Glendo Corporation

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.

GraverMach™ • GraverMax SC™

OPERATION AND MAINTENANCE MANUAL

INTRODUCTION

The **GraverMach/GraverMax SC** fulfills the need for a machine capable of allowing rapid but precise cutting and carving of metal, stone, wood, ivory, and many other materials. The precise control feature of the machine also makes it an ideal tool for stone setting, stippling, matte finishing on jewelry, stipple engraving on crystals, etc.

of an air-powered hammer capable of delivering controlled impacts at speeds of 400 to 8,000 strokes per minute. A foot pedal controls the impact power in much the same way the gas pedal works on a car.

The wide range of power and control allows the user to freely move from light to heavy cuts. To realize the full capability of the **GraverMach** or **GraverMax SC** you need to become familiar with both the operation and routine maintenance of your machine.

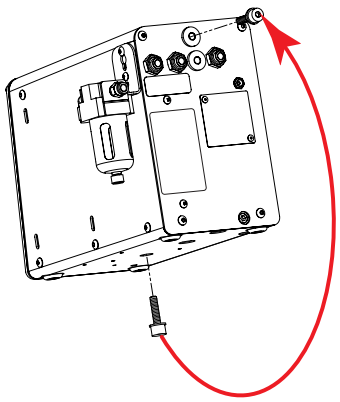
This manual is intended to help you master both the machine, handpiece, and the proper preparation of the graver.

GraverMach

1 Air pressure gauge
2 Air pressure control knob
3 Press on/off Switch
4 Air filter
5 Auxiliary air open/close knob for quick connect fitting
6 Strokes per minute selector knob
7 Power off indicator light (GRS logo)
8 Handpiece no. 2 quick connect fitting
9 Handpiece no. 1 quick connect fitting
10 Handpiece selector knob
11 Bias control knob
12 Power on indicator light (GraverMach)
13 Air input quick connect fitting
14 Foot throttle quick connect fitting
15 Retain screw here, see **IMPORTANT NOTICE**
16 Retain air output plug here
17 Air output quick connect fitting for Airtact
18 24 Volt power jack

⚠ IMPORTANT NOTICE

When you unpack your new **GraverMach** notice the screw protruding from the bottom of the machine. This screw is holding the working mechanism to protect it from damage during shipping. You will need to loosen and remove the screw with the hex wrench provided in the accessory kit (use the larger one of the two) before placement and use. Store the screw and washer by inserting it into the rubber grommet located on the back of the machine. Shown in illustration to the left.



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

GraverMax SC

1 Air pressure gauge
2 Air pressure control knob
3 Press on/off Switch
4 Air filter
5 Auxiliary air open/close knob for quick connect fitting
6 Strokes per minute selector knob
7 Handpiece selector knob
8 Handpiece no. 2 quick connect fitting
9 Handpiece no. 1 quick connect fitting
10 Air input quick connect fitting
11 Foot throttle quick connect fitting
12 Retain screw here, see **IMPORTANT NOTICE**
13 24 volt power jack

IMPORTANT

NEVER LAY THE MACHINE ON ITS SIDE AND TURN IT ON. ALWAYS USE THE MACHINE IN A VERTICAL POSITION.

In both models, the ROTARY VALVE is lubricated by air passing through it. DO NOT RUN ELECTRICAL SYSTEM UNLESS AIR SYSTEM IS ON.

⚠ IMPORTANT NOTICE

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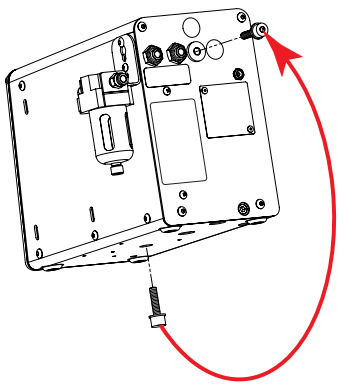


Please note, if you are going to transport this machine -OR- ship it, YOU MUST replace and tighten the screw to prevent damage.

MACHINE SET-UP

Remove the machine and accessories from the carton. The first thing you will notice is the machine does not sit level. There is a screw that secures the motor during shipping that must be removed. Please read the **IMPORTANT NOTICE** on page 2 before removing.

CONNECT AIR SUPPLY

GraverMach / GraverMax SC recommends 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/ coalescing filter should be installed ahead of the unit. Be sure to clean/purge all filters and water traps regularly. **IMPORTANT:** ***Never add oil to the compressed air for the*** **GraverMach / GraverMax SC.** Oil can foul internal parts and cause erratic handpiece operation. If your compressor requires oil, YOU MUST use Coalescing Filter (#004-579) to ensure this oil does not contaminate your compressed air.

Decide where you want to locate the machine on your bench. (NOTE: The machine must be in vertical position - DO NOT lay on its side).

Next, decide where you would like the air filter located. Make its location readily accessible so it is easy to purge moisture from the bowl. You may attach the air filter to your machine, bench, or wherever you desire. Keep the location of the filter where you can see it and easily maintain it. Here we show it attached to the back right side of the machine (**fig.1**). Remove the screw at this location and replace it with the 10-32 X 1/2" Socket Head Screw (#002-067) supplied in the accessory bag. As you replace the screw, place the head of 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.

Connecting the hoses...

If "push-to-connect" fitting are new to you...they are amazing. With the AIR PRESSURE SHUT 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. It is identified on the air filter with the marking "N ⇧". Connect your 1/4" OD (6,35mm) air supply hose direct to the "push-to-connect" fitting simply by pushing the hose end inside the orange ring receiver **(A)**. 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. Connect this 5 1/2" hose to the air outlet **(fig. 2) - (B)** on the air filter (opposite the air input). Connect the other end of that hose into the fitting on the back of

Suggest location for Air Filter.
Read CONNECT AIR SUPPLY for other options.

fig. 1

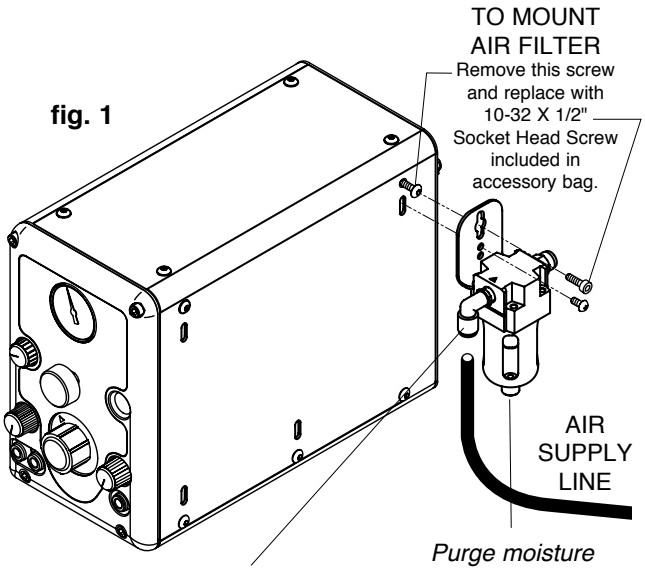
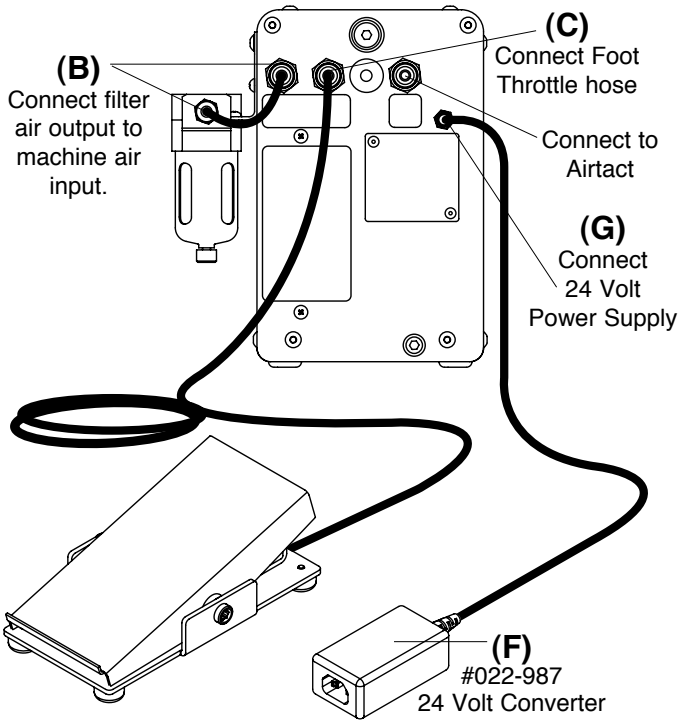


fig. 2 • GraverMach Hose Connection



the machine **(B)** marked AIR INPUT on the label below it. *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. 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 **(C)**.

CONNECT HANDPIECES

There are two fittings (**D**) to attach impact handpieces. 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 ring receiver. A selector knob above the connections lets you select which impact handpiece you want to use...#1 or #2.

The Auxiliary Outlet (**E**) is a straight flow air supply that is limited to 40 psi (2.7 bar). The knob is a "twist open - twist close" valve. This is where you connect a Rotary Handpiece or other pneumatic tools.

CONNECT ELECTRICAL POWER

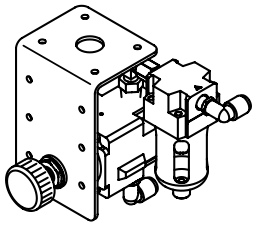
IMPORTANT: In both models, the ROTARY VALVE is lubricated by air passing through it. DO NOT RUN ELECTRICAL SYSTEM UNLESS AIR SYSTEM IS ON.

Connect the electrical power cord into the 24 Volt Converter Box (**F**). Plug the converter cord into the jack on the back of the machine (**G**).

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 (**H**) adapter supplied in the accessory box. *You are ready to tune the handpieces.*



IMPORTANT NOTICE FOR GRS PRECISION REMOTE AIR REGULATOR OWNERS

If you currently have a Precision Remote Air Regulator attached to your bench for GraverMax or GraverMate, please note this:

We do not recommend using the Precision Remote Air Regulator (#004-930) with the **GraverMach** or the **GraverMax SC**. Due to the precision nature of the internal regulator in both models the external regulator is not needed. Using an additional precision external regulator in the air supply line may create a problem with air pressure consistency. If you desire to use the Precision Remote Air Regulator, please call the factory for information and instructions on disabling the internal regulator.

NOTICE FOR GRS PROGRESSIVE FOOT CONTROL OWNERS

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

fig. 2 • GraverMax SC Hose Connection

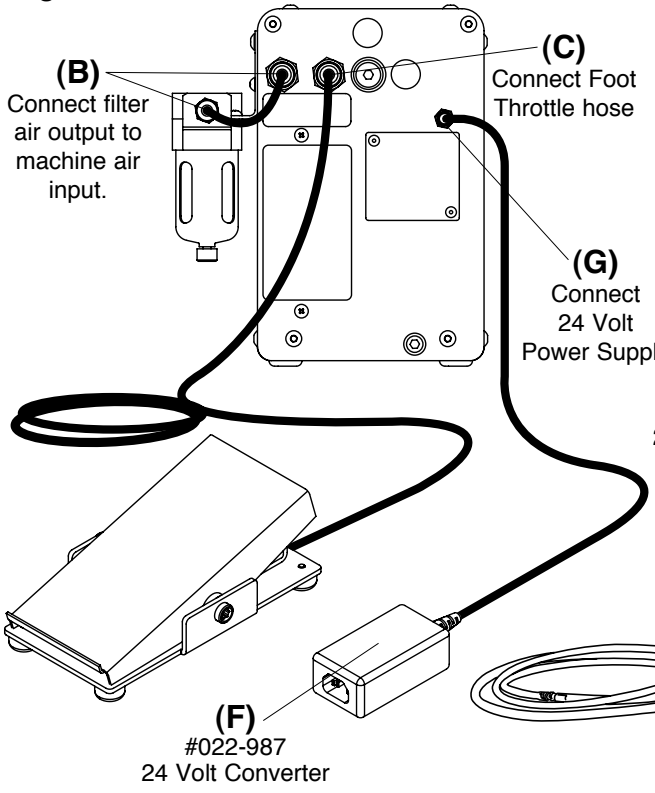
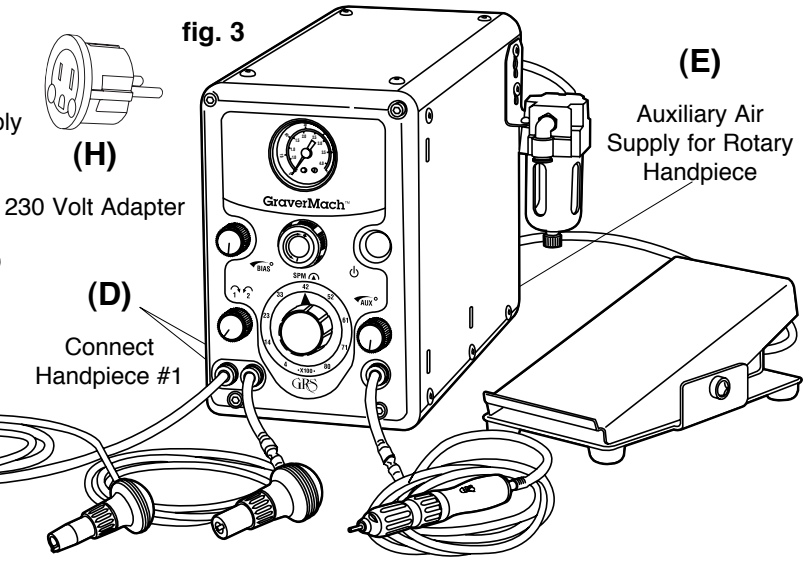


fig. 3



OPERATION

STROKES PER MINUTE (SPM)

Stroke speed setting (**fig. 4**) 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 / GraverMax SC** 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 at times.

fig. 4

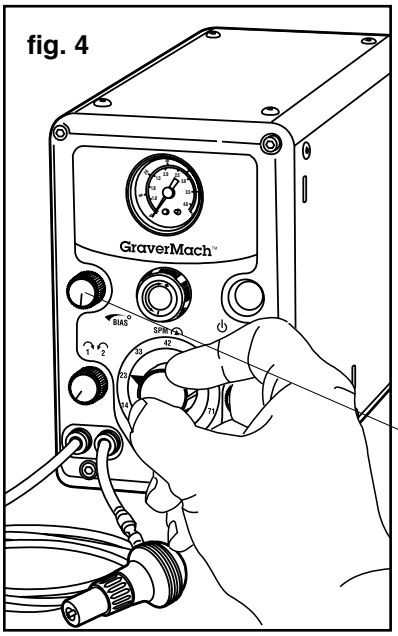
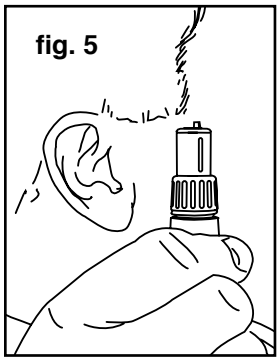


fig. 5



IMPORTANT:
MAKE SURE THE BIAS CONTROL IS **CLOSED (OFF)** BEFORE TUNING THE MACHINE.

TO CLOSE:
TURN BIAS KNOB CLOCKWISE UNTIL IT STOPS.

How to TUNE the GraverMach/ GraverMax SC

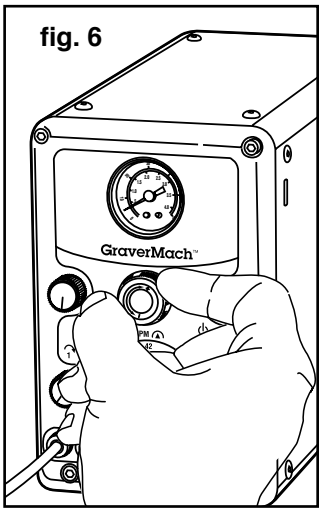
By "tuning" your machine, we mean adjusting the strokes per minute and air pressure for optimum performance. TUNING YOUR MACHINE PROPERLY IS THE SINGLE MOST IMPORTANT OPERATION YOU SHOULD LEARN.

1. Turn ON your air compressor and allow the tank to ffig. *Wait for the compressor to cycle off and stop running.*
2. Turn the **GraverMach / GraverMax SC** on and set the stroke per minute dial at 2300 **(fig. 4)** and using the regulator knob on the front of the machine, back the air pressure down to 2 to 5 PSI (0.1 to 0.4 bar) *(On the GraverMach models, also close the bias valve).*
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 control, SLOWLY increase the air pressure **(fig. 6)** 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 the middle of the ***Normal Air Pressure Range*** for the handpiece you are using. Thegoal 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

fig. 6



HANDPIECE Tuning Chart

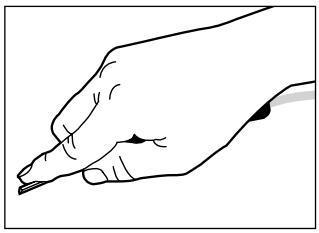
Handpiece Type		Normal Operating Range *Strokes Per Minute*	Normal Air Pressure Range *psi (bar)*	Recommended Initial Setting: Strokes *Per Minute*	Recommended Initial Setting: Air Pressure *psi (bar)*
004-506 Large		800 - 2400	20 - 30 psi (1.4 - 2.1 bar)	1400	24 psi (1.6 bar)
004-508 Standard		1000 - 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)
004-901 / 910	Standard Spring	1400 - 3400	18 - 22 psi (1.2 - 1.5 bar)	2700	19 psi (1.3 bar)
	Fine Spring	1600 - 3600	12 - 15 psi (0.8 - 1.0 bar)	3000	13 psi (0.9 bar)
004-921 Monarch	Standard Spring	2300 - 4000	11 - 14 psi (0.7 - 0.9 bar)	3600	12 psi (0.8 bar)
	Fine Spring	2300 - 4000	5 - 9 psi (.34 - .62 bar)	3600	7 psi (0.4 bar)
004-940 Magnum		800 - 3400	20 - 23 psi (1.3 - 1.5 bar)	2400	21 psi (1.4 bar)

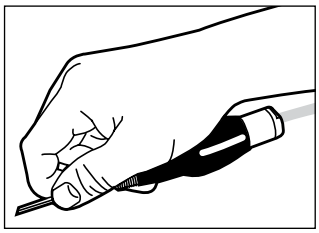
pressure is probably too low. If the handpiece fades out at full throttle, the air pressure is probably too low, or the strokes per minute is too high for that handpiece. The handpiece should start
to operate within 3/8" (9.525mm) of depression of the foot control… if it doesn't, the air pressure is probably too high. Always make small adjustments in air pressure or strokes per minute, not large ones, until you are familiar with your machine.

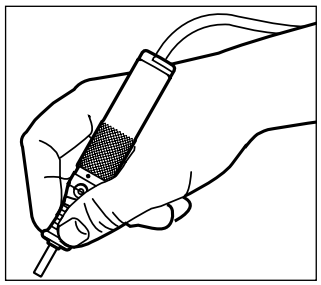
If you have "tuned" your machine properly, the handpiece will operate smoothly and predictably. New operators often use too much air pressure or the incorrect strokes per minute range. This can make your machine difficult to control for fine work. Both the **GraverMach** and **GraverMax SC** have extremely fine control for the smallest stone setting and the finest engraving. But, you must learn to "tune" the machine correctly to achieve this fine control! After a while, you can experiment with variations in air pressure and stroke speed to suit your work preference.

HOW TO HOLD YOUR HANDPIECE

Normally, you should hold your handpiece like a table knife, not like a pencil. A few exceptions are hammering and stippling. Resist the urge to grip your handpiece tightly. Train yourself to hold the handpiece as softly 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.



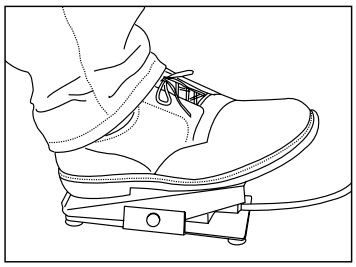




Hammering is a special situation. When hammering you usually hold the handpiece like a pencil. If you are hammer setting, be sure to press the hammer tip down firmly on the work BEFORE using the foot control to start hammering. Also, do NOT operate the hammer by holding the tip slightly above the work 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

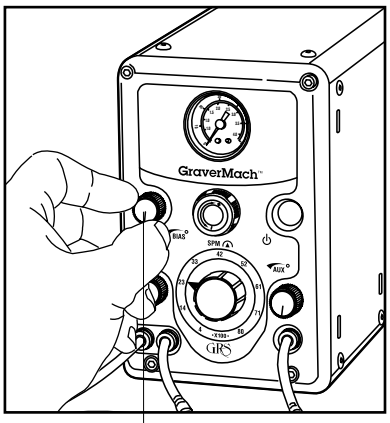
The **GraverMach / GraverMax SC** foot throttle is operated like an automobile accelerator and NOT like a flexible-shaft foot control. You should put the tool in position BEFORE depressing the foot control. Never depress the foot throttle and then try to bring a stroking handpiece to the work! If you 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 control 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
-GRAVERMACH ONLY-

After you "tune" the handpiece (see page **How to TUNE** at left) 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. Now, open the Bias Control 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 like 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 very fine stippling.



BIAS
CONTROL
KNOB

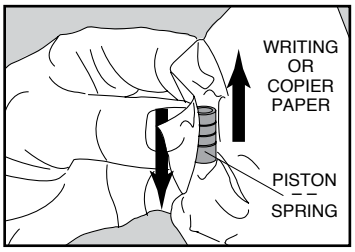
MAINTENANCE

IMPACT HANDPIECE CLEANING

• • USE NO SOLVENT • •

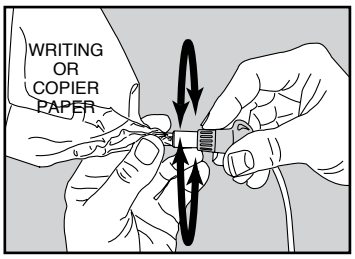
The impact handpiece must be kept clean for proper operation. If operation becomes sluggish, erratic, or fails, cleaning is indicated. *Below is the proper way to clean a handpiece.*

fig. 6



Remove piston & 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 (see **fig.6**) "buff & polish" off any dirt or residue. Folding the paper, use the edge to clean between the piston grooves and the spaces between the spring.

fig. 7



To clean the handpiece inside, take the WRITING or COPIER paper and twist it to a point (see **fig.7**). Insert the paper point into the handpiece and rotate paper and handpiece against each other. This will "buff & polish" the inside clean.

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

Oiling - occasionally place a drop of synthetic oil or light grease on the handpiece chuck threads / jaws or Quick Change chuck. This will extend useful life, and improve operation.

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.

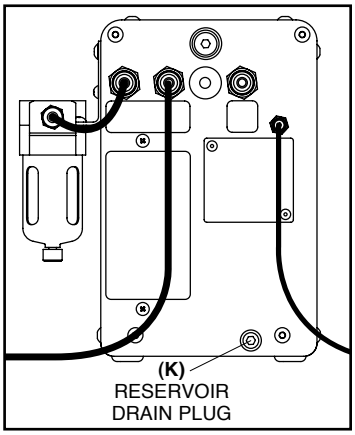
If moisture is noted in the handpiece or throttle hoses, shut the unit down immediately and drain the filter bowl.

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. 8**) is the drain plug **(K)** 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.

fig. 8 • GraverMach Drain Plug

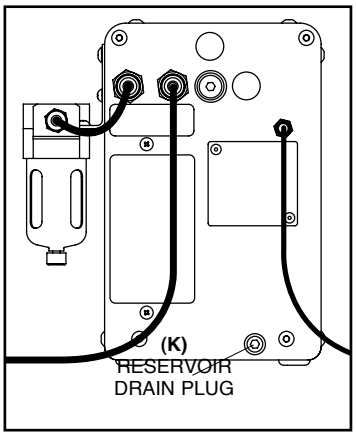


ROTARY VALVE

The Rotary Valve is lubricated by air passing through it. Additional lubrication is not required or recommended.

DO NOT RUN ELECTRICAL SYSTEM UNLESS AIR SYSTEM IS ON.

fig. 8 • GraverMax SC Drain Plug



DO NOT RUN ELECTRICAL SYSTEM UNLESS AIR SYSTEM IS ON.

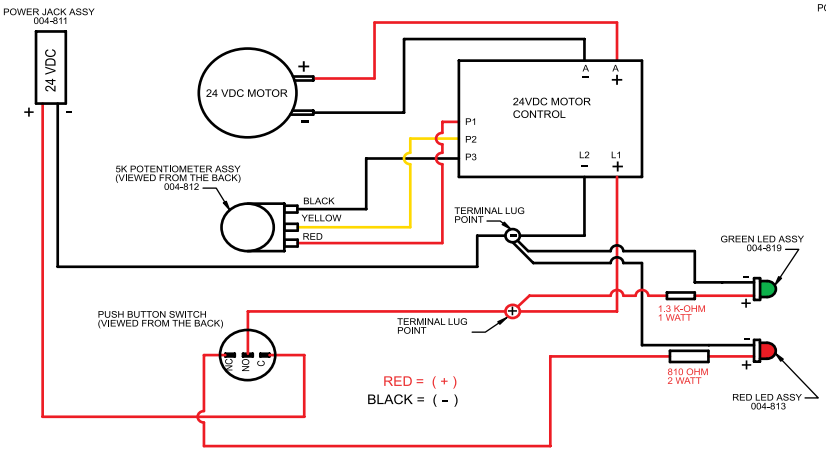
ELECTRICAL SYSTEM

The electrical system is composed of a D.C. permanent magnet motor, speed control, 24 Volt power supply and switch.

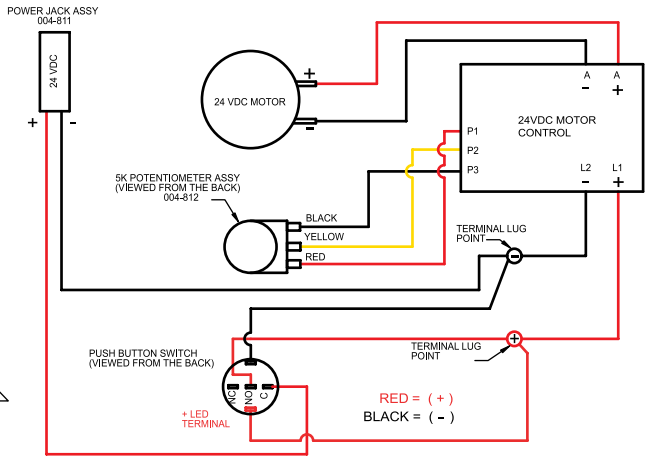
If unit fails to operate, first check the 24 Volt DC Power Supply. If replacement is required, replace with (#022-987) 24 Volt DC Power Supply from the factory or dealer.

DO NOT USE OTHER BRAND 24 Volt Power Supply - DAMAGE WILL OCCUR to machine.

If unit remains inoperable after you have performed these steps, please contact the GRS Tools factory or your local dealer.



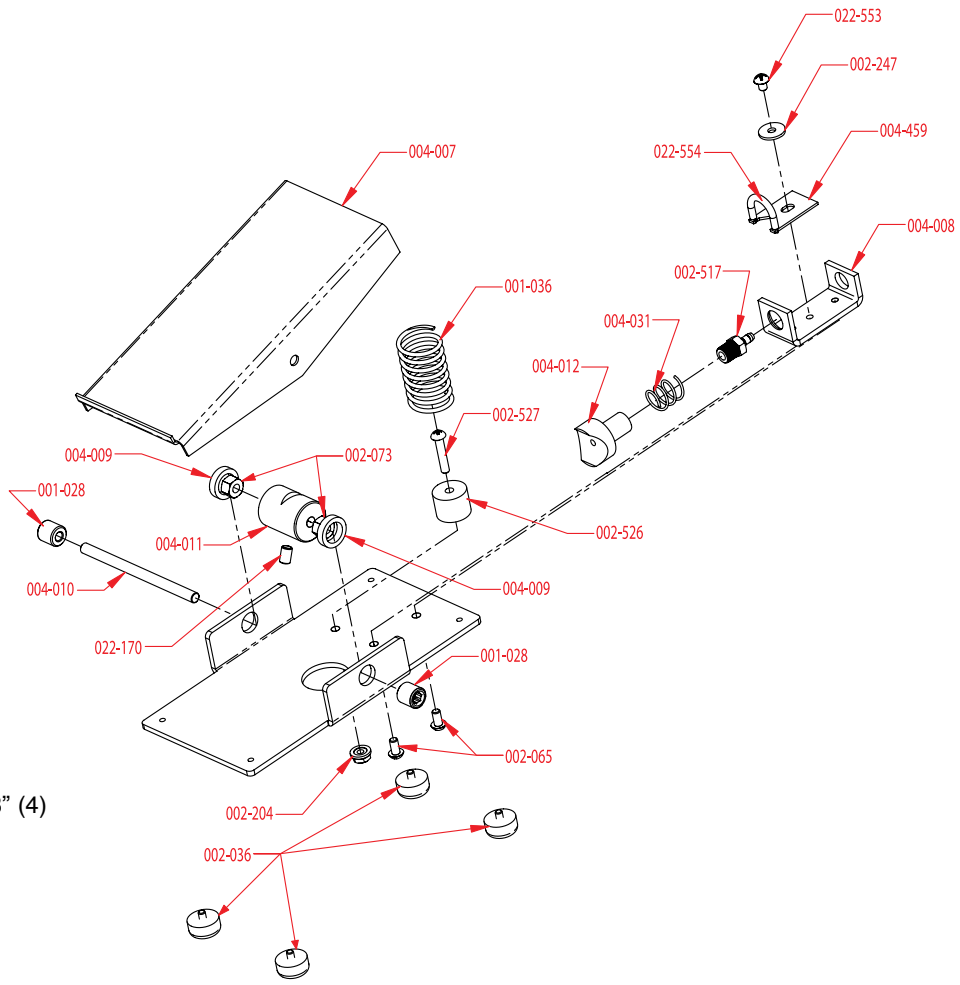
Wiring Diagram for GraverMach



Wiring Diagram for GraverMax SC

FOOT THROTTLE # 004-519

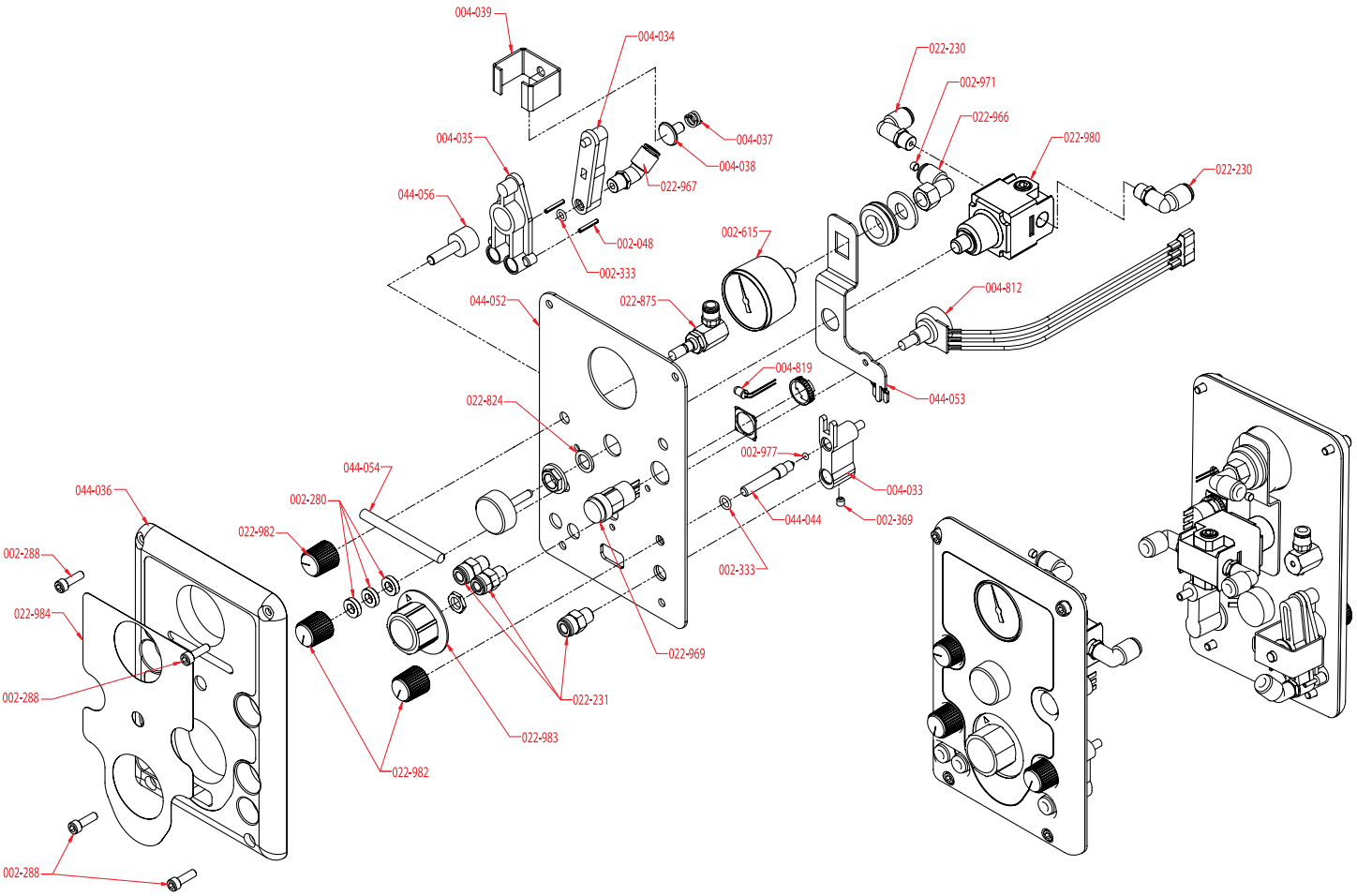
PART NO.	DESCRIPTION
001-028	Throttle Hinge Nut (2)
001-036	Throttle Spring
002-065	10-32 X 3/8” RHMS (2)
002-073	1/4-28 Nut (2)
002-204	10-32 Hex Whiz Loc Nut
002-247	Washer
002-517	1/8” NPT X .170 Barb Fitting
002-526	Spring Retainer
002-527	10-32 X 3/4” RHMS
004-006	Throttle Base
004-007	Hinge Plate
004-008	Spring Retainer
004-009	Spacer (2)
004-010	Pivot Shaft
004-011	Bleed Shaft
004-012	Outlet
004-031	Throttle Outlet Spring
004-459	Spring Retainer
011-210	Rubber Foot Assy. 8-32 X 3/8” (4)
022-170	1/4-40 X 3/16” SHSS
022-553	10-32 X 1/4” RHMS



GraverMach

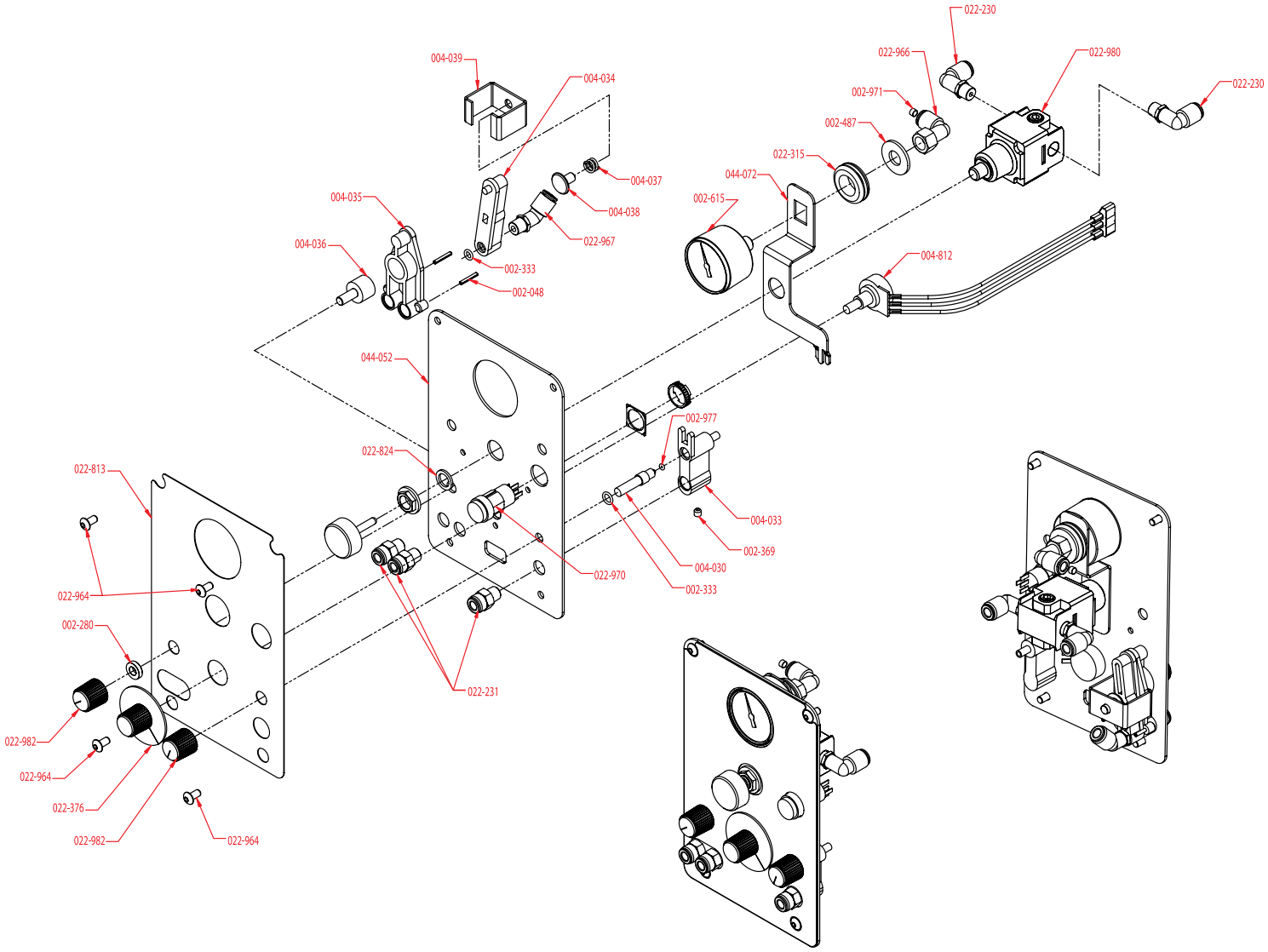
FRONT PANEL ASSEMBLY

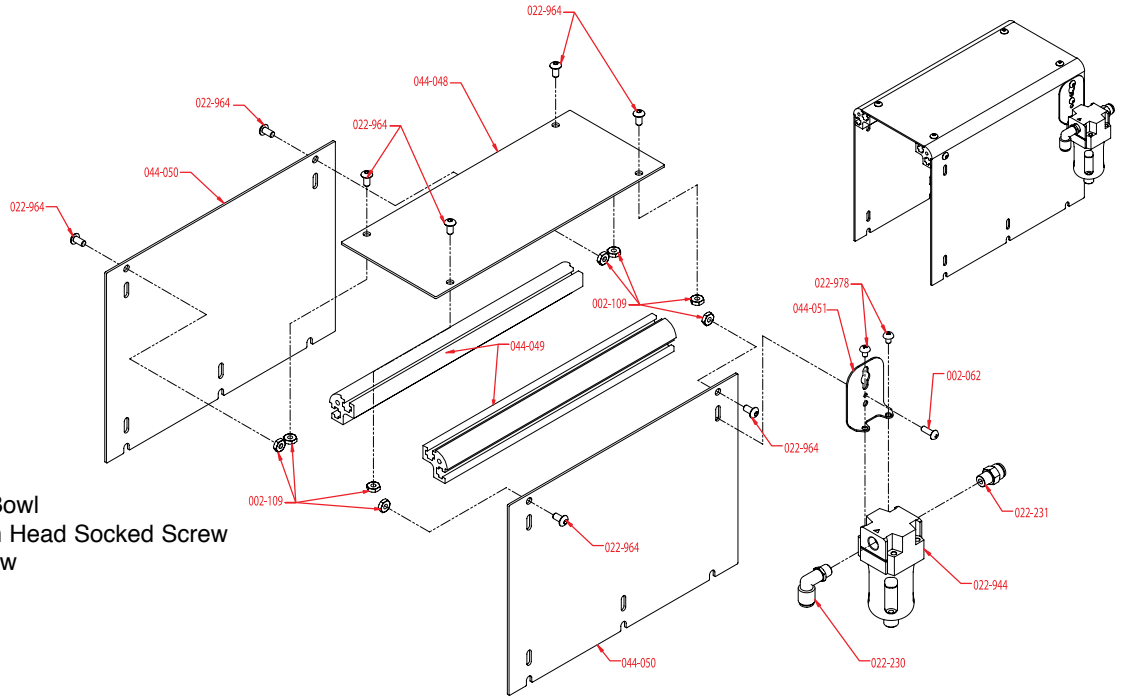
PART NO.	DESCRIPTION
002-048	Roll Pin 3/32” X 5/8”
002-280	Washer
002-288	#10-32 X 5/8” SHCS
002-333	O-Ring 3/16” X 5/16” X 1/16”
002-369	Set Screw #10-32 X 3/16”
002-447	Washer, 3/8 flat 13/16 O.D. Z/P
002-487	Washer 3/8” X 1.00” O.D. X .083”
002-615	Air Pressure Gauge
002-971	Sintered Disk
002-977	O-Ring 1/16” X 3/16”
004-033	Valve Body
004-034	Valve Plate
004-035	Valve mount 1/8 NPT fittings
004-037	Spring 2 Way Valve
004-038	Spring Pad
004-039	Valve Keeper
004-812	Speed Pot Wire Assembly
004-819	Green LED Assembly (All parts not shown)
022-230	90° Elbow
022-231	Straight Fitting
022-234	Washer .260 x .473 x .06
022-315	Rubber Grommet
022-824	Washer .587” X .400” X .060” SS
022-875	Throttle bias valve
022-966	Female Elbow
022-967	45° Male Elbow
022-969	IDEC AB6M-A1-G non-illuminated switch
022-980	IR1000-N01 SMC regulator
022-981	Throttle bias valve
022-982	Control Knob
022-983	Control Knob
022-984	Decal for Front Face
044-036	GraverMach Face
044-044	Valve Needle
044-052	Front Frame Plate
044-054	Reflector
044-056	Valve Shifter-Long
044-073	Gauge Mounting Bracket



FRONT PANEL ASSEMBLY

PART NO.	DESCRIPTION
002-048	Pin Roll 3/32” X 5/8”
002-280	Washer 16FW250125
002-333	O-Ring 3/16” X 5/16” X 1/16”
002-369	Set Screw #10-32 X 3/16”
002-487	Flat washer 3/8” X 1.00” O.D. X .083”
002-615	Gauge Air Pressure
002-971	Sintered Disk for snubbing air pulse
002-977	O-Rings 1/16” x 3/16”
004-030	Valve Needle
004-033	Valve Body
004-034	Valve Plate
004-035	Valve Mount 1/8” NPT Fitting
004-036	Valve Shifter
004-037	Spring 2 Way Valve
004-038	Spring Pad
004-039	Valve Keeper
004-812	Speed Pot Wire Assembly
022-230	90° Elbow
022-231	Straight Fitting
022-315	Rubber Grommet
022-376	Control Knob
022-813	Front Decal for GraverMax SC
022-824	Washer, .587” x .4” x .06” Stainless Steel
022-964	10-32 X .375” Button Head Socked Head Screw
022-966	Female Elbow
022-967	45° Male Elbow
022-970	Green Illuminated Switch Body
022-980	Regulator
022-982	Control Knob
044-052	Front Frame Plate
044-072	Gauge Mounting Bracket with Formed Tines





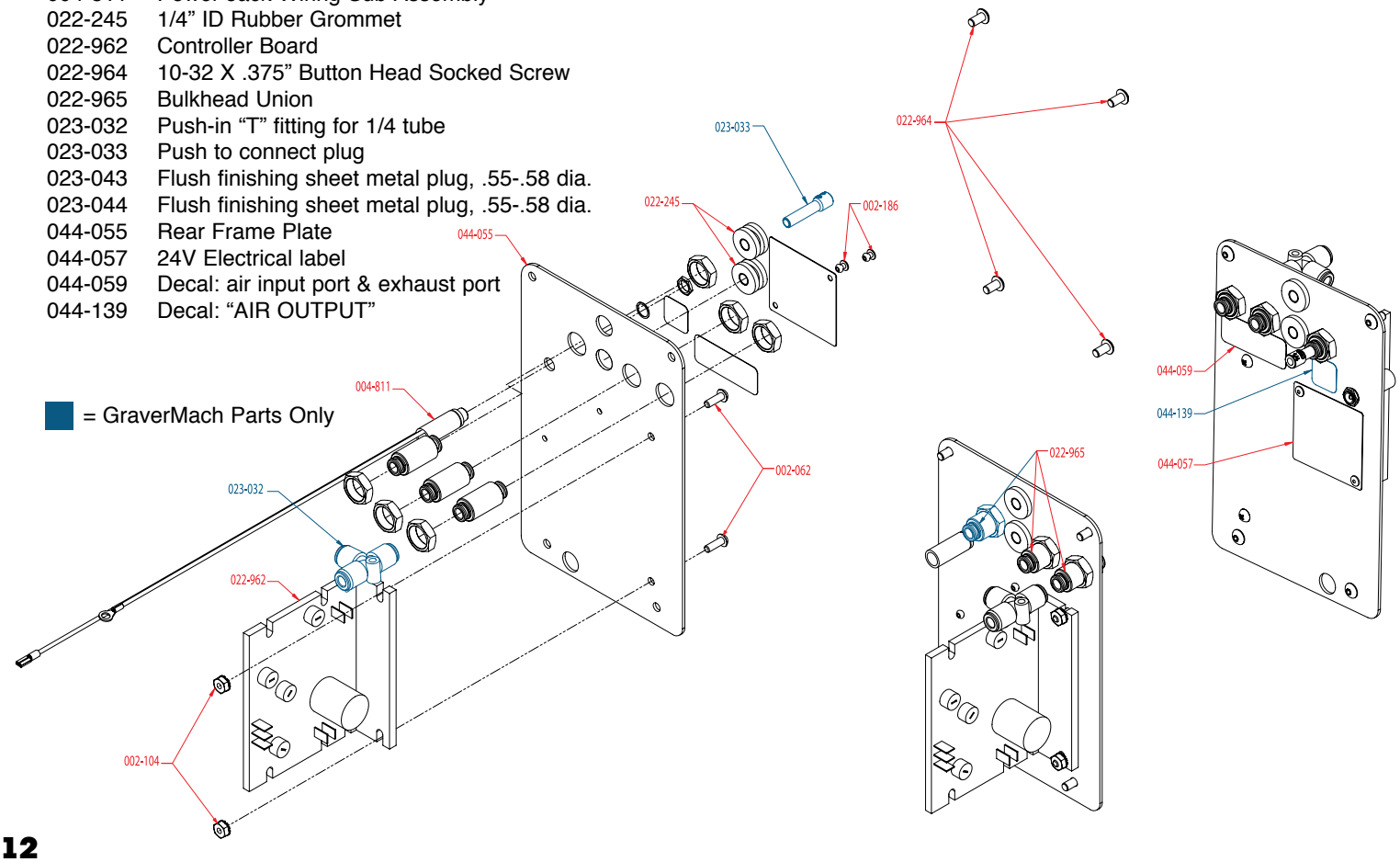
COVER ASSEMBLY

PART NO.	DESCRIPTION
002-062	#8-32 x 1/2 RHMS
002-109	Nut #10-32 Hex Z/P
022-230	90° Elbow
022-231	Straight Fitting
022-944	5-Micron Filter and Bowl
022-964	10-32 X .375" Button Head Socked Screw
022-978	4M X .7" Metric Screw
044-048	Top Frame Plate
044-049	Extruded Corner
044-050	Side Frame Plate
044-051	To Mount Filter

REAR PANEL ASSEMBLY

PART NO.	DESCRIPTION
002-062	#8-32 X 1/2" RHMS
002-104	Nut #8-32 Hex Z/P
002-186	Pop Rivet
004-811	Power Jack Wiring Sub Assembly
022-245	1/4" ID Rubber Grommet
022-962	Controller Board
022-964	10-32 X .375" Button Head Socked Screw
022-965	Bulkhead Union
023-032	Push-in "T" fitting for 1/4 tube
023-033	Push to connect plug
023-043	Flush finishing sheet metal plug, .55-.58 dia.
023-044	Flush finishing sheet metal plug, .55-.58 dia.
044-055	Rear Frame Plate
044-057	24V Electrical label
044-059	Decal: air input port & exhaust port
044-139	Decal: "AIR OUTPUT"

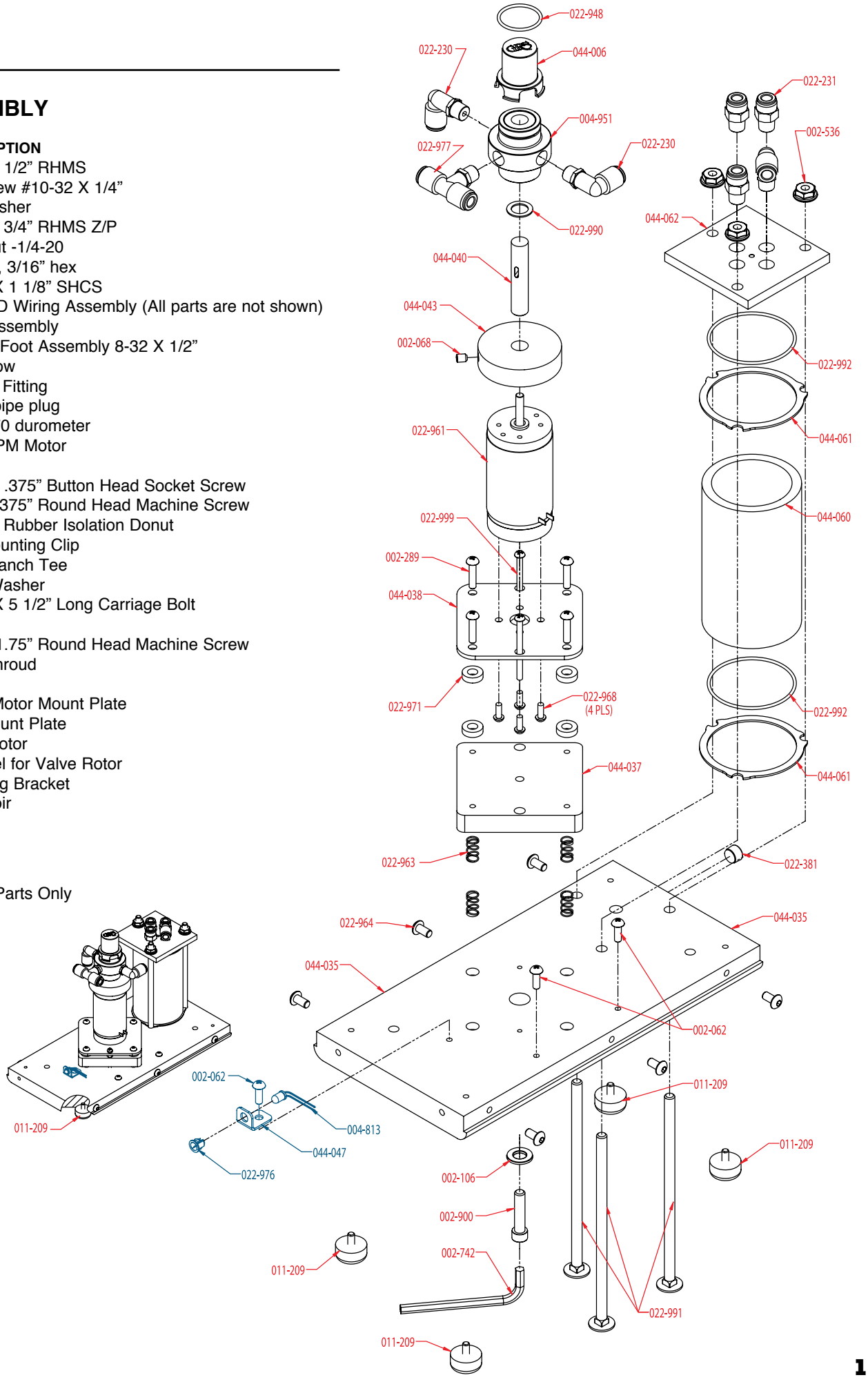
■ = GraverMach Parts Only



BASE ASSEMBLY

PART NO.	DESCRIPTION
002-062	#8-32 X 1/2" RHMS
002-068	Set Screw #10-32 X 1/4"
002-106	1/4" Washer
002-289	#8-32 X 3/4" RHMS Z/P
002-536	Lock Nut -1/4-20
002-742	Wrench, 3/16" hex
002-900	1/4-20 X 1 1/8" SHCS
004-813	Red LED Wiring Assembly (All parts are not shown)
004-951	Valve Assembly
011-209	Rubber Foot Assembly 8-32 X 1/2"
022-230	90° Elbow
022-231	Straight Fitting
022-381	1/8-27 pipe plug
022-948	O-ring 70 durometer
022-961	4000 RPM Motor
022-963	Spring
022-964	10-32 X .375" Button Head Socket Screw
022-968	6-32 X .375" Round Head Machine Screw
022-971	Silicone Rubber Isolation Donut
022-976	LED Mounting Clip
022-977	Male Branch Tee
022-990	Nylon Washer
022-991	1/4-20 X 5 1/2" Long Carriage Bolt
022-992	O-Ring
022-999	6-32 X 1.75" Round Head Machine Screw
044-006	Rotor shroud
044-035	Base
044-037	Lower Motor Mount Plate
044-038	First Mount Plate
044-040	Valve Rotor
044-043	Flywheel for Valve Rotor
044-047	Mounting Bracket
044-060	Reservoir
044-061	Flange
044-062	Cap

■ = GraverMach Parts Only



TOOL INFORMATION

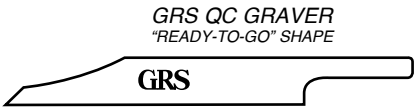
The ability to exercise precise control under all operating conditions is the most important feature of the **GraverMach/ GraverMax SC.** Coordination of the throttle and handpiece is very similar to steering your car while depressing the gas pedal.

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.

INSTALLING TOOLS INTO THE HANDPIECE

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



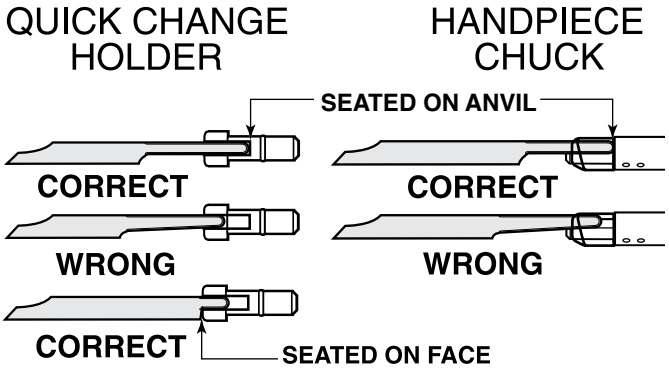
Standard gravers normally used with wood handles (point, knife, liners, etc.) may be used in all handpieces. The tang (or shank) end must be modified by grinding to fit the chuck properly.

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 following sketch shows how the graver should be modified.

CAUTION - Do NOT use tools 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.

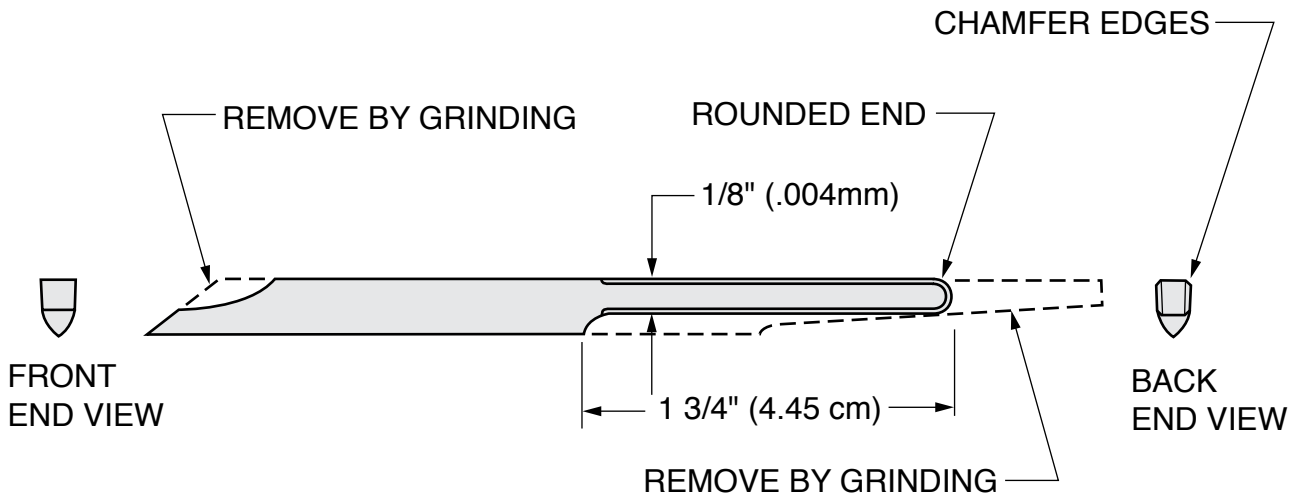


MORE ABOUT MODIFYING TOOLS

Removing the top / front of the engraver tip will allow a better view of the area being cut and will permit faster sharpening as there is less surface to be sharpened.

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.



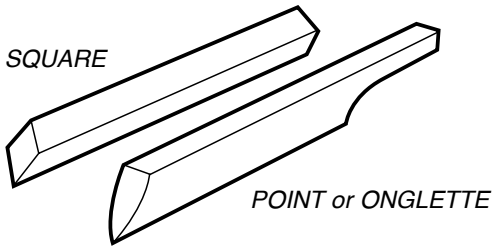
TOOL SHARPENING TECHNIQUES

While the **GraverMach/ GraverMax SC** 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 perhaps 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 a Graver Sharpening Simplified Video (#011-272) and a DVD called; The Expert's Guide to Graver Sharpening by Sam Alfano, Master Engraver (#022-375).

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.



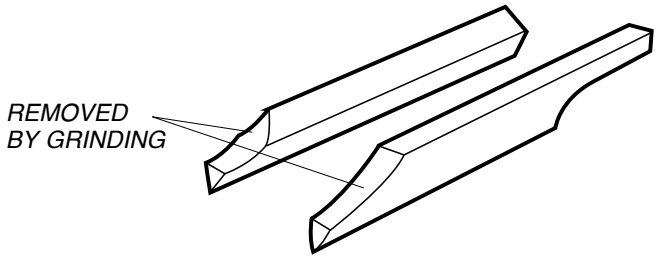
In his book, *THE ART OF ENGRAVING*, Mr. Meek's excellent illustration and discussion of the importance of proper tool sharpening technique and geometry is especially helpful. He relates to this subject in chapters 2, 4 and 7. This subject is of utmost importance, and this reference material is most helpful.

Gravers should be ground on the face first. An approximate 45-degree 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.

FOR A COMPLETE LINE OF GRAVERS VISIT
THE GRS TOOLS GRAVER WEBSITE:

www.gravers.us

A common error in sharpening is the tendency to increase the angle of the face gradually each time the graver is resharpened. 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.

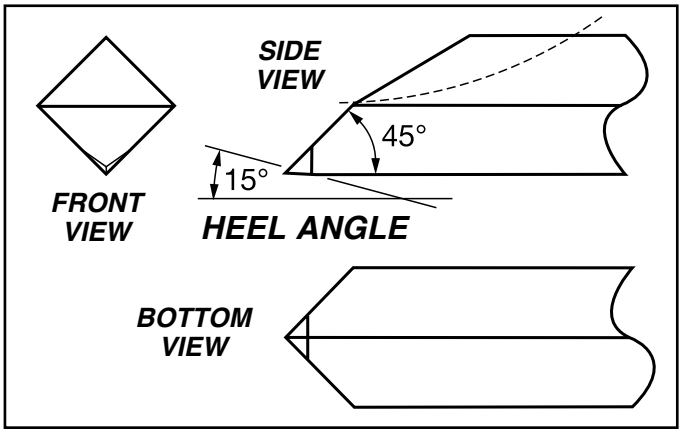


For good results, the graver must be heeled, or set-up. This task takes some experimentation and practice to produce satisfactory results. The finish of the engraved cut is greatly affected by the finish of the graver heel. For a bright cut, finish the heel using polishing paper or a ceramic lap.

Here is what the heel accomplishes:

A. It raises the working angle of the graver to a convenient height from the work surface.
B. It provides depth control.
C. 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.
D. It improves the quality and appearance of the cut.

Usually a heel angle of 15 degrees 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.



EFFECTIVE TIPS

The **GraverMach/GraverMax SC** 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/GraverMax SC**. 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*. ...we recommend it highly.

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:

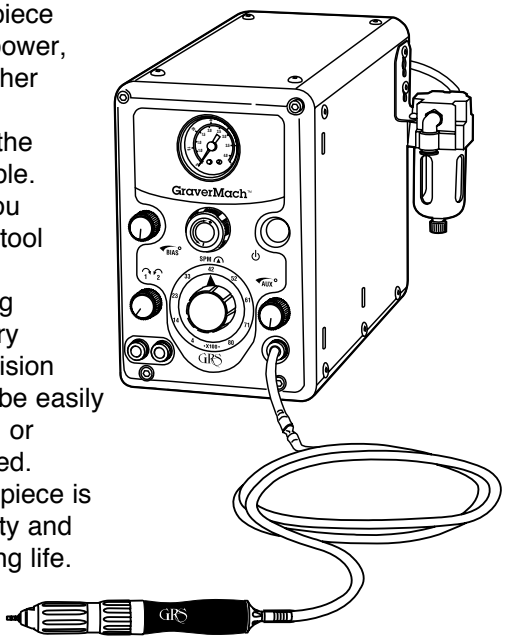
- The concept of variable power applied to the handpiece seems strange at first.
- Coordination of power and tool cutting action with the foot throttle might feel awkward, but after a small amount of practice it will become natural.
- It seems strange and different at first - but extremely effective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

TRY THESE TECHNIQUES -

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 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 become 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.

GRS 850 ROTARY HANDPIECE



The 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 handpiece to auxiliary air output on your **GraverMach or GraverMax SC**. The handpiece is designed to operate at a maximum of 35 psi (2.4 bar).

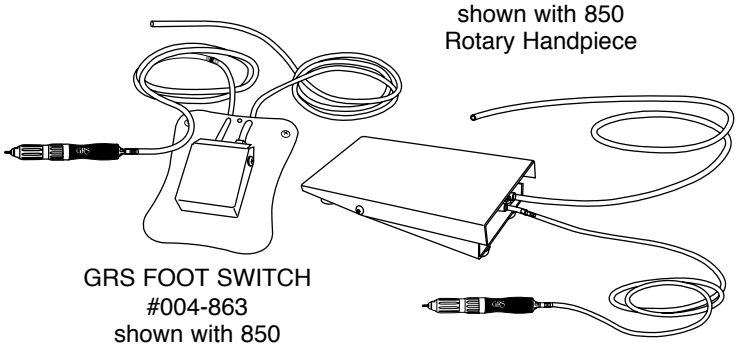
Stop the rotary handpiece by turning the auxiliary knob until the air is shut OFF. For frequent ON / OFF usage, we recommend adding a GRS foot switch in the air line. This will facilitate your work.

ROTARY HANDPIECE SAFETY

1. Use safety glasses or goggles. Also use 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 burs. 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***.

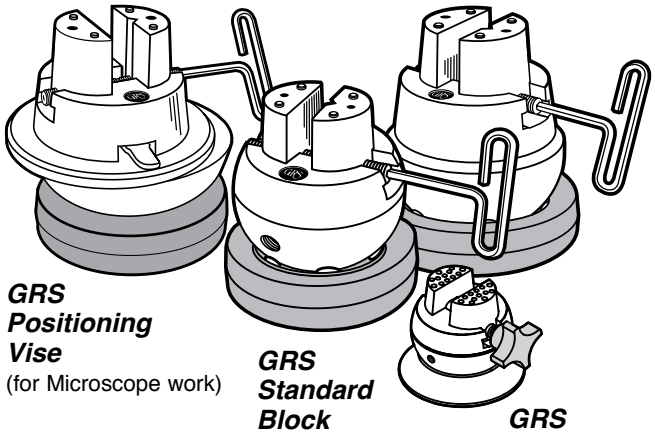
WORK HOLDING

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
VARIABLE PRESSURE
FOOT CONTROL
#004-771
shown with 850
Rotary Handpiece

GRS FOOT SWITCH
#004-863
shown with 850
Rotary Handpiece

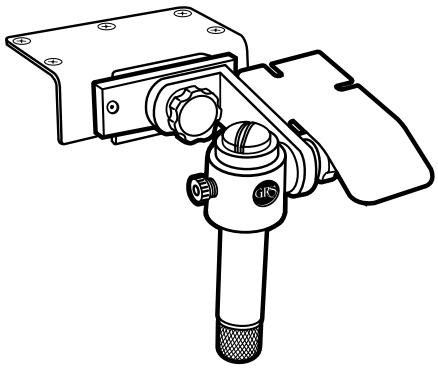


GRS Magnablock

GRS Positioning Vise
(for Microscope work)

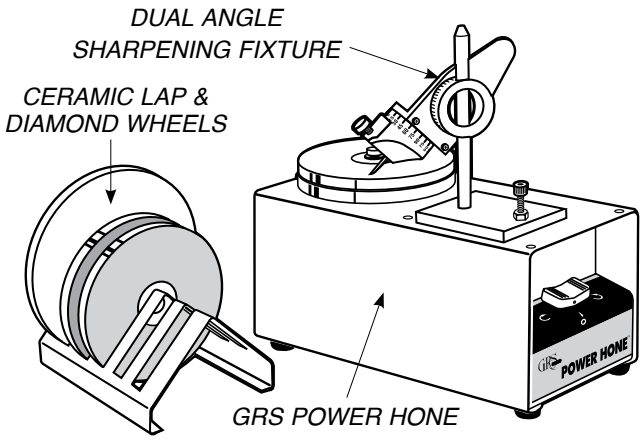
GRS Standard Block

GRS Microblock



GRS Bench Mate
Work-Holding system for Jewelers

NOTE:
READ THE INSTRUCTIONS THAT COME WITH THE ROTARY HANDPIECE CAREFULLY.



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.

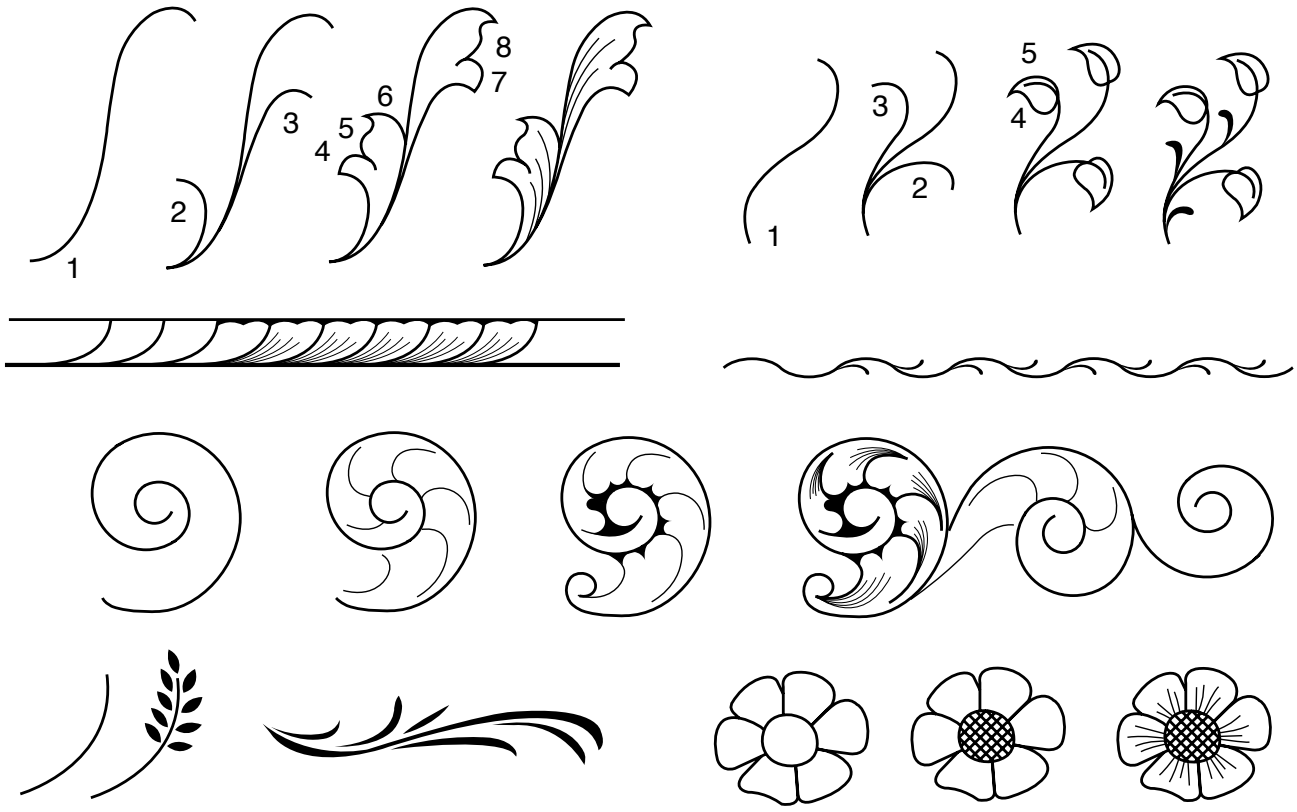
The combination of the GRS Power Hone® and the Sharpening Fixture provides the ideal sharpening system. The Sharpening Fixture is designed specifically for use with the Power Hone. With this combination, you can sharpen repeatedly with consistent results time after time. It is easy to learn - you merely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

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 and GraverMax SC, including handpieces and foot control, carries a full 2-year warranty covering parts and labor.

These units 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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