

**Instruction Manual IM150  
For  
Turbine Tension Studs & Nuts  
Frame 6C and 6A8 Generator**

REVISION LETTER	GE ALTERATION NOTICE NUMBER

No Revision	08/11/03	
A	09/10/03	Added GE 382A4352 and HF-2312
B	09/19/03	DRAWINGS

**Instruction Manual IM150  
For  
Gas Turbine Tension Studs and Nuts,  
Fr.6C Turbine to 6A8 Generator GE 381A6851  
Steam Turbine to 6A8 Generator GE 382A4352**

GE Power Generation		GENERAL ELECTRIC COMPANY Schenectady, NY	
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GE NOT TO REVISE. GE REVISION LEVEL IS AS SHOWN ON THIS APPLIQUE. THIS DOCUMENT IS FILED UNDER THE GE DRAWING NUMBER			
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GE SIGNATURES	DATE	GE DRAWING NUMBER	REV
CHECKED		373A4006	-
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**Instruction Manual IM150  
For  
Turbine Tension Studs & Nuts,  
Fr. 6C and 6A8 Generator**

## **1.0 Scope**

This document describes the procedure to be used to install the stud and nut sets supplied by the Riverhawk Company in the flanges at the Turbine/Coupling, Coupling/Gear and Gear/Generator connections.

The various frame configurations covered in this manual are listed in Sections 1.1 through 1.5 with differences as related to connective hardware defined. Listed also are the pertinent hardware drawings (HF-). These drawings as well as tooling drawings (HT-) form part of this manual.

### **1.1 Fr. 6C Turbine to 6A8 Generator GE 381A6851 HF-2267, HT-2268, HT-2286**

The hardware drawing depicts the stud and nut set for both Turbine to Load Coupling and Coupling to Gearbox (1 1/8" size, Qty 48) as well as Gearbox to Generator (1 5/8" size, Qty 40)

### **1.2 Steam Turbine to 6A8 Generator GE 382A4352 HF-2312, HT-2268**

The hardware drawing depicts the stud and nut set for both Turbine to Generator (1 5/8" size, Qty 40)

## **2.0 General**

**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 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.

### **2.1 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.

### **2.2 Hardware – Balance**

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



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**2.3 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

**2.4 Hand Tools**

Several hand wrenches and micrometers will be required to perform installation of the studs:

- 5/8” open-end wrench
- 15/16” open-end wrench
- 1” wrench
- 5” – 6” micrometer
- 6” – 7” micrometer

**2.5 Special Tools**

- Hydraulic Pressure Kit MP-0130(manual) or AP-0532(air driven)
- 1 1/8” Hydraulic Tensioner Kit HT-2286
- 1 5/8” Hydraulic Tensioner Kit HT-2268

**3.0 Preparation of Hardware**

**3.1 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 installation 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.



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### **3.2 Stud Preparation**

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

Previously installed studs require cleaning as follows:

Wire brush using a petroleum based solvent to remove any foreign material on the shank and the threads.

If previous installation employed a thread locking compound, which will be visible as a grayish-green residue when the nut is removed, remove as much of this compound as possible.

**Do not apply thread lubricants to the threads.**

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

### **3.3 Stud Length Measurement**

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 the 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**

### **4.0 Stud and Nut Assembly**

Refer to the Hardware Assembly Drawing (HF- ) listed in Section 1.0 of this manual. Assemble the cylindrical nut to the tapered thread end (Pull End) of the stud. Slide the stud and cylindrical nut assembly into the flange as shown in Figures 1, 2 & 3 and install the other nut on the backside. **Adjust nut/stud assembly so that the stud protrudes from the face of the cylindrical nut the amount depicted on the hardware drawing (HF-).** **SETTING THIS PROTRUSION OF STUD TO NUT IS CRITICAL FOR PROPER TENSIONER OPERATION. Hand tighten the assembly to a snug fit.**

## **5.0 Assembly of Hydraulic Tensioner Equipment**

### **5.1 Kit Assembly**

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

#### **5.1.1 Fittings**

Make sure both male and female parts are clean and free of debris, see Figure 4 for fitting configuration. Hold female part securely when tightening so as to prevent damage to the adjacent tubing. If the 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 protective caps when finished with the tooling.



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## **5.2 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.

## **5.3 Bleeding Hydraulic System**

Follow the tensioner assembly instructions of Section 6.0.

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

Mount tensioner on a stud per the assembly instructions of Section 6.0. Make sure the pump is situated below the tensioner assembly. The tensioner assembly has two ports, one for pressurizing and one for bleeding the system. These ports service a common chamber and therefore may be treated interchangeability. The bleed port must always be oriented in the uppermost position. The puller tool is shipped with a 5/8 in. hex coned stem bleeder fitting installed. With this fitting loosened stroke the pump repeatedly until the stream of oil exiting the tool is free of air then retighten the fitting.

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.

## **6.0 Assembly of Tensioner on Stud**

Two types of Tensioner Kits will be encountered in the field. They are most readily identified by the safety cages that they employ. One cage is separate from the puller tool and the other is integral. Other design differences and operational characteristics are defined in Sections 6.1 and 6.2 which follow. The two assemblies are depicted in Figures 6 & 7.

All tensioning (pulling) 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, & 3.

### **6.1 Assembly of Tensioner Kit with Integral Safety Cage.**

Refer to Tensioner Assembly drawing and Figure 5 for tensioner to flange mounting. This assembly has the following features which should make stud tensioning safer and easier.

- The safety cage is integral (bolted) to the puller tool
- The hydraulic piston is spring loaded to retract
- The puller screw is a 2-piece design, This requires that the operator tighten the puller screw into the stud and then install a puller nut.

Assembly sequence is as follows:



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- **Open the hydraulic return valve on the pump to allow hydraulic fluid to be pushed back from the puller tool into the pump reservoir.**
- Place the spanner ring on the puller side cylindrical nut.
- Place and hold the puller tool over the end to be tightened.
- Insert the puller screw through the puller tool into the tapered thread of the stud and tighten.
- **Be sure not to cross-thread the assembly.**
- Tighten the puller screw using Allen wrenches on the puller screw and the stud. **DO NOT** wrench on the Hex nut opposite the puller tool.
- Install the puller nut until it seats snugly on the piston and then back-off 2 flats. This is particularly important for removal because the stud shortens during disassembly and the tensioner may then bind.
- At this point the Tensioner Assembly **MUST BE FREE TO ROTATE**, the puller screw is tight in the stud and the puller nut has been backed-off the 2 flats.

Note: If the tool is not free to rotate it is most likely that the nuts must be repositioned so that the stud may be shifted slightly to the puller tool side of the flange. This can be accomplished as follows:

- Back off the puller nut and slightly loosen the puller screw.
- Back off the Hex nut opposite the puller tool about 1 /2 turn.
- Tighten the puller screw side cylindrical nut to take up the slack
- Retighten the puller screw per above and check for tool looseness

**Note: Do not over extend the stud. Over extension can cause the piston to lose 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 assembly is free to turn.**

### **7.0 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 inserting the puller screw into the tapered thread of the stud carefully clean both the male and female tapered threads and apply a high pressure lubricant such as “Never Seize” to the male taper. 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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**7.1 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</u>	<u>Stud Diameter</u>	<u>50% Pressure</u>
Turbine/Coupling	1.125 in.	9000 psi (620 bar)
Coupling/Gear	1.125 in.	9000 psi (620 bar)
Gear/Quill Shaft	1.625 in.	7500 psi (520 bar)
Quill Shaft/Generator	1.625 in.	7500 psi (520 bar)

**7.1.1 Tightening of 1 1/8" Nuts**

Tighten the cylindrical nuts hand tight using the pin wrench and spanner ring, ref. Figures 5.

**7.1.2 Tightening of 1 5/8" Nuts**

Tighten the cylindrical nuts hand tight using the pin wrench and spanner ring ref. Figures 6.

**7.1.3 Puller Tool Removal**

Puller tool removal is to be accomplished as follows:

- Release the puller tool pressure by opening the valve on the pump. Leave valve open.
- Unscrew the puller screw using a wrench.
- Tapping the wrench with a hammer may be necessary to loosen the puller screw
- Move the tool to the next stud/nut assembly to be tensioned, following the sequence/pattern as defined on the supplied data sheets

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**7.2 Tensioning at Final Pressure**

Repeat the pulling and tensioning procedure spelled out in Section 7.1 at final pressure. Measure the length of the studs after all have been pulled. The required stretch values are listed in the following table.

<u>Flange</u>	<u>Size</u>	<u>Stretch (in.)</u>	<u>Pressure</u>
Turbine/Coupling	1.125 in.	.009/.011	18000 psi (1250 bar)
Coupling/Gear	1.125 in.	.008/.010	18000 psi (1250 bar)
Gear/Quill Shaft	1.625 in.	.007/.009	15000 psi (1035 bar)
Quill Shaft/Generator	1.625 in.	.007/.009	15000 psi (1035 bar)

**CAUTION**

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

**7.2.1 Retensioning**

Excessive stretch variations or low stretch values can be corrected by retensioning 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.

**8.0 Thread Locking Using a Mechanical Locking Device.**

Mechanical lock nuts have two set screws located in the top face, see Figure 7. Before threading the nut onto the stud check to be certain 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.

<b>Nut Diameter in.</b>	<b>Set Screw Size</b>	<b>Seating Torque in. lbs.</b>
1.125	#10-32	30 - 36
1.625	1/4-28	65 - 87

**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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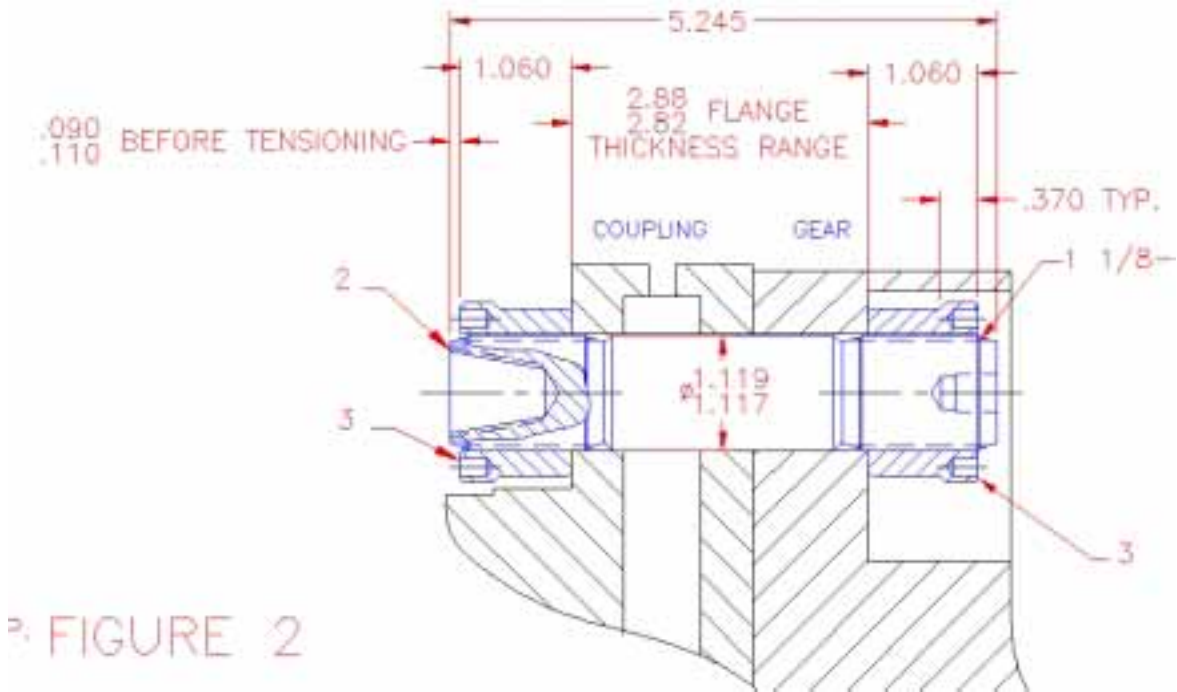
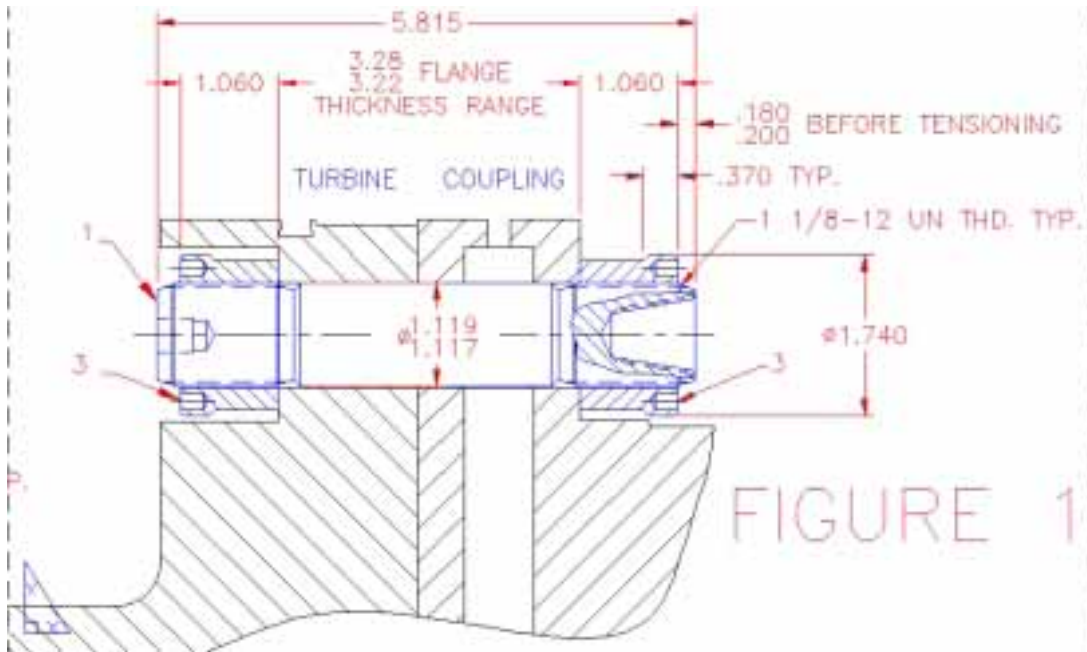
**WARNING:**

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

**9.0 Removal of Assemblies with Mechanical Locknuts**

For those assemblies which have been locked using mechanical lock nuts, removal is accomplished as follows: 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. With an Allen-wrench loosen the two locking set screws but do not remove from nut see Figure 5. Install the appropriate puller tool to the stud as described in Section 6.0. Apply the appropriate hydraulic pressure per the table of Section 9.1 and using the spanner ring and spanner wrenches shown in Figure 6 loosen the nut, then release the pressure and remove the puller tool.

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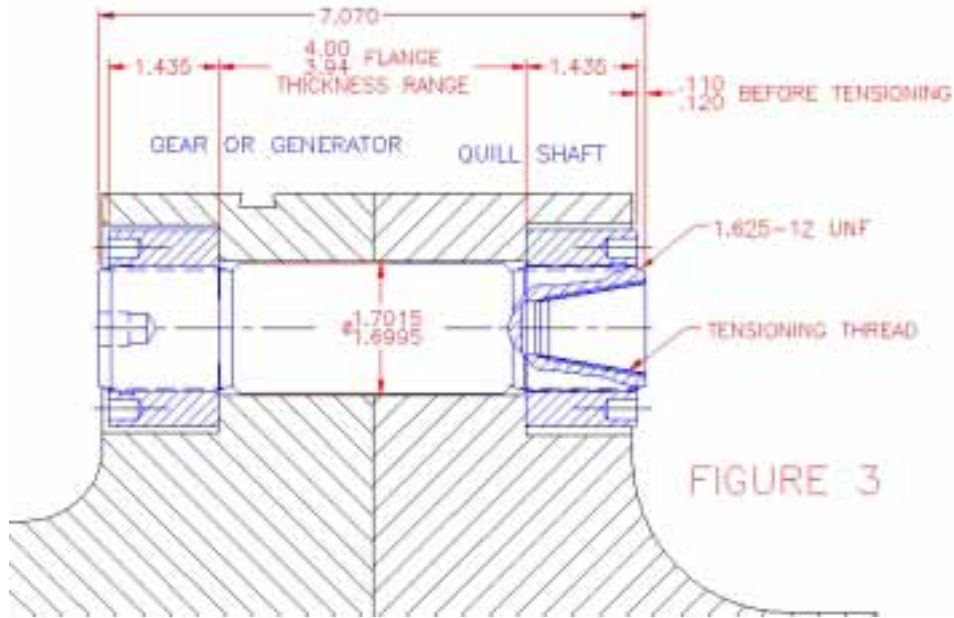
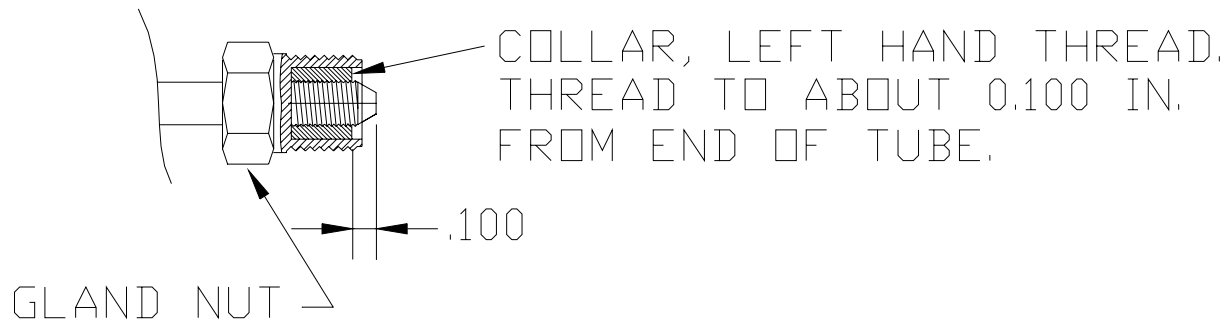
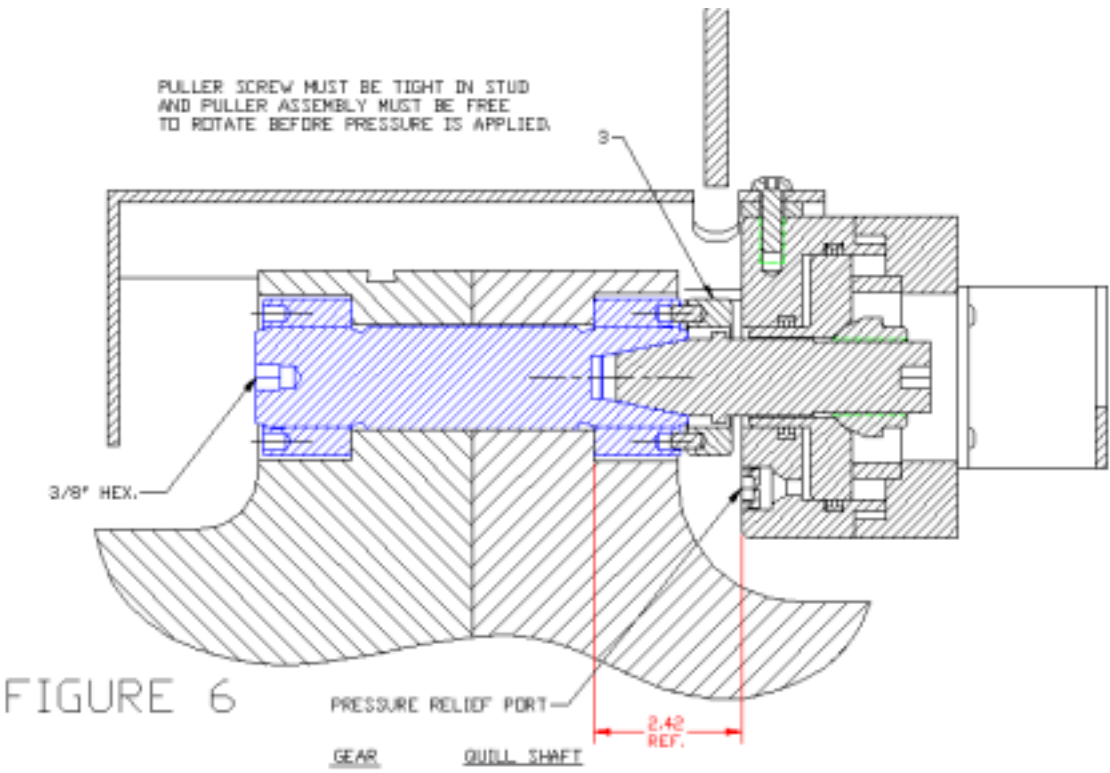
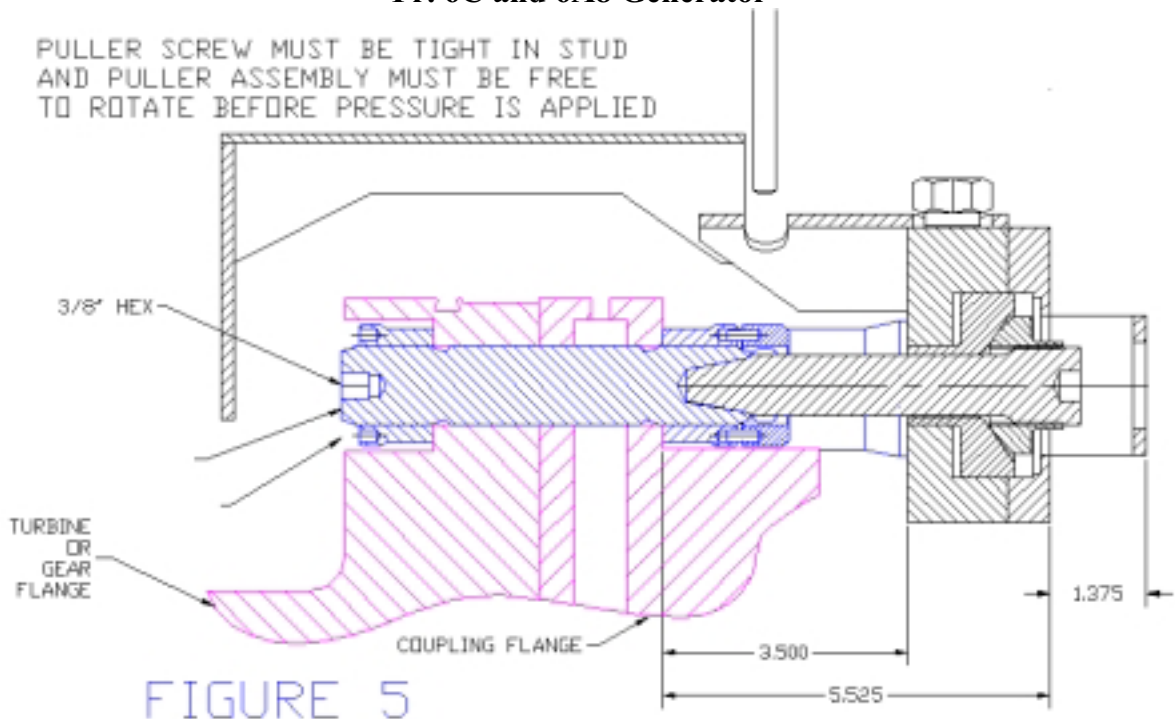


FIGURE 4 PRESURE PORT



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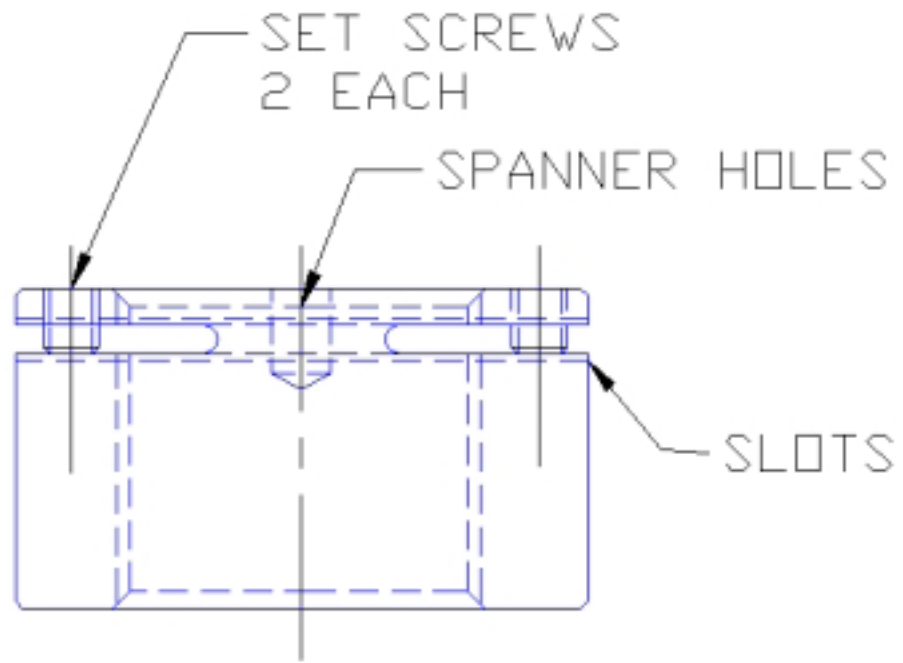


FIGURE 7

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Photo 1  
Looking down on gear to generator  
flange of 6FA machine. Shows 2”  
puller tool mounted with safety cage in  
place.



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Photo 2  
Side view of 2" puller tool  
and safety cage on 6FA  
machine.



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Photo 3 Top view of 1 1/8" puller tool and safety cage in place. Tool is mounted on coupling to gear flange of 6FA machine.



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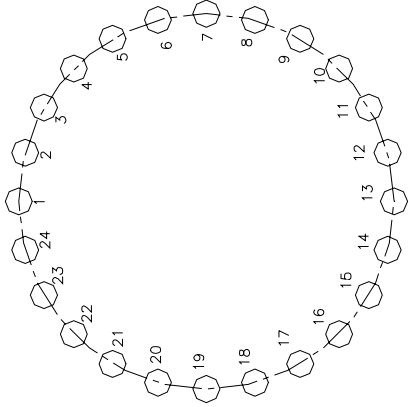
Photo 4  
View of 1 1/8 puller tool and  
safety cage mounted on turbine  
to coupling flange of 6FA  
machine. Tool is pressurized  
and millwright is tightening  
nut



1 2 3 4

D C B A

STRETCH RECORD SHEET FOR (24) STUD PATTERN



MACHINE \_\_\_\_\_  
 FLANGE \_\_\_\_\_  
 DATE \_\_\_\_\_  
 TECHNICIAN \_\_\_\_\_  
 SUPERVISOR \_\_\_\_\_

STUD LOCATION	FIRST PULL		SECOND PULL	
	ORIGINAL LENGTH	LENGTH (1) STRETCH (1)	LENGTH (2) STRETCH(2)	STRETCH(2)
1	-----	-----	-----	-----
13	-----	-----	-----	-----
2	-----	-----	-----	-----
14	-----	-----	-----	-----
3	-----	-----	-----	-----
15	-----	-----	-----	-----
4	-----	-----	-----	-----
16	-----	-----	-----	-----
5	-----	-----	-----	-----
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10	-----	-----	-----	-----
22	-----	-----	-----	-----
11	-----	-----	-----	-----
23	-----	-----	-----	-----
12	-----	-----	-----	-----
24	-----	-----	-----	-----
	AVG. STRETCH	-----	AVG. STRETCH	-----
			FINAL	-----

UNITS in. mm, CIRCLE ONE

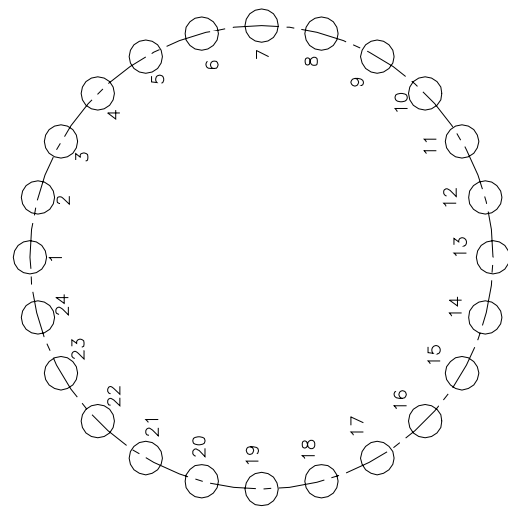
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DWG. NO.	DATE:	SIZE	DWG. NO.
160716-001	01/02/96	C	960716-001
CHECK:	DATE:	SCALE	SHEET
			1

TORQUE PATTERN FOR (24) STUDS

1 2 3 4

4 3 2 1

# STRETCH RECORD SHEET FOR (24) STUD PATTERN



STUD LOCATION	ORIGINAL LENGTH	FIRST PULL LENGTH (1)	STRETCH (1)	SECOND PULL LENGTH (2)	STRETCH (2)
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2	---	---	---	---	---
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23	---	---	---	---	---
12	---	---	---	---	---
24	---	---	---	---	---

AVG. STRETCH \_\_\_\_\_  
 AVG. STRETCH \_\_\_\_\_  
 FINAL \_\_\_\_\_

MACHINE \_\_\_\_\_  
 FLANGE \_\_\_\_\_  
 DATE \_\_\_\_\_  
 TECHNICIAN \_\_\_\_\_  
 SUPERVISOR \_\_\_\_\_

UNITS in. mm, CIRCLE ONE

REVISIONS			
ZONE	REV	DESCRIPTION	DATE
A	A	SCALE CHART LARGER	11/26/96
			APPROVED RW

**MATERIAL:**



Riverhawk Company  
 2425 W. Whitesboro St. Ulster, N.Y.

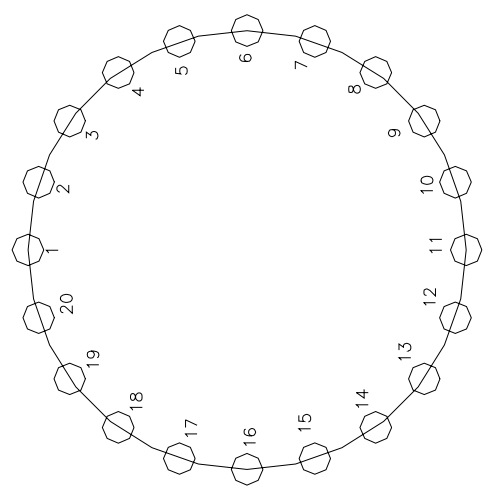
TORQUE PATTERN FOR (24) STUDS

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CHECK:	DATE:	C		960716-001	1

4 3 2 1

4 3 2 1

D C B A



MACHINE \_\_\_\_\_  
 FLANGE \_\_\_\_\_  
 DATE \_\_\_\_\_  
 TECHNICIAN \_\_\_\_\_  
 SUPERVISOR \_\_\_\_\_

STUD  
LOCATION

ORIGINAL  
LENGTH

FIRST PULL

LENGTH (1) STRETCH (1)

SECOND PULL

LENGTH (2) STRETCH(2)

1	---	---	---	---	---
11	---	---	---	---	---
2	---	---	---	---	---
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20	---	---	---	---	---

AVG. STRETCH

AVG. STRETCH

FINAL

UNITS in. mm, CIRCLE ONE

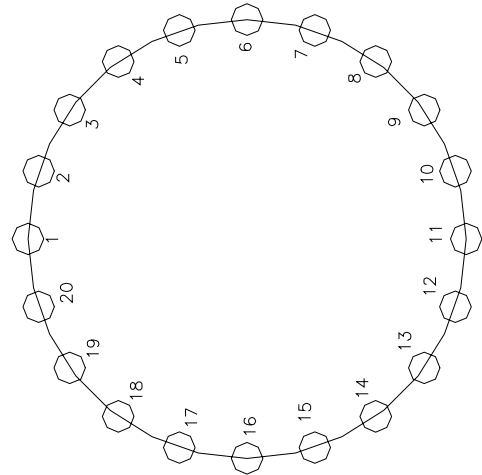
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DWG: RMW	DATE: 07/16/96	SIZE FSCM NO. C	DWG NO. 960716-002
CHECK:	DATE:	SCALE:	SHEET
TIGHTENING PATTERN FOR (20) STUDS			

4 3 2 1

4 3 2 1

D C B A

REVISIONS		
ZONE	REV	DATE
A	A	11/26/96
DESCRIPTION		APPROVED
SCALE CHART LARGER		RAW



STUD LOCATION

ORIGINAL LENGTH

FIRST PULL LENGTH (1) STRETCH (1)

SECOND PULL LENGTH (2) STRETCH(2)

1	---	---	---	---
11	---	---	---	---
2	---	---	---	---
12	---	---	---	---
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20	---	---	---	---

AVG. STRETCH

AVG. STRETCH

FINAL

MACHINE \_\_\_\_\_  
 FLANGE \_\_\_\_\_  
 DATE \_\_\_\_\_  
 TECHNICIAN \_\_\_\_\_  
 SUPERVISOR \_\_\_\_\_

UNITS in. mm, CIRCLE ONE

MATERIAL: \_\_\_\_\_

2425 W. Willsebers Sl. Ulster, N.Y.

TIGHTENING PATTERN FOR (20) STUDS

DWG. NO.	SIZE	DATE:
960716-002	C	07/16/96
CHECK:	SCALE	DATE:

SHEET 1

4 3 2 1