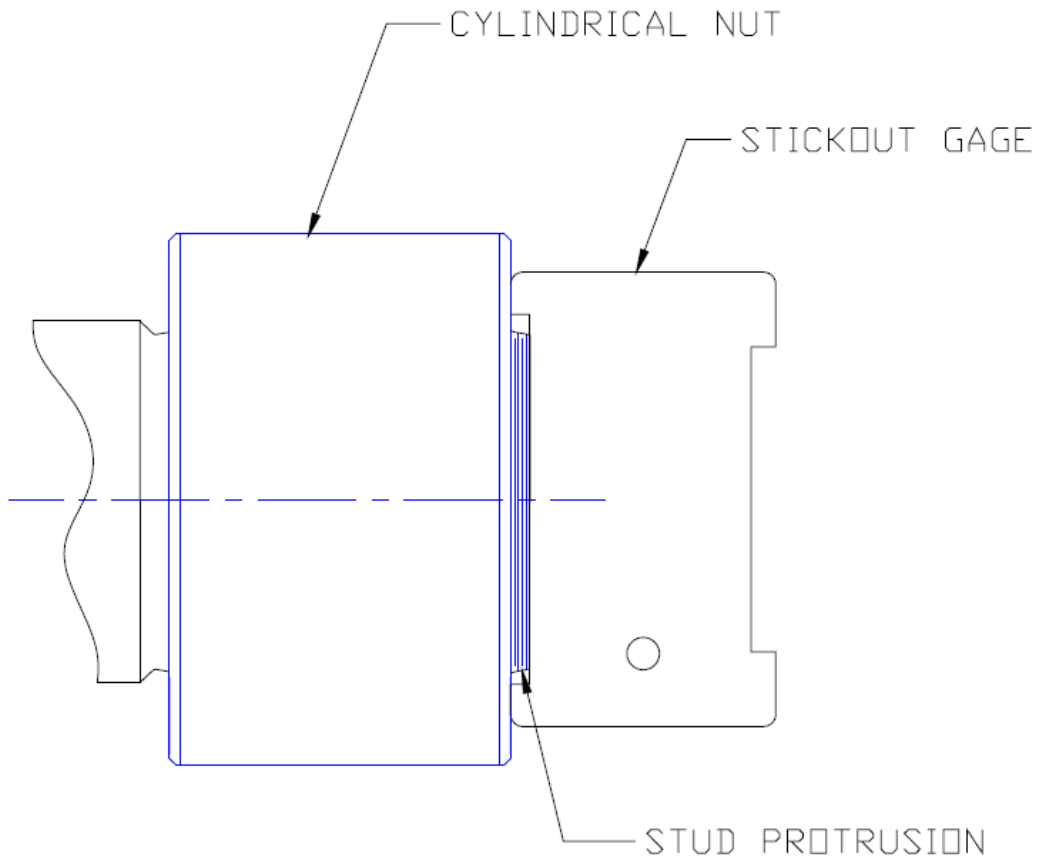


FIGURE 6



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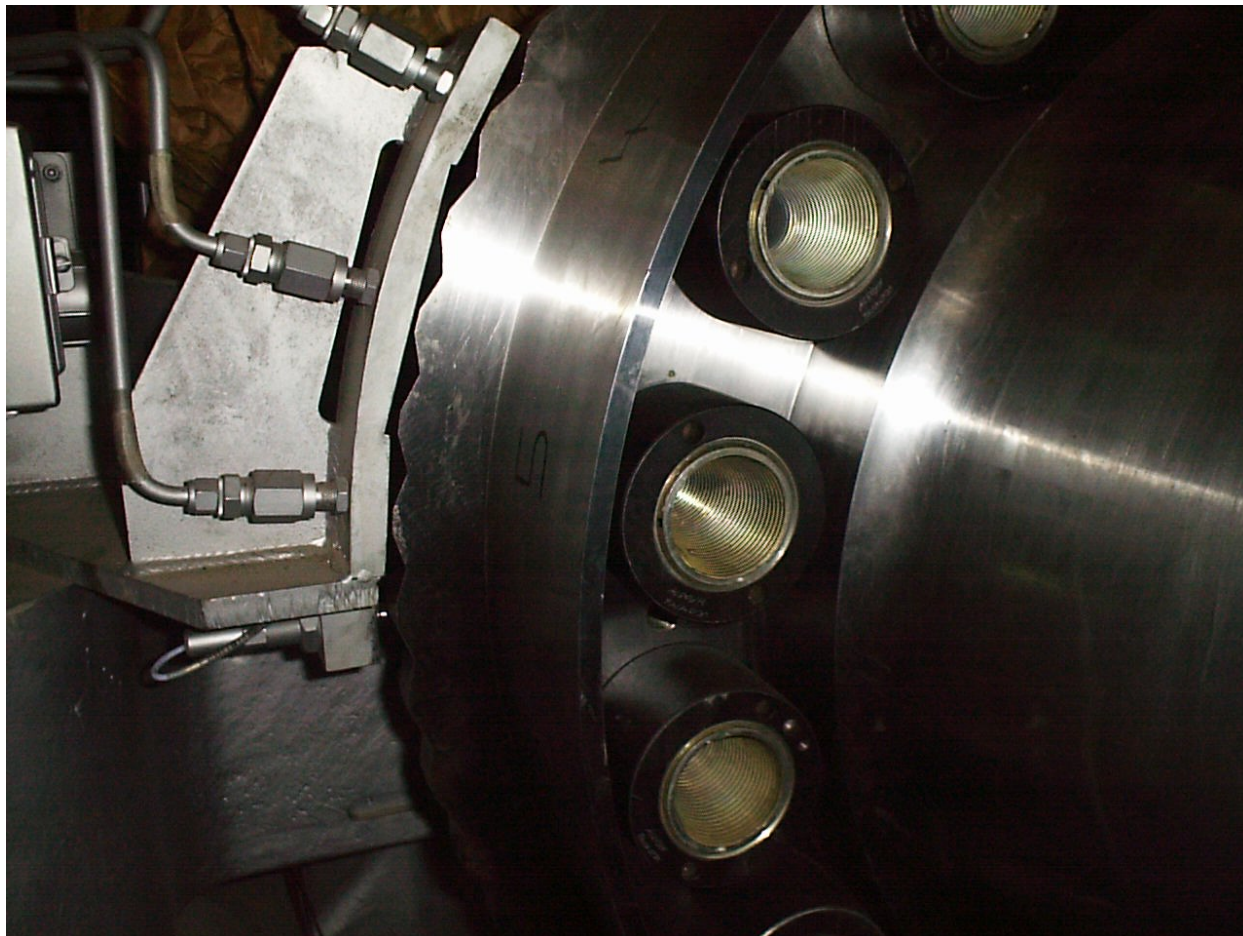


Photo 1  
Section of 9FA turbine flange with  
studs in place prior to tensioning.



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



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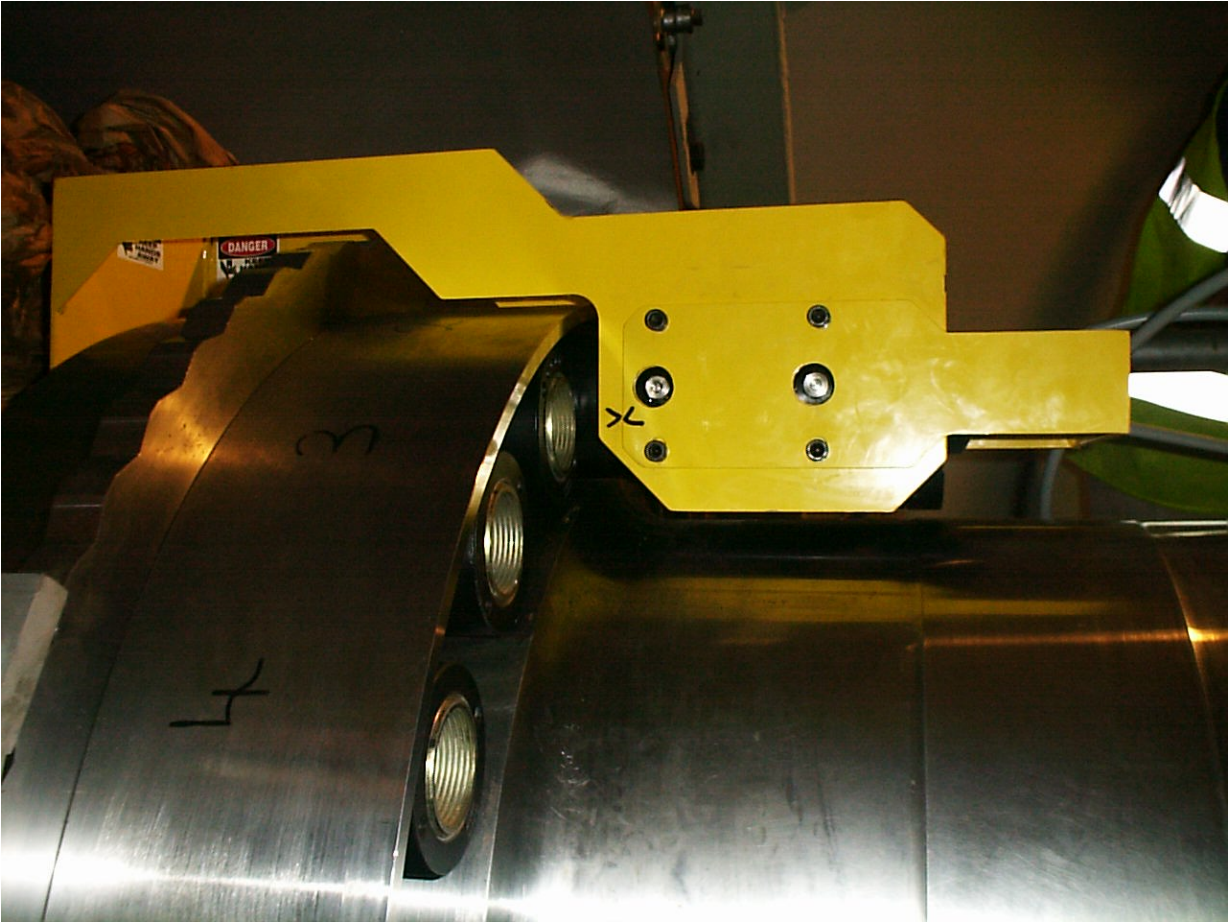


Photo 3  
Side view of tensioner mounted  
on 9FA turbine flange.



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



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Photo 5  
Tensioner in operation while  
mounted on 9FA turbine flange.



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