PACE® TECHNOLOGIES
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NANO-1200S Polisher

INSTRUCTION MANUAL

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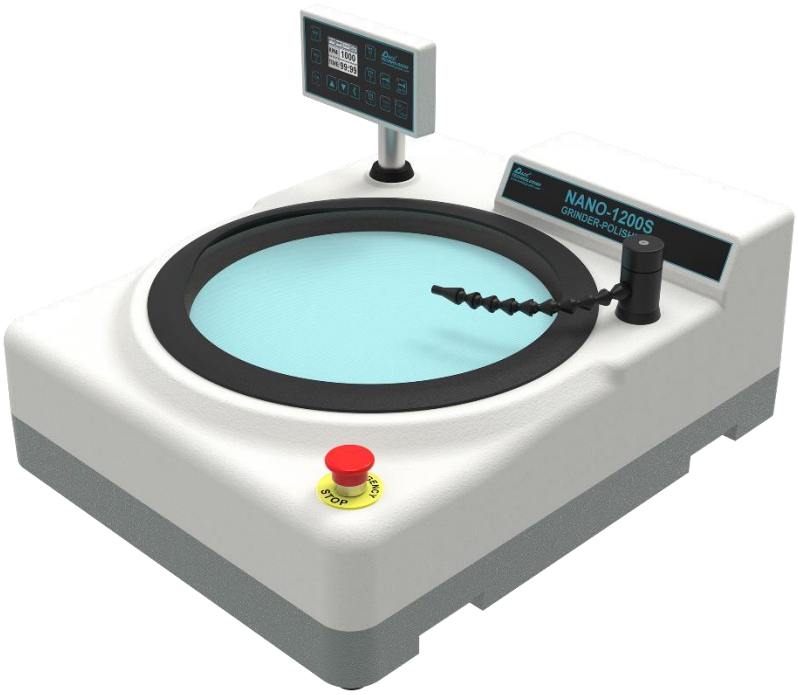

Equipment Type:	12 and 14-inch diameter Single Grinder / Polisher
Model:	***NANO-1200S***
Speed:	100 – 1000 rpm
Electrical Requirements:	110 / 220 Volts
Frequency:	50 / 60 Hz
Motor Power:	1.33 Hp (1000 W) dynamic high torque servo motor
Manual Revision Date:	November 20, 2023

Please read this instruction manual carefully and follow all installation, operating and safety guidelines.

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WARRANTY

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1. LIMITED WARRANTY AND DISCLAIMER:

PACE Technologies Products are warranted for two years from the purchase date to be free from defects in material and workmanship under correct use, normal operating conditions, and proper application. PACE Technologies obligation under this warranty shall be limited to the repair or exchange, at PACE Technologies option, of any PACE Technologies Product or part which proves to be defective as provided herein. PACE Technologies reserves the right to either inspect the product at Buyer's location or require it to be returned to the factory for inspection. Buyer is responsible for freight to and from factory on all warranty claims. The above warranty does not extend to goods damaged or subjected to accident, abuse or misuse after release from PACE Technologies warehouse, nor goods altered or repaired by anyone other than specifically authorized PACE Technologies representatives. PACE Technologies shall not in any way be responsible for the consequences of any alteration, modification or misuse unless previously approved in writing by an officer of PACE Technologies. Note: Corrosion is considered a maintenance issue and not a warranty issue.

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PACE Technologies maximum aggregate liability for loss and damage arising under, resulting from or in connection with the supply or use of the Equipment and Consumables provided under this purchase, or from the performance or breach of any obligation (s) imposed hereunder, whether such liability arises from any one or more claims or actions for breach of contract, tort, (including negligence), delayed completion, warranty, indemnity, strict liability or otherwise, unless otherwise limited by the terms hereof, shall be limited to one hundred percent (100%) of the purchase price.

3. DELIVERY:

Customer assumes and shall bear the risk of all loss or damage to the Products from every cause whatsoever, whether or not insured, and title to such Products shall pass to Customer upon PACE Technologies delivery of the Products to the common carrier of Pace Technologies choice, or the carrier specified in writing by Customer, for shipment to Customer. Any claims for breakage, loss, delay, or damage shall be made to the carrier by the Customer and Pace Technologies will render customer reasonable assistance in prosecuting such claims.

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4. ACCEPTANCE:

Customer shall inspect the Products promptly upon receipt of delivery. Unless customer objects in writing within thirty (30) business days thereafter, customer shall be deemed to have accepted the Products. All claims for damages, errors, or shortage in Products delivered shall be made by Customer in writing within such five (5) business day period. Failure to make any claim timely shall constitute acceptance of the Products.

5. PAYMENT:

Customer agrees to provide timely payment for the Products in accordance with the terms of payment set forth on the reverse side hereof or in any proposal submitted herewith. If any payment is not paid on or before its due date, Customer shall pay interest on such late payment from the due date until paid at the lesser of 12% per annum or the maximum rate allowed by law.

6. DEFAULT:

If Buyer is in default (including, but not limited to, the failure by Buyer to pay all amounts due and payable to Seller) under the work or purchase order or any other agreement between Buyer and Seller, Buyer 's rights under the warranty shall be suspended during any period of such default and the original warranty period will not be extended beyond its original expiration date despite such suspension of warranty rights.

7. MISCELLANEOUS PROVISIONS:

This agreement has been made in and shall be governed by the laws of the State of Arizona. All disputes arising under or relating to the purchase of the equipment shall be brought and resolved solely and exclusively in the State of Arizona, Pima County. These terms and conditions and the description of the Products on the reverse side hereof or in any proposal submitted herewith constitute the entire agreement and understanding of the parties with respect to this sale and supersede all prior and contemporaneous agreements or understandings, inducements or representations, expressed or implied, written or oral, between the parties with respect hereto. Any term or provision of this Agreement may be amended, and any observance of any term of this Agreement may be waived, only by a writing signed by the party to be bounds. The waiver by a party of any breach shall not be deemed to constitute a waiver of any other breach. Should suit be brought on this Agreement, the prevailing party shall be entitled to recover its reasonable attorneys' fees and other costs of suit including costs and attorneys' fees incurred on appeal or in collection of any judgment., errors, or shortage in Products delivered shall be made by Customer in writing within such five (5) business day period. Failure to make any claim timely shall constitute acceptance of the Products.

8. RESTOCKING FEE:

All Returns are subject to a restocking charge equal to 15% (fifteen percent) of the Invoice, unless the Goods are proved to be non-conformed by PACE Technologies

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1.0 Safety Guidelines

1.1 Warning Sign: ! A large exclamation point is used to point out special safety features on the machine.

1.2 Safety Precautions

! Careful attention to this instruction manual and the recommended safety guidelines is essential for the safe operation of the ***NANO-1200S***.

! Proper operator training is required for the operation of the ***NANO-1200S***. Any unauthorized mechanical or electrical modifications made to the ***NANO-1200S***, as well as improper operation, voids all warranty claims. All service issues need to be reported to the manufacturer or supplier.

! Operate unit as specified in this manual.

! Disconnect from power before opening the unit.

! Do not rest anything on the working wheel.

! Ensure that the air slots on the back panel remain unobstructed.

! Turn off the water when the machine is not in use.

! Hold all samples securely (using two hands is recommended).

1.3 Emergency Statement

The ***NANO-1200S*** polisher has been designed for polishing metallographic specimens up to a 2- inch diameter. **DO NOT GRIND OR POLISH** oversized samples (greater than 1/3 the diameter of the working wheel). Always follow proper operational guidelines and avoid contact with moving parts, lubricants, and abrasives. Seek immediate medical care for cutting injuries.

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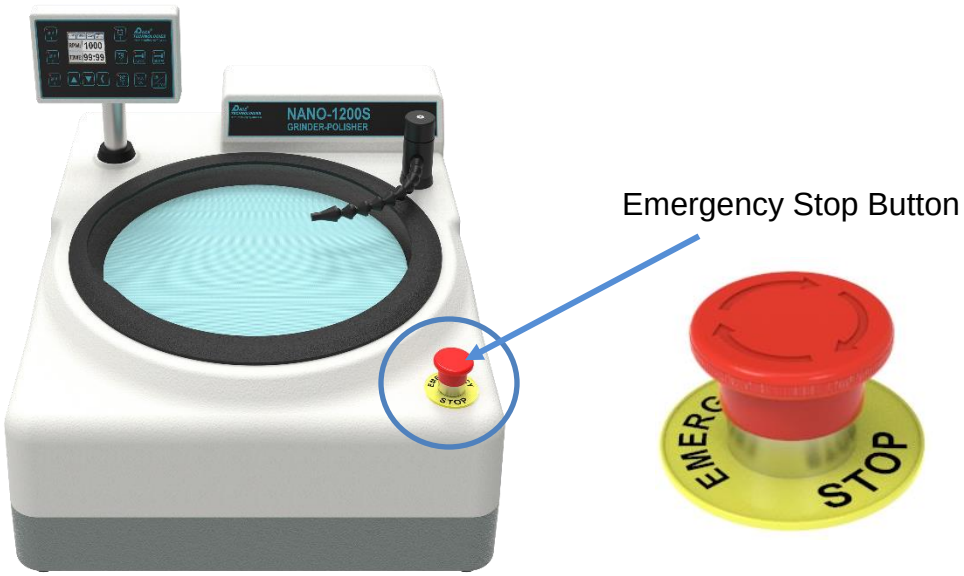
1.4 Safety Test

! Important: The following safety check of the emergency stop button is **required** to verify that the ***NANO-1200S*** is functioning properly and is ready to use.

Test:	1). Activate the main power switch to turn on the machine. 2). Start the motor. 3). Depress emergency stop button.
Correct Response:	The machine immediately powers down.
Malfunction:	The machine does not lose power.
Corrective Measure:	If the system fails to lose power, disconnect the power supply cord, and call a service technician before continuing use.



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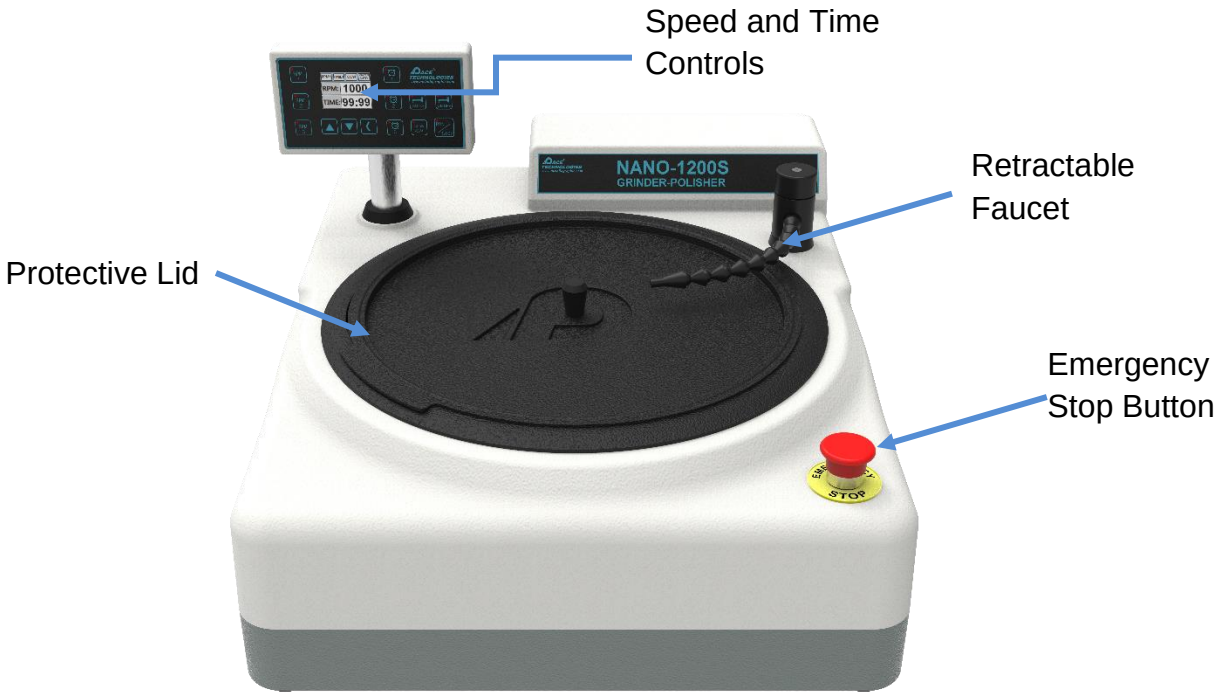
2.0 Product Description

2.1 General Description



- The ***NANO-1200S*** is a 12 or 14-inch single wheel grinding / polishing machine used for manual wet grinding or polishing of metallographic specimens.

- The ***NANO-1200S*** is a variable speed polisher (100-1000 rpm) with programmable speed and time settings.

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2.2 Technical Specifications

Electrical Specifications:	110 / 220 Volts (50 / 60 Hz)
Working Wheel Diameter:	12-inch (300 mm) 14-inch (350 mm)
Motor Power:	1000W (1.33 HP)
Polishing Base Speed:	100 - 1000 rpm variable speed Programmable speed settings
Weight:	Approx. 95-lbs (43-kg)
Dimensions (W x H x D):	Approx. 20 x 16.5 x 25 inches (510 x 420 x 635 mm)
Working Temperature:	32° - 100°F (0 – 40°C)
Shipping Temperature:	32° - 130°F (0 – 54°C)
Storage Temperature:	32° - 100°F (0 – 40°C)
Maximum Sample Diameter:	1/3 diameter of the working wheel

CE

EU Directives:	Machinery directive 2006/42/EC RoHS Directive 2011/65/EU
EU Harmonized Standards:	EN ISO 1200:2010 EN 61010-1:2010 EN 61326-1:2006

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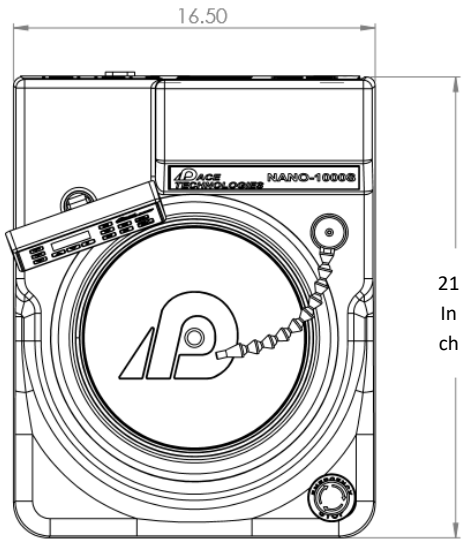
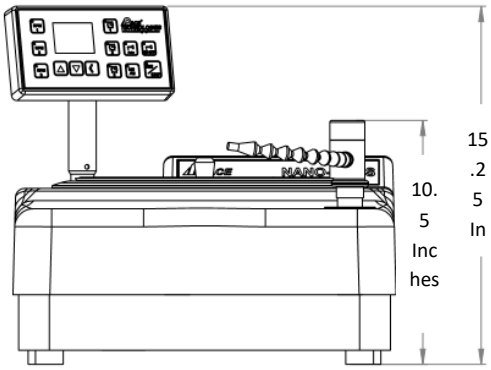
2.3 Basic Size Dimensions

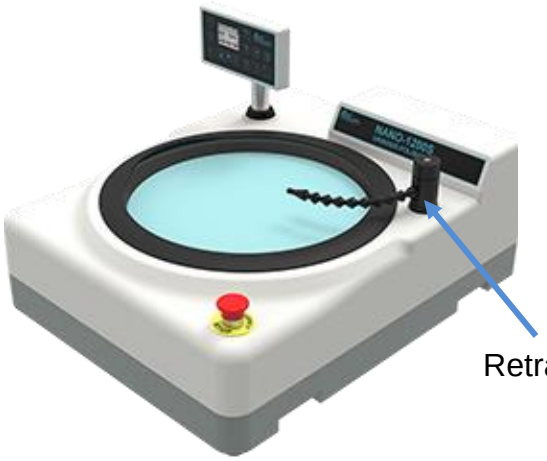
Note: Installation of the ***NANO-1200S*** should take place on a sturdy flat surface with access to water, drain, and electrical connections.



2.4 Features

- The ***NANO-1200S*** is equipped with a powerful 1000W (1.33 hp) servo motor for better torque over the entire rpm range.
- It also includes a full color LCD screen and easily programmable speed and time settings.
- A retractable faucet and flexible hose system allows for easy water access.





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2.4 Features Continued

- The easy-to-view screen post features height, pivot, and rotational adjustments for maximum viewing angles.
- Included low-profile splash ring prevents excess water from escaping the bowl.
- A protective lid reduces the chance of contamination while storing.

3.0 Shipping, Unpacking and Installation

3.1 Shipping

- The ***NANO-1200S*** is shipped in a specially designed custom box. When unpacking, check that all parts are included and undamaged.

3.2 Unpacking

- When moving the box, lift from the bottom.
- It is recommended a minimum of two people assist when moving an object exceeding 40-lbs.

Measurements: (W x H x D)	Approx. 20 x 16.5 x 25 inches (510 x 410 x 630 mm)
Weight:	Approx. 120 lbs (55-kg)

! Caution: Heavy equipment. Take care to avoid bodily injury.

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3.3 Installation

- The ***NANO-1200S*** should be placed on a stable flat surface with access to water, drain, and electrical connections.

- After water, drain, and electrical connections are established, the system is ready for operation by activating the main power switch.

Backside Connections:

Note: Inspect operating voltage on name plate before operating.

FEMTO Communication Port

FEMTO Power Connector

Power Supply (110 / 220 V)

Power Switch

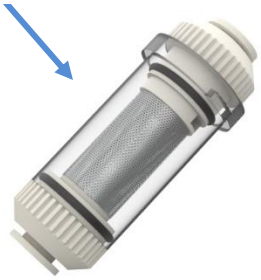
Water Drain

External Water Supply

External Water Supply:

The water supply line requires a ¼-inch compression fitting. It is recommended that the water supply be turned off when the unit is not in use. Inlet water should be clean and contamination-free to extend the life and performance of the system.

In-line Filter



Electrical Connection:

Connect electrical power cable to source.

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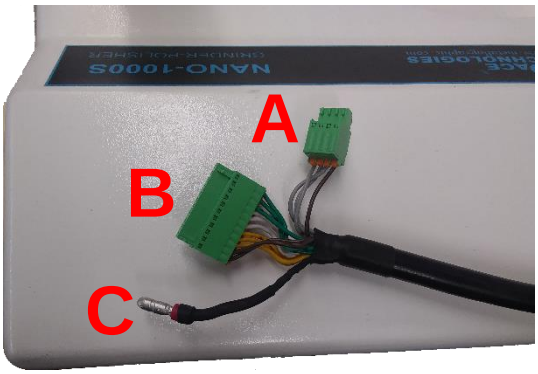
3.4 Screen Post Installation

The ***NANO-1200S*** Polisher has a removable screen. Follow the below steps to install the screen. The steps can be completed in reverse if removing the screen in the instance that a FEMTO-S head is being installed.

3.4.1 Installation Steps:

1. Remove the screen post from the box.
2. Using a Phillips head screwdriver, unscrew the 5 screws from the back panel of the machine:

3. Look over the connectors labeled in the below image:



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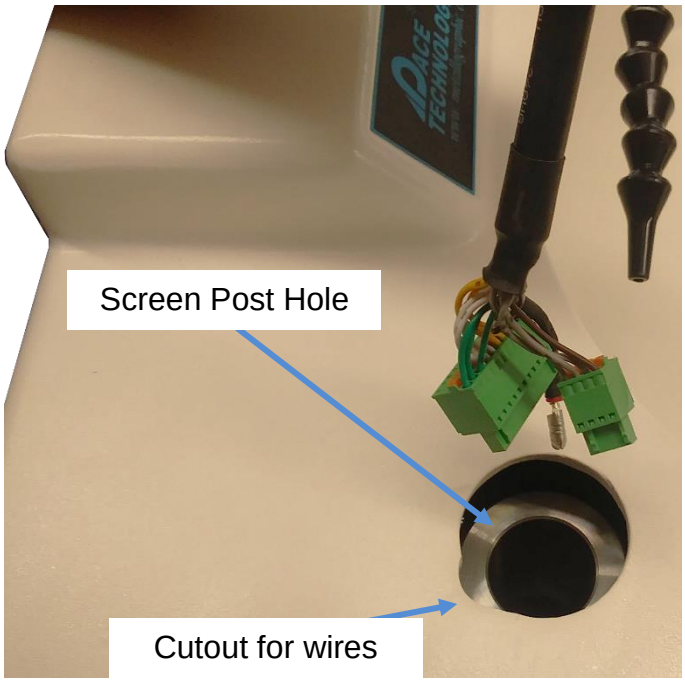
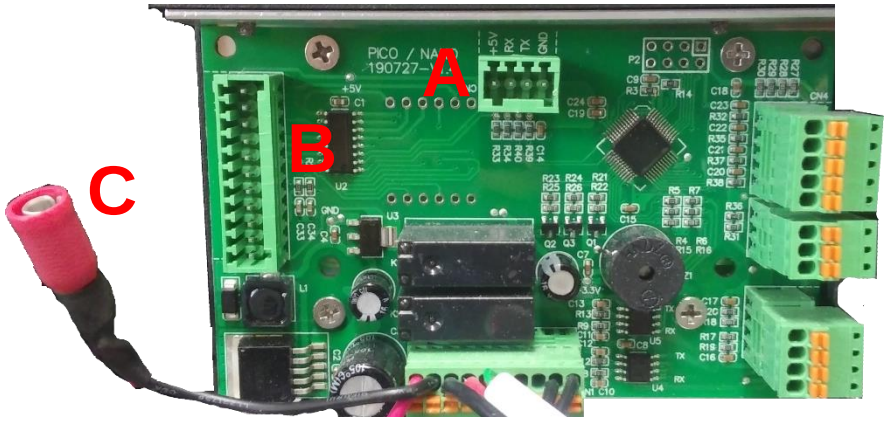
4. Place the bottom end of the post through the Screen Post Hole located on the top of the machine cover. Feed the wires above the hole and towards the back of the machine. Use the small cutout to assist with routing the wires. DO NOT feed the wires into the Screen Post Hole.



5. Connect the wires as follows:



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6. Replace the fasteners taken from the back panel and close the machine.

7. Position the screen's view to a comfortable orientation using the height, pivot, and rotational adjustment capabilities of the Screen Post.

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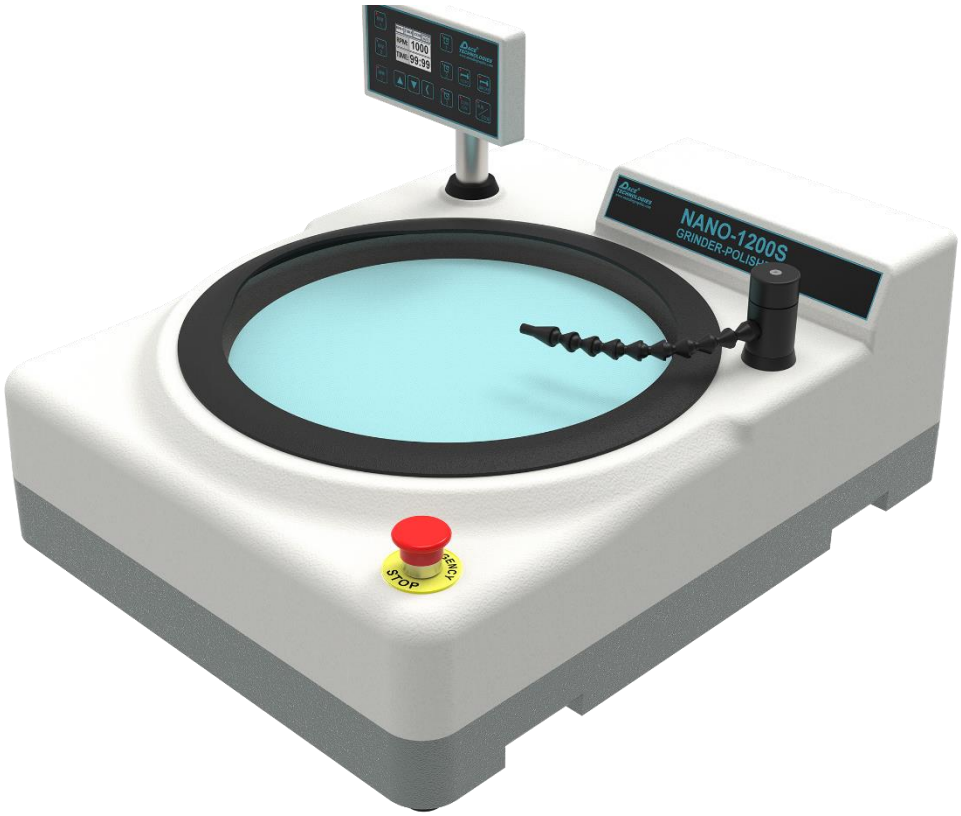
4.0 Start-up and Operation

4.1 General

The ***NANO-1200S*** is a manual grinding / polishing machine. By adding the FEMTO power head, semi-automated polishing can be achieved.



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4.2 Control Panel

	Rpm Selection:	Three programmable rpm settings.
	Directional Buttons:	Incrementally adjusts rpm and moves the number digit selector.
	Time Selection:	Three programmable run time settings.
	Water On / Off:	Stops and starts water.
	Water Auto:	Water automatically activates when the machine is running.
	Wheel Direction:	Selects clockwise or counterclockwise wheel direction.
	Run / Stop:	Runs and stops the wheel.

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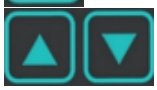
4.2.1 Manual Direction and Speed Controller

1. To select a wheel rotation direction, press the Wheel Direction button (as seen above) on the control panel.

2. Manually adjust speed by using the Directional Buttons:

   a.  Moves the digit selector to the desired spot.

   b.  Adjusts the number up and down.

4.2.2 Programming the rpm and Time Presets

1. Press and hold the button you would like to set until the screen changes to the number display.

2. Using the Directional Buttons, change the number to your desired preset.

3. Press the desired program button again to save the preset.

4. Now press the programmed button to set the machine to the programmed value.

4.3 Grinding and Polishing by Hand

1. Install the working wheel and attach the grinding surface/polishing cloths.

2. Switch on the machine in the back and set the direction, speed, and time (if required).

3. Position flexible waterspout over working wheel. During sample preparation, adjust water flow by turning the water control knob as needed.

4. Press RUN / STOP to start and stop the machine in manual mode.

Note: Initial operation of water valve may contain air in the lines. Turn water on slowly to purge air from the system.

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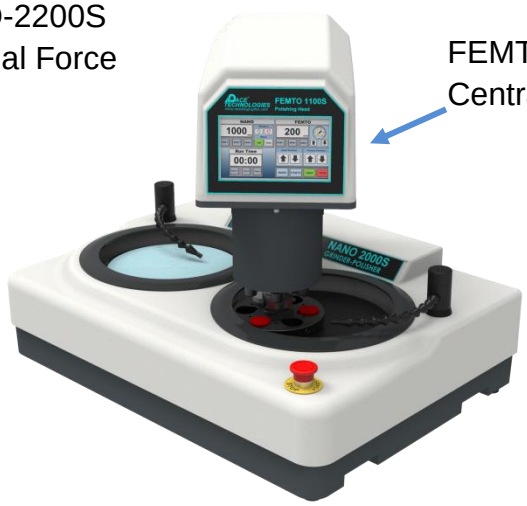
4.4 Semi-automated Grinding / Polishing (Optional)



Metallographic semi-automated polishing machines are available with individual (single) specimen loading (FEMTO-2200S) or with a fixed central and individual force (FEMTO-2500S) holders.

Semi-automated Polishing: Individual vs. Central Force

Individual Force: The force is applied to each sample individually. The main advantage for individual (or single) sample preparation is the elimination of the planar grinding steps resulting in fewer steps overall. The primary disadvantage is that the specimen plane is not fixed in a rigid position during grinding and can result in a loss of flatness across the sample.

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Individual Force Advantages:

- Reduced number of preparation steps.
- Lower cost for consumables.
- Sample can be re-polished without having to re-planarize the specimen.

Individual Force Disadvantages:

- Can result in a loss of flatness across the specimen if heavy duty grinding is required.
- It is recommended that the grinding and polishing steps only be done at matching head and base speeds, with the rotation being in the same direction.

FEMTO 2200S Auto Polishing Head

Individual Force Holder

Central Force: For central force holders, the specimens are locked into a rigid position, or fixed plane, so that the specimens cannot rock during sample preparation. This is especially important for the planar grinding or coarser grinding steps.

Central Fixed Force

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Central Force Advantages:

- Locking the samples into a rigid position results in flatter specimens.
- Specimens can be polished in both the contra and complementary head and base directions.

Central Force Disadvantages:

- A minimum of 3 samples are required in the holder.
- Typically requires 1 – 3 additional coarser grinding steps to planarize all specimens.
- Additional grinding steps increase both consumable cost and total preparation time.
- Coarser grinding can result in more surface and subsurface damage to the specimen.
- Specimens need to be re-planarized if they are removed from the fixed holder.

FEMTO 2500S Auto Polishing Head

Interchangeable Central Force Holders

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Individual vs. Central Force Preparation Requirements:

Step	Individual Force	Central Force
Planar Grinding	N/A	120, 240 Grit SiC
Rough Grinding	360, 600 Grit SiC	360, 600 Grit SiC
Fine Grinding	800, 1200 Grit SiC	800, 1200 Grit SiC
Intermediate Polishing	1-micron Polycrystalline Diamond on a Woven Pad	1-micron Polycrystalline Diamond on a Woven Pad
Final Polishing	0.05-micron NANOMETER Alumina on a Napped Pad	0.05-micron NANOMETER Alumina on a Napped Pad

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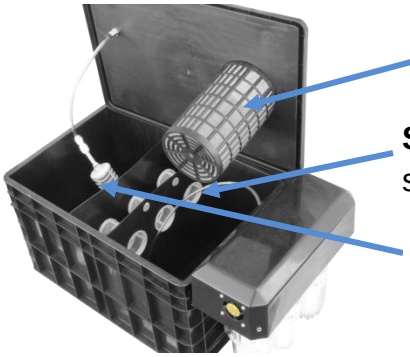
4.5 Recirculating Filter System (RC-1000A Optional Attachment)

The recirculating-filter system allows for the polisher to be both mobile as well as to filter and remove polishing swarf and abrasives generated from PACE Technologies NANO series polishers. Utilizing a positive pressure pump, the recirculating filter system can provide clean water containing 0.2 µm particles, thus eliminating waste flow to the building drainage system.



Stage 1: Coarse straining filter

Stage 2: Intermediate straining filters (3 filters)

Stage 3: Supply filter

Stages 4-6: Exchangeable fine particulate cartridge filters (1, 0.5 and 0.2 µm)

Description	Recirculating-Filter System
Filtering	Coarse (2-straining filters) Fine Filters (RC-F-COARSE 0.5, RC-F-MEDIUM 0.5 and RC-F-FINE 0.2 µm)
Electrical specification	110 / 220V (50/60 Hz)
Chambers	3-section chamber
Pump	24VDC Diaphragm Pump, 1.3 GPM (5L/min)
Dimensions (W x D x H)	31 x 16 x 19-inch (790 x 400 x 480 mm)
Volume of Tank	18 gallons (70 L)
Weight	30 lbs. (14 kg)
Part No.	RC-1000A

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4.6 Automated / Manual Dispensing Unit (Optional Attachment)

The ZETA-2000S dispensing unit allows for either manual or automated dispensing of the abrasive suspension. The ZETA-2000S has 4-fluid peristaltic dispensing pumps, auto priming, and a water flushing features.

Feature	ZETA 2000S Technical Specifications
Pumps:	4 (24V) Programmable Peristaltic pumps
Pump Control:	Frequency, Duration, Time
Flow Rates:	1.2~90 ml/minute
Dispenser:	Manual and Auto operation with priming and flushing
Controls:	7-inch touchscreen interface
Dispensing Arm:	Flexible for easy set-up
Water Supply:	Direct line water inlet
Electrical:	110/220V (50/60 Hz)
Dimensions (W x D x H):	9.5 x 10.6 x 12-inches (240 x 270 x 300 mm)
Weight:	12 lbs. (5.5 kg)

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4.7 Metallographic Specimen Preparation Basics

A typical metallographic specimen preparation consists of the following basic steps:

Preparation Stage	Purpose
Initial Documentation:	• To document the initial condition of the sample. • To map the sample surface. • To highlight the area of interest.
Sectioning / Cutting:	• To reduce the size of large samples. • To sample the specimen close to the area of interest.
Rough, or Planar Grinding:	• To obtain a planar surface. • To remove sectioning damage. • To approach the area of interest.
Rough Polishing:	• Ideally to remove all the subsurface and microstructural damage produced during cutting and rough grinding (Superficial scratches may still be present after this step).
Final Polishing:	• Generally, more for cosmetic purposes than for removing microstructural damage. In most cases, this stage should be minimized to avoid over-polishing and distorting the microstructural features.
Etching:	• To enhance microstructural features such as grain boundaries, grain size, phase differences, etc.
Examination:	• A variety of examination techniques are used in metallography, including optical microscopy, electron microscopy, and hardness testing.

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4.7.1 Rough / Planar Grinding

- Rough or planar grinding is required to produce flat specimens and to reduce the damage created by sectioning. The planar grinding step is accomplished by decreasing the abrasive grit particle size sequentially to obtain surface finishes that are ready for polishing. Care must be taken to avoid being too abrasive in this step and creating greater specimen damage than produced during cutting. This is especially true for very brittle materials such as ceramics and silicon.

- The machine parameters which affect the preparation of metallographic specimens include grinding/polishing pressure, grinding direction, and the relative velocity distribution between the specimen and the polishing wheel.

Grinding Pressure

- Grinding/polishing pressure is dependent upon the applied force (pounds or Newton's) and the area of the specimen and mounting material. Pressure is defined as the Force/Area (psi, N/m^2, or Pa). For specimens significantly harder than the mounting compound, pressure is better defined as the force divided by the specimen surface area. Thus, for larger hard specimens, higher grinding/polishing pressures increase stock removal rates. However, higher pressure also increases the amount of surface and subsurface damage produced in the specimen.

Note: Regarding SiC grinding papers, as the abrasive grains dull and cut rates decrease, increasing grinding pressures can extend the life of the SiC paper.

- Higher grinding/polishing pressures can also generate additional frictional heat which may be beneficial for the chemical-mechanical polishing (CMP) of ceramics, minerals, and composites. Likewise, for extremely friable specimens (such as nodular cast iron), higher pressures and lower relative velocity distributions can aid in retaining inclusions and secondary phases.

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Grinding Direction

- The orientation of the specimen can have a significant impact on the preparation results, especially for specimens with coatings. In general, when grinding and polishing materials with coatings, the brittle component should be kept in compression. In other words, for brittle coatings, the direction of the abrasive should be through the coating and into the substrate. Conversely, for brittle substrates with ductile coatings, the direction of the abrasive should be through the brittle substrate and into the ductile coating.

Manual Preparation

- To ensure that the previous rough grinding damage is removed when grinding by hand, the specimen should be rotated 90 degrees and continually ground until all the scratches from the previous grinding direction are removed. When necessary, the abrasive paper should be replaced with a newer paper to maintain cutting rates.

4.7.2 Rough Polishing

- The purpose of the rough polishing step is to remove the damage produced during cutting and planar grinding. Proper rough polishing will maintain specimen flatness and retain all inclusions or secondary phases. By eliminating the previous damage and maintaining the microstructural integrity of the specimen at this step, a minimal amount of time is required to remove the cosmetic damage at the final polishing step.

- Rough polishing is accomplished primarily with diamond abrasives ranging from 9-micron to 1-micron. Polycrystalline diamond (because of its multiple small cutting edges) produces high cut rates with minimal surface damage. Therefore, polycrystalline diamond abrasives are recommended for metallographic rough polishing on low-napped polishing cloths.

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Rough Polishing Guidelines

Materials	Recommendation
Metals (Ferrous, Non-ferrous, Tool Steels, Superalloys, etc.)	• Rough polishing usually requires two polishing steps • Example: a 6-micron diamond followed by a 1-micron diamond on low-napped polishing cloths.
Ceramics and Ceramic Matrix Composites (CMC)	• Low-napped polishing pads using polycrystalline diamond, alternating with colloidal silica. • This provides a chemical-mechanical polishing (CMP) effect which results in a damage-free surface.
Polymer Matrix Composites (PMC)	• Diamond-lapping films are recommended.
Biomaterials	• Low-napped polishing pads with polycrystalline diamond, alternating with colloidal silica. • Alternatively, diamond-lapping films may work well.
Microelectronic Specimens	• Diamond-lapping films are recommended.
Plastics and Polymers	• 800 and 1200 grit SiC abrasive paper is recommended.
Plasma Spray Materials	• Diamond-lapping films or low-napped polishing pads with alternating diamond and colloidal silica abrasives.

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4.7.3 Final Polishing

The purpose of final polishing is to remove only the cosmetic surface damage. It should not be used to remove any damage remaining from cutting and planar grinding. If the damage from these steps is not completely removed, the rough polishing step should be repeated or continued.

Final Polishing Guidelines

Material	Recommendation
Metals (Ferrous, Non-ferrous, Tool Steels, Superalloys, etc.)	• High-napped polishing pads with a nanometer alumina polishing abrasive. • The polishing times should nominally be less than 30 seconds.
Ceramics and Ceramic Matrix Composites (CMC)	• Low-napped polishing pads using 1- µm polycrystalline diamond, alternating with colloidal silica or colloidal silica alone.
Polymer Matrix Composites (PMC)	• Fine abrasive diamond-lapping films, followed by a very light polish on a high-napped polishing pad.
Biomaterials	• Low-napped polishing pads with polycrystalline diamond, alternating with colloidal silica.
Microelectronic Specimens	• Diamond-lapping films followed by a very light polish on a high-napped polishing pad.
Plastics and Polymers	• Light polish with alumina on a high-napped polishing pad.
Plasma Spray Materials	• Diamond-lapping films followed by a very light and short alumina or colloidal silica polish on a high-napped polishing pad.

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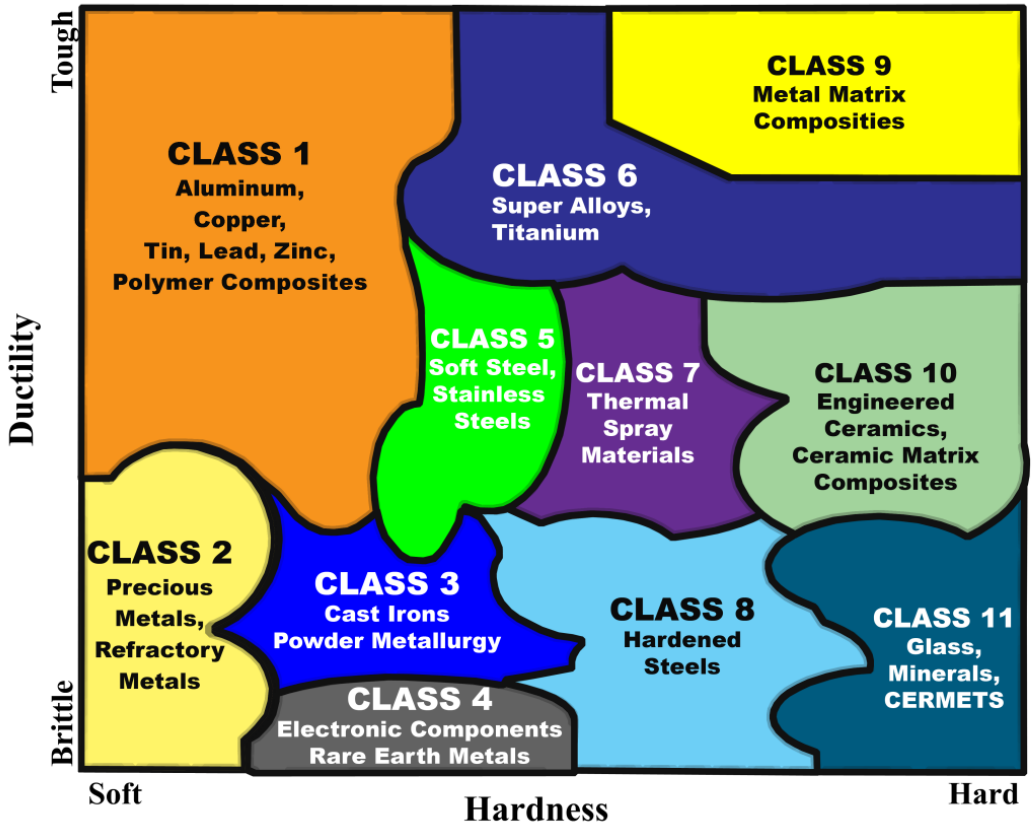
4.8 Metallographic Preparation Guidelines

Metallographic specimen preparation requires knowledge of the specimen properties. The most important characteristics are the hardness and ductility of the specimen. Based on these material properties, the proper metallographic consumables and equipment parameters can be determined.

4.8.1 Metallographic Class Procedures – Chart

The following chart shows the hardness and ductility for most metallographic material classes that are analyzed by metallographic techniques. Specimen procedures are fundamentally derived from this metallographic applications chart.



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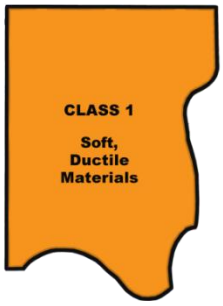
4.8.2 Metallographic Class Procedures – Icons

Class	Common Materials	Link to Online Procedures
	• Aluminum • Copper • Lead • Tin • Zinc • Polymer Matrix Composites	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-1-Description.html
	• Precious Metals • Refractory Metals	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-2-Description.html
	• Powder Metallurgy • Cast Irons	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-3-Description.html
	• Powder Metallurgy • Cast Irons	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-4-Description.html
	• Stainless Steels • Soft Steels	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-5-Description.html

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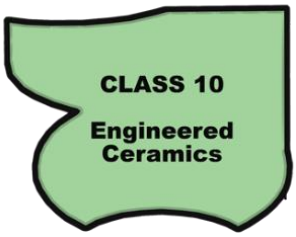
Class	Common Materials	Link to Online Procedures
	• Super Alloys • Titanium	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-6-Description.html
	• Thermal Spray Coatings	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-7-Description.html
	• Hard Steels	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-8-Description.html
	• Metal Matrix Composites	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-9-Description.html
	• General Ceramics • Engineering Ceramics • Ceramic Matrix Composites	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-10-Description.html
	• Glass • Minerals • CERMETS	https://www.metallographic.com/Metallographic-Preparation-Procedures/Class-11-Description.html

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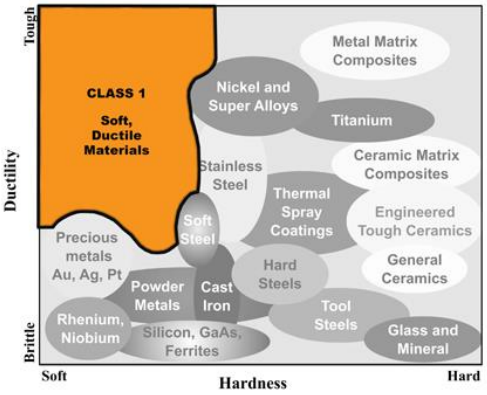
4.8.3 Metallographic Class Procedures – Examples

4.8.3.1 Class 1: Soft Ductile Materials (Example: Aluminum)

The difficulty in preparing Class 1 materials arises from the fact that these materials contain oxide inclusions in their microstructures. Proper specimen preparation retains these oxides, eliminating scratching and smearing caused by these particles. If the specimen is not prepared properly, the microstructure will not be accurately represented.

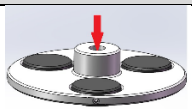
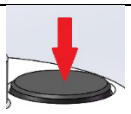
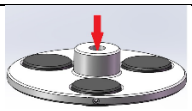
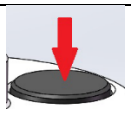
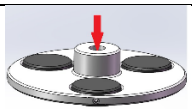
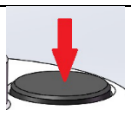
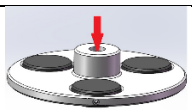


Sectioning:

- MAXCUT Abrasive Blade (Cat. No. MAX-C or MAX-I series)

Mounting:

- Compression Mounting with Phenolic, Epoxy, or Diallyl Phthalate compression mounting resins.

Abrasive / Surface	Lubricant	Force / sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
P120 grit ALO paper* P220 grit ALO paper*	Water	5 – 10 lbs	100 / 100 rpm	Planar (1-min)	N/A	
P500 grit ALO paper P1200 grit ALO paper	Water	5 – 10 lbs	100 / 100 rpm	1-min		
1-µm DIAMAT Diamond on ATLANTIS polishing pad	Water	5 – 10 lbs	100 / 100 rpm	2-min		
0.05-µm Nanometer Alumina on NAPPAD polishing pad	Water	5 – 10 lbs	100 / 100 rpm	1-min		

***Required for central polishing force**

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4.8.3.2 Class 2: Very Soft, Low Ductility Materials (Example: Rhenium)

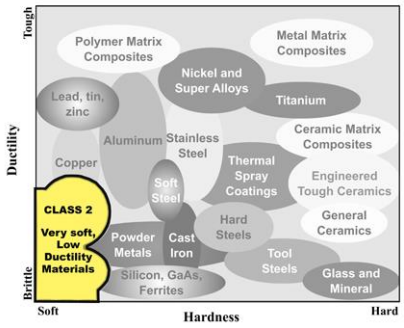
Refractory materials such as Rhenium, Niobium, Tungsten and Molybdenum are very soft. Therefore, any loose or fractured abrasive particles can be easily embedded. This makes specimen preparation very difficult because it will gum up diamond grinding disks or become embedded with fractured SiC particles when ground with SiC papers. The key to preparation of this material is to use the tougher alumina abrasive and to chemically etch the specimen with each grinding step. The purpose of etching is to remove the embedded particles and not carry them over as contamination.

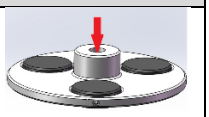
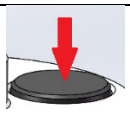
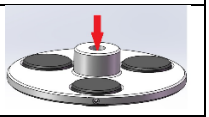
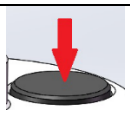
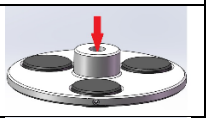
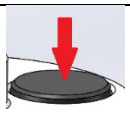
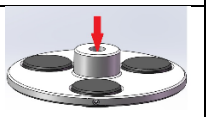
Sectioning:

- MAXCUT Abrasive Blade
  (Cat. No. MAX-C or MAX-I series)

Mounting:

- Compression Mounting with Phenolic, Epoxy or Diallyl Phthalate compression mounting resins.



Abrasive / Surface	Lubricant	Force / sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
P120 grit ALO paper* P220 grit ALO paper*	Water	5 – 10 lbs	100 / 100 rpm	Planar (1-min)	N/A	
P500 grit ALO paper P1200 grit ALO paper	Water	5 – 10 lbs	100 / 100 rpm	1-min		
1-µm DIAMAT Diamond on ATLANTIS polishing pad	Water	5 – 10 lbs	100 / 100 rpm	2-min		
0.05-µm Nanometer Acid Alumina on a BLACKCHEM 2 pad	Polishing with 10% Diluted etchant below: Rhenium: 30-ml lactic acid, 30-ml HNO3 1-ml HF	5 – 10 lbs	100 / 100 rpm	1-min		

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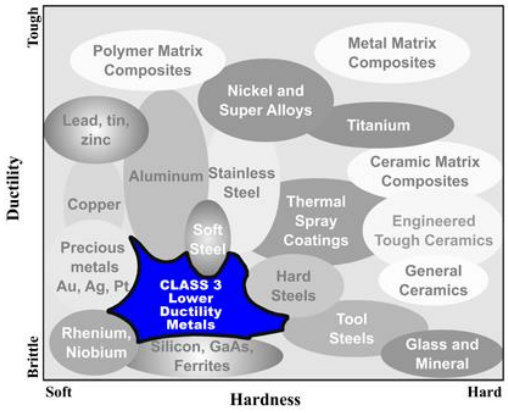
4.8.3.3 Class 3: Lower Ductility Materials (Example: Cast Iron)

Cast Irons are difficult materials to prepare properly because the graphite nodules (or graphite flakes) are easily pulled out during preparation. By minimizing the sectioning damage and by starting with a modest grit size SiC paper, retaining these difficulties can be accomplished.



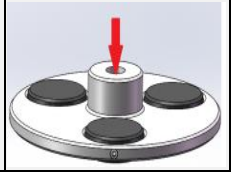
Sectioning:

- MAXCUT Abrasive Blade (Cat. No. MAX-D or MAX-I series)

Mounting:

- Compression Mounting with Phenolic, Epoxy or Diallyl Phthalate compression mounting resins.

Polishing:

Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
120 grit SiC paper* 240 grit SiC paper*	Water	5 – 10 lbs.	200 / 200 rpm	Planar 1-min	N/A	

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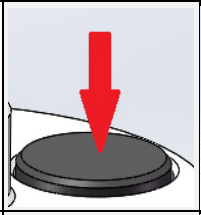
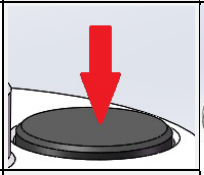
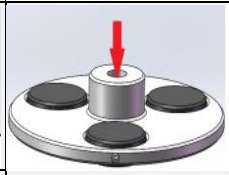
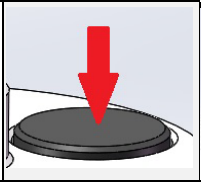
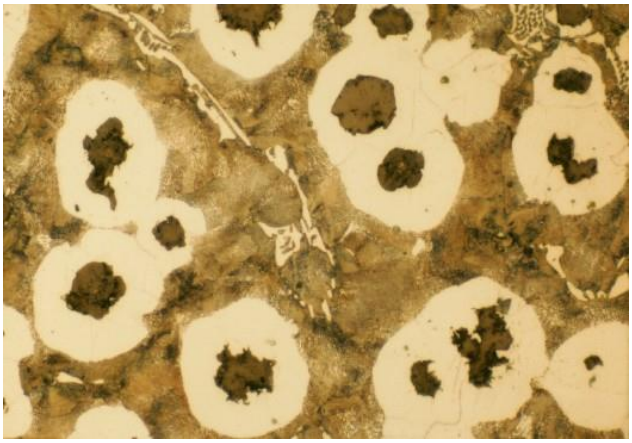
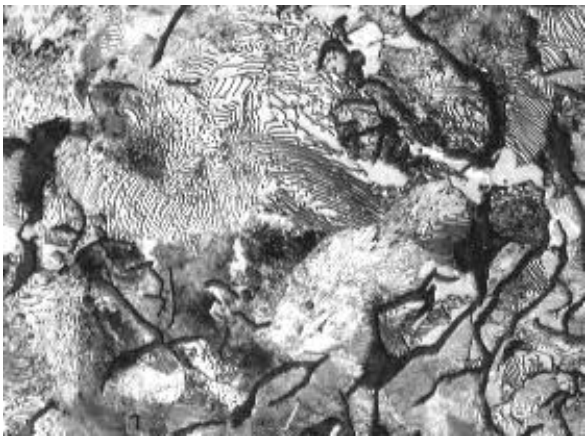
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
360 grit SiC paper 600 grit SiC paper 800 grit SiC paper 1200 grit SiC paper	Water	5 – 10 lbs.	200 / 200 rpm	1-min		
1-µm DIAMAT diamond on GOLDPAD polishing pad	DIALUBE Purple Extender	5 – 10 lbs.	200 / 200 rpm	2-min		
0.05-µm Nanometer Alumina on TRICOTE polishing pad	N/A	5 – 10 lbs.	100 / 100 rpm	30-sec		



Cast Iron 2% Nital Etchant
100X (DIC)



Graphite Cast Iron 2% Nital Etchant
500X

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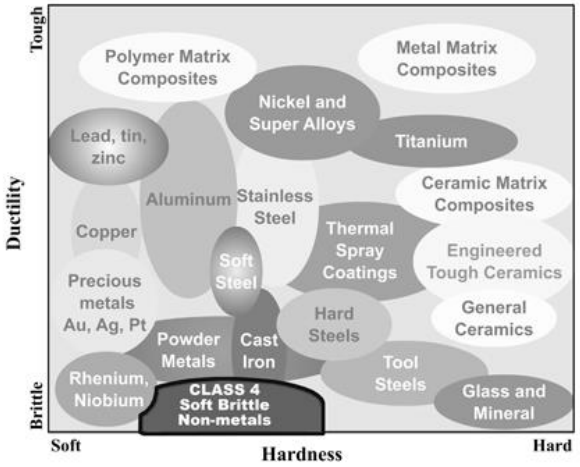
4.8.3.4 Class 4: Soft, Brittle, Non-Metals (Example: Silicon Substrate Electronic)



Specimen preparation of friable or brittle materials such as silicon offer a microstructural preparation challenge. Proper microstructural preparation of these materials must minimize fracturing the silicon structure. This is accomplished by first cutting or sectioning with fine grit / low concentration diamond blades. Oftentimes, microelectronic cross sections are not encapsulated and just mounted using a hot-melt tape. If the specimens are encapsulated, a castable mounting compound such as an acrylic or an epoxy is recommended. Initial grinding and polishing with diamond lapping films is required to prevent undue damage to the silicon during grinding. Rough polishing is accomplished on low-napped polishing cloths using diamond, with final polishing for a very short time on a high-napped cloth using colloidal silica.

Sectioning:

- Diamond Wafering Blade – Fine Grit / Low Concentration

Mounting:

- Hot melt tape or castable mounting with Epoxy or Acrylic resins.

Polishing:

Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode

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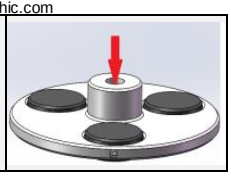
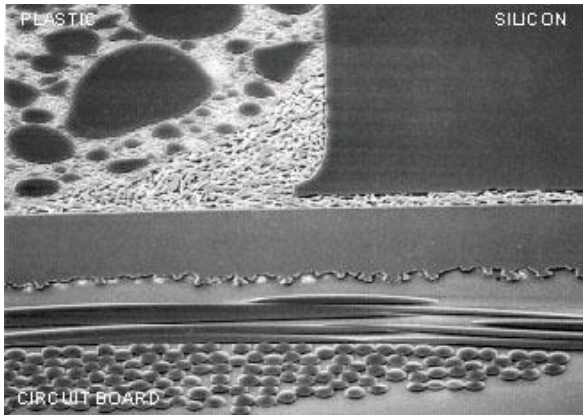
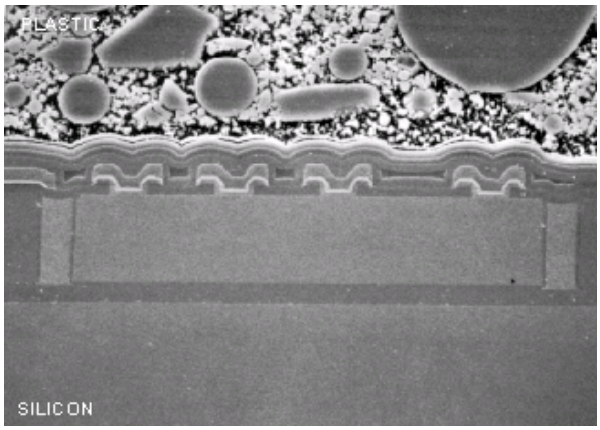
3-µm Diamond Lapping Film*	POLYLUBE Diamond Extender	5 – 10 lbs.	200 / 200 rpm	Planar	N/A	

***Required for central polishing force**



Electronic Package



Electronic Package

4.8.3.5 Class 3: Medium Hard, Ductile Metals (Example:

Stainless steels have high concentrations of chromium (>12%) and are generally relatively soft compared to heat treated steels. This makes stainless steel more susceptible to smearing. Preparation is relatively straight forward.

Sectioning:

- Diamond Wafering Blade – Fine Grit / Low Concentration

Mounting:

- Hot melt tape or castable mounting with Epoxy or Acrylic resins.

Polishing:

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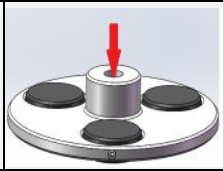
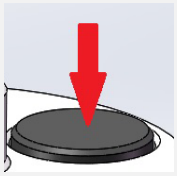
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode

***Required for central polishing force**

Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
120 grit SiC paper* 240 grit SiC paper*	Water	5 – 10 lbs.	200 / 200 rpm	Planar 1-min	N/A	
360 grit SiC paper 600 grit SiC paper 800 grit SiC paper 1200 grit SiC paper	Water	5 – 10 lbs.	200 / 200 rpm	1-min		

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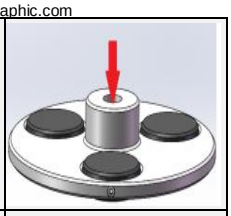
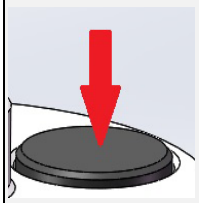
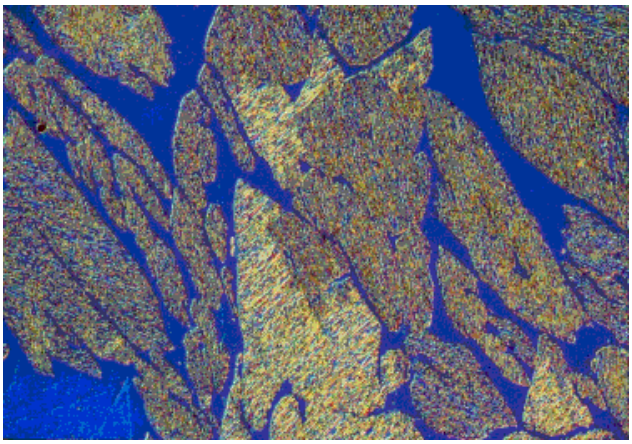
1-µm DIAMAT diamond on GOLDPAD polishing pad	DIALUBE Purple Extender	5 – 10 lbs.	200 / 200 rpm	2-min		
0.05-µm Nanometer Alumina on TRICOTE polishing pad	N/A	5 – 10 lbs.	100 / 100 rpm	30-sec		



431 Series Stainless Steel etched with Modified Murakamis 400X

300 Series Stainless Steel etched with Oxalic Acid 200X (BF)

4.8.3.6 Class 6: Tough, Hard Non-Ferrous Metals (Example: Iron-Cobalt-Nickel Alloys)

Please read this instruction manual carefully and follow

Superalloys are high-performance alloys which exhibits excellent mechanical strength and creep resistance at high temperatures, good surface stability, and corrosion and oxidation resistance. The base elements in superalloys are nickel, cobalt, and nickel-

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Sectioning:

- MAXCUT Abrasive blade (Cat. No. MAX-C or MAX-I series)

Mounting:

- Compression Mounting with Phenolic, Epoxy or Diallyl Phthalate compression mounting resins.

Polishing:

Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
120 grit SiC paper* 240 grit SiC paper*	Water	5 – 10 lbs.	200 / 200 rpm	Planar 1-min	N/A	

***Required for central polishing force**

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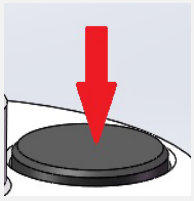
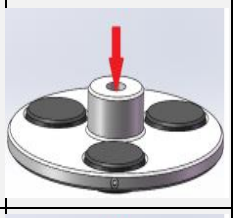
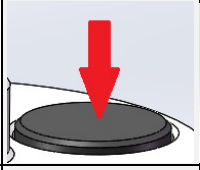
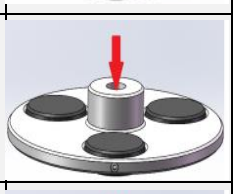
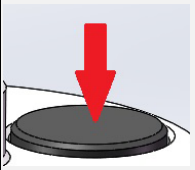
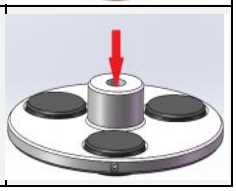
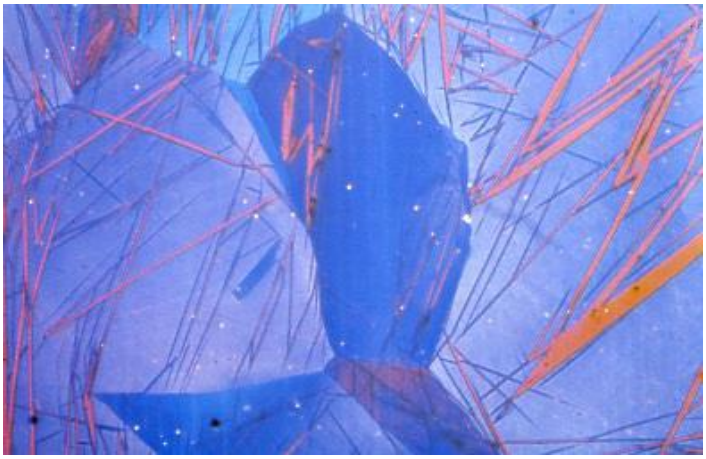
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
360 grit SiC paper 600 grit SiC paper	Water	5 – 10 lbs.	200 / 200 rpm	1-min		
9-µm DIAMAT diamond on POLYPAD polishing pad	DIALUBE Purple Extender	5 lbs.	200 / 200 rpm	3-min		
6-µm DIAMAT Diamond on TEXTPAN polishing pad	DIALUBE Purple Extender	5 lbs.	200 / 200 rpm	3-min		



Fe-Ni-Co-Al Alloy
400X (Polarized Light)

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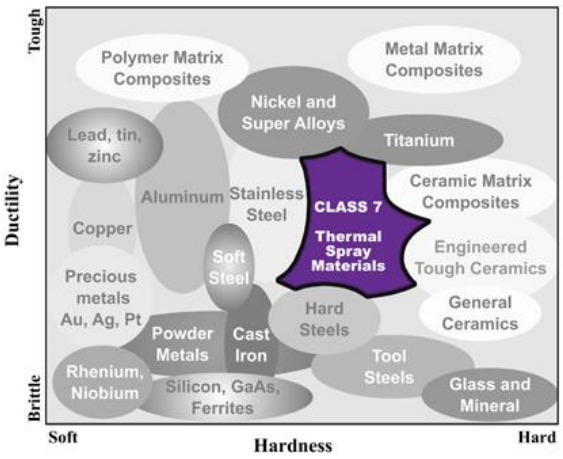
4.8.3.7 Class 7: Thermal Spray Coating (Example: Nickel-Aluminum)

The metallographic specimen preparation of nickel-aluminum thermal spray coatings is relatively straight forward. Microstructural features of interest include porosity, flow, thickness, and inclusions. Since these materials can have inclusions and particles, vibratory polishing with NANOMETER alumina for several minutes can significantly clean up any remaining surface damage.



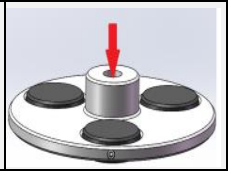
Sectioning:

- MAXCUT Abrasive blade (Cat. No. MAX-E or MAX-I series) (if required)

Mounting:

- Compression Mounting fine EPOCOMP Epoxy compression mounting resins.

Polishing:

Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
240 grit SiC paper*	Water	5 – 10 lbs.	200 / 200 rpm	Planar	N/A	

***Required for central polishing force**

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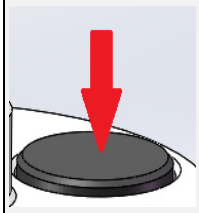
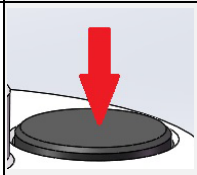
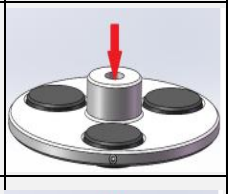
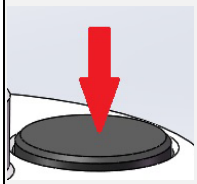
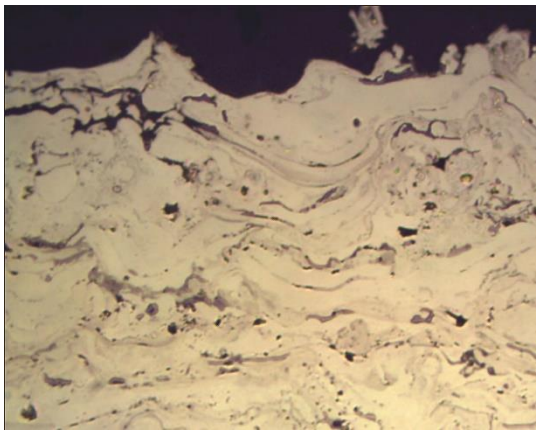
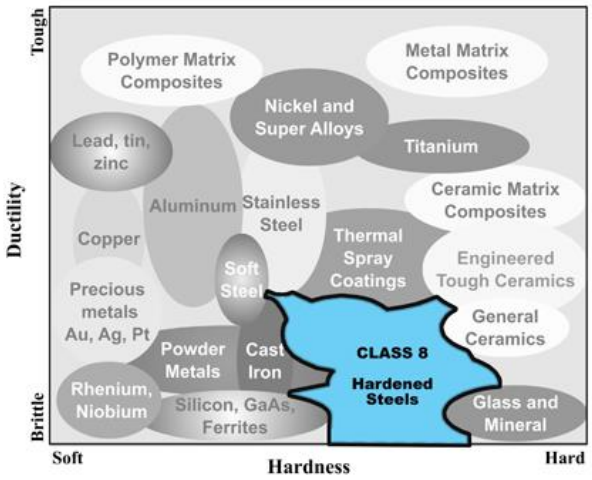
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
360 grit SiC paper 600 grit SiC paper 800 grit SiC paper 1200 grit SiC paper	Water	5 – 10 lbs.	200 / 200 rpm	1-min		
3-µm DIAMAT Diamond on GOLDPAD polishing pad	DIALUBE Purple Extender	10 lbs.	200 / 200 rpm	2-min		
1-µm DIAMAT Diamond on ATLANTIS polishing pad	SIAMAT Colloidal Silica	10 lbs.	200 / 200 rpm	2-min		
0.05-µm NANOMETER Alumina on MICROPAD polishing pad	Vibratory Polishing			15-30 min	N/A	N/A



Nickel-aluminum Thermal Spray Coating, as polished
500X (BF)

4.8.3.8 Class 8: Hardened and Heat-Treated Steels (Example: Nitrided Steel)

Nitriding is a heat-treating process used for producing a very hard case (Vickers 1100) and is typically used to produce hard, strong, tough steels. The process involves heating the steel to 500-540°C (930-1000°F) in an atmosphere of ammonia gas for about 50 hours. No further quenching or heat treatment is required. The case depth is about 0.4-mm. Nitrided surfaces can also improve corrosion resistance.



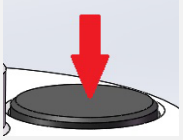
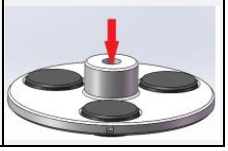
Sectioning:

- MAXCUT Abrasive Blade (Cat. No. MAX-E or MAX-V series)

Mounting:

- Compression Mounting with Phenolic, Epoxy or Diallyl Phthalate compression mounting resins.

Polishing:

Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
120 grit SiC paper* 240 grit SiC paper*	Water	5 – 10 lbs.	200 / 200 rpm	Planar 1-min	N/A	
360 grit SiC paper 600 grit SiC paper	Water	5 – 10 lbs.	200 / 200 rpm	1-min		

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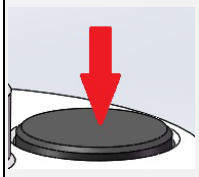
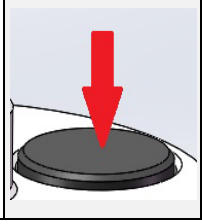
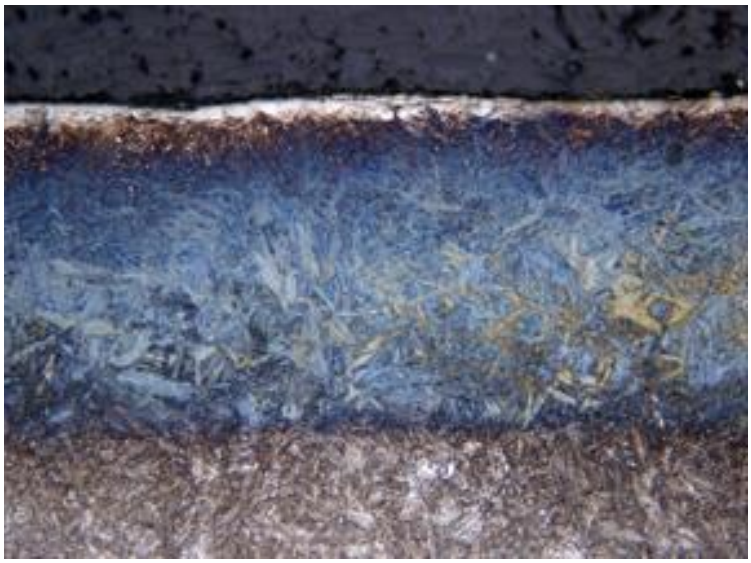
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
9-µm DIAMAT Diamond on POLYPAD polishing pad	DIALUBE Purple Extender	5 lbs.	200 / 200 rpm	3-min		
***Required for central polishing force** Diamond on TEXTPAN polishing pad	Purple Extender	5 lbs.	200 / 200 rpm	3-min		



Nitrided Steel, Picral Etchant
200X (BF)

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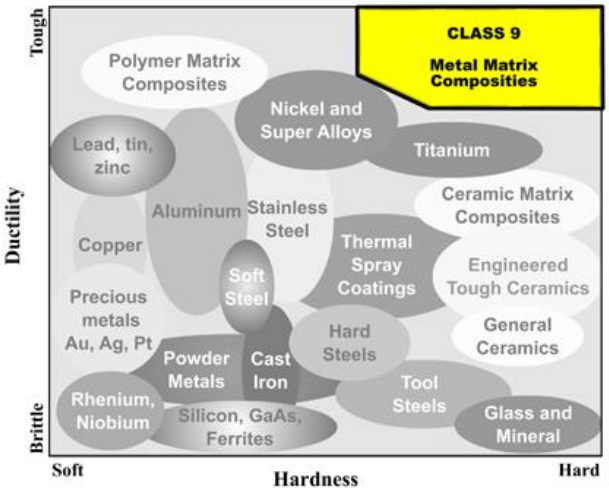
4.8.3.9 Class 9: Metal Matrix Composites (MMCs) (Example: SiC Particles in Aluminum Matrix)



Hard particles in a metal matrix can be difficult to microstructurally prepare because of particle pull-out as well as excessive relief between the particles and the matrix. The key to preparation of metal matrix composites (MMCs) is to minimize damage at each preparation stage. This includes sectioning with the appropriate diamond wafering blade and using the finest practical abrasive for initial grinding.
Polishing with SIAMAT colloidal silica provides chemical-mechanical polishing (CMP) action which is the most effective means for eliminating both surface and subsurface damage. The combination of SIAMAT colloidal silica with DIAMAT polycrystalline diamond also produces the required surfaces finishes in a minimal amount of time.

Sectioning:

- Diamond Wafering Blade - Medium Grit / Low Concentration

Mounting:

- Castable Mounting with Epoxy or Acrylic resins.

Polishing:

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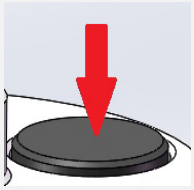
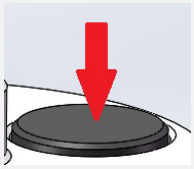
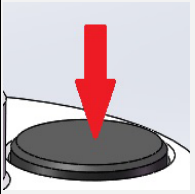
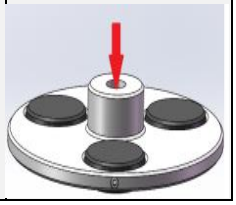
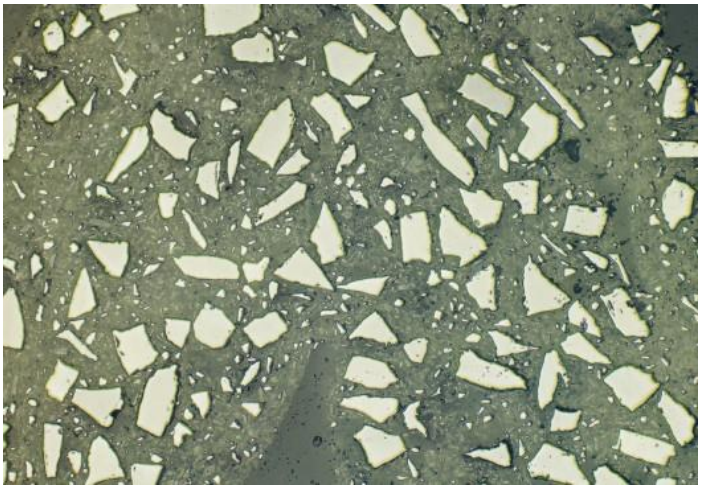
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
30-µm DIAMAT Diamond Suspension on CERMESH Metal mesh cloth	N/A	5 – 10 lbs.	200 / 200 rpm	5-min		
9-µm DIAMAT diamond on POLYPAD polishing pad	DIALUBE Purple Extender	5 – 10 lbs.	200 / 200 rpm	5-min		
3-µm DIAMAT Diamond on GOLDPAD or ATLANTIS polishing pad	N/A	5 – 10 lbs.	200 / 200 rpm	5-min		



SiC Particles in an Aluminum Matrix 400X (DIC)

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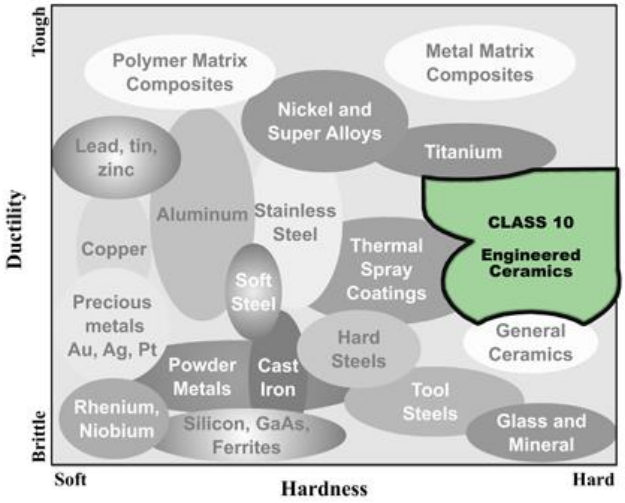
4.8.3.10 Class 10: Engineered Ceramics (Example: Alumina and Sapphire Ceramic)



The preparation of hard / brittle / porous ceramic materials is not especially difficult with a few simple preparation tricks. First, to minimize grain pull-out (or fracturing in single crystals) which may be falsely characterized as porosity, sectioning damage must be minimized. This is accomplished by sectioning with the appropriate diamond wafering blade and using the finest practical abrasive for initial grinding. Planar grinding is best achieved with the use of as small a diamond abrasive as possible on a metal mesh cloth. Note: there is a trade-off between planar grinding time (abrasive size) and induced damage. In some cases, for ceramics, it is better to take more time and minimize damage at planar grinding in order to reduce overall polishing times. The use of SIAMAT colloidal silica also provides chemical-mechanical polishing (CMP) action which is the most effective means for eliminating both surface and subsurface damage. The combination of SIAMAT colloidal silica with DIAMAT polycrystalline diamond also produces the required surfaces finishes.

Sectioning:

- Diamond Wafering Blade - Medium Grit / Low Concentration

Mounting:

- Castable Mounting with Epoxy or Acrylic resins.

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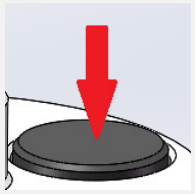
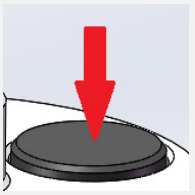
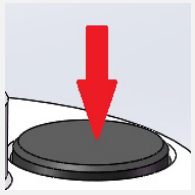
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
70-micron Diamond grinding disk*	Water	5 – 10 lbs.	200 / 200 rpm	Planar	N/A	
30-µm DIAMAT Diamond Suspension on CERMESH Metal mesh cloth	N/A	5 – 10 lbs.	200 / 200 rpm	5-min		
6-µm DIAMAT Diamond on TEXTPAN polishing pad	SIAMAT Colloidal Silica	10 lbs.	200 / 200 rpm	5-min		
1-µm DIAMAT Diamond on GOLDPAD or ATLANTIS polishing pad	SIAMAT Colloidal Silica	10 lbs.	200 / 200 rpm	5-min		

99+% Alumina, Thermally Etched 5000X

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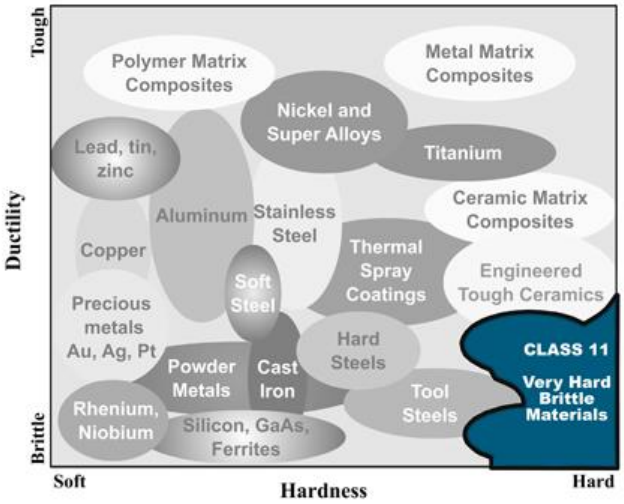
4.8.3.11 Class 11: Glass and Minerals (Example: Alumino-silicate Glass Ceramic)



Glass ceramics are unique materials that have very small crystalline structures. The primary advantage of glass ceramics is that they produce very interesting thermochemical properties because they are impervious to thermal shock.

Proper microstructural preparation of these materials require minimizing damage during cutting or sectioning. Therefore, the most important step in the preparation of glass ceramics is sectioning. If the glass ceramic is chipped or excessively cracked during sectioning, it may be impossible to remove this damage. Wafer sectioning with a fine grit diamond wafering blade is essential.

Planar grinding is accomplished with diamond on a metal mesh cloth to minimize cracking and subsurface damage. For rough polishing, the use of a low-napped polishing pad with polycrystalline diamond and colloidal silica eliminates most of the surface and subsurface damage. Final polishing is accomplished with a resilient porous urethane polishing pad such as BLACKCHEM 2 using SIAMAT colloidal silica.

Sectioning:

- Diamond Wafering Blade - Medium Grit / Low Concentration

Mounting:

- Castable Mounting with Epoxy or Acrylic resins.

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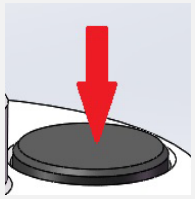
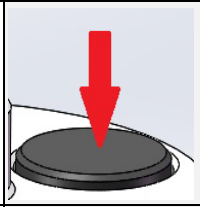
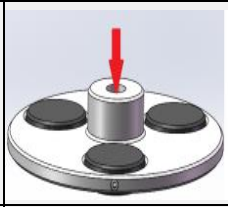
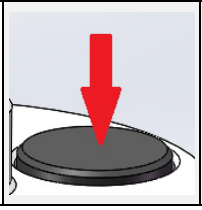
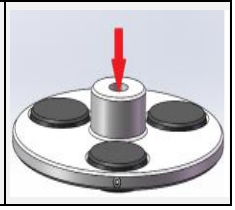
Abrasive / Surface	Lubricant	Force / Sample	Speed (Head / Base)	Time	Individual Force Mode	Central Force Mode
70-micron Diamond grinding disk*	Water	5 – 10 lbs.	200 / 200 rpm	Planar	N/A	
30-µm DIAMAT Diamond Suspension on CERMESH Metal mesh cloth	N/A	5 – 10 lbs.	200 / 200 rpm	5-min		
6-µm DIAMAT Diamond on TEXTPAN polishing pad	SIAMAT Colloidal Silica	10 lbs.	200 / 200 rpm	5-min		
1-µm DIAMAT Diamond on GOLDPAD or ATI ANTIS polishing	SIAMAT Colloidal Silica	10 lbs.	200 / 200 rpm	5-min		

***Required for central polishing force**

Alumino-silicate Glass Ceramic
400X (Polarized Light)

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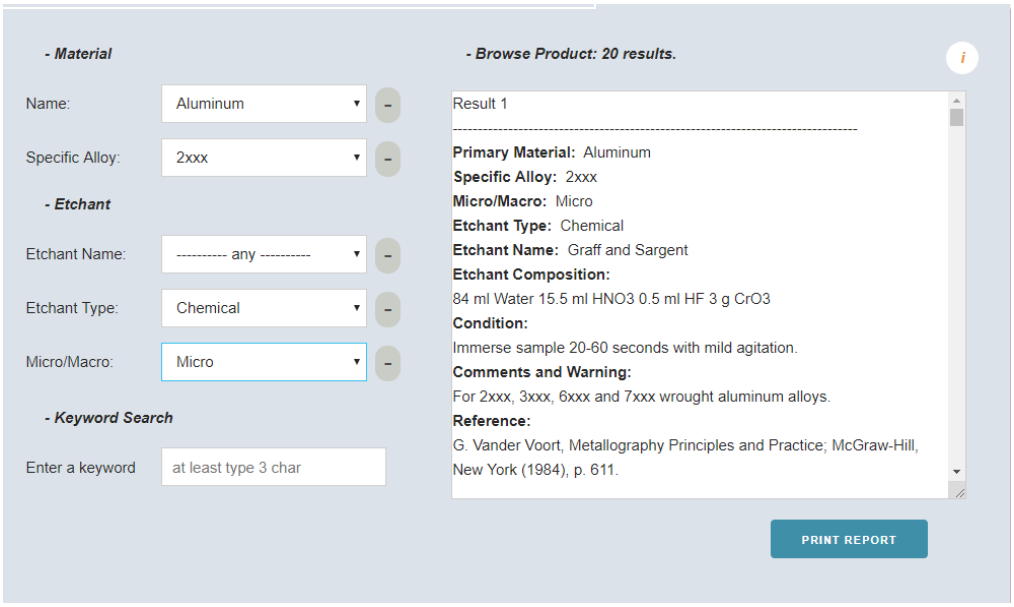
Educational Etchant Database online at:
https://database.metallographic.com/pace-etchant.php

Etchant Database

- Over 2200 etchants
- Search fields
    1) Material or metal type
    2) Specific alloys
    3) Etchant name
    4) Micro vs Macro etchant
    5) Keyword
- MSDS for etchant chemicals



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5.0 Maintenance

5.1 Introduction

- The ***NANO-1200S*** requires very minimal maintenance. However, to increase the life of the polisher, it is suggested that the unit be rinsed after use.
- Periodic testing of the E-Stop is also recommended to ensure a safe working environment.

5.2 Cleaning Outside Cover

- The cover should be cleaned occasionally with a moistened cloth.
- Do not use any chemicals or cleaning abrasives.

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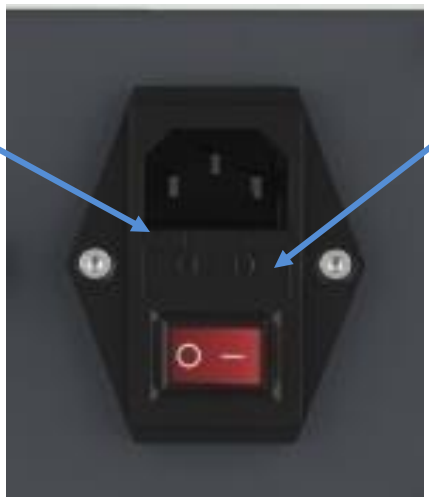
6.0 Troubleshooting

More extensive troubleshooting, repair guides, videos, & parts list are provided online at https://metallographic.com and on the *NANO-1200S* service page.

Problem	Cause	Solution
No power or function	a. Unit is disconnected from the main electrical power supply	a. Verify the electrical source and connection
	b. Main power switch is off	b. Turn on the main power switch
	c. Blown fuse	c. Replace fuse
	d. Emergency stop is depressed	e. Twist emergency stop to deactivate
No water supply	a. Water valve is closed	a. Open water valve
	b. Water tube is bent	b. Straighten out water tube
Working wheel is not running flat	a. Dirt trapped (abrasive between working wheel and carrier wheel)	a. Clean or replace if necessary

Pry open fuse holder with a small flat-head screwdriver



Replace fuse
(10 Amp Fast-blow)

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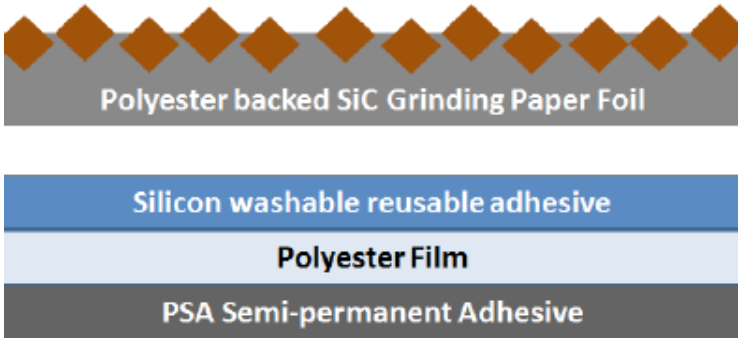
7.0 Metallographic Consumables

- **7.0.1 SiC Grinding Papers**
  Silicon Carbide Grinding papers are the most reliable and easy to use method for grinding most metals and alloys. SiC papers produce maximum efficiency (cut-rate, stock removal, and minimal damage) because new abrasive is exposed as the old abrasive breaks down.

- **7.0.2 Grinding Foils (Alternative to PSA backed adhesive papers)**
  As an alternative to PSA (pressure-sensitive adhesive) backed silicon carbide papers, PACE Technologies offers non-PSA-backed abrasive grinding foils. Grinding foils utilize a polyester film backing which attaches to a reusable/washable silicon adhesive receiver disk. The grinding foils are a great lower-cost alternative to PSA-backed grinding papers.

- **7.0.3 Diamond MD Grinding Disks**
  Diamond Grinding Disks are commonly used for the initial grinding of many materials; however, they are particularly useful for initial grinding of ceramics and glass materials. With the additional MD (magnetic base) system, these surfaces are easily changed for fast and easy grinding.

- **7.0.4 Composite Grinding Disks**
  Composite grinding disks are an alternative to intermediate grinding and polishing on pads. These disks are reusable and are charged with a diamond slurry. Proper use of composite disks can result in superior edge flatness and reduced consumables cost.



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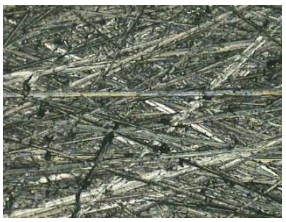
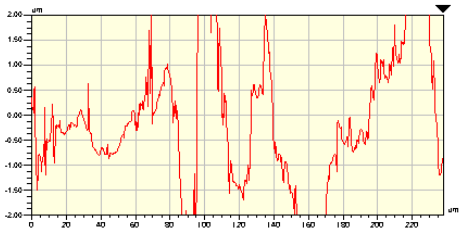
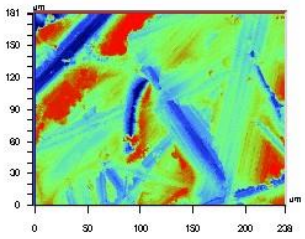
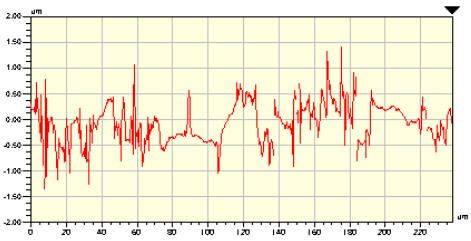
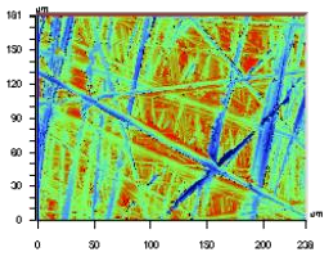
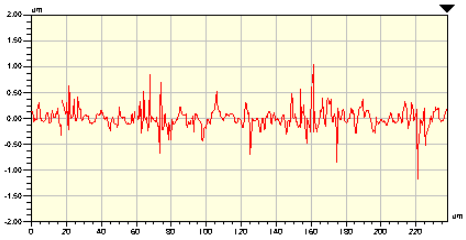
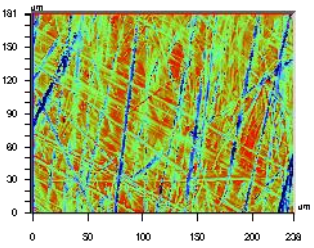
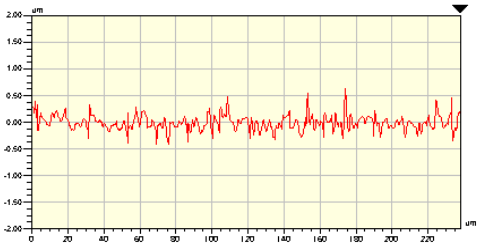
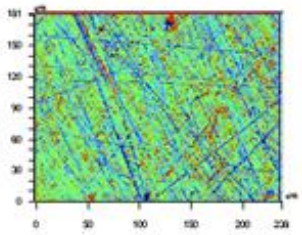
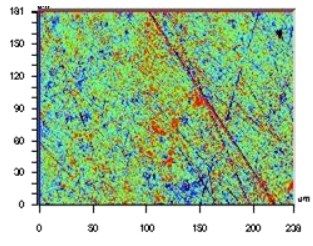
Abrasive / Surface	2-D Line Profile	3-D Optical Contour Mapping
60-Grit SiC 		
240-Grit SiC 		
400-Grit SiC 		
600-Grit SiC 		
1200-Grit SiC 		

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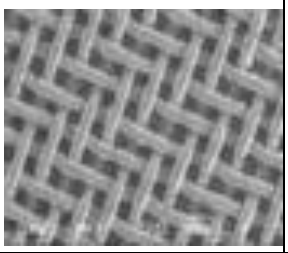
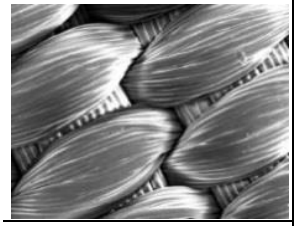
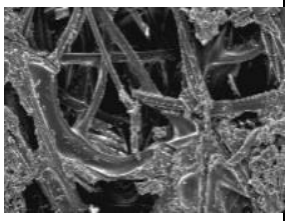
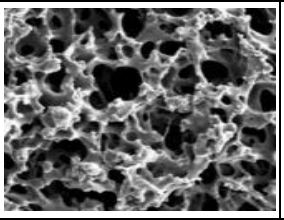
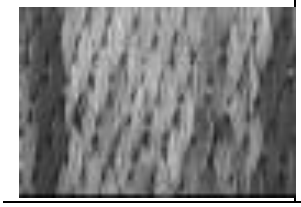
7.3 Polishing Pads

SEM Photograph	Polishing Pad Abrasive Application	Macro Image
	**CERMESH™ Metal Mesh Pad** is a wire-mesh surface useful for coarse and intermediate lapping/polishing. The texture of this wire allows for the abrasive to become semi-fixed, thus offering the advantage of increased stock removal while minimizing damage.	
	**POLYPAD™ Polishing Pad** is a very tightly woven and rugged polishing pad for intermediate polishing which provides good removal and flatness.	
	**TEXPAN™ Polishing Pad** is commonly used as an intermediate polishing pad for metals and ceramics. It is low-napped for superior edge retention.	
	**BLACK CHEM™ 2 Polishing Pad** is a porometric polymer pad that has a consistency similar to a porous rubber type of pad. It has a low nap and is widely used for chemical-mechanical polishing (CMP).	
	**DACRON® 2 Polishing Pad** is a low-napped polishing pad for polishing primarily with 1 – 9 micron diamond abrasives. It is also a very effective pad for coarser alumina abrasives.	
	**NYPAD™ Polishing Pad** is a low-napped silk polishing pad for intermediate polishing primarily with mid-sized intermediate diamond abrasives.	

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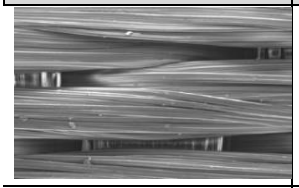
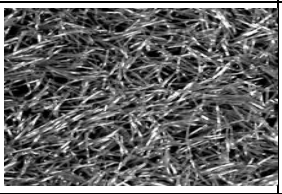
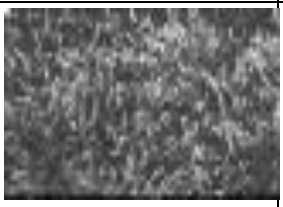
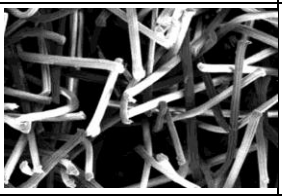
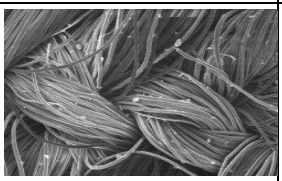
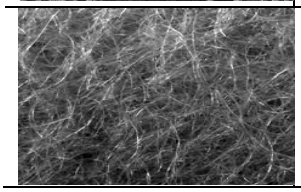
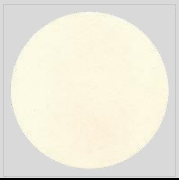
SEM Photograph	Polishing Pad Abrasive Application	Macro Image
	**GOLD PAD Polishing Pad** is a low-napped polishing pad for intermediate polishing primarily with 1 - 3-micron diamond abrasives.	
	**ATLANTIS Polishing Pad** is a low-napped intermediate polishing pad for most metals. It is a stacked pad for better contouring to the specimen surface with minimal relief.	
	**MICROPAD™ Polishing Pad** is the most common high-napped final polishing pad for metals and polymers. The high nap provides a very soft and gentle polishing action.	
	**TRICOTE™ Polishing Pad** is a tight high-napped final polishing pad for most metals. It has a tighter nap than the MICROPAD™ polishing pads.	
	**NAPPAD™ Polishing Pad** is another high-napped final polishing pad useful for most metals and polymers. It is especially useful for very soft materials such as aluminum and copper.	
	**MOLTEC™ 2 Polishing Pad** - is a natural (wool) pad used for final polishing.	
	**FELT PAD** - is a thick felt pad for polishing glass and large surface area parts (sapphire windows, etc.)	

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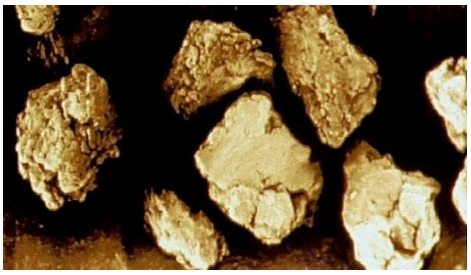
7.4 Polycrystalline Diamond Abrasives

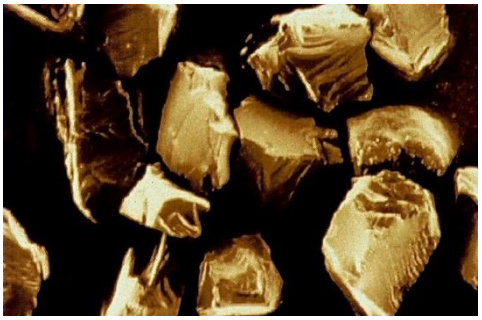
Polycrystalline diamond is a synthetic diamond which provides better surface finishes and higher removal rates than monocrystalline diamond. The following are advantages of polycrystalline diamond over monocrystalline diamond:

- Higher removal rates (self-sharpening abrasive)
- Very uniform surface finish
- More uniform particle size distribution
- Harder / tougher particles
- Blocky shaped particles
- Hexagonal microcrystallites (equally hard in all directions)
- Extremely rough surface (more cutting points)
- Surface area is 300% greater than with a microcrystalline diamond
- No abrasion-resistant directionality (abrasion is independent of particle orientation)

Diamond Size (µm)	Color Code
0.10	Charcoal
0.25	Gray
0.50	**White**
1.0	Blue
3.0	Green
6.0	Yellow
9.0	Red
15	Brown
30	Orange
45	Purple



Polycrystalline Multifaceted Diamond



Monocrystalline Blocky Diamond

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7.5 Final Polishing Abrasives

Final polishing abrasives include fine diamond, alumina, and colloidal silica. For successful microstructural preparation, the polishing abrasive / cloth combination must be appropriately matched to the specimen hardness, fracture toughness, and corrosion properties of the specimen.

Colloidal Silica

- Colloidal silica is a relatively soft abrasive with high chemical activity. It is an ideal chemical-mechanical polishing (CMP) abrasive. The chemical activity of colloidal silica results from the electrochemical balance (zeta potential ζ) required to keep very fine particles from aggregating. This chemical balance also produces a surface phenomenon which makes the specimen surface more chemically active. This produces a surface layer which can be mechanically removed by the colloidal silica particles themselves, or by the mechanical scrubbing of the surface with the polishing pad.

- For ceramics, the combination of fine polycrystalline diamond and colloidal silica improves surface finishes and increases polishing rates.

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Nanometer Alumina

- Nanometer alumina is polycrystalline colloidal alumina processed by a proprietary seeded gel process. Polycrystalline alumina offers two significant improvements over conventional alumina calcining processes:

    1) Tighter, more controlled particle size distributions

    2) Harder alpha alumina particles

- The tighter, more controlled particle size distribution is a result of less particle aggregation which produces significantly less scratching in soft metals such as aluminum, tin, lead, copper, and soft steels.

- Nanometer alumina is available in an acidic (pH 4) or basic (pH 10) range.

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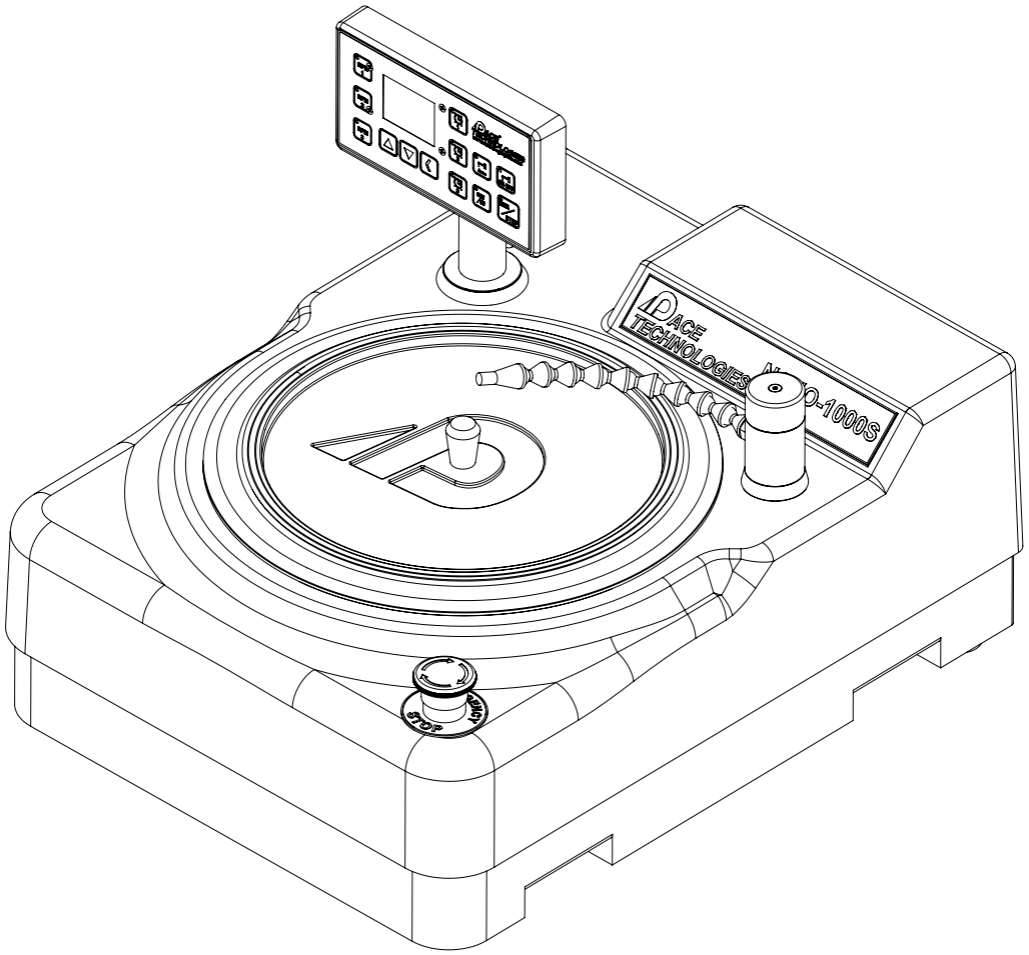
8.0 Mechanical and Electrical Drawings

8.1 Assembly Drawings



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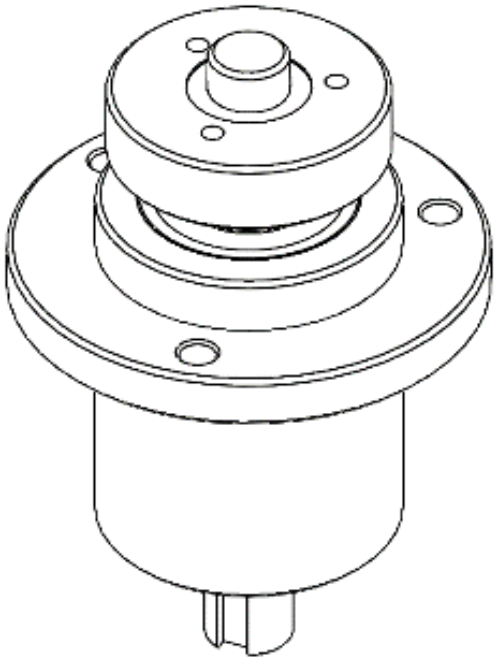
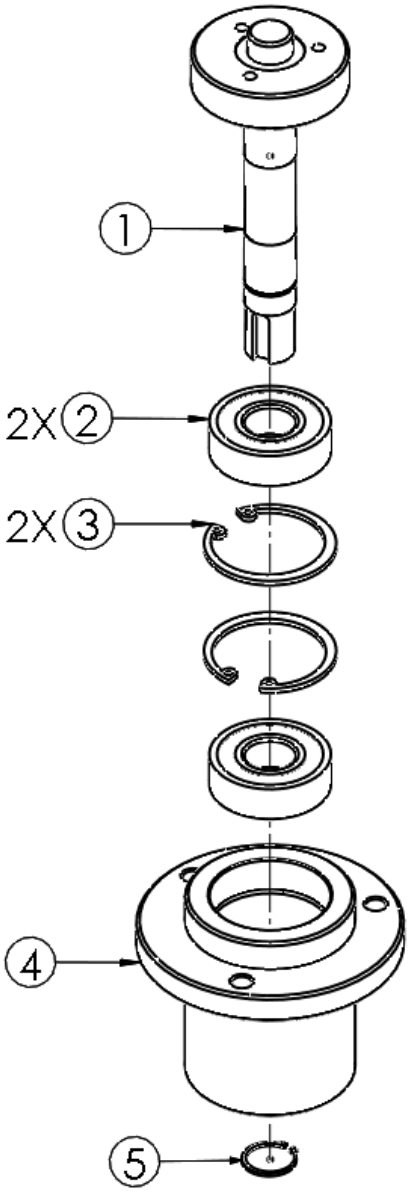
Bearing Housing Assembly





ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	N1S-SA-B	Wheel Shaft	1
2	BB-17-40	NANO 1000S Housing Bearing	2
3	SN-IN-40	Hole Jump Ring ¢40, 304	2
4	N1S-SA-A	Bearing Shaft Housing	1
5	SN-EX-17	Bearing Jump Ring ¢17, 304	1

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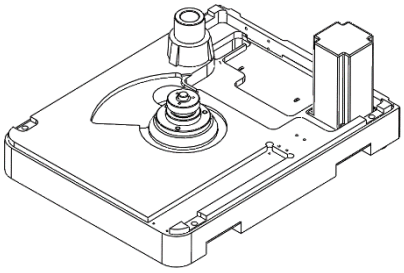
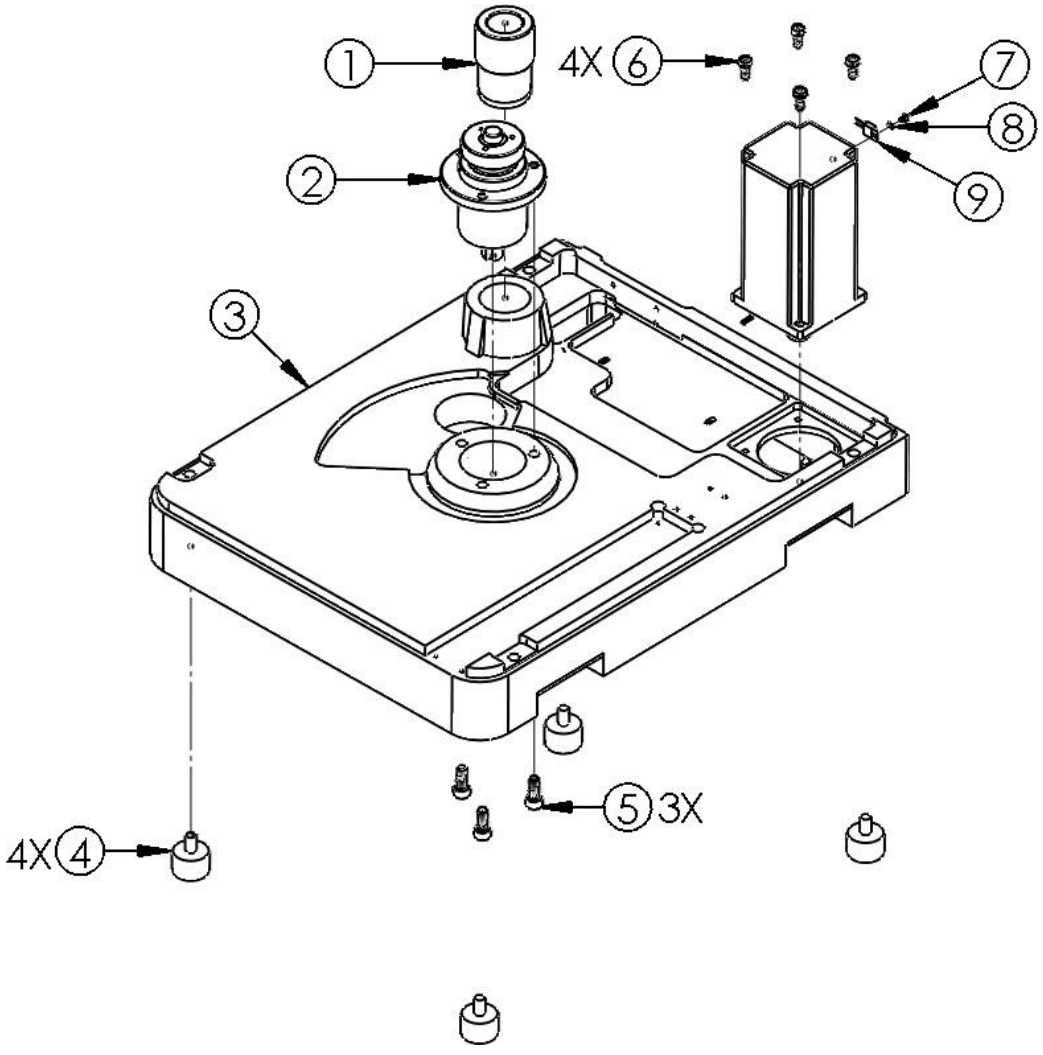


NOTES:

-APPLY LOCTITE 243 THREADLOCKER TO PART 5.



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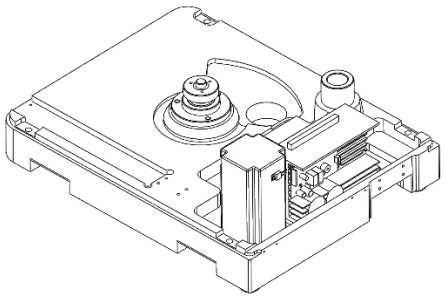
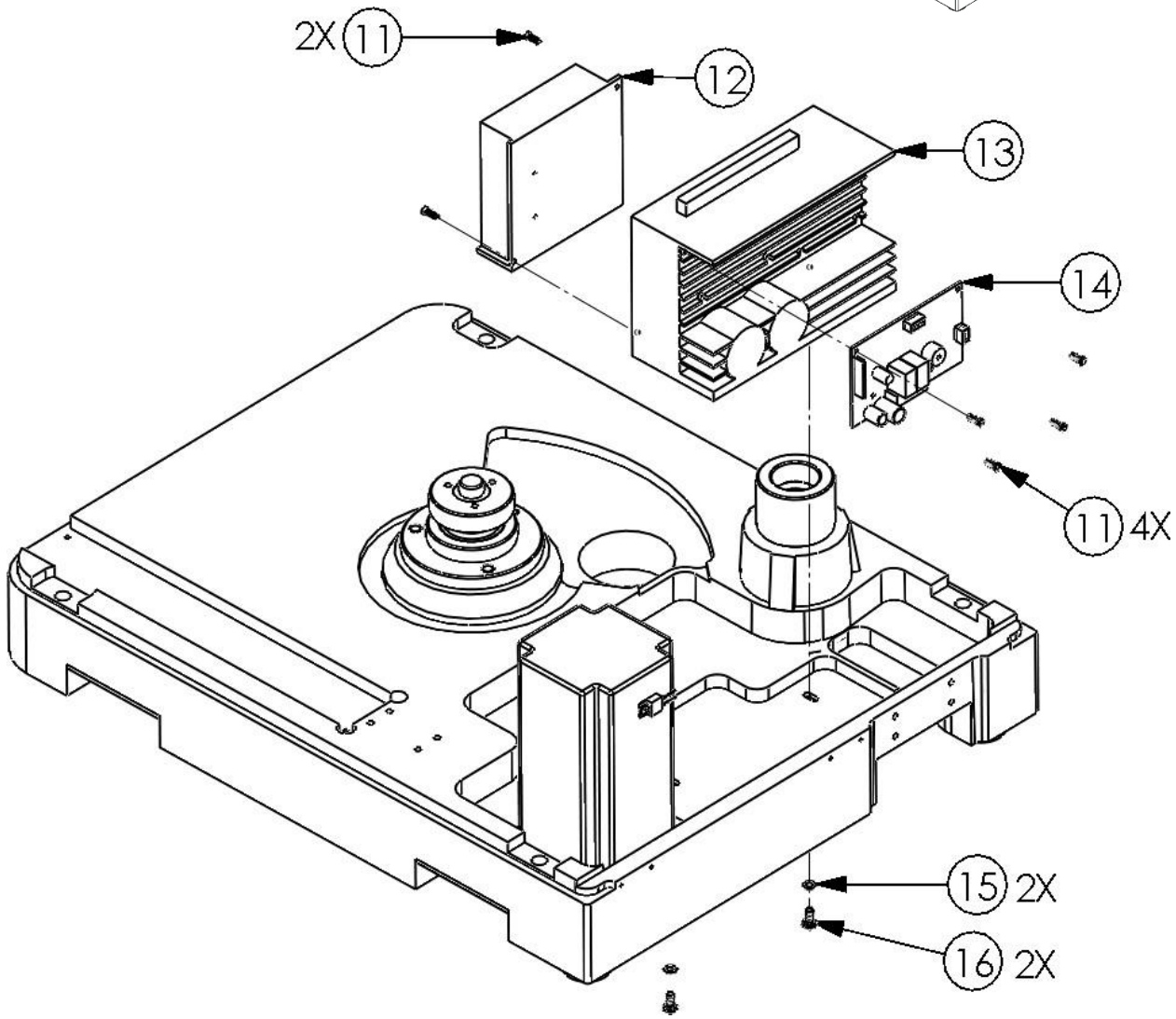


NOTES:-WIRE MACHINE AFTER COMPLETING STEPS.



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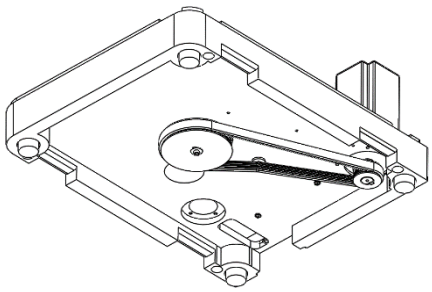
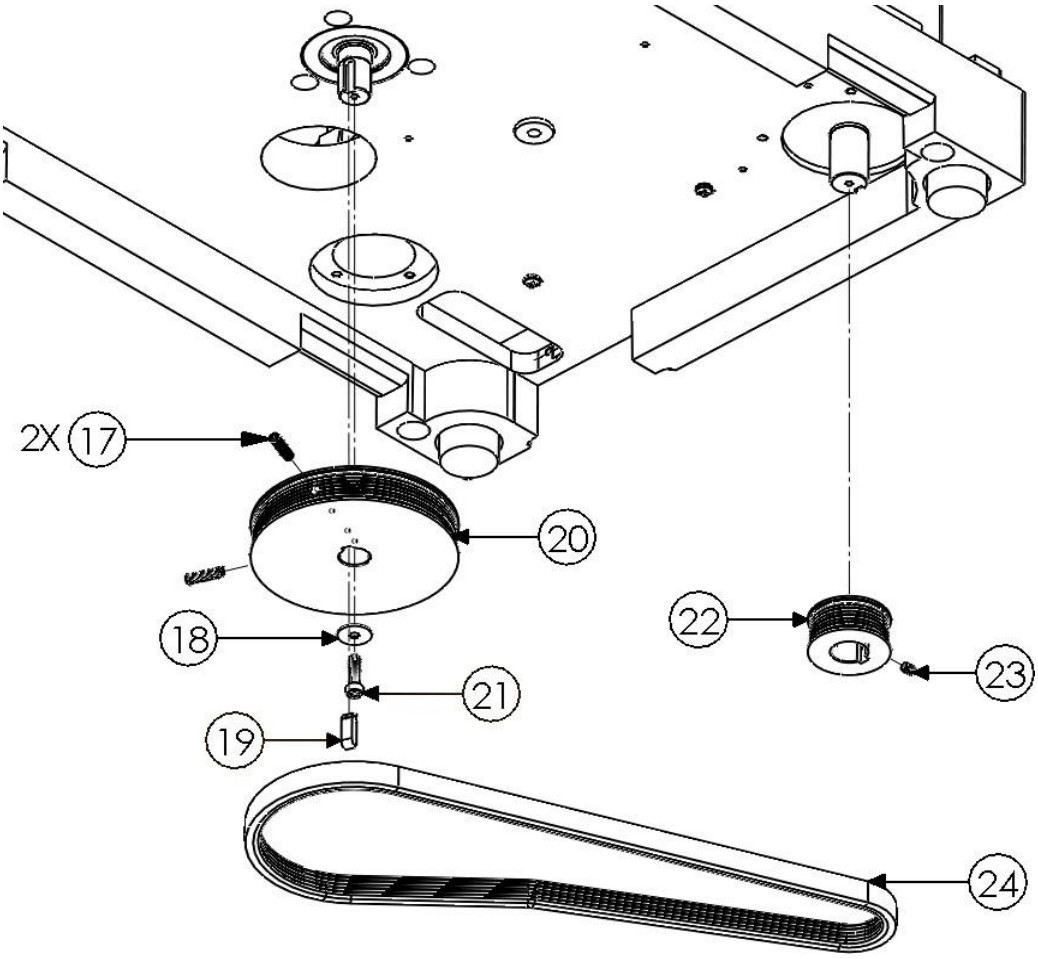
NOTES:

-LEVEL PULLEYS WITH FLAT BAR TO ENSURE ALLIGNMENT.

- APPLY LOCTITE 243 THREADLOCKER TO PARTS 17 AND 23.





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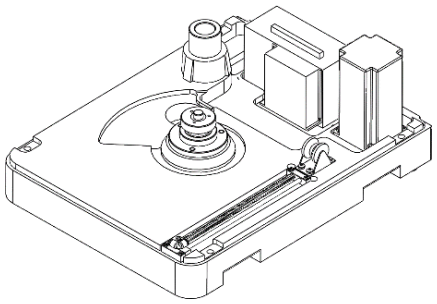

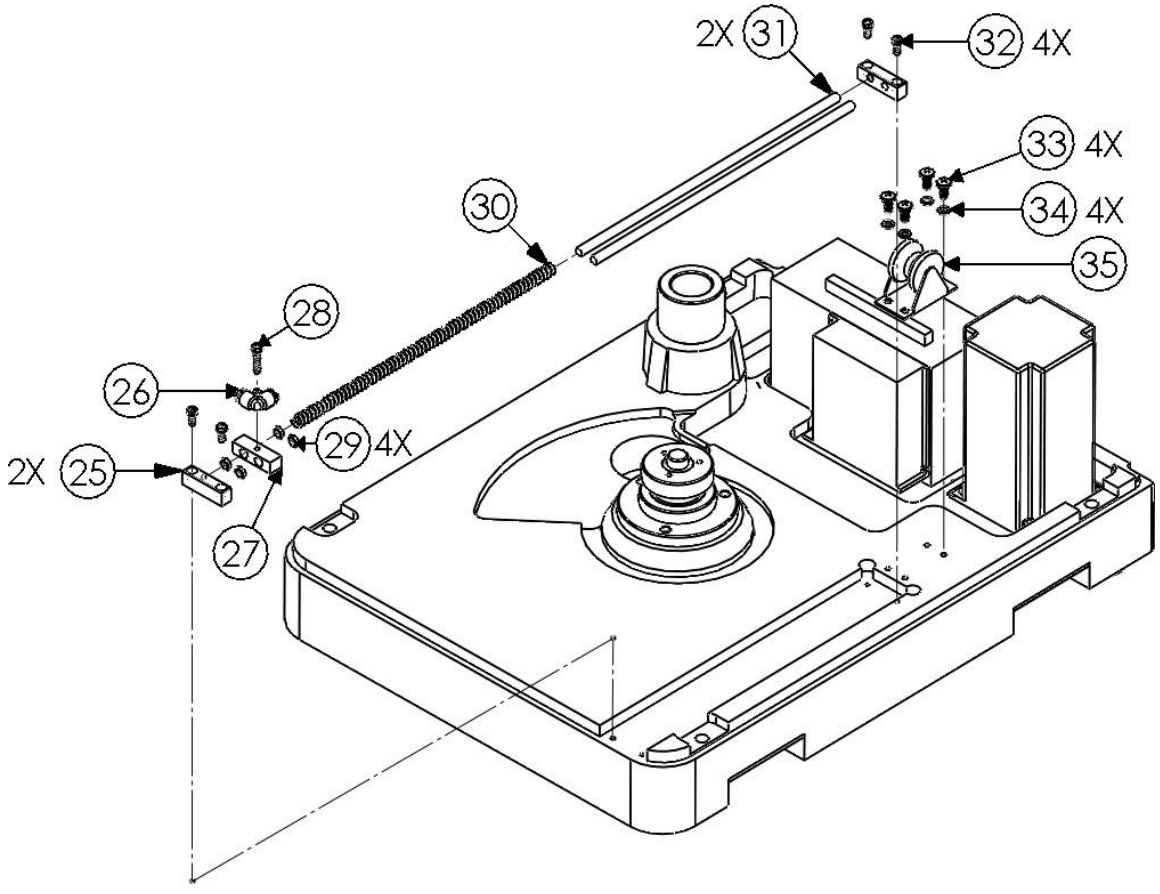

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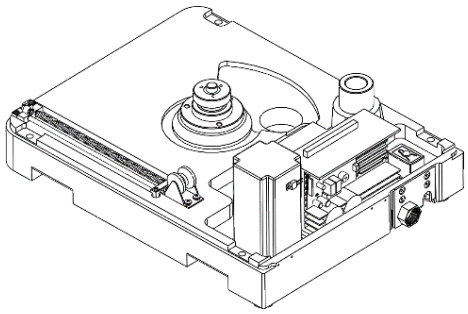
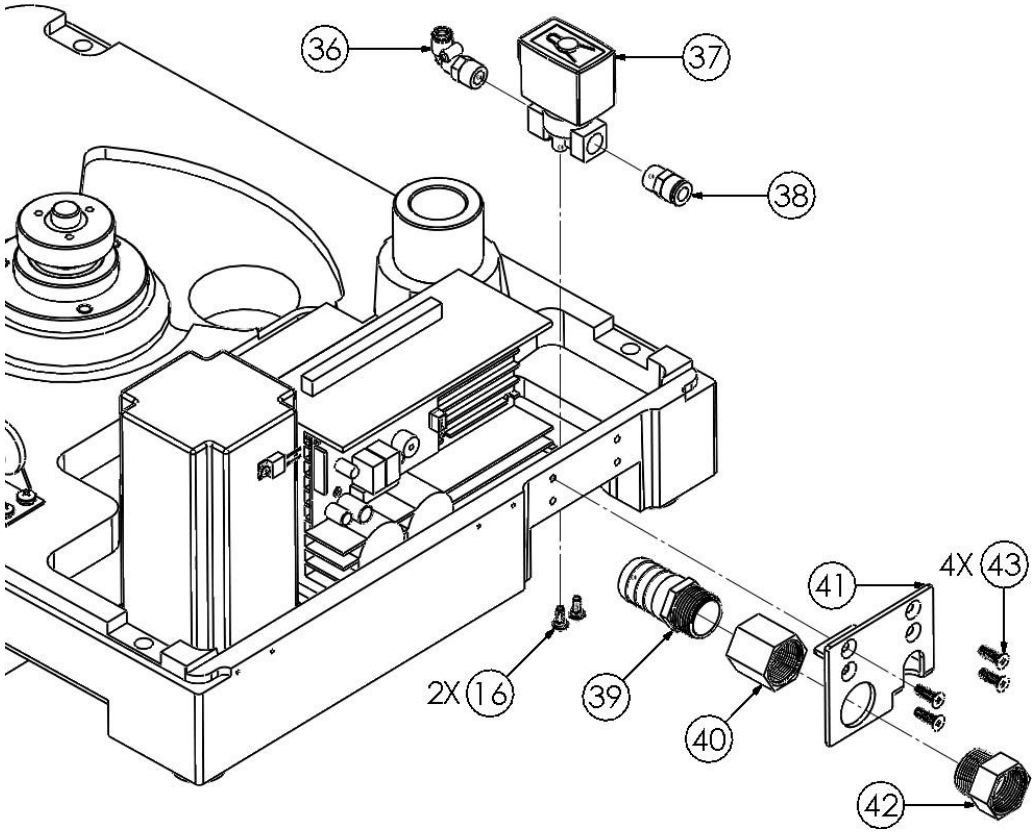
NOTES:

-INSTALL SOLENOID (ITEM 37 AFTER FASTENING ITEM 41.

-INSTALL SOLENOID WITH WIRES FACING THE OOPOSITE WAY OF BACK PANEL.

-TEFLON MALE THREADS FOR ITEMS 36, 38, 39 AND 42.





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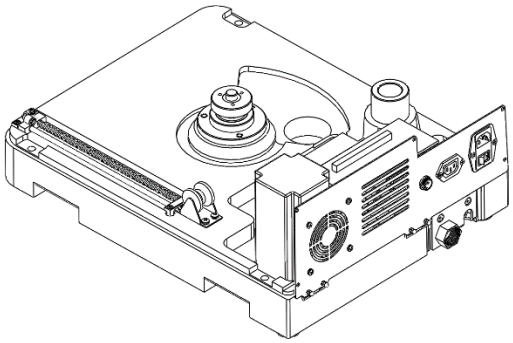

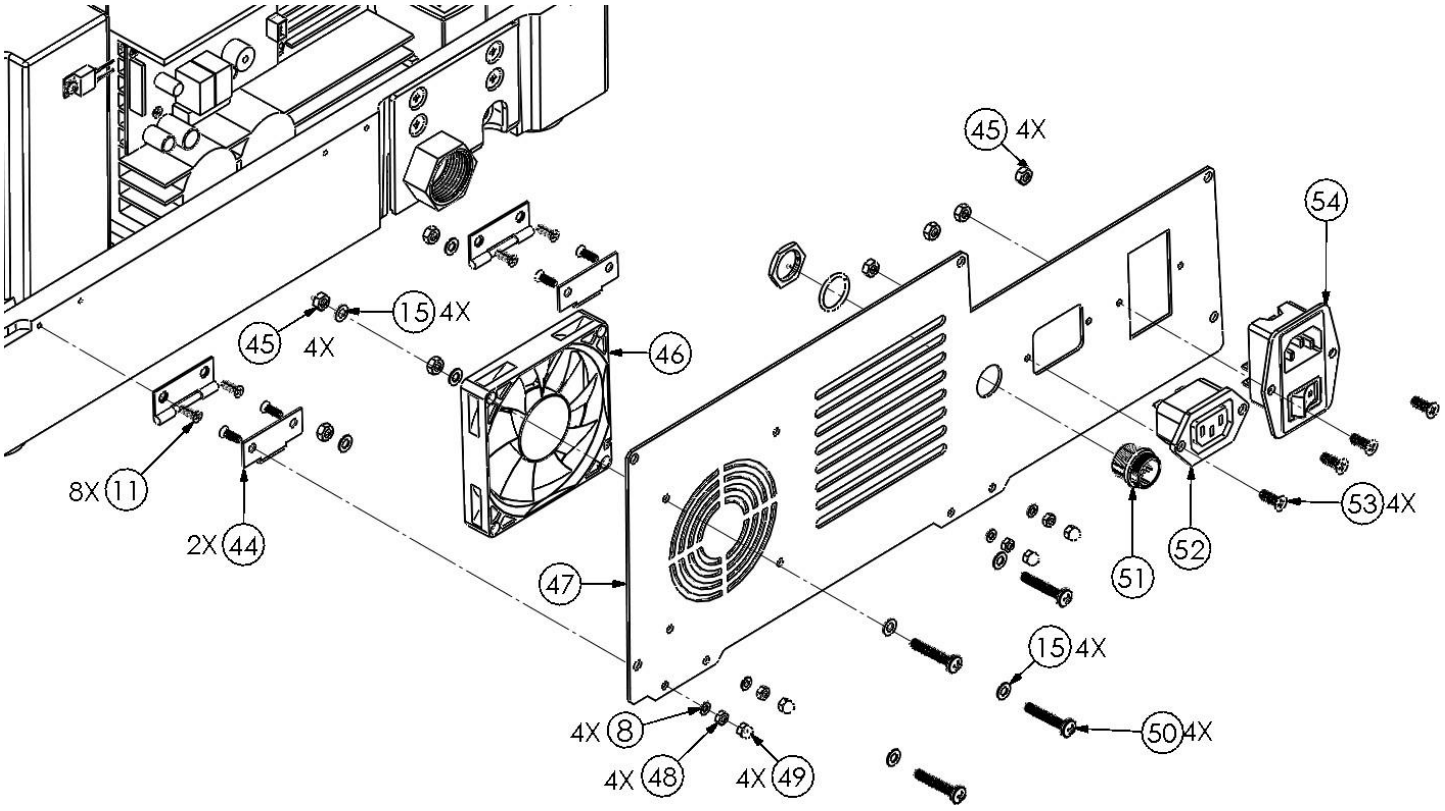

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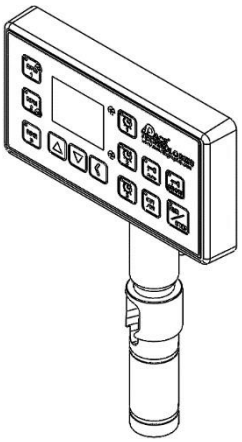
Control Panel

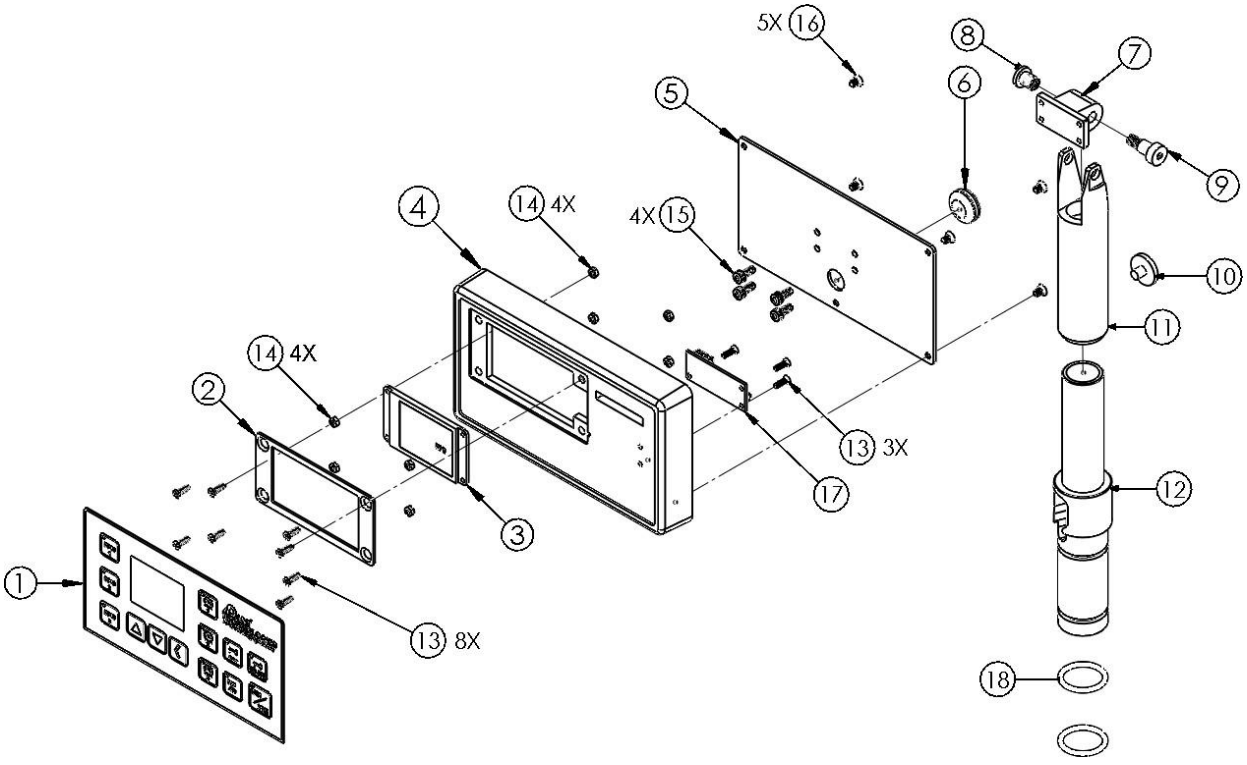


NOTES:

-RUN CABLE FROM ITEM 1 THROUGH ITEM 4 AND SOLDER IT TO ITEM 17.

-CABLE RUNS THROUGH ITEM 10 THEN THROUGH ITEMS 11 AND 12.

-PART LIST ON NEXT PAGE.



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ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	NANOS-T	NANO 1000S Screen Template	1
2	N1S-SCA-E	NANO 1000S Control Box PCB Adapter	1
3	SCR-2-inch	NANO 1000S 2.2in LCD Screen	1
4	N1S-SCA-D	NANO-1000/2000S FRP Screen Box	1
5	N1S-SCA-F	NANO 1000S Control Box Back Metal Panel	1
6	N1S-SCA-G	NANO 1000S Protective Ring	1
7	N1S-SCA-C	NANO-1000/2000S Control Box Back Metal Mount	1
8	NUT-8-M6-10	Nut for Control Rear Plate and Post M6*10*8	1
9	SCREW-8-M6-10	Screw for Control Rear Plate and Post 8*M6*10	1
10	Stock	Screw M6*10 ¢20	1
11	N1S-SCA-B	NANO 1000S Screen Post Sleeve	1
12	N1S-SCA-A	NANO 1000S Fixed Screen Post	1
13	Stock	M3 0.5 x 10mm Flat Head	11
14	Stock	M3 Hex Nut	4
15	Stock	M4 0.7 x 10mm Allen Bolt	4
16	Stock	M4 0.7 x 6mm Flat Head	5
17	NANO-SCR-PCB	NANO Controller PCB	1
18	Stock	NANO Controller O-ring	2

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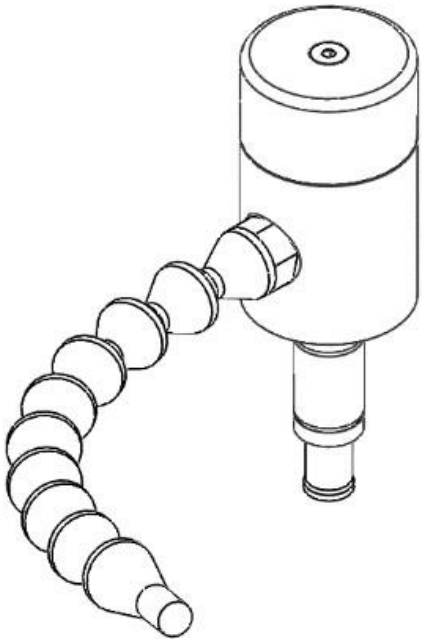
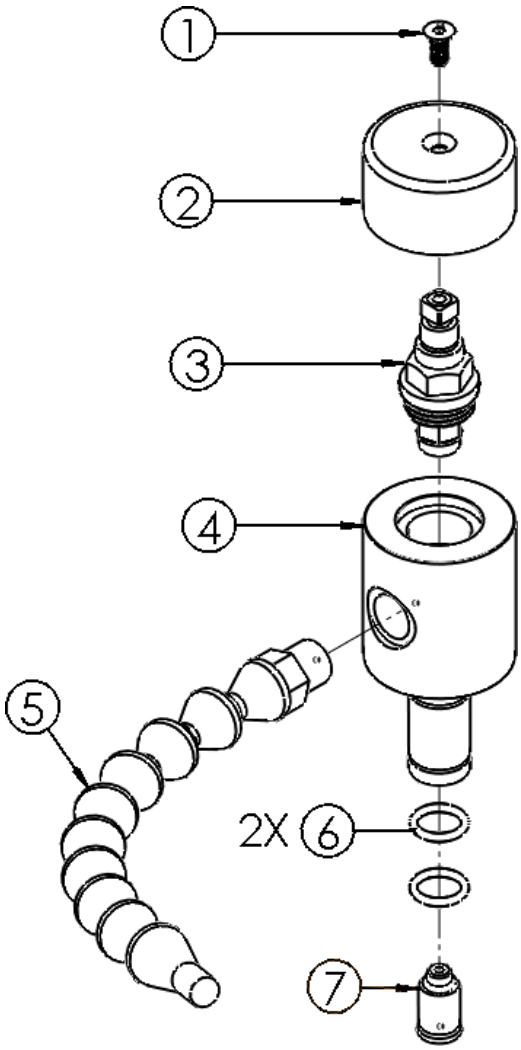
Faucet





ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Stock	M4 0.7 x 10mm Flat Head	1
2	P-FAUCET-A	Faucet Cap	1
3	P-FAUCET-G	Faucet Valve	1
4	P-FAUCET-B	NANO-1000/2000S Faucet Body	1
5	P-FAUCET-D	Faucet Plastic Flex Hose-Black and G1/4	1
6	P-FAUCET-H	Faucet O-rings: ID:13mm, D:1.0mm	2
7	PTC-M6-M-6MM	M6-6 Fitting	1

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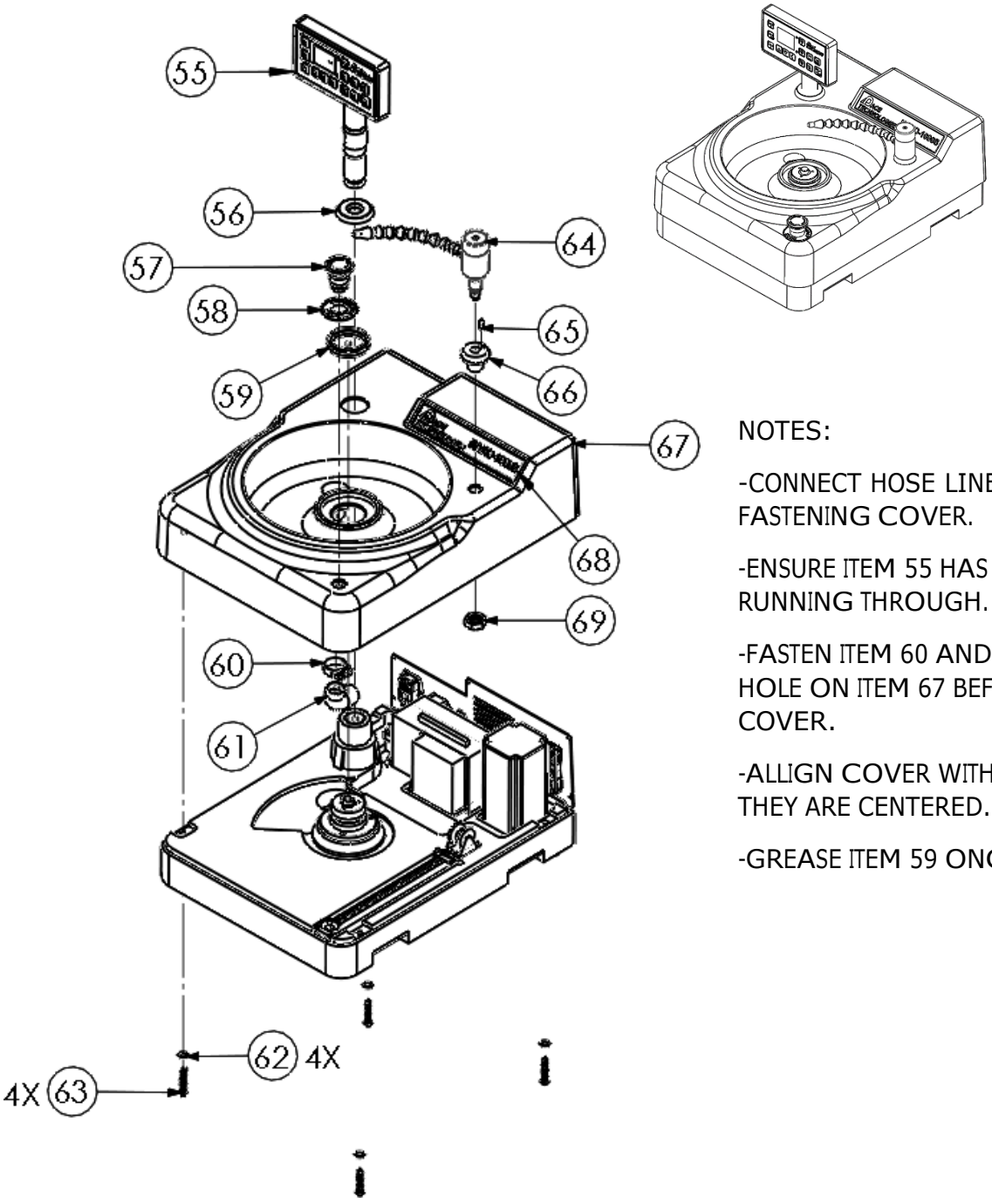

NOTES:

-CONNECT HOSE LINE BEFORE FASTENING COVER.

-ENSURE ITEM 55 HAS ITS WIRE RUNNING THROUGH.

-FASTEN ITEM 60 AND 61 TO DRAIN HOLE ON ITEM 67 BEFORE FASTENING COVER.

-ALLIGN COVER WITH ITEM 59 SO THEY ARE CENTERED.

-GREASE ITEM 59 ONCE INSTALLED.

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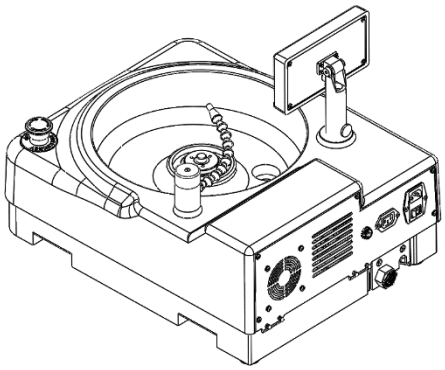

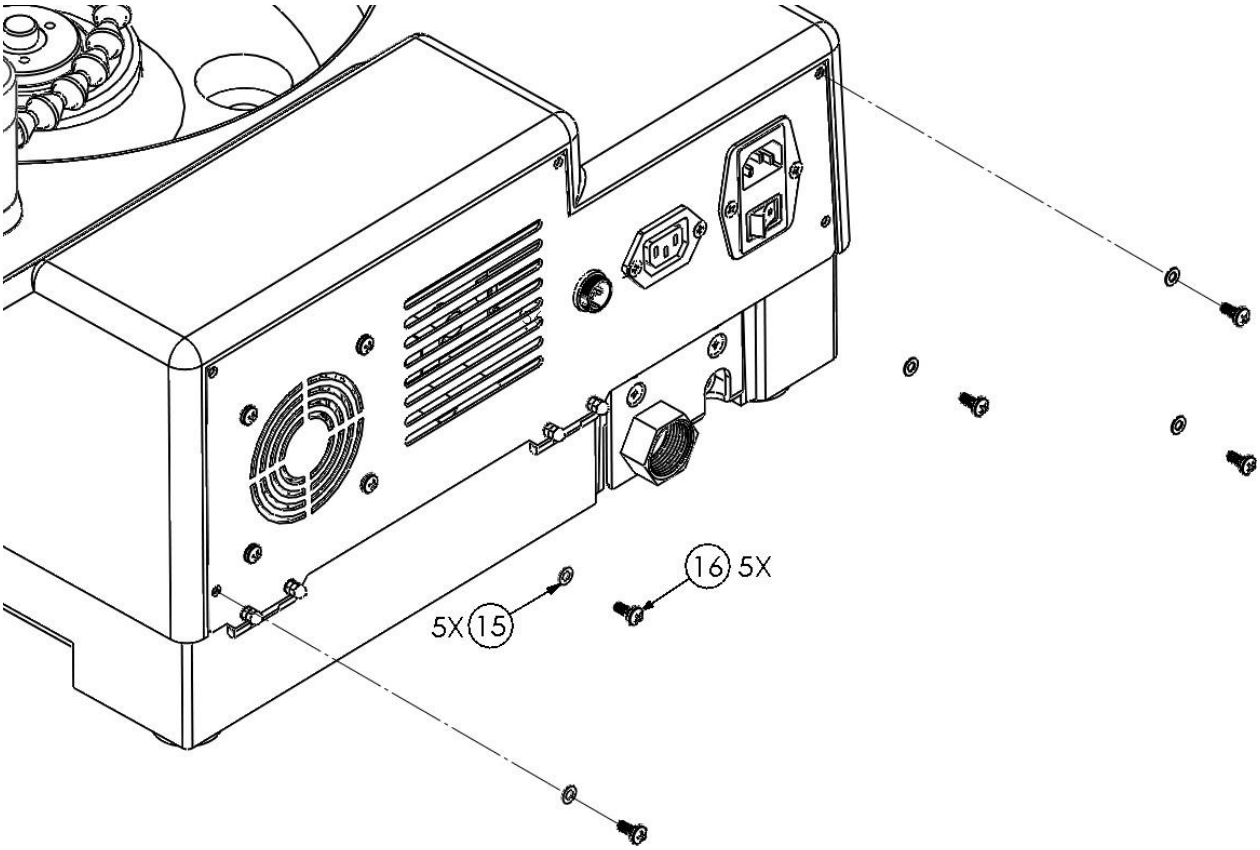

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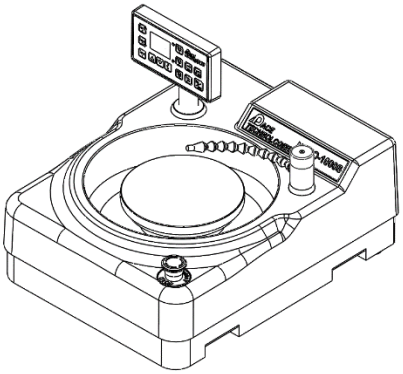

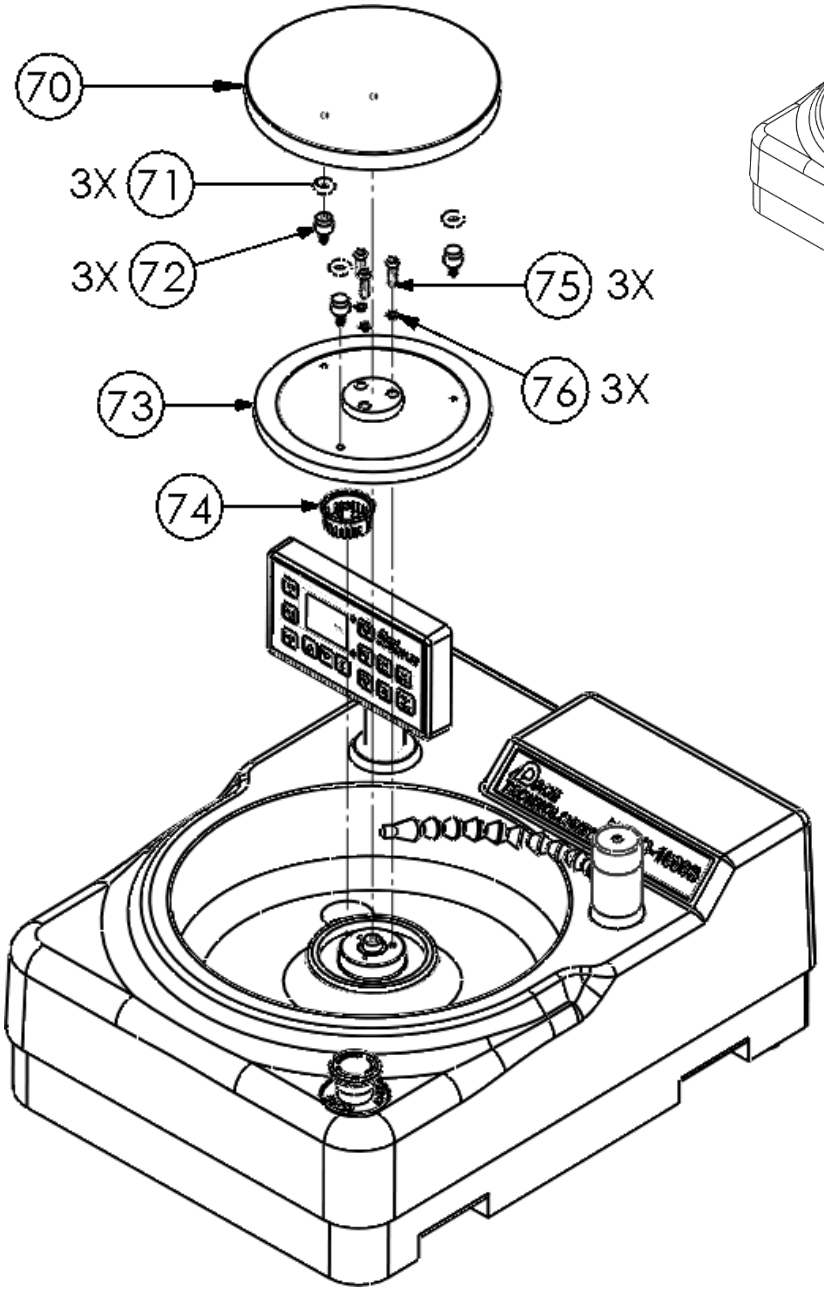

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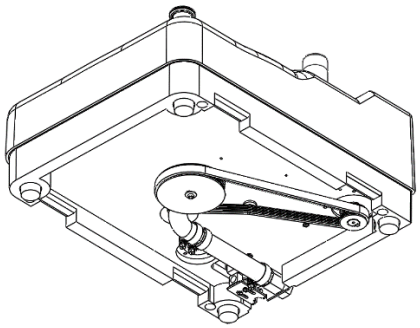

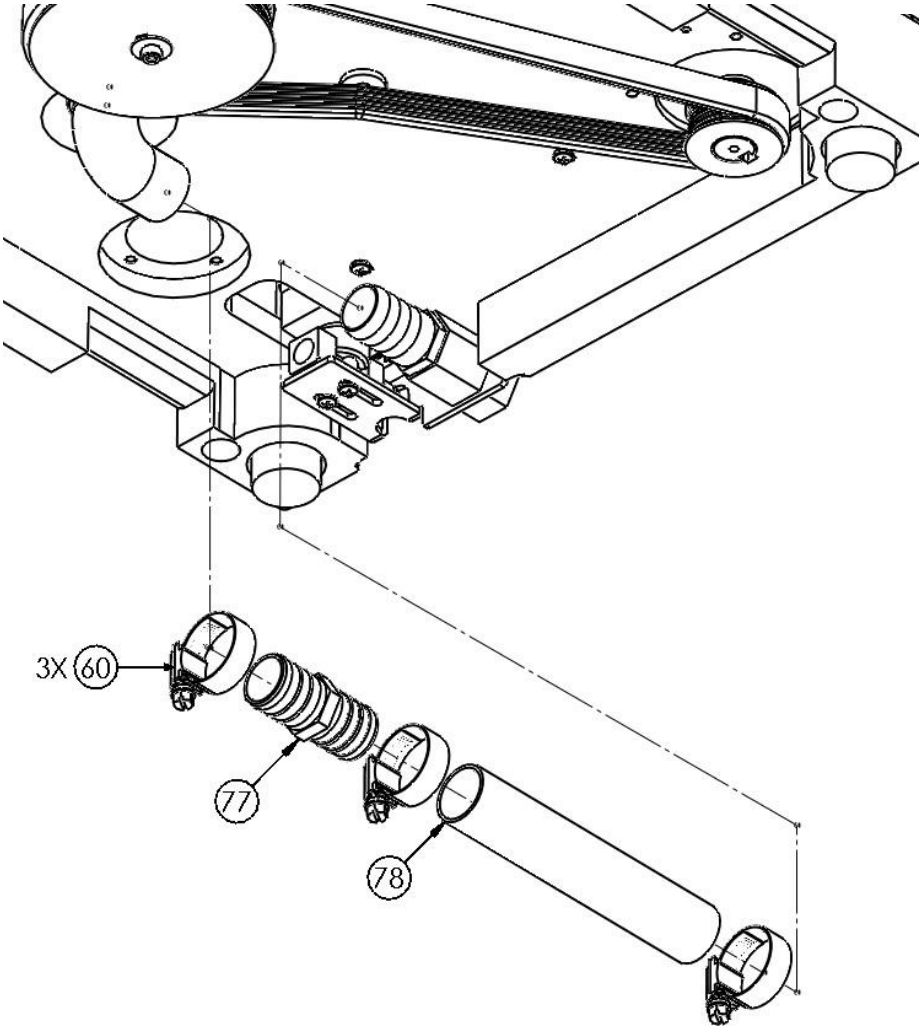

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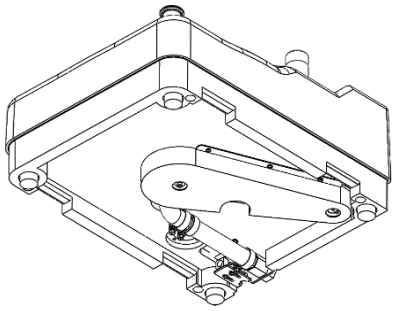

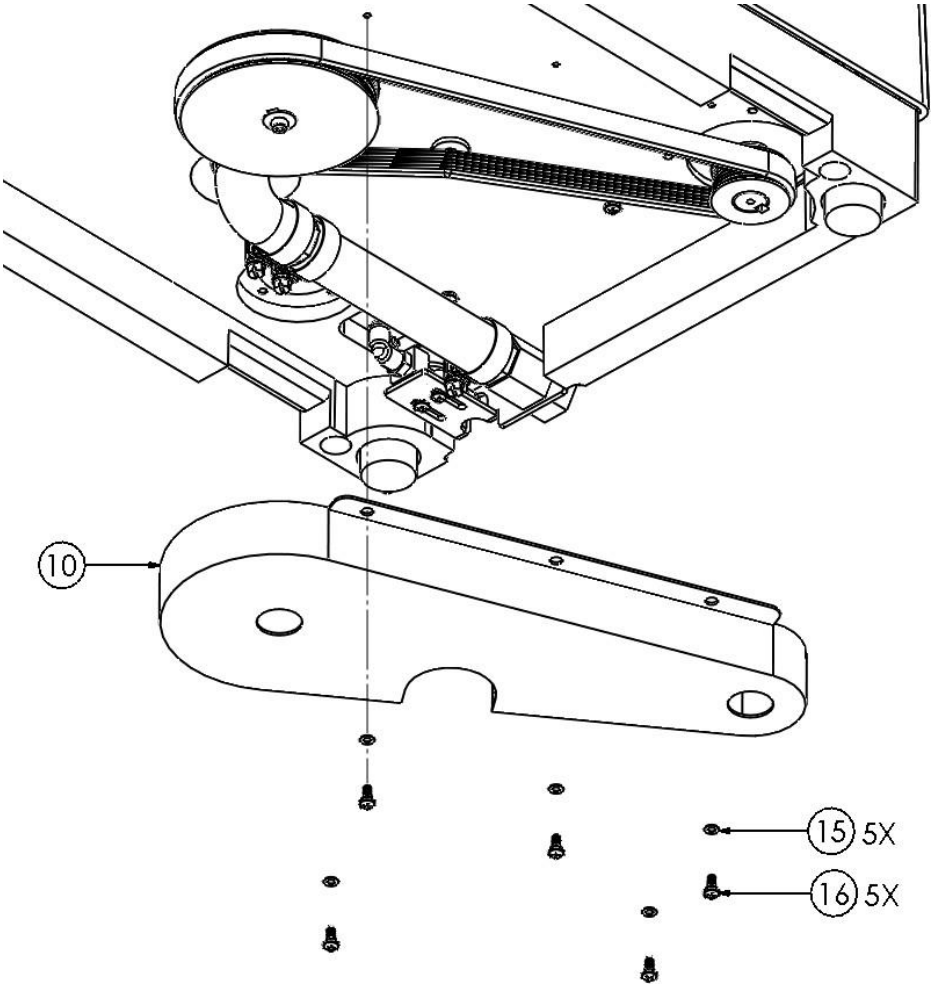

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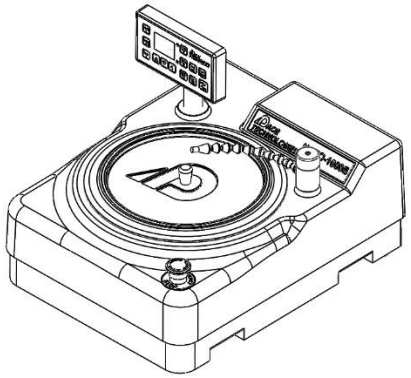

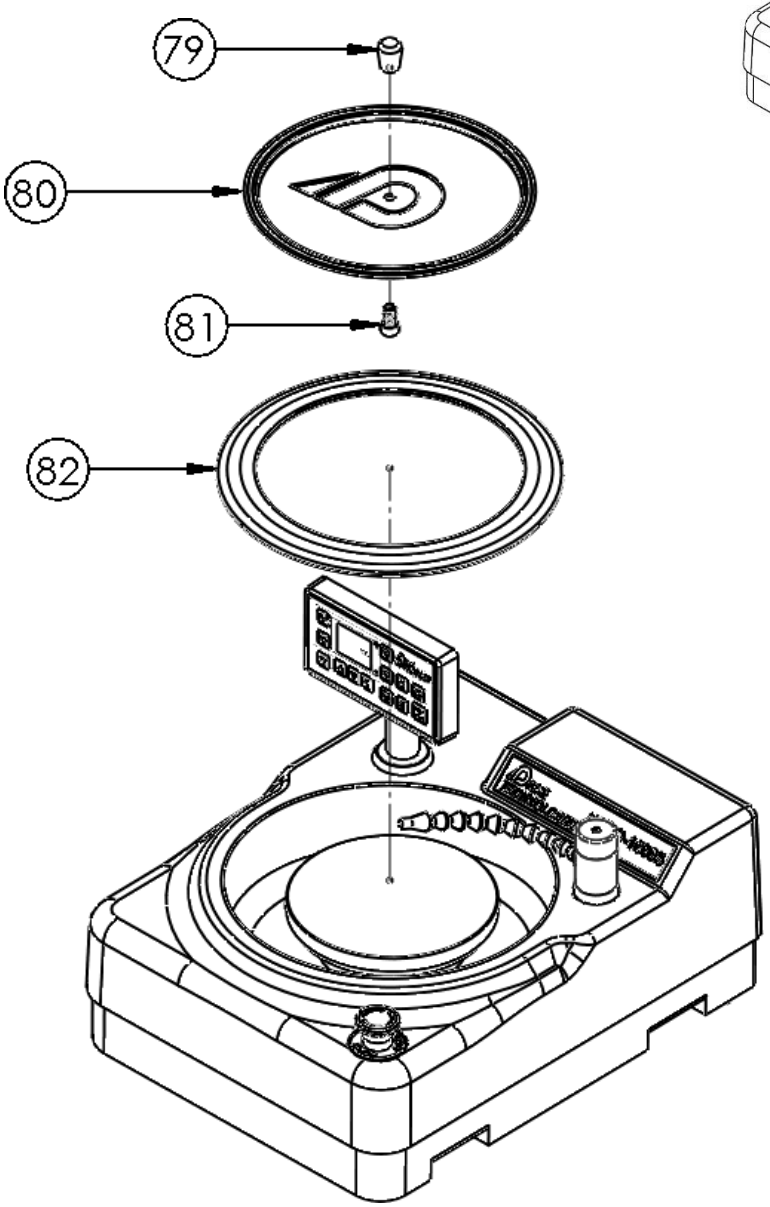

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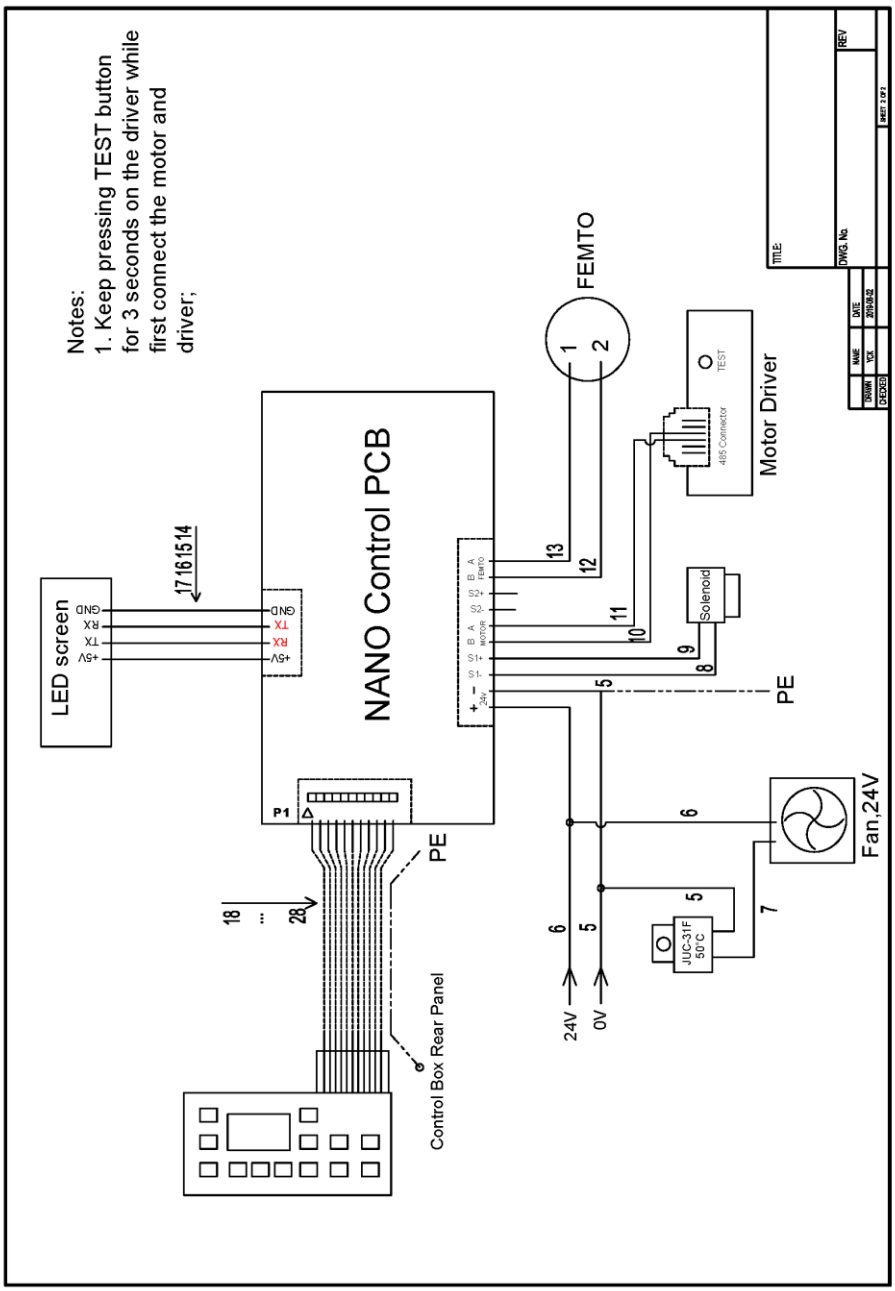
8.2 NANO Wiring Diagram



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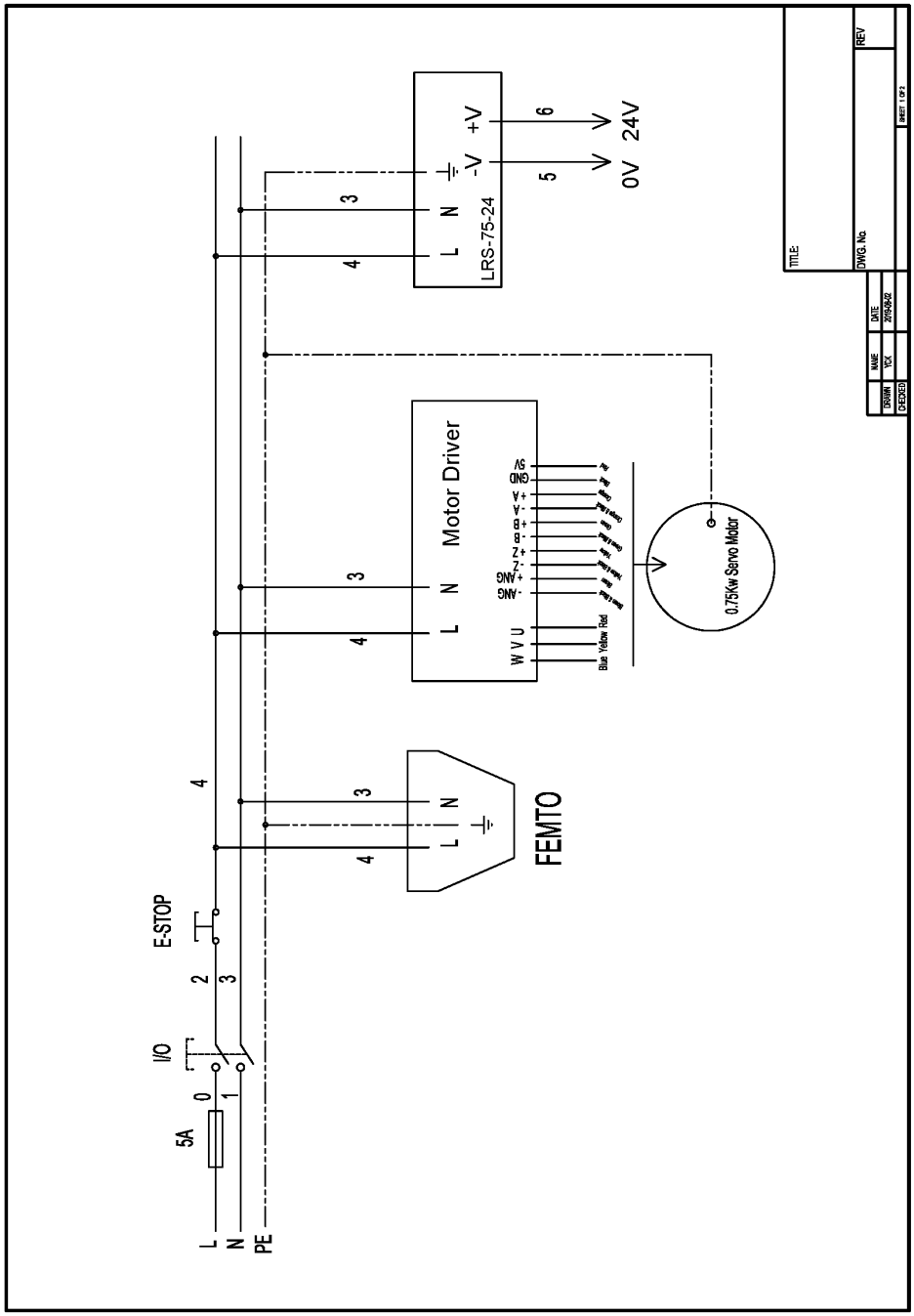
8.3 FEMTO Wiring Diagram



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