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Rev. J	10/24/02	GE Dwg REV. ltr A, pg 9 para. 10.1
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Rev. L	06/01/05	Added HT-2176, rev. Turbine End Pressure
Rev. M	06/22/05	Added HT-1168, updated additional information
Rev. N	04/7/08	Added Dual Units (Metric)

Instruction Manual IM110
for
Gas Turbine Tension Studs and Nuts

7E Turbine GE 358A7395P001
7E Turbine End Only GE 358A7395P003
7E Turbine – Generator End Only GE358A7395P005

GE Power Generation

GENERAL ELECTRIC COMPANY
Schenectady, NY

VENDOR SUPPLIED DRAWING

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Instruction Manual IM110
For
Gas Turbine Tension Studs & Nuts,
Fr.7E Turbine, Turbine- Mechanical Drive, Turbine- Generator

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

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.

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.

CAUTION

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

NOTICE

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

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

WARNING:

Keep hands clear of the tool while the pressure is building up. This includes the pin wrench for tightening the spanner ring (nut). Once the tool is stabilized at pressure then and only then can the nut be tightened. This reduces the potential of personal injury should the puller screw have not been properly installed.

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Instruction Manual IM110
For
Gas Turbine Tension Studs & Nuts,
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1.0 Scope

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

HF-0220	HF-0276	HF-0747	HF-0841	HF-1169
HF-0275	HF-0746	HF-0748	HF-0842	

2.0 General

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.

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 as 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 spare parts.
-

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.

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2.4 Hand Tools

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

- 5/8" (15.88mm) open-end wrench
- 8" – 9" (203.2mm-228.6mm) micrometer
- 3/8" (9.53mm) hex key wrench (Allen)

2.5 Special Tools

- Hydraulic Pressure Kit MP-0130
- 2" (50.8mm) Hydraulic Tensioner Kit HT-0252, HT-0286, HT-0716, HT-1168, HT-2176

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.

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.

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.

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.

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" (.02mm)**
- **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 and install the other nut on the backside. **Adjust the 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 SEE FIGURE 8. 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 the instructions in section 5.3, **after the tool has been properly installed on a stud**.

5.1.1 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 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.

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.

Step 1 - Mount tensioner on a stud, per the assembly instructions of Section 6.0.

Step 2 - Make sure the pump is situated below the tensioner assembly. The tensioner assembly has two 9/16-18 ports, one for pressurizing (connecting the hose or quick connect) and one for bleeding the system, see Figure 9. These ports service a common chamber and therefore may be treated interchangeability (one on the left and one on the right). The bleed port must always be oriented in the uppermost position for bleeding. Therefore locate the tool at the 3 O'clock or 9 O'clock stud position to orient the bleed port at the top. The puller tool is shipped with a 5/8" (15.88mm) hex coned stem bleeder fitting installed (for bleeding in the 9/16-18 threaded hole). With this fitting loosened stroke the pump repeatedly until the stream of oil exiting the tool is free of air then retighten the fitting with the 5/8" (15.88mm) wrench.

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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 (exception of HT-1168, no safety cage). 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 different tensioner assemblies are depicted in Figures 5, 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. With the exception of **HT-1168**, where the tensioning is performed on the Turbine side as shown in HT-1168.

6.1 Assembly of Tensioner Kit with Separate Safety Cage

Refer to Tensioner Assembly drawing and Figure 6 for tensioner to flange mounting. Assembly sequence is as follows:

- **Open the hydraulic return valve on the pump to allow hydraulic fluid to be pushed back from the puller tool into the pump reservoir as the puller tool is tightened.**
- Place the spanner ring on the puller side 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 hand tighten
- **Be sure not to cross-thread the assembly**
- Tighten the puller screw using an open-end wrench and spanner or Allen wrench, depending on hardware configuration, on the opposite end of the stud (DO NOT WRENCH THE NUT).
- At this point the puller screw must be tight in the stud and the tensioner assembly **MUST BE FREE TO ROTATE.**

Note: If the tool is not free to rotate when the puller screw is tight, then either:
(1) The piston is not fully retracted; open the valve on the pump and retighten the puller screw. Or
(2) The nuts must be repositioned so that the stud is shifted slightly more on the puller tool side. This can be done as follows:

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

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6.2 Assembly of Tensioner Kit with Integral Safety Cage.

Refer to Tensioner Assembly drawing and Figure 7 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:

- **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 hand 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.

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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.

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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 (when provided) 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.

7.1 Tensioning

7.1.1 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

Flange	Stud Diameter	50% Pressure
Turbine/Coupling	2.000 in. (50.8 mm)	8000 psi (550 Bar)
Coupling/Generator	2.000 in. (50.8 mm)	7000 psi (480 Bar)

7.1.2 Tightening of Nuts

WARNING:

Keep hands clear of the tool while the pressure is building up. This includes the pin wrench for tightening the spanner ring (nut). Once the tool is stabilized at pressure then and only then can the nut be tightened. This reduces the potential of personal injury should the puller screw have not been properly installed.

Tighten the cylindrical nuts hand tight using the pin wrench and spanner ring, as depicted in either Figure 6 or Figure 7. Turn the nut until it bottoms on the flange. Then apply torque to turn the nut an additional 10 degrees. This will aid in achieving the desired stretch.

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 allen 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

7.1.3 Tightening of Nuts at Final Pressure

Repeat the pulling and tensioning procedure spelled out in Sections 7.1.1 – 7.1.2 at final pressure. Measure the length of the studs after all have been pulled. The required stretch values and final pressures are listed in the following table.

CAUTION

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

	Flange Size	Stretch (in.)	Pressure
Turbine/Coupling	2.000 in. (50.8 mm)	.011/.013 (.28/.33mm)	16000 psi (1100 Bar)
Coupling/Generator	2.000 in. (50.8 mm)	.010/.012 (.28/.30mm)	15000 psi (1030 Bar)

8.0 Retensioning

For the procedures of Section 7, 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.

9.0 Thread Locking :

Once pulling and tensioning is completed all stud nuts must be locked in position. Two methods of thread locking may be encountered in the field. Early version hardware required a liquid thread locking compound while the later configuration employs a mechanical locking device. Each method is described in detail in Sections 9.1 & 9.2.

9.1 Thread Locking Using a Liquid Locking Compound

These nuts have no visible locking feature. **RARELY FOUND IN THE FIELD**

Apply the specified number of drops (see table below) of thread locking compound Permatex Industrial “After Lock” No. 81794 (included with each set of hardware from the factory) to each end of the stud at the stud/nut interface as follows.

Apply the drops to the face of the nut at the top of the assembly allowing material to run down onto the stud threads.
An alternate method of applying the thread locking compound is to use a short (2-3”) length of thin wire. Place the bottom tip of the wire at the top of the nut/stud thread interface with the wire held at about a 45 deg. angle. Apply the liquid to the wire so that it runs along the wire into the threads.

Stud Size	Amount of Liquid
2.000 in. **(50.8 mm)**	6 drops

NOTICE

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

9.2 Thread Locking Using a Mechanical Locking Device.

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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 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.

Nut Diameter in.	Set Screw Size	Seating Torque in. lbs.
2.000 in. (50.8 mm)	1 / 4 – 28	65 to 75 (7.3-8.5 Nm)

10.0 Stud/Nut Removal

Sections 10.1 and 10.2 respectively describe the procedures to be followed in removing nuts that have been locked with liquid locking compound and those with the mechanical locking feature.

10.1 Removal of Assemblies with Liquid Locking Compound

For those assemblies which have been locked with the liquid locking compound, 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 that may have accumulated during service.
- Install the appropriate puller tool to the stud as described in Section. 6.0.
- Apply hydraulic pressure per the table in paragraph 7.1.5 and without using unreasonable force attempt to loosen the nut using the spanner ring and spanner wrench as shown in Figure 5.
- **If the nut cannot be loosened, release the pressure and repeat the procedure.**
- **Ordinarily two or three attempts are sufficient to break the bond.**
- **Should the nut refuse to loosen after three attempts the application of heat will be required.**

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

Apply a smear of 550/650-deg F tempil stick to the side of the nut opposite the application of heat and heat the nut using a propane torch. Continue to apply heat until the tempil smear indicates that the nut has reached 550/650 deg F. **Never overheat to a cherry red condition.** Remove the source of heat and as quickly as possible reinstall the appropriate puller tool, apply the appropriate pressure and loosen the nut. Then release the pressure and remove the puller tool.

10.2 Removal of Assemblies with Mechanical Locknuts

For those assemblies that 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 4. Install the appropriate puller tool to the stud as described in Section 6.0. Apply the appropriate hydraulic pressure per the table of Section 10.1 and using the spanner ring and spanner wrenches shown in either Figure 5, 6 or 7 loosen the nut, then release the pressure and remove the puller tool.

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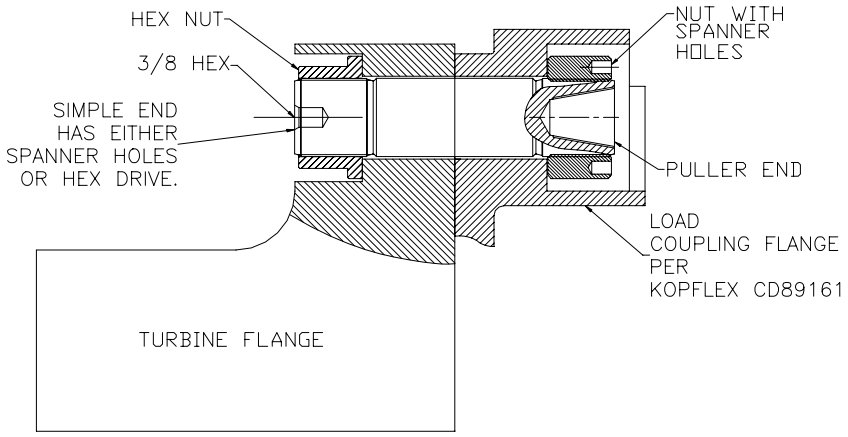
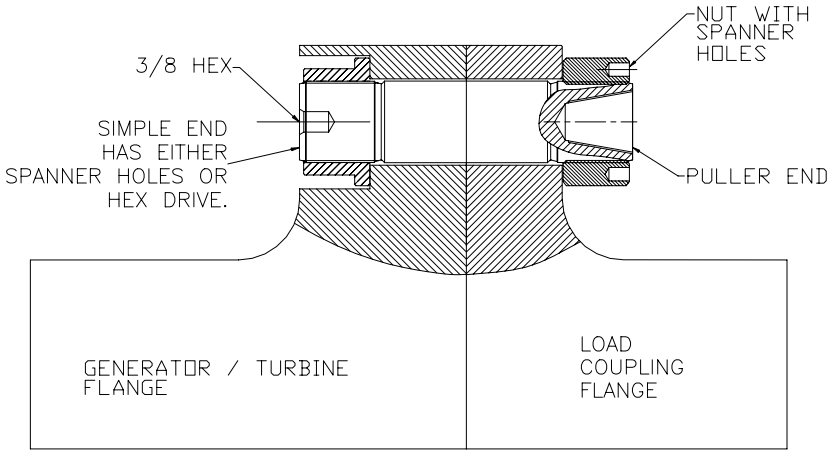
FIGURE 1



TURBINE – MECHANICAL DRIVE

FIGURE 2



GENERATOR DRIVE

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FIGURE 3 PRESURE PORT

FIGURE 4

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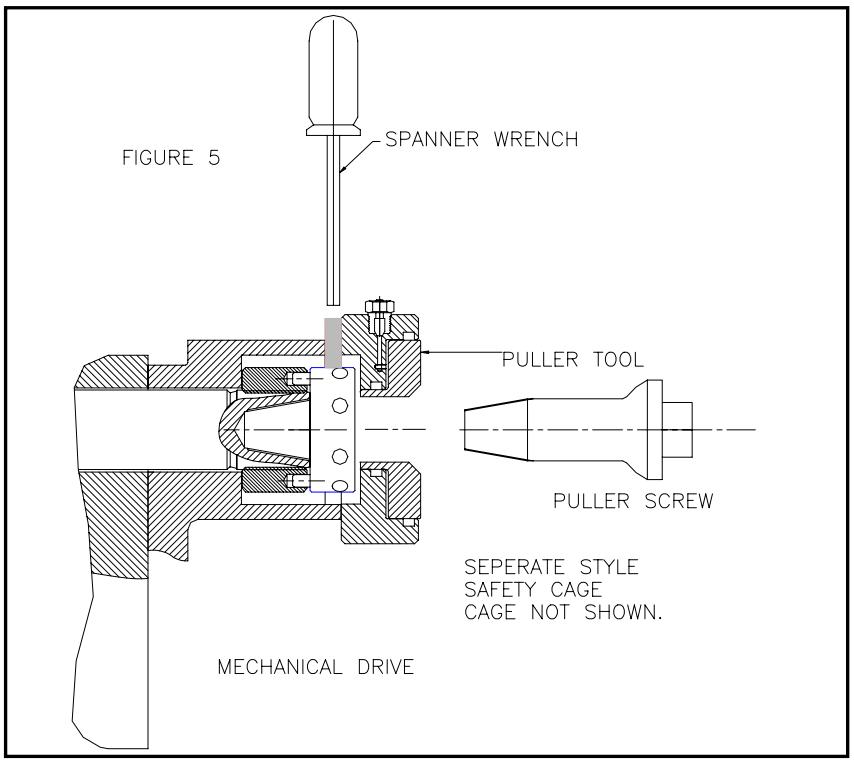

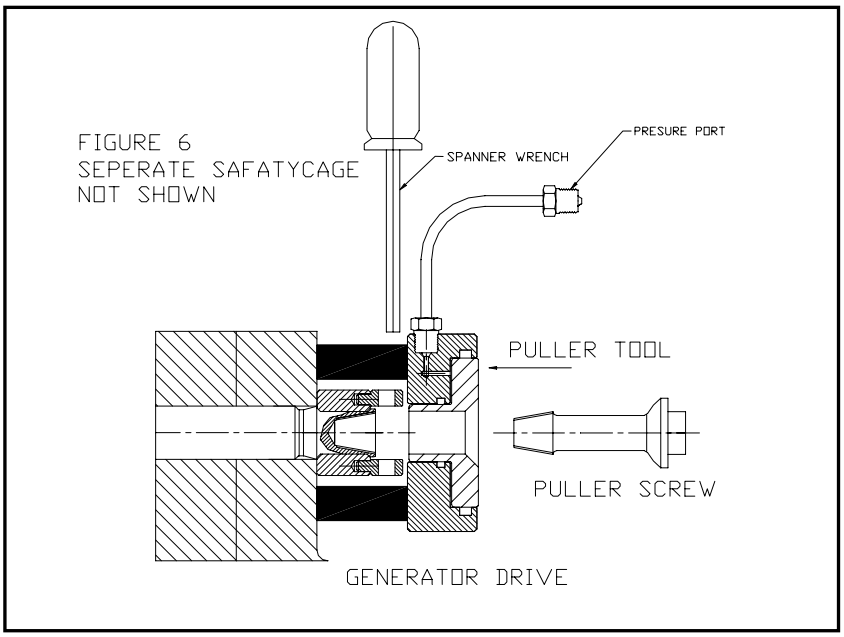

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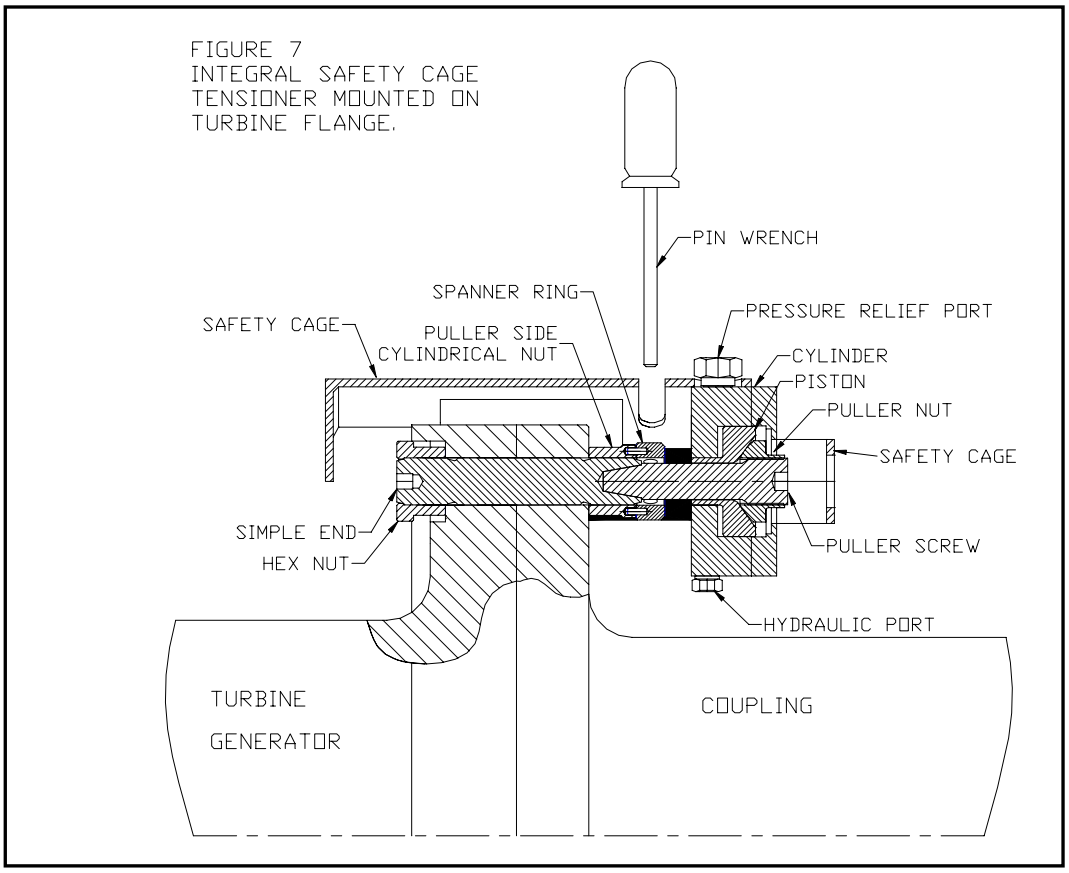

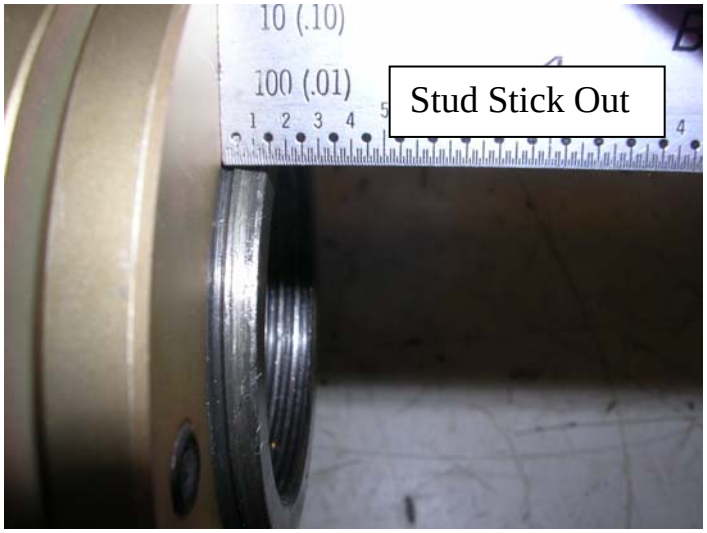

FIGURE 8

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FIGURE 9

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Photo 1
HT-0716 Installed on the Generator End of a 7EA

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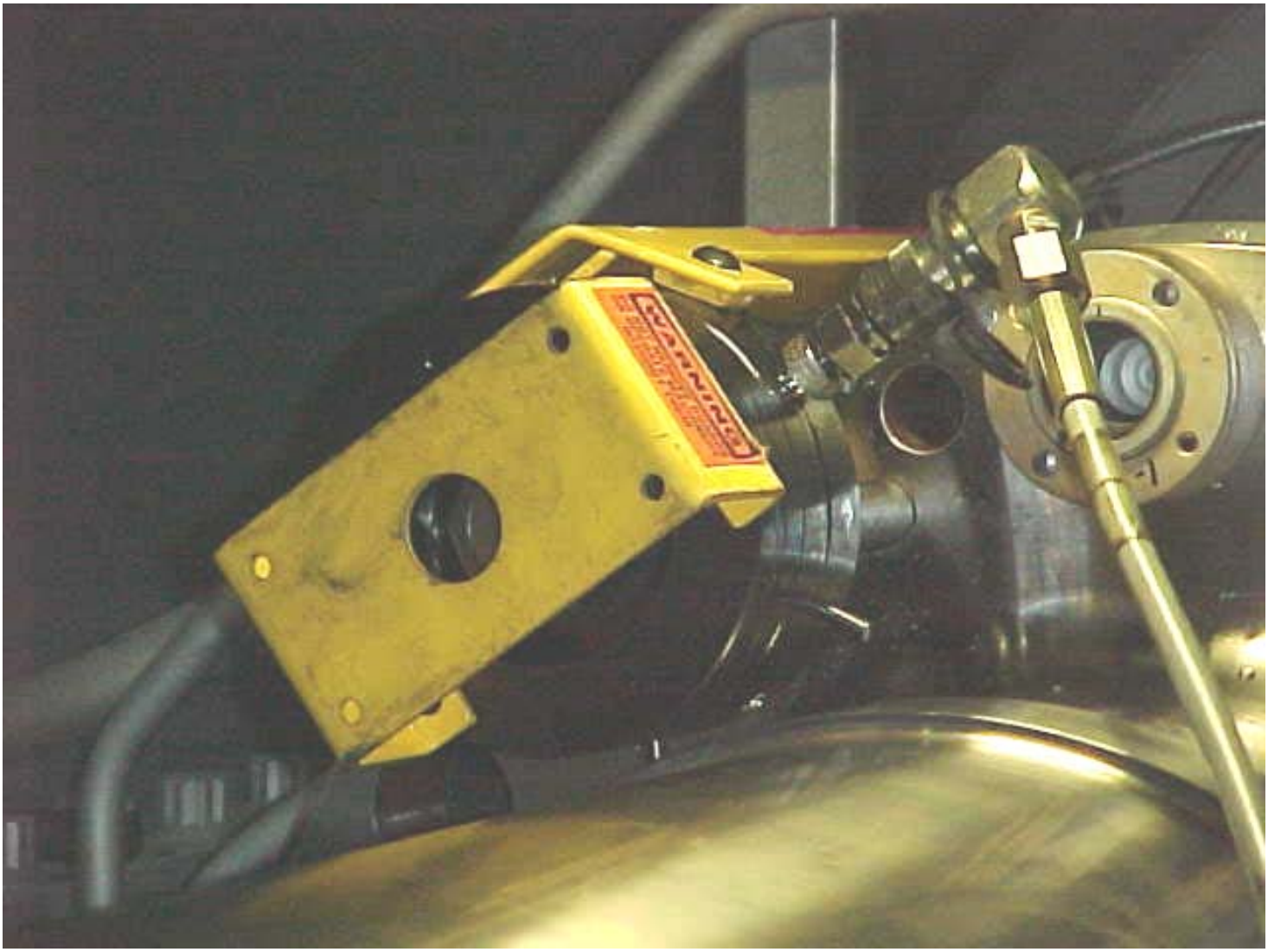
Photo 2
HT-0716 Installed on the Turbine End of 7EA at Greenville



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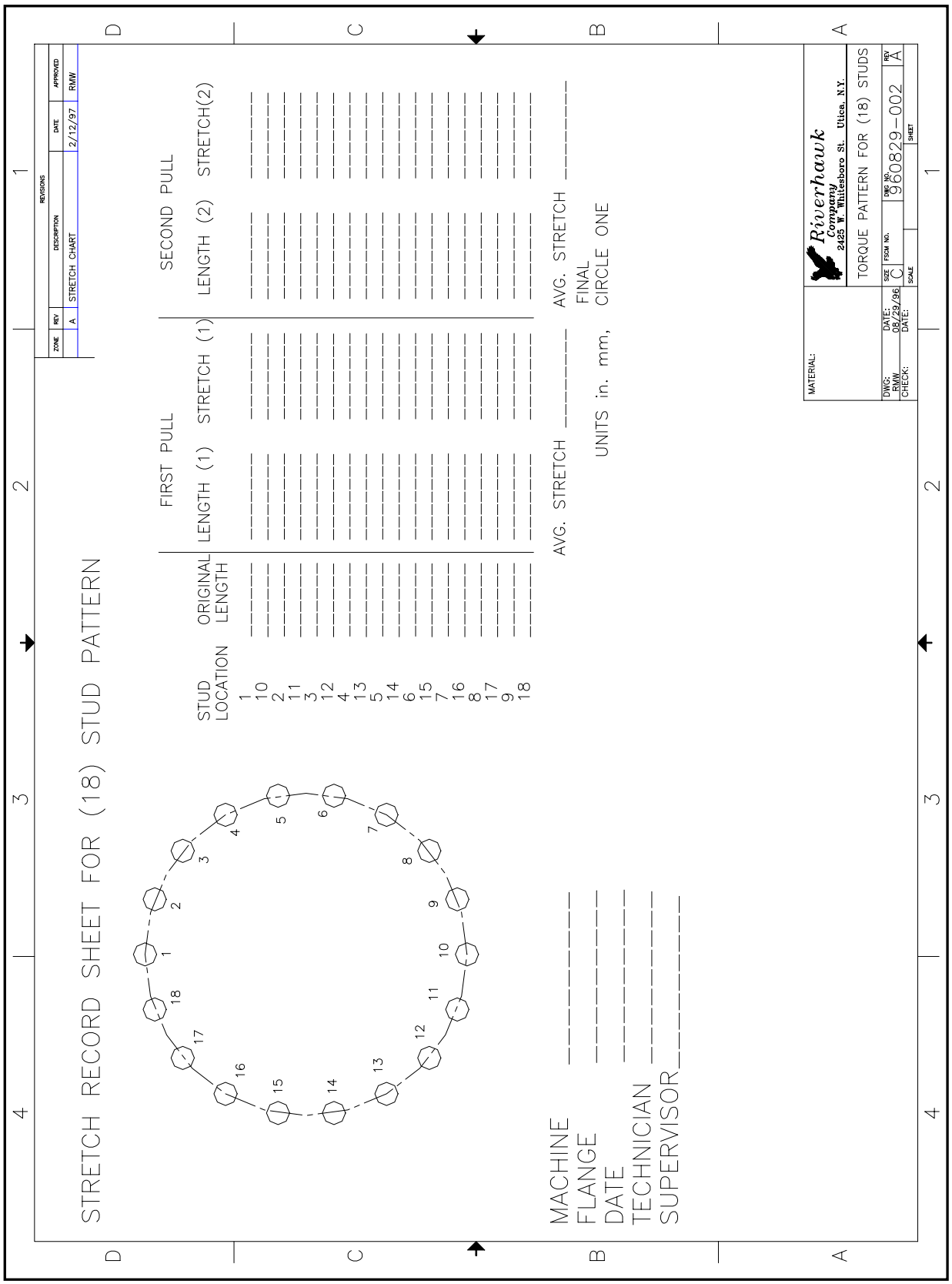

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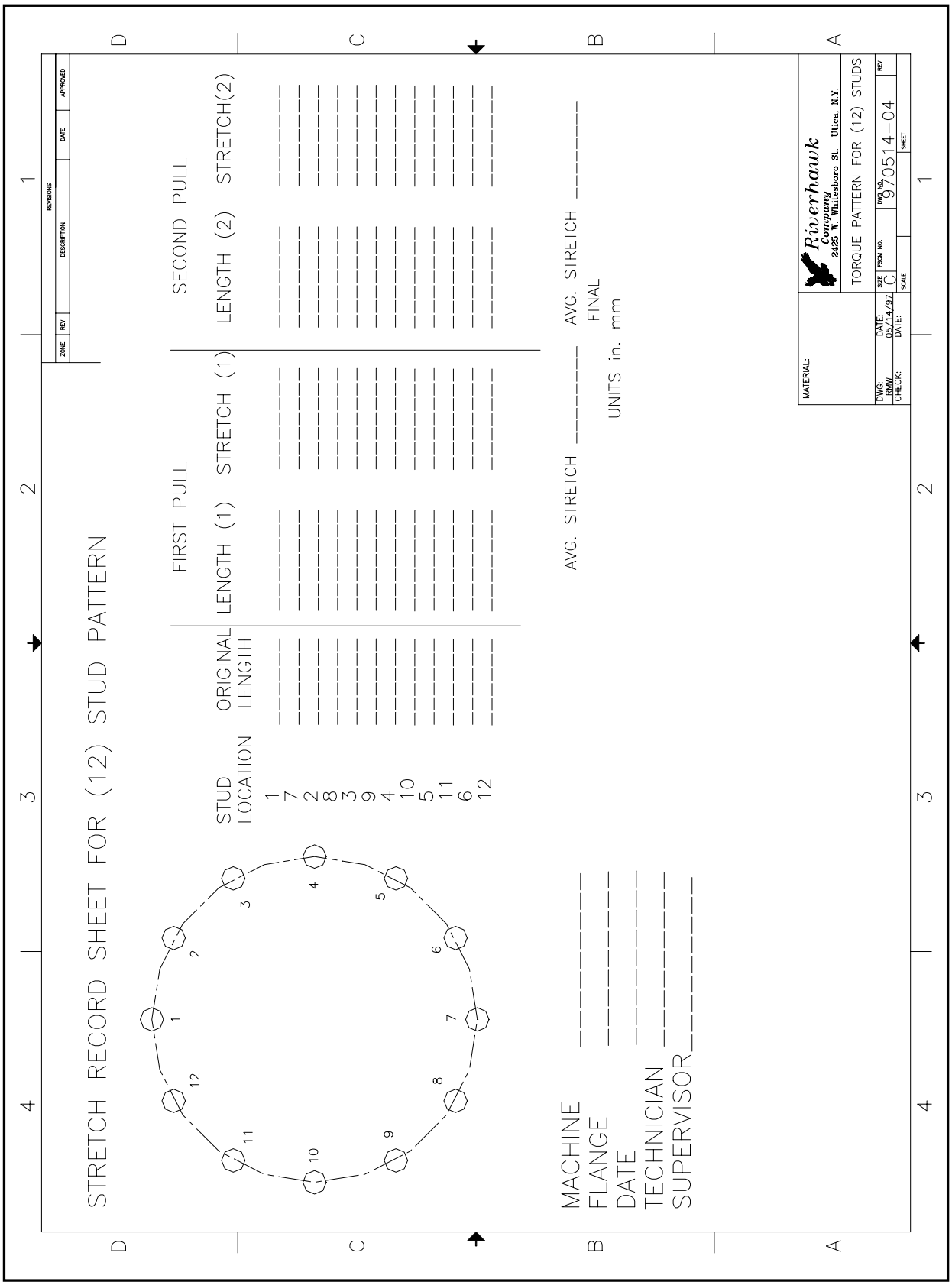

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