



Equipment Type:

Precision Wafering Saw
(3,4,5 and 6-inch blades – 7-inch without sample tray)

Model:

PICO-155P Precision Saw

Electrical Requirements:

110/220 Volts (single-phase)

Frequency:

50/60 Hz

Motor power:

150 watts

Manual Revision Date:

October 12, 2024



PICO-155P Precision Saw



INSTRUCTION MANUAL

3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: pace@metallographic.com Web: <https://www.metallographic.com>

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

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WARRANTY

Terms and Conditions applying to all PACE Technologies Products

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.

PACE TECHNOLOGIES MAKES NO EXPRESS WARRANTIES OTHER THAN THOSE WHICH ARE SPECIFICALLY DESCRIBED HEREIN. Any description of the goods sold hereunder, including any reference to Buyer's specifications and any description in catalogs, circulars and other written material published by PACE Technologies, is the sole purpose of identifying such goods and shall not create an express warranty that the goods shall conform to such description.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE. THIS WARRANTY STATES PACE TECHNOLOGIES ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM FOR DAMAGES IN CONNECTIONS WITH PACE TECHNOLOGIES PRODUCTS. PACE TECHNOLOGIES WILL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, NOR FOR ANY SUM IN EXCESS OF THE PURCHASE PRICE.

2. LIABILITY CAP:

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

- ! This sign points to 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 **PICO-155P** wafering saw.

Proper operator training is required for the safe operation of the **PICO-155P** wafering saw. Any unauthorized mechanical and electrical change, as well as improper operation, voids all warranty claims. All service issues need to be reported to the manufacturer / supplier.

- ! Before operating, cutting chamber hood must be closed.
- ! Use only certified wafering wheels from a professional supplier. Improper blade selection voids warranty. (For appropriate blade selection, refer to the Abrasive Blade Selection Guidelines Chart in Section 9)
- ! Disconnect power before opening electrical back panel.
- ! Replacement parts should be installed only by qualified personnel.
- ! Securely clamp the part / sample to the working table. During cutting, consider that the part may pinch and cause jamming of the wafering blade. Use the appropriate clamping devices to avoid this occurrence.
- ! Never start a cut under load.

1.3 Emergency Statement

Always follow proper operational guidelines and avoid bodily contact with coolants and abrasives. Seek appropriate medical care for cutting injuries.



1.4 Safety Tests

! Examine and verify that the **PICO-155P** wafering saw safety devices and operating performance are in good working condition prior to use. The following safety checks are considered important:

Emergency stop switch



Emergency stop switch

Test: Activate main switch and close hood.
Depress emergency stop switch.

Proper Response: Machine powers down.

Malfunction: Machine does not lose power.

Corrective measure: If system does not power down, disconnect power supply cord and call service technician.



Safety cut-off switch

Safety cut-off switch

Test: Activate main switch and close hood.
Turn on cut-off wheel. Open the hood slightly (approx. 1 inch).

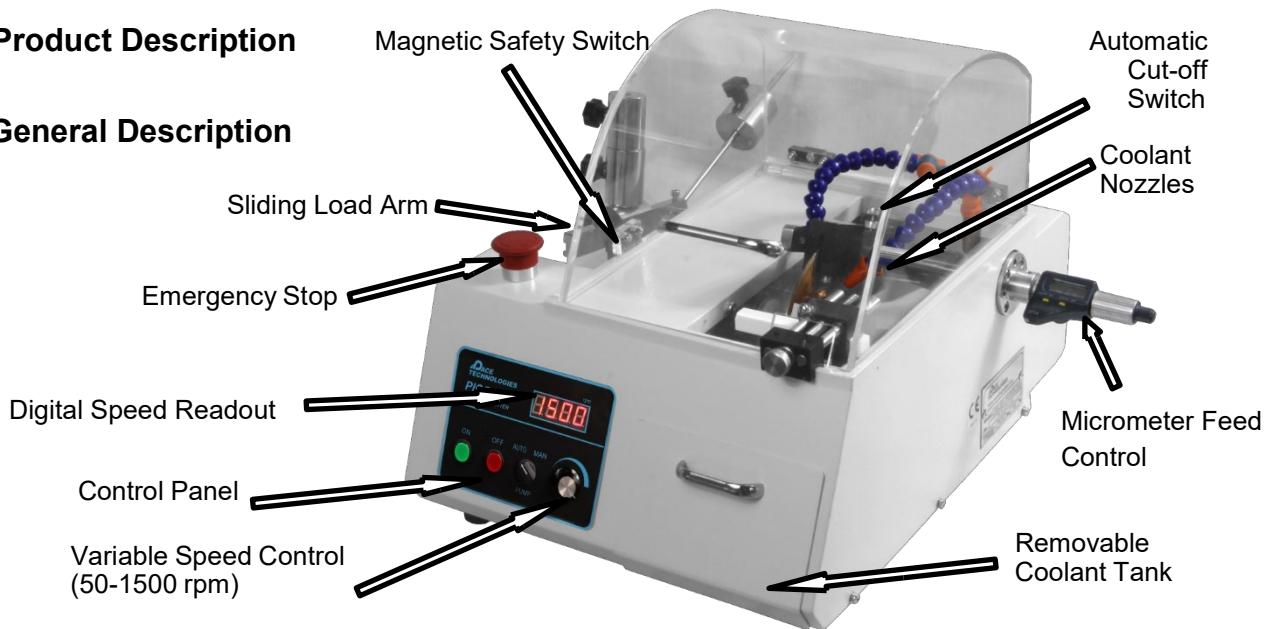
Proper Response: Cut-off wheel stops.

Malfunction: Cut-off wheel does not stop.

Corrective measure: If cut-off wheel does not power down, disconnect power supply cord and call service technician.

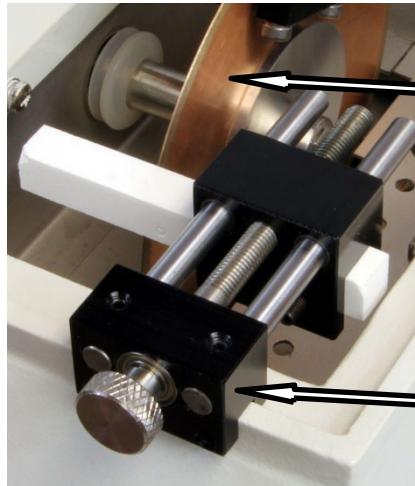
2.0 Product Description

2.1 General Description



The **PICO-155P** is a precision wafering saw for sectioning delicate specimens ranging from fish bones to microelectronic components. It is an ideal saw for the metallographic laboratory. The **PICO-155P** has the ability to cut at speeds ranging from 200 to 1500 rpm, with loads ranging from 0 up to 1500 grams.

The **PICO-155P** is a very robust and durable precision saw with its cast aluminum alloy and stainless-steel construction. The **PICO-155P** utilizes diamond wafering blades ranging from 3 to 7-inches in diameter. A new feature and benefit of the **PICO-155P** is that it uses a pump coolant system for better lubrication at the cutting surface as compared to traditional gravity drag lubricant machines. This is especially important for cutting with smaller diameter wafering blades.





2.2 Technical Specifications

Electrical specifications:	110V/220V single-phase
Motor power:	150 W - 24V (50/60 Hz)
Cut-off wheels:	3 - 7-inch diameter blades
Wheel arbor:	0.5 inches (12.5 mm) diameter
Speed:	200-1500 rpm
Load:	0-1500 grams
Weight:	Approx. 65 lbs. (30 kg)
Dimensions (W x D x H):	Hood closed 14.5 x 18 x 14.5 inches (368 x 457 x 368 mm) Hood open 14.5 x 23 x 19 inches (368 x 584 x 483mm)
Micrometer feed:	0-1 inch (0-25 mm)
Working temperature:	32° - 100°F (0 - 40°C)
Shipping temperature:	32° - 100°F (0 - 40°C)
Storage temperature:	32° - 100°F (0 - 40°C)
Coolant tank (included):	1/2 gallon (1.9 liters)



EU Directives:

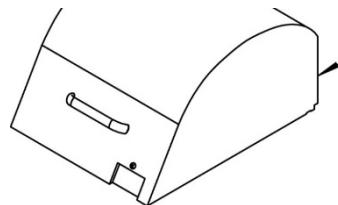
 Machinery directive 2006/42/EC
 RoHS Directive 2011/65/EU

EU Harmonized Standards:

 EN ISO 1200:2010
 EN 61010-1:2010
 EN 61326-1:2006

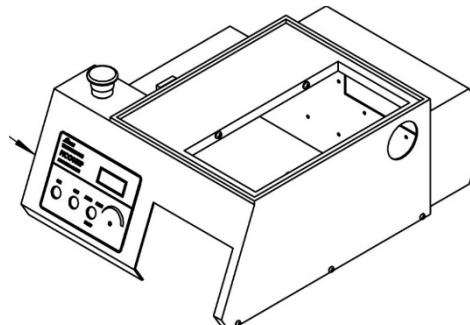


PICO-155P ASSEMBLY DRAWINGS

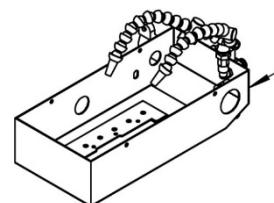


Lid

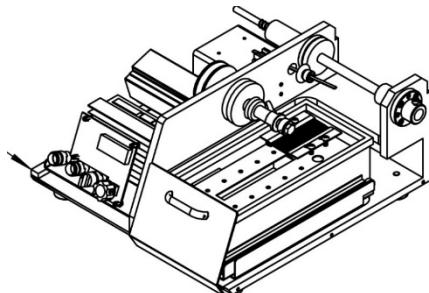
Housing



Cooling System

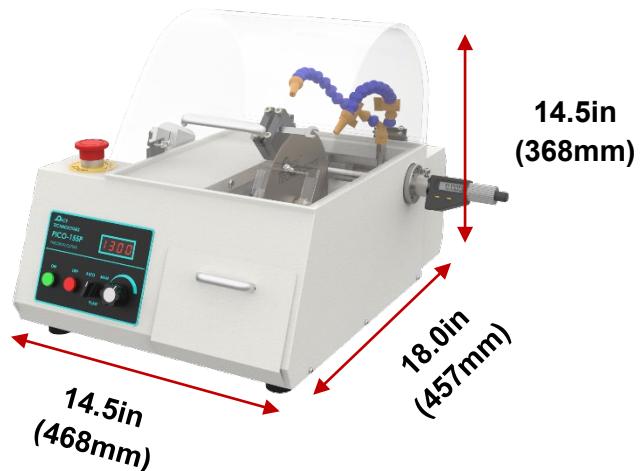


Casting





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NOTE: Assembling the counterweight rod will add 4.75-inch (~120mm) in depth.



2.4 Features



Improved Coolant System

The **PICO-155P** is an upgraded version of the PICO 155 medium speed wafering saws. Utilizing a 24V pump and flexible coolant lines, the **PICO-155P** allows for better coolant distribution, even for smaller diameter wafering blades.



Motor feedback

The **PICO-155P** is equipped with a 125 W motor that has a feedback loop for maintaining the cutting velocity, even under higher loads and increased drag. In addition, the circuit board has overload protection feedback which will stop the motor if the blade becomes jammed or pulls too many amps.

Easy to use

The **PICO-155P** is a user-friendly precision cutter with simple controls. Simply align the sample and start the cut. The variable speed motor can easily be adjusted by turning the knob on the front panel. Following completion of the cut, the motor will stop and activate an audible buzzer.

Multi-purpose machine

The **PICO-155P** saw is a very versatile precision cutter. It can be used as a standard precision saw or as a tabletop saw for cutting larger samples such as printed circuit boards.

3.0 Unpacking, Shipping, and Installation

3.1 Unpacking



Unit is delivered in a box. Unpack and check for completeness of parts.

Crate Measures W x H x D: 24 x 36 x 23 inches

Crate Weight: Approximately 105 lbs.

3.2 Shipping



When moving cutter, lift by the base.

The **PICO-155P** is constructed with sensitive electronic and mechanical components.

DO NOT DROP.

! **Caution:** Take care to avoid bodily injury.

3.3 Installation

! Install unit carefully! Improper installation voids warranty.

The **PICO-155P** should be placed on a flat, stable surface.

Connect the micrometer by pushing the micrometer flush and then snugly tighten the locking bolt.

CAUTION: DO NOT over tighten as this may damage the micrometer.

Then position the specimen arm and loading bar to the micrometer shaft so they are both at about the same angle to the shaft.

(Installation continues on following pages)

3.3.1 Installation - Coolant Tank

1. Insert stainless-steel tank cover tray onto coolant tank with the larger diameter hole located on the back right side of the tank. Apply Vaseline to the rubber gasket and slide tank into chamber. It is highly recommended that a cutting solution with a corrosion inhibitor be used in the PICO saws. Fill with approximately 1250 ml cutting solution.

NOTE: Distilled water and/or deionized water are not recommended for use with the PICO precision saws as both these liquids will absorb carbon dioxide from the air and form a corrosive solution.

The rubber gasket seal around the PICO tank is ethylene propylene diene monomer (EDPM) rubber which has poor stability to aliphatic hydrocarbon and aromatic hydrocarbon solvents (such as gasoline, benzene and mineral oil).

2. Slide in the left side of the two-piece stainless-steel sample tray cover and then the right-side cover.

3. Clean and insert pump filter through both the sample tray cover and the stainless-steel tank cover.



Apply a small amount of Vaseline to rubber gasket

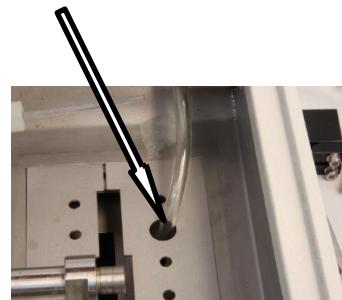
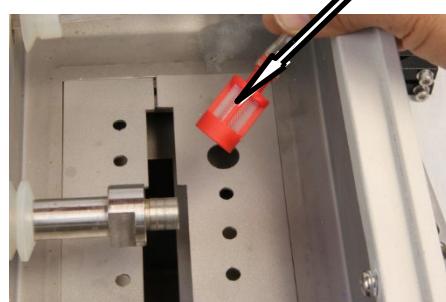


Insert LEFT sample tray cover



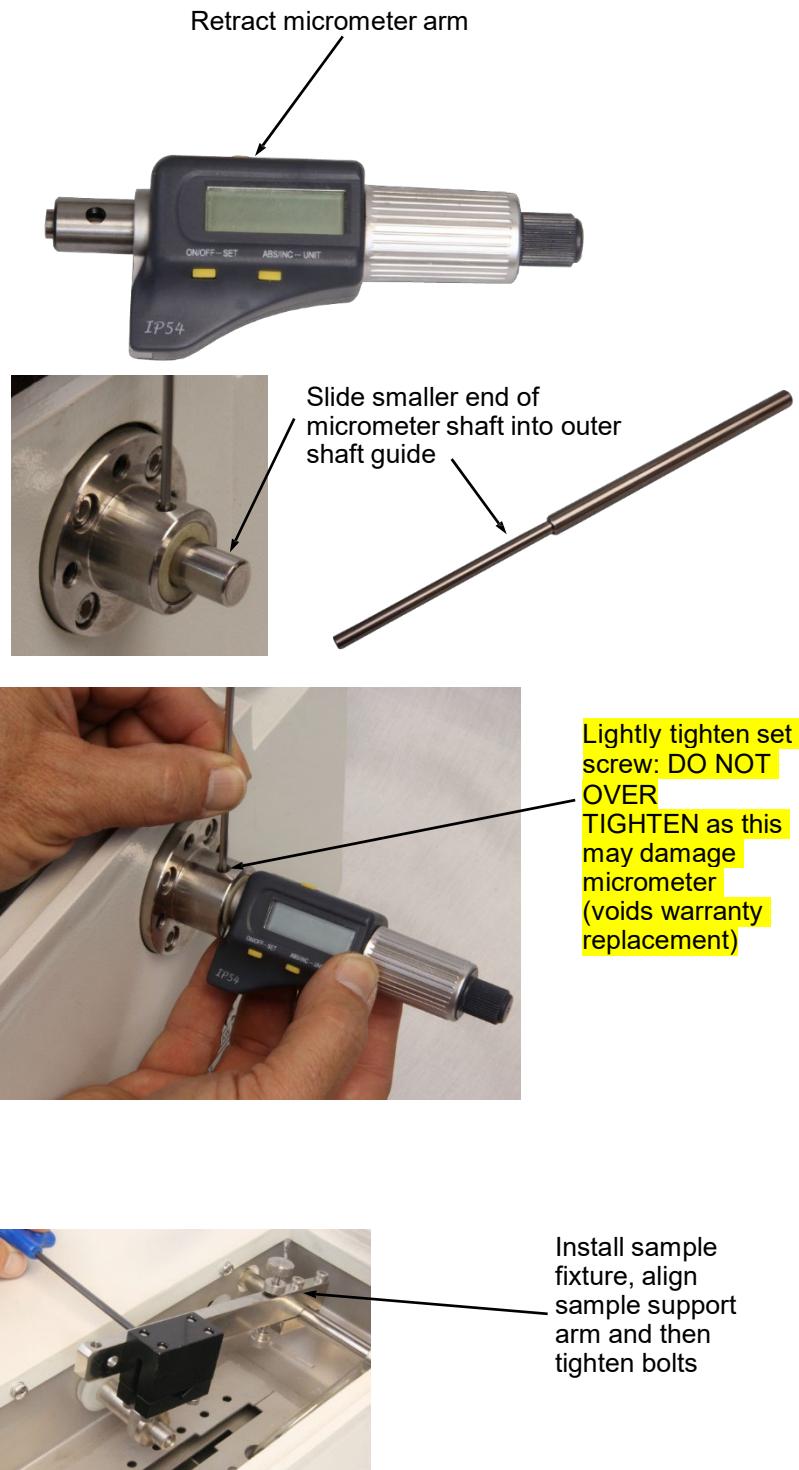
Insert RIGHT sample tray cover

Feed filter through the hole



3.3.2 Installation - Micrometer

1. For easier installation, retract micrometer adjustment arm - do not force movement beyond limits as this may damage the micrometer.
2. Loosen bolts on sample support arm and slide smaller diameter side of micrometer shaft into outer shaft guide. DO NOT tighten bolts on sample support arm at this point.
3. Push micrometer into the outer shaft guide thus pushing the micrometer shaft to the right. While holding micrometer in place, tighten set screw on outer shaft guide.
 NOTE: The hole in the micrometer does not need to line up with the bolt. DO NOT over tighten the bolt as this may damage and pinch the micrometer.
4. Attach sample fixture to sample support arm and then align holder to approximately where the wafering blade will be installed. Tighten sample holding arm bolts.

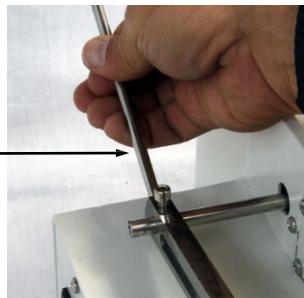


3.3.3 Installation - Weight and Counter Balance

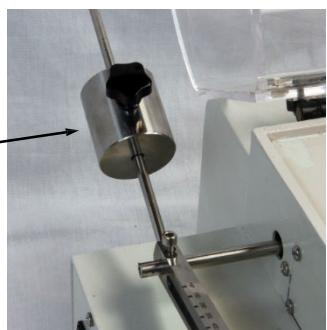
1. Attach load arm, then snugly tighten.



2. Attach counterbalance rod.



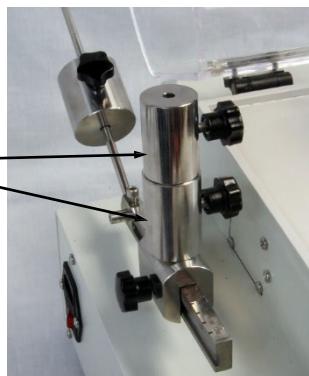
3. Attach sliding counterbalance weight.



4. Attach main sliding weight.



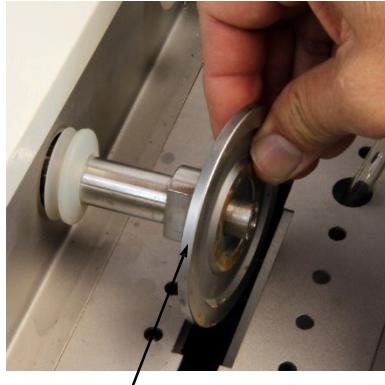
5. Attach additional loading weights if desired.



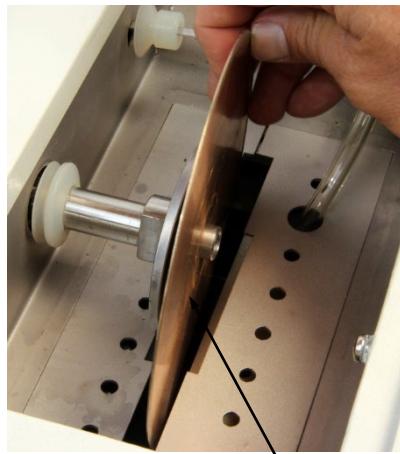
3.3.4 Installation - flanges and blade



Arbor size is
1/2-inch diameter



Use largest flange as possible
for more blade support



Follow recommended
guidelines for blade choice



Attach outside flange



Attach end cap
and bolt



Tighten bolt to secure
wafering blade



Adjust mechanical
cut-off height every
time the flange size is
changed

Note: It is recommended that the blade be dressed periodically to optimize its effectiveness.

3.3.5 Installation - dressing fixture

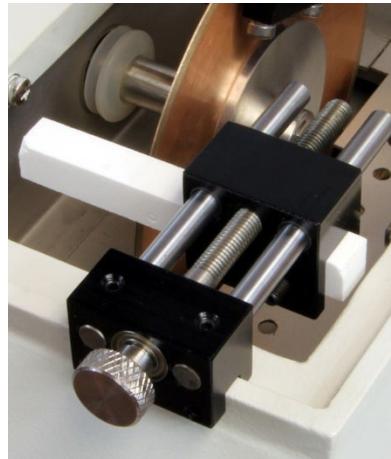
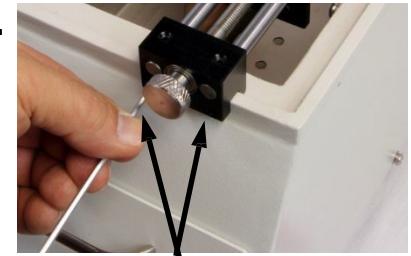
For optimum cutting performance, it is recommended that the wafering blade be periodically dressed. This will improve/decrease cutting times as well as extend the life of the blade.

Note: Even for hard ceramic materials, dressing is important as the wafering blades are metal pressed blades and the metal from the blade itself can coat or blind the diamond, thus resulting in less efficient cutting.

Proper dressing should be conducted at slow speeds and low loads (e.g., 300 rpm and low feed rate).



Select proper dressing stick.
Install onto the dressing fixture
and secure with the Allen screws.



Align dressing fixture with lip on front of casting panel with opening in cover. Then attach the dressing fixture to the cover with the Allen screws.

Slowly feed dressing stick into wafering blade while running saw at a slow speed.

3.3.6 Installation

Sample fixture can be positioned differently with respect to the blade.

Note: For soft or gummy materials, it is recommended that the sample be positioned on the back side of the blade. This will reduce the tendency of the sample to jam the blade.



- ! Machine can run at either 110V or 220V power.
- ! Connect the electrical plug and activate the main power switch (note: the hood must be closed for power to turn on at the front panel). Verify that the emergency stop switch is deactivated and the system will be ready for operation.



Turn emergency switch clockwise to release

Power switch

The safety fuse takes a 3 amp fuse if running the machine at 110v or a 1.5 amp fuse if running at 220v.

4.0 Start-up and Operation

4.1 General

The **PICO-155P** is a low-medium speed precision wafering saw.

4.2 Control Panel



Emergency Shut Off: Immediately cuts all power to machine.

Cutting wheel ON: Starts the cutting wheel.

Cutting wheel OFF: Stops the cutting wheel (inductive brake engages to slow wheel).

Pump Control: Manually controls pump ON/OFF or automatically controls pump when cutting (AUTO).

Variable Speed Controller: Continuous variable speed between 50-1500 rpm.

4.3 Changing Wafering Blade

1. Remove blade-locking bolt and remove blade.
2. Position new blade into position.

! Use only certified wafering blades. See Table IV
 for recommended blade for your application.

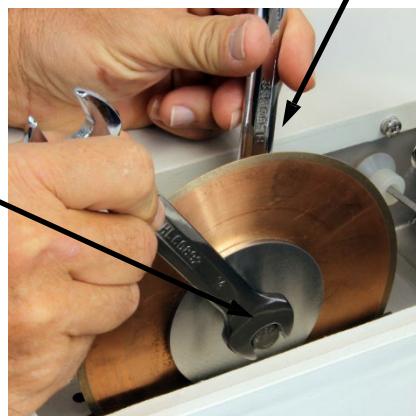
4. Gently tighten blade locking bolt.

To prevent shaft from turning, use wrench to hold in place

Changing Blade

Remove: Loosen by
 turning counter-
 clockwise

Tighten: Turn clockwise



4.4a Zeroing the micrometer

1. Turn micrometer on with left button.
2. Press left button again and hold for several seconds until -inchset-inch starts to blink in the upper right-hand corner of the screen.
3. Press the right button several times until the numbers read zero.
4. Press the left button to set the number.

4.4b Changing between microns and inches

To change between microns and inches, turn off micrometer, and then turn back on with left button. Depress right button and hold until the scale changes.



4.5 Positioning Sample Over Blade

- The **PICO-155P** wafering saw is the only metallographic precision saw that allows you to change the position of the sample relative to the wafering blade. This is important in order to prevent the blade from jamming and to eliminate the oscillation (bouncing) of the specimen during cutting.
- A common issue with wafering saws is that the specimen can bounce or oscillate during cutting, especially if the sample is positioned at the apex of the blade. In this case, reposition the sample: generally, closer to the backside of the blade is better.
- For soft gummy materials, it is recommended that the sample be positioned towards the back side of the wafering blade. For this condition, the blade is rotating up into the specimen. Note: if the blade is positioned to the front, the blade has a tendency to grab the sample and pull it down into the blade, thus jamming and tripping the safety overload protection for the motor.



Shut-off screw



4.6 Automatic Shut Off

Adjust the height of the shut-off screw so that the saw will turn off after it completes the cut.



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WAFER CUTTING CONSUMABLES SELECTION GUIDELINES CHART

3-inch Diamond Blades (1/2-inch) Arbor (0.006-inch thick)

Pace Product Name	Catalog Number	Packaging per box
3-inch fine-grit, low concentration wafering blade	WB-0030LC	each
3-inch medium-grit, low concentration wafering blade	WB-0035LC	each
3-inch medium-grit, high concentration wafering blade	WB-0035HC	each

4-inch Diamond Blades (1/2-inch) Arbor (0.012-inch thick)

Pace Product Name	Catalog Number	Packaging per box
4-inch fine-grit, low concentration wafering blade	WB-0040LC	each
4-inch medium-grit, low concentration wafering blade	WB-0045LC	each
4-inch medium-grit, high concentration wafering blade	WB-0045HC	each
4-inch medium-grit, low concentration stainless steel wafering blade	WB-004LCS	each
4-inch medium-grit, high concentration stainless steel wafering blade	WB-004HCS	each
4-inch medium-grit, high concentration CBN/diamond wafering blade	WB-004GP	each

5-inch Diamond Blades (1/2-inch) Arbor (0.015-inch thick)

Pace Product Name	Catalog Number	Packaging per box
5-inch fine-grit, low concentration wafering blade	WB-0050LC	each
5-inch medium-grit, low concentration wafering blade	WB-0055LC	each
5-inch medium-grit, high concentration wafering blade	WB-0055HC	each
5-inch medium-grit, low concentration stainless steel wafering blade	WB-005LCS	each
5-inch medium-grit, high concentration stainless steel wafering blade	WB-005HCS	each
5-inch medium-grit, high concentration CBN/diamond wafering blade	WB-005GP	each

6-inch Diamond Blades (1/2-inch) Arbor (0.020-inch thick)

Pace Product Name	Catalog Number	Packaging per box
6-inch fine-grit, low concentration wafering blade	WB-0060LC	each
6-inch medium-grit, low concentration wafering blade	WB-0065LC	each
6-inch medium-grit, high concentration wafering blade	WB-0065HC	each
6-inch medium-grit, low concentration stainless steel wafering blade	WB-006LCS	each
6-inch medium-grit, high concentration stainless steel wafering blade	WB-006HCS	each
6-inch medium-grit, high concentration CBN/diamond wafering blade	WB-006GP	each

7-inch Diamond Blades (1/2-inch) Arbor (0.030-inch thick)

Pace Product Name	Catalog Number	Packaging per box
7-inch fine-grit, low concentration wafering blade	WB-0070LC	each
7-inch medium-grit, low concentration wafering blade	WB-0075LC	each
7-inch medium-grit, high concentration wafering blade	WB-0075HC	each
7-inch medium-grit, low concentration stainless steel wafering blade	WB-007LCS	each
7-inch medium-grit, high concentration stainless steel wafering blade	WB-007HCS	each
7-inch medium-grit, high concentration CBN/diamond wafering blade	WB-007GP	each

Electroplated Diamond Blades (1/2-inch) Arbor

Pace Product Name

4-inch electroplated diamond wafering blade
 5-inch electroplated diamond wafering blade
 6-inch electroplated diamond wafering blade

Catalog Number Packaging per box

WB-0040EPD	each
WB-0050EPD	each
WB-0060EPD	each

CBN Wafering Blades (1/2-inch) Arbor

Pace Product Name

4-inch CBN wafering blade
 5-inch CBN wafering blade
 6-inch CBN wafering blade

Catalog Number Packaging per box

WCBN-0045	each
WCBN-0055	each
WCBN-0065	each

7-inch Abrasive Blades (1/2-inch) Arbor

Pace Product Name

7-inch abrasive blade - alumina general purpose

Catalog Number Packaging per box

MAX-7000S	10/pkg
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Wafer Cutting Fluids

Pace Product Name

DIACUT Oil-based Cutting Fluid (16 oz)
 DIACUT Oil-based Cutting Fluid (32 oz)
 DIACUT Water-based Cutting Fluid (16 oz)
 DIACUT Water-based Cutting Fluid (32 oz)

Catalog Number Packaging per box

OL-3000-16	16 oz
OL-3000-32	32 oz
WL-3000-16	16 oz
WL-3000-32	32 oz

Miscellaneous

Pace Product Name

DIACUT Dressing Stick (1/4 x 1/4 x 4-1/2-inch)

Catalog Number Packaging per box

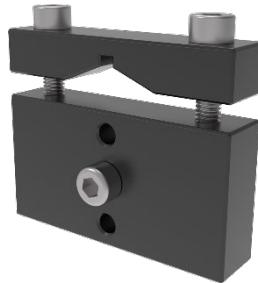
DRES-0010	each
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Note: Although abrasive blades can be used on the **PICO-155P** Precision Saw, it is not an abrasive cutter. If the bulk of your work requires abrasive blades, please consider using an abrasive saw instead of the **PICO-155P**.

4.7 Cutting Procedure

1. Install correct wafering blade.
2. Add 1250 ml proper lubricant (recommended lubricant has an anti-corrosion inhibitor additive)
2. Position sample close to cut-off wheel.
3. Set speed and load.
4. Start cut.
5. Remove and clean specimen after cutting.

Universal Vice
P150-702



4.8 Sample Fixturing

For proper clamping, use the appropriate clamping vises to securely hold the sample in place. It is recommended that both sides of the part be clamped to avoid pinching of the blade (possibly breaking the blade) and to minimize burning of the work piece during cutting.

! For proper fixturing, take into account the initial stress of the samples.



Tear Drop
P150-707



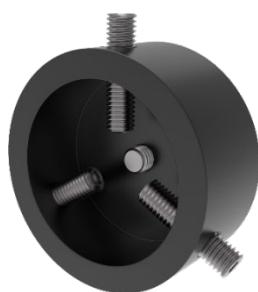
Large Universal
P150-702b



Irregular Samples
P150-706



Fastener Vice
P150-711



Ø32mm Round
P150-702



Ø40mm Round
P150-708



Adhering Vice
P150-711



Double Saddle
P150-703

4.8.2 Included Sample Fixtures

All items below are included with the purchase of a PICO-155P:

- Universal Vice
- Tear Drop Vice
- Large Universal Vice
- Irregular Samples Vice
- Vertical Fastener Vice
- 32mm Round Vice
- 40mm Round Vice
- Adhering Surface Vice
- Double Saddle Vice

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5.0 Maintenance

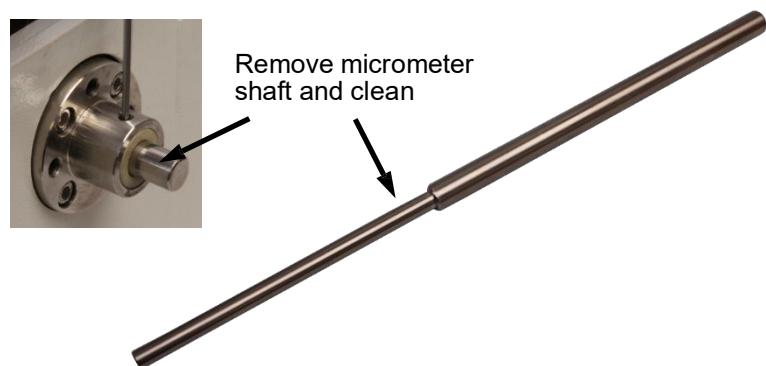
5.1 Introduction

The **PICO-155P** wafering saw requires very minimal maintenance. However, to increase the life of the saw, it is suggested that the cutting fluid be changed regularly (weekly) using a cutting fluid containing an anti-corrosion additive (e.g. DIACUT 2 cutting fluid). **NOTE: Distilled water and/or deionized water are not recommended for use with the PICO precision saws as both these liquids will absorb carbon dioxide from the air and form a corrosive solution.**

After use, it is also recommended that the unit be thoroughly rinsed and dried with the hood left open in order to avoid creating a corrosive humidity chamber inside the chamber.



Periodically remove the micrometer shaft and clean any cutting swarf material build-up on the shaft.

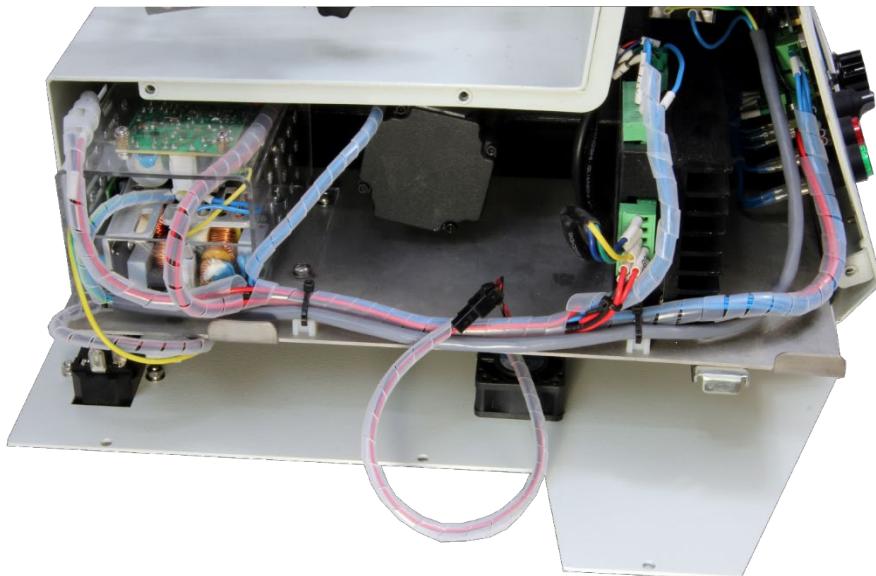


5.2 Cleaning Outside Cabinet

The cabinet and hood shield should be cleaned occasionally with a moist cloth. Do not use any chemicals or cleaning abrasives. We recommend an anti-condensation gel be used on the front panel.

5.3 Service Panel

For ease of service, we have designed the **PICO-155P** to have a side access panel with the main electrical components on an easy pull out rail system.



6.0 Troubleshooting

More extensive troubleshooting, repair guides, videos, & parts list are provided online at www.metallographic.com or give us a call at 520-882-6598 with any questions.

Problem	Cause	Solution	Images
No power or function	<p>a. Unit is disconnected from a main electrical power supply.</p> <p>b. Main power switch is off.</p> <p>c. Emergency stop button engaged.</p> <p>d. Magnetic switch not engaged.</p> <p>e. Shut off switch engaged.</p> <p>f. Loose or broken wire.</p> <p>g. Unable to determine problem.</p>	<p>a. Verify electrical source and connection.</p> <p>b. Turn on main power switch.</p> <p>c. Release by turning clockwise.</p> <p>d. Close hood or adjust hood in closed position.</p> <p>e. Lift specimen holder arm or adjust shut-off screw to be higher.</p> <p>f. Disconnect power and open side access panel. Check for any loose or broken wires at the 110/220 V switch and power switch.</p> <p>g. Contact service technician.</p>	    
Main motor does not operate	<p>a. Hood not closed.</p> <p>b. Overload activated (error E1).</p> <p>c. Transformer switch not set to the correct voltage.</p>	<p>a. Close hood.</p> <p>b. Press stop button and then start button.</p> <p>c. Set switch to correct voltage.</p>	

Problem	Cause	Solution
Blade is easily chipped or breaking	a. Improper blade dressing.	a. Use mechanical dressing fixture.
	b. Insufficient sample clamping.	b. Secure specimen with rubber mounting pad.
	c. Cutting force initially too high.	c. Reduce initial force to set cutting kerf.
Low cutting rates	a. Smeared material on the blade.	a. Redress blade at <100 grams and <300 rpm.
	b. Cutting speed and/or force is too low.	b. Increase cutting speeds and applied force.
Excessive damage or chipping of specimen	a. Too large an abrasive.	a. Use finer grit diamond blade.
	b. Excessive vibration.	b. Secure specimen with rubber mounting pad.
Burr formation on specimen at the end of the cut	a. Cutting speed and/or force is too high at the end of the cut.	a. Reduce speed and cutting force to reduce cutting rate.
	b. Excessive vibration.	b. Secure specimen with rubber mounting pad.
Pump does not appear to be working	a. Pick-up line is air-locked/diaphragm is restricted.	a. Blow compressed air through line with pump running until sound of pump changes.
	b. Not enough fluid in tank.	b. Add cutting fluid to tank.
	c. Hoses are not sealing.	c. Reseat hoses into connection points.
Corrosion on fabricated parts	a. Improper cleaning	a. Clean, dry and store with cover open when not in use
	b. Corrosive cutting fluid	b. Use a cutting fluid with an anti-corrosion inhibitor added. Do not use distilled or deionized water as carbon dioxide absorption produces a corrosive environment
EPRM Tank gasket material deformed	Incompatible cutting fluid to EPDM rubber	Use cutting fluid that does not contain aliphatic hydrocarbon and aromatic hydrocarbon solvents (such as gasoline, benzene, etc.) and mineral oil (such as n-heptane, toluene, etc)



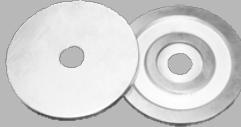
PICO-155P Precision Saw



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7.0 List of Spare Parts

Part no.	Description	Images
Mechanical Components		
P155-M-001	Aluminum Casting	
Stock	Arbor Shaft Assembly	
P155-M-002	50mm Arbor Flange	
P155-M-003	75mm Blade Arbor Flange	
P155-M-004	Arbor Shaft Ring	
P155-BBS-A	Blade Spacer	

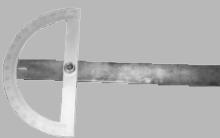
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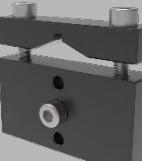
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P155-M-005	Motor Bracket Extension Tube	
P155-A-COS	M5x0.8 Stainless Steel Knurled-Head Thumb Nut	
P155-M-006	Micrometer Shaft	
P155-M-007	Inner Micrometer Shaft Guide	
P155-M-008	Outer Micrometer Shaft Guide	
P155-SSA-A	Sample Support Arm	
P155-M-009	Sliding Load Arm	

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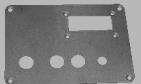
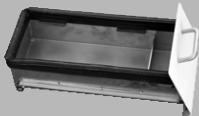
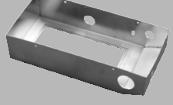
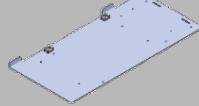
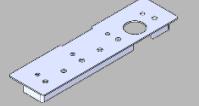
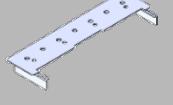
P155-M-010	Weight-Sliding	
P155-M-011	Weight Rod	
P155-M-012	Weight- 250 grams	
P155-M-013	Weight-300 grams	
P155-M-014	Counterbalance Weight	
P155-M-015	Counterbalance Rod	
P155-A-PG	Protractor Guide for Cutting Table	

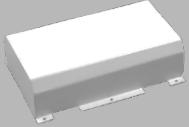
P150-701	Blade Dressing Fixture	
P150-702	Sample Fixture-Single Universal	
P150-702b	Sample Fixture-Universal Large	
P150-703	Sample Fixture-Double Parallel	
P150-706	Sample Fixture-Irregular Shaped	
P150-707	Sample Fixture- ø32mm Round Mount	
P150-708	Sample Fixture-ø40mm Round Mount	

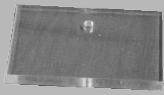


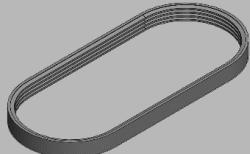
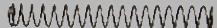
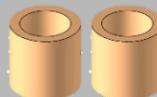
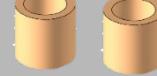
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P150-709	Sample Fixture-Adhering Surface	
P150-710	Sample Fixture- Tear Drop (18-40mm)(0.7-1.6in)	
P150-711	Sample Fixture- Fastener Fixture	

Part no.	Description	Images
Sheet Metal Parts		
P155-F-001	Aluminum Template	
P155-TA-A	Tank (430 stainless steel)	
P155-F-002	Stainless Steel Tank Cover Tray	
P155-F-003	Motor Holding Bracket	
P155-F-004	Stainless Steel Cutting Chamber	
P155-F-005	Tank Guide Roller Plate	
P155-F-006	Electronics Base Panel	
P155-F-007	2-Piece Tray Cover-1	
P155-F-008	2-Piece Tray Cover-2	

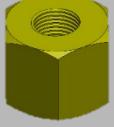
P155-F-009	Metal Cover	
P155-F-010	Pump Cover	
P155-F-011	Cut-Off Switch Cover-1	
P155-F-012	Left Side Access Panel Door	
P155-CA-A	Magnet Switch Holding Bracket of cutting table	

Part no.	Description	Images
Metalloid Parts		
P155-001	Power Supply Acrylic Cover	
P155-002	Magnetic Plastic Spacer	
P155-003	Hood	
P155-004	Acrylic Hinge Spacers	
P155-005	Dressing Fixture acrylic cover	

Part no.	Description	Images
Standard Parts		
P155-007	Polychain	
P155-008	Micrometer Shaft Spring	
SN-EX-8	Ø8mm Snap Ring	
P155-009	M12x1.25 slotted lock nut	
BB-12-28	Arbor Shaft Bearings	
BB-8-16	Ball Bearing 8 ID-16 OF	
DB-8-10-10	Dry Bearing 8 x 10 x 10	
DB-7-5-8	Ø7x Ø5x8 oilless bearing for fastener fixture	

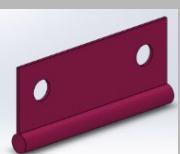
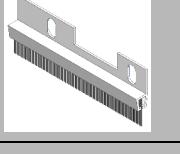
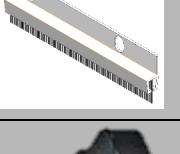
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P155-010	Hood Hinge (pair)	
P155-011	Hood handle	
P155-012	Arbor Shaft Rubber Boot	
P155-013	Cut-Off Switch Boot	
P155-014	Cutting chamber and micrometer shaft seal (Inside)	
P155-015	Cutting chamber and micrometer shaft seal (Outer)	
P155-016	Outer Micrometer Shaft Guide O-Ring	
P155-017	Dual Coolant Spray Nozzles	
P155-P-001	Brass Reducer Bushing 17MM to 10MM	

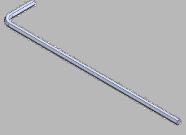
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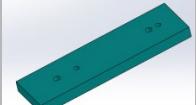
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PAN-18-26-18	18-inchx26-inchx18-inch gauge full size aluminum drip pan for PICO 155 wafering saw	
M8-FEET	Set of 4 Rubber Feet	
P155-TA-C	Tank gasket	
P155-018	Tank Handle	
P155-019	Side Panel Hinges	
P155-020	Cutting Table Brush	
P155-021	Brush for Tray Cover-1	
P155-022	Brush for Tray Cover-2	
P155-023	M5 x 0.8 x 15 Thumb Screw (Stainless Steel)	



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TOOL-2.5-ALLEN	2.5mm Allen	
TOOL-4-ALLEN	4mm Allen	
TOOL-W-14-17	14 and 17 Combo Wrench	

Part no.	Description	Images
Electronic Parts		
BTN-G-001	Toggle Button (Green)	
BTN-R-002	Toggle Button (Red)	
SWT-E-001	Pump Switch	
P155-E-003	Speed Dial and Potentiometer	
PCB-P155	Front Panel Control Board	
MD-24V-DC	24VDC Motor drive controller	
PS-24V	Power supply (main board)	
TB-RAIL	C45 U guide rail Fix hole 4.4 24	

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40MM-FAN	40mm Cooling Fan	
PLD-2201/24V	24V Pump	
POW-F-SWITCH	Power Switch and Fuse Holder	
POW-E-STOP	Emergency stop	
FUSE-3A	3 Amp Fuse	
FUSE-1.5A	1.5 Amp Fuse	
SWT-MAG-IN	Internal Magnetic Safety Switch	
SWT-MAG-EX	External Magnetic Safety Switch	
MOT-BLDC-125	Motor (125W, 3 phase, 8 pole) 57BLF-123ONBB	

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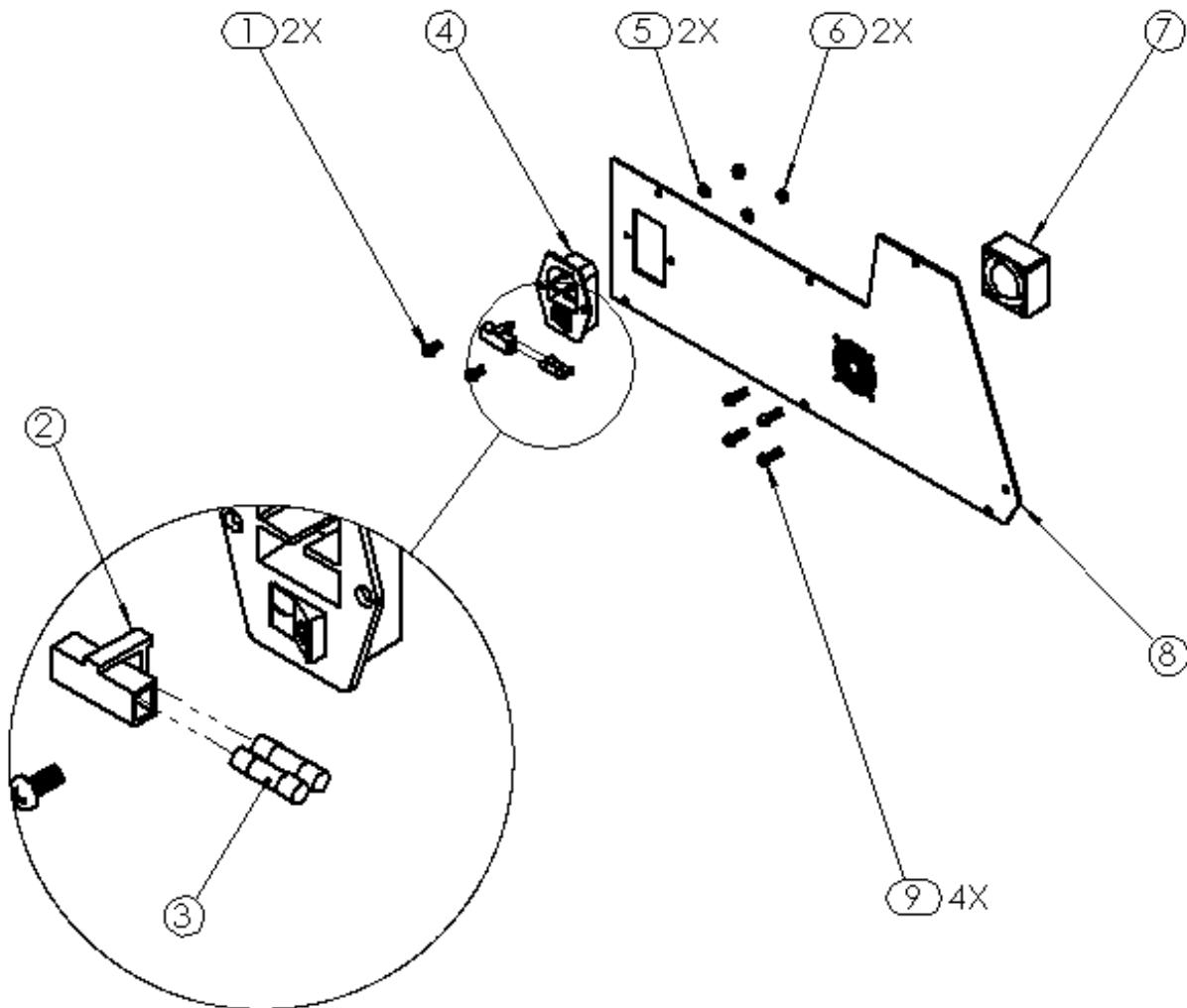
SWT-CUT-OFF	Contact Cut-Off Switch	
P155-006	Micrometer	
C-110V-001	110V USA Power Cord	
C-220V-001	220V Round Pronged Cable	
C-220V-002	220V Flat Pronged Cable	
P155P-T	PICO 155P Template	



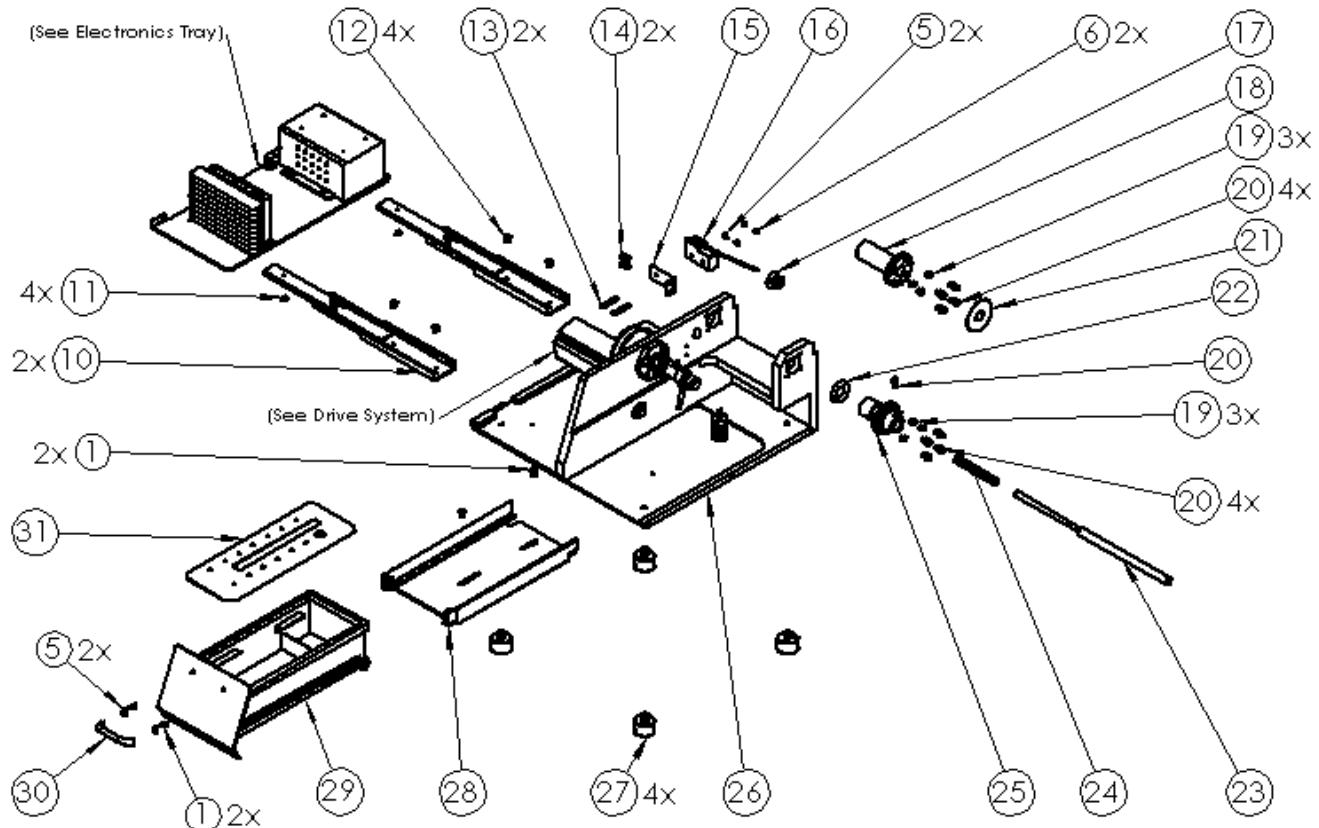
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8.0 Electrical and Mechanical Drawings

ACCESS PANEL ASSEMBLY



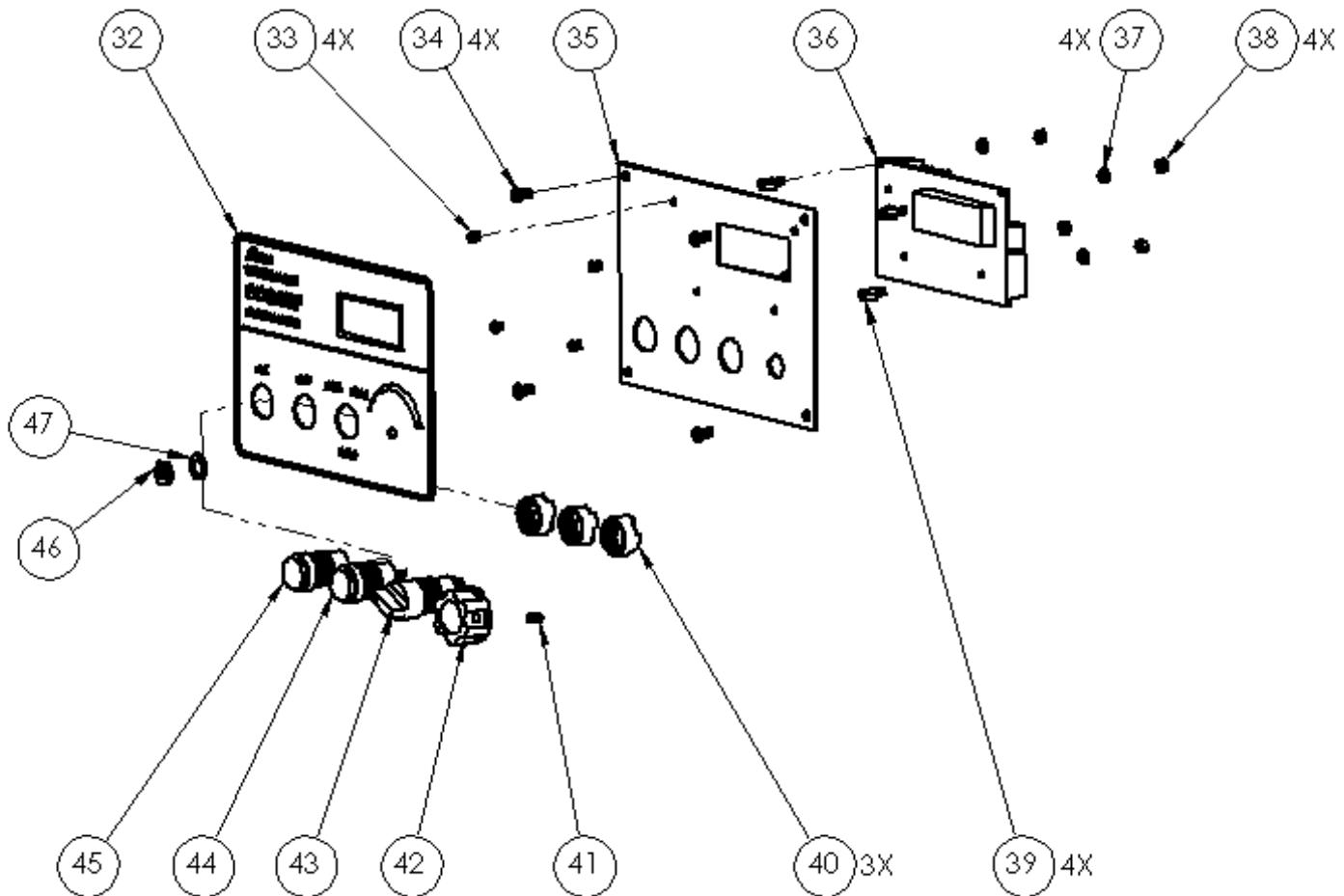
BASE ASSEMBLY





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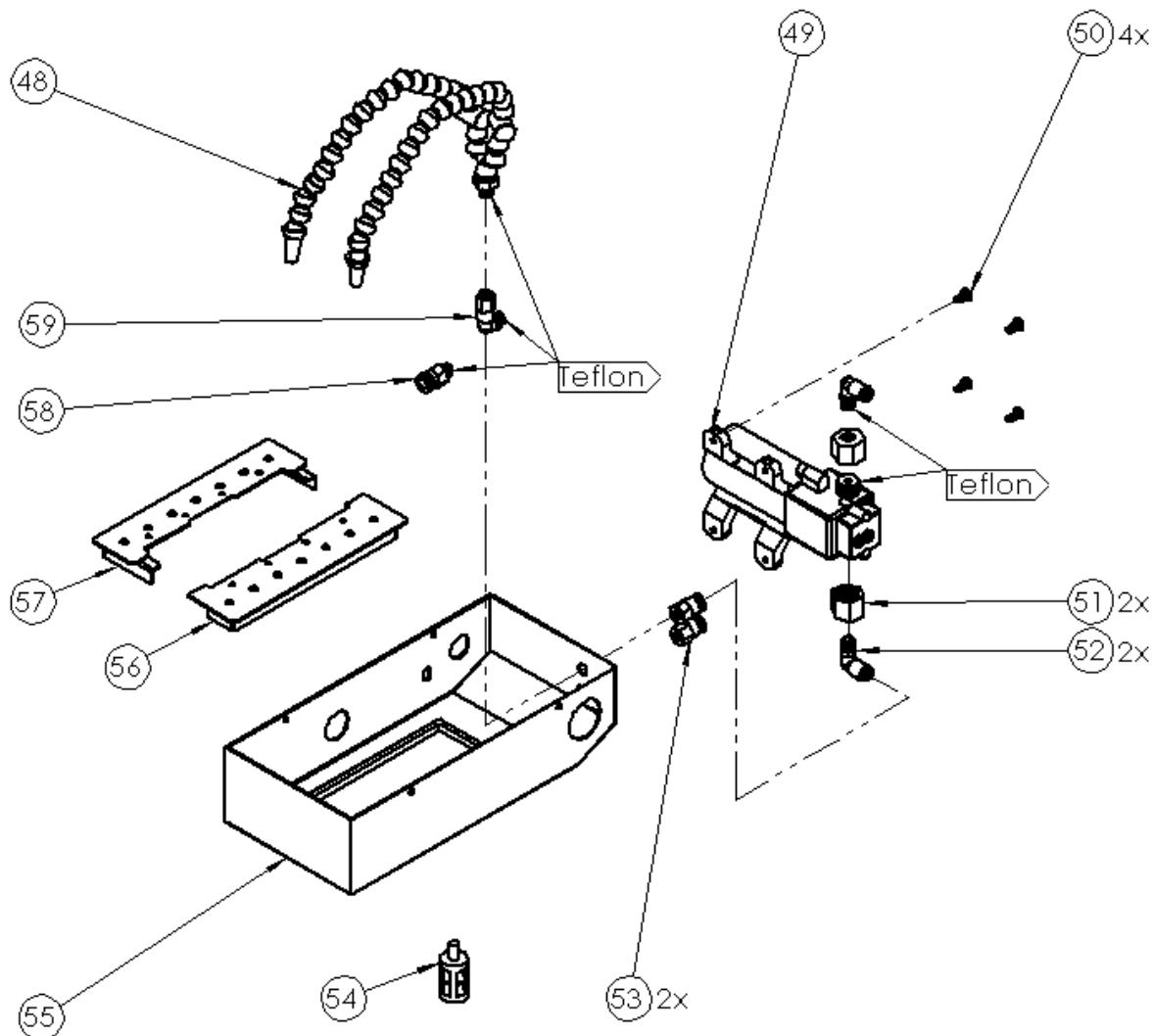
CONTROL PANEL ASSEMBLY





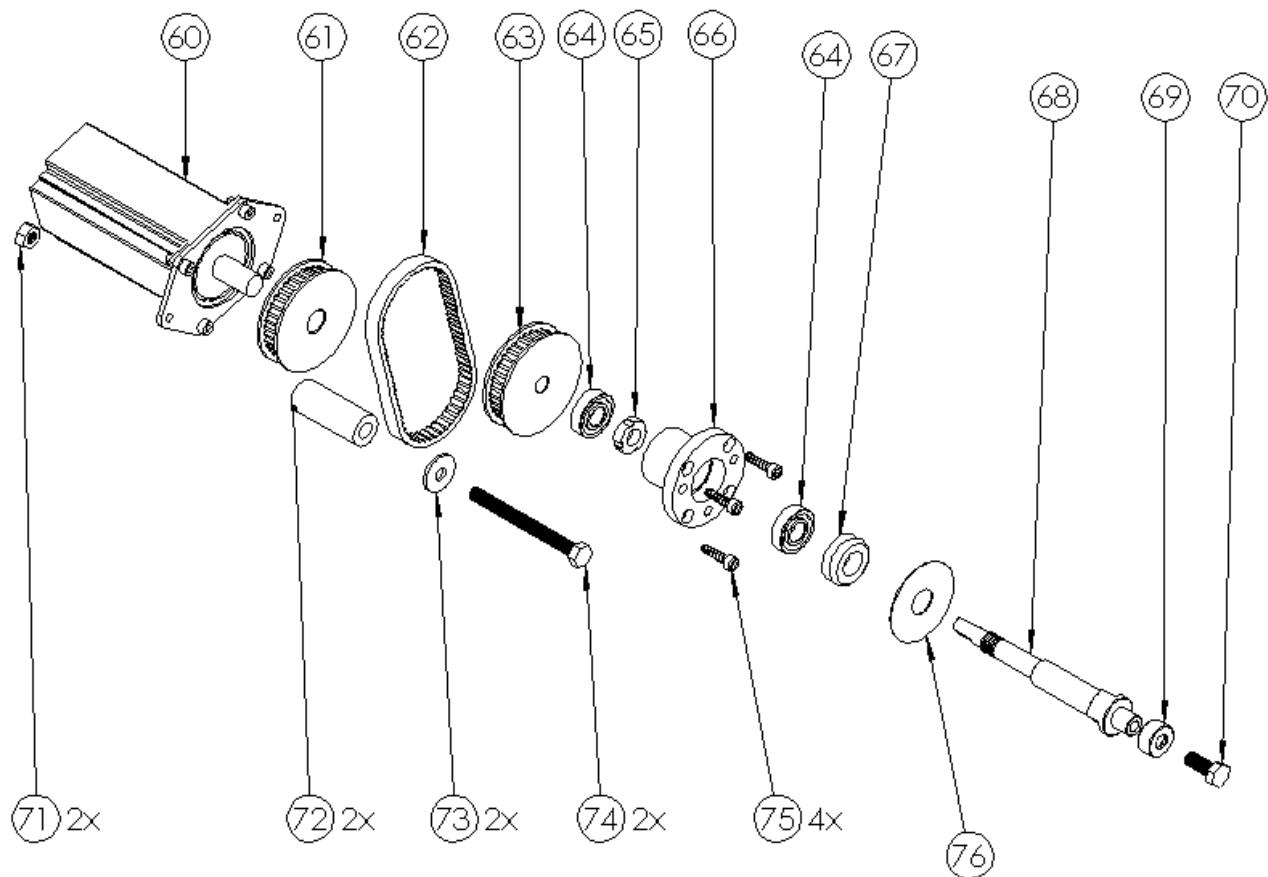
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COOLING SYSTEM ASSEMBLY





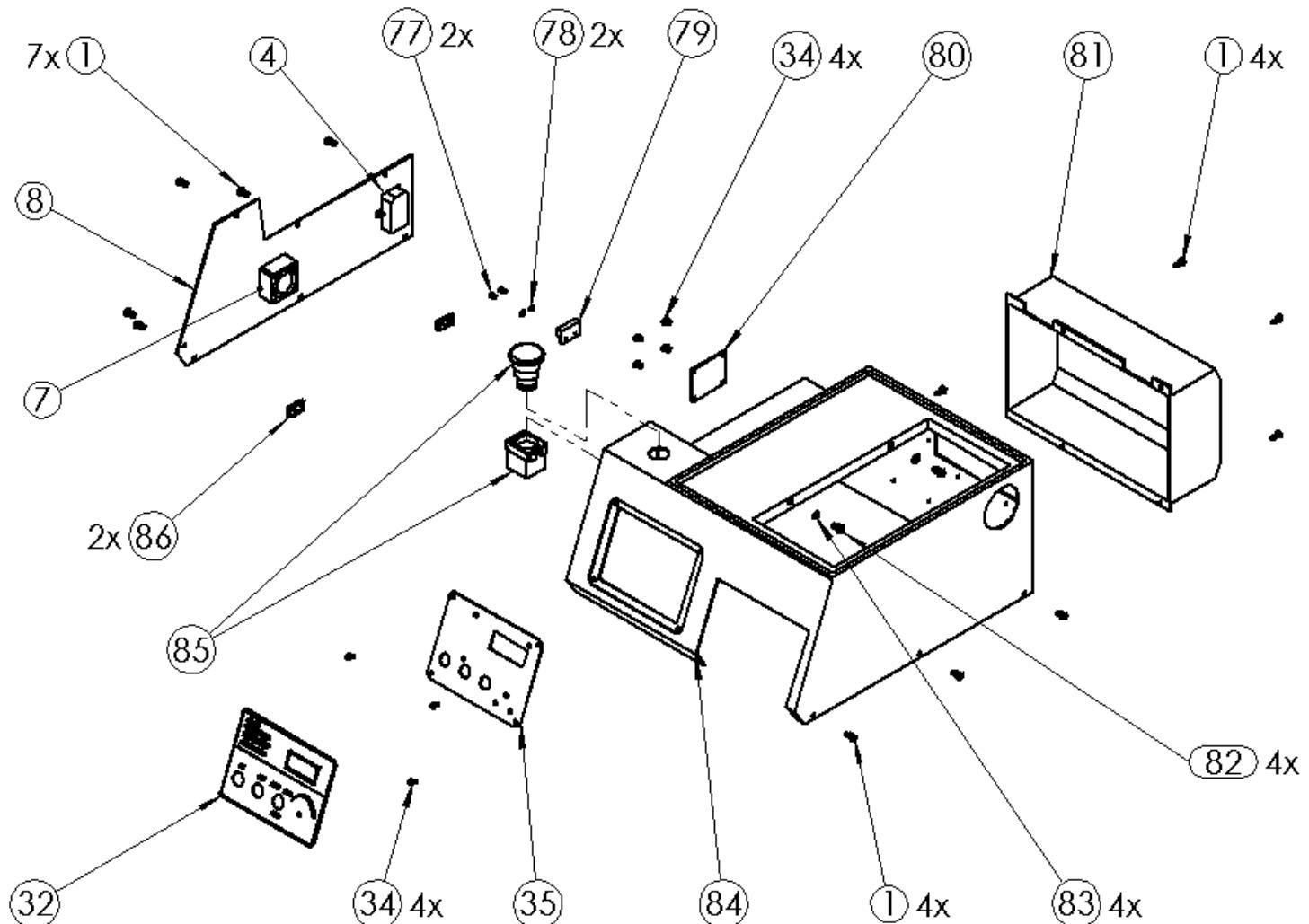
DRIVE SYSTEM ASSEMBLY



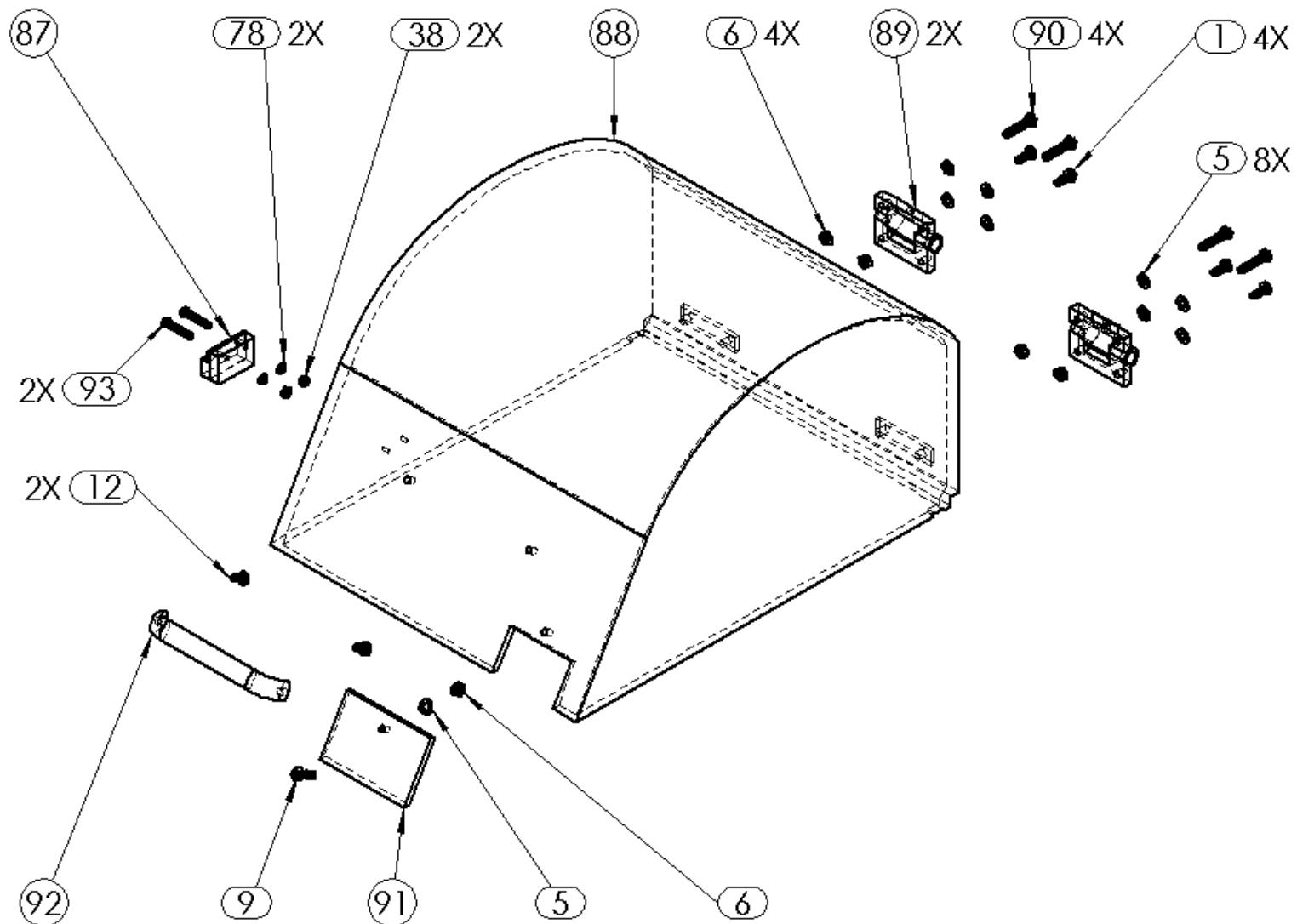


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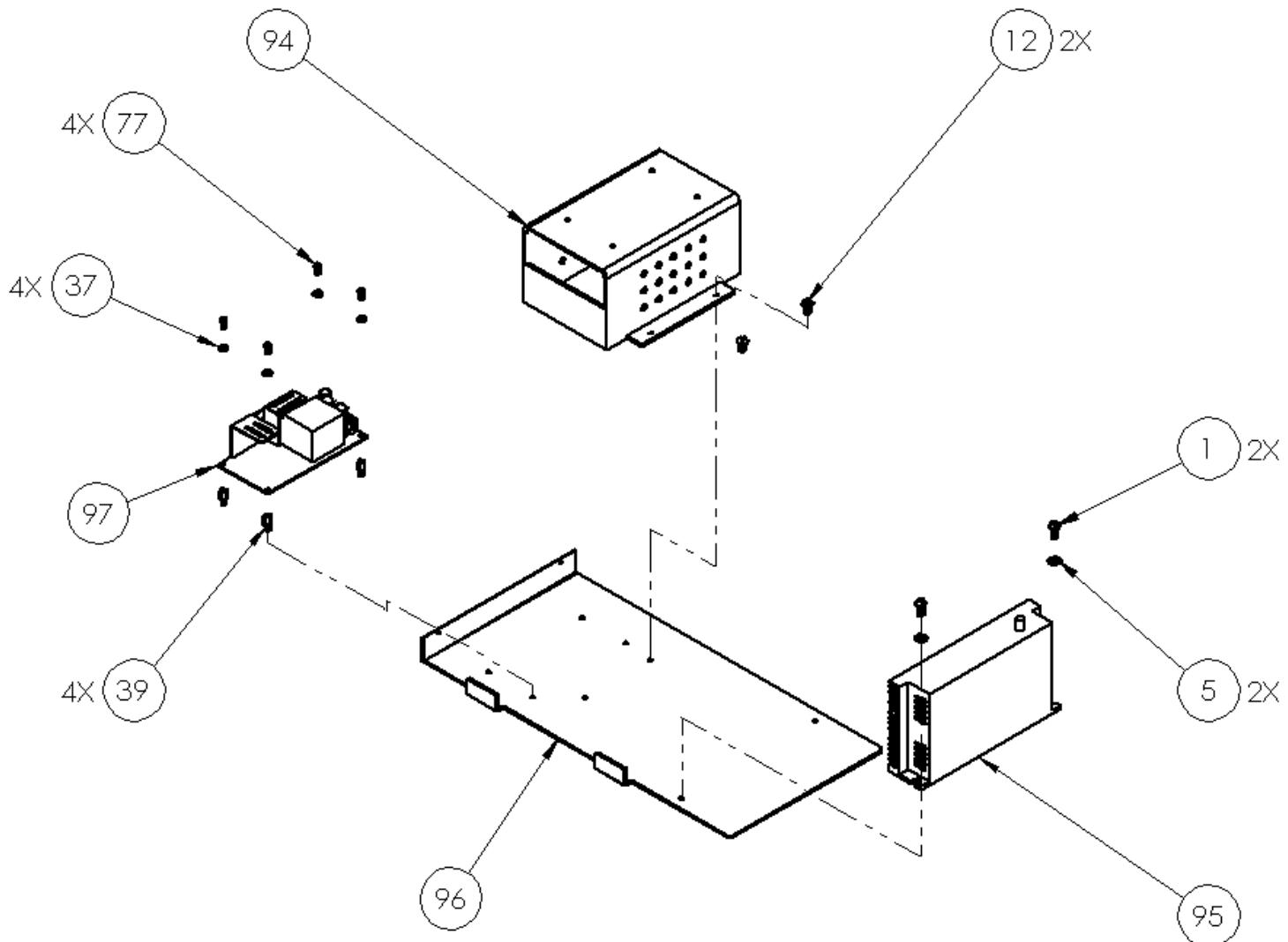
HOUSING ASSEMBLY



HOOD ASSEMBLY



POWER SUPPLY ASSEMBLY



Bill of Materials

ITEM NO.	Description	Part Number	QTY.
1	Phillips Pan Head Screw 4mm, 0.7 x 10mm		27
2	Fuse Box		1
3	Fuses	Fuse-7A	2
4	Power Switch and Fuse Holder	POW-F-SWITCH	1
5	Washer 4.5 mm		17
6	Hex Nut 4mm, 0.7		9
7	40mm Fan	40MM-FAN	1
8	Left side Access Panel door	P155-F-012	1
9	Pan Head Bolt 4mm, 0.7 x 14mm		5
10	PICO Electronics Board Rail	TB-Rail	2
11	Phillips Pan Head Screw 4mm, 0.7 x 5mm		4
12	Phillips Pan Head Screw 4mm, 0.7 x 8mm		8
13	Phillips Pan Head Screw 4mm, 0.7 x 30mm		2
14	Phillips Pan Head Screw 4mm, 0.7 x 15mm		2
15	Cut-Off Switch Bracket	P155-F-013	1
16	Cut-off-switch	SWT-CUT-OFF	1
17	Cut-off switch Rubber Boot	P155-013	1
18	Inner Micrometer Shaft Guide	P155-M-007	1
19	Allen-Cup Set Screw (3mm) 6mm, 1.0 x 8mm		6
20	Allen-Bolt (4mm) 5mm, 0.8 x 10mm		9
21	Cutting Chamber and Micrometer Shaft Seal	P155-014	1
22	Outer Micrometer Shaft Guide O-Ring	P155-016	1
23	Micrometer Shaft	P155-M-006	1
24	Micrometer Shaft Spring	P155-008	1
25	Outer Micrometer Shaft Guide	P155-M-008	1
26	Aluminum Base Casting	P155-M-001	1
27	Base Feet	M8-FEET	4
28	Tank Guide Roller Plate	P155-F-005	1
29	Stainless Steel Tank	P155-TA-A	1
30	Tank Handle	P155-018	1
31	Stainless Steel Tank Cover	P155-F-002	1
32	PICO 155P Control Panel Template	P155P - T	1

ITEM NO.	Description	Part Number	QTY.
33	Phillips Flat Head Screw 3mm, 0.5 x 2mm		4
34	Phillips Flat Head Screw 4mm, 0.7 x 6mm		12
35	Aluminum Template	P155-F-001	1
36	Front Control Pannel Board	PCB-P155	1
37	Washer 3.5mm		8
38	Hex Nut 3mm, 0.5 x 2mm		6
39	Hex Bolt Extension 3mm, 0.5 x 6mm		8
40	Button Locks		3
41	Slotted Set Screw 3mm, 0.5 x 2mm		1
42	Speed Control Knob	P155-E-003	1
43	Auto/Manual Pump Switch (XB6EA/3BIT)	SWT-E-001	1
44	Red Stop Button (XB6EA)	BTN-R-002	1
45	Green Start Button (XB6EA)	BTN-G-001	1
46	Hex Nut 6.5 mm, 0.75 x 2.25mm		1
47	Washer 7.5 mm		1
48	Dual Coolant Spray Nozzles	P155-017	1
49	24V Pump (PLD-2201/24V)	PLD-221/24V	1
50	Phillips Pan Head Screw 5mm, 0.8 x 10mm		4
51	90 Degree Male Compression Fitting 1/8" BSPT 8mm	CF-1/8-E-MF	2
52	Hex Cap Adaptor		2
53	Female Compression Fitting	PTC-1/8-F-8MM	2
54	Strainer Filter	TUBE-ST	1
55	Stainless Steel Cutting Chamber	P155-F-004	1
56	2-Piece Stainless Steel Sample Tray Cover	P155-F-007	1
57	2-Piece Stainless Steel Sample Tray Cover	P155-F-008	1
58	Male Compression Fitting	P155P - MCF	1
59	Pump 90 degree elbow 90° 8mm Push-to-Connect, M10 Male	PTC-M10-E-M-8MM	1
60	Motor (125W, 3 phase, 8 pole) 57BLF-123ONBB	MOT-BLDC-125	1
61	Arbor Shaft Gear	P155-PCG-A	1
62	Polychain	P155-007	1
63	Motor Gear	P155-PCG-B	1
64	Arbor Shaft Bearing	BB-12-28	2

INSTRUCTION MANUAL

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ITEM NO.	Description	Part Number	QTY.
65	M12x1.25 Slotted Lock Nut	P155-009	1
66	Arbor Guide	P155-AS-A	1
67	Arbor Shaft Rubber Boot	P155-012	1
68	Arbor Shaft	P155-AS-B	1
69	Arbor Spacer	P155-BBS-A	1
70	Arbor Hex Bolt 8mm, 1.25 x 20mm	P155-BBS-B	1
71	Hex Nut 8mm, 1.25		2
72	Motor Bracket Extension Tube	P155-M-005	1
73	Washer 8.5mm		2
74	Hex Bolt 8mm, 1.25 x 85mm		2
75	Allen Bolt (4mm) 5mm, 0.8 x 20mm		2
76	Cutting Chamber and Arbor Shaft Guide Seal	P155-014	4
77	Pan Head Bolt 3mm, 0.5 x 6mm		6
78	3mm washer		4
79	Internal safety magnet	SWT-MAG-IN	1
80	Cut-Off-Switch Cover	P155-F-011	1
81	Pump Cover	P155-F-010	1
82	Pan Head Bolt 5mm, 0.8 x 11mm		4
83	Washer 5.5mm		4
84	Metal cover	P155-F-009	1
85	Emergency Stop	POW-E-STOP	1
86	Side Panel Hinges	P155-019	2
87	External safety magnet (part no. SWT-MAG-EX)	SWT-MAG-EX	1
88	Hood	P155-003	1
89	Lid Hinges (Pair)	P155-010	1
90	Phillips Bolt 4mm, 0.7 x 20mm		4
91	Dressing fixture acrylic cover	P155-005	1
92	Hood handle	P155-011	1
93	Pan Head Bolt 3mm, 0.5 x 20mm		2
94	Electronics Acrylic Cover	P155-001	1
95	BLD-300B Motor Driver	MD-24V-DC	1
96	Electronics Base Pannel	P155-F-006	1
97	Power Supply	PS-24V-002	1

FIXTURES AND ACCESSORIES



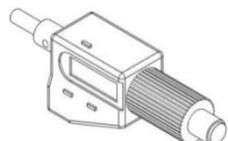
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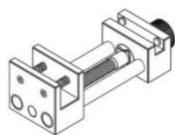
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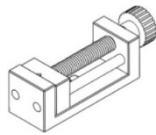
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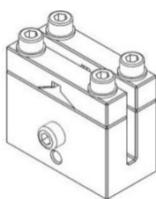
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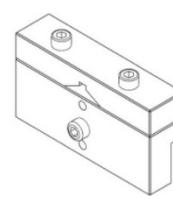
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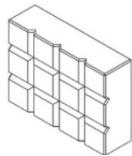
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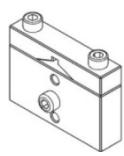
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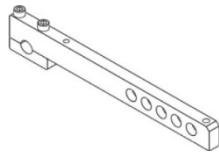
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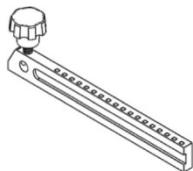
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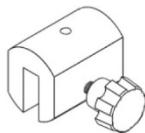
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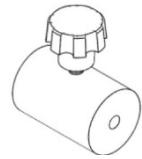
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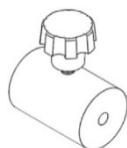
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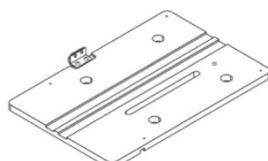
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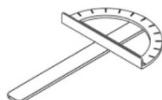
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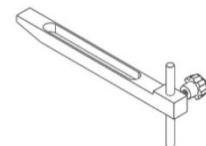
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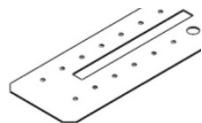
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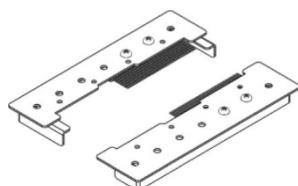
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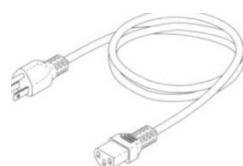
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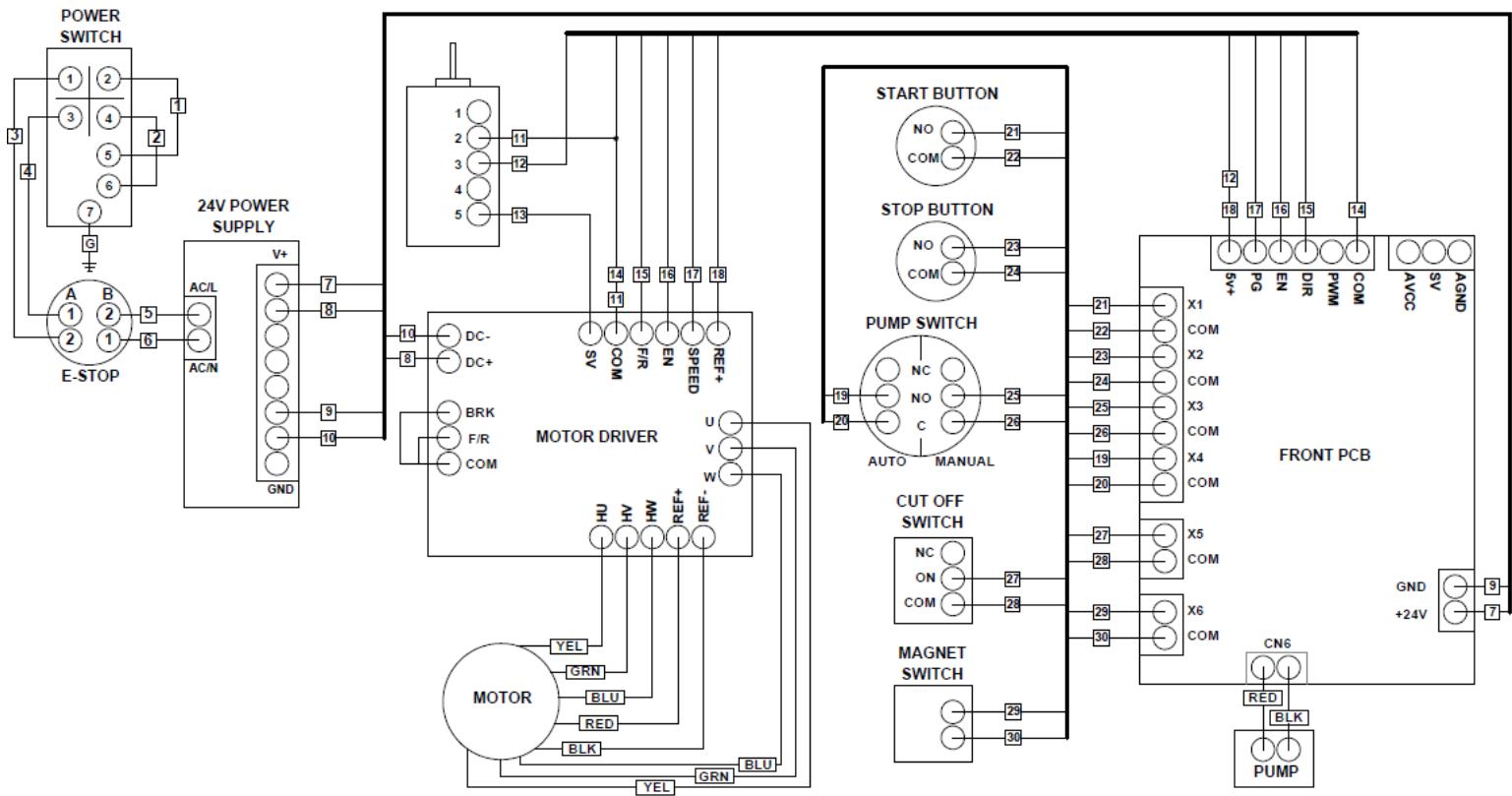
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ITEM	PART NO.	DESCRIPTION	QTY.
a	TOOL-W-14-17	14/1 7 mm Wrench	2
b	TOOL-4-ALLEN	4mm Allen Wrench	1
c	TOOL-2.5-ALLEN	2.5 mm Allen Wrench	1
d	P155-006	Micrometer	1
e	P155-A-DF	Dressing Fixture	1
f	P150-711	Fastener Vise for Longitudinal Sectioning of Fasteners	1
g	P150-703	Double Parallel Vise for Long Specimens	1
h	P150-702b	Larger Single Saddle with Lip	1
i	P150-708	40mm (1.6 inch) Round Specimen Vise	1
j	P150-707	32mm (1.4 inch) Round Specimen Vise	1
k	P150-706	Specimen Vise for Irregular Shaped Samples	1
l	P150-710	Teardrop Holder (18-40 mm) (.7-1.6 inch)	1
m	P150-709	Specimen Vise for Adhering Samples	1
n	P150-702	Universal Holder	1
o	P155-A-SSA	Sample Support Arm	1
p	P155-A-COS	Cut-Off Screw	1
q	P155-M-009	Sliding Load Arm	1
r	P155-M-010	Sliding Load Arm Weight	1
s	P155-M-015	Counterbalance Rod	1
t	P155-M-013	300 g. Weight	1
u	P155-M-012	250 g. Weight	2
v	P155-M-011	Weight Rod	1
w	P155-M-003	75mm (3.0 inch) Arbor Flanges	1
x	P155-M-002	50mm(2.0 inch) Arbor Flanges	1
y	P155-M-004	Flange Spacer	1
z	P155-A-CA	Cutting Table	1
aa	P155-A-PG	Protractor Guide	1
ab	P155-A-CS	Cutting Splash Guard	1
ac	P155-F-002	Stainless Steel Tank Cover	1
ad	P155-A-STC	2-Piece Stainless Steel Sample Tray Cover	1
ae	C-110V-001	110V Power Cord	1

WIRING DIAGRAM



9.0 Precision Wafer Sectioning

9.1a Precision Wafer Sectioning Introduction

Precision wafer cutting is used for sectioning very delicate samples or sectioning a sample to a very precise location. Precision wafering saws typically have micrometers for precise alignment and positioning of the sample as well as variable loading and cutting speed control (see Figure 9-1).



Figure 9-1 **PICO-155P** Precision wafering saw

9.1b Wafering Blade Characteristics

In order to minimize cutting damage, precision wafer cutting most frequently uses diamond wafering blades. However, for some materials, the use of cubic boron nitride (CBN) is more efficient. In addition, optimal wafer cutting is accomplished by maximizing the abrasive concentration and abrasive size, as well as choosing the most appropriate cutting speed and load. Table III provides some general guidelines and parameters for precision-sectioning a variety of materials.

The particle size of fine diamond grit blades is 10-20 microns or approximately 600 grit. For medium grit diamond wafering blades, the particle size is 60-70 micron or 220 grit. For these types of wafering blades, the abrasive is mixed with a metal binder and then pressed under high pressure (Figure 9-2). As will be discussed in the next section, periodic dressing / conditioning of the metal pressed blades is required for optimum cutting performance of the blade.



Figure 9-2 Metal pressed diamond and CBN wafering blades.

TABLE III. Precision Cutting Blade Specifications

Wafering Blade Description	Characteristic
Fine grit	10-20 micron (600 grit)
Medium grit	60-70 micron (220 grit)
Coarse grit	120 micron (120 grit)
High concentration	100%
Low concentration	50%

In some cases, precision cutting requires a coarser grit wafering blade. Usually, the coarsest standard blade uses 120 grit abrasive particles. For metallographic applications, coarse abrasives are mostly associated with electroplated blades (Figure 9-3a). The main characteristic of coarse electroplated blades is that the abrasive has a much higher or rougher profile. The advantage of this higher profile is that the blade does not -inchgum up-inch when cutting soft materials such as bone, plastics, and rubbery types of materials.

Although less common, thin resin/rubber abrasive blades can be used for cutting on precision wafering saws (Figure 9-3b). For cutting with abrasive blades on precision wafer saws, set the speed of the saw to at least 1500 rpm. Note that abrasive blades create significantly more debris which requires changing out the cutting fluid more frequently.



Figure 9-3 (a) electroplated diamond blade for soft materials (left) and (b) alumina resin/rubber blade (right).

Perhaps the most important parameter for precision sectioning is the abrasive size. Similar to grinding and polishing, finer abrasives produce less damage. For extremely brittle materials, finer abrasives are required to minimize the damage produced during sectioning. Sectioning with a fine-abrasive wafering blade is often the only way that a specimen can be cut such that the final polished specimen represents the true microstructure. Examples include: silicon computer chips, gallium arsenide, brittle glasses, ceramic composites, and boron/graphite composites. Figure 9-4a and 9-4b compares the effects of cutting with a fine-grit blade vs. a standard medium-grit blade for sectioning a boron graphite golf shaft. As can be seen, the fine grit blade produces significantly less damage to boron fibers.

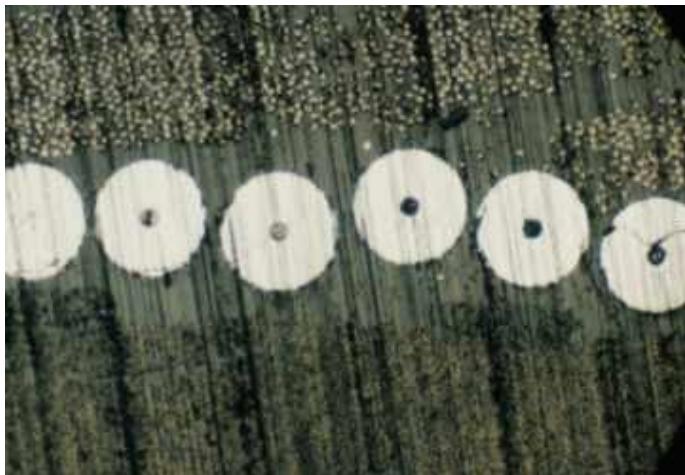


Figure 9-4a Fine diamond cut for boron graphite composite



Figure 9-4b Medium grit diamond cut for boron graphite composite

The second most important blade characteristic is the abrasive concentration because it directly affects the load applied during cutting. For example, brittle materials such as ceramics require higher effective loads to efficiently section, whereas ductile materials such as metals require a higher abrasive concentration in order to have more cutting points. The result is that low-concentration blades are recommended for sectioning hard brittle materials such as ceramics, and high concentration blades are recommended for sectioning ductile materials containing a large fraction of metal or plastic.

TIP: Minimizing the amount of damage created during sectioning can significantly reduce the amount of time required for grinding and polishing.

The wafering blade bonding matrix can also significantly affect a blade's cutting performance. Metal-pressed wafering blades require periodic dressing in order to maintain performance. A common misconception is that the cutting rates for these blades decrease because the diamond or abrasive is being -inchpulled-out-inch of the blade. In reality, the metal bond is primarily smearing over the abrasive and -inchblinding-inch the cutting edge of the abrasive. With periodic dressing using a ceramic abrasive encased in a relatively soft matrix (Figure 9-5), this smeared material is removed and the cutting rate restored. Figure 9-6 shows the effect of dressing a standard grit low-concentration diamond blade for cutting a very hard material such as silicon nitride. Without dressing the blade, the cut rate significantly decreases after each subsequent cut. After dressing the blade, the sample once again cuts like a new blade. Note: it is highly recommended that a dressing fixture be used for conditioning or dressing the wafering blades in order to reduce the risk of breaking or chipping the wafering blades (Figure 9-7). Blade dressing is also accomplished at low speeds (<300 rpm) and at light loads (<100 grams).



Figure 9-5 DIACUT Dressing Stick

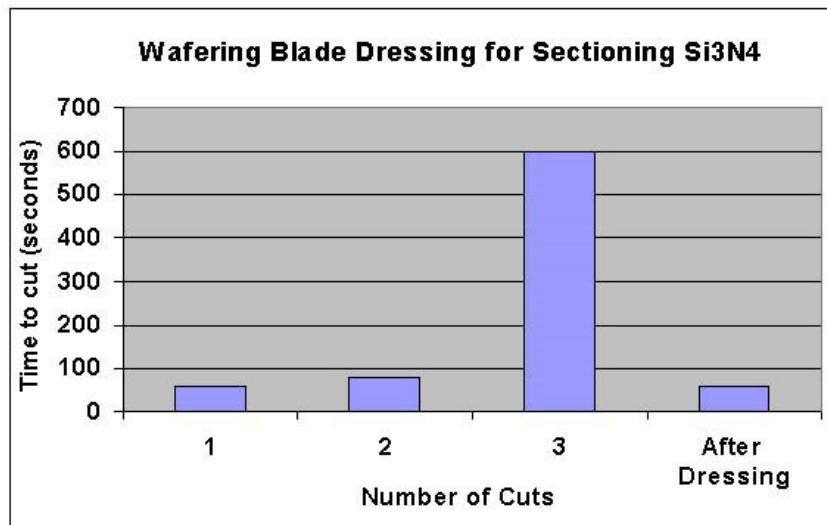


Figure 9-6 Cutting performance vs wafering blade conditioning

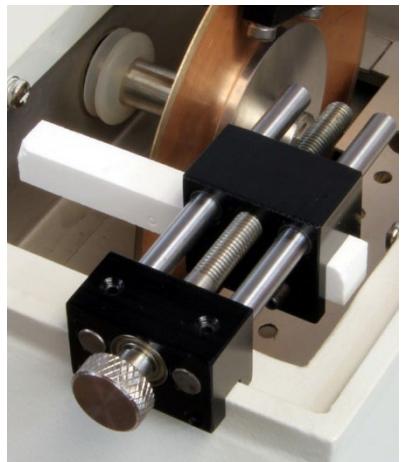


Figure 9-7 Proper dressing fixturing will minimize damage to the wafering blade.

Table IV provides some recommended guidelines for sectioning a variety of materials ranging from very brittle to very hard and tough.

TABLE IV. Guidelines for Wafering Cutting Various Materials

Material	Characteristic	Speed (rpm)	Load (grams)	Blade (grit/conc.)
Silicon substrate	Soft / brittle	<300	<100	Fine / low
Gallium arsenide	Soft / brittle	<200	<100	Fine / low
Boron composites	Very brittle	500	250	Fine / low
Ceramic fiber composites	Very brittle	1000	500	Fine / low
Glasses	Brittle	1000	500	Fine / low
Minerals	Friable / brittle	1500	>500	Medium / low
Alumina ceramic	Hard / tough	1500	>500	Medium / low
Zirconia (PSZ)	Hard / tough	1500	>800	Medium / low
Silicon nitride	Hard / tough	1500	>800	Medium / low
Metal matrix composites	Variable	1500	>500	Medium / high
General purpose	Variable	Variable	Variable	Medium / high

9.2 Cutting Parameters

Most wafer cutting is done at speeds between 50 rpm and 5000 rpm with loads varying from 10-1000 grams. Generally, harder specimens are cut at higher loads and speeds (e.g., ceramics and minerals) and more brittle specimens are cut at lower loads and speeds (e.g., electronic silicon substrates) (see Table IV). It is interesting to note that the cutting efficiency for sectioning hard/tough ceramics improves at higher speeds and higher loads. Figure 9-8 compares the resulting surface finish for sectioning partially stabilized zirconia at low-speed/low-load (Figure 9-8a) vs cutting at a higher load/higher speed (Figure 9-8b). As can be seen, partially stabilized zirconia has less fracturing and grain pull-out after sectioning at higher speeds and loads. This observation may seem counterintuitive; however, for sectioning hard/tough ceramics, high cutting speeds and loads result in producing a crack that propagates in the direction of the cut instead of laterally into the specimen.

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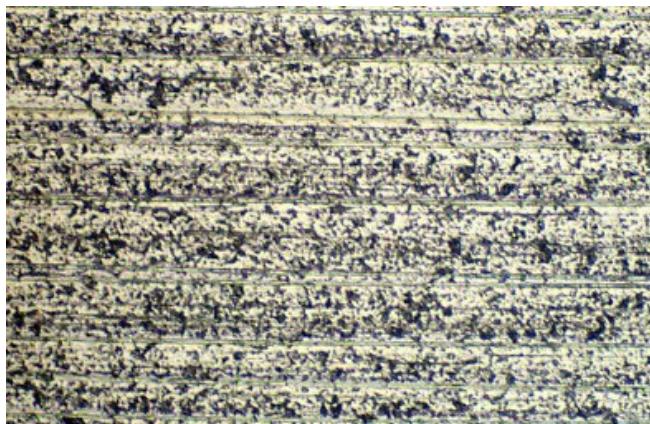


Figure 9-8a Partially stabilized zirconia sectioned at low speeds and low loads

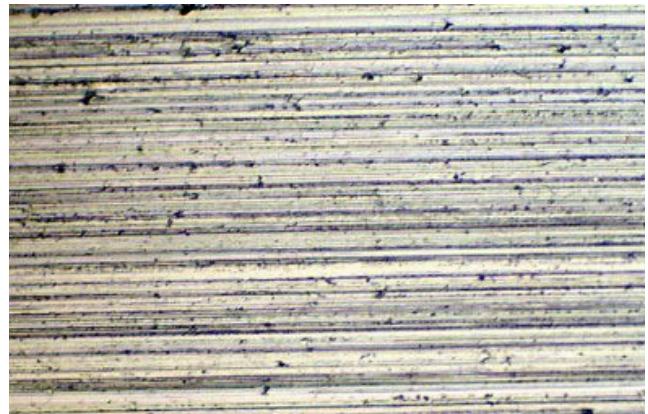


Figure 9-8b Partially stabilized zirconia sectioned at high speeds and high loads

For wafer cutting, it is recommended that a cutting fluid be used. The characteristics of a good cutting fluid include:

- Removes and suspends the cutting swarf
- Lubricates the blade and sample
- Reduces corrosion of the sample, blade, and cutting machine parts

In general, cutting fluids are either water-based or oil-based (Figure 9-9). Water-based cutting fluids are the most common because they are easier to clean. However, oil-based cutting fluids typically provide more lubrication.



Figure 9-9 Oil-based, water-based, and anti-corrosion cutting fluids

9.3 Recommended Wafer Cutting Procedures

- Prior to cutting the sample, condition or dress the wafering blade with the appropriate dressing stick.
- Clamp the specimen sufficiently so that the sample does not shift during cutting. If appropriate, clamp both sides of the specimen in order to eliminate the cutting burr which can form at the end of the cut.
- For brittle materials, clamp the specimen with a rubber pad to absorb vibration from the cutting operation.
- Begin the cut with a lower force in order to set the blade cutting kerf.
- Orient the specimen so that it is cut through the smallest cross section.
- For samples with coatings, keep the coatings in compression by sectioning through the coating and into the substrate material.
- Use largest appropriate blade flanges to prevent the blade from wobbling or flexing during cutting.
- Reduce the force toward the end of the cut for brittle specimens.
- Use the appropriate cutting fluid.