



30230 Los Alamos Rd. Murrieta, CA 92563

800-279-5659 • FAX 951-926-2334

TappingMachines.com

HP-104 & HP-106

**Tapping Machine
OPERATIONS MANUAL**

&

OPERATING INSTRUCTIONS



WARNING READ:

Before using this product, read owners manual and follow all Safety Rules and Operating Instructions.

*Thank you for purchasing 2LBin products.
2Lbin is committed to providing rugged, professional and safe products
for the pipeline industry. If you have any suggestions or comments to help
us meet this commitment, please contact us.*

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(read and understand prior to performing work)

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CAUTION:

2LBinTapping Machines perform connections under pressure without shut down of the pipeline system.

This product can be used by most operators but similar to being trained in the art of welding all the training data can be available, but aptitude, art form, safety and experience is as important as the training instructions.

It is the end users responsibility to determine whether you can incorporate the aptitude, art form, safety and determine whether you or your staff can perform the installation work described below.

1.0 SAFE OPERATING PRACTICES

DANGER – Your Tapping machinery was built to be operated according to rules for safe operation. As with any type of mechanical equipment, carelessness or error on the part of the operator can result in serious injury, death or damage to property. It is your responsibility as the customer to establish your own safe operating procedures that incorporate the following rules and post in a conspicuous place within your facility.

The HP-Series machinery is a precision piece of field equipment that performs “pressurized” Hot tapping operations on pipelines within the limitations set forth in this manual.

Many hazards exist but some most noticeable hazards are the following:

- A) An added drill motor is a rotational member and can catch loose clothing. Keep all loose clothing away from machinery.
- B) Pressure test machinery and all connection assemblies prior to tapping.
- C) Tapping machine will get extremely hot when tapping high temperature pipelines and vessels.
- D) Do not use the machinery beyond recommended ratings and out side of intended use.

To follow are some regulations that must be incorporated into your safety and operating procedure.

Never allow an untrained operator to use any of the various tools!

If the machine is not working properly, STOP and advise your supervisor IMMEDIATELY.

Never alter the machinery from original design.

Never use machine beyond specified safe working pressure and temperature.

Always use proper fittings, valves and equipment intended for this machine.

Never use this machine unless the tapping assemblies have been fully pressure tested before each hot tap is performed.

Always use proper safety clothing and accessories for the environment in which you are to work.

Always use this machine in accordance with OSHA's regulations.

Safety goggles, gloves and hearing protection are required at all times.

Always turn off power to tapping machine when changing hole-saws, adaptors, and servicing equipment.

Stand in an area which provides sure footing and don't let spectators stand too close.

If using an electric drive source, plug drill motor into a rated GFI (Ground Fault Protection)

Work from a scaffold or flat safe surface, preferably not from a ladder.

Read and understand the entire operators manual prior to attempting your first tap. Each operator should practice on a test line until competent in safety and performance. Once you start a live tap you will be committed to finishing it, and your line may not be easily shut down to repair the damage if an error is made.

Inspect all pieces of equipment before each use. DO NOT assume that everything is still in operational condition after each tap is performed.

Determine the type of pipeline material you are tapping into, confirm what pressure and/or product prior to proceeding. Be sure you are trained in each special aspect prior to proceeding. If you need special assistance answering safety questions, contact your supervisor or call Occlude at the phone number listed on the front of this manual.

WARNING – Work on pressurized piping systems is potentially hazardous. Proper safety training on this equipment is necessary. Do not operate any tapping equipment unless you have been fully trained. Contact IFT for a list of Authorized and certified trainers.

2.0 2LBin WARRANTY

2LBin products sold to our customers are guaranteed to be of the quality as described by 2LBin. Any 2LBin product may be returned within 10 days from customers receipt and 2LBin will provide full compensation to the customer less shipping, packaging, possible restocking if required, less usage and any damage.

2LBin warrants its products to be free of defects in workmanship and material under normal use and service, when used for the purposes and under the conditions for which they are intended. Obligation under this Warranty is limited, at Company's option; to adjustment, repair or replacement of the defective product. Purchaser must immediately notify 2LBin in writing of the claimed defect. Company shall have the right to inspect said product and Purchaser shall, if requested, return the defective product to 2LBin, with transportation prepaid. Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight charges in connection with the foregoing remedy. Any alteration of machinery voids all warranties.

NOTE: 2LBin shall not be liable for indirect, special, incidental or consequential damages or penalties and does not assume any liability of purchaser to others, or to others, for injury to persons or property.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, AND IMPLIED.

Section I: Introduction

1.0 Introduction

This manual is designed to provide the operator with recommended operation and maintenance instructions for safe and effective use of the IFT HP-104/HP-106 Tapping Machine.

This equipment is designed with adequate safety factors; however, do not exceed the factory recommended specifications under any circumstances.

Understand and Practice all safety precautions and procedures to ensure operator safety and satisfactory results.

Read the entire manual before operating the IFT HP-104/HP-106 Tapping Machine.

Follow the manual for all operation and maintenance procedure.

Use a test setup on a short length of pipe before going into the field for actual operations.

1.1 Tapping Machine

Terms:

1. Feed Tube
2. Body Tube
3. Boring Bar
4. Ratchet Handle
5. Bleeder Valve
6. Drill or Hole Saw

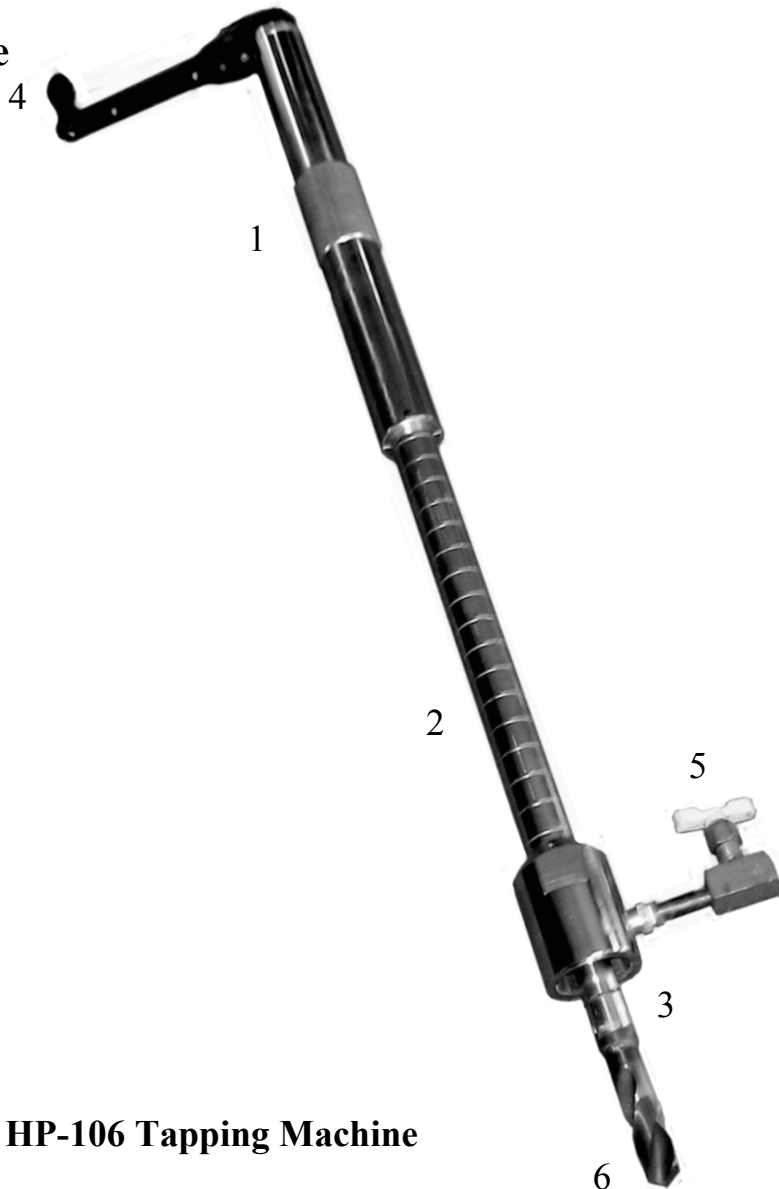


Fig. 1. HP-104 & HP-106 Tapping Machine

2.0 Specifications

Table 1 HP-104 & HP-106 Specifications

| Description | Size/Rating |
|--|---|
| Maximum operating pressure | 1440 psi at 100 deg. F |
| Maximum operating temperature | 700 deg. At 700 psi * |
| Sizes: Using a twist drill | ½”, ¾”, 1”, 1 ¼” 1 7/16” |
| Using a hole saw | 1 ¼”, 1 ½”, 2”, 3”, 4”, 6” ** (normal size) |
| Maximum boring bar travel | 18” for the HP-104 / 28” for the HP-106 |
| Machine weight | 32 lbs. for the HP-104 |
| Machine weight | 40 lbs. for the HP-106 |
| Rate of travel | Manual feed, 1/8” per revolution |
| Operation: Basic machine is manually operated. Can be operated with an optional air / electric motor and socket adapter. | |

* 700 deg. F (371 deg. C) for intermittent services only. Maximum continuous rating 350 deg. F (177 deg. C) at 1,025 psi (70bar)

**6” taps that are size-on-size require a special cutter.

2.1 Equipment

Table 2 Equipment used for various options HP-104/HP-106 tapping machines

| Terms of Items | Description & Function | Sizes Available |
|-------------------------------------|---|--|
| HP-104 Hot Tap Machine | Manual or power driven machine that taps into pipe. Provides means to plug tapped opening | |
| Valve Adapter (Threaded or Flanged) | Element that attaches tapping machine threaded end to tapping valve and houses drills and cutters. | Treaded: 1”, 1 ¼”, 1 ½”, 2”, 3” Flanged: 2”, 3”, 4”, 6”, 150, 300, or 600 ANSI Rating. |
| Drill | High-speed steel twist drill that cuts into pipe. | ½”, ¾”, 1”, 1 ¼”, 1 7/16” |
| Hole saw and Cutter Holder w/ Pilot | One-piece steel hole-saw. Holder secures the saw and pilot retains the coupon. | 1 ¼”, 1 ½”, 2”, 3”, 4” 6” for size-on-size application using HP-106 special cutter. |
| Line-stop Plug Holder | A device that holds and guides a completion Plug Allowing removal of a temporary valve | |
| Line-stop fitting | A steel nipple and completion plug used to allow entry into pipelines and tanks. | 1” and 6” Fittings |
| Line-stop Plug Holder | Enables user to set 1” - 4” 2L Bin Completion Plugs | 1” – 6” |
| Air Motor (option) | Hose-connected, hand-held power tool which can be used rather than manually operating tapping machine ratchet handle. Use of a different air motor is recommended for 6” tap. | |
| Socket Adapter (optional) | Deep-socket adaptor that connects air motor to tapping machine to the hex drive. | ¾” size |

3.0 Safety

Learn location and function of all safety features built into the HP-104/ HP-106 Tapping Machine and related equipment. Wear protective clothing, safety glasses and suitable gloves.

3.1 Bleeder Valve Connection

The bleeder valve connection is located on the drilling machine near the bottom of the body tube. The bleeder valves serves to purge air from fitting and serves to bleed off pressure after drilling is completed, the drill retracted and the tapping valve is closed.



Fig. 2 Bleeder Valve Connection

3.2 Protective Clothing

Protective clothing is required whenever working around, machinery. Suggestions are: hard hat, suitable gloves, safety goggles, safety shoes, safety clothing to cover exposed areas of skin, and breathing apparatus when toxic atmosphere exists.

4.0 Tapping Valve Requirements

**Table 3
Valves to use with Drills (see Note 1)**

| Drill Diameter | Drill Length | Minimum Valve Size | Minimum Thru-Bore | Notes |
|-----------------------|---------------------|---------------------------|--------------------------|--------------|
| 1/2" | 6" | 1 1/4" | 1.250" | (2) |
| 1" | 6" | 1 1/4" | 1.250" | (2) |

Notes:

1. The valve minimum size and minimum thru-bore listed above are the minimum sizes that will accommodate the drill. If a completion plug or other device is to be set in the line, the valve will have to be of sufficient thru-bore to accommodate the device. See table 4.

2. A 1.250" minimum bore to allow passage of the boring bar.
3. If a 1" treaded valve is used, the longer adapter and drill are required because of the boring bar diameters.
4. 1.500" minimum bore to allow passage of the drill diameters.

Table 4
Valves to Use with Hole Saws
And Completion Plugs (Size-on-Size)

| Nominal Size | Valve Size | Thru-bore Min. ID |
|--------------|-------------|-------------------|
| 1 1/4" | 2" threaded | 1 5/16" |
| 6" | 6" flanged | 6 1/8" |

5.0 HP-104 Tapping Machine Operation

To get a better understanding of how the drilling machine operates, the operator should remove the drilling machine from its case and try each of the following.

- A. Hold hex drive with a ratchet and rotate feed tube clockwise by hand. Notice that the boring bar is extended and does not rotate.
- B. Hold the feed tube and rotate hex drive clockwise with ratchet handle. Notice that the boring bar rotates, but does not extend or retract.
- C. Hold the hex drive and rotate the feed tube counter clockwise. The boring bar retracts, but does not rotate
- D. Tighten the socket-head set screw. With the ratchet handle, rotate hex drive clockwise. Note that the boring bar and the feed tube rotate and the boring bar rotates and retracts.
- E. With the ratchet handle, rotate hex drive counterclockwise. Note that the boring bar rotates and retracts.

5.1 Feed (Manual)

The HP-104/HP-106 tapping Machine is a manual feed machine. A clockwise rotation of the feed tubes extends the boring bar and a counterclockwise rotation retracts the boring

bar. With the socket-head set screw tightened, turning the hex drive clockwise both turns and extends the boring bar. One revolution of the hex drive will extend the boring bar 1/8".

Note: the socket-head set screw is to be tightened only when setting and removing completion plugs. Do not tap or drill with the set screw tightened.

CAUTION: When tapping, be sure you do not overfeed. Overfeeding, along with underfeeding, will damage the drill or hole saw.

Section II: Tapping Operations

1.0 General Information

It is strongly recommended that the operator becomes familiar with all tapping machine operation procedures. Practice operating the machine to get the feel of the controls before doing an actual hot tap job out in the field. A test setup should be made on a short length pipe to practice with the tapping procedure.

2.0 Tapping with a Drill

2.1 Select Equipment

Select the correct tapping valve by looking at Table 3, Section 1, for minimum dimensions.

To select the correct drill, see Table 3, Section 1. For the correct valve adapter, refer to parts list Section IV. It must be remembered that 18" is the maximum travel distance of the HP-104 boring bar, and 28" for the HP-106.

2.2 Assemble Equipment

- A. After nipple has been welded to the pipe, wrap Teflon tread sealant tape or apply sealing compound to nipple threads. Next, thread tapping valve to nipple. Open valve fully. When a flanged valve is used, the center of the valve thru-bore must be concentric with the flanged thru-bore.
- B. Hold the tapping machine's body tube and rotate the feed tube clockwise to extend the boring bar until the retainer spring can be removed. Remove the retainer spring.
- C. Insert drill into the boring bar and reinstall the retainer spring.
- D. Install valve adapter. Use sealing compound on the treads of the valve adapter to assure a tight seal. Thread adapter to the tapping machine.

CAUTION: Use only 2LBin valve adapters to assure correct alignment of equipment. Misalignment can result in equipment damage.

- E. Hold the body tube of the tapping machine and rotate the feed tube counterclockwise until the feed tube is at the zero mark on the body tube. Drill is completely retracted.

2.3 Compute Travel Distance

A. Travel distance is the distance the drill must travel from the zero mark on the body tube to the point that the drill has fully penetrated the pipe. It has two components: lower-in distance and drilling distance.

WARNING: Improper measurements may result in tapping through bottom of the pipe.

B. Calculate the lower-in distance required for the drill tip to come into contact with the pipe. (Boring bar fully retracted and feed tube at zero mark on the body tube)

C. Measure and record distance, tip of drill to the valve adapter face. If threaded adapter is used, tip of drill to valve adapter face, must be adjusted for thread makeup between adapter and tapping valve. Thread makeup varies and must be measured each time. If:

1. The tip of the drill is inside the adapter, the thread makeup is subtracted from the, tip of the drill to the valve adapter face measurement, and the result added in determining the lower-in distance.
2. The tip of the drill extends below the valve adapter face, thread makeup is added to, the tip of the drill to the valve adapter face measurement, and the result subtracted in determining lower-in distance.

D. Measure and record the distance of the valve face to the top of the pipe.

E. The sum of these two measurements should be the body tube reading when the drill contacts the pipe. Mark this measurement on the body tube.

F. Travel Distance (distance required to complete the tap) equals lower-in distance plus drilling distance. Add these figures and mark the body tube.

CAUTION: If the total of these figures is more than 18", maximum boring bar travel for the HP-104 (or 28" maximum boring bar travel for the HP-106), then the tap cannot be done with the HP-104/HP-106 tapping machine.

2.4 Install Equipment

A. Attach the machine to the tapping valve. Close and open the valve to make sure that it works properly and that the drill does not interfere with the opening and closing of the valve. Be sure the valve is in full open position before continuing to the next step.

B. Remove pipe plug from tapping machine bleeder valve connection. Make sure the bushing is not removed along with the pipe plug.

C. Thread bleeder valve and ¼" nipple into the bushing.

D. Test setup for pressure tightness of machine and assembly by pressuring through the bleeder valve on the tapping machine. Leave bleeder valve open after test.

2.5 Perform the Tap

A. By rotating the feed tube clockwise, extend the drill until it contacts the pipe. The feed tube should be at the first mark on the body tube (lower-in distance). Rotate slowly during the last inch of travel to prevent damage to the drill tip. After the measurement has been checked, turn feed tube counterclockwise $\frac{3}{4}$ of a turn before proceeding to the next step.

B. Attach ratchet handle to $\frac{3}{4}$ " hex drive. While a ratchet handle is furnished, best results will be obtained if handle is rotated a full 360 deg. while cutting. Turn clockwise only. The advance of the feed tube determines the rate of advance for the drill. Eight revolutions of the feed tube will lower the drill one inch.

C. As the drill turns by rotating the ratchet handle, turn the feed tube clockwise to continue advancing the drill.

D. As the drill penetrates the pipe wall, allow the line fluid to completely fill valve and fitting to purge all air. Close bleeder valve.

WARNING: Vent pressure bleed valve away from work area and personnel. Stand clear of bleeder valve. Personal injury may result from blowing debris.

NOTE: If machine stalls during the tap, turn feed tube counterclockwise until drill is free. Resume tapping (with a slower feed), to clean burr from the hole by turning the ratchet handle and reducing the rate of turning the feed tube.

E. When second mark (total travel distance) is reached on the body tube, tap should be complete. At this point, the feed tube should turn with little effort. The "feel" and rate of feed confirm the tap to be complete. Rotate feed tube one complete revolution clockwise. Feed tube should turn freely.

WARNING: Do not tap through bottom of the pipe.

E. By rotating feed tube counterclockwise, retract drill until feed tube is at zero mark on the body tube. If line is under high pressure, it may be necessary to tighten the setscrew and retract the boring bar by using the ratchet. Refer to paragraph 5.0 (A), page 5.

2.6 Remove Equipment

A. Close tapping valve.

B. Stand clear of bleeder valve. Bleed off pressure trapped in the valve adapter by opening bleeder valve on tapping machine. If pressure does not stop bleeding off, do not remove tapping machine.

C. Remove bleeder valve.

D. Remove machine from tapping valve.

CAUTION: High temperature taps—after each tap above 350 deg. F, or taps in corrosive fluids, replacement of packing is recommended. Equipment damage might otherwise result.

3.0 Tapping with A Hole Saw

On 2" and smaller taps the use of a hole saw is recommended for size-on size taps. If a hole-saw is used on other than size-on size, a flat-plate cutting condition will be encountered as pipe diameter and wall thickness increase, making completion of the tap and retention of the coupon difficult. Therefore, A twist drill is recommended for other than size-on-size.

3.1 Select Equipment

A. Select proper tapping valve using dimensions in Table 3, attach to tapping fitting, and open to full-open position.

NOTE: The tapping valve must allow the hole saw to pass through the bore unobstructed without damage to the hole saw or valve. The bore should be unobstructed by seat ring lugs, ect. The bore of the valve must be round and the minimum inside diameter must correspond to thru-bore minimum inside diameter dimension in table 4, Section I.

B. Select proper hole saw holder pilot, hole saw, and valve adapter from Section IV. Be sure that the U-wire in the holder pilot works freely and moves from side to side by its own weight.

3.2 Assemble Equipment

A. Install adapter. Use Teflon tape sealant or sealing compound on threads of the valve adapter to the tapping machine.

CAUTION: Use only 2LBin valve adapters to assure correct alignment of equipment. Misalignment can result in equipment damage.

B. Attach hole saw to holder pilot.

C. While holding body tube, rotate feed tube clockwise to extend boring bar until retainer spring can be removed. Remove retainer spring.

D. Insert hole saw holder pilot into boring bar and attach retainer spring. **Do not use grease in hole saws.**

E. While holding body tube, rotate feed tube counter clockwise until feed tube is at zero mark the body tube.

3.3 Compute Travel Distance

A. Travel distance is the distance the hole saw must travel to complete the tap and is measured from the zero mark on the body tube to the point at which the saw will have cut completely through the pipe and have retained the coupon. It has two components: lower-in distance and cutting distance.

WARNING: Improper measurements can result in tapping through the bottom of the pipe.

B. Calculate lower-in distance: from pilot drill tip to contact pipe. (Boring bar fully retracted and feed tube at zero mark on the body tube.)

C. Measure and record distance of the tip of the pilot drill to valve-adapter face. If threaded adapter is used, subtract threaded makeup between adapter and the tapping valve. Threaded makeup is not constant. It must be measured every time.

D. Measure and record distance of the valve face to the top of the pipe.

E. The sum of these two measurements should be the body tube reading when the pilot drill contacts the pipe. Mark this measurement on the body tube.

G. Example:

Assume we are using a threaded valve adapter

1. If distance of the tip of the pilot drill to the valve-adapter face measures 2" after tread makeup is subtracted, and
2. Distance of the valve face to the top of the pipe is 12", then
3. The total lower-in distance would be 14"

H. Determine cutting distance.

I. For size-on-size taps (2" tap on 2" pipe, 4" on 4"), cutting distance for standard weight pipe is shown in Table 7

Note: If a size-on-size tap is being made on heavy wall pipe, make sure that the ID of the pipe is larger than the OD of the cutter in order to complete a successful tap and retain the coupon.

J. Travel distance (distance required to complete the tap) equals lower-in distance, total of measurements of the pilot drill to the valve-adapter face and distance of the valve face to the top of the pipe, plus cutting distance from Table 7. Add these figures and mark on the body tube.

CAUTION: If the total of the figure is more than 18" maximum boring bar travel for the HP-104 or 28" for the HP-106, the tap cannot be completed with the HP-104/HP-106 tapping machine.

3.5 Install Equipment

CAUTION: When using flanged adapters, make sure the bore of the tapping valve and the bore of the fitting are in alignment.

A. Attach machine to the tapping valve. Operate valve to make sure it opens and closes without interference from the tip of the pilot drill. Be sure the valve is in full-open position before continuing to the next step.

B. Remove pipe plug from bleeder valve connection and install bleeder valve and nipple, open bleeder valve.

WARNING: Make sure bleeder valve is in open position. If not, open it.

C. Test setup for pressure tightness by pressuring through bleeder valve on the tapping machine.

CAUTION: When conducting pressure test, do not exceed internal pipeline pressure.

3.5 Perform Tap

A. By rotating feed tube clockwise, extend pilot drill until it contacts pipe. The feed tube should be at the first mark on the body tube (lower-in distance). Rotate slowly during last inch of travel to prevent damage to the tip of the pilot drill. After measurement has been checked, turn feed tube counterclockwise three-quarters of a turn before proceeding to the next step.

B. Attach ratchet Handle to $\frac{3}{4}$ " hex drive. While a ratchet handle is furnished, best results will be obtained if handle is furnished, best results will be obtained if the handle is rotated 360 deg. while cutting. Turn clockwise only. The rate of advance of the hole saw is determined by the advance of the feed tube. Do not overfeed to prevent damage to the pilot drill or hole saw. Eight revolutions of the feed tube will lower the hole saw on inch.

C. As the pilot drill penetrates the pipe wall, allow line fluid to completely fill valve and fitting to purge all air. Close bleeder valve.

WARNING: Stand clear of the bleeder valve. Personal injury might result from blowing debris.

NOTE: As the tap nears completion, the cutting noise may become louder and more irregular. This is caused by the coupon changing shape or relieving stress. If the pipe is highly stressed at the tapping location, the hole saw may become locked by the loosened coupon spreading out. In this case retract hole saw by turning feed tube one revolution counterclockwise. Resume tap (with a slow feed) to clear burr from hole.

D. When the second mark (total travel distance) is reached on the body tube, tap should be complete. At this point, the feed tube should turn with little effort. The "feel" and rate of feed confirm the tap to be complete.

3.6 Remove Equipment

A. By rotating feed tube counterclockwise, retract hole saw until feed tube is at the zero mark on the body tube or until it comes to a firm stop. If line is under high pressure, it may be necessary to tighten the set screw and retract the hole saw by using the ratchet handle.

- B. Close tapping valve.
- C. Bleed off pressure trapped in valve adapter by opening bleeder valve on the tapping machine. Stand clear of the bleeder valve. If pressure does not stop bleeding off, do not remove tapping machine.
- D. Remove the bleeder valve.
- E. Remove the machine from the tapping valve.

CAUTION: High temperature taps—after each tap above 350 deg. F, or taps in corrosive fluids, replacement of packing is recommended. Equipment damage might otherwise result.

- F. Remove coupon. To enable coupon to slide off the pilot drill, the coupon must be pushed up to allow U-wire to rotate. Slide coupon over pilot drill.

Section III: Maintenance

(This Section will be complete with photos soon)

1.0 General Maintenance

The HP-104/HP-106 Tapping Machines have been designed for rugged service and require a minimum amount of maintenance. A reasonable amount of care will keep the machine in top operating conditioning for a long time. The following are recommended for proper care and handling.

- A. The exposed end of the boring bar should be protected when the machine is not in use.
- B. Use open-end or an adjustable-type of flat wrench on the two flat surfaces provided when attaching the machine to a valve adaptor.
- C. After each use, clean dirt and any foreign material from the exterior of the machine.
- D. Care should be taken not to damage the hex drive at the top of the machine.
- E. Lubricate ratchet handle regularly with oil.
- F. After each tap, inspect the pilot for any damage. Make sure that the U-wire works freely and drops by its own weight.
- G. Disassemble and lubricate each part every six months or thirty taps, whichever comes first.
- H. High temperature tap- after each high temperature tap above 350 deg. F, or tap in corrosive fluids, replacement of packing is recommended.
- I. The drill, holder pilot, and hole saws are parts to be protected from corrosion by an oil coating. These parts should be inspected regularly and recoated with oil before storing.

2.0 Machine Assembly/Disassembly

2.1 Disassembly

- A. Hold tube and rotate feed tube clockwise until boring bar is fully extended from body tube. The feed tube should be at the 18° mark on the body tube.
- B. Loosen socket-head setscrew on the bearing and cap retainer.
- C. Use Allen wrench to loosen the setscrew in the top of the bearing and cap retainer.
- D. Using packing wrench provided, remove retainer nut next to the bearing at the top of the machine by turning counterclockwise.
- E. When the retainer nut is removed, Care must be taken that the brass pellet inside does not fall out. It is this pellet that, when the socket-head cap screw is tightened, locks the feed tube and body together for plug setting operations.
- F. Remove snap ring and three-piece thrust bearing at the top of the machine.
- G. Remove the boring bar through the bottom of the machine.
- H. Remove split bushing at the bottom of the feed tube by removing screws.
- I. Hold the body tube and rotate feed tube counterclockwise until threads are disengaged. With Prawn body tube from the feed tube.
- J. Using packing wrench provided, remove the packing retainer nut from the body tube by turning clockwise (threads are left-handed). Remove packing.

2.2 Machine Reassembly

Reassembly procedures are basically the reverse of steps A through H of Paragraph 2.1, Machine Disassembly. However, the following additional information is provided and refers to various steps in the disassembly procedures.

- A. Grease all parts prior to assembly.
- B. Replace packing: Replace packing with high-temperature packing. See item 15, parts list for part number. Enough sections should be used to make a stack 1" high. The grooves should be greased and inserted one section at a time with the tip toward the bottom.
- C. Packing retainer nut. Inspect packing-retainer nut. A nylon insert on the side serves as a lock washer. Inspect this insert for condition. Replace if necessary. A nylon pellet $\frac{1}{4}$ " in diameter and $\frac{7}{32}$ " long will be required.
- D. Packing retainer nut. Remember that the packing-retainer nut has left-handed threads. Turn counterclockwise to install. Tighten firmly; making sure that the boring bar will rotate without excessive torque.
- E. Install thrust bearing. When replacing three-piece thrust bearing at the top of the machine, grease each bearing individually. Inspect snap ring.

F. Install retainer nut. Before installing retainer nut, replace brass pellet with a new one, and refer to item 9, parts list for part number. It can be held in place by grease.