

PIA EUGH

GraverMach AT™

OPERATION AND MAINTENANCE MANUAL



IMPORTANT

Read these instructions BEFORE operating the machine. There are a few things that must be done before connecting the machine to any power source.



NOTICE

This machine requires clean, dry oil free air. We suggest using an oil free compressor. If your compressor is an oil type, you **MUST** have an oil removal filter (coalescing type) in the air supply line to this machine. If you are unsure of this requirement, please call 800-835-3519 or 620-343-1084 and ask for Technical Services. **OIL CONTAMINATION IS NOT COVERED BY WARRANTY.**

INTRODUCTION

The GraverMach AT is designed to assist the metal, jewelry, stone, wood, or ivory artisans in creating their unique masterpiece(s).

The GraverMach AT coupled with a GRS handpiece creates an air-powered hammer system. The machine creates the air pulses and the handpiece turns those air pulses into a mechanical hammer action. How the handpiece hammers is dependent upon the settings of the GraverMach AT. Settings include: strokes per minute, air pressure, bias, handpiece, and range of power control by hand or foot. These settings allow the artisan an efficient means to fine tune the system to their needs. In addition, the GraverMach AT offers an auxiliary air system for a rotary handpiece or other air tools.

The GraverMach AT Operation and Maintenance Manual has been prepared for you so that you can familiarize yourself with this machine. Please read this document thoroughly before use.

Fig. 1 • GraverMach AT



Front View



Back View



REQUIRED EQUIPMENT

The following items are required to begin using your GraverMach AT:

- **We recommend oil free compressors** for use with this equipment. If you are using an oil type you **MUST** use a coalescing oil removal filter to protect your GraverMach AT and preserve your 2-year warranty. Failure due to oil or water contamination is NOT covered by warranty.
- Use the appropriate handpiece. Only handpieces intended for the GraverMachs, GraverMaxes, GraverMates, or GraverSmiths will work with this unit. *System 3 and GraverMeister handpieces will not function with this machine.*
- A clean, sturdy work surface and adequate lighting is essential to the success of the user and the equipment.

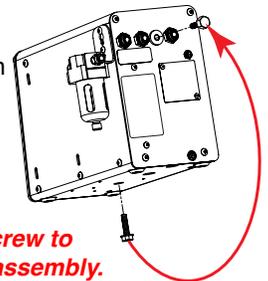
GraverMach AT™

- A. Airtact air pressure gauge
- B. Airtact air pressure control knob
- C. Power On/Off button
- D. Bias control knob
- E. Primary air pressure gauge
- F. Primary air pressure control knob
- G. Handpiece selector knob for J and K
- H. Strokes per minute selector knob
- I. Airtact hand/foot control selector knob
- J. Airtact handpiece twist lock control ports
- K. Handpiece quick connect fittings
- L. Auxiliary air open/close knob
- M. Air filter input quick connect fitting
- N. Air filter
- O. Air filter output quick connect fitting
- P. Air input quick connect fitting
- Q. Foot throttle quick connect fitting
- R. Retain stabilizer screw here, see **IMPORTANT NOTICE**
- S. Auxiliary air quick connect fitting
- T. 24 Volt power jack
- U. Reservoir drain plug
- V. Motor mount assembly stabilizer screw



IMPORTANT NOTICE

When you unpack your new GraverMach AT notice the screw protruding from the bottom of the machine (Fig. 1-V). This screw is holding the motor mount assembly to protect it from damage during shipping. You will need to remove the screw with a 7/16" wrench or socket, or an adjustable end wrench before placement and use. Store the screw and washer by inserting them into the rubber grommet located on the back of the machine (Fig. 1-R). Shown in the illustration to the right.



Please note, if you are going to transport this machine OR ship it, YOU MUST replace and tighten the screw to prevent damage to the motor mount assembly.

Never lay the machine on its side and turn it on. ALWAYS use the machine in a vertical position. The rotary valve is lubricated by air passing through it. DO NOT the run electrical system unless the air supply is turned on and adequate air pressure is present.

MACHINE SETUP

AIR SUPPLY REQUIREMENTS

GraverMach AT requires 1.4 CFM (40 liters/min.) at a minimum 45 psi (3.1 bar). Maximum input is 125 psi (8.6 bar). We encourage reducing the air pressure from the compressor with a regulator to 45~60psi (3.1~4.1 bar) as this ensures a stable air pressure supply. The compressed air must be clean, dry, and oil free. The filter supplied with each unit is a final filter and is not capable of removing large amounts of water, oil, or contaminants.

If the air supply has excessive water, oil, or contaminants, an additional filter/water trap and coalescing oil removal filter must be installed ahead of the unit. Oil or water contamination is NOT covered by the 2 year warranty.

Never add oil to the compressed air for the GraverMach AT. Oil can damage internal parts and cause erratic handpiece operation. If your compressor requires oil YOU MUST use a Coalescing Oil Filter (#004-579 or equivalent) to ensure this oil does not contaminate your compressed air.

INITIAL SETUP

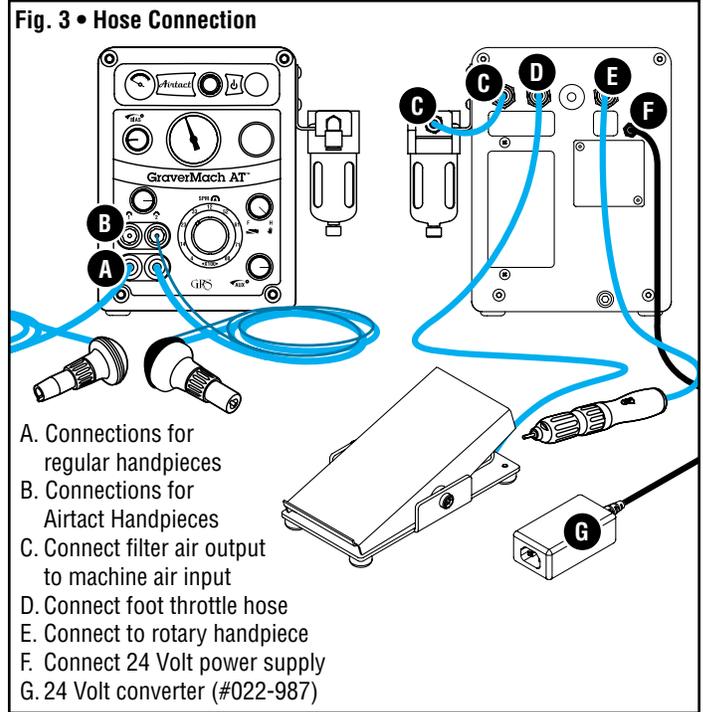
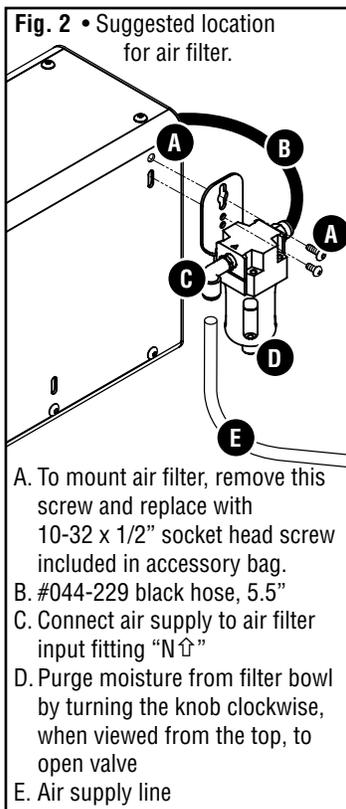
Decide where you want to place the machine on your bench and where you would like the air filter located. Make its location readily accessible so it is easy to drain water from the bowl daily. You may attach the air filter to your machine, workbench, or wherever you desire. Here we show it attached to the back right side of the machine. Remove the screw at this location and place the screw through the key hole opening in the filter bracket. Tighten the screw to secure bracket. The bottom screw in the bracket will position into the slot to keep the filter from twisting.

HOSE CONNECTION

If push-to-connect fittings are new to you, they are amazing. With the AIR PRESSURE TURNED OFF, simply insert the hose all the way into the fitting opening — it stays attached. To disconnect, press in on the orange ring while gently pulling the hose out.

Locate the air input fitting on the air filter (Fig. 2-C). It is identified on the air filter with the marking "N⇑". Connect your 1/4" OD (6.35mm) air supply hose directly to the push-to-connect fitting. If your air supply hose is larger than 1/4" OD you have two options. Use a reducer (not supplied) and step the air hose size down to a 1/4" OD (6.35mm) or replace the push-to-connect fitting with the included barbed fitting and attach air supply hose.

Locate the 6' (1.82m) air hose (#044-069) and cut a 5 1/2" (139mm) piece from it. **NOTE: This is if you are going to locate the Air Filter as described above. If locating the filter in a different place, cut the 6' hose to fit as needed.** Connect the 5 1/2" hose to the air outlet on the air filter (opposite the air input). Connect the other end



of that hose into the fitting on the back of the machine marked AIR INPUT (Fig. 3-C). Use these same connections no matter where you locate the filter.

CONNECT FOOT THROTTLE

Place the foot throttle on the floor in a convenient position. Run the hose to the back of the machine (Fig. 3). If you need to snake the hose through an opening on your bench, make sure the hose is not pinched or kinked. Connect the hose from the foot throttle to the push-to-connect fitting above the label marked THROTTLE CONNECTION (Fig. 3-D).

NOTE: It is normal to hear air leaking when you depress the foot throttle, this is what activates the handpiece.

CONNECT HANDPIECES

There are two fittings to attach standard impact handpieces (Fig. 3-A). Decide which handpiece you want in positions 1 and 2. Connect the handpiece hose to the push-to-connect fitting simply by pushing the hose inside the orange fitting. A selector knob above the connections lets you select which impact handpiece you want to use, 1 or 2 (Fig. 1-G). If you are using the Airtact handpiece, the twist-to-lock connections above the main air fittings are conveniently placed for easy hook-up (Fig. 3-B). **NOTE: Make sure selector knob is turned until it stops, either direction.** The auxiliary outlet is a straight flow air supply that is limited to 40 psi (2.7 bar) and is located at the rear of the unit (Fig. 3-E). This is the connection for a rotary handpiece or other pneumatic tool. The knob is a twist open-twist close valve on the face of the machine (Fig. 1-L).

USING AN AIR DRIVEN ROTARY HANDPIECE

DO NOT EXCEED 35 psi (2.8 bar) when using the 850 Rotary Handpiece.

CONNECT ELECTRICAL POWER

IMPORTANT: The ROTARY VALVE is lubricated by air passing through it. DO NOT RUN ELECTRICAL SYSTEM UNLESS AIR SYSTEM IS ON. Connect the electrical power cord into the 24 Volt converter box. Plug the converter cord into the jack on the back of the machine (FIG. 3-F&G).

OPERATION

STROKES PER MINUTE (SPM)

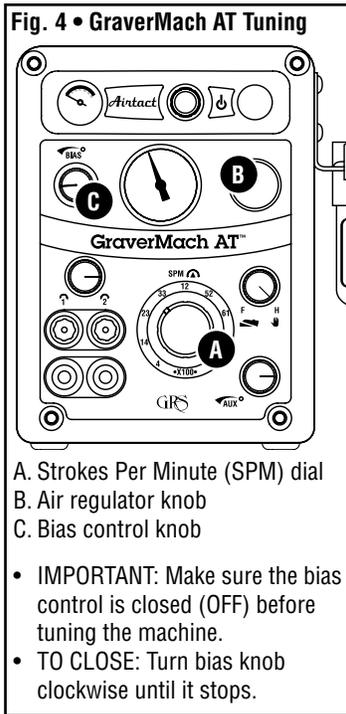
Stroke speed setting is a matter of personal preference and experience. Generally speaking, lower speed settings are preferred for some stippling, matting or staking functions. Try mid range settings for tasks requiring maximum power. Higher speeds work best for fine, delicate cuts and to obtain the best finish. The GraverMach AT shows a range of 400 to 8,000 strokes per minute. The calibrations on the dial are only approximate. Each model of handpiece has a normal range of strokes per minute. Operating outside this range can produce erratic operation.

HOW TO TUNE THE GRAVERMACH AT

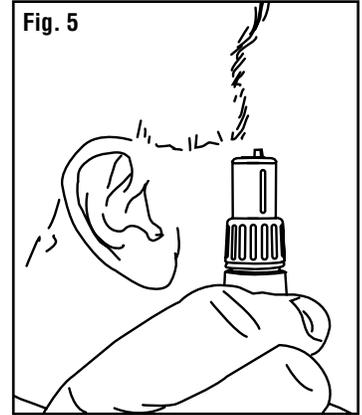
(Fig. 4) By tuning your machine, we mean adjusting the strokes per minute and air pressure for optimum performance. TUNING YOUR MACHINE PROPERLY IS THE SINGLE MOST IMPORTANT OPERATION YOU SHOULD LEARN.

1. Turn ON your air compressor and allow the tank to fill. Wait for the compressor to cycle off and stop running.

SPECIAL NOTE: When you turn on the GraverMach AT, you hear a little puff of air coming from the inside. This is an electrically controlled air solenoid valve designed to come on when the machine is powered up. It will make a pop and hiss sound when the unit is turned off. This feature is designed to allow the user to turn off the air supply at the GraverMach AT when you are leaving the bench area for a break. It will keep air in your compressor tank when your machine is not running.



2. Turn on the GraverMach AT and select handpiece port 1 or 2 to operate the handpiece of your choice. Next, move the hand/foot selector control knob to the operating system you wish to use. Now, set the stroke per minute dial at 2300 and using the regulator knob (Fig. 4-B) on the front of the machine, back the air pressure down to 2 to 5 PSI (0.1 to 0.4 bar). Close the bias valve (Fig. 4-C).
3. Hold the handpiece you have selected to use with the tool holder end up (vertically) next to your ear (Fig. 5).
4. WITHOUT depressing the foot throttle or hand control, SLOWLY increase the air pressure until the handpiece begins to buzz. While continuing to increase the air pressure, the handpiece will vibrate, more air pressure will make it knock. Slowly add air pressure and when the knocking barely stops, this is considered the perfect air pressure operating range for that particular handpiece.



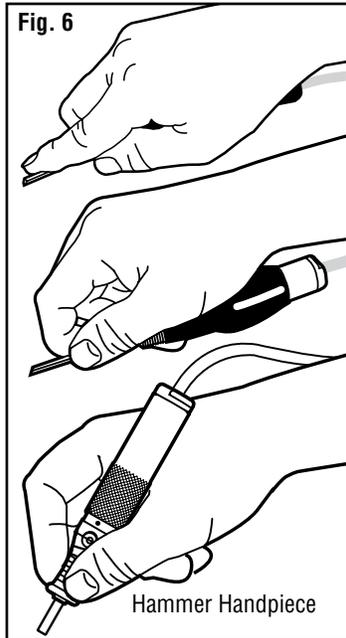
Another method of tuning (although not as precise) is to use the initial setting shown in the chart below. Set the Strokes Per Minute dial to the Recommended Initial Setting. Set the air regulator knob to Recommended Initial Setting for the handpiece you are using. The goal is to use the least air pressure possible that will properly operate the handpiece. Remember, if the handpiece vibrates without depressing the foot control, the air pressure is probably too low. If the handpiece fades out at full throttle, the air pressure is probably too low, or the strokes per minute is too high for that handpiece. The handpiece should start to operate within 3/8" (9.525mm) of depression of the foot throttle. If it doesn't, the air pressure is probably too high. Always make small adjustments in air pressure or strokes per minute, not large ones, until you are familiar with your machine. If you have tuned your machine properly, the handpiece will operate smoothly and predictably. New operators often use too much

HANDPIECE TUNING CHART					
Handpiece Type	Normal Operating Range Strokes Per Minute	Normal Air Pressure Range psi (bar)	Recommended Initial Setting		
			Strokes Per Minute	Air Pressure psi (bar)	
004-940 Magnum	800 - 3400	20 - 23 psi (1.3 - 1.5 bar)	2400	21 psi (1.4 bar)	
004-921/926 Monarch	Standard Spring	2300 - 4000	3600	12 psi (0.8 bar)	
	Fine Spring	2300 - 4000	3600	7 psi (0.4 bar)	
004-901/910	Standard Spring	1400 - 3400	2700	19 psi (1.3 bar)	
	Fine Spring	1600 - 3600	3000	13 psi (0.9 bar)	
004-506 Large	800 - 2400	20 - 30 psi (1.4 - 2.1 bar)	1400	24 psi (1.6 bar)	
004-508 Standard	1000 - 2800	18 - 23 psi (1.2 - 1.6 bar)	2000	20 psi (1.4 bar)	
004-563 Bulino	1600 - 4000	19 - 23 psi (1.3 - 1.6 bar)	3000	20 psi (1.4 bar)	
004-610/609 Hammer	1000 - 2700	20 - 25 psi (1.4 - 1.7 bar)	1800	22 psi (1.5 bar)	
004-710 Hammer	1000 - 2700	20 - 25 psi (1.4 - 1.7 bar)	1800	22 psi (1.5 bar)	
004-801/810	1800 - 4000	21 - 25 psi (1.5 - 1.7 bar)	3000	22 psi (1.5 bar)	
004-720 Heavy-Duty	800 - 2400	20 - 30 psi (1.4 - 2.1 bar)	1400	24 psi (1.6 bar)	

air pressure or the incorrect strokes per minute range. This can make your machine difficult to control for fine work. The GraverMach AT has extremely fine control for the smallest stone setting and the finest engraving. However, you must learn to tune the machine correctly to achieve this fine control. After you are comfortable with your handpiece control, you can experiment with variations in air pressure and stroke speed to suit your work preference.

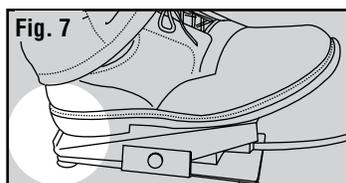
HOW TO HOLD YOUR HANDPIECE

(Fig. 6) Normally, you should hold your handpiece like a table knife, not like a pencil. Some exceptions are hammering and stippling. Resist the urge to grip your handpiece tightly. Train yourself to hold the handpiece as lightly as you can. When you grip it tightly or push hard with your hand, you lessen the impact power and create more work for yourself! So, relax and let the machine do the work while you concentrate on the design you are working on. When you are doing heavy work, try this: partially release your grip on the handpiece as you add more power with the foot control. You will be amazed at how much more power you have! If you slip with the graver, you are not operating your handpiece properly, and probably pushing too hard with your hand. Hammering is a special situation. When hammering you usually hold the handpiece like a pencil. If you are hammer setting, be sure to press the hammer tip down firmly on the work BEFORE using the foot control to start hammering. Also, do NOT operate the hammer by holding the tip slightly above the work as with many flexible-shaft hammers. Do NOT allow the hammer tip to bounce against the work. Use just enough downward pressure to keep the hammer from jumping off the work. GRS handpieces have tremendous power. Use just enough power to do the work ... take it easy at first!



HOW TO USE THE FOOT THROTTLE

Set the hand/foot control selector knob to the foot control position (Fig. 8-E). The GraverMach AT foot throttle is operated like an automobile accelerator and NOT like a flexible-shaft foot control. Begin by placing your foot on the top plate with your heel resting against the inside of the bottom bend on the top plate (Fig. 7). You should put the tool in position BEFORE depressing the foot throttle. Never depress the foot throttle and then try to bring a stroking handpiece to the work! If you need more power when cutting deeper, push more on the foot throttle to increase the handpiece power. You will soon learn to coordinate your foot action with the need for more power as you work. A beginner will push the foot throttle down a set amount and try to do the rest by pushing the handpiece harder, while never changing foot position. This is incorrect and not a safe way to use a handpiece. At the start of the cut, increase power in a smooth fashion. If you need more power, press more with your foot. As the cut tapers to the end, reduce the foot pressure gradually as your hand tilts the graver up and



out. With a little practice, this hand/foot coordination will become as natural as driving a car.

HOW TO USE THE BIAS CONTROL

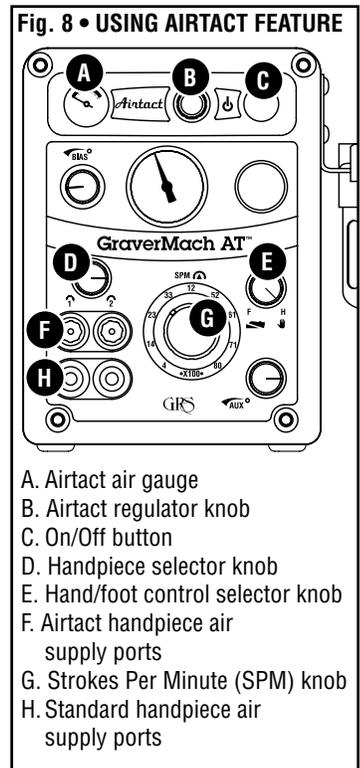
After you tune the handpiece, notice that the handpiece starts working as you press down on the foot throttle. Add one or two pounds of air pressure to the pressure gauge with the air pressure dial (Fig. 4-B). Now, open the bias control (Fig. 4-C) by turning it counter-clockwise and notice that it does not take as much pressure on the foot throttle to activate the handpiece. The bias control allows you to adjust the foot throttle action so you can predict the moment the handpiece will start, giving you optimum handpiece control. This is a feature that one would use for fine detail work such as Bulino or shading. By opening the bias control fully you will find that the handpiece will start to work without pressing on the foot throttle. You may find this function useful for some operations such as stippling.

SETUP AIRTACT FOR USE

Disconnect the air supply by turning off the GraverMach AT power switch (Fig. 8-C). Connect the larger handpiece hose to the standard handpiece air supply port on the GraverMach AT (Fig. 8-H). Take the smaller hose and connect it to the Airtact handpiece air supply port (Fig. 8-F) by gently twisting the hose end connector knob half a turn clockwise until it stops. Turn the air supply pressure back on and check carefully for leaks. Turn the selector knob from foot control to Airtact hand control (Fig. 8-E).

AIRTACT AIR PRESSURE ADJUSTMENTS

Begin by turning the power switch on to the GraverMach AT system and adjust the strokes per minute (SPM) knob to 2300 or 2400 SPM. Switch the handpiece selector knob to the handpiece you wish to use. The Airtact control unit has a regulator and gauge on the upper face located above the primary air pressure gauge and bias valve. By lowering the air pressure settings you are really changing the range at which the handpiece will operate. A lower pressure setting means that the handpiece will not reach full power but it still has the same operating range up to that point. The power you want the handpiece to have is controlled by the pressure applied to the touch element on the handpiece. Using the Airtact controls, move the small regulator knob (Fig. 8-B) and increase the Airtact air pressure to 12 psi (0.8 bar). Now, use the primary air regulator (Fig. 4-B) by turning it counter-clockwise until the gauge shows 5 psi (0.4 bar). Hold the handpiece vertically next to your ear and slowly begin to increase the air pressure by turning the primary regulator knob clockwise. You will feel the handpiece begin to buzz, then vibrate, and knock lightly. When the knocking stops, your handpiece is considered tuned.



- A. Airtact air gauge
- B. Airtact regulator knob
- C. On/Off button
- D. Handpiece selector knob
- E. Hand/foot control selector knob
- F. Airtact handpiece air supply ports
- G. Strokes Per Minute (SPM) knob
- H. Standard handpiece air supply ports

NOTE: Placing the flat twist-lock cap, provided with the machine when shipped, over the Airtact port position will also give you an automatic stroking feature that is designed for stippling or other operations where multiple hits are desired without the need for control inputs. This can be used to check for proper handpiece function. It will immediately give full handpiece power to insure your connections are correct, if not, find the problem and correct.

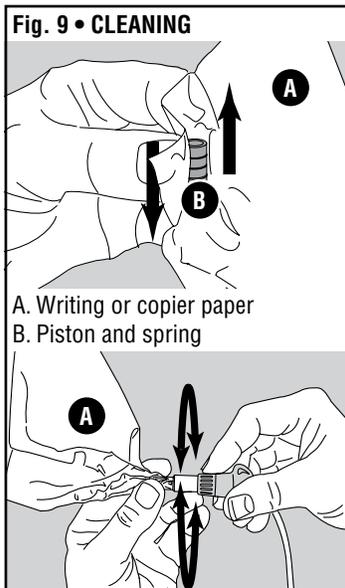
SUGGESTIONS FOR AIRTACT TOUCH ELEMENT

At approximately 12 psi, the Airtact will give full power range for any handpiece. Less than 12 psi, you will limit the range of power. This can be very useful for shading because you can lessen the pressure (try 4 or 5 psi) to limit the power for really fine control. ALWAYS BE AWARE THAT AT LESS THAN 12 PSI you will NOT have full power.

MAINTENANCE

KEEPING THE HANDPIECE CLEAN

The impact handpiece must be kept clean for proper operation. If operation becomes sluggish, erratic, or fails, cleaning is needed. Fig. 9 shows the proper way to clean a handpiece. Remove the piston and spring from the handpiece. Take each, one at a time, and place in a sheet of WRITING or COPIER paper. **DO NOT USE paper towel, tissue, or newsprint.** Holding it between your fingers buff and polish off any dirt or residue. Folding the paper, use the edge to clean between the piston grooves and the spaces between the spring. To clean the handpiece inside, take the WRITING or COPIER paper and twist it to a point. Insert the paper point into the handpiece and rotate paper and handpiece against each other. This will buff and polish the inside clean.



A. Writing or copier paper
B. Piston and spring

IMPORTANT NOTE: DO NOT LUBRICATE PISTON, SPRING OR BORE.

Occasionally place a drop of synthetic oil or light grease on the handpiece chuck threads/jaws. This will extend useful life, and improve operation. Using a quality light weight silicone grease, LIGHTLY touch the tip of the tube to your index finger and RUB/ROLL the o-ring area of the tool holder between your index finger and thumb. Use this lubricant VERY SPARINGLY as too much will attract dirt and metal chips.

IMPORTANT NOTE: DO NOT USE OTHER BRAND 24 Volt converters - DAMAGE WILL OCCUR to the machine. The power converter supplied with your machine will accept 120 Volt 60 Hz or 230 Volt 50 Hz using a PROPERLY grounded electrical circuit. Older homes and businesses may still have 2 prong receptacles for electrical connections. These may not allow the 3 prong male

plug to have a proper ground. This unit must have a suitable ground to prevent damage to the electronic components. If in doubt, consult a qualified electrician. Use the supplied adapter to convert the power supply for use with the 230 Volt 50 Hz voltage. The power converter supplied with your machine will accept 120 Volt or 230 Volt. All that is necessary to convert power supply is to use the 230 Volt adapter supplied in the accessory box.

ADDITIONAL NOTE: This 24 Volt converter has more output than the ones supplied with the original GraverMach and GraverMax SC. DO NOT use these earlier converters with the GraverMach AT. The additional electrical requirements with the air solenoid valve may cause other converters to fail or cause damage to this unit.

If replacement of the power converter is required, use only part #024-121.

IMPORTANT NOTICES

GRS PROGRESSIVE FOOT CONTROL OWNERS

If you would like to use your GRS Progressive Foot Control (#004-519PRO) with your GraverMach AT go right ahead, it will work fine. Attach the foot control throttle to the quick connect fitting on the back of the machine.

GRS 850 ROTARY HANDPIECE

Refer to the GRS 850 operating instructions for routine maintenance of the rotary handpiece. *NOTE: Do not exceed 32-35 psi when using.*

THROTTLE

The throttle should require little maintenance. It should be cleaned periodically. OILING: Periodically place a drop of oil on the throttle hinges. Keep the floor clean and when you sweep or vacuum, place foot throttle on your bench or chair.

AIR SYSTEM

If large amounts of water and contaminants are in the air supply to the unit, more frequent attention must be given to the unit filter. The bowl must be drained frequently to prevent water from entering the rotary valve, hoses, handpiece, etc. In addition, the filter element must be cleaned and/or replaced frequently. If moisture is noted in the handpiece or throttle hoses, shut the unit down immediately and drain the filter bowl.

Then proceed as follows:

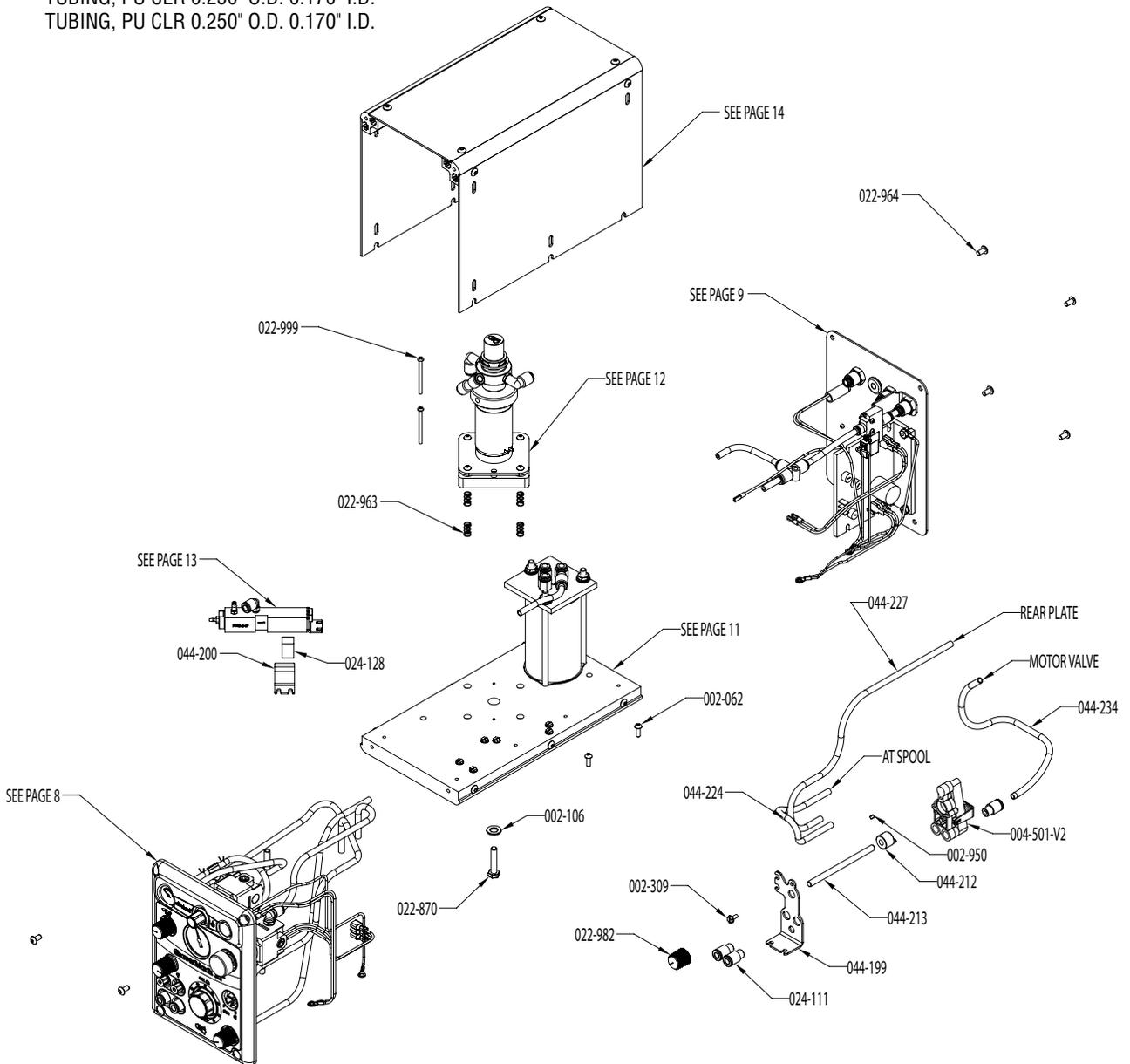
1. Disassemble and clean impact handpiece(s) and reassemble.
2. Reduce pressure setting to 10 psi and turn unit ON to purge moisture from valves, hoses, etc.
3. Located on the lower back of the machine (Fig. 1-U) is the drain plug to the internal air reservoir. Using a 3/16" hex wrench remove the plug and drain any moisture from reservoir. Replace drain plug. Before using machine again, figure out where the moisture came from and fix the problem. It may require an additional filter(s) or water trap in the line.

ROTARY VALVE

The rotary valve is lubricated by air passing through it. Additional lubrication is not required or recommended. DO NOT RUN ELECTRICAL SYSTEM UNLESS AIR SUPPLY IS TURNED ON.

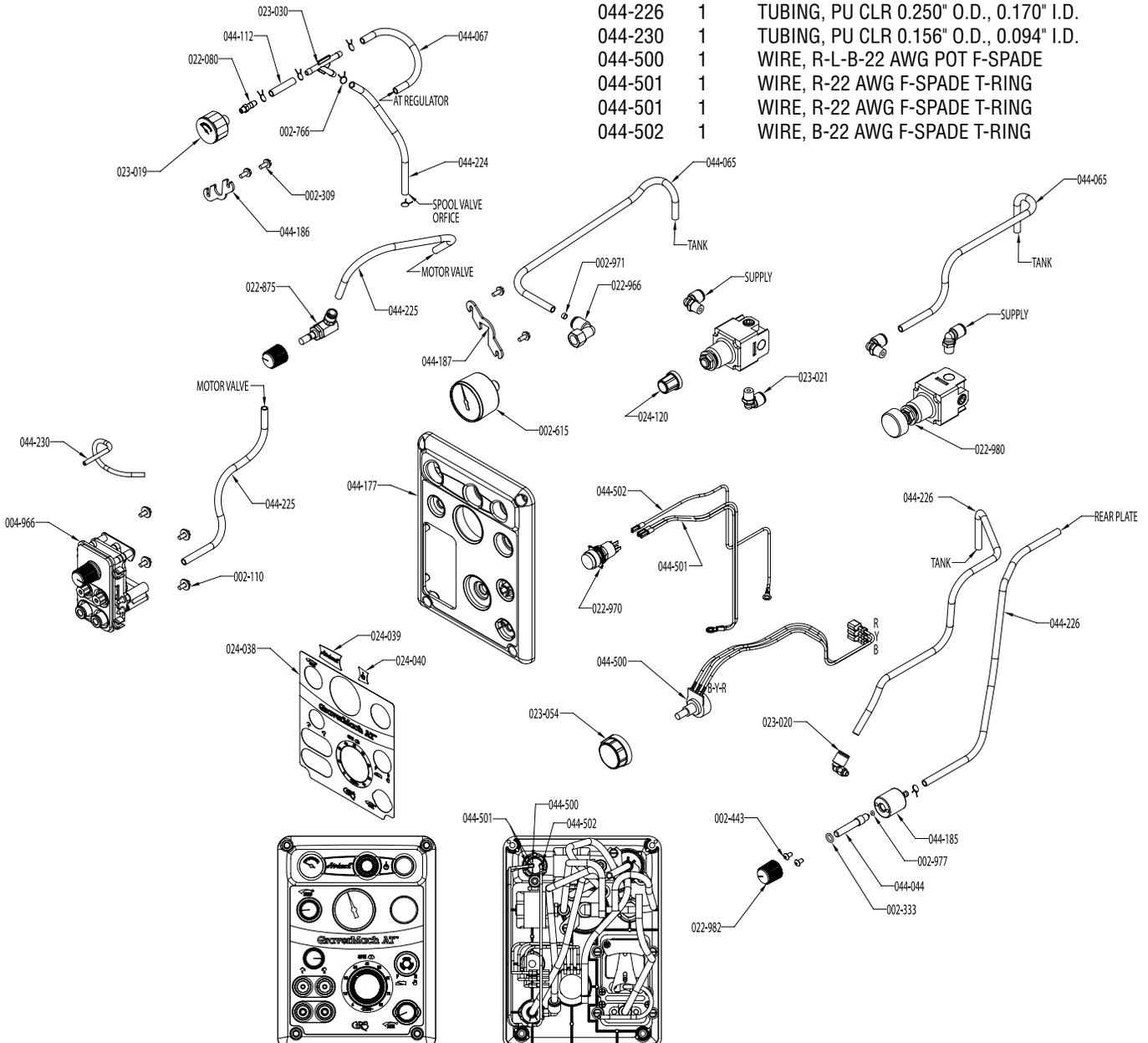
GraverMach AT™ Parts List

PART NO.	QTY.	DESCRIPTION
002-062	2	RHMS, #8-32 x 0.50" Z/P
002-106	1	WASHER, 1/4" FLAT Z/P
002-309	1	HHSMS, #6 x 0.38" Z/P
002-950	1	SHSS, #8-32 x 0.13" BLK
004-501-V2	1	VALVE, 2-WAY SWITCHING
022-870	1	HHCS, 1/4"-20 x 1.25" P-LOK Z/P
022-963	4	SPRING, COMP 0.300" O.D. 0.570" FL
022-964	8	BHSCS, #10-32 x 0.38" BLK
022-982	1	KNOB, GRAY 0.75" O.D. 0.25" I.D. x 0.69"
022-999	2	RHMS, #6-32 x 1.75" Z/P
024-111	3	FITTING, PTC 0.25" INLINE M 1/8" NPT
024-128	1	FOAM, OPEN CELL
044-199	1	BRACKET, 2-WAY VALVE
044-200	1	BRACKET, AIRTACT MUFFLER
044-212	1	VALVE SHIFTER ECCENTRIC
044-213	1	VALVE SHIFTER SHAFT
044-224	1	TUBING, PU CLR 0.250" O.D. 0.170" I.D.
044-227	1	TUBING, PU CLR 0.250" O.D. 0.170" I.D.
044-234	1	TUBING, PU CLR 0.250" O.D. 0.170" I.D.



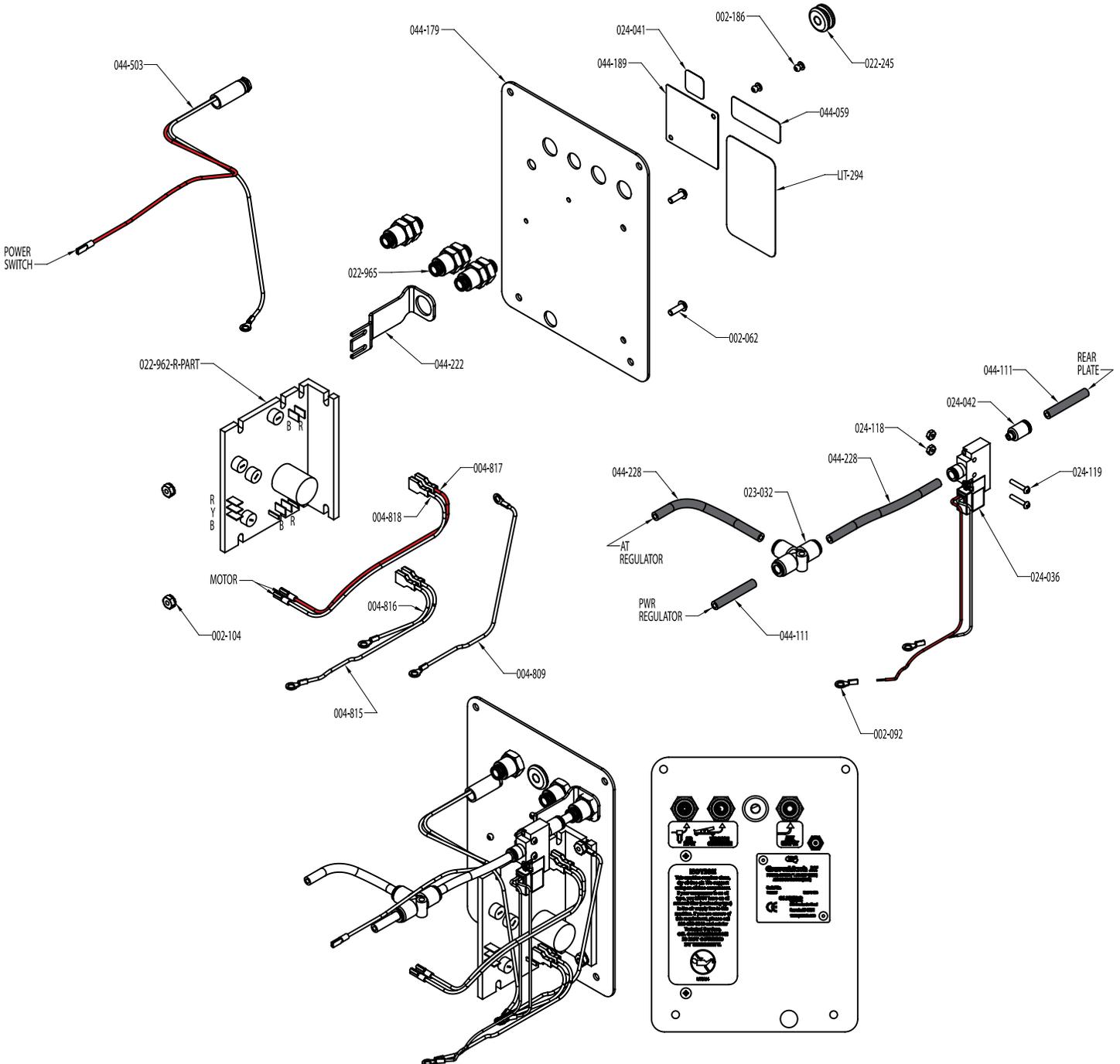
GraverMach AT™ Front Face Plate Parts List

PART NO.	QTY.	DESCRIPTION
002-110	4	WASHER, #8 FLAT Z/P
002-309	8	HHSMS, #6 x .38" Z/P
002-333	1	O-RING, 0.313" O.D., 0.188" I.D.
002-443	2	BHCS, #6-32 x 0.25" BLK
002-615	1	GAUGE, 1.63" O.D., 0-60 PSI AIR
002-766	6	CLAMP, WIRE, 0.25" O.D. TUBE
002-971	1	PLUG, 0.190" O.D. x 0.125" SINTERED
002-977	1	O-RING, 0.188" O.D., 0.063" I.D.
004-966	1	VALVE, 4-WAY SWITCHING
022-080	1	FITTING, B-0.17" I.D. TUBE M#10-32
022-875	1	VALVE, PTC 0.25" NEEDLE
022-966	1	FITTING, PTC 0.25" 90° F 1/8" NPT
022-970	1	SWITCH, ILLUMINATED POWER
022-980	1	REGULATOR, PRECISION AIR
022-980	1	REGULATOR, PRECISION AIR
022-982	2	KNOB, GRAY 0.75" O.D., 0.25" I.D. x 0.69"
023-019	1	GAUGE, 1.10" O.D. 0-30 PSI AIR
023-020	1	FITTING, PTC 0.25" 90° M #10-32
023-021	4	FITTING, PTC 0.25" 90° M 1/8" NPT
023-030	1	FITTING, B-Y 0.19" I.D. TUBE
023-054	1	KNOB, B-G 1.25" O.D., 0.25" I.D. x 0.61"
024-038	1	DECAL, GRAVERMACH AT FRONT
024-039	1	DECAL, GRAVERMACH AT AIRTACT
024-040	1	DECAL, GRAVERMACH AT ON/OFF
024-120	1	KNOB, B-G 0.75" O.D., 0.19" I.D. x 0.70"
044-044	1	NEEDLE, VALVE
044-065	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-065	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-067	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-112	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-177	1	PLATE, GRAVERMACH AT FRONT FRAME
044-185	1	VALVE BODY, AUXILIARY AIR
044-186	1	BRACKET, 1.10" AIR GAUGE
044-187	1	BRACKET, 1.63" AIR GAUGE
044-224	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-225	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-225	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-225	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-226	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-226	1	TUBING, PU CLR 0.250" O.D., 0.170" I.D.
044-230	1	TUBING, PU CLR 0.156" O.D., 0.094" I.D.
044-500	1	WIRE, R-L-B-22 AWG POT F-SPADE
044-501	1	WIRE, R-22 AWG F-SPADE T-RING
044-501	1	WIRE, R-22 AWG F-SPADE T-RING
044-502	1	WIRE, B-22 AWG F-SPADE T-RING



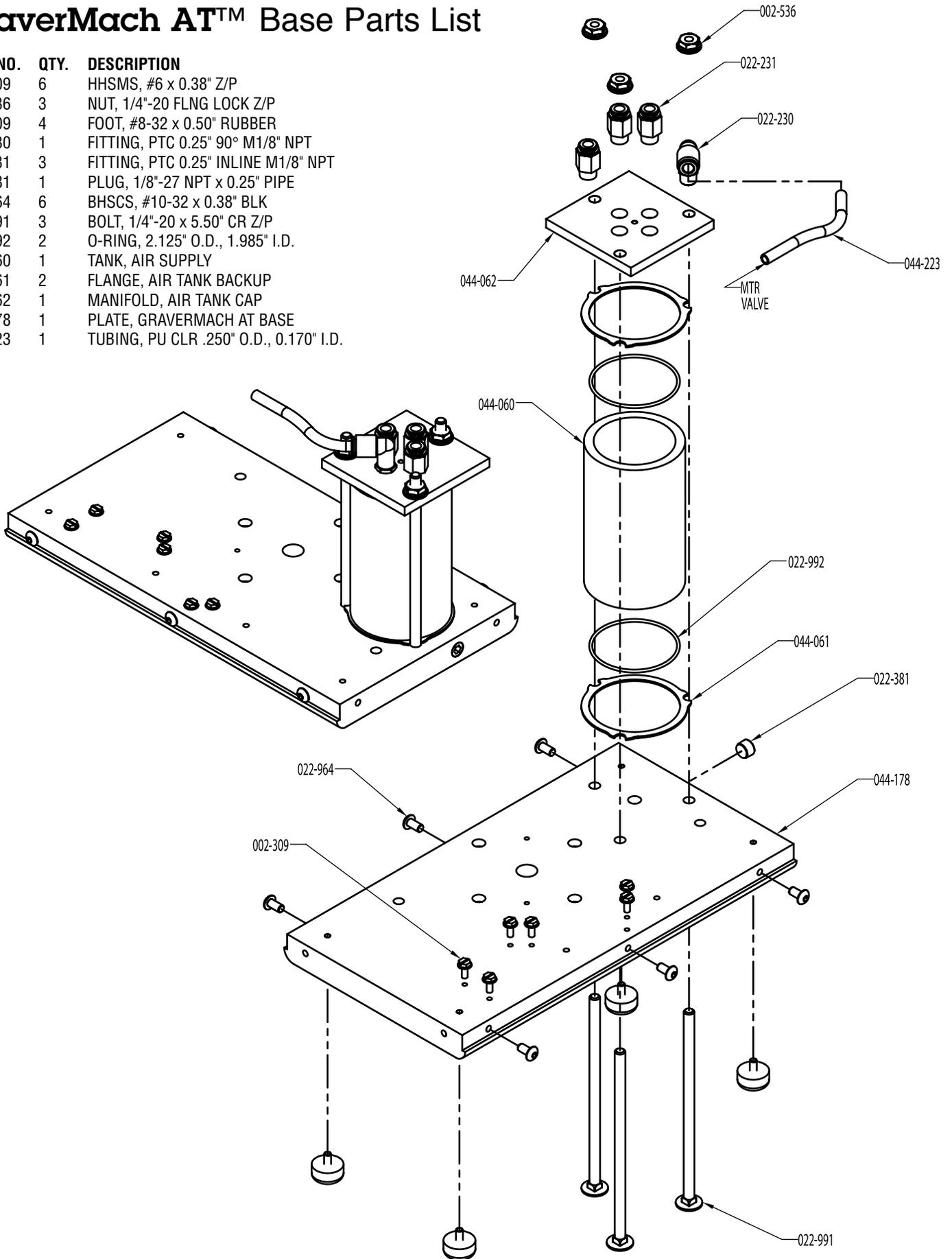
GraverMach AT™ Back Parts List

PART NO.	QTY.	DESCRIPTION
002-062	2	RHMS, #8-32 x 0.50" Z/P
002-092	2	TERMINAL, 22-16 AWG #10 RING
002-104	2	NUT, #8-32 HEXKEP Z/P
002-186	2	RIVIT, 0.125" DIA. x 0.125" POP
004-809	1	WIRE, B-22 AWG T-RING T-RING
004-815	1	WIRE, R-22 AWG F-SPADE T-RING
004-816	1	WIRE, B-22 AWG F-SPADE T-RING
004-817	1	WIRE, R-22 AWG F-SPADE F-SPADE
004-818	1	WIRE, B-22 AWG F-SPADE F-SPADE
022-245	1	GROMMET, 0.50" O.D., 0.188" I.D. RUBBER
022-962	1	CONTROLLER, 24VDC PWM MOTOR
022-965	3	FITTING, PTC 0.25" BULKHEAD
023-032	1	FITTING, PTC 0.25" T
024-036	1	VALVE, 24VDC SOLENOID
024-041	1	DECAL, AUXILIARY OUTPUT
024-042	1	FITTING, PTC 0.25" M#10-32
024-118	2	NUT, #4-40 HEX Z/P
024-119	2	RHMS, #4-40 x 0.63" Z/P
044-059	1	DECAL, AIR INPUT/THROTTLE
044-111	1	TUBING, PU BLK 0.250" O.D., 0.130" I.D.
044-111	1	TUBING, PU BLK 0.250" O.D., 0.130" I.D.
044-179	1	PLATE, GRAVERMACH AT REAR FRAME
044-189	1	SERIAL PLATE, GRAVERMACH AT
044-222	1	BRACKET, SOLENOID
044-228	1	TUBING, PU BLK 0.250" O.D., 0.130" I.D.
044-228	1	TUBING, PU BLK 0.250" O.D., 0.130" I.D.
044-503	1	WIRE, B-R-22 AWG P-JCK F-SPD T-R
LIT-294	1	DECAL, DRY AIR NOTICE



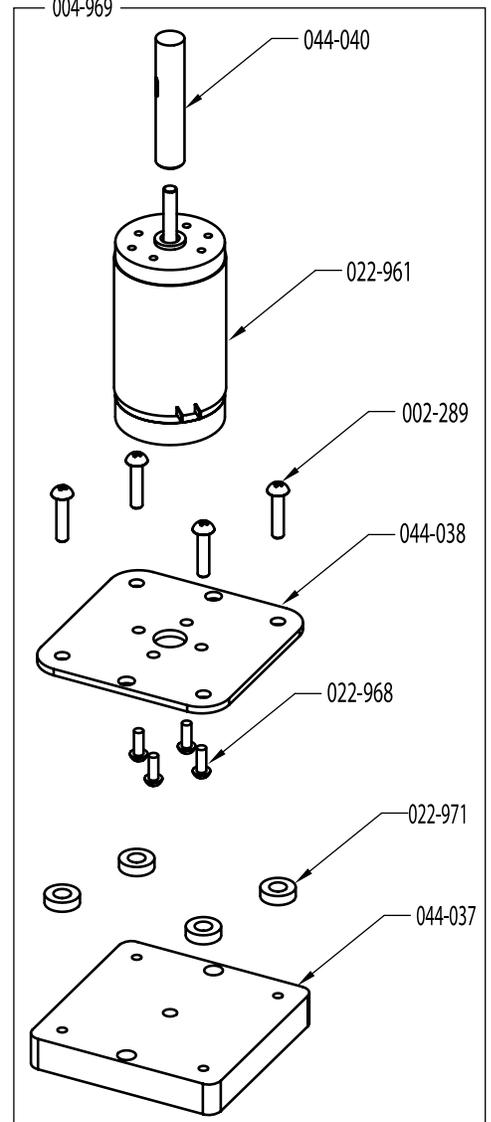
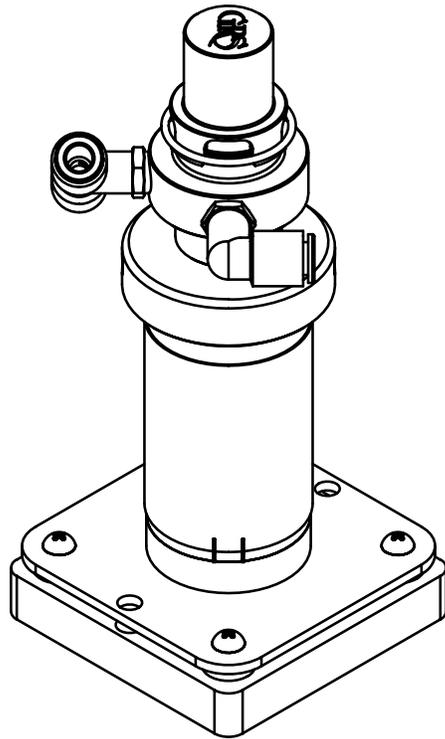
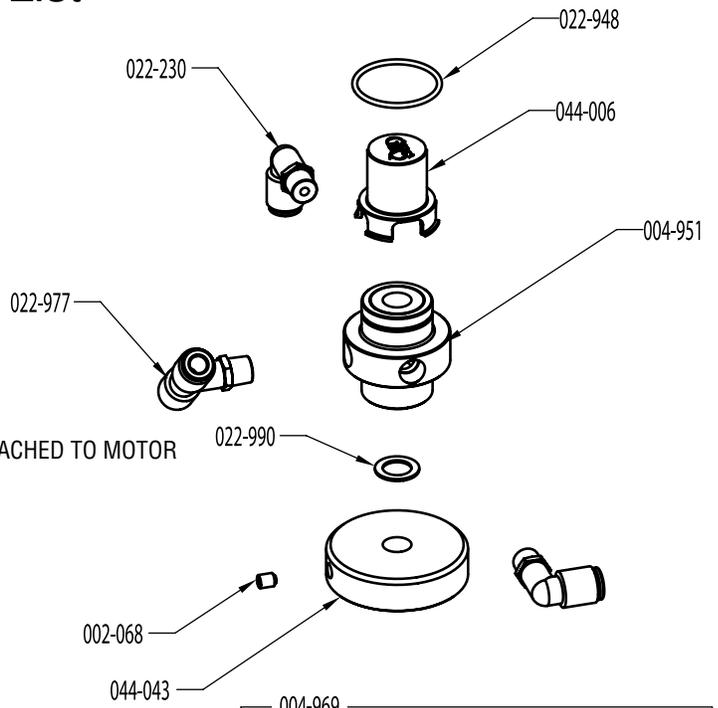
GraverMach AT™ Base Parts List

PART NO.	QTY.	DESCRIPTION
002-309	6	HHSMS, #6 x 0.38" Z/P
002-536	3	NUT, 1/4"-20 FLNG LOCK Z/P
011-209	4	FOOT, #8-32 x 0.50" RUBBER
022-230	1	FITTING, PTC 0.25" 90° M1/8" NPT
022-231	3	FITTING, PTC 0.25" INLINE M1/8" NPT
022-381	1	PLUG, 1/8"-27 NPT x 0.25" PIPE
022-964	6	BHSCS, #10-32 x 0.38" BLK
022-991	3	BOLT, 1/4"-20 x 5.50" CR Z/P
022-992	2	O-RING, 2.125" O.D., 1.985" I.D.
044-060	1	TANK, AIR SUPPLY
044-061	2	FLANGE, AIR TANK BACKUP
044-062	1	MANIFOLD, AIR TANK CAP
044-178	1	PLATE, GRAVERMACH AT BASE
044-223	1	TUBING, PU CLR .250" O.D., 0.170" I.D.



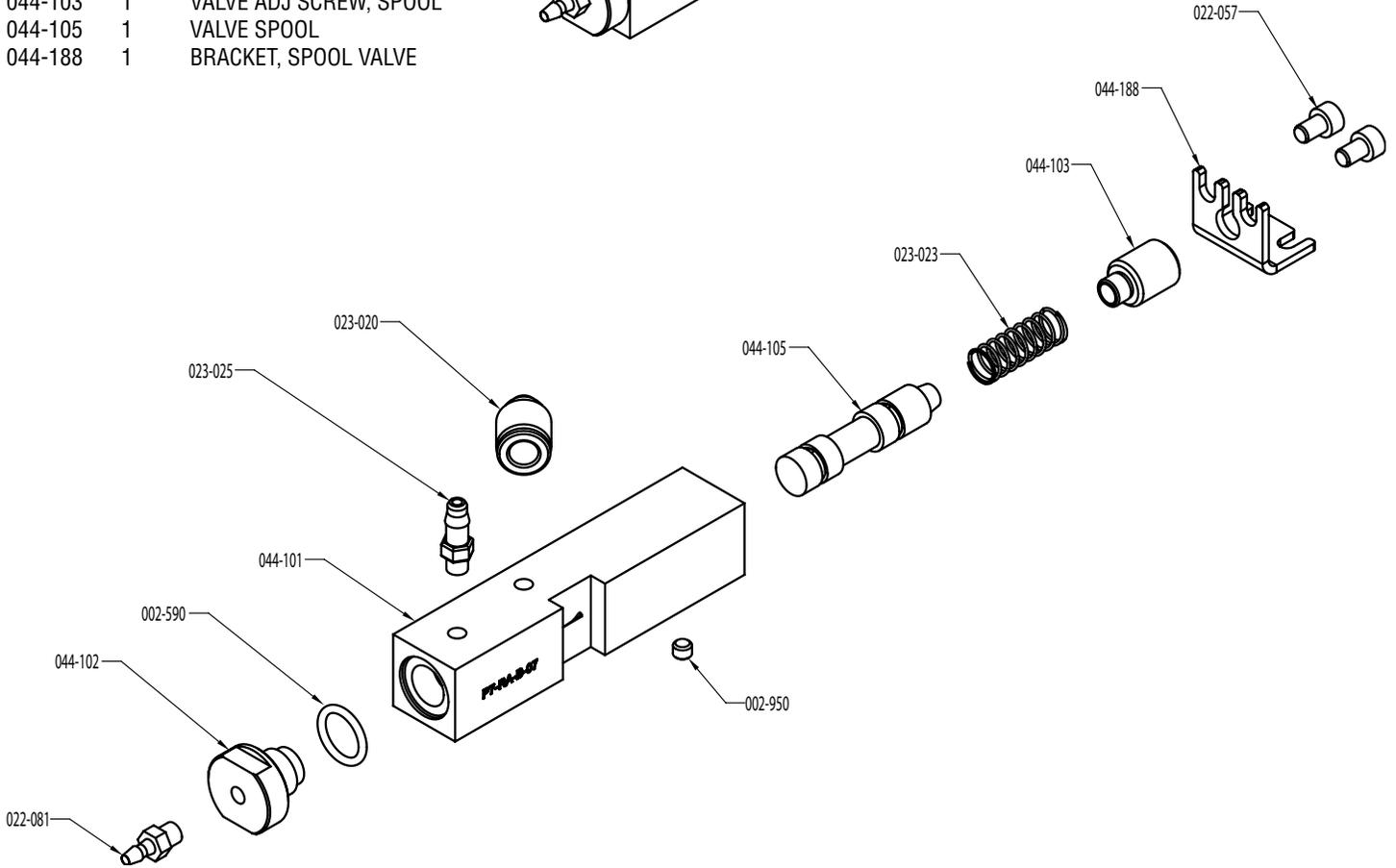
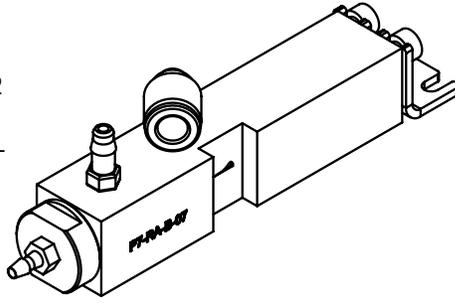
GraverMach AT™ Motor Parts List

PART NO.	QTY.	DESCRIPTION
002-068	1	SHSS, #10-32 x 0.25" BLK
002-289	4	#8-32 x 3/4" RHMS Z/P
004-951	1	VALVE BODY, ROTARY
004-969	1	MOTOR & ROTOR ASSEMBLY
022-230	2	FITTING, PTC 0.25" 90° M1/8" NPT
022-948	1	O-RING, 1.078" O.D., 0.938" I.D.
022-961	1	MOTOR
022-968	4	6-32 x 0.375" ROUND HEAD MACHINE SCREW
022-971	4	SILICONE RUBBER ISOLATION DONUT 50 DURO
022-977	1	FITTING, PTC 0.25" T M-1/8" NPT
022-990	1	WASHER, 0.63" O.D., 0.41" I.D. x 0.03" NY
044-006	1	VALVE SHROUD, ROTARY
044-037	1	LOWER MOTOR MOUNT PLATE
044-038	1	FIRST MOUNT PLATE IN MOTOR MOUNT STACK ATTACHED TO MOTOR
044-040	1	VALVE ROTOR
044-043	1	MOTOR FLYWHEEL



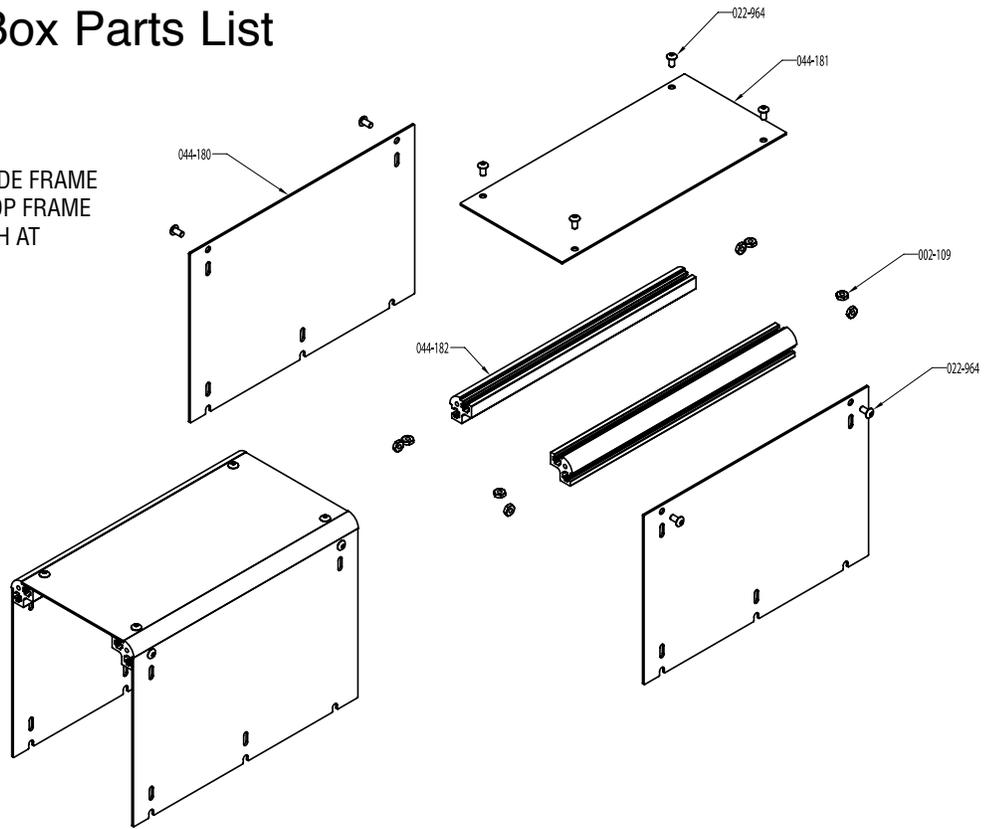
GraverMach AT™ Spool Parts List

PART NO.	QTY.	DESCRIPTION
002-590	1	O-RING, 0.563" O.D., 0.438" I.D.
002-950	1	SHSS, #8-32 x 0.13" BLK
022-057	2	SHCS, #8-32 x 0.25" BLK
022-081	1	FITTING, B-0.125" I.D. TUBE M#10-32
023-020	1	FITTING, PTC 0.25" 90° M#10-32
023-023	1	SPRING, COMP 0.320" O.D., 0.890" FL
023-025	1	FITTING, 0.010-22081-BLUE
044-101	1	VALVE BODY, SPOOL
044-102	1	VALVE END CAP, SPOOL
044-103	1	VALVE ADJ SCREW, SPOOL
044-105	1	VALVE SPOOL
044-188	1	BRACKET, SPOOL VALVE



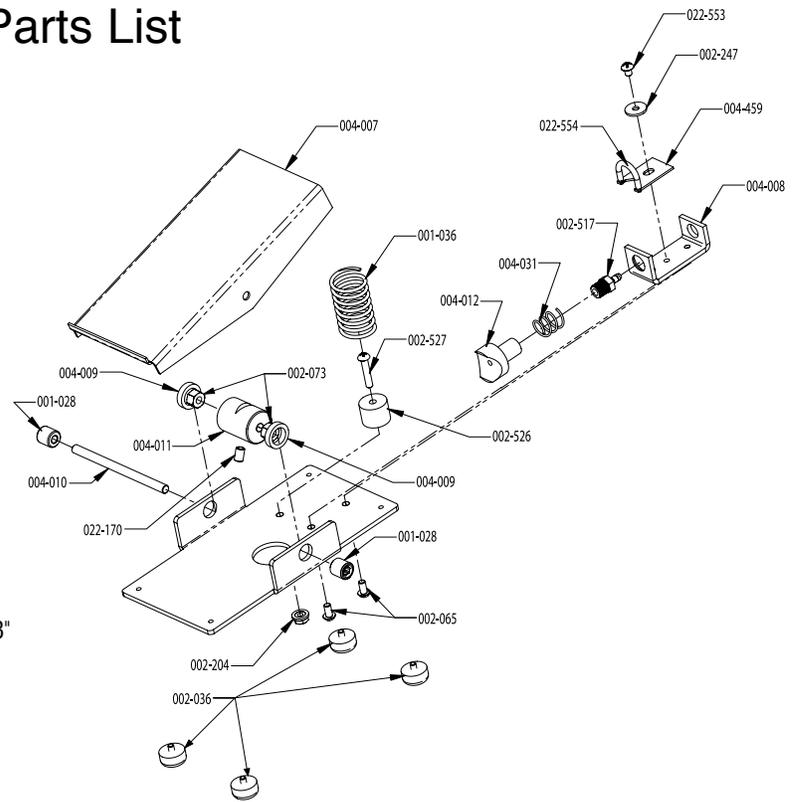
GraverMach AT™ Box Parts List

PART NO.	QTY.	DESCRIPTION
002-109	8	NUT, #10-32 HEX Z/P
022-964	8	BHSCS, #10-32 x 0.38" BLK
044-180	2	PLATE, GRAVERMACH AT SIDE FRAME
044-181	1	PLATE, GRAVERMACH AT TOP FRAME
044-182	2	BOX CORNER, GRAVERMACH AT

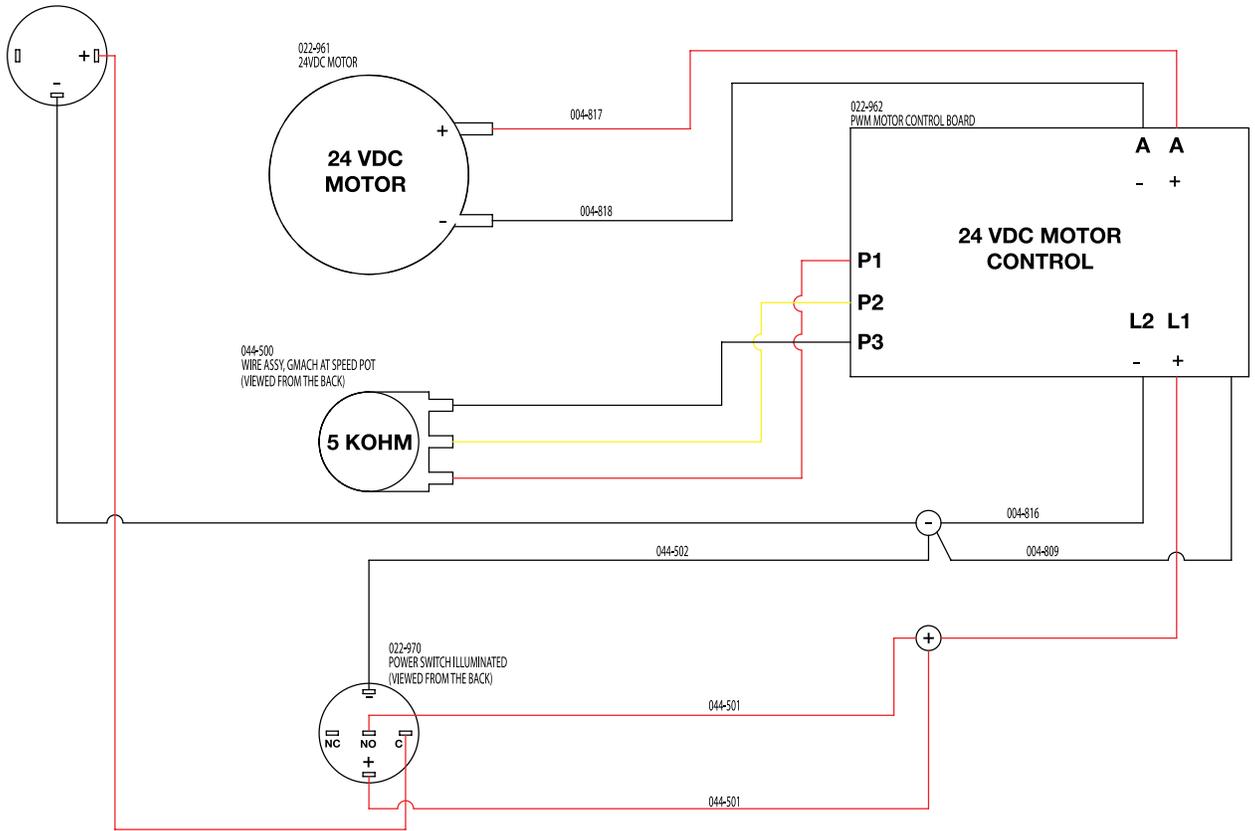


Foot Throttle #004-519 Parts List

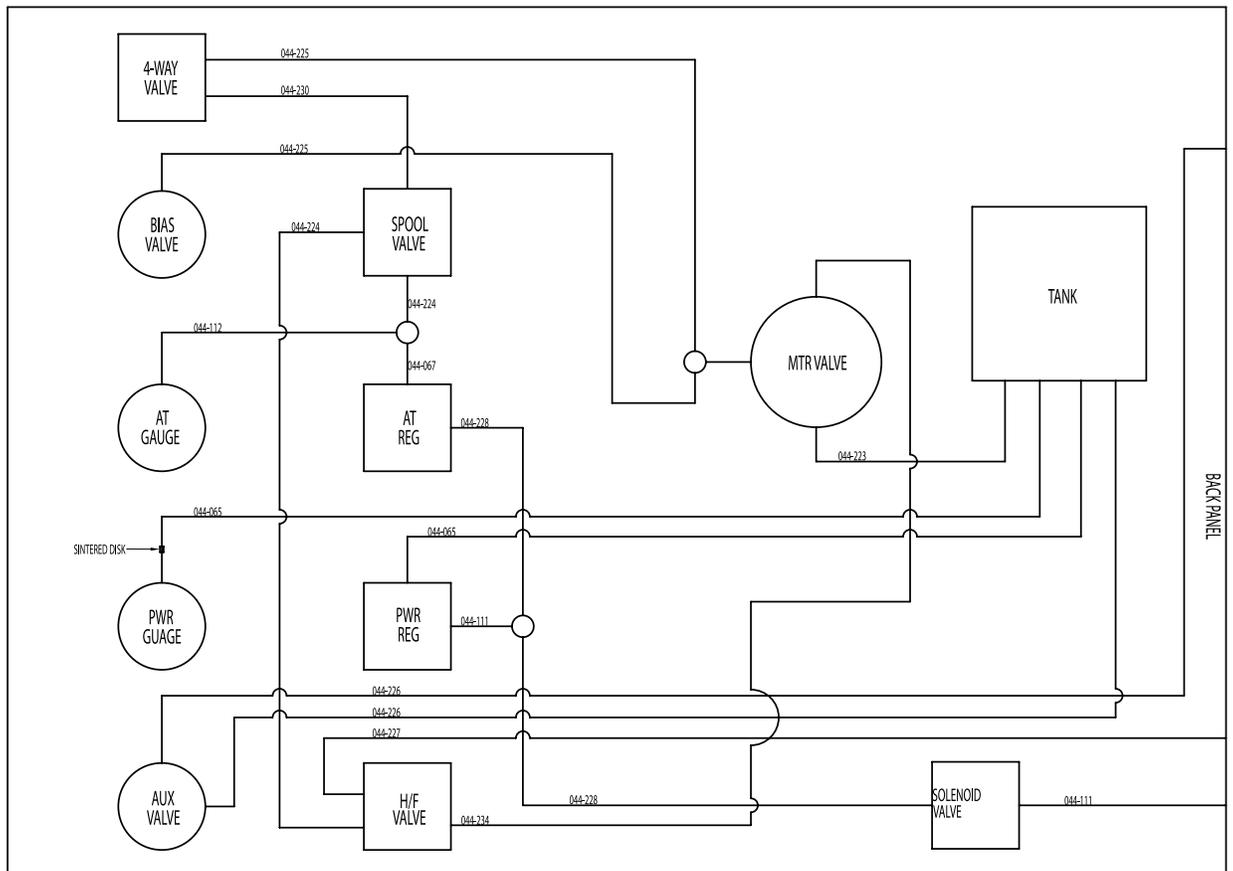
PART NO.	QTY.	DESCRIPTION
001-028	2	THROTTLE HINGE NUT
001-036	1	THROTTLE SPRING
002-065	2	10-32 x 3/8" RHMS
002-073	2	1/4-28 NU
002-204	1	10-32 HEX WHIZ LOC NUT
002-247	1	WASHER
002-517	1	1/8" NPT x 0.170" BARB FITTING
002-526	1	SPRING RETAINER
002-527	1	10-32 x 3/4" RHMS
004-006	1	THROTTLE BASE
004-007	1	HINGE PLATE
004-008	1	SPRING RETAINER
004-009	2	SPACER
004-010	1	PIVOT SHAFT
004-011	1	BLEED SHAFT
004-012	1	OUTLET
004-031	1	THROTTLE OUTLET SPRING
004-459	1	SPRING RETAINER
011-210	4	RUBBER FOOT ASSEMBLY. 8-32 x 3/8"
022-170	1	1/4-40 x 3/16" SHSS
022-553	1	10-32 x 1/4" RHMS



GraverMach AT™ Wiring Diagram



GraverMach AT™ Hose Diagram



GraverMach AT™

TIPS & TECHNIQUES TO GETTING STARTED

TOOL INFORMATION

The ability to exercise precise control under all operating conditions is the most important feature of the GraverMach AT. Coordination of the throttle and handpiece is very similar to steering your car while depressing the gas pedal. Place the cutting point of the tool in position before depressing the throttle. Stop the stroking action before repositioning the tool, or at the end of a cut.

Use sufficient impact force to perform the cutting with a minimum of hand pressure. If your hand or arm becomes tired quickly, you are pushing the tool. Use only enough hand pressure to maintain complete control over the cutting action. If the tool point slips out of position and gouges your work, you are using too much hand pressure, or the point is improperly sharpened or broken.

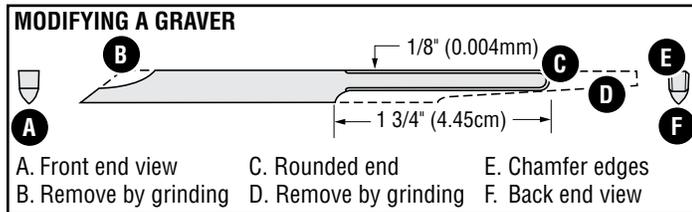
INSTALLING TOOLS INTO THE HANDPIECE

GRS offers a full line of gravers, points, and tools. GRS QC gravers are preshaped and ready to be sharpened and used.

Standard gravers normally used with wood handles (point, knife, liners, etc.) may be used in all handpieces. The tang (or shank) end must be modified by grinding to fit the chuck or QC Tool Holder properly.

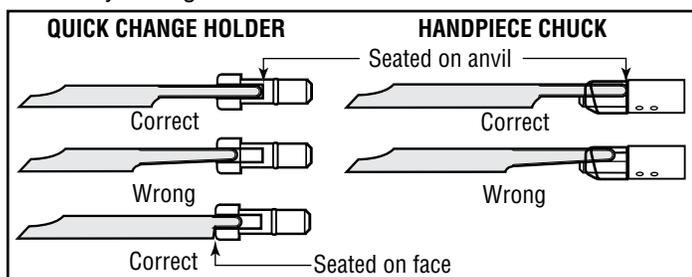
When inserting the desired tool into the chuck, it is not necessary that it be aligned perfectly; however, it must be firmly seated inside the chuck, on the face of the chuck, or on the ledge provided in the chuck jaws.

The illustration below shows how the graver should be modified.



CAUTION: Do NOT use tool bits with sharp edges on the tang, it will damage the sides and bottom of the chuck. Grind away any sharp edges or points off the chuck end.

Do not use tool bits with a taper larger than the chuck will easily accept. If the tool bit shank is so large that it will not "bottom out", the impact during use will wedge the tool into the chuck so tight that it may damage it.

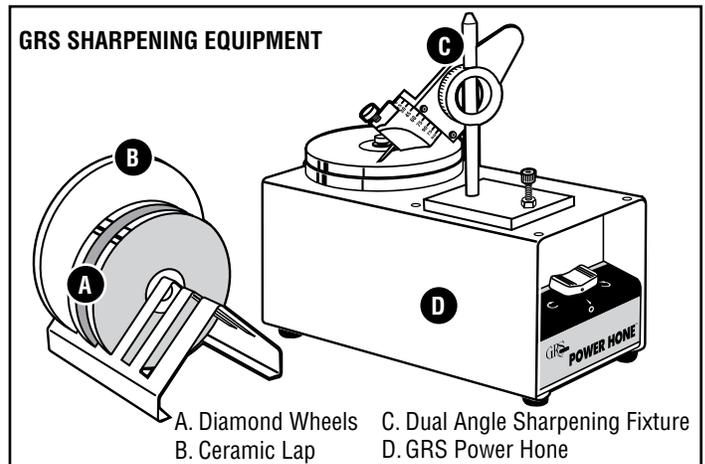


MODIFYING & SHARPENING

GRS SHARPENING EQUIPMENT

GRS sharpening equipment is a most valuable aid in tool sharpening. It is especially helpful for beginners in the art of engraving, and has been readily accepted by accomplished engravers who have found that it is faster and produces more consistent results than other methods.

The combination of the GRS Power Hone® and the Sharpening Fixture provides the ideal sharpening system. The Sharpening Fixture is designed specifically for use with the Power Hone. With this combination, you can sharpen repeatedly with consistent results time after time. It is easy to learn - you merely follow the instructions.



TOOL SHARPENING TECHNIQUES

While the GraverMach AT is a tremendous aid in solving the most difficult task in engraving or carving, it does not help in another important area - the task of tool sharpening. In fact, it even emphasizes that problem. You will be cutting faster and deeper, and the need for proper point geometry and condition will soon become apparent. Be prepared to go through a learning period in tool sharpening. A few minutes spent with someone who knows how to sharpen tools properly can save hours of frustrating experimentation.

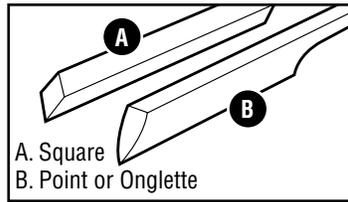
If a session with someone versed in tool sharpening is not possible, read the following information - and practice. In the end, you must learn an effective technique so that when you put the tool into the work, you know the result will be as you planned.

GRS Tools offers two DVD's to help you with proper graver sharpening:

- Easy Step-by-Step Graver Sharpening, #011-484
- The Expert's Guide to Graver Sharpening by Sam Alfano, #022-375

For additional information on these videos please visit, www.grstools.com or call 800-835-3519 or 620-343-1084 to speak to a sales representative.

Various types of gravers are used for different types and styles of cutting, but the square and point (onglette) are the most important in metal cutting. Once you master the sharpening techniques for them, you should have little difficulty with others.

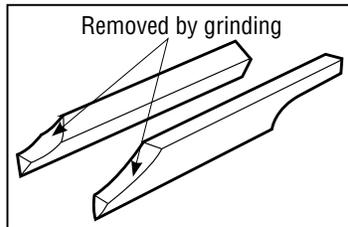


For a complete line of gravers, visit www.gravers.us

James B. Meek's book, *The Art of Engraving*, illustrates and discusses the importance of proper tool sharpening techniques and geometry. He relates to this subject in chapters 2, 4 and 7. This subject is of utmost importance, and this reference material is most helpful.

Gravers should be ground on the face first. An approximate 45° angle should be maintained. Keep the graver in the handpiece for free hand sharpening. First, this will save time. Second, the additional length provided is an aid in maintaining the proper angle on the stone. A considerable amount of care and practice is required to maintain the proper angle while sweeping the tool point across the stone.

A common error in sharpening is the tendency to increase the angle of the face gradually each time the graver is sharpened. To help prevent this and to reduce sharpening time, it is helpful to remove some of the excess material near the point with a bench grinder.



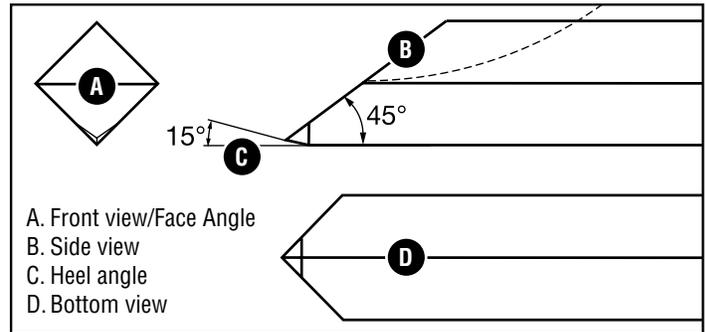
For good results, the graver must be heeled, or setup. This task takes some experimentation and practice to produce satisfactory results. The finish of the engraved cut is greatly affected by the finish of the graver heel. For a bright cut, finish the heel using polishing paper or a ceramic lap.

Here is what the heel accomplishes:

- It raises the working angle of the graver to a convenient height from the work surface.
- It provides depth control.
- It gives clearance when working on irregular surfaces and prevents the bottom surface of the graver from dragging on the edges of the cut when making curved cuts.
- It improves the quality and appearance of the cut.

Usually a heel angle of 15° is used. Only a small amount of material need be removed. A few light strokes on a fine, hard stone is sufficient. Don't be confused by the tremendous number and variety of gravers available in the supply catalogs; virtually all work can be accomplished with a small variety of points.

NOTE: When grinding a tool on a bench grinder wheel, do not let the tool tip get too hot and burn. Burning means the tool metal will turn blue, which takes the temper or hardness out of the tool and it will not hold a cutting edge. To avoid burning the tool, do not press too hard against the wheel; take your time. Have a container of water that you frequently dip the tool into before it gets warm in your hand. Always be sure that the tool point is sharp. Refer to the TIPS section for sharpening technique.



EFFECTIVE TIPS

The GraverMach AT provides an effective, unique method for performing a variety of functions in many materials. You may not achieve effective results with the machine at first. In fact, your initial attempts may be disappointing or downright discouraging! Begin by expecting a learning period - whether you have had experience engraving by another method or are a novice. After the initial learning period, the results and the satisfaction derived from use of the machine are fantastic! It takes a little practice, some learning, and perhaps some re-learning. It may seem awkward and ineffective at first - like your first attempt to ride a bicycle ... remember?

The easiest and most productive way to learn quickly is to work with someone accomplished in the use of the GraverMach AT. If this is not possible, the information contained in these "TIPS" will be helpful. A most valuable and useful information source is James B. Meek's book, *The Art of Engraving*.

Most of the information in this section is directed toward the task of metal engraving. Even if your purpose for using the machine differs, this information is relevant and helpful. The engraving of metal, especially steel, is most difficult and demanding. When the principles of metal engraving are understood, then other uses will be less demanding. We have never known a person who could effectively carve a deep relief scene that could not easily set a stone, florentine or engrave a ring, matte finish a piece of jewelry, carve wood, or prepare a fossil.

Here are some reasons why you may not achieve effective results at first:

- Coordination of power and tool cutting action with the foot throttle might feel awkward, but after a small amount of practice it will become natural.
- It seems strange and different at first — but extremely effective when mastered. Again, remember how easy it was to ride a bicycle after you learned. Successful cutting requires just the right amount of forward pressure on the handpiece, and proper manipulation of the throttle.

TECHNIQUES TO TRY

Try these, then review results, and try them again:

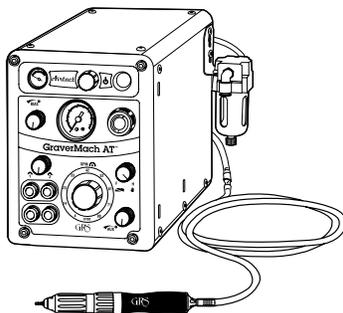
- Turn the machine ON, hold the handpiece in your hand, and work the foot throttle to get the feel of the power variation from light, short strokes to heavy, long strokes. You will begin to anticipate the foot throttle position for the various power settings desired.
- When cutting or engraving, hold the handpiece as you would a table knife - not a pencil. Place your index finger on the graver or chisel as you would on a knife blade to exert slight downward pressure. Hold it like a pencil only when stippling, background matting, chipping, etc.

- Place the tool cutting point on the work piece BEFORE applying power with the throttle. Attempting to enter the cut with the power ON and the handpiece stroking will quickly dull or damage the tool point.
- Apply power with the throttle only AFTER positioning the tool on the work. Use slight forward pressure to keep the tool point moving forward into the cut. Both tool angle and downward pressure control the depth of cut. Avoid using too much downward pressure; it's tiring and often indicates the need for better tool sharpening or a more relaxed technique.
- Vary the power input with the throttle to control the speed and depth of cut. Do not let the cutting action get ahead of your ability to guide the tool. Stop the throttle action to reposition the work. Leave the tool point in the cut.
- Overcome the tendency to let the handpiece continue to stroke when not actually cutting (by failing to take your foot off the throttle.) With practice, control of the throttle becomes an automatic response.
- Use a stable vise or heavy engraver's block on a sturdy workbench or table to hold the work. If the work is not held solidly, vibration will decrease effectiveness of the tool's power and will quickly dull or chip the point. A GRS engraving block is a most effective work holding device.
- Don't push hard! If your hand becomes tired or cramped, you aren't using the power of the machine to do the work - or you may not have the tool properly sharpened or heeled.
- Keep the tool sharp and properly heeled. Sharpen frequently - before you lose the point entirely. With practice you will begin to feel when the point is beginning to dull. At this time, only a slight amount of sharpening is necessary to bring it back to the desired sharpness. Hardness of the material you are cutting will greatly affect tool life.
- There should be no noticeable vibration of the tool point in the cut. If the point is allowed to vibrate in the cut, the point will dull quickly.

ROTARY HANDPIECE

The GRS 850 Rotary Handpiece delivers high horsepower, but low torque. Feather touch or brushing techniques remove the most material possible. With this method, you will have a superior tool for fine, delicate, intricate, and exciting work. The 850 Rotary Handpiece is a precision instrument that can be easily damaged if misused or improperly maintained.

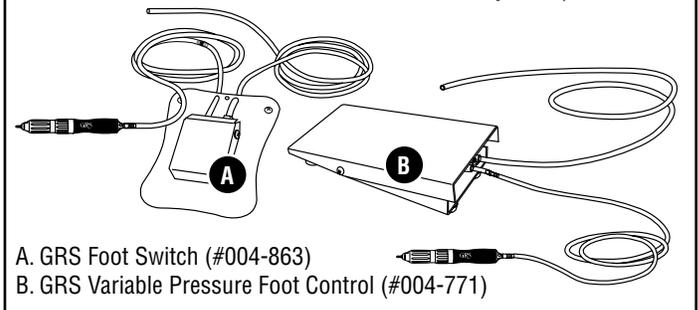
Your rotary handpiece is engineered for quality and manufactured for long life. To use, attach the handpiece to the auxiliary air output on the back of your GraverMach AT. The handpiece is designed to operate at a maximum of 35 psi (2.4 bar). Turn auxiliary air knob a few turns counter-clockwise.



Stop the rotary handpiece by turning the auxiliary knob until the air is turned OFF. For frequent ON/OFF usage, we recommend adding a GRS foot switch in the air line. This will facilitate your work.

NOTE: Read the instructions that come with the rotary handpiece carefully.

FOOT CONTROL OPTIONS • Shown with 850 Rotary Handpiece



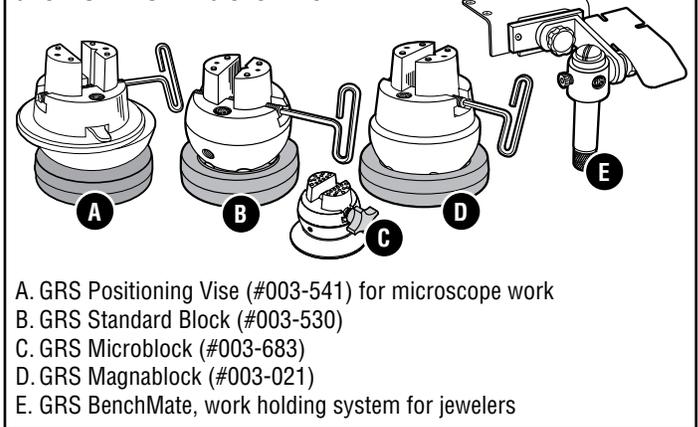
ROTARY HANDPIECE SAFETY

1. Use safety glasses or goggles. Also use a face or dust mask if cutting operation is dusty or if working on glass. When working on glass, wet the surface to help keep the dust down.
2. Keep work area clean and uncluttered.
3. All visitors should be kept at a safe distance.
4. Do not force tool. It will do a safer and better job at the rate it was designed for.
5. Use the correct bur. Do not force bur to do the job of a heavier duty tool.
6. Use clamps or vise to secure work.
7. Avoid accidental starting. Turn tool OFF immediately after use.
8. Do not depress bur ejector while running -- possible damage to tool may occur.
9. Do not operate tool without a bur.
10. Use 35 psi (2.4 bar) or less air pressure.

WORK HOLDING

The workpiece must be held as firmly as possible. If it is not, much of the power and cutting capability of the tool is lost. Use either an engraver's ball vise or a vise which can be rotated with your free hand to position the work as the cut progresses. GRS offers a selection of vises to fit different tasks.

GRS WORK HOLDING SYSTEMS



- A. GRS Positioning Vise (#003-541) for microscope work
- B. GRS Standard Block (#003-530)
- C. GRS Microblock (#003-683)
- D. GRS Magnablock (#003-021)
- E. GRS BenchMate, work holding system for jewelers

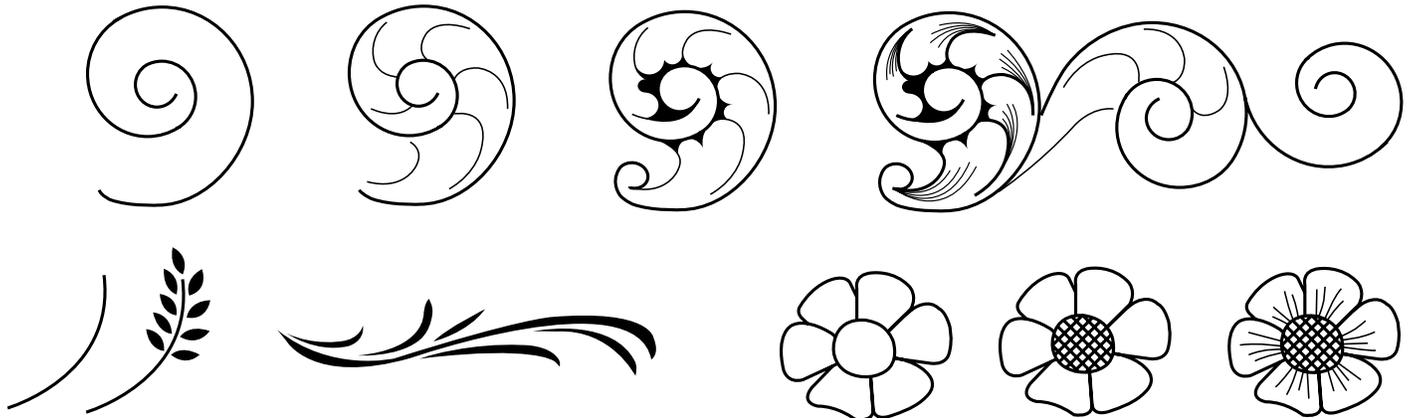
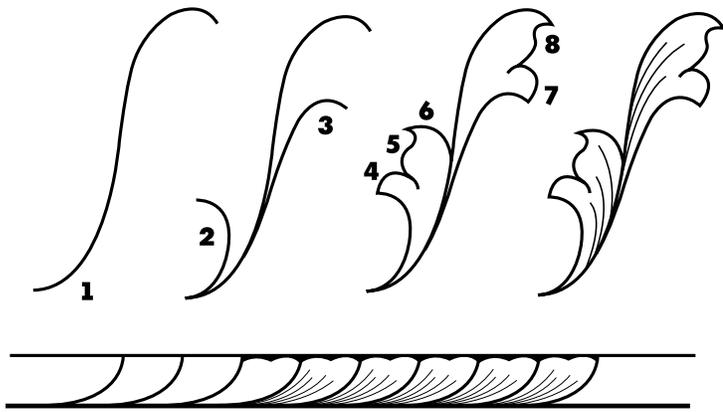
TIPS FOR PRACTICE SESSIONS

Start with simple cuts. Using a square or point (onglette) graver, begin by cutting straight lines - then simple curves. Practice depth control, cutting both fine shallow lines and deep cuts. It is good practice to master the technique of varying the depth of cut to produce a pleasing shaded effect. These practice sessions will help you acquire the necessary skills in both tool control and tool sharpening techniques.

After you have mastered the basic skills, you can concentrate on learning the more difficult and intricate designs. With confidence

in your ability to control the tool, you will be able to execute progressively more difficult patterns with varying depth of cut and subtle shading - and finally on curved or irregular surfaces.

Simple exercises like those sketched below are good beginning practice designs as they are relatively simple. It is easy to determine the progression of the cuts to generate the design, and they do not require a large amount of rotation or manipulation of the work piece. This type of design is also good practice for the beginning woodcarver.



WARRANTY

Each **GraverMach AT**, including handpieces and foot control, carries a full 2-year warranty covering parts and labor. Call for a Return Goods Authorization (RGA) number before returning any equipment.

These products are designed for reliable operation using most sources of compressed air. However, some air supplies contain excessive water, oil, dirt, rust, or other contaminants. The unit's built-in filter is a final filter to protect against normal dirt and water. If your compressed air has excessive contaminants, you should install the necessary filter(s) and water trap(s) ahead of your unit.

Oil contamination can be gradual and subtle. If you notice an oil residue (usually a yellow to brown colored sticky or liquid residue) in the unit's filter bowl or handpiece / throttle hose, you probably have an oil problem in your compressed air. Older oil lubricated and "silent" compressors that use internal oil are more likely to cause oil contamination. If this occurs, install a Coalescing Oil Filter (GRS #004-579 or equivalent).

NOTE: Damage caused by contaminated compressed air is not covered by the warranty.



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OEA € JI AJc c* æ 470^!{ æ ^

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