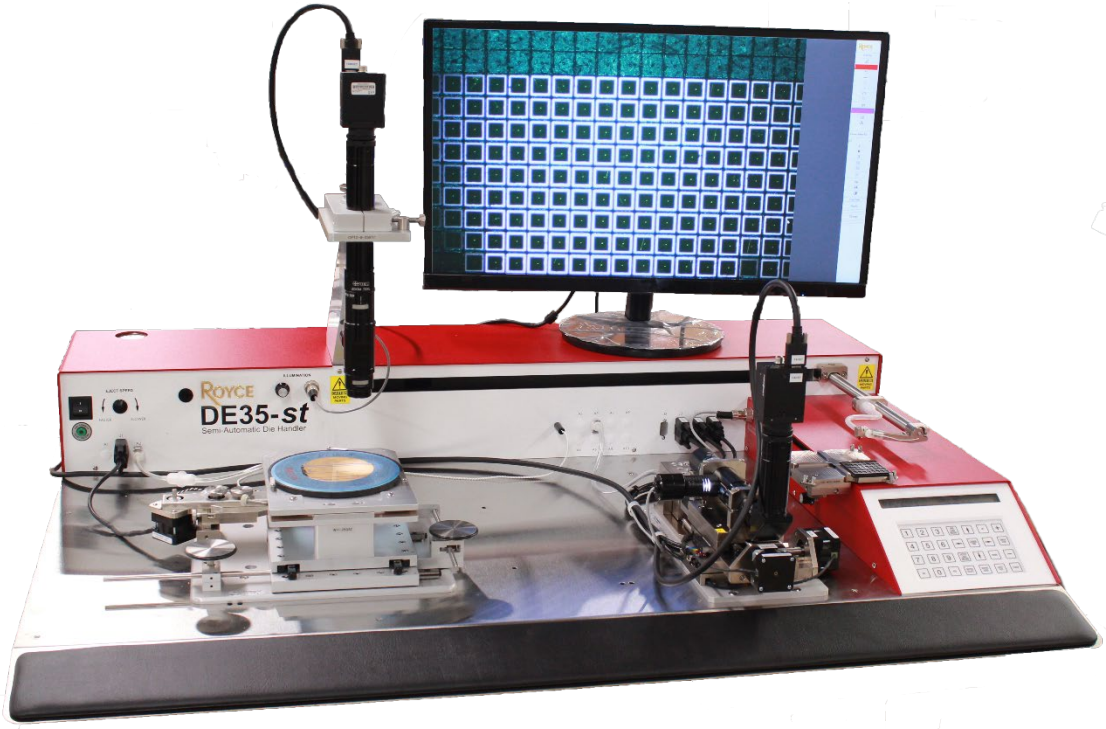
ROYCE INSTRUMENTS



DE35-ST & DE35-300

User's Guide

User's Guide #D292469I

V-TEK INC.

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EC Declaration of Conformity

Manufacturer's Name: V-TEK Inc.
Manufacturer's Address: 751 Summit Avenue
Mankato, MN 56001

Bearing sole responsibility, hereby declare that the product referred to by this declaration is in conformity with the following standards or normative documents:

Description: **Royce Die Sorter**
Specification: **Model DE35-ST**
Serial #: **XXXXXXX**

The following standards have either been referred to or been complied with in part or in full as relevant:

Low Voltage Directive (LVD)
EN 61010 — Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

89/336/EEC **Electromagnetic Compatibility (EMC)**
EN61326: 1997
EN55011: 1998

2011/65/EU RoHS 2 — Restriction of Hazardous Substances

Full Name of responsible person and place of signing

Mitchell Jacobs

Place V-TEK Inc. **Position** President/CEO

Signature **Date** 02/11/2021

EC REP
QNET BV
Hommerterweg 286
6436 AM Amstenrade
The Netherlands

CONTENTS

Introduction & Overview

Overview

The DE35 ST and DE35-300 semi-automatic die pick-and-place systems are a simple low cost machine for picking die from sawn or scribed wafers mounted on adhesive film. Die can be placed into waffle packs, gel packs, film frames, or directly onto substrates. The DE35-ST and DE35-300 will handle die sizes from as small as 0.008 inch square to over 1.0 inch square.

Setup and option information is preserved in non-volatile memory so that following a weekend shutdown, for example, you can restart the machine without further setup.

Waffle pack pockets for die placement are automatically selected. Manual selection using the keyboard arrow keys enables completion of partially filled waffle packs. If a grading output mode is selected, the machine places the die in the next pocket of the corresponding waffle pack and advises the operator when any of the waffle packs are full.

Standard configuration is for Surface contact pick up, where the die is lifted by an eject needle and the pickup tip touches the die and holds the die with vacuum. The system is also available in a Non-Surface Contact, (NSC) configuration. In NSC, the die is picked by the edges using tweezers like fingers.

Additional options available with the DE35 Series allow for Underside inspection of the die picked and Facet inspection for Laser Diode operations.

Utility Requirements

AIR 40 - 80 psi (2.7 - 5.4 atm), oil free
Tubing, polyurethane, 85A, 1/8 ID, 1/4 OD, 126 PSI MAX @ 75 DEG F, TRANSPARENT BLUE, or equivalent (customer supplied).

***Note**: Oil free air preferred since some discharge to atmosphere will take place.*

VACUUM 20 in Hg (508 mm Hg)
Tubing, vinyl (PVC OR TYGON), 1/8 ID, 1/4 OD, CLEAR, or equivalent (customer supplied)

ELECTRICAL 110-220 VAC, 50 - 60 HZ

POWER 25 watts continuous, 50 watts intermittent

FUSE: **DE35-ST** 5 Amp
DE35-300 5 Amp

Installed Dimensions: DE35-ST

WIDTH 45 in. (1.15m)

DEPTH 33 in. (0.83m)

HEIGHT 25 in. (0.66m)

WEIGHT 205 lb. (93 kg)

***Note:** All dimensions are approximate and subject to change without notice.*

Installed Dimensions: DE35-300

WIDTH 48.0 in. (1.22m)

DEPTH 40.3 in. (1.02m)

HEIGHT 26 in. (0.66m)

WEIGHT 430 lb. (195 kg)

***Note:** All dimensions are approximate and subject to change without notice.*

Machine Setup & Installation

The DE35 ST Die Pick and Place System is intended to be installed in a facility meeting the listed environmental requirements unless otherwise specified in a particular section.

- Indoor use
- Altitude up to 2000 meters
- 60 to 70 degrees Fahrenheit
- Maximum Relative Humidity of 10 to 90 percent, non- saturating.
- Main supply voltage fluctuations not to exceed ±10% of nominal voltage.
- Transient over-voltages according to installation categories: Over voltage Categories II
- Pollution Degree 2

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Safety Instructions

The information in this document is subject to change in order to improve reliability, design, or function without prior notice and does not represent a commitment on the part of this company.

1. **Read Instructions** - All the safety and operating instructions must be read before the machine is operated.
2. **Follow Instructions** - All operating and use instructions must be followed.
3. **Heat** - The machine should be situated away from heat sources such as radiators, heat registers, ovens, or other machinery that produce heat.
4. **Power-Cord Protection** - Power-supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the appliance.
5. **Object and Liquid Entry** - Care must be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.
6. **Do not use the machine near water, or when you are wet** - If the machine comes in contact with any liquids, unplug the power and line cords immediately. Do not plug the machine back in until it has been dried thoroughly.
7. **Damage Requiring Service** - The machine must be serviced by qualified service personnel when:
    A. The power supply cord or the plug has been damaged; or
    B. Objects have fallen or liquid has been spilled into the machine; or
    C. The machine has been exposed to rain; or
    D. The machine does not appear to operate normally or exhibits a marked change in the performance; or
    E. The machine has been dropped, or the enclosure is damaged.
8. **Servicing** - The user should not attempt to service the machine beyond that described in the operating instructions. All other servicing should be referred to qualified service personnel. Opening the machine or reassembling it incorrectly may expose you to dangerous voltages or other risks.
9. **Install this machine securely on a stable surface** - Serious damage may result if the machine falls. Ensure the PC is mounted securely on the top left side of the mainframe for safety.
10. **During thunderstorms**, avoid using machines connected to a phone line - There may be a slight chance of electric shock from lightning.

11. **Do not use machine in the vicinity of a gas leak** - If you suspect a gas leak, report it immediately, but use a telephone away from the area where gas is leaking.
12. **Use only the correct power source as marked on the machine** - If you are not sure of the power supply; consult your local power company. If the machine uses a wall plug-in transformer, use only the transformer supplied.
13. **Your wall outlet must only accept a polarized, three-prong grounded-plug** - Such plugs are designed for your safety. Do not attempt to defeat this purpose. If you cannot insert the plug easily, an electrician should replace your outlet.
14. **EMO switch cables must be plugged in correctly** - PC monitor and illuminator must be plugged into the mainframe (not into the wall) to ensure that they are shut off if EMO switch is engaged.
15. **Moving and lifting the DE35 ST** - The DE35 ST mainframe weighs 205 lbs (93 kg). Moving or lifting the system requires four individuals, with one positioned at each corner of the machine.

    Moving and lifting the DE35 300 - The DE35-300 mainframe weighs 430 lbs (195 kg). Moving or lifting the system requires a mechanical lifting system. Do NOT attempt to move the machine manually.

Unpacking & Installation

Uncrate the DE35-ST/DE35-300

1. Remove all packaging material and place the mainframe on a suitable, secure table.
2. Connect air and vacuum in accordance with the specifications given in Utility Requirements section.
3. Connect all power.

Unpack the Carton

1. Inventory all parts and accessories against the shipping document.
2. Verify all parts are received.
3. Carefully inspect for small parts before discarding any packing material.
4. Call Royce with any questions concerning parts found when unpacking.

Setup & Start-Up

Connections & Setup

1. Locate the Foot Switch and plug into the appropriate connector on the Rear Panel.
2. Remove the Transit Screw holding the X-Y Stage in position. This is located at the front right corner of the X-Y Stage and has a red plastic cap.
3. Install the Target Camera Mounting Bracket with Lens assembly, using (2) ¼ x 20 Socket Head Cap Screws provided. (Requires a 3/16 Allen wrench).
    a. Screw the Camera onto the top of the Lens Assembly until it stops and is snug, but not tight.

       NOTE: *Be careful, the screw threads are fine and are easily damaged.*

    b. The Camera orientation is set at the factory so that a non-inverted image appears on the monitor.
4. Install an Eject Head into the Eject Actuator (see directions on the following page).
    a. If you have more than one type of Eject Head a single needle Eject Head is preferable for alignment purposes.
    b. Verify air and vacuum are connected to the Actuator and the Eject Head.

Figure 1 - Back panel of PC

5. Connect the Power Supply (1).
6. Connect the Display Port to HDMI cable between the PC and monitor (2).
7. Attach the COM cable from the Mainframe's COM2 port to the USB to Serial convertor's DB9. Plug the USB side into the PC's USB (3).
8. Connect all USB devices based on Type A or B system configurations:
    a. The system possesses a single camera
        i. Connect the camera to USB (4)

ii. Connect the keyboard and mouse to USB (5 & 6)

b. The system possesses multiple cameras:

i. Connect the cameras to USB 4 – 6.

ii. Connect the keyboard and mouse to the PC's front USB ports.

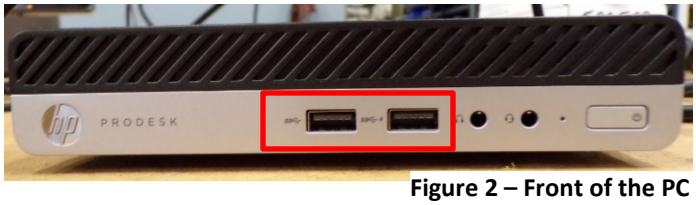


Figure 2 – Front of the PC

Power Up

Figure 2 – Front of the PC

1. Verify that Illumination (part of the DE35 optics package) is turned ON.
2. Press the **Power** button on the front of the monitor.
3. Press the **Power** button on the front of the PC. The camera will turn on automatically when the PC is turned on.
4. A light should now be seen on the front of the PC, showing that the PC is on (see Figure 2).
5. Once the PC is booted login with the Royce account (default password is ROYCE).
6. Royce Technical Video will auto launch with each boot.

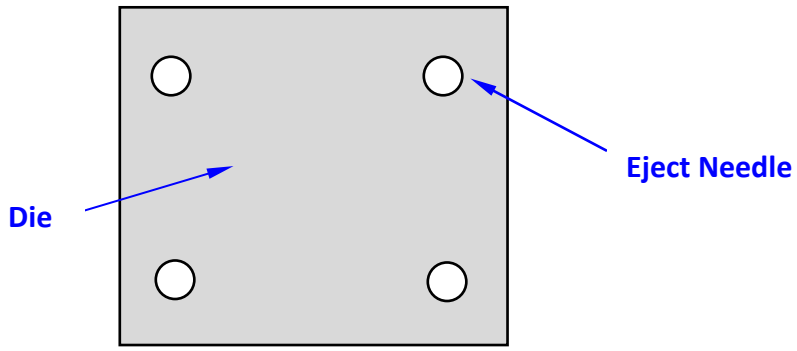
Note: *There are two user accounts on the system. The administrator account is "ROYCE", password "ROYCE". The user account is "User", password "User".*

Installing an Eject Head

Select the appropriate Eject Head for the die size which will be picked. If unsure which Eject Head to use, refer to the **Table of Recommended Eject Head Sizes** at the end of this manual.

1. Screw the Eject Head into the Actuator located in the center of the machine, directly under the Camera.
    a. If the Eject Head is a single needle (used to pick die smaller than 30 mil square), the orientation is not important. Tighten the Eject Head so that it is snug.
    b. For multiple needle heads, the Eject Head will need to be rotated until the needles are square with the die being picked. For motorized stages (DES-AUM), the Eject Head should always be screwed fully into the Actuator so the Eject Head Body is flush with the top of the Actuator.

       To rotate the Eject Head, loosen the screws at the base of the Actuator and rotate the Actuator until needles are in desired position. Then tighten screws at the base of the Actuator.
    c. For the standard four-needle Eject Head, the needles should line up with the four corners of the die, as shown below.

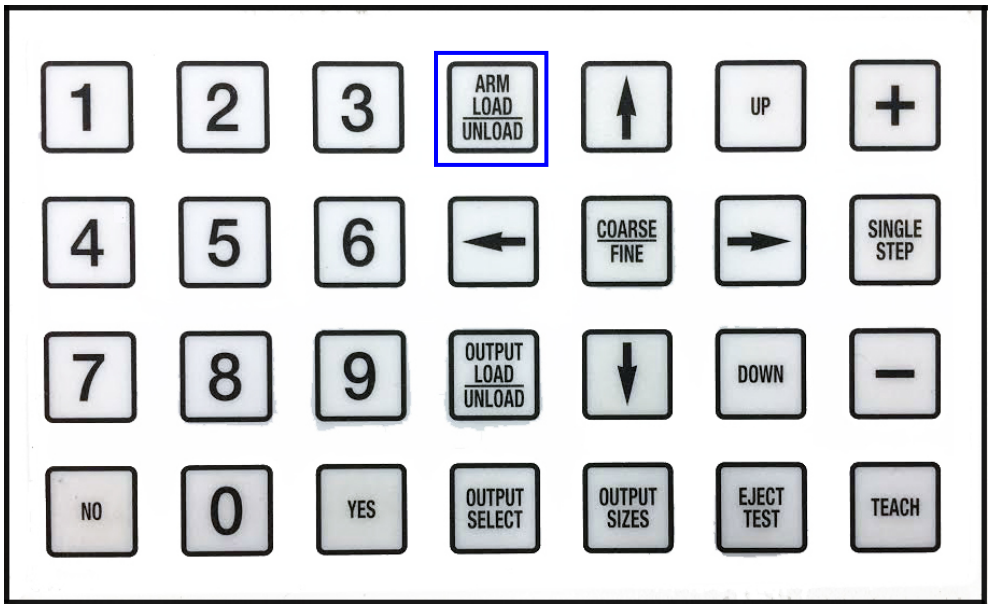


2. Connect the Vacuum Tube from the Front Panel of the machine to the Nozzle protruding from the Eject Head.

Installing a Pickup Tip

To install a Pickup Tip you will need a .050 Allen Hex Key and the proper size tip for the die you want to pick.

1. With the power **ON**, use the **ARM LOAD/UNLOAD** key to sequence the Z-Arm till it is located between the Wafer Holder and the Output Plate.



2. Insert tip into hole in bottom of Pickup Head.
3. Carefully snug the setscrew to hold the tip in the head.

Installing the Wafer Holder

1. Install the Wafer Holder on the Die Eject Stage (DES) with the 10-32 x 2.25 socket cap screws provided.

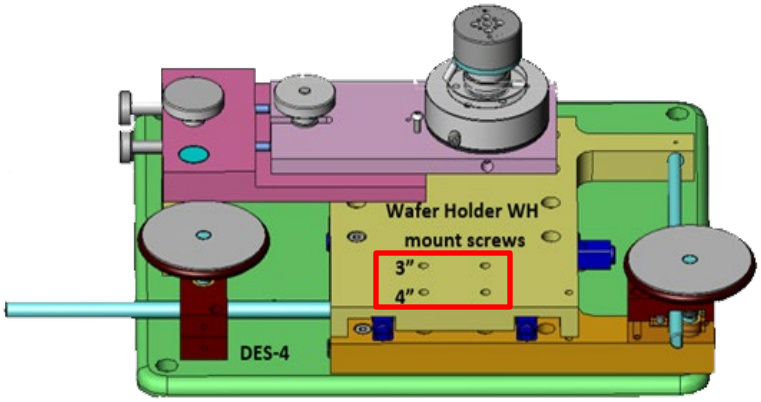


Figure 1.1: Max 4 in Wafer Diameter Holder

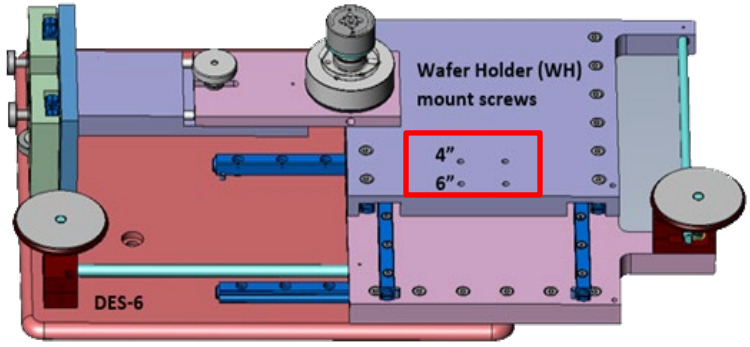


Figure 1.2: Max 6 in Wafer Diameter Holder

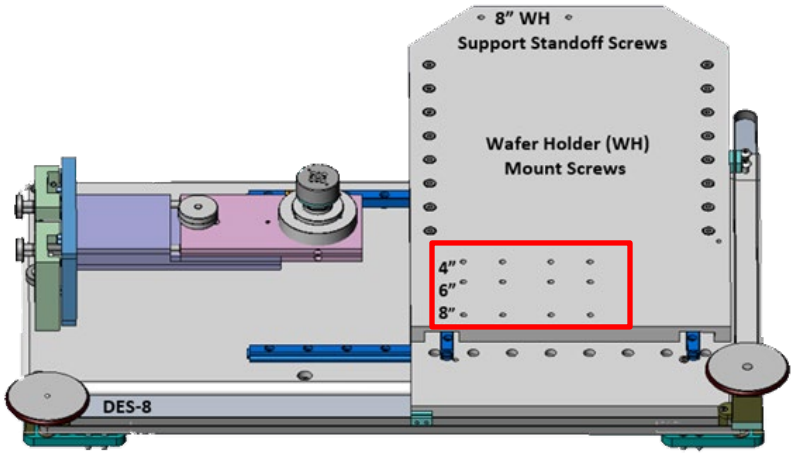


Figure 1.3: Max 8 in Wafer Diameter Holder

2. Plug the Interlock Cable into the connector located on the panel to the right of the DES.
3. Install a Wafer with die on the Wafer Holder.
4. Align the die on the X and Y Axis by rotating the wafer in the holder. Final alignment can be done with the Theta Adjustment of the Wafer Holder.
5. Ensure the Wafer Holder is closed, and the Micro Switch is made. (Adjust the lever on the frame until the switch is made.)

Check Follow Focus & Zoom Center

NOTE: *The Camera and Zoom Lens have been set up to ensure that the lens is "zoom centered" and "follows focus" throughout the zoom range.* ***Any adjustment of the camera tube height or alignment is strongly discouraged without first consulting the manufacturer.***

1. Turn on the Monitor and the PC. The Royce TV program will automatically launch.
2. Click on the '**+**' button and then move the cursor over to the live video image. Click in the top left corner and drag down to the bottom right corner and release. This should create a cross in the middle of the video image.
3. Zoom Camera Lens into **maximum** zoom.
4. Using the hand wheels on the DES, align a die with the crosshairs in the upper right segment of the Monitor. Align the die so the left and bottom edges of the die are on the crosshairs. Adjust the focus for a clear presentation.
5. Zoom the Camera Lens out to **minimum** zoom. The presentation should stay in focus and the die should not move away from the crosshairs.

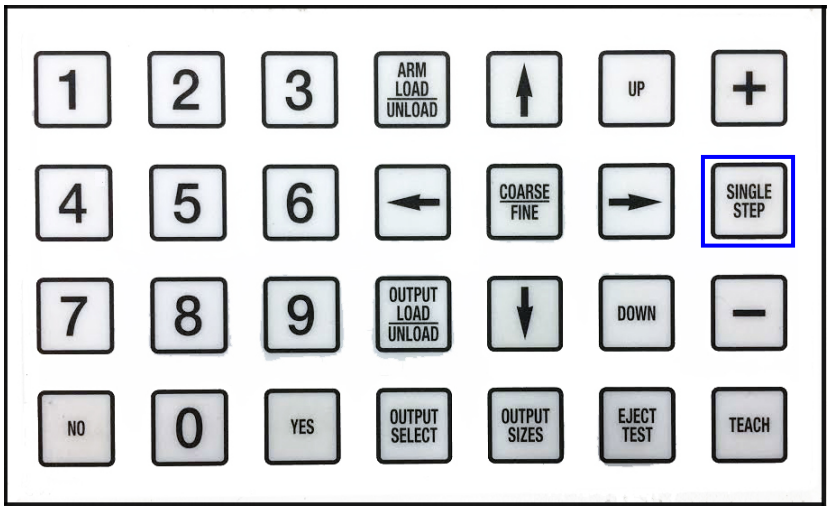
NOTE: *If the alignment or focus changes when doing the above, see Optical Center and Follow Focus in the Maintenance section of this manual.*

System Alignment: DE35

NOTE: *For DE35-300 alignment, proceed to the next section.*

After the System has been assembled it must be aligned. The Pickup tip, Eject needle and the Camera must be properly aligned for the system to properly pick and place die.

1. Turn on the power and allow the system to reset, (30-40 seconds).
    a. If the error message, ***Frame holder open, please close to continue*** is displayed, check the micro switch on the holder and/or the plug in the connector.
    b. When the LCD displays ***To resume, press the Yes key***, press **YES.** The system will continue resetting.
2. On the DE35 ST keyboard, select **Single Step**.



    a. The LCD should display ***Teach Step Fine or Coarse*** in upper left corner and “Pickup Clear” in the upper right corner.
    b. The second line indicates what will occur next, when the foot switch is depressed: ***Turn on Tape Vacuum***
3. Use the DES to move the Wafer Holder until the die are out of the way and bare tape is over the Eject Head.
4. Press the Foot Switch until the Pickup Arm is over the Eject Stage, and the LCD reads ***Go Down To Pick Height***
5. Press the Foot Pedal once more to move the Pickup Head down to pick height. If using a Vespel tip, tap the tip lightly down on the tape surface.
6. Press the **NO** key to terminate the cycle. The Arm will move to the right to the Wait Position. A circular mark should now be visible on the tape.

7. Loosen the large Thumbscrew on the top of the Camera Mount. Unscrew both adjustment screws until the crosshairs are past the mark then lightly snug the large Thumbscrew. Turn the adjustment screws until the crosshairs bisect the mark on the tape left by the tip. Tighten the large Thumbscrew. The crosshairs should now be at the center of the tip.
8. Press the **Eject Test** key twice. The needle should now come up and penetrate the tape and retract, leaving a mark. Align this mark with the center of the crosshairs.

   If the needle does not leave a mark, raise the needle height by turning the Stop Ring on the Eject Actuator counter clockwise. This is the large ring just below the Eject Head.

   If using motorized ejector (DES-AUM), the needle height can only be adjusted during the eject step of a single step cycle. Press the foot pedal to start a cycle and step through until the LCD reads ***Lift Eject Needles XXXX***. Press the **+/-** keys until the desired eject height is shown, then step on the foot pedal again to raise the needles. Press **NO** to cancel the cycle and lower the needles.

   NOTE: *This ring has a nylon tipped Setscrew that should be snugged up to ensure it does not vibrate out of adjustment.*
9. Make adjustments to the Eject Head position by loosening the large thumbnut on the Eject Actuator Arm of the DES. Using the (2) small thumbnuts, move the Eject Needle to the crosshairs. With a square or rectangular Eject Head, center the tip between the needles.

   NOTE: *Make sure the needle is down when moving the eject head.*
10. When the Eject Needle is aligned with the crosshairs, move the Pickup Tip over a clear spot on the tape and mark the tape again. Press **NO** after marking the tape to move the tip out of the way.
11. Press the **Eject Test** key again and check the needle position with the tip. Make any adjustments necessary to align the two.
12. After aligning the tip with the needle move the Wafer and place a die under the crosshairs. Carefully dissect the die with the crosshairs and zoom in to present as large a presentation as possible. Recheck the alignment to ensure the crosshairs are centered on the die.
13. Click on the '**#**' in the Royce Technical Video software. Move the cursor over to the live video image. Click on the top left corner of the die and drag down to the bottom right corner of the die and release. This creates a cross hair along each edge of the die. The die is now correctly targeted.

If desired, click on the original '**+**', then ensure it is selected by pressing **send forward** or **send backward** until the active handle boxes are on the '**+**'. Right click and select delete.

System Alignment: DE35-300

NOTE: *For standard DE35 alignment, see the previous section.*

After the System has been assembled it must be aligned. The Pickup tip, Eject needle and the Camera must be properly aligned for the system to properly pick and place die.

1. Turn on the power and allow the system to reset, (30-40 seconds).
    a. If the error message, ***Frame holder open, please close to continue*** is displayed, check the micro switch on the holder and/or the plug in the connector.
    b. When the LCD displays ***To resume, press the Yes key***, press **YES.** The system will continue resetting.
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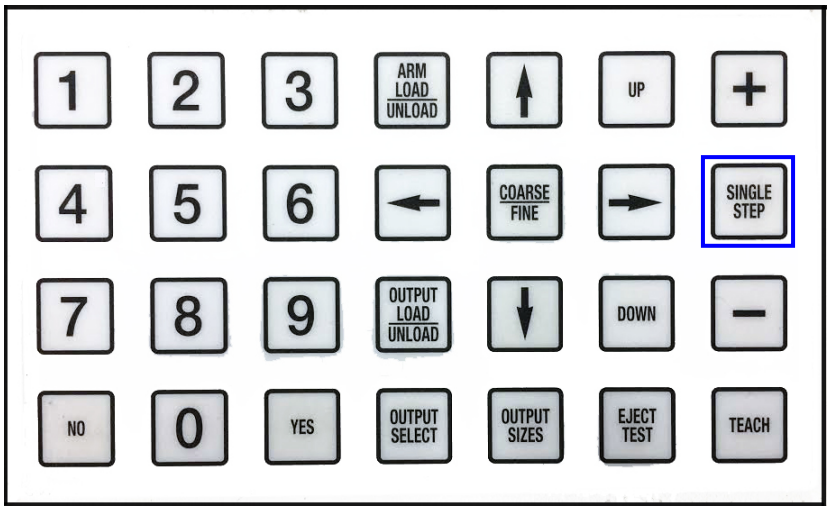

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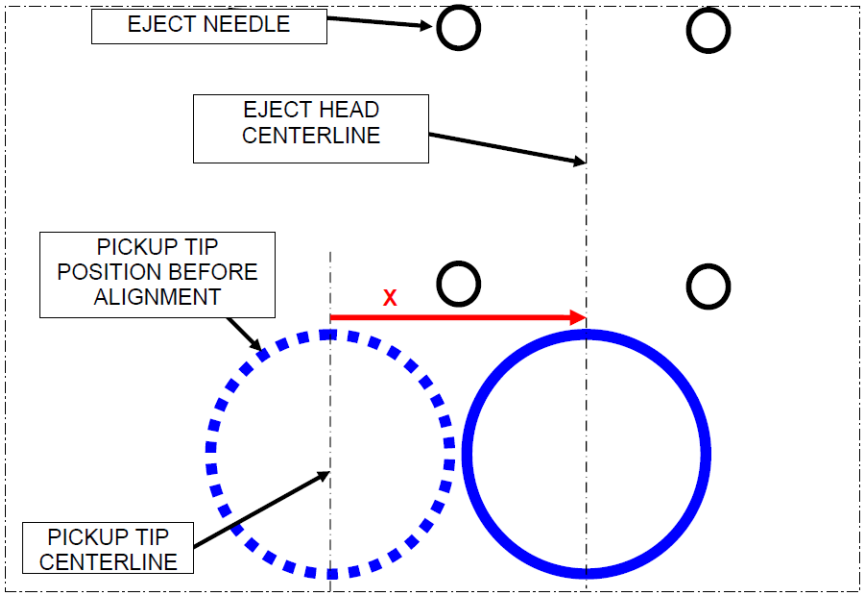
    b. The second line indicates what will occur next, when the foot switch is depressed: ***Turn on Tape Vacuum***
3. Use the DES to move the Wafer Holder until the die are out of the way and bare tape is over the Eject Head.
4. Press the Foot Switch until the Pickup Arm is over the Eject Stage, and the LCD reads ***Go Down To Pick Height***
5. Press the Foot Pedal once more to move the Pickup Head down to pick height. If using a Vespel tip, tap the tip lightly down on the tape surface.

6. Press the ← or → keys to move the pick position left or right.
7. Press the **NO** key to terminate the cycle. The Arm will move to the right to the Wait position. A circular mark from the Pickup Tip on the tape should be visible at this time.
8. Repeat this step until the pickup tip X position is centered with the Eject Needle positions.



9. Align the Eject Head [Y] position to the Pickup Tip.
    a. Press the **Eject Test** key twice. Each needle should rise, penetrate the tape and retract, leaving a mark. This mark needs to be aligned with the center of the pickup tip.

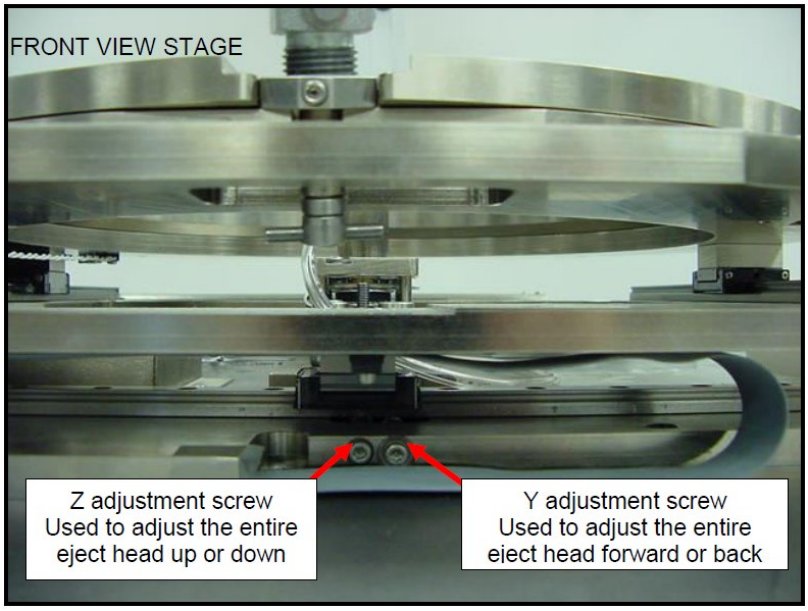
       If the needle does not leave a mark, raise the needle height by turning the Stop Ring on the Eject Actuator counter clockwise. This is the large ring just below the Eject Head.

NOTE: *This ring has a nylon tipped Setscrew that should be snugged up to ensure it does not vibrate out of adjustment.*

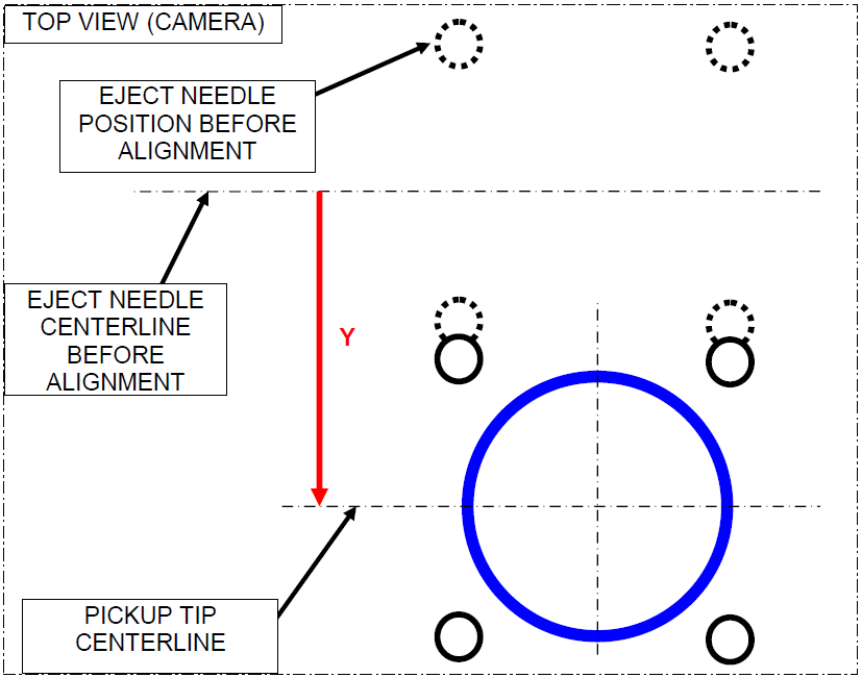
       If using motorized ejector (DES-AUM), the needle height can only be adjusted during the eject step of a single step cycle. Press the foot pedal to start a cycle and step through until the LCD reads ***Lift Eject Needles XXXX***. Press the **+/-** keys until the desired eject height is shown, then step on the foot pedal again to raise the needles. Press **NO** to cancel the cycle and lower the needles.

    b. Adjust the Eject Head position in the "Y" direction by turning the Eject Head Assembly Positioning Screw with a 7/64 Allen key. The screw is

located under the Wafer Holder on the operator side of the base as shown below.



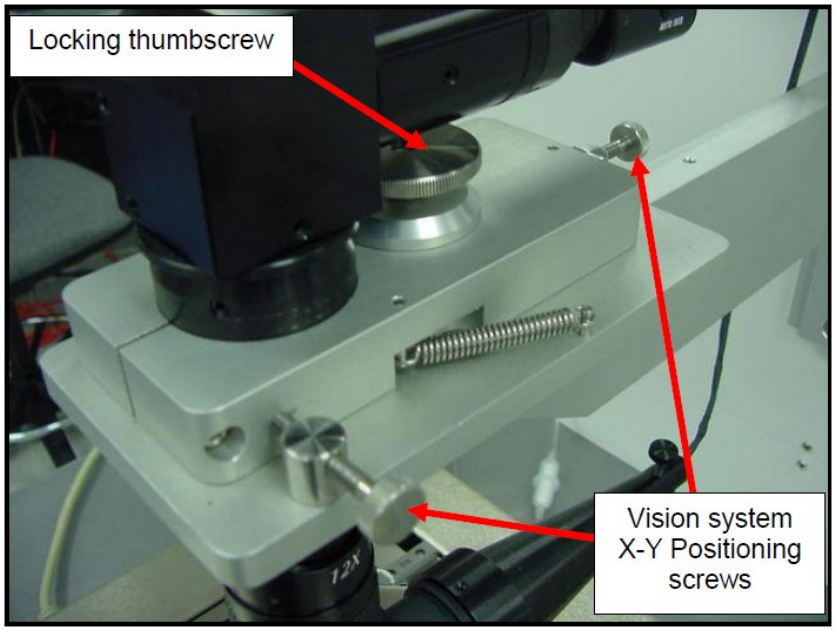
WARNING: DO NOT MOVE THE EJECT HEAD Y POSITION WHILE THE NEEDLES ARE UP, doing so may break the needles or tear the wafer tape.

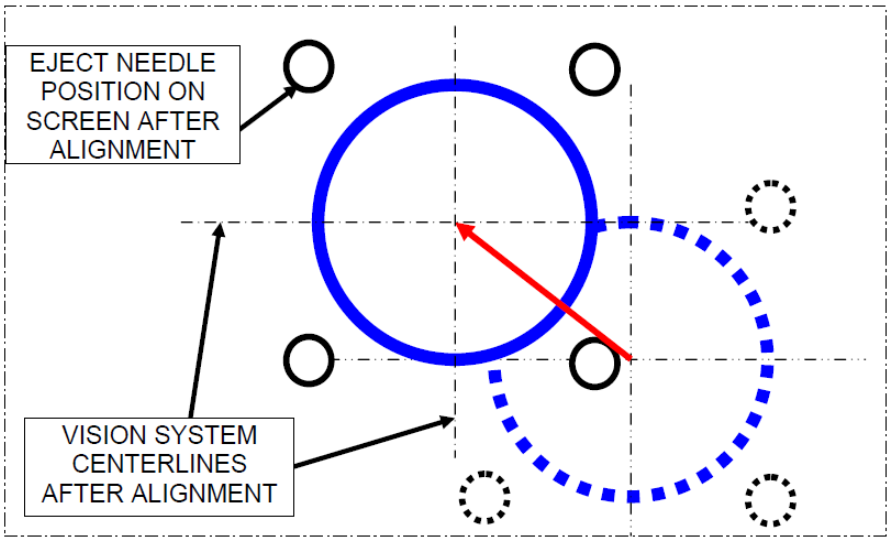


10. Align the Vision System [X-Y] to the Eject Head and Pickup Tip.
    a. Loosen the large thumbscrew on the top of the Camera Mount

b. Adjust the X-Y positioning screws

c. Secure the locking thumb screw





11. Click on the '**#**' in the Royce Technical Video software. Move the cursor over to the live video image. Click on the top left corner of the die and drag down to the bottom right corner of the die and release. This creates a cross hair along each edge of the die. The die is now correctly targeted.

    If desired, click on the original '**+**', then ensure it is selected by pressing **send forward** or **send backward** until the active handle boxes are on the '**+**'. Right click and select delete.

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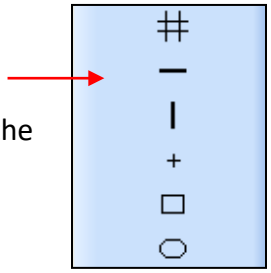
Basic Operation

Royce Technical Video Operation

Shapes:

Shapes are used by the operator to target die onscreen prior to beginning a pick and place cycle. Shapes can also be used on the screen to show the position of the Pick Up Tip and/or Eject Needles to aid with system alignment.

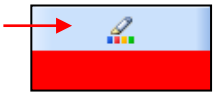
Creating Shapes:



1. On the Toolbar, click on the icon for the desired shape.
2. Move the cursor over to the live video image. Click and drag until the shape is the desired size.
3. Repeat until all desired shapes have been created.

Editing Shapes:

1. Click on the shape in the live video image. This makes the shape "active" and small handle boxes will appear to allow editing.
   - To resize the shape, click and drag any of the Handle Boxes.
   - To move the shape, click on the shape (not on a handle box) and drag the shape to the desired location.
   - To change the color of the shape's outline, click on the **Pen Icon**. This will open the Color Selection Box (see Figure 4). Select the desired color and click **OK**.



   - To change the shape's fill color, click on the **Color Grid Icon**.

Select the desired color from the color selection box and click **OK**.

Figure 4 - Color Selection Box

For no fill color (transparent background), right click on the shape and deselect "Background Transparent" from the right-click menu

Figure 5 - Right-Click Menu when shape is "active"

- To change the shape's line style and weight, right click on the shape. Select "Set Line Style" from the right-click menu. In the *Set Line Style* window, the desired Line Weight and Line Style can be selected, as well as the Line Color. Click **Accept** to save the changes. See Figures 5 and 6 for more detail.

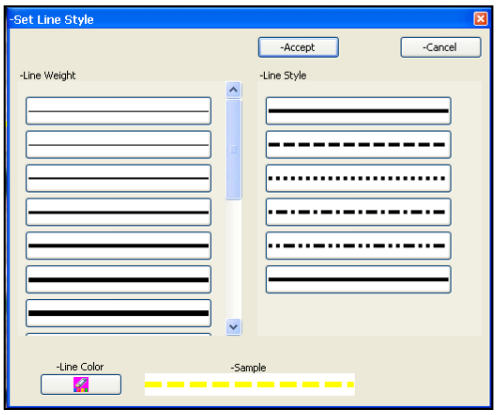
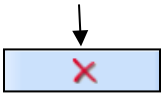


Figure 6 – Set Line Style Window

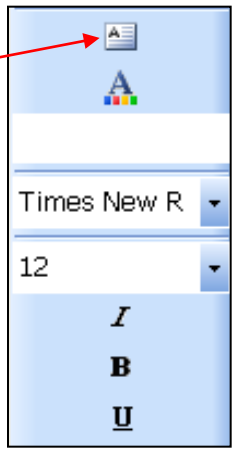
2. When using multiple shapes that overlap, the order of the shapes can be altered by selecting the desired shape and clicking "Bring To Front" or "Send To Back" from the right click menu. The user can also press either of these buttons on the toolbar. This operation changes which shape is displayed on top, and which is behind.

3. Once a shape is "active", it can be deleted by selecting "Delete Selected Objects" from the right-click menu, or by clicking this button on the toolbar.



Text Boxes:

These are used to add text to the live video image.



1. To create a Text Box, click the **Text Box** button and then click and drag on the live video screen to create a text box of the desired size.
2. Click inside the text box to activate the text editing cursor and then type the desired text.
3. While the text box is selected, the color, font, size, and style of the text can be changed using the buttons on the toolbar.
4. The text box itself (size, fill color, etc.) can be edited like a shape. See section on Editing Shapes for more detail.

Dimensions

The program can display onscreen the dimensions of the crosshair shape, and the dimensions and area of the square and ellipse shapes.

Set Dimensions:

In order to show the dimensions, they must first be set up. To do this an object of known size is required.

1. Place item of known size in the camera's field of view.
2. Draw a rectangle around the item.
3. Right click on the rectangle and select "Set Dimensions".
4. In the "Set Dimensions" window (see Figure 7), select either "Set Width" or "Select Height", based on which dimension the user knows. Only the height or the width can be entered, and the other will be calculated automatically.
5. Enter the known dimension in the "Dimension" box.
6. Enter the units for the dimension in the "User Units" box.
7. Select the desired number of decimal places to display dimensions in the "Decimal Places" box.
8. Click **Accept** to save the changes.
9. The dimensions for all shapes onscreen will be calculated based on the dimension specified for the rectangle. If changes are made to a rectangle's "Set Dimensions" window, the dimensions for all onscreen shapes will update automatically.

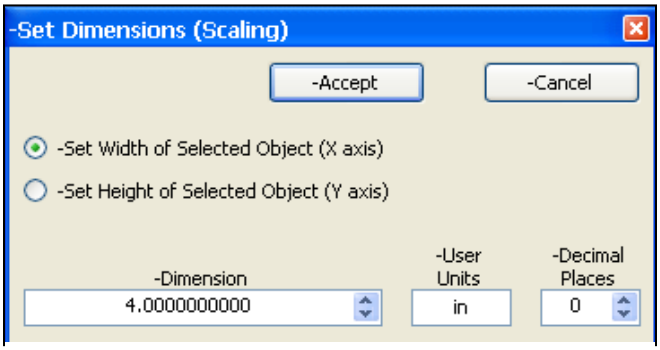


Figure 7 - Set Dimensions window

Note: Manually adjusting the zoom (magnification) of the optics will make the displayed dimensions no longer correct. After any adjustments to the optics zoom knob, the "Set Dimension" procedure should be followed.

Show Dimensions:

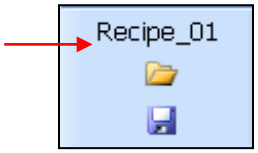
1. Right click on the desired object (must be a crosshair, rectangle, or ellipse).
2. Select “Show Dimensions”.

Using Dimensions:

Once dimensions are configured as described above, a shape can be drawn around any item of interest (die, surface defect, feature, etc.), and the real dimensions of that shape will be calculated and displayed.

Recipes:

Recipes allow the user to save the screen pattern (all shapes, text boxes, and dimensions shown onscreen) as an .rtv file. This allows the user to set up a different screen pattern for each different die size and save it as a separate file. When switching between different die, the user will only need to change recipes.



- The name of the active recipe is displayed in the toolbar.

- To save the current screen pattern as a new recipe, click on the **Floppy Disk Icon** on the toolbar. This will open the *Windows File Structure* window where the user can enter a file name and select where they want to save the recipe file. The default location is:

  C:\Program Files (x86)\Royce Instruments\RoyceTechnicalVideo\Recipes

- To open an existing recipe file, click the **Open Folder Icon** on the toolbar. Select the appropriate .rtv file and select **OPEN**. The program will load the selected recipe.

Note 1: The program automatically saves any changes to the open recipe when the program is closed or a recipe is opened.

Note 2: Recipes created in the Royce Technical Video software program are separate from the Process Recipes 1-9 that are programmed via the DE35-ST keypad.

Image Capture:

This feature allows the user to take a snapshot of the image shown in the live video portion of the screen. This snapshot is captured with and without the on-screen shapes.

- By pressing the **Camera Icon** on the toolbar, the program automatically captures two screenshots and saves them at the below location as .png image files:

C:\Program Files (x86)\Royce Instruments\RoyceTechnicalVideo\Images

- The file name is automatically created based on the date and time (down to the millisecond) at which the snapshot was taken.
- Either the letter A or Z is added to the end of the file name. The A image does not show the on-screen shapes; the Z image does show the on-screen shapes. See Figure 8 for an example.

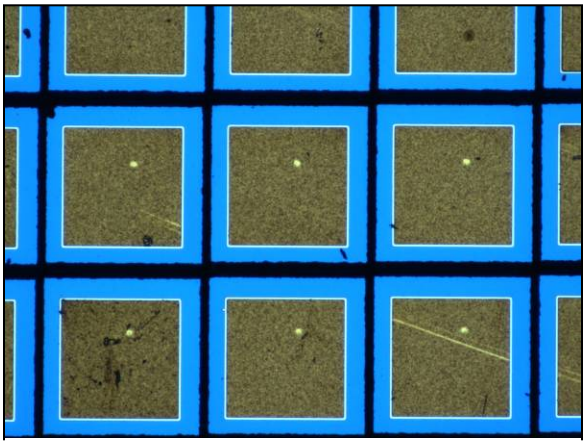
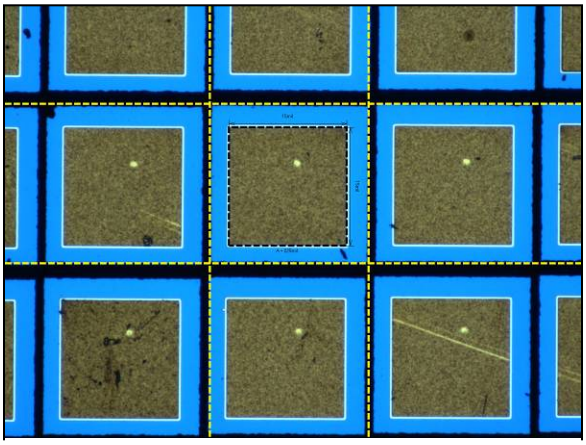


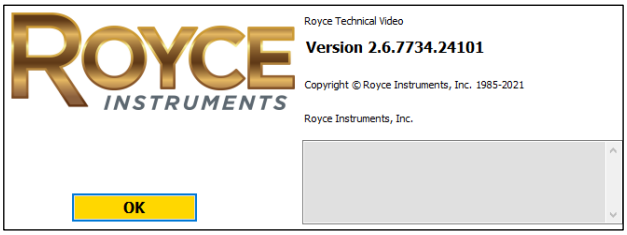
Figure 8 - Screenshot A



Screenshot Z

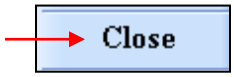
Additional Program Information:

- To display RoyceTechnicalVideo software information and version number, click the Royce logo on the toolbar.



- The frame rate of the live video image is displayed for the user's reference in the Toolbar (1 Hz = 1 frame per second).

- The user can minimize the program and return to the Windows desktop by pressing the **Windows key + D**.
- The user can close the program, automatically saving any changes to the recipe, by clicking the **Close** button.



- Pressing the **Power** button on the PC front panel (Figure 2), will close the program and safely shutdown Windows. When the **Power** button is next pressed, the system will resume its state prior to shutdown.

Multiple Cameras

(For use with Underside or Facet Inspection options):

- When multiple cameras are installed, a button for each camera will appear in the toolbar. For example, in the illustration on the right the **Targeting, Underside** and **Facet** camera buttons are displayed and the **Targeting** button is selected.

  The user can switch between cameras for pressing on the appropriate camera button in the toolbar.
- A separate recipe file for each camera is not necessary. The onscreen shapes/dimensions for each camera are stored together in one recipe.
- The **Image Capture** button will capture the image for just the active camera. To capture an image of one of the other cameras, click on the appropriate camera and then click the image capture button.

Digital Camera Adjustments

For FLIR USB3 Digital Cameras:

The digital camera settings are adjusted at the factory and typically do not require subsequent adjustment. If running new applications or raw live camera images are too dim, bright, or otherwise unclear even after illumination and focus adjustments, then making adjustments to the digital camera settings may help resolve the issue.

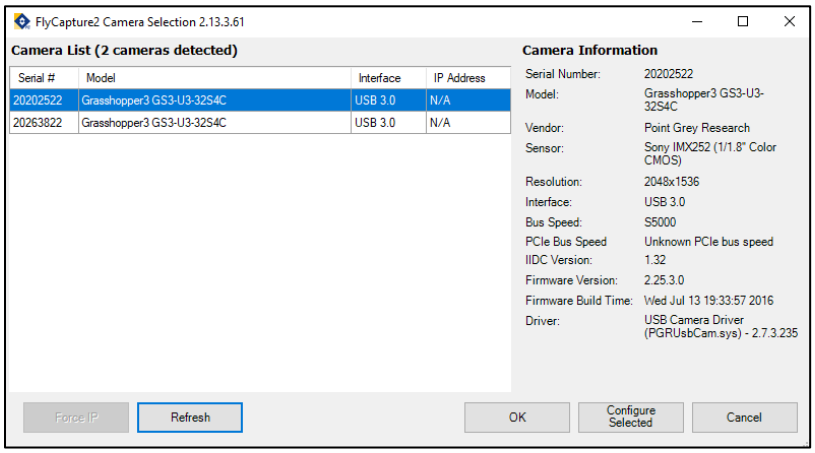
Ensure that Royce Technical Video software is closed. Launch the FlyCap2 utility, which if not available on Desktop can be found in the Windows Start menu as follows:

Start -> All Programs -> Point Grey FlyCap2

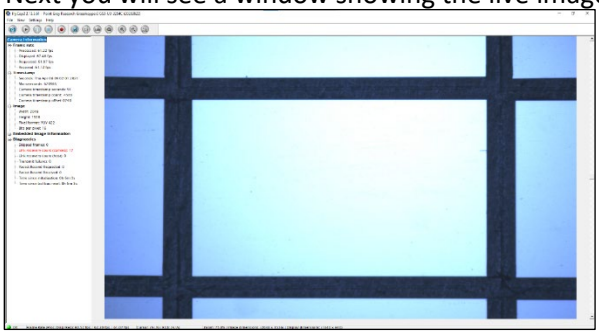
Or

C:\Program Files\Point Grey Research\FlyCap2 Viewer\bin64\Point Grey FlyCap2.exe

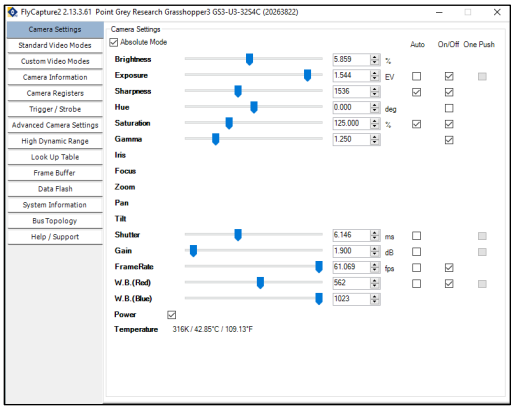
In the Select Camera dialog, click on the camera in the list box so that the whole row becomes selected, then click OK.



Next you will see a window showing the live image from the selected camera.



From the Settings menu, select **Toggle Camera Control Dialog** to open the camera settings.



Adjust relevant camera settings in the **Camera Settings** tab and see the effect of changes on the live camera image screen. Shutter and gain are most helpful to adjust improve image quality.

It is highly recommended that all Auto values be unchecked. If the camera auto adjusts during the run as it will when neighboring die are picked or near the perimeter of the wafer, then the vision parameters set earlier may no longer be valid. In addition, as the arm moves in front of the camera during operation, if auto is checked, it will cause the settings to be adjusted, so again, they will no longer be valid.

IMPORTANT: Changes to settings must be saved otherwise the settings will revert back to their prior values.

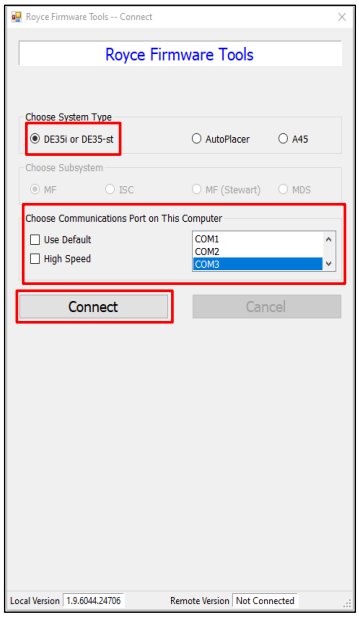
To Save Settings:

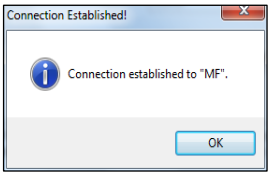
Ensure that the section **Advanced Camera Settings** is selected in the left pane.
At the bottom of the screen, under **Memory Channels**, ensure that **Channel 1** is selected.
Click **Save.**
Close settings window.
Close live image window.

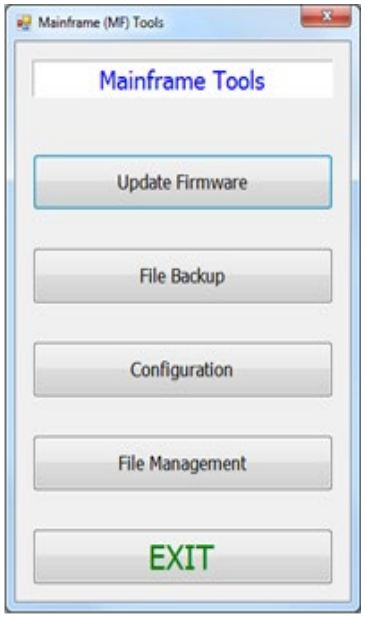
NOTE: You must exit FlyCap2 prior to relaunching Royce Technical Video software.

Connect to the DE35 with the Royce Firmware Utility

1. Verify that the USB to Serial converter is connected to the DB9 RS-232 cable. Connect the USB side to USB port#3 as defined in Figure 1 (page 1).
2. Connect the other end of the DB9 to the mainframe COM2 port on the back panel of the DE35.
3. Press **Windows key + X** 
4. Select **Device Manager** from the list of options.
5. Navigate to the Ports (COM & LPT) section.
6. Expand it and find the Prolific USB-to-Serial Comm Port (COM_X)
7. Make note of the COM number and close Device Manager.
8. Double click the Royce Firmware Management icon on the Desktop.
9. When the application opens do the following:
    a. Choose the system type of **DE35i or DE35-st**.
    b. Uncheck **Use Default**.
    c. Use the vertical scroll bar to select the COM port identified in step 6.
    d. Turn the DE35's power off for a duration of approximately 45 – 90 seconds.
    e. Click the connect button and toggle the DE35's power switch to the ON position.
    f. Once the connection has been made the prompt below will appear.
    g. Clicking Ok will display the Mainframe Tools window.







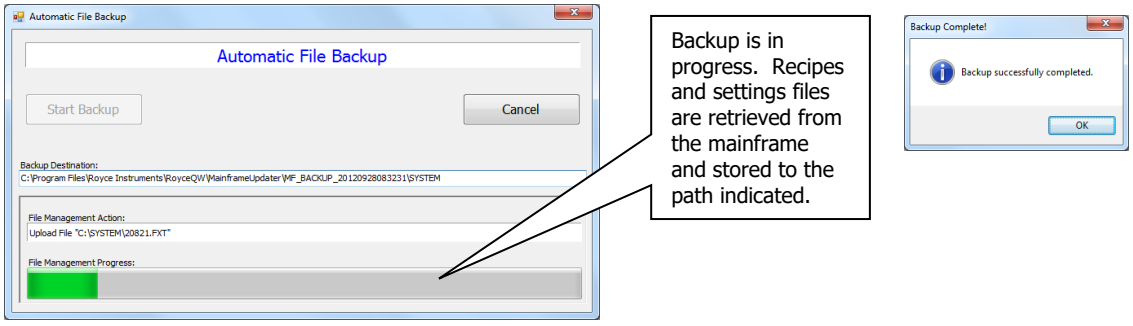
Using Mainframe Tools to Perform a Firmware Backup

Description –

To backup all 9 DE35-ST mainframe process recipes, including output patterns, pattern calibrations, process settings, and pick and place settings, a Firmware Backup can be completed to save a copy of this information to the Royce Technical Video PC. Once a backup has been created, the Update Firmware function can be used to restore DE35-ST mainframe firmware from the backup.

Note: You must complete the *Connect to the DE35 with the Royce Firmware Utility* section prior to using the Mainframe Tools.

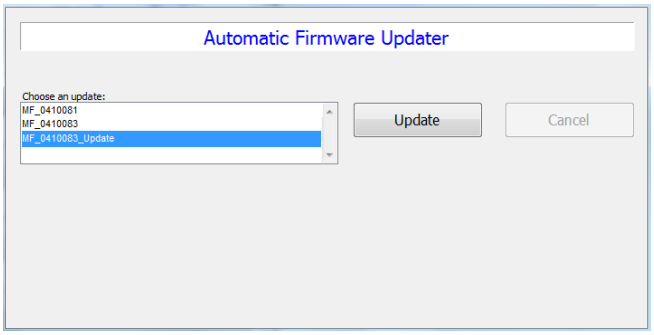
1. Click the File Backup button.
2. In the subsequent window click ***Start Backup***[1].
3. Once the backup has completed a message will appear at which point you can click Ok and close the Automatic File Backup window.

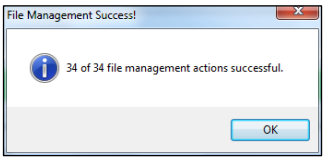


[1] The numeric portion of the backup name (see Backup Destination, above) is the date and time the backup was started, encoded as follows: yyyyMMddHHmmss.

Using Mainframe Tools to Perform a Firmware Upgrade

1. Click Update Firmware.
2. Within the new window click the desired firmware package[2] and click **Update**. To restore mainframe firmware from a backup, click the desired backup (MF_BACKUP_YYYYMMddHHmmss).
3. Once the update has completed a File Management Success dialog will appear and indicate the number of affected files.
4. After completion click **Exit** to complete the process and reboot the DE35 with the updated firmware.



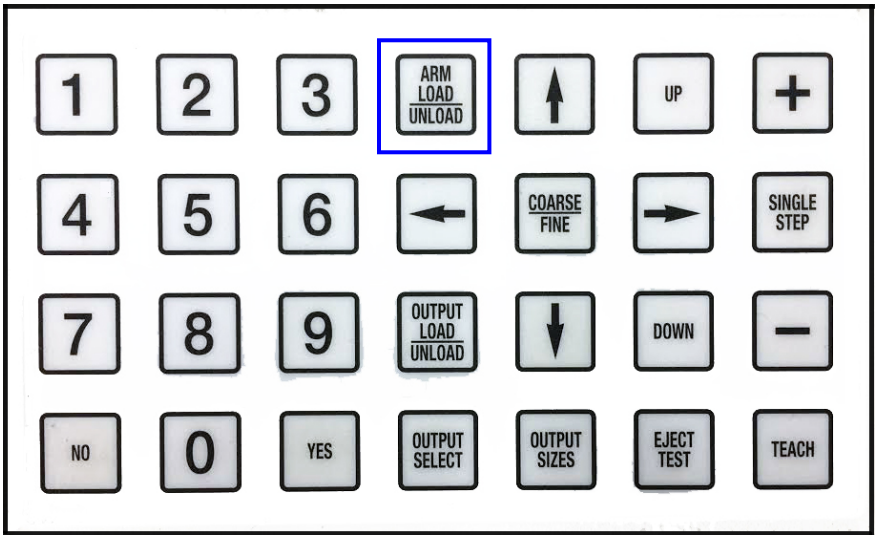


[2] Packages without the _Update suffix will overwrite the system's current fixture file settings.

Operational Set Up

The following is a step-by-step setup procedure and will vary between machines according to what options you have installed. It quickly sets up the DE35 ST for basic operation. A more detailed description of all keys, menus and operation can be found later in the manual.

After the system has been aligned you will need to set up for the die that will be packaged.



1. **Move the Z Arm to Reset Position.**

   Press the **Arm Load/Unload** key until the Z-Arm is at the reset position on the right side of the machine.

2. **Open/Create a Recipe.**

   The system has the capability of storing up to nine recipes. All nine recipes are initially saved as factory defaults.

   a. Open an existing recipe by pressing the **Output Select** key, then scroll through the menu until it displays ***Process Recipe***. The ***Process Recipe*** line allows you to select a saved recipe or generate a new recipe by stepping through each line item and then saving that recipe.

   b. To save a new recipe, select a recipe number (e.g. 1) and step through the menu items, selecting from the available choices. When completed, select that recipe number again to save changes to the recipe.

   NOTE: *Any changes made to the current recipe loaded will be saved when calling up a new recipe number.*

3. **Output Setup.**

   Press the **Output Select** key. The following options will appear:

a. ***>QUIT MENU***

i. With the curser **>** in front of ***>QUIT MENU***, press the **YES** key to exit the menu.

ii. With the curser **>** at any position in the menu, pressing the **NO** key to place the curser in front of ***>QUIT MENU***.

b. ***>PROCESS RECIPE***

Select desired Recipe.

i. Press the **YES** Key. ***>PROCESS RECIPE*** line becomes active.

Note: *When a line becomes active the '>' changes to a '*'. This applies to all menus that have multiple options for a particular line.*

ii. Use **+/ -** keys to select ***RECIPE 1*** through ***RECIPE 9***.

iii. Press **YES** key. The LCD will display one of the following:

- ***SAVING RECIPE # X*:** All current machine settings will be saved to whatever recipe number is currently loaded/selected.
- ***LOADING RECIPE # X*:** The new recipe number selected will be loaded into the system. Use the **ARROW** key to move the cursor down to the next line item of the menu.

c. ***>PICK FROM WAFER - PLACE TO OUTPUT***

Select desired Pick & Place function.

i. Press the **YES** key. The ***>PICK FROM WAFER - PLACE TO OUTPUT*** line becomes active.

ii. Use the **+ / -** keys to scroll through the available options and select the Pick and Place function desired. A few examples of Pick and Place options are listed below:

- ***Pick from Wafer, Place to Output***
- ***Pick from Tray, Place to Output***
- ***Pick from Gel-Pak, Place to Output***
- ***Pick from Tray, Place to Left***

iii. Press the **YES** key again to select the chosen option. Use the **ARROW** key to move the cursor down to the next line item of the menu.

d. ***>4 TRAYS, 2 IN. - PLATE 3105***

Select desired Output.

i. Press the **YES** key. ***>4 TRAYS, 2 IN. - PLATE 3105*** line becomes active.

ii. Press **+ / -** keys to scroll through the output types available and choose the desired output. A few examples of Output options are listed below:

- ***2 Trays, 2 In Vacuum Release*** ***Plate 13784***
- ***1 Tray, 4 In*** ***Plate 3084***
- ***2 Trays, 4 In*** ***Plate 5089***
- ***2 Trays, 4 In Vacuum Release*** ***Plate 16712***
- ***2 Vials*** ***Plate 9948***
- ***1 Substrate*** ***Plate 13472***
- ***Wafer Output Type 8*** ***Plate 5528***
- ***Wafer Output Type 7*** ***Plate 12758***
- ***Wafer Output Type 27*** ***Plate 13679***
- ***Wafer Output Type 7 & 29*** ***Plate 14468***

Note: *Not all fixtures shown in software are available on all systems. Please contact Customer Service for assistance in selecting the appropriate plate number if the plate you are using is not found.*

iii. Press the **YES** key to select the chosen option. Use the **ARROW** key to move the cursor down to the next line item of the menu.

NOTE: *The X-arm may move.*

e. ***>X Output Grades***

This line when active allows you to choose from 1, 2, 3 or 4 grades for your output when using any 4-pack configuration. You can choose 1 or 2 grades when using any 2-pack configuration.

By default all trays are set to Grade 1. To assign a different grade to a tray:

i. Use the **ARROW** key to move the cursor (**>**) so it points at the desired tray.

ii. Press **Yes** to make to make that tray active.

iii. Use the **+/-** buttons on the keypad until the desired grade is shown. Output Grade choices will appear as follows:

- ***1 Output Grade***
- ***2 Output Grade***
- ***3 Output Grade***
- ***4 Output Grade***

iv. Press **Yes** to save.

Note: *Each tray can be assigned a different grade or all trays can be assigned the same grade. The system will not allow more grades than the number of trays available on the Output Fixture.*

f. ***>PLACEMENT PATTERN – FULL***

Select desired Placement Pattern.

i. Press the **YES** key to toggle between ***FULL/CHECKERBOARD*** pattern options.

ii. Use the **ARROW** key to move the cursor down to the next line item of the menu.

g. ***>INSPECTION OPTIONS - SUB MENU***

Select desired Inspection option(s).

i. Press the **YES** key. A Sub Menu will open and allow you to select available inspection options.

- **>INSPECT DIE FACET – SELECTED**

  The **YES** key will toggle between SELECTED/NOT SELECTED.

- **>ROTATE DIE XXX DEG DURING INSPECTION**

  Press the **Yes** key to toggle between 90 and 180 degrees.

- **>INSPECT UNDERSIDE - SELECTED**

  Press the **YES** key to toggle between ***SELECTED / NOT SELECTED***.

ii. When selections are complete, press the **NO** key to return to the ***QUIT MENU***. Press **YES** to quit the Sub Menu and return to the ***OUTPUT SELECT*** menu.

h. ***>QUIT MENU***

i. Press the **YES** key to exit the menu and return to the operational program. The output table will perform a reset.

ii. Press the **NO** key at this time will take you to ***QUIT MENU*** for the ***OUTPUT SELECT*** menu. Pressing the **YES** key again will take you back to ***QUIT MENU***.

i. Press the **Output Sizes** key.

Select/Enter Waffle Pack part number.

i. Move the cursor to ***PATTERN NUMBER*** and press the **YES** key. The first digit of the 6-digit P/N will be flashing.

ii. Using the Keyboard, enter the Waffle Pack number you are going to use and press the **YES** key. For example, if the waffle pack number is H20-55-24 then enter 000055-24. The H20 indicates a 2" waffle pack.

iii. The display will say either ***Catalog*** or **New Pattern #**. If it is a catalog pattern number the dimensions will be automatically loaded. If it says ***NEW***, go to the *Programming Your Own Waffle Pack* chapter before proceeding.

Note: *There are 250 programmed waffle packs in the system.*

iv. Press the **NO** key to return to ***QUIT MENU***, press the **YES** key to quit.

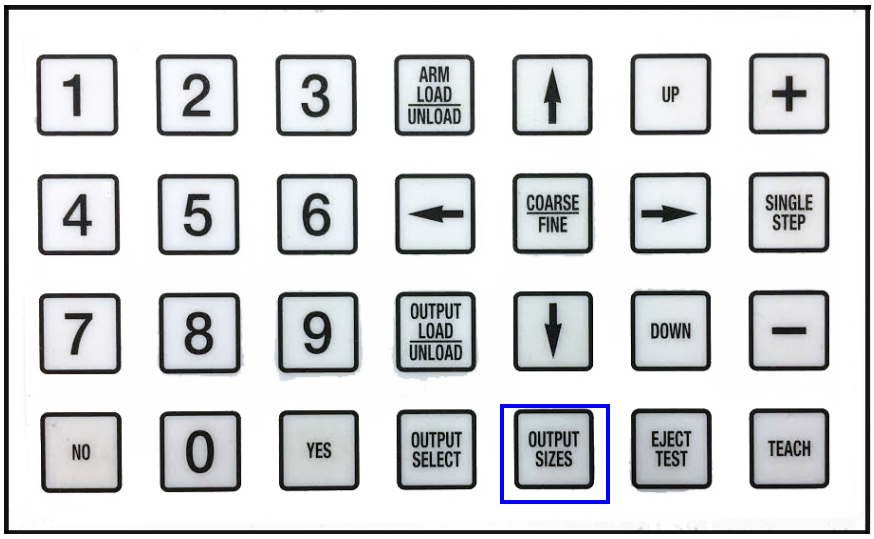
4. Install Waffle Packs.

To install the waffle packs onto the output stage, release the clamp pins by pulling on the fluted edges of the clamp plates at each corner of the output tooling plate. The waffle packs should be installed so that the corner bevel is towards the front and facing to the left hand side of the machine. This insures the X and Y pitch orientation is correctly aligned If the waffle pack cavities are rectangular.

Calibrating Waffle Packs

The waffle pack dimensions are loaded when the part number is entered. The dimensions are rough, and to insure proper placement accuracy the *waffle packs should be calibrated each time a new part number is used*. The same applies when the waffle pack is filled and fresh packs are installed.

For better accuracy in calibration you can start in single step and pick a die, move over to the place position with the die on the tip press **CALIBRATE TRAYS**. This will allow you to adjust pockets to place the die into the pocket.



1. On the keyboard, press the **OUTPUT SIZES** key.
2. On the LCD Display, scroll down to ***CALIBRATE TRAYS***, then press the **YES** key. The Pickup Tip will move to the first pocket of the first pack and move down to place height.
3. Use the **DOWN** key to lower the tip into the pocket to make it easier to see where the tip is in the pocket.
4. Use the **ARROW** keys to align the tip in the center of the pocket. Use the **COARSE/FINE** keys to toggle between large steps and small steps. Use the **UP/DOWN** buttons to adjust the height of the pick-up tip. In the X direction a small step is 2 mils. In the Y direction a small step is 1 mil. A large step for both is 10 small steps.
5. When the first pocket is aligned, press the **+** key to move the pickup to the last pocket of the pack and repeat step 4.
6. Repeat steps 4 and 5 until the first and last pocket of all packs are calibrated. Press the **YES** key when the last pack is calibrated to return to the menu. Press **NO**, then **YES** to return to normal operation.

Note: *All trays must be calibrated even if they will not be used. If any trays are not properly adjusted, then the calibration of the other trays will be off.*

Full Cycle: Pick & Place in Single Step Mode

This cycle will vary with different options selected.

1. *TURN ON TAPE VACUUM.*
2. *ARM GO TO PICK POSITION.*
3. *GO DOWN TO PICK HEIGHT.*
4. *TURN ON PICKUP VACUUM.*
5. *LIFT NEEDLES.*
6. *WAIT X.XXX SECS FOR DIE TO LIFT.*
7. *LIFT TO SEARCH HEIGHT AT 8000 u/sec.*
8. *GO UP TO TRAVERSE HEIGHT.*
9. *TURN OFF TAPE VACUUM.*
10. *RETRACT NEEDLES.*
11. *TABLE GO TO PLACE POSITION.*
12. *GO TO TRAY POSITION.*
13. *GO DOWN TO PLACE HEIGHT.*
14. *TURN OFF PICKUP VACUUM.*
15. *PURGE PICKUP X.XXX SECS.*
16. *GO TO TRAVERSE HEIGHT.*
17. *FINISH CYCLE.*

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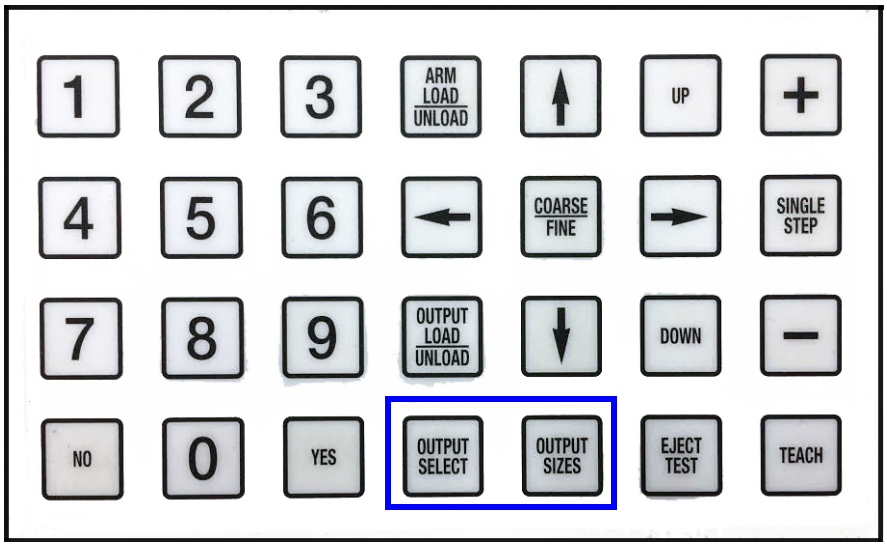
Detailed Operation

Menus



Overview

The DE35 ST has two menus: **OUTPUT SELECT** and **OUTPUT SIZES**.

The **OUTPUT SELECT** menu is used to process Recipes, select Pick and Place mode, and select the type of Output Plate, Output Grades, Output Pattern and Inspection Options. It includes the following features.

- Process up to nine recipes.
- Select between two 2”, four 2”, one 4”, or two 4” waffle or gel packs.
- Choose Vial output, Substrate output, or Type 7, 8, 27 or 29 wafer output.
- Choose 1 grade, 2 grades or 4 grades, when using 2” packs and 1 grade or 2 grades when using 4” packs.
- Select synchronized on non-synchronized Die Lift with motorized Die Eject Actuator option.
- Select any optional features such as Underside Inspection, Facet Inspection or Die Inverter.
- Choose output pattern: place a die in every pocket (Full) or every other pocket (Checkerboard)

The **OUTPUT SIZES** menu is used to Calibrate Trays, Clear Trays and to select the Pattern Number for the output tray.

- Enter the Pattern number of the waffle pack being used.
    - If it is a programmed pattern number the dimensions will automatically be called up.
    - If the number is not programmed the display will flash ***New Pattern Number*****.** Enter the *X and Y PITCH*, and the *X and Y COUNT* to be used for the output pattern.
    - Once saved, the information will be available for future use and will display ***Custom*** on the LCD when this part number is loaded.
    - Once the output is programmed, calibrate the trays to insure proper placement of the Die.

Output Select

To open the menu, press the **OUTPUT SELECT** key. The menu has many options, however, only two lines will be displayed at a time. Press the **YES** key with the curser **>** in front of any menu item to select that item. If the option selected changes a previously selected option, the previous selection will be de-selected. Below are the menu items and function in the order they will appear on the LCD.

> ***NOTE:*** *The menu items may be slightly different depending on your specific options and software version.*

Quit Menu

This line allows you to quit this menu and exit back to the main program by pressing the **YES** key.

Process Recipe

Process Recipe allows the selection of nine possible recipes.
The recipe contains all the information contained in the **OUTPUT SELECT** menu and the **OUTPUT SIZES** menu. When a RECIPE is loaded you can step through the menus and set up the process.

Pick from Wafer - Place to Output

When active, this line allows you to select available Pick and Place options to set up the process you want to perform. A few examples of Pick and Place options are listed below:

PICK FROM WAFER - PLACE TO OUTPUT

In this sequence the system will pick a die from the wafer and place it in the selected output device. If any of the Inspection options are selected that function will be performed in sequence.

PICK FROM TRAY - PLACE TO LEFT

This sequence allows picking of Die from the output tray and placing it to the left on various fixtures.

PICK FROM GEL-PAK - PLACE TO RIGHT

This sequence allows picking of die from a Gel-Pak (vacuum release tray) installed on the input stage and placing it to the right output tray.

PICK FROM TRAY - PLACE TO RIGHT

This sequence allows picking of a die from a waffle pack or other tray and placing it to the right output tray.

X Trays, X in - Plate XXXXX

This line will allow you to select the output configuration from a list of ten possible outputs. Select this line by pressing **YES** and scroll through with the **+/ -** keys. This line will always display as one of the selections.

4 trays, 2in - Plate 03105

This will set up output of the machine for four, two inch, waffle packs. The sequence of which the machine will place the die is in the first pocket of the first waffle pack then the second pocket of the first waffle pack and so on, until the waffle pack is full. The arm will then advance to the second waffle pack, the third and fourth.

2 trays, 2 in Vacuum Release - Plate 13784

This will set up the output of the machine for two, two inch Gel-paks with vacuum release. The sequence of which the machine will place the die is in the first pocket of the first gel-pak then the second pocket of the gel-pak and so on, until the gel-pak is full.

1 trays, 4 in - Plate 3084

This will set up the output of the machine for one, four inch, waffle pack. The sequence of which the machine will place the die is in the first pocket of the waffle pack then the second pocket of the waffle pack and so on, until the waffle pack is full.

2 trays, 4 in - Plate 5089

This will set up the output of the machine for two, four inch, waffle packs. The sequence of which the machine will place the die is in the first pocket of the first waffle pack, then the second pocket first waffle pack and so on, until the waffle pack is full. The Arm will then advance to the second pack.

2 Trays, 4 in Vac Release - Plate 16712

This will set up the output of the machine for two, four inch, Gel-paks. The sequence of which the machine will place the die is in the first pocket of the first Gel-pak, then the second pocket and so on, until the Gel-pak is full. The Arm will then advance to the second pak.

2 Vials - Plate 9948

Die will be placed into the vials starting from the front vial. When that vial is full or the specified die count is reached, die will then be placed into the back vial.

1 Substrate - Plate 13472

The die will be placed directly on a Substrate that has been screened with some form of bonding material. The pattern must be repetitive to place the die properly.

Wafer Output Type 8 - Plate 5528

Wafer Output Type 7 - Plate 12758

Wafer Output Type 27 - Plate 13679

Wafer Output Type 7, 29 - Plate 14460

Die will be placed into a rectangular array on adhesive tape on the output-tooling adapter until the array is full or the specified die count is reached. You must have the correct array tooling plate fitted to the output stage to take advantage of this option.

1 Tray 1 X 7, 50 mm - Plate 17401

This plate is a custom tray, with one X position and seven Y positions. These specifications can be modified within the limits of the hardware.

X Output Grades

This line when active allows you to choose from 1, 2, 3 or 4 grades for your output when using any 4-pack configuration. You can choose 1 or 2 grades when using any 2-pack configuration.

When using grades, pressing **OUTPUT LOAD/UNLOAD** after placing a Die will move the table out to the load/unload position allowing you to replace that tray without affecting the count of the other grades.

When reaching the full count for a grade, the table will automatically move to the load/unload position to replace trays for that grade, pressing **YES** will resume operation. Only the grade affected will have the count reset.

***Note**: The number of trays listed will depend on the number of trays/substrates available for the programmed output fixture. For example, if a 4 tray fixture is selected, four output trays will be listed.*

*By default all trays are set to Grade 1. To assign a different grade to a tray, move the **>** so it points at the desired tray, press **Yes** to make active, then use the **+/-** buttons on the keypad until the desired grade is shown. Press **Yes** to save.*

*Each tray can be assigned a different grade, all trays can be assigned the same grade, or each tray can be assigned a grade. **The system will not allow more grades than the number of trays available on the output fixture.***

Placement Pattern: Full/Checkerboard

This line toggles between **FULL** and **CHECKERBOARD**.

FULL: Die will be placed in every position of the Output device until full or the specified Die count is reached.

CHECKERBOARD: Die will be placed into a checkerboard pattern in the Output device until full or the specified die count is reached.

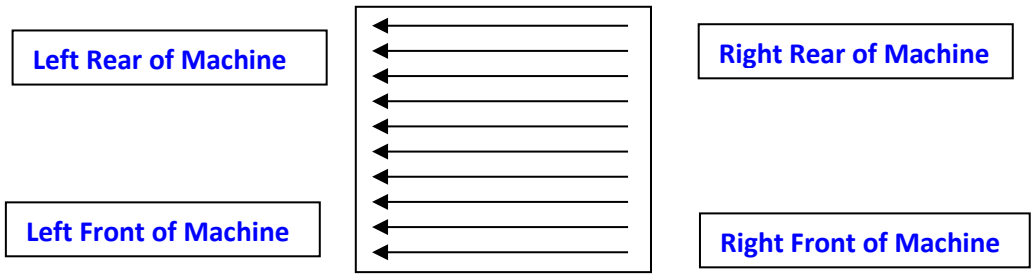
SKIP FIRST AND LAST: Die will be placed in every position of the Output device except for the first pocket and last pocket of each tray.

Synchronized Die Lift: Yes/No

When *Synchronized Die Lift* is set to **Yes**, the Pickup tip will lift as the Die Eject needle rises. This will only function if the system has a motorized Eject Actuator installed.

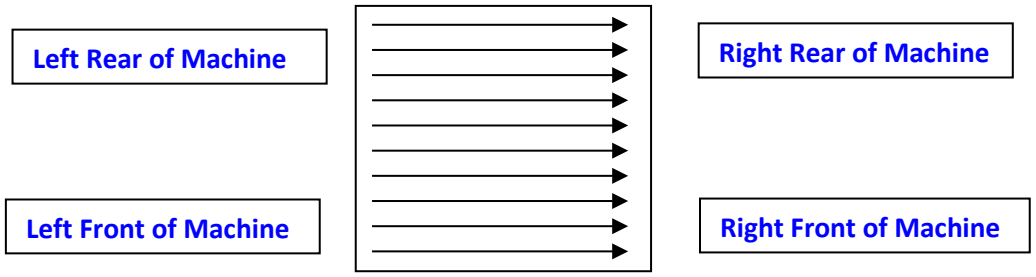
X-Axis Placement Sequence: Normal/Inverted

The normal X-Axis Placement Sequence in a waffle pack or Gel Pak is shown below:



The Normal sequence starts on the front right side of the Waffle Pack or Gel Pak and places die from right to left.

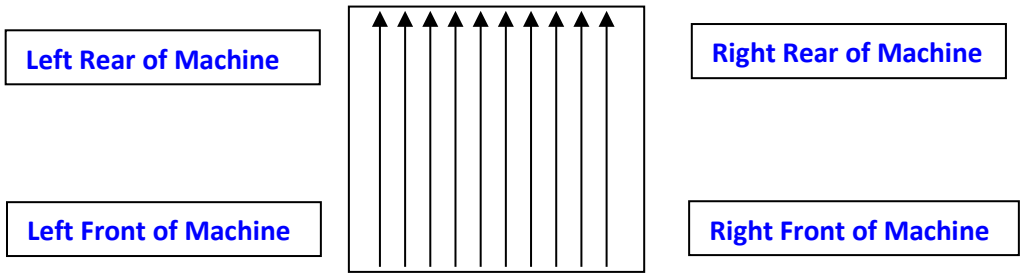
The Inverted X-Axis Placement Sequence in a Waffle Pack or Gel Pak is shown below:



The Inverted sequence starts on the front left side of the Waffle Pack or Gel Pak and places die from left to right.

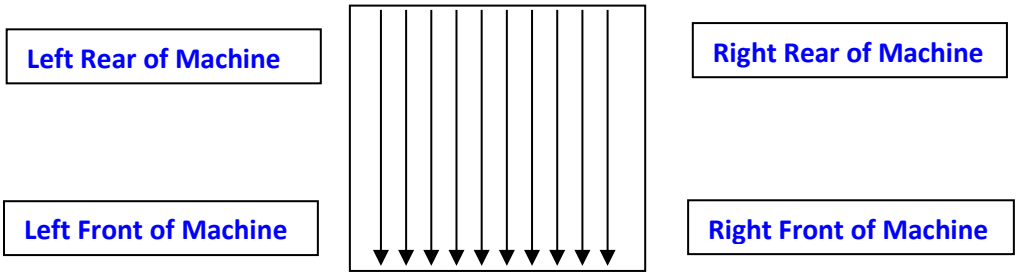
Y-Axis Placement Sequence: Normal/Inverted

The Normal Y-Axis Placement Sequence in a Waffle Pack or Gel Pak is shown below:



The *Normal Y-Axis Placement Sequence* starts on the front side of the Waffle Pack or Gel Pak and places die from Front to Rear.

The *Inverted Y-Axis Placement Sequence* in a Waffle Pack or Gel Pak is shown below:



The Inverted sequence starts on the Rear side of the Waffle Pack or Gel Pak and places die from Rear to Front.

A combination of the X-Y Placement sequences will allow the user to begin in any corner of the Waffle Pack or Gel Pak.

Note: *Regardless of X and Y Axis Placement sequence direction selected, the DE35-ST will index in the specified X direction until no further columns are available before moving to the next row in the specified Y direction.*

Inspections Options Submenu

This Sub Menu allows you to select or de-select any Inspection options that may be on your machine.

Inspect Die Underside- Selected/Not Selected:

Selecting this mode allows the operator to view and inspect the underside of the die. This will set up the machine so that the pickup arm stops over the optional underside inspection camera, before placing the die. The underside inspection option must be installed to view the underside of the die.

Inspect Die Facet - Selected/Not Selected:

Selecting this mode allows the operator to view and inspect the Edges of the die. This will set up the machine so that the pickup arm stops at the optional facet inspection position, before placing the die. The facet inspection option must be installed to view the facet of the die.

Die Pickup: Non Surface Pickup / Surface Pickup

Surface Pickup

This will set up the machine for pick up tips that touch the top of the die to pick them. Vacuum is applied through the pickup tip to hold the die.

Non-Surface Contact Pickup

This will set up the machine for the non-surface contact grippers (NSC) to pick the die. The fingers of the grippers will lift the die from the sides, or bottom edges to pick them. You must have the non-surface contact machine, with the NSC pick up head installed to take advantage of this feature. An NSC machine can be converted for Surface Pickup but a Surface contact machine cannot be converted for NSC operation.

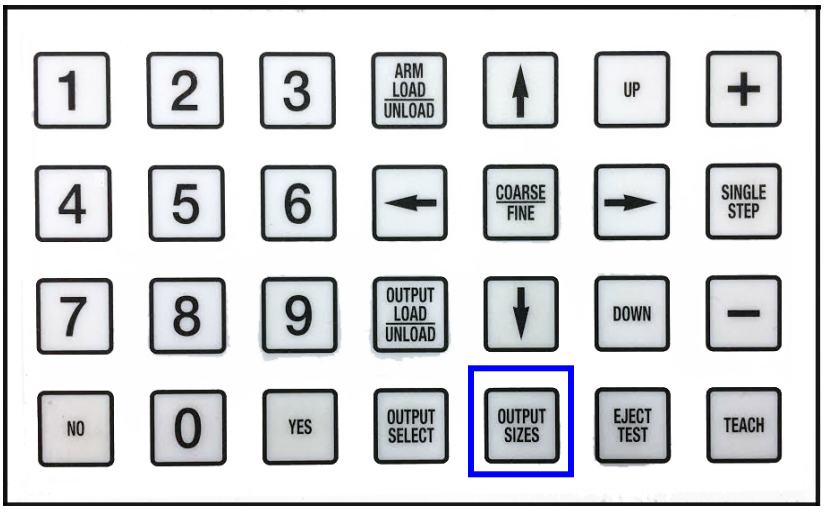
Die Inverter: Selected/Not Selected

Die Inverter is selectable on systems that have a DI-26837. This device will allow the user to invert die before placing them into Waffle Pack or Gel-paks.

This device can be setup using the procedures listed in THE DIE INVERTER SYSTEM.

Output Sizes Menu

To enter the menu, press the key labeled **OUTPUT SIZES**.



The Output Sizes menu has many options, however, only two lines will be displayed at a time. Pressing the **YES** key with the curser **>** in front of any menu item will place a blinking curser in the option, allowing you to change the numeric value. Below are the menu items and function in the order they will appear on the LCD.

Quit Menu

With the curser **>** in front of ***Quit Menu***, press the **YES** key to exit the menu. Pressing the **NO** key with the curser **>** at any position in the menu will place the curser in front of ***Quit Menu***.

Calibrate Trays

Although ***Calibrate Trays*** is at the top of the menu, it should be selected after the waffle pack is entered and saved. Because the waffle packs are not perfect, you must calibrate them, even if the part number entered is a standard number and pitches have been loaded from memory. These pitches are approximate and will have to be calibrated as closely as possible.

Press the **YES** key to place the machine into teach mode in which you must teach the exact coordinates of both the first and last position of EACH waffle pack. The output tray will reset and the arm will lower to the first position of the first waffle pack.

Press the **DOWN** key to lower the head further so you can better align the tip in the pocket. Press the **ARROW** keys to move the head to the center of the pocket. Press the **COARSE/FINE** key will allow you to make large steps, or small steps.

Once the tip is centered in the first pocket, press the **+** key to advance to the last position of the waffle pack. The better these positions are aligned, the better the die placement will be. For a more accurate calibration: start in single step; pick a die; move it to place height; and then select ***CALIBRATE TRAYS***.

NOTE*: You must calibrate all possible waffle packs, for example if you are using a output fixture capable of attaching four waffle packs, but decide only to use two packs, you still must calibrate all four waffle packs.*

Clear All Trays

Selecting this will clear all trays and put them back to *Zero Loaded*. The operator should do this when changing packs on the Output Fixture before they are empty/full to insure the system starts back at pocket 1 for the new pack.

Pattern Number

Pressing **YES** with the curser **>** in front of ***Pattern Number*** will allow you to enter the waffle pack part number.

A standard waffle pack will have a part number printed on one of its outside edges. The part number will begin with *H20* for 2-inch waffle packs or *H44* for 4-inch waffle packs. This portion of the part number will be ignored when entering the number.

The display on the DE35 will default to ***000000-00***. If the part number to be entered is *H20-002*, it should be entered as ***000002-00*** on the display. If the part number includes a second dash such as *H20-018-09*, it should be entered as ***000018-09*** on the display.

If the part number entered is a standard waffle pack, the DE35 will display the word ***CATALOG*** to the right of the number and the machine will set the approximate X/Y coordinates of the selected waffle pack. If the waffle pack is not standard, the machine will briefly display ***NEW PART #*** and the word ***CUSTOM*** will be displayed to the right of the part number. The X and Y pitches and the X and Y positions must be entered.

Die Per Tray

This item should not be manually entered. The number of die per tray will be calculated automatically when the X and Y positions are entered. If you want to put less die in the pack than a full pack will hold, you may manually enter the smaller number after the waffle packs have been calibrated.

X Pitch

This number represents the distance in inches, from the leading edge of one pocket to the leading edge of the next pocket in the X direction.

Y Pitch

This number tells the machine the distance in inches from the leading edge of one pocket to the leading edge of the next pocket in the Y direction.

X Positions

This number tells the machine how many die will be placed per row in the X direction.

Y Positions

This number will tell the machine how many die will be placed per row in the Y direction.

Save Output Pattern

After all items are entered, pressing **YES** with the curser **>** in front of ***Save Output Pattern*** will save the entered settings. If the waffle packs are custom packs, or if you have altered the pitches of the catalog packs, this will save the settings so they do not have to be re-entered each time the machine is powered off.

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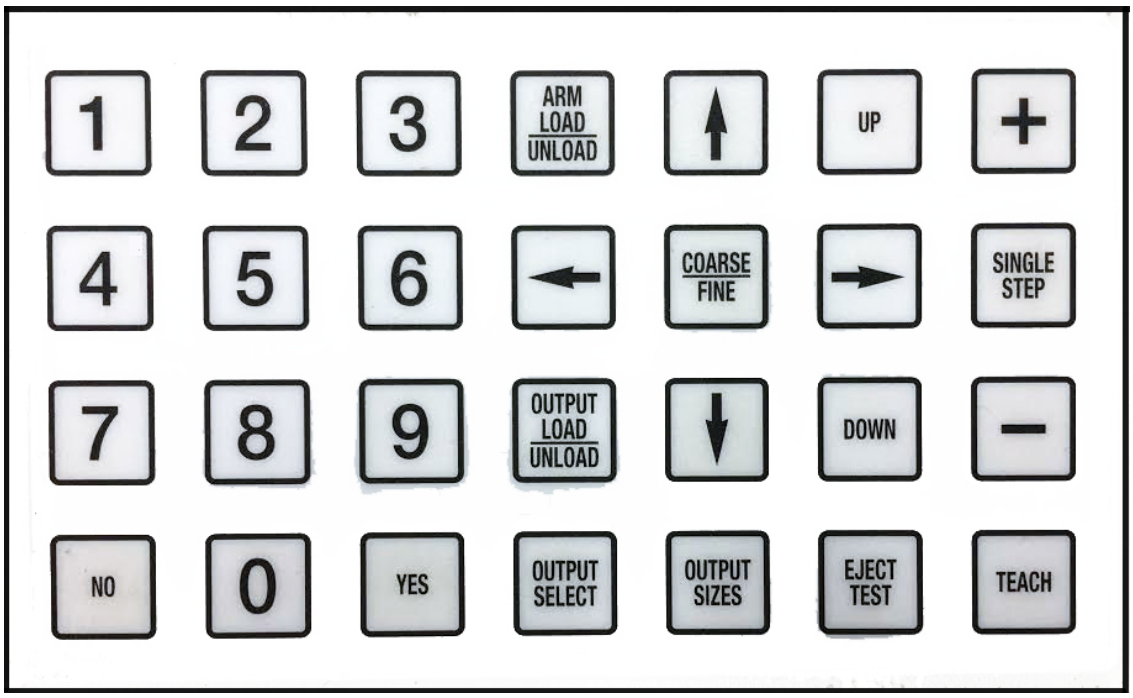
Modes of Operation

Run Mode

When the machine is in *Normal Operations* mode, the currently selected Waffle Pack pattern number will be shown on the top line of the display and the total number of devices placed will show on the bottom line of the display.

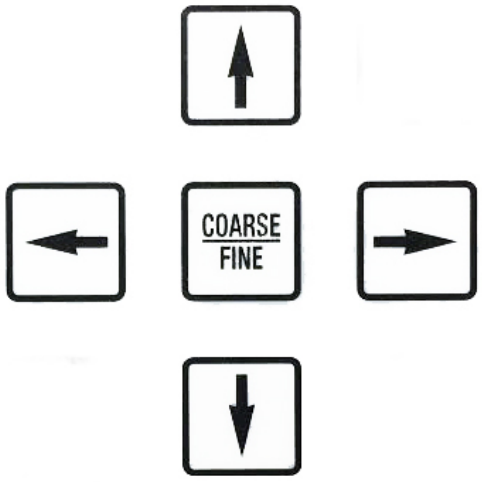
When the Foot Pedal is pressed, the arm will leave its current position (usually the *Wait Position*) and will go directly to the *Die Pickup Position*. The Pickup Arm then waits for a short time at the pickup position for the die to be lifted. After the die is picked, the arm moves to the next empty waffle pack location. The arm will then return to the *Wait Position*, where it will stop unless the Foot Pedal is still held down. If the Foot Pedal is held down, a new cycle will begin without stopping. This cycle will be different if the machine has underside inspection, facet inspection or bar stacking capabilities. (See *Underside Inspection* or *Facet Inspection* sections for details.)

Keyboard Function in Run Mode



The following will describe keyboard functions when the machine is in the *Run Mode*.

Coarse/Fine
This key has no function in RUN mode.



Left/Right Arrow
Pressing the **Right/Left Arrow** key with the pick arm in the wait position will move the arm to the last placement position on the waffle pack. Once the arm has moved to this position, the **Right Arrow** will move the arm through the current row of both waffle packs in that axis.

Up/Down Arrow
If the pickup tip is has been moved to the waffle pack by pressing either the **Left Arrow** or **Right Arrow**, the **Up/Down Arrow** key will move the Pickup Tip position through each pocket of the current column of both waffle packs in that axis.

NOTE: *The pocket that the tip is left in will be the next pocket the die will be placed to when the Foot Pedal is pressed. The die will then be placed in order from that new position, however, if the die count is not adjusted it will continue from its current count.*

UP Key
Pressing the **UP** key when the Pickup Tip is in the wait position will cause the Pickup Tip to find its *Home Position* and return to traverse height.

DOWN Key
Pressing the **DOWN** key when the Pickup Tip is in the wait position will lower the head to the current pick height setting. If the head is left in this position and the foot pedal is pressed, it will first raise to traverse height before picking and placing.

+/- Keys

Pressing the **+/-** keys with the Pick Arm in the wait position will move the arm to the last placement position on the waffle pack.

Once the arm has moved to this position, the **+** key will move the arm *forward* through each pocket of the current waffle pack until it reaches the *last* pocket. It will then move to the first position of the next waffle pack.

The **-** key will do the opposite, moving the arm *backward* through each pocket of the current waffle pack until it reaches the *first* pocket. It will then move to the last pocket of the previous waffle pack.

NOTE: *The die count will be incremented each time the **+** key is depressed and decremented each time the **–** key is depressed. The pocket that the tip is left in will be the next pocket the die will be placed to when the foot pedal is pressed. The die will then be placed in order from that position and the die count will be adjusted.*

Eject Test

Pressing the **Eject Test** key will eject the Eject Head needles. Pressing this key again will retract the needles. If you are unsure if the needles are ejected, pressing **NO** always retract the needles in *RUN Mode*.

Arm Load/Unload

Pressing **Arm Load/Unload** will move the arm left or right, depending on where the arm is positioned when pressed.

If the arm is in the *Wait Position*, pressing this key will move the arm left to the *Pick Position*. Pressing this key again will cause the arm to move right, seeking its *Home Position*. Continued pressing of this key will cycle the arm through various positions, depending on the options on the machine, until it seeks its *Home Position* again.

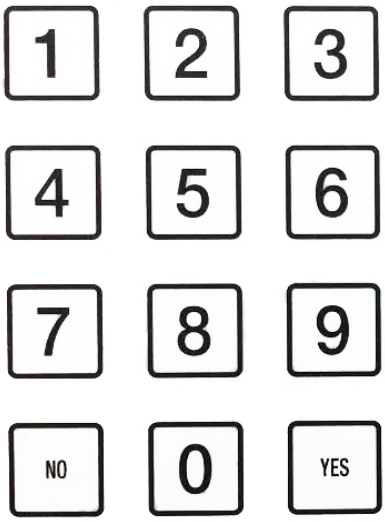
When **Arm Load/Unload** is pressed, the last placement position and die count are remembered. This function is helpful when the arm needs to be moved out of the way to replace a wafer in the Wafer Holder, waffle packs on the Output Plate, or if the arm has run into something and has lost position.

When using Grades, pressing **Arm Load/Unload** after placing a die will move the table out to the *Load/Unload Position* allowing that tray to be replaced without affecting the count of the other grades.

Output Load/Unload

Pressing **Output Load/Unload** will move the output stage to home position, toward the back of the machine. Pressing it again will move the stage to the front of the machine for easy access to the waffle packs. When this key is pressed, the place position will reset to the first pocket of the first waffle pack and the die count is reset to 0.

Numeric Keys



If more than one output grade has been assigned to the output trays from the **OUTPUT SELECT** menu, then pressing a number on the keypad will tell the system which grade to place the next die pick to. For example, if 2 is pressed, the next die picked will be placed to the next available pocket in the tray assigned to grade 2.

When a number is pressed, the display updates to show which tray that grade is assigned to and how many pockets in that tray have already been filled.

Any numbers above the number of output grades available will have no function.

Single Step Mode

This mode forces the machine to go through the pick and place cycle one step at a time, stopping between each step until the foot pedal is pressed. It also automatically puts the machine into a teach mode to allow for positions, delay times etc. to be edited.

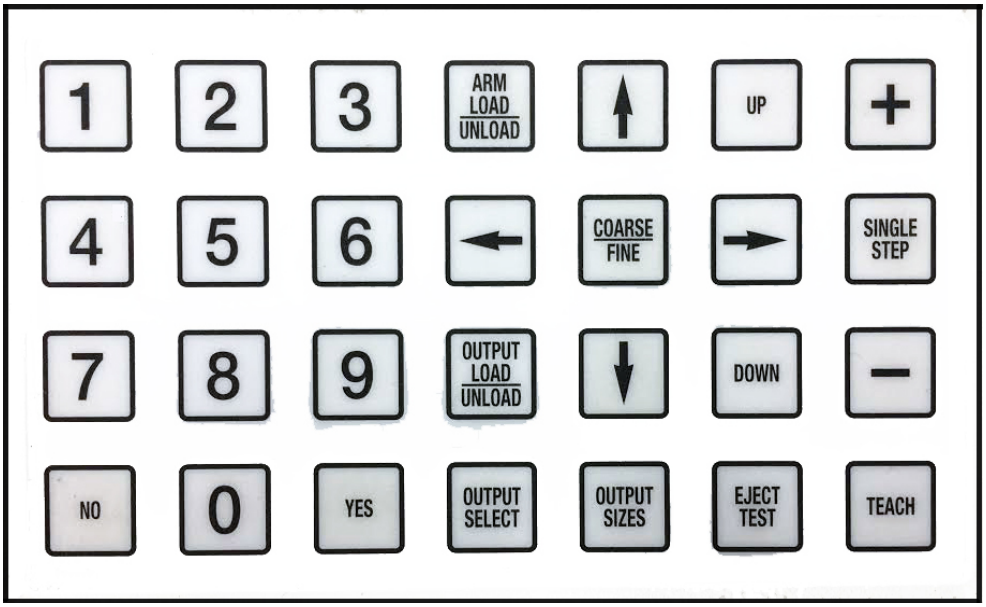
Single Step Mode will need to be used for first set up of the machine, any time a new die size will be picked, any time the Eject Head is removed or adjusted, any time the Pickup Tip is removed, or if you find the pick and placement of the die is not accurate.

To enter *Single Step Mode*, press the **SINGLE STEP** key. ***TEACH STEP FINE*** will be displayed in the top line of the LCD. You can now verify pick up and place positions, verify that solenoid valves are functioning, and edit settings.

Pressing the Foot Pedal will advance the machine to the next step in the pick and place cycle. The second line of the LCD will display the event that will take place the next time the foot pedal is pressed. If you keep the foot pedal pressed, the machine will cycle slowly, since the foot pedal (and all other keys for that matter) repeats automatically after being held for more than 1 second.

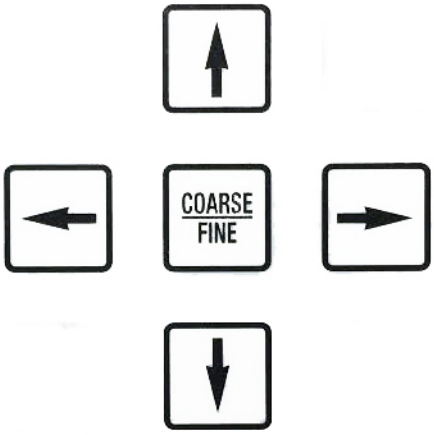
To return to normal *RUN Mode*, press the **SINGLE STEP** key again. The machine will complete the pick and place cycle the next time the Foot Pedal is pressed. If at any time you do not want the machine to complete the cycle, press the **NO** key. The message ***CYCLE TERMINATED*** will be displayed briefly and the X-arm will return to the Wait Position.

Keyboard Function in Single Step/Teach Mode



The following describes the key functions when the system is in Single Step/Teach Mode.

Coarse/Fine
Switches between **Fine** (1 Step) and **Coarse** (10 steps) for each action of the X, Y and Z drives. The X-drive moves 2 mils per step. The Y and Z drives move 1 mil per step. ***COARSE*** or ***FINE*** is displayed on the LCD on the right side of the top line. When adjusting pick up delay, **Coarse/Fine** switches delay increment from 0.010 sec. to 0.100 sec.



Down/Up Arrows
If the Pickup Tip is currently over the waffle pack area, then the **Down/Up Arrow** keys adjust the waffle pack table towards the back/front of the machine by either a **Coarse** or **Fine** movement. This has the effect of moving the Pickup Tip towards the back/front of the machine. If the pickup is not located over the waffle pack area, the machine will beep but nothing will happen.

Left/Right Arrows
Adjust the pickup arm towards the Left/Right of the machine, by either a **Coarse** or **Fine** movement.

Up/Down Keys
Raises/Lowers the Pickup Tip by either a **Coarse** or **Fine** movement.

If the pickup tip is in the down position over the Waffle Pack/Output area, pressing the **UP** key will raise the placement height while pressing **DOWN** will lower it.

If the pickup tip is in the down position over the Wafer, pressing the UP key will raise the die picking height while pressing **DOWN** will lower it.

If the pickup tip cannot be adjusted any further in the up/down direction, the message ***REACHED LIMIT*** will appear briefly in the display, accompanied by 3 beeps.

If the pickup tip comes into contact with anything with a force greater than 7-10 grams, the display will change from ***PICK UP CLEAR*** to ***PICKUP IN CONTACT***.

NOTE: *The pickup tip will only sense forces pushing up on the bottom of the tip. If the pickup tip cannot be adjusted any further in the down direction, the message* ***REACHED LIMIT*** *will appear briefly in the display, accompanied by 3 beeps.*

+ /- Keys

If the adjustment being made is a time adjustment, such as delay time, then the **+** key will increase the time and the **–** key will decrease the time. Each can use either a **COARSE** or **FINE** increment.

NOTE: *Adjustments made are permanently stored and will remain after the machine is turned off. At any time a limit is reached,* ***REACHED LIMIT*** *will show on the display.*

Pick & Place Cycle

The following is a breakdown of the full pick and place cycle, with a description of the action and adjustments allowed when in Single Step.

1. ***TURN ON TAPE VACUUM***

   Vacuum is applied through the Eject Head to hold the tape in place. No adjustments are necessary or allowed.

2. ***ARM GO TO PICK POSITION***

   The Pickup Arm will move to position the tip directly above the center of the next die to be picked. In this position the **Left/Right Arrow** keys will move the Pickup Arm left or right to align the tip with the Eject Needle if necessary.

3. ***GO DOWN TO PICK HEIGHT***

   The Pickup Head will lower to the height at which it will pick the die. This position should be set so that the Pickup Tip either just contacts the die or is just out of contact with the die. This height can be adjusted using the **Up/Down** keys along with the **Coarse/Fine** keys in this position.

4. ***TURN ON PICK UP VACUUM***

   Vacuum is applied through the Pickup Tip. No adjustments are necessary.

5. *LIFT NEEDLES*

Eject Head Needles are raised. No software adjustment necessary, however, the needle height may need adjustment. This is a mechanical adjustment: to raise the needles turn the Stop Ring on the Eject Actuator counter clockwise, to lower turn the Stop Ring clockwise.

***Note**: Pneumatic Ejectors only, see Motorized Ejector section on page 105 for details.*

6. *WAIT N.NNN SECS FOR DIE TO LIFT.*

Displayed time will be the amount of time the Pickup Arm waits in the current position for the die to be released from the tape. Generally, the default time of 0.030sec is correct, but larger die may need a longer amount of time to peel from the tape. This time is adjustable using the **+/ -** keys with the **Coarse/Fine** keys. Run the machine in normal *RUN Mode* for a few cycles to determine how long the wait time should be.

7. *LIFT TO SEARCH HEIGHT AT 8000 u/sec.*

When this is displayed on the LCD you can adjust the speed at which the pickup head will lift to search height. The range is 100 to 8000 u/sec. **Coarse** will adjust in increments of 1000 and **Fine** will adjust in increments of 100.

8. *GO UP TO TRAVERSE HEIGHT.*

The Pickup Head will rise to *Traverse Height* to clear obstructions when moving.

If a delayed pick is desired to allow the Gel-pak to peel off the die, set a search height that is above the *Pick Height* and below the *Traverse Height*. The Pickup Head will travel to this height at the speed set in the previous step. If no delay is desired, leave the *Search Height* the same as the *Pick Height*.

9. *TURN OFF TAPE VACUUM.*

The vacuum to the Eject Head is turned **OFF**.

10. *RETRACT NEEDLES.*

The air to the Actuator is turned **OFF** and the needles are retracted. This allows the wafer to be moved to the next die to be picked.

11. *TABLE GO TO PLACE POSITION.*

The table will move to the proper position to place the next die. If inspection options are installed on the system, this step will occur after the inspections are completed.

12. ARM GO TO PLACE POSITION.

The arm will now move to the right to the position over the waffle pack to place the die. If inspections options are installed on the system, the arm will move to whatever is the next position in the sequence.

13. GO DOWN TO PLACE HEIGHT.

The Pickup Arm will go down to the *Place Height* to place the die into the waffle pack. At this time, use the **UP/DOWN** keys to properly adjust the *Place Height*. The **ARROW** keys may also be used to move the arm left/right and the table forward/backward to properly position the die into the waffle pack.

14. TURN OFF PICKUP VACUUM.

The pickup vacuum is turned **OFF** to release the die in the waffle pack.

15. PURGE PICKUP X.XXX SECS.

A puff of air is applied to the Pickup Tip to insure the die releases. Use the **+ / –** keys to increase or decrease this time according to the **Coarse/Fine** key. **Fine** will adjust the time by 0.010 increments and **Coarse** will adjust by 0.100 increments.

16. GO TO TRAVERSE HEIGHT.

Pick up lifts to *Traverse Height* in order to clear all obstructions while traveling to the wait position.

17. FINISH CYCLE.

Arm goes to the wait position just to the right of the field of view of the optics. This position is adjustable using the **Left/Right Arrow** keys. This position can be placed as close to the pick position as the Operator wants to improve their through-put.

Teach Mode

When the system is in *Teach Mode,* ***TEACH RUN*** will appear on the LCD and the system settings (positions, delay times etc.) are enabled to be changed.

> ***NOTE:*** *When the SINGLE STEP key is pressed the system is automatically put into the teach mode. While in the Single Step Mode pressing the TEACH key will toggle the teach mode disabling the edit function.*

Teach Mode is designed to allow the Operator to make adjustments to the machine settings during operation. Any change made while in *Teach Mode* it will be a global change.

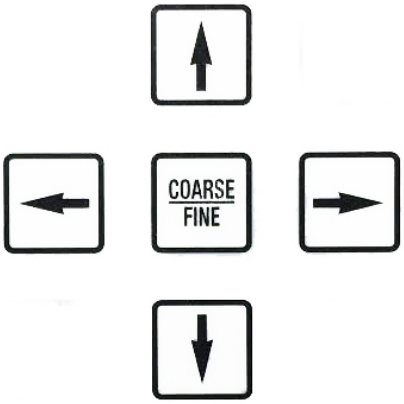
When adjusting the *Place Position* in *Teach Mode*, move the whole box and do **not** affect the Pitch values like when you are in *Calibrate Trays*.

Output Setup

Changing Output Sizes

To change the output waffle pack dimensions, press the **OUTPUT SIZES** key. This will display the ***Output Sizes Menu*** on the LCD display with a cursor **>** pointing to the relevant line.

Use the **Up/Down Arrow** keys to move the cursor **>** through the menu lines, displaying the dimensions already in use.



To browse through the Waffle Pack part numbers and corresponding dimensions, press the **Left/Right Arrow** keys. The **Left Arrow** key will present the previous part number in the list, the **Right Arrow** key will present the next part number in the list. It does not matter which line in the menu the cursor **>** is pointing at, you will still be able to browse through the values associated with the next waffle pack part number.

Selecting a New Die Count

1. To change the die count, press the **OUTPUT SIZES** key.
2. Press the **Down Arrow** to scroll to the ***00000 DIE PER WAFFLE PACK*** display on the screen.
3. Enter the desired number of die per waffle pack, remembering to fill all spaces provided. For example: For a die count of 400, enter *00400*. Press the **YES** key to save this setting.
4. Use the **Up Arrow** key to scroll up until ***QUIT MENU*** is displayed on the screen. Press the **YES** key to quit menu.

Selecting a New Waffle Pack Type

1. To change the waffle pack part number, press the **YES** key when the cursor **>** is pointing at the ***PART NUMBER*** line.
2. A dark, blinking square will appear in the display where the Waffle Pack number will be entered. Use the keypad to enter the correct part number. If an incorrect number is entered, use the **NO** key to backspace the cursor one position.

3. Press **YES** again. The system will search its memory to see if it already has that part number programmed. During that time, a ***SEARCHING LIST*** message will show in the display.

   If the Waffle Pack part number is already saved in the program, the dimensions for that part number will be automatically assigned and will appear in the display.

   If that part number cannot be found then ***NEW PART NUMBER*** will appear in the display and all the values will be returned to zero.

   If the part number is a standard pre-programmed part number then ***CATALOG*** will show in the display. If the part number has been, programmed by the user, then ***CUSTOM*** will show in the display.

Calibrating Waffle Packs

Waffle packs generally have poor dimensional accuracy. Anti-Static Waffle Packs are often up to 0.020 inches undersize. The preprogrammed dimensions were taken directly from Fluoroware prints and are thus nominally correct. However, in general, these dimensions are best thought of as a good first guess of the actual waffle pack size.

When using the colored ABS Waffle Packs, the preprogrammed dimensions will probably be adequate provided the die is at least 0.010 in. smaller than the cavity. For a tighter fit or when using Anti-Static Waffle Packs, calibrate each batch of waffle packs.

For a more accurate calibration start in *Single Step Mode* and pick a die. Move to the place position and place height then perform the calibration with a die on the tip. This is especially handy when working with a close tolerance Die-to-Pack fit.

To Calibrate a Waffle Pack, proceed as follows:

1. Load (4) new waffle packs.

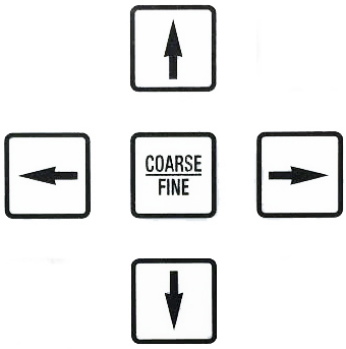
NOTE: *The system will take the average pitch from all four waffle packs; therefore, all four waffle packs must be calibrated, even if only one will be used.*

2. Press the **OUTPUT SIZES** key, then ARROW down through the display menu to ***CALIBRATE TRAYS.*** Press **YES**.

3. The Output Table will move to its *Home Position* and the LCD will display ***+ KEY - KEY SELECTS NEXT POCKET, ARROW KEYS ADJUST, YES KEY ENDS CALIBRATION***.

4. Press the **+** key. The arm will jump to the first calibration pocket of the currently selected waffle pack. The Pickup Tip will lower to placement height.

5. Use the **Up/Down** and **Left/Right Arrow** keys to position the Pickup Tip in the center of the cavity.



6. When tip is positioned correctly, press the **+** key again.

7. The arm will step to the next calibration pocket and repeat the adjustment.

   - The calibration pockets are two diagonally opposite pockets in each waffle pack. Select the next/previous calibration pocket using the **+ / -** keys. To backtrack and verify the calibration of any waffle pack, hit the **-** key.
   - If the calibration is started after some die have been placed in the waffle pack, the next placement pocket position will be remembered when operation resumes.

At any time calibration can be terminated by pressing the **YES** key. When calibration is terminated, the system calculates the true values for X pitch and Y pitch and the adjusted datum corner positions for each of the four waffle packs.

The X and Y pitch values are averaged and are then displayed in the ***OUTPUT SIZES*** menu. These new values are saved and the next time this part number is loaded, these values will be loaded.

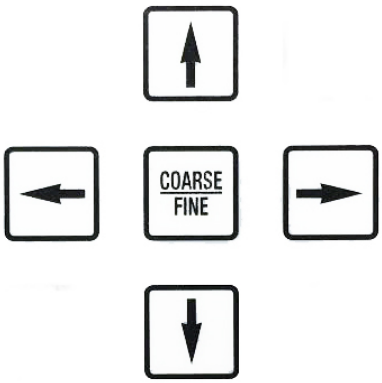
Programming Waffle Pack Dimensions

There are many non-catalog waffle packs in use that are not pre-programmed into the machine. This is not a problem since the machine can be user programmed for up to 75 user specified waffle pack part numbers and dimensions. Similarly, the user can also assign Gel Pack part number and dimensions to the Output Array Pattern of choice.

1. To enter your own information into the memory, press the **OUTPUT SIZES** key to enter the output sizes menu.

2. Using the **Up/Down Arrow** keys, position the cursor **>** in front of ***PATTERN NUMBER*** and press the **YES** key. A dark, blinking square will appear on the display where the next number will be entered from the keypad.

   NOTE: *Press the **NO** key to back up the cursor by 1 position, erasing that text. Press the **YES** key again to save the number entered.*



Part Number

This must be an 8-digit number with zeros entered to bring the number to 8 digits. For example if the actual part number is H20-55-24 then enter the part number as "000055-24".

X Pitch

The pitch is the distance from the center of one cavity to the center of the next cavity. X indicates movement along the left/right axis. If programming a new waffle pack, the easiest way to derive the X pitch is by using the waffle pack calibration feature. If you intend to do this then just enter an educated guess of the waffle pack X pitch at this point, you can calibrate the exact waffle pack sizes later.

Y Pitch

The pitch is the distance from the center of one cavity to the center of the next cavity. Y indicates movement from front to back. If programming a new waffle pack, the easiest way to derive the Y pitch is by using the waffle pack calibration feature. If you intend to do this then just enter an educated guess of the waffle pack Y pitch at this point, you can calibrate the exact waffle pack sizes later.

X Pockets

This is the number of columns pockets in a left to right direction. If you enter a number too large for the size pack you are using the system will beep three times and display ***OUTPUT DIMENSIONS INVALID***.

Y Pockets

This is the number of positions from front to back. . If you enter a number too large for the size pack you are using the system will beep three times and display ***OUTPUT DIMENSIONS INVALID***.

NOTE: *When entering your own waffle pack or GEL pak configuration the option* ***SAVE CONFIGURATION****? will display in the menu. You do not have to save the configuration, you can use your own waffle pack configuration temporarily and are not obliged to save it permanently, if you have no long term need.*

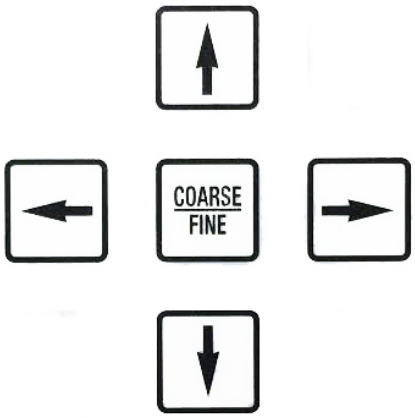
To save the configuration in long-term memory, press the **YES** key at the ***SAVE CONFIGURATION?*** prompt in the menu. The system will then attempt to save your chosen configuration in nonvolatile memory (long term storage space). It will search for a waffle pack part number of 000000-00 as a vacant "pigeonhole" in memory to save the new configuration in for future use. Once the configuration is saved, it can be selected from the menu just as if it had been one of the standard catalog waffle pack part numbers.

NOTE: *Do not assign 000000-00 as a valid waffle pack part number. This number is reserved for saving custom configurations to long term memory as described above.*

The limit for custom part numbers is 75. Once 75 part numbers have been programmed, no more may be saved. The message ***MEMORY FULL*** will show in the display and a warning beep will sound.

Erasing Unwanted Pattern Numbers

To make room in the list for new user programmed pattern numbers, you may need to erase old pattern numbers which are not currently active.



1. Select the pattern number to be erased in the menu, either by keying the pattern number into the pattern number line in the menu or by browsing through the list with the **Left/Right Arrow** keys.
2. Press the **YES** key and overwrite the old pattern number with "000000-00". All pitch and pocket count values will be returned to zero.
3. Use the **Up/Down Arrow** keys to move through the menu to the ***SAVE CONFIGURATION?*** line. Press the **YES** key and the old pattern number will be erased and this memory "pigeon hole" will now be available for storing a new waffle pack pattern number.
4. To exit the menu at any time, press the **YES** key when the cursor **>** is pointing at the ***QUIT MENU*** line. You can quickly get to this line from any line in the menu by pressing the **NO** key or by using the **Up/Down Arrow** keys.

   ***NOTE**: You can only quit from the menu if the output dimensions you have chosen are realistic.*

Changing Output Configuration

To change the output configuration of the DE35 ST, press the **OUTPUT SELECT** key. This will display two lines of the ***Output Select Menu*** with the cursor **>** pointing to ***Quit Menu***.

1. Arrow down to ***Output Plate Configuration***, press **YES**.
2. With this line active, use the **+ / –** keys to scroll through the possible selections.

• ***4 Trays, 2 in.***	***Plate 3105***
• ***2 trays, 2 in vacuum release***	***Plate 13784***
• ***1 Trays, 4 in.***	***Plate 3084***
• ***2 Trays, 4 in.***	***Plate 5089***
• ***2 Trays, 4 in. vacuum release***	***Plate 16712***
• ***2 Vials***	***Plate 9948***
• ***1 Substrate***	***Plate 13472***
• ***Wafer Output Type 8***	***Plate 5528***
• ***Wafer Output Type 7***	***Plate 12758***
• ***Wafer Output Type 27***	***Plate 13679***
• ***Wafer Output Type 7, 29***	***Plate 14460***

Note: *Once the Output Plate is changed, any calibrations made for that plate will be lost. It is recommended to use a separate process recipe for each different Output Fixture in order to maintain calibrations when changing from one process to the next.*

PICKUP HEAD ADJUSTMENT

Adjusting the Pickup Height and Position

1. Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key.

2. Cycle the system until the Pickup is at pick height over the Die Ejector.
3. Press the **UP/DOWN** keys to adjust the pickup height as needed.

   Each key press will move the head one step (.00125 in) or ten steps (.0125 in), according to the **COARSE/FINE** key setting.
4. If using a Single Needle or Dual Needle Eject Head, the Pickup Tip should make contact with the die before die ejection starts.

   If using a Multi-Needle Eject Head, the pickup tip can be out of contact with the die.
5. From the height at which the display shows ***PICKUP IN CONTACT***, raise the Pickup Tip about five fine steps (.00625 in).
6. If the Pickup Tip needs adjustment in the left or right direction, use the **Left/Right Arrow** keys to adjust as needed.

Adjusting the Die Pickup Delay

When the Die Ejector is activated, the needles start to rise and lift the die from the adhesive tape. The ***DIE PICKUP DELAY*** setting controls how long the needles will remain up before the pickup head moves to traverse height. This time period allows the adhesive to peel off the bottom of the die as the vacuum holds the die on the Pickup Tip. The delay can only be adjusted in *Single Step Mode*.

1. Press the **SINGLE STEP** key on the DE35 ST keyboard.

2. Cycle the system until the LCD displays ***WAIT X.XXX SEC FOR DIE TO LIFT*****.**
3. The **+ / –** keys will increase or decrease this time in either .01 steps or .1 sec steps, depending on the **COARSE/FINE** selection.

   NOTE: *Any value from 0.030 - 10 seconds may be used for the delay.*

4. When the Foot Pedal is pressed again, the delay will commence. This means that if a delay of ten seconds was selected, the machine will appear to do nothing for ten seconds. At the end of the delay the next step in the pick and place cycle will start once the foot pedal is pressed.

5. The new value for Pick Up Delay is retained in long term memory and will not have to be re-entered when the machine is next turned **ON**.
6. The delay may be changed at any time using the procedure outlined above.

Adjusting Lift to Search Height

LIFT TO SEARCH HEIGHT AT XXXX u/se enables a slow lift off the Gel-pak or tape to a predetermined search height. This is to assist in peeling the adhesive off the back of the die and without jerking the die off the Pickup Tip.

1. Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key.

2. Cycle the system until the LCD displays ***LIFT TO SEARCH HEIGHT AT XXXX u/sec***.
3. The **+ / -** key will increase or decrease the speed the Pickup Tip will lift to a predetermined search height. The **COARSE/FINE** key will toggle between 100 and 1,000 U/sec increments. The range is between 100 and 8,000 u/sec.

4. When the Foot Pedal is pressed again the lift to search height will occur and the LCD will display ***GO UP TO TRAVERSE HEIGHT***.

5. At this step the **UP** and **DOWN** keys will adjust the search height. For no delay in picking, make the search height the same as the pick height.

Adjusting Pickup Tip Height at Placement

Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key. Cycle the system until the pickup is at the down position over the waffle pack. In this position, pressing the **UP** or **DOWN** keys will adjust the placement height.

When a die is removed from tape, a tiny static charge is generated. Depending on die structure and pickup tip material, this charge may not leak away into the pick up tip. For die sizes smaller than 0.050 in., the backside charge can cause unreliable die placement and should be grounded onto the conductive waffle pack.

To ensure this, the placement height should be adjusted so that the die is placed into contact with the bottom of the waffle pack cavity. When in contact, the message ***PICKUP IN CONTACT*** will show in the display.

Usually backside static charge is only an inconvenience with die sizes under about 0.050 in. With die sizes larger than this, placement height is not critical.

If necessary, use the **COARSE/FINE** key to toggle adjustment between 0.00125 inch/step and 0.0125 inch/step, ***COARSE*** or ***FINE*** will appear in the top line of the display on the right.

Adjusting Die Pickup Tip Force

The die Pickup Head is supported by two flat Cantilever Springs. The Cantilevers ensure that the Pickup Head can move up and down without any side-to-side "play" or backlash. This is essential when handling small die. The Cantilevers also provide a way to adjust the pickup force that is imposed on the die during the die ejection process. This can be very important when working with fragile semiconductor structures. Pick up forces as low as 7g. may be used repeatedly.

The ***TOUCH DOWN*** force is set at 7 to 10 grams during machine setup when the head is at its lower height limit. This force is what is required to break an electrical contact of the Cantilevers with the Z-Arm. When this electrical contact is broken, the LCD display will indicate the ***PICKUP IN CONTACT***. This force will be altered by the pickup height: the higher above the lower limit, the higher the force necessary to indicate ***PICKUP IN CONTACT*****.** The height of the Die Eject Head should be set as low as possible while making contact with the Pickup Tip in the *Pick Position*.

1. Press **SINGLE STEP**.

2. Lower the Eject Head all the way down, using the thumbscrew(DE35-ST) /screw (DE35-300) on the right of the DES Eject Head support.
3. Cycle the system until the Z-Arm is in the *Pick Position* at Pick height, LCD will indicate ***TURN ON PICKUP VACUUM*** and ***PICKUP CLEAR***.
4. Use the DES Height Adjusting Screw to slowly raise the Eject Head until the LCD displays ***PICKUP IN CONTACT*****.**
5. Press the **COARSE/FINE** key until ***FINE*** is displayed on the LCD.

6. Use the **UP** key to raise the pickup arm until the LCD indicates ***PICKUP CLEAR*****.**
7. Raise the needles by pressing the **EJECT TEST** key. The message ***PICKUP IN CONTACT*** will show in the top right of the display.

8. Contact indicates the tip is touching the die. The needles should raise the die high enough to touch the tip and allow the tape to release. Needle height should not be excessive. Raising the die higher than necessary will only increase the load on the die, possibly damaging the die.

   If Needle height needs adjusting, press **EJECT TEST** to lower the needles and adjust the Stop Ring on the Eject Actuator to adjust the needles. Raise the needles again and recheck as above.

As the ejection proceeds, the needles will push the die up and further increase the deflection of the Cantilever. The maximum force that the die will be exposed to will occur at the end of the die ejection process.

- Raising the Pickup by one fine step increases the pickup load by about 2.0 gm and lifts the Pickup by about 1.25 mil.

- Raising the Pickup by one coarse step increases the pickup load by about 40 g. and lifts the Pickup by about 12.5 mil.
- For general purposes, use a Pickup load of about 50 g.
- Pickup load is not a critical adjustment as far as the machine operation is concerned.
- Lower loads may be necessary for fragile die. Higher loads may be necessary when using a single needle head and large die to counter the tipping tendency of the die.

Once the pickup height has been adjusted to give the appropriate loading, press the **EJECT TEST** key to lower the needles.

Adjusting Pickup Tip Purge (Blow Off)

When the die is placed in the cavity or is in the discard position, the Pickup Vacuum is turned **OFF** and the system waits for about 50 msec. for the vacuum line to return to atmospheric pressure. Immediately after this, a short pressure impulse is applied to the Pickup Tip to dislodge the die from the tip. To minimize static accumulation at the Pickup Tip, the Pickup Body is fully grounded. For best performance, the pickup tip should be made from static dissipating material.

Blow off pressure can be set between 2 and 10 psi. Factory setting will be about 5 psi. This will prevent silicon dust build up in the vacuum lines. The Blow Off Pressure Regulator is on the back left side of the machine. The Blow Off Pressure Gauge is visible through the top of the left machine panel.

The amount of time that the purge pressure is applied can be adjusted from the keyboard when in *Single Step Mode* as follows:

1. Press the **SINGLE STEP** key.
2. Cycle the machine until the message ***PURGE PICK UP 0.030 SEC.*** appears in the display. This is the amount of time the purge air is turned on. A figure of 0.030 sec. is used as an initial factory setting.

   NOTE: *This message will appear over the waffle pack and in the discard position and can be independently set*
3. Press the **+ / -** key to adjust the time showing in the display. The purge time can be adjusted in the range 0.000 sec. to 1.000 sec. The **COARSE/FINE** key will change the adjustment increment from .01 sec to .1 sec.
4. Purge Time is stored in memory and any changes will be retained when the machine is next turned on

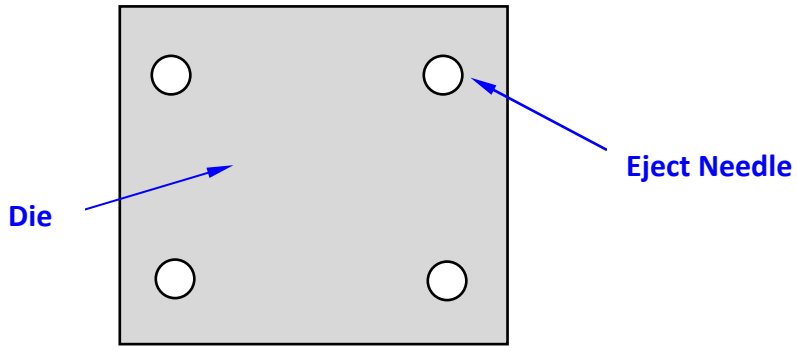
NOTE: *Any contamination on the pickup surface (such as finger grease), or on the wafer (such as photo-resist material) will impair die release reliability.*

There is a trade-off between Purge Time and Purge Pressure. You will need a shorter time using a higher pressure. When using high blow off pressure, it is important to adjust the placement height so that the die is not blown out of the cavity. See ADJUSTING THE PLACEMENT HEIGHT section above.

Die Eject System

Adjusting the Die Ejector

It is important that Eject Head Needle Pattern aligns squarely with the Front/Back Axis of the machine, as shown below.



1. The Eject Head can be screwed up against the O-ring as far as necessary to align the needle pattern. This is the only function of the O-ring. It is not required for sealing.
2. Rotate fully counter clockwise the Micrometer speed control, then rotate the control counter clockwise by about half a turn. This will set the die plunge up speed at the lower end of its speed range.
3. Press the **EJECT TEST** key. You will hear a click as the Die-Eject Vacuum Solenoid Valve turns **ON**, followed by a short delay and another click as the Die-Eject Compressed Air Solenoid Valve turns **ON**. You will now see the Eject Needles emerge from the top of the plunge up Head Assembly.

   Although not a critical adjustment, the needles should emerge at least 0.050 in. as a starting point.

NOTE: *If the needles are left in the up position, there is a danger of moving the Film Frame Holder and tearing the film. To minimize this possibility,* ***the system will drop the needles after about 60 seconds****. You can toggle the needles on and off in Single Step Mode when the pickup arm is actually over the top of the Eject Head. This is a handy way of verifying head/needle alignment.*

If the needles do not appear, ensure that the compressed air supply is turned **ON** and that the Eject Speed Control is not screwed fully clockwise.

Note*: Pneumatic Ejectors only, see Motorized Ejector section on page 94 for details.*

If the air is turned **ON** and the needles still do not appear, it is likely that the needle height has been incorrectly set and the needles are being prevented from coming up to the required height. Press the **EJECT TEST** key a second time to turn off the Die Ejector then adjust the large Diameter Ring that surrounds the Ejector Actuator in a counter clockwise direction. This will increase the maximum needle height, which you can now test by pressing **EJECT TEST** key again.

4. Adjust Eject Speed (the time it takes for the needles to fully extend) using the Micrometer Adjustment Knob on the left side of the Front Panel, next to the Power ON/OFF switch.

   This setting is nominally set to **1** at the factory. Turning this adjustment clockwise, to less than 1 will slow the needle eject-time. Turning this adjustment counter clockwise to greater than 1, will speed up the eject time.

   Repeat the adjustment and **EJECT TEST** until the needles take around 0.5 second to fully protrude. This is a good starting point.

   - If the speed of the ejection is too fast for the die size being picked, or the vacuum supply is inadequate, the film may lift off the Vacuum Head before the tape has had time to peel off the back of the die.
   - The actual speed setting must be found by experiment, since the tape adhesion varies widely with wafer backing, type of tape, age of the tape, ambient humidity etc.
   - With very large die or for fragile structures, for example, an eject time of 2 or 3 seconds would not be unusual.

   Warning: With die less than 0.010 thick or made from Gallium Arsenide, there is danger of cracking the die from using excessive eject speed.

Note: *Pneumatic Ejectors only, see Motorized Ejector section on page 94 for details.*

Adjusting the Die to the Pickup Tip: DE35-ST

NOTE: *For DE35-300 alignment, see System Alignment section on page 20.*

For reliable operation, the Pickup Tip, Die Ejector Needle and Video Cross Hair must all be positioned correctly. This is a critical adjustment for die sizes under 0.050 in. sq. or when using an edge contact, Collet style, pick up tip.

The following is the recommended sequence for setting up the machine.

1. Press the **SINGLE STEP** key to place the system in Single Step Mode and enable positions to be adjusted.

2. Install a Ring or Frame in the Wafer Holder with tape and die on the film. Locate the Wafer Holder so there are no die over the Eject Head.
3. Turn on the Monitor and PC. Select one pair of cross hairs on the screen.
4. Align the crosshair to bisect the screen into four equal parts.
5. Using the FOOT SWITCH, step the Pick Head over to pick position at pick height. The **Left/Right Arrow** keys can be used to align the tip approximately in the middle of the Eject Head.
6. Lightly tap the Pickup Tip onto the film to leave a mark.
7. Press the **NO** key to terminate the cycle and the Pickup Arm will move to the right, out of the way. **Do not press the footswitch and raise the Eject Needles,** it will damage the tip.
8. Using the Camera Adjustment Screws on the Camera Mount, align the single crosshair to bisect the mark left by the Pickup Tip.
9. Press the **EJECT TEST** key to locate where the needle is in relation to the cross hairs.

10. Press the **EJECT TEST** key to lower the needles to allow the head to move.
11. Using the Thumbscrews located at the left end of the Die Ejector System, adjust the Die Ejector Head so that the Die Eject Needle rises into the center of the cross hairs.
12. Move the tape to a clear area as often as needed to clearly see where the needle is.
13. When the needle is in the cross hair juncture, tighten the Thumbwheel that holds the ejector in position.
14. Move to a clean spot on the tape. Make a new mark with the Tip and eject the needle to recheck the final position of all three. Re-adjust as necessary until all are in the same spot.

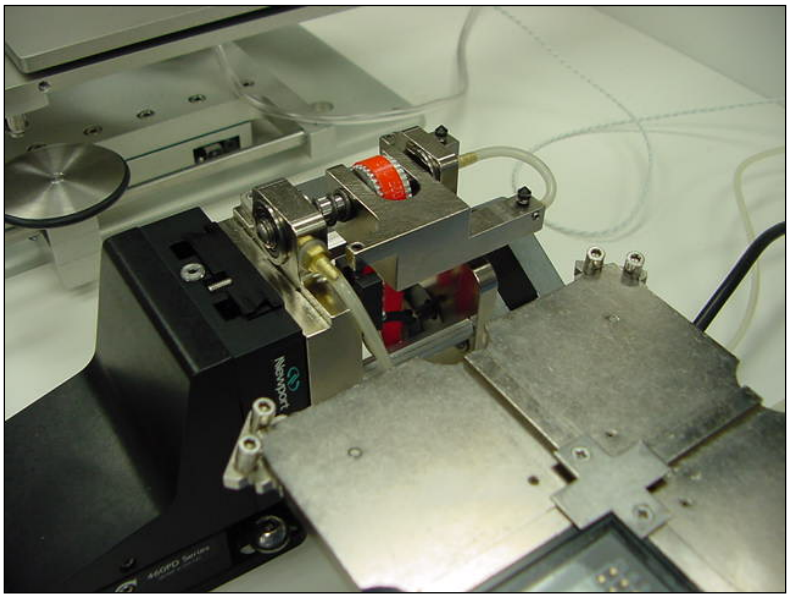
NOTE: *The Die Ejector is automatically switched off after about 1 minute*

Die Inverter System

The Die Inverter is an optional device used to invert or flip the die upside down before placing to the Output Fixture.

In order for the die to be inverted, the die must first be picked and placed to the Die Inverter place position. The inverter then activates an arm that rotates 180 degrees to bring the Inverting Tip into contact with the top of the die. The Place Position Tip Vacuum is turned off and the inverting tip vacuum is turned on. The arm then rotates back 180 degrees to its original position. The inverted die is then picked from the Inverter Tip and placed to the Output Fixture.

It is important to remember that when the system is powered up the Die Inverter will be the last assembly to be homed. Therefore, the Inverter Arm should always remain in the normal position when the DE35 ST is not using the inverter or the system is powered down.



Inverter Arm in the normal position

Die Inverting Cycle

The following is a breakdown of the Die Inverting Pick and Place Cycle. You can view each of these steps by pressing the **SINGLE STEP** key and stepping through the cycle using the Foot Switch.

1. ***DIE INVERTER TO HOME POSITION***

   The Die Inverter will home before each Pick & Place cycle. This will ensure that the arm is in the proper position for each cycle. The arm will home in the non-inverted position.

2. ***ARM GO TO DIE INVERTER PLACE POSITION***

   The Pickup Arm will move to position the Pickup Tip directly above the center of the Inverter Flexure position (a pick tip is installed into the flexure and is used for this position). The **Left/Right Arrow** keys can be used to move the X Axis Pickup Head as necessary.

3. ***GO DOWN TO INVERTER PREPLACE HEIGHT***

   The Pickup Arm Z will move down to the Preplace Height. The **Up/Down** keys can be used to move the Z Axis as necessary.

   This position is provided to allow the Operator to make fine X adjustments to the Inverter Flexure/Die position without the die coming in contact with the Flexure Tip. This height can be adjusted to be the same as the Inverter Place Height if desired.

4. ***GO DOWN TO INVERTER PLACE HEIGHT***

   The Pickup Arm Z will move down to the Place Height. The **Up/Down** keys can be used to move the Z Axis as necessary. This position is provided to place the die gently onto the Inverter Flexure Tip.

5. ***DIE INVERTER FLEXURE VAC ON + DELAY***

   The Inverter Flexure pick tip vacuum will turn **ON**. This is necessary to achieve proper die transfer. There is a small delay that is not programmable.

6. ***TURN OFF PICKUP VACUUM***

   The Pickup vacuum will turn **OFF**.

7. ***PURGE PICKUP X.XXX SEC***

   The Pickup Tip will purge for the time displayed on the screen. The time is programmable from 0.001 to 9.999 seconds

8. ***GO UP TO TRAVERSE HEIGHT***

   The Pickup Arm Z will move up to the traverse height to clear obstructions when moving.

9. ARM GO TO DIE INVERTER CLEARANCE POS.

The Pickup Arm will go to the Inverter Clearance Position. This is defaulted to the right of the Inverter Assembly. This position can be adjusted by using the **Left/Right Arrow** keys to move the X Axis Pickup Head as necessary. This position is provided to ensure that the Pickup Head is clear of the Inverter during the rotation step.

10. DIE INVERTER TO PICKUP POSITION

The Die Inverter Pickup Arm will rotate 180 degrees to bring the Inverter Pickup Tip into contact with the previously placed die on the Inverter Flexure.

11. DIE INVERTER PICKUP VAC ON + DELAY

The Inverter Pickup Vacuum will turn **ON**. This is necessary to achieve proper die transfer. There is a small delay that is not programmable.

12. DIE INVERTER FLEXURE VAC OFF + DELAY

The Inverter Flexure Tip Vacuum will turn **OFF**. This is necessary to achieve proper die transfer. There is a small delay that is not programmable.

13. DIE INVERTER TO NORMAL POSITION

The Die Inverter Pickup arm will rotate back 180 degrees to the normal position.

14. ARM GO TO DIE INVERTER PICK POSITION

The pickup arm will move to position the pickup tip directly above the center of the Inverter pickup position (a Pick Tip is installed into the arm and is used for this position). The **Left/Right Arrow** keys can be used to move the X Axis Pickup Head as necessary.

15. GO DOWN TO DIE INVERTER PRE-PICK HEIGHT

The Pickup Arm Z will move down to the Pre-Pick Height. The **Up/Down** keys can be used to move the Z Axis as necessary. This position is provided to allow the Operator to make fine X adjustments to the Inverter pickup/Die position without the die coming in contact with the Inverter Tip. This height can be adjusted to be the same as the Inverter Pick Height if desired.

16. GO DOWN TO DIE INVERTER PICK HEIGHT

The Pickup Arm Z will move down to the Pick Height. The **Up/Down** keys can be used to move the Z Axis as necessary. The **Left/Right Arrow** keys can also be used to make adjustments to the X position of the Pickup Tip. This position is provided to pick up the die from the Inverter Pick Tip.

17. TURN ON PICKUP VACUUM

The Pickup Tip Vacuum will turn **ON.**

18. DIE INVERTER PICKUP VAC OFF + DELAY

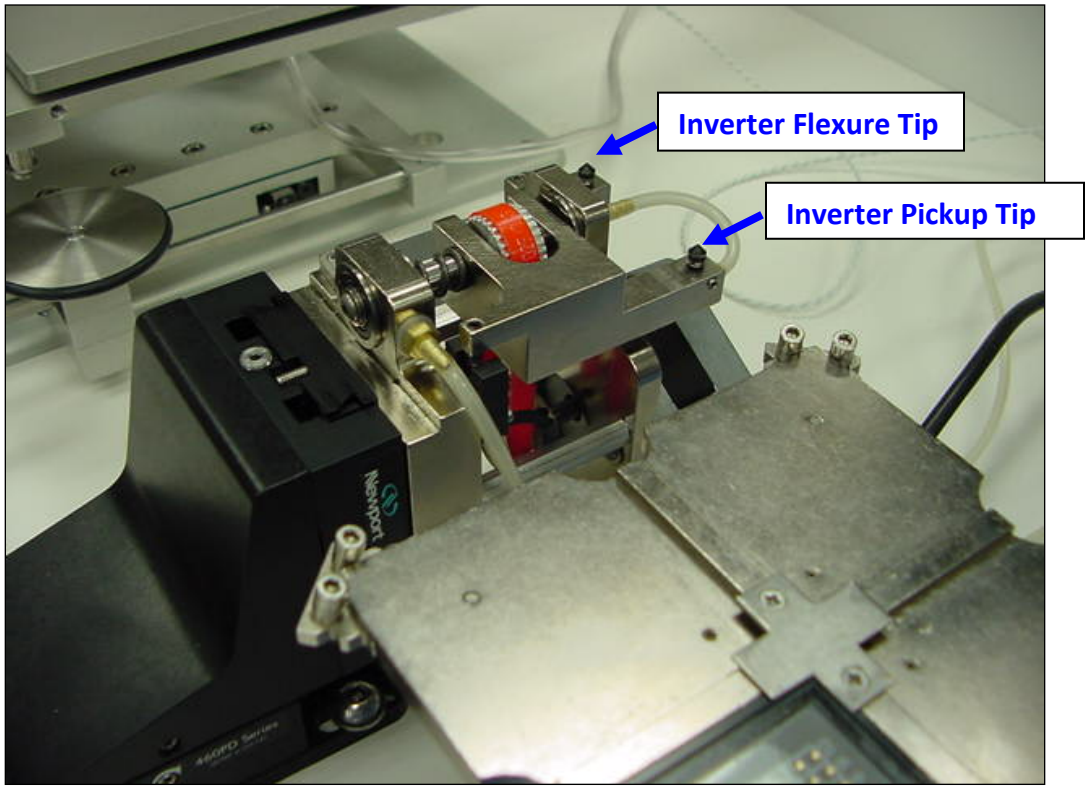
The Inverter Pickup Tip Vacuum will turn **OFF**. This is necessary to achieve proper die transfer. There is a small delay that is not programmable.

19. GO UP TO TRAVERSE HEIGHT

The Pickup Arm Z will move up to the traverse height to clear obstructions when moving.

Die Inverting Discussion

The Die Inverter uses two Pickup Tips to achieve the inverting process. The tips should normally be the same type. Normally, a Pickup Shank and rubber tips are used. This will help to prevent damage to the die during the inversion process.

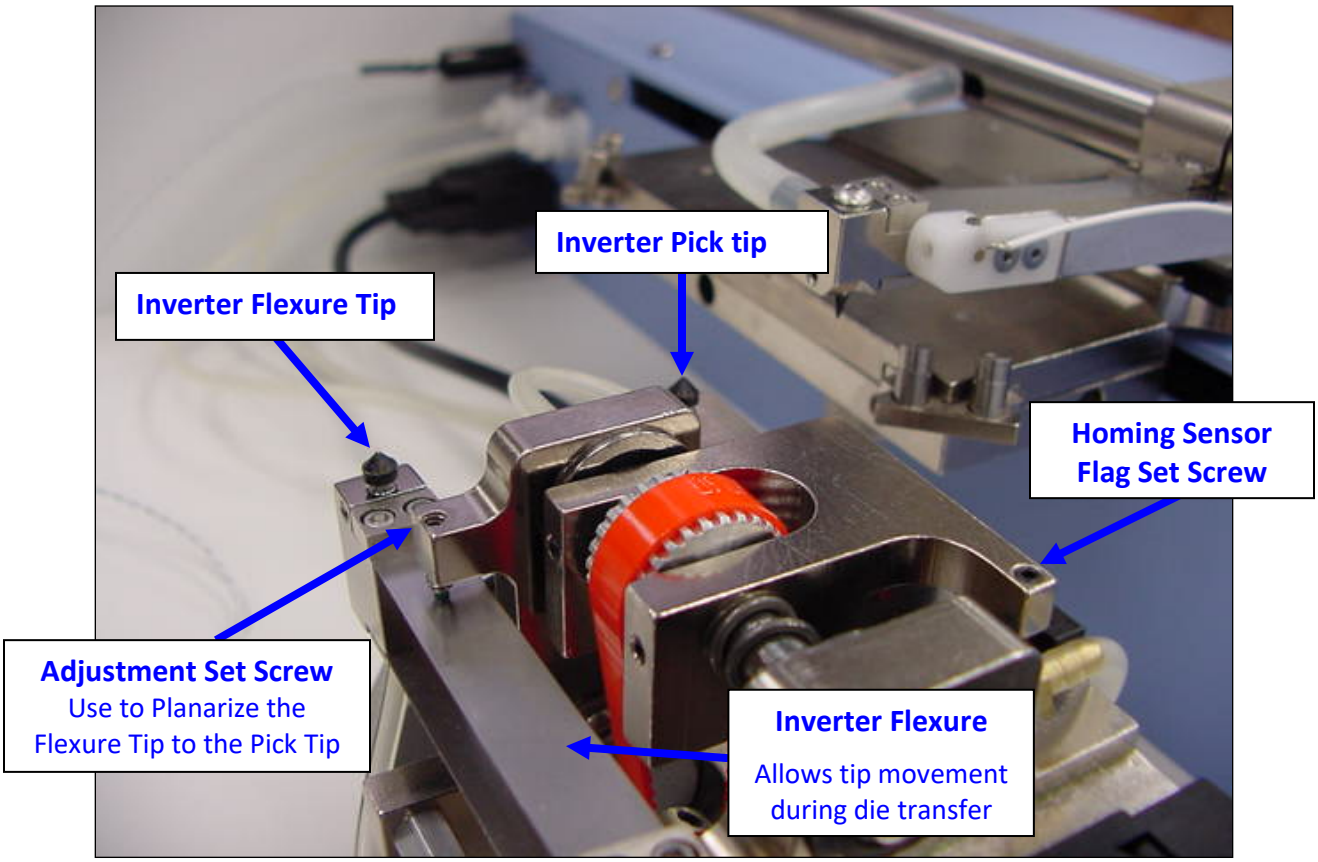


The inverter tips should be adjusted so that they are at the same vertical height. The inverter is designed to receive, invert and deliver a die to the Main Pickup Head in the same horizontal plane.

When placing a small die (< 30 mils square) to the Inverter Flexure Tip the die should be gently placed onto the tip and not pushed. When picking a die from the Inverter Pickup tip the same gentle force should be observed.

Adjust Die Inverter Home Position

The Inverter Pick Tip is attached to the Inverting Arm. This arm will rotate 180 degrees from the homed position. To ensure proper die transfer, it is necessary to ensure that the tip position on the arm is level with the system. The arm homing position can be adjusted by adjusting the position of the Homing Sensor Flag (a black anodized set screw is used for this purpose).



NOTE: *There is some trial and error required to adjust the position.*

1. Select **SINGLE STEP** mode.
2. Using the Foot Switch, STEP the system until the LCD displays, ***DIE INVERTER TO HOME POSITION***. The next Foot Switch press will home the inverter.
3. Check the position of the Inverter Arm. If the arm is in the desired position you are finished. If not proceed to step 4.
4. Press **NO** to escape from the current cycle. Leave the machine in **SINGLE STEP** mode.
5. Adjust the Homing Sensor Flag Set Screw and repeat steps 2 and 3.

Adjust the Inverter Flexure

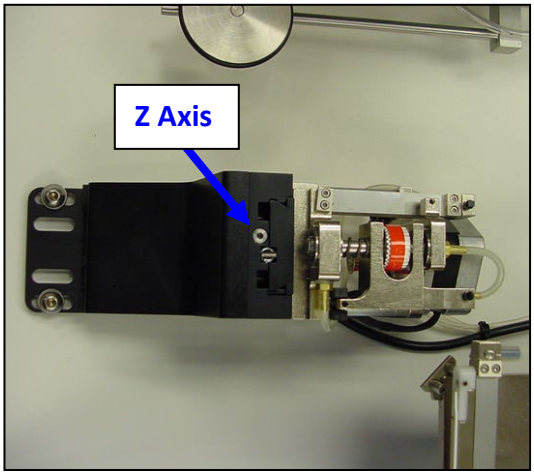
The Inverter Flexure is the portion of the Die Inverter that receives the previously picked die. This flexure will bend downward as the die is being transferred from the Pickup Tip. The position of the Flexure is adjusted using a nylon tipped set screw. This position should be adjusted so that the Flexure Tip is level or planar with the Inverter Pickup Tip. Please see picture above.

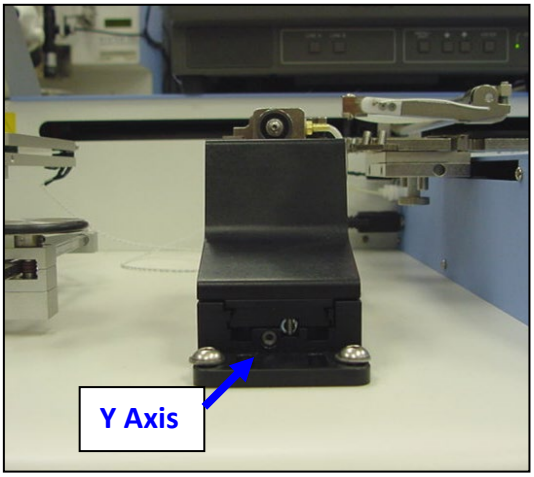
Adjust Inverter Z & Y Position

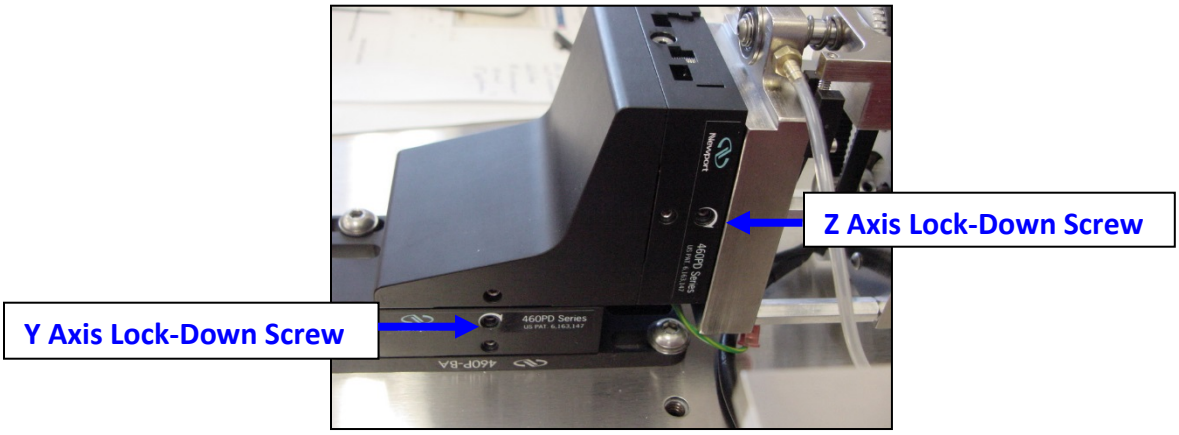
The Die Inverter is mounted on a precision slide assembly. Both Axis Adjustment Screws are locked in place.

1. Loosen the Lockdown Screws before adjusting.
2. The **Z Axis** is adjusted by turning the Adjustment Screw clockwise for DOWN and counter clockwise for UP.

   The **Y Axis** is adjusted by turning the Adjustment Screw clockwise to move the stage to the BACK of the machine and counter clockwise to move the stage to the FRONT of the machine.
3. Secure the Lock-Down Screws once the alignment is completed.







Non-Surface Contact Operation

Non-Surface Contact (NSC) is a method of picking up the die which prevents any physical contact with the top surface of the die. To perform NSC die pick up from adhesive tape, the die must first be ejected from the tape. Once ejected, the die is picked up by the edges.

In order for the die to be picked up by its edges, it must first be elevated from the wafer yet remain in position on top of the needles. This allows the Gripper Fingers to make reliable contact with the edges of the die.

During NSC operation, a blunt Stabilizing Pin is used in the center of the conventional four Eject Needle array. Its purpose is to prevent the tape from completely releasing from the back of the die. If the tape is permitted to release completely, at the final moment of release the tape tends to snap away from the back of the die. This causes the die to jump unpredictably. The Stabilizing Pin maintains a very small area of adhesive contact and prevents the full release of the die from the tape. The remaining adhesive force is usually under 1 or 2 grams and is easily overcome when the die is lifted.

Non-Surface Contact Pickup Cycle

The following is a breakdown of the Non-Surface Contact pick and place cycle. You can view each of these steps by pressing the **SINGLE STEP** key and stepping through the cycle.

1. **TURN ON TAPE VACUUM**

   Vacuum is applied through the Eject Head to hold the tape in place. No adjustments are necessary.

2. **ARM GO TO PICK POSITION**

   The Pickup Arm will move to position the Pickup Tip directly above the center of the next die to be picked. The **Left/Right Arrow** keys can be used to move the Pickup Tip as necessary.

3. **GO DOWN TO PICK HEIGHT**

   The Pickup Head will lower to the position at which it will pick the die. This position should be set so when the needles rise the die will move up between the Gripper Fingers. This height can be adjusted using the **UP/DOWN** keys along with the **COARSE/FINE** key.

4. LIFT NEEDLES

Eject Head Needles are raised. No software adjustment is necessary; however, the needle height may need adjustment. This is a mechanical adjustment. To RAISE the needles turn the Stop Ring on the Eject Actuator counter clockwise, to LOWER the needles turn the Stop Ring clockwise.

5. WAIT N.NNN SECS FOR DIE TO LIFT.

Displayed time will be the amount of time the Pickup Arm waits in the current position for the die to be released from the tape. Generally the default time of 0.030 sec is correct, but larger die may need a longer time to peel from the tape. Increase or decrease the time using the **+ / –** keys in conjunction with the **COARSE/FINE** key. You may need to run the machine in the normal *Run Mode* for a few cycles to determine how long the wait time should be.

6. CLOSE GRIPPERS

The Grippers are closed by vacuum being applied to the Finger Diaphragms. The Vacuum Regulator Knob is located to the right of the Micrometer Needle Speed Control and controls the force at which the Gripper Fingers close.

7. WAIT N.NNN SECS FOR GRIPPERS TO CLOSE

Displayed time will be the amount of time the Pickup Arm waits in the current position for the Gripper Fingers to close on the die. Increase or decrease the time using the **+ / –** keys in conjunction with the **COARSE/FINE** key. You may have to run the machine in the normal *Run Mode* for a few cycles to determine the correct wait time.

8. TURN OFF TAPE VACUUM

The vacuum to the Eject Head is turned **OFF**.

9. GO UP TO TRAVERSE HEIGHT

The Pickup Arm will rise to traverse height to clear obstructions when moving.

10. RETRACT NEEDLES

The air to the Eject Head is turned **OFF** and the Needles are retracted. This allows the wafer to be moved to the next die to be picked.

11. TABLE GO TO PLACE POSITION

The Table will move to the proper position to place the next die. If inspection options are installed on the system, this step will occur after the inspections are completed.

12. ARM GO TO PLACE POSITION

The Pickup Arm will now move to the right to the position over the Waffle Pack to place the die. If inspection options are installed on the system, the arm will move to the next position in the sequence.

13. GO DOWN TO PLACE HEIGHT

The Pickup Arm will move down to place height to place the die into the Waffle Pack. Use the **UP/DOWN** keys to adjust the place height. Use the **ARROW** keys to properly position the die into the pocket.

14. OPEN GRIPPERS

Vacuum to the Grippers is turned **OFF** and the Grippers open, releasing the die into the pocket.

15. WAIT N.NNN SECS FOR THE GRIPPERS TO OPEN

Displayed time is the time the pickup arm waits in the current position for the Grippers to open.

16. GO UP TO TRAVERSE HEIGHT

The Pickup Arm will rise to traverse height to clear obstructions when moving.

17. FINISH CYCLE

Pickup Arm goes to the wait position just to the right of the field of view of the Optics. This position is adjustable using the **Left/Right Arrow** keys. This position can be placed as close to the pick position as the Operator wants to improve through-put.

Edge Pick Up

When the die is elevated, it is essential that the die be lifted without obstruction. If the die bumps into the Gripper Fingers during ejection, the pickup process will fail.

During die elevation, the Gripper Finger will be at the pick height. Using *Single Step Mode*, adjust this height using the **UP/DOWN** keys. The goal is to ensure the Gripper Fingers satisfactorily pinch the die but do not make contact with un-picked die remaining on the wafer.

> ***NOTE:*** *Occasionally during setup, it may be useful to open or close the gripper fingers manually. To do this, press the* ***YES*** *key.*

When the Gripper Fingers are activated, they will take a certain amount of time to close completely. The time required is a function of the currently selected *Vacuum Force* and the *Vacuum Flow Needle Valve Setting*. Using *Single Step Mode*, the delay time can be adjusted when ***WAIT 0.100 SEC FOR GRIPPERS TO CLOSE*** shows in display. Adjust delay time by pressing **+ / -** keys.

During the placement part of the cycle, the Gripper Fingers will open to drop the die into the Waffle Pack cavity. The placement height is not critical, for example, successful trials have been made dropping the die from the full *Arm Traverse Height*. Although this is the fastest mode of operation, **it is not recommended**. In general, lowering the Gripper Fingers to about 0.010 in. from the top surface of the Waffle Pack works best.

Very little time is needed for the Gripper Fingers to open. If necessary, using *Single Step Mode* adjust the delay by pressing the **+ / -** keys when ***WAIT 0.100 SEC FOR GRIPPERS TO OPEN*** shows in display.

At the end of the cycle, the arm will return to the wait position.

Adjust Pickup Grippers

1. Planarize Grippers.
    a. Using a scrap wafer, **SINGLE STEP** the arm to the pick position at the pick height.
    b. Loosen the Gripper Finger Set Screws so that the Gripper Fingers fall onto the wafer surface. Planarize the Gripper Fingers.
    c. Once Gripper Fingers are level, tighten the Locking Setscrews.
    d. Press the **NO** key to abort the cycle.
2. Adjust Gripper Width.
    a. The left and right Gripper Fingers are each independently adjusted by a Knurled Screw.
    b. The Gripper Fingers can be adjusted to handle die sizes in the range of 0 to 0.75 in. Each gripper finger can close by about 0.040 in. from its rest position, so there is considerable latitude in setup.
    c. Open the gap between the Gripper Fingers until they are at least 0.050 in. wider than the die.
3. Adjust Gripper Height.
    a. **SINGLE STEP** the system until a die is elevated between the Gripper Fingers.
    b. Adjust *Gripper Finger Height* using the **UP/DOWN** keys until the tips of the Gripper Fingers are clear of the wafer surface.
4. Adjust Die Elevation.
    a. *Die Elevation* may be adjusted using the ring at the base of the Eject Head.

5. Adjust Closing Speed & Force
    a. The *Closing Speed* of the Gripper Finger is adjusted using the Needle Valve located on top of the right Solenoid Valve.
    b. The *Closing Force* may be adjusted from zero up to about 20 grams using the Front Panel Vacuum Regulator Control located to the right of the Die Eject Speed Control. The closing speed is a function of the *Needle Valve Setting* and the *Vacuum Force Control*.
6. Adjust Vacuum.
    a. Rotate the Regulator Control Knob on Front Panel clockwise to increase the vacuum, thus increasing gripper pressure.

Replace Gripper Fingers

The Gripper Fingers are locked in the Gripper Arms by #2-56 set screws pushing on a 1/16-diameter ball bearing at the tip. The ball minimizes the tendency of the needle moving when the setscrew is tightened.

The Gripper Finger is the same diameter as a Die Ejector Needle, so a discarded Die Eject Needle may be used if the Gripper Finger needs to be replaced. While not essential, a soft vinyl sleeve pushed over the Gripper Finger makes a very soft die contact surface.

Blank Page

Die Underside Inspection

Systems equipped with the Underside Inspection Camera have the option to view the bottom of the die before placement, allowing the operator to observe any defects in the back side of the diode to include impurities, damage and voids.

After inspection the operator is given several different placement locations to choose from:

- Up to 5 locations including a discard option when using 2 inch waffle packs
- Up to 3 locations including a discard option when using 4 inch waffle packs.

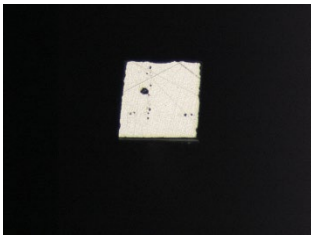
In RUN mode with the Underside Inspection option selected, the normal pick and place cycle is interrupted immediately following the die being picked. The arm stops over the Underside Inspection Camera and the head is lowered to bring the die into focus. The Operator can now look at the bottom of the die and choose the category the die should be packaged as, or discard it if damaged.

Optics are optimized for the customer's die size. The image is displayed on the Main Targeting Monitor when the die is in place over the lens.

> ***NOTE:*** *This height can be adjusted for optimal performance. The LCD will then display the optional locations to place the die*

Adjust Pickup Tip Height at Underside Inspection

1. Adjust Pickup Tip Height
    a. Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key.
    b. Cycle the system until the Pickup is at the down position over the Underside Inspection Camera.
    c. Press the **UP/DOWN** keys to adjust the pickup height.
    d. Press the LEFT/RIGHT Arrow keys to adjust Pickup Tip position accordingly.



Underside Inspection of a 300 um die.

Underside Inspection Cycle

The following is a breakdown of the full pick and place cycle with the Underside Inspection Option:

1. **TURN ON TAPE VACUUM.**
2. **ARM GO TO PICK POSITION.**
3. **GO DOWN TO PICK HEIGHT.**
4. **TURN ON PICKUP VACUUM.**
5. **NEEDLE SPEED = XXXX u/sec**
6. **LIFT NEEDLES.**
7. **WAIT X.XXX secs.**
8. **LIFT TO SEARCH HEIGHT AT XXXX u/sec.**
9. **GO UP TO TRAVERSE HEIGHT.**
10. **TURN OFF TAPE VACUUM.**
11. **RETRACT NEEDLES.**
12. **ARM GO TO UNDERSIDE INSPECT POSITION.**
13. **GO DOWN TO INSPECT HEIGHT.**
14. **INSPECT UNDERSIDE OF DIE.**
15. **FOOTPEDAL, GRADE KEY ACCEPTS, KEY 0 REJECTS.**

    NOTE: *When Underside Inspection is followed by Facet Inspection, the screen will read:* ***FOOTPEDAL ACCEPTS, KEY 0 REJECTS****.*

16. **GO UP TO TRAVERSE HEIGHT.**
17. **START FACET INSPECTION IF ACTIVE.**
18. **GO TO TRAY POSITION.**
19. **GO DOWN TO PLACE HEIGHT.**
20. **TURN OFF PICKUP VACUUM.**
21. **PURGE PICKUP X.XXX secs.**
22. **DELAY AFTER PLACE X.XXX secs.**
23. **GO UP TO TRAVERSE HEIGHT.**
24. **FINISH CYCLE.**

Die Facet Inspection

The Facet Inspection Station uses a high magnification lens to view cuts, chips, cracks and defects in the die. This station rotates the die and allows the operator to move the Optics along the length of the die while under high magnification. All sides of optical filters, or facets of laser diodes, and other devices can be observed. The die can be inspected at 0, 90, 180, or 270 degrees of rotation. The die can also be inspected anywhere from 0 to 360 degrees manually by turning the knob on the Remote Operator Control (ROC).

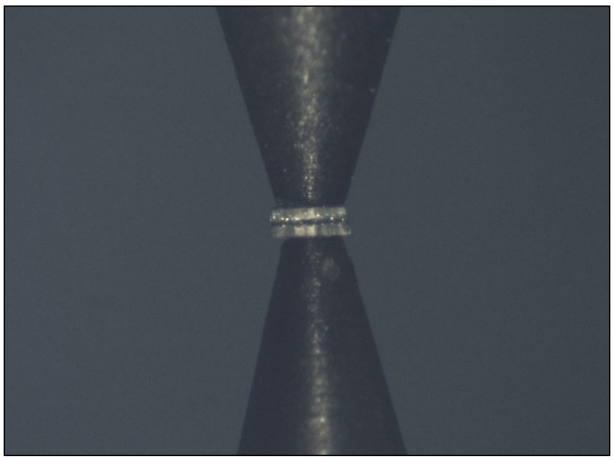
Adjust Pickup Tip Height at Facet Inspection

1. Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key.
2. Cycle the system until the pickup is holding a die at the Down position over the Rotating Spindle of the Facet Inspection Camera.
3. Press the **UP/DOWN** keys to adjust the pickup height.

Adjust Die Position on Rotating Spindle at Facet Inspection

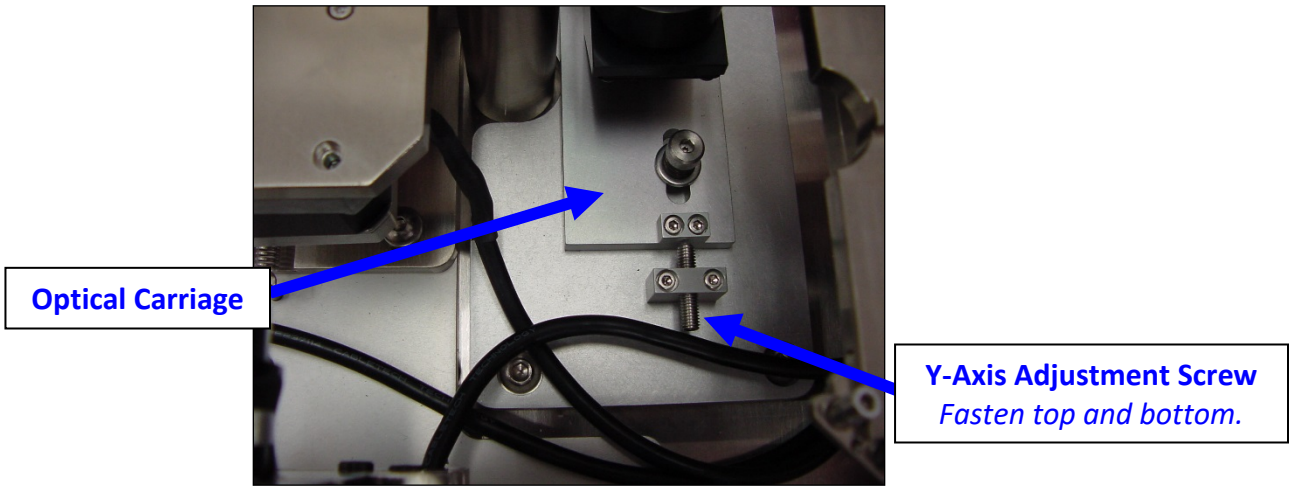
To adjust the Die (Pickup Tip) on the X Axis (left or right) direction:

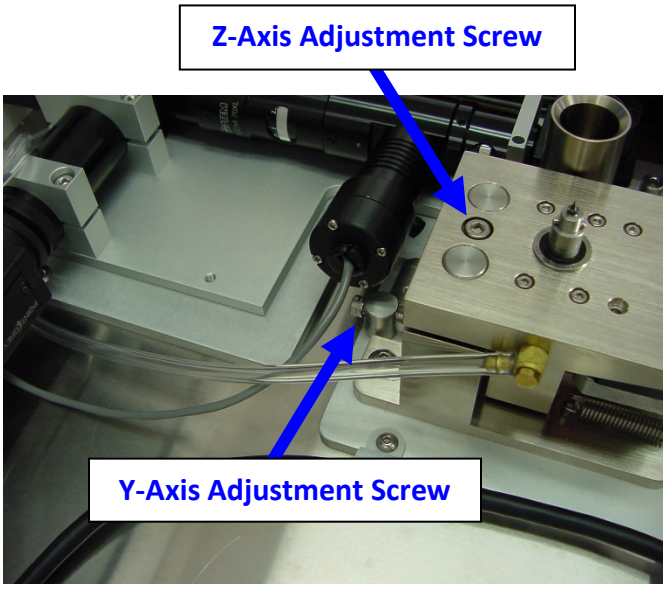
1. Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key.
2. Cycle the system until the pickup is holding a die at the Down position over the Rotating Spindle of the Facet Inspection Camera.
3. Press the **Left/Right Arrow** keys to adjust Pickup Tip position accordingly. The image below illustrates the die in Facet Inspection position.



To adjust the Die (Pickup Tip) on the Y Axis (front to back) direction, there are mechanical adjustments made with positioning screws:

1. Place the system in *Single Step Mode* by pressing the **SINGLE STEP** key.
2. Cycle the system until the pickup is holding a die at the Down position over the Rotating Spindle of the Facet Inspection Camera.
3. Make adjustments using the Positioning Screws. The images below demonstrate the Positioning Screws that may need to be adjusted.





Facet Inspection Cycle

1. *TURN ON TAPE VACUUM.*
2. *ARM GO TO PICK POSITION.*
3. *GO DOWN TO PICK HEIGHT.*
4. *TURN ON PICKUP VACUUM.*
5. *NEEDLE SPEED = XXXX u/sec*
6. *LIFT NEEDLES = XXX u*
7. *WAIT N.NNN SECS FOR DIE TO LIFT.*
8. *LIFT TO SEARCH HEIGHT AT XXXX u/sec.*
9. *GO UP TO TRAVERSE HEIGHT.*
10. *TURN OFF TAPE VACUUM.*
11. *RETRACT NEEDLES.*
12. *START UNDERSIDE INSPECTION IF ACTIVE.*
13. *ARM GO TO FACET INSPECT POSITION.*
14. *GO DOWN TO FACET INSPECT HEIGHT.*
15. *TURN ON INSPECT POSITION VACUUM.*
16. *TURN OFF PICKUP VACUUM.*
17. *PURGE PICKUP X.XXX secs.*
18. *GO UP TO TRAVERSE HEIGHT*
19. *PERFORM DIE FACET INSPECTION*
20. *FOOTPEDAL ROTATES, GRADE KEY ACCEPTS, KEY 0 REJECTS.*
    Die rotates when foot pedal or step key is pressed.

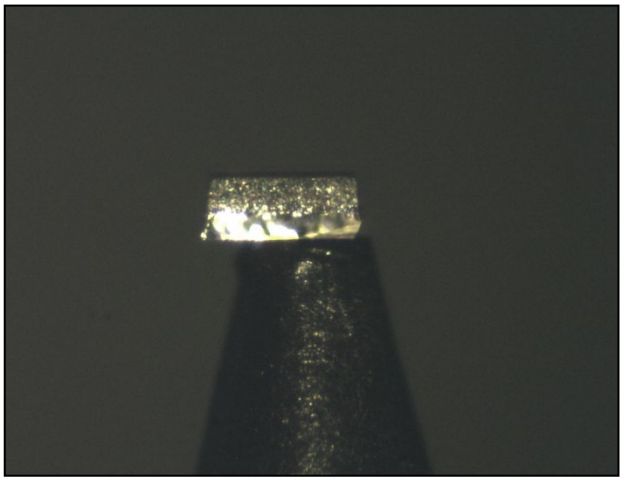
    The toggle (+) key has two functions: shifting the camera display in the x-axis (left or right) or to rotate the spindle manually 0 to 360 degrees. The controls on the Remote Operator Control will operate these functions.
21. *GO DOWN TO FACET INSPECT HEIGHT.*
22. *TURN ON PICKUP VACUUM.*
23. *TURN OFF INSPECT POSITION VACUUM.*
24. *GO TO TRAVERSE HEIGHT.*
25. *GO TO TRAY POSITION.*
26. *GO DOWN TO PLACE HEIGHT.*
27. *TURN OFF PICKUP VACUUM.*

28. PURGE PICKUP X.XXX secs.

29. DELAY AFTER PLACE X.XXX secs.

30. GO TO TRAVERSE HEIGHT.

31. *FINISH CYCLE.*



300um die on Rotating Spindle under LED Light

Wafer Holders

The DE35 ST Wafer Holders are available for both expanding and non-expanding film holders for all current film frames or rings, handling up to 8-inch wafers.

Expanding Wafer Holders are designed to stretch the tape mounting the wafer to make the die easier to pick by loosening the adhesive and widening the streets between the die. Expandable film is available in both UV release tape and Nitto tape. When working with fragile die, the preferred tape is UV release for the least adhesiveness and ease of picking.

The down side of Expanding Holders is the distortion in the tape from stretching which can create a slight bow in the streets between the die. This slight curving will cause a skewing of the die being picked from one end of the wafer to the other.

Non-Expandable Wafer Holders do not expand the film when put onto the machine. These are normally used where the wafer is sawn leaving wide kerfs between rows of die for ease of picking. With no stretching there is no distortion of the tape meaning less skew in the die when picking.

Wafer Holder Interlock

All wafer holders are equipped with a Wafer Holder Interlock System. This system is used to help prevent accidentally jamming the arm against an open Wafer Holder.

When the Wafer Holder is opened, a lever on top of the holder releases the Interlock Switch if the arm is activated. Three beeps are heard, and the LCD displays ***FRAME HOLDER OPEN, PLEASE CLOSE TO CONTINUE***. After the wafer holder has been closed, the LCD will read, ***TO RESUME, PRESS THE (YES) KEY; TO ABORT, PRESS THE (NO) KEY***.

When the **Yes/No** keys are pressed, the arm will move. When **Yes** is pressed, the arm will finish the cycle. When **No** is pressed, the arm will move to the rest position.

The Activating Lever may need to be adjusted when changing Film Holders out. To adjust: loosen Cap Screw, adjust as needed, and then tighten Cap Screw. When adjusted properly, an audible click can be heard as the Frame Holder is closed and latched.

Film Frame Holders

Frame Holders are a flat circular frame with notches and flats to polarize the location of the frame in the holder. This insures the die is loaded into the DE35 ST in the proper orientation every time. Frame Holders come in a variety of sizes for all wafer sizes.

Operation of Expanding Film Frame Holder

1. Install the desired frame holder.
2. Plug the Wafer Holder Interlock Switch (on right back of Wafer Holder) into the side of the Y-Stage.
3. Raise and unlatch the red handle, then lift the Top Plate.
4. Insert the Film Frame into the fixture, engaging the Alignment Pins in the notches of the Film Frame.
5. Lower the Top Plate and press it down until the Clamp Mechanism can be latched under the Bottom Plate.
6. Push the red handle over until it is horizontal. This will stretch the film by about 0.5 in. across the diameter of the wafer.

   Occasionally, due to excessive saw through depth, the film may split during the expansion process. If this happens, slackening the Knurled Screws holding the Hinge Bar at the back of the Film Frame Holder can reduce the degree of expansion. The Clamp Assembly at the front of the wafer holder can also be slackened off in half revolution increments.

   NOTE: *The Locking Set Screw bears onto the screw thread of the Clamp Mechanism via a Nylon Insert to prevent damage to the Clamp Mechanism screw thread.*
7. Ensure the Activating Lever trips the Frame Holder Interlock Switch on the top of the Film Frame Holder.
8. The wafer will probably not be oriented exactly with the North/South Axis of the X-Y stage. While this is not an operational problem, it is easier to use if the wafer streets are aligned with this axis.

   To check North/South orientation, push the Frame Holder backward and forward quickly. If the orientation is correct, the CCTV image of the saw cuts will scan accurately along the cross hairs.
9. The Wafer Holder is designed with a Theta correction of about 5 degrees. To rotate it, adjust the Theta Adjust Knurled Screw which is located at an angle on the left side of the frame holder.
   a. If the frame is too far off for this correction, set the holder back to the middle and then open the holder and remove the locator pins.

b. While moving the holder back and forth, rotate the frame until the streets are close to the cross hairs.

c. Close the holder and use the Theta Adjust Knurled Screw to fine adjust the ring.

Ring Holders

Film Rings are two-piece rings approximately 1/4 in thick and various diameters for various wafer sizes. The film is placed on the Center Ring, then the Outer Ring is pressed over the Center Ring slightly tensioning the tape on the ring.

Operation of Expanding Ring Holder

1. Install the desired ring holder.
2. Plug the Wafer Holder Interlock Switch (on right back of Wafer Holder) into the side of the Y-Stage.
3. Raise and unlatch the red handle and lift the Top Plate.
4. Insert the Film Ring into the fixture such that the alignment of the die is in the correct X and Y orientation.
5. Lower the Top Plate and press it down until the Clamp Mechanism can be latched under the Bottom Plate.
6. Push the red handle over until it is horizontal. This will stretch the film by about 0.5 in. across the diameter of the wafer.

   Occasionally, due to excessive saw through depth, the film may split during the expansion process. If this happens, slackening the Knurled Screws holding the Hinge Bar at the back of the Film Frame Holder can reduce the degree of expansion. The Clamp Assembly at the front of the wafer holder can also be slackened off in half revolution increments.

   NOTE: *The Locking Set Screw bears onto the screw thread of the Clamp Mechanism via a Nylon Insert to prevent damage to the Clamp Mechanism screw thread.*
7. Ensure the Activating Lever trips the Frame Holder Interlock Switch on the top of the Film Frame Holder.
8. The wafer will probably not be oriented exactly with the North/South Axis of the X-Y stage. While this is not an operational problem, it is easier to use if the wafer streets are aligned with this axis.

To check North/South orientation, push the Frame Holder backward and forward quickly. If the orientation is correct, the CCTV image of the saw cuts will scan accurately along the cross hairs.

9. The Wafer Holder is designed with a Theta correction of about 5 degrees. To rotate it, adjust the Theta Adjust Knurled Screw which is located at an angle on the left side of the frame holder.
    a. If the frame is too far off for this correction, set the holder back to the middle and then open the holder and remove the locator pins.
    b. While moving the holder back and forth, rotate the frame until the streets are close to the cross hairs.
    c. Close the holder and use the Theta Adjust Knurled Screw to fine adjust the ring.

DES-AUM Die Eject Actuator

The Automated Die Eject Actuator is a motorized actuator with a controller capable of fine adjustments in Needle Height and Eject Speed.

The Needle Height has a range of 100 to 2000 microns, and can be adjusted in increments of 10 or 100 Microns. The Eject Speed has a range of 100 to 7000 Microns/sec adjustable in increments of 10 or 100 Microns/sec.

Adjust Needle Speed & Height

1. Place system in **SINGLE STEP**.
2. Step through the sequence until ***NEEDLE SPEED = XXXX MICRONS/SEC*** appears in the LCD.
3. Use the **+ / -** keys to adjust the needle speed. The **COARSE/FINE** key toggles between 10 and 100 Microns/sec steps.
4. Step to ***LIFT NEEDLES XXXX MICRONS***.
5. Use the **+ / -** keys to adjust the Needle height. The **COARSE/FINE** key toggles between 10 and 100 Micron steps.

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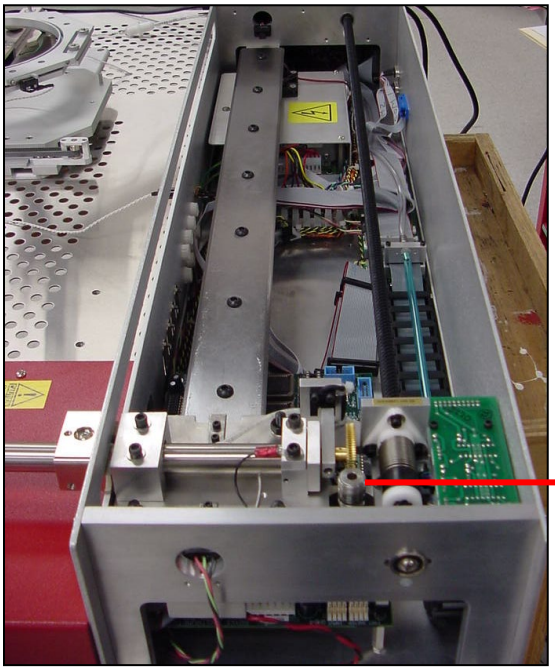
Basic Troubleshooting & Maintenance

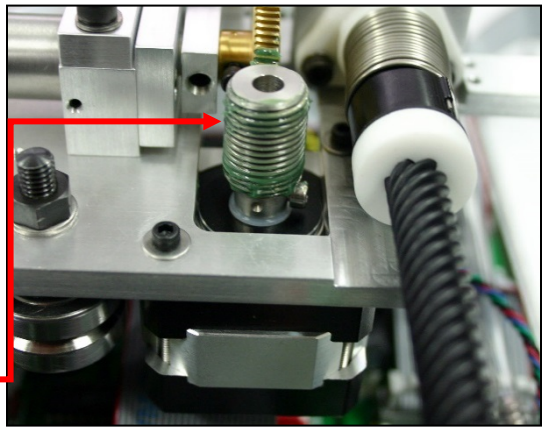
Preventative Maintenance Schedule

Warning: Do Not Lubricate X- or Y- Lead screws!!!

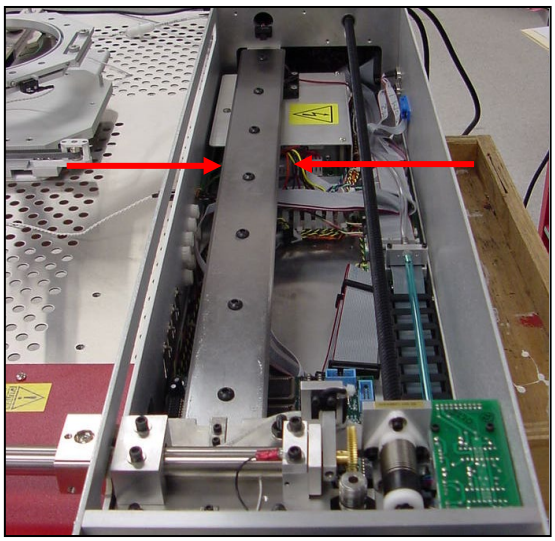
Bi-monthly Maintenance

1. Grease Z-Motion Worm Gear with Teflon grease (Royce P/N 2359).

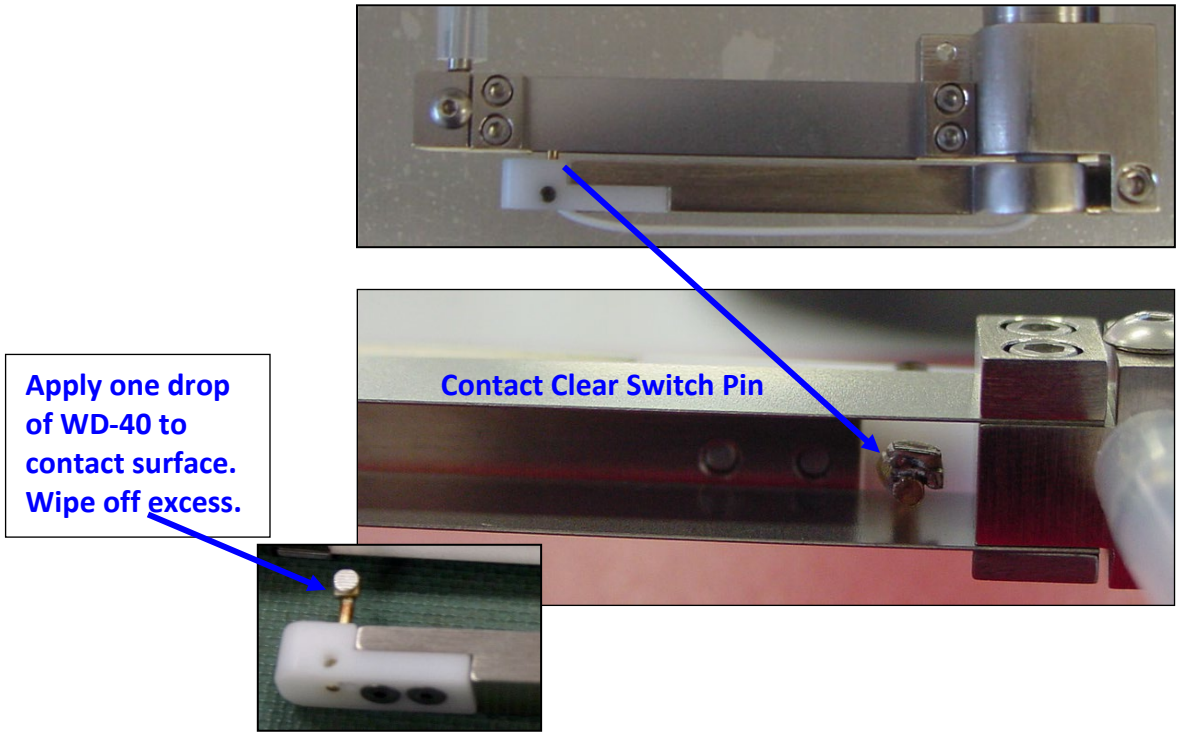




2. Lightly lubricate X-Slide Bar. Use light machine oil (such as “3 in 1” oil). Wipe off excess oil.



3. Lubricate Contact Clear Switch Pin with **one drop** of WD-40.



Semi-Annual Maintenance:

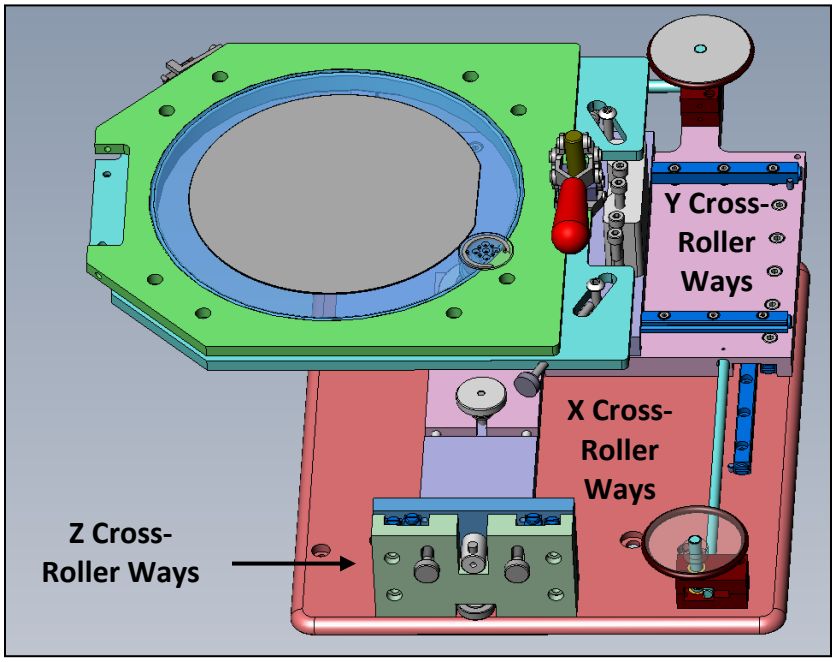
Die Eject Stage

NOTE: *An example of the DE35-ST stage is shown below. If working with a DE35-300, the stage appearance may vary but the maintenance requirements will remain the same.*

1. Lubricate Cross Roller Ways

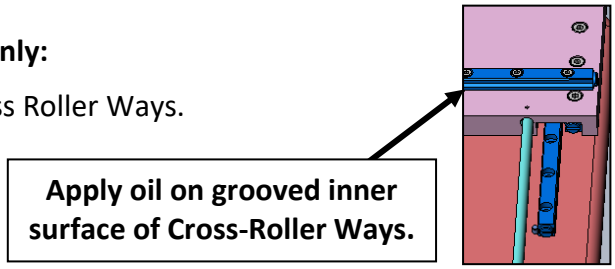
   For both DES-AUM & DES Pneumatic Stages:

   Lightly lubricate X-, Y- and Z-Motion Cross-Roller Ways. Use light machine oil (such as "3 in 1" oil). Wipe off excess oil.



For DES Pneumatic Stages only:

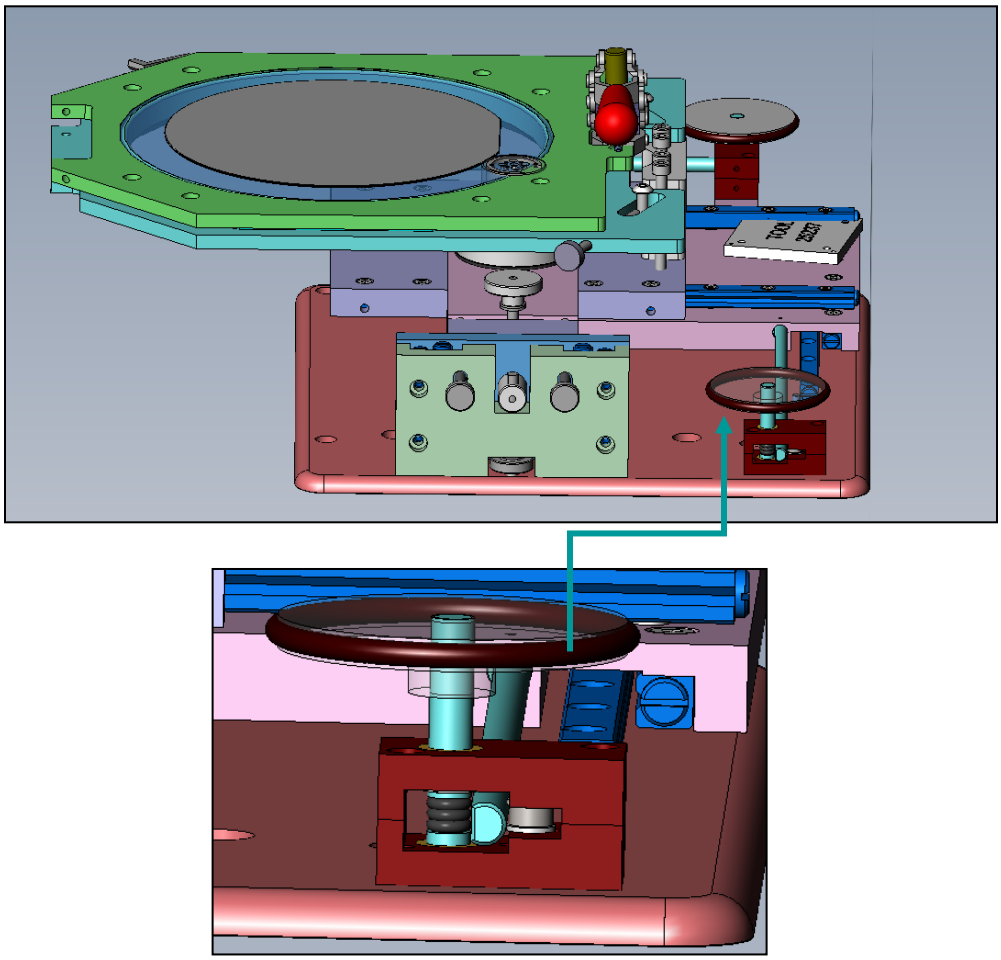
Lubricate the Z- Motion Cross Roller Ways.



2. Check DES Hand Wheel Assembly:

    a. O-rings around the outside rim of Hand Wheel (Royce P/N 2439); (1) left and (1) right.

    b. O-rings inside the Hand Wheel Bearing Block (Royce P/N 2440); (3) in the left side block and (3) in the right side block.



    c. Replace O-rings if cracked or loose. **DO NOT LUBRICATE O-RINGS!!!**

NOTE: *Do not tighten Set Screws so tight that motion becomes hard and lumpy. This will break the O-Ring Pressure Bearing.*

Maintenance Procedures

Setting the Camera Tube Mounting Position

1. Rotate the Focus Adjust, so that it is in the center of its travel.
2. Hold the Camera Tube and loosen the Allen Screw on the right side of the Camera Tube Mounting Block (next to the Thumb Screw).
3. With the system and Monitor **ON**, slide the Tube Assembly up/down until the sample below is in focus.
4. Once the sample is in focus, tighten the Allen screw.
5. Perform the *Optical Center and Follow Focus Setup* procedure below.

Optical Center and Follow Focus Setup

Follow Focus

1. Place a sample in the holder.
2. Zoom all the way in and focus on a die.
3. Zoom all the way out. If it is still in focus, STOP. If not, go to step 4.
4. Loosen the (3) Focus Screws on the camera, and (1) of the Optical Center Screws (OCS).
5. Turn the Center Collar until it is in focus.
6. Tighten all screws.
7. Repeat steps 2 thru 6 until focus is good.

Optical Center

1. Align the two cross hairs in the center of the screen.
2. With the Camera zoomed all the way in, move a corner of a die (or other easily recognizable spot) to the center of the cross hairs.
3. Zoom out. If the spot is still aligned with the cross hairs STOP! If the spot has moved go on to step 4.
4. If the spot has moved, use the (3) Optical Center Screws (OCS) on the Camera Tube to move the spot back to the center of the cross hairs.
5. Zoom all the way in and line up a spot with the cross hairs. Zoom out.
6. It should be close at this point, but usually requires steps 2-5 to be repeated twice. This is a critical alignment to insure proper picking.

Adjusting Pickup Height at the Pick Position

1. Turn the DE35 **OFF**.
2. Lower the Eject Head to its lowest height.
3. Turn the DE35 **ON** and allow it to reset.
4. Install sample into the work holder.
5. Position a die sample over the Eject Head.
6. Press **SINGLE STEP**.
7. Press the Foot Switch until the pickup arm lowers to the pick position and the LCD displays ***TURN ON PICKUP VACUUM***.
8. Press the **COARSE/FINE** key so that the LCD also says ***FINE***.
9. Press the **DOWN** key until the display reads ***REACHED LIMIT***.
10. Raise the *Eject Head* up until the display reads ***PICKUP IN CONTACT***.
11. Press the **UP** key until the display reads ***PICKUP CLEAR*** by one fine step.
12. Press **SINGLE STEP** to return to normal operation. The machine will now lower to this height during normal operation.

Adjust Pickup Height at Place Positions

1. Turn **ON** the DE35 ST and let it reset.
2. Install a sample into the work holder.
3. Position a die sample over the Eject Head.
4. Press **SINGLE STEP**.
5. Press the Foot Switch until a die is picked, the tip is over the Waffle Pack and the LCD displays ***TURN OFF PICKUP VACUUM***.
6. Press the **COARSE/FINE** key so the LCD displays ***FINE***.
7. Press the **DOWN** key until the LCD displays ***PICKUP IN CONTACT*** by one fine step.

   NOTE: *If the LCD displays* ***PICKUP IN CONTACT*** *when moving to this position, press the* ***UP*** *key until the LCD displays* ***PICKUP CLEAR****, then perform step seven.*
8. Press **SINGLE STEP** to return to normal operation.
9. The machine will now lower to this height during normal operation

Eject Head Maintenance, Needle Replacement and Planarization.

Needle Replacement and Planarization: EJT, EJTN, EJM, EJMN, EJA, EJAN

Required Tooling & Supplies:

- Planarization Kit [PLNZ-TOOL-17277]
  - Tool rings [2607, 3359, 28477]
  - Flat mirror [4359]
  - Hex Allen key 0.035" [2976]
  - Hex Allen key 0.050" [3703]
  - Hex Allen key 0.0275" [6232]
  - Grease [2359]
  - ¼" Permanent Dot Sticker [111019]
- ¼ Inch Open Ended Wrench
- Foam Swabs

Note: Contact Customer Support if you have any questions about this procedure.

Links:

Eject Head Overview

Needle Replacement & Planarization of 0.75 inch diameter (small) Eject Heads

Needle Replacement & Planarization of 1.1, 1.5 and 2.0 inch diameter (large) Eject Heads

General Mirror Use Tips:

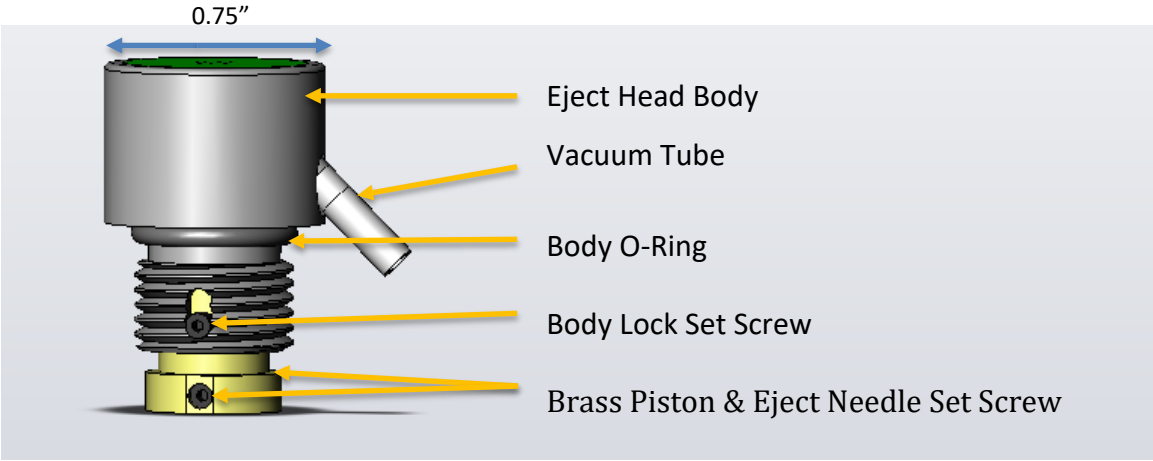
- Use clean and pristine mirror only. No scratches, pits or cracks.
- Needles tips caught in scratches, pits or cracks will not meet planarity requirements.
- Set tool rings and eject caps gently on mirror surface.
- Avoid sliding on the mirror surface at all times, especially with needles inserted.
- Insert needles and planarize them by gravity only.
- Excessive pushing on needles will pit and scratch mirror as well as break needle tips.
- Tighten set screws very gently while needles are in contact with mirror.
- Fully tighten set screws after piston is lifted off mirror.

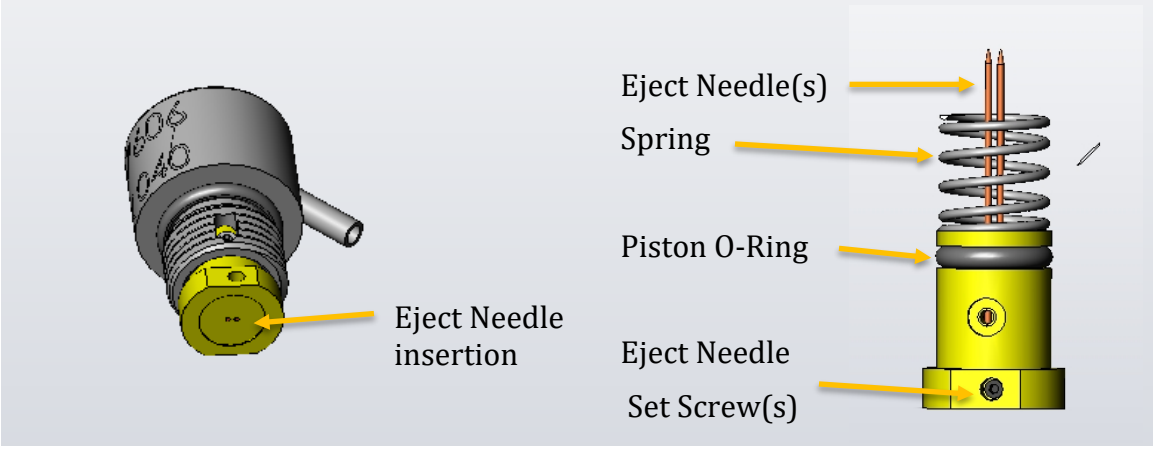
- Use appropriate shim for NSC needle height adjustment.
- Use piston installed in eject cap where needle access allows.
- Use small and large tool rings for most pistons.

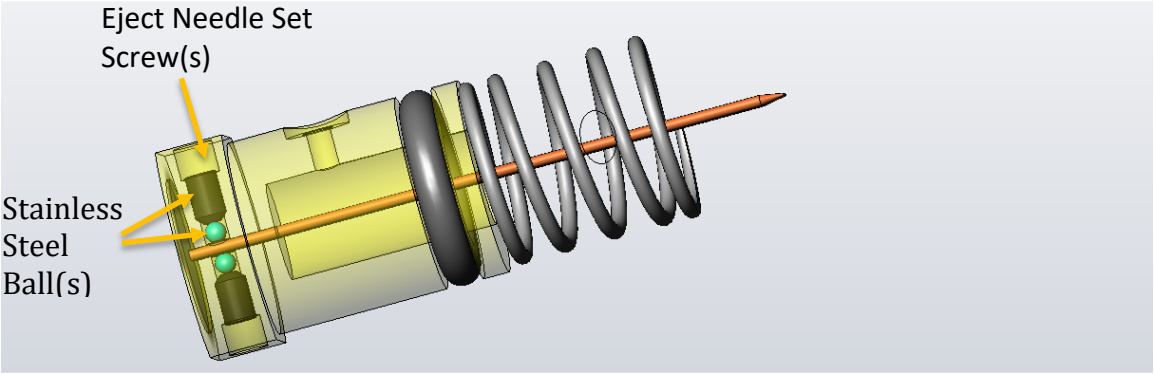
Eject Head Overview

The Piston houses the eject needles and is the moving part during the needle eject. The Eject Head Body houses the piston and supplies vacuum to the wafer tape via the body cap.

0.75” Diameter Eject Heads



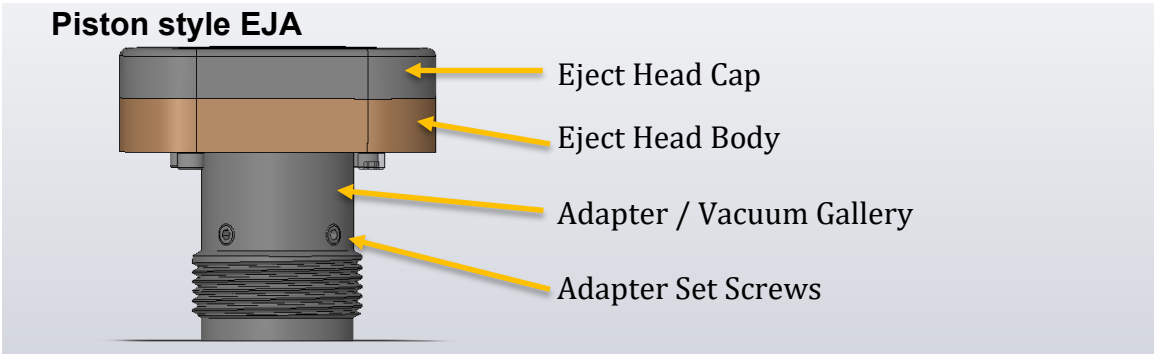


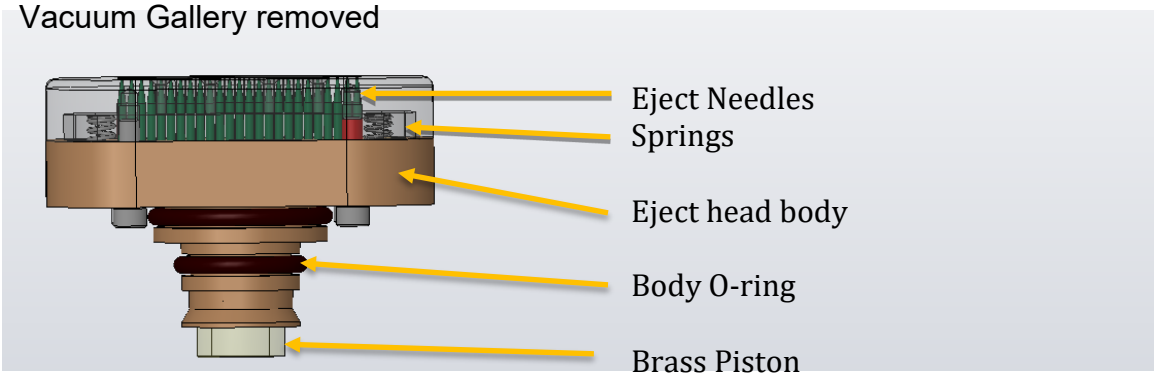


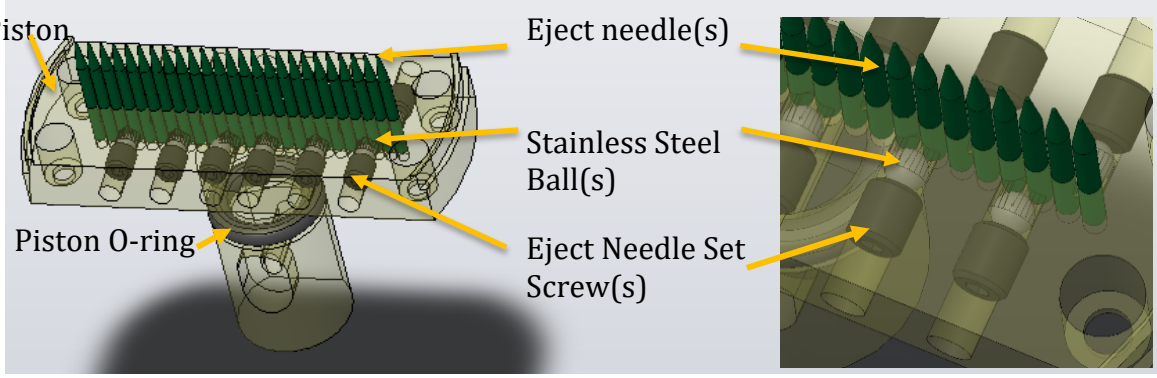
1.1, 1.5 & 2.0 Diameter Eject Heads

Note for piston and hex style eject heads:

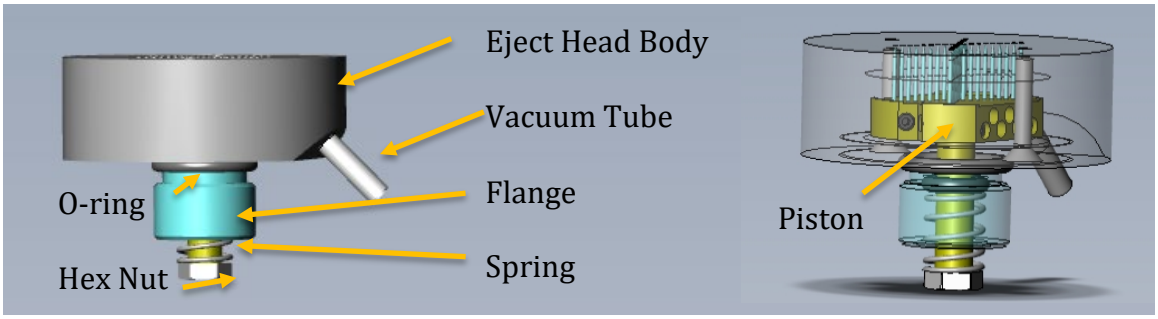
Based on piston design, a set screw may secure more than one needle in the piston and can vary by eject head. The user should consult the eject head needle configuration/set-up documentation that is provided with those eject heads.

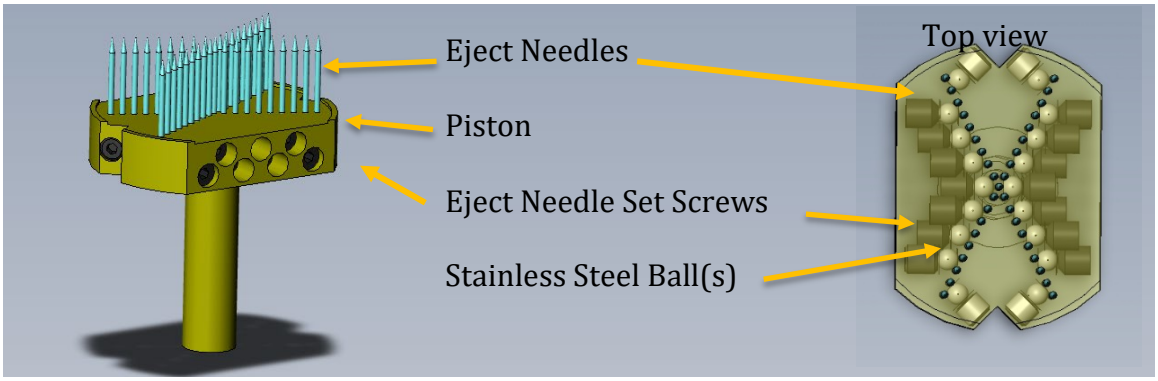




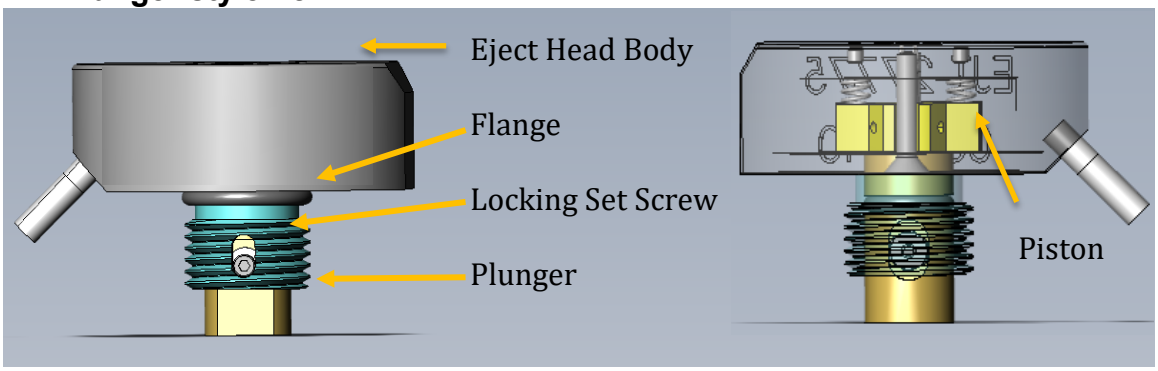


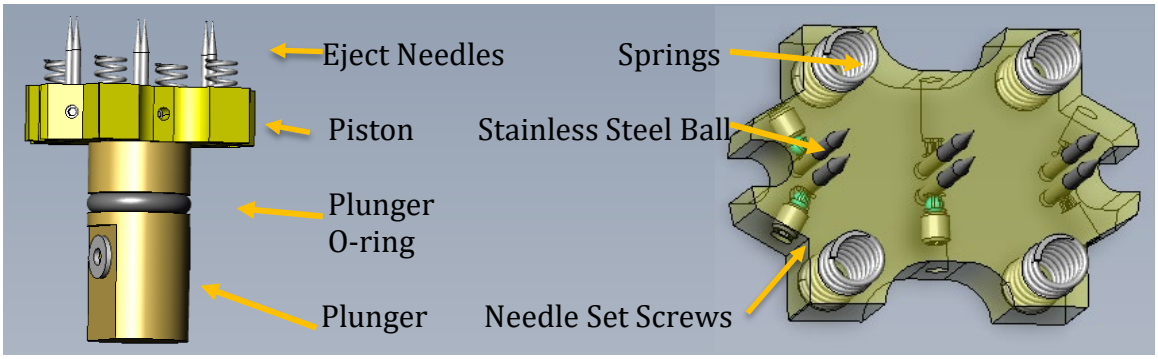
Hex style EJT





Plunger style EJT



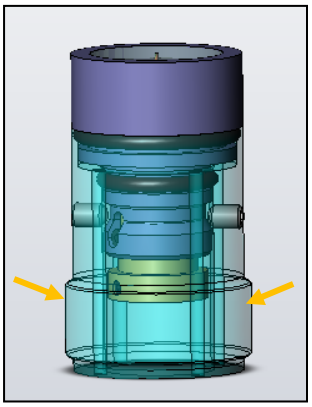


Needle Replacement & Planarization of 0.75 inch diameter (small) Eject Heads

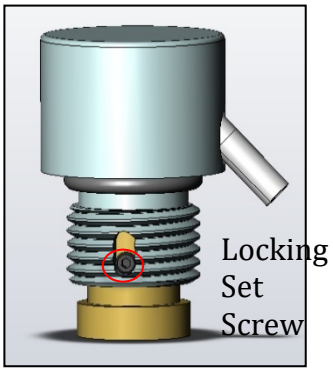
Removal of broken needles

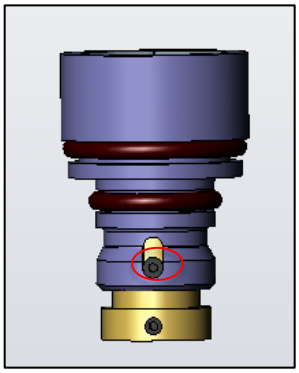
Note: If there are no broken needles, there is no need to remove eject head body. Loosen the eject needle setscrew(s) on the piston, remove the eject needle(s) from the bottom of the piston, replace and planarize. See step 7.

1. If the Eject Head includes Integrated Vacuum Gallery (EJA), loosen the two small set screws around the body clamping the two cylinder halves together. Remove threaded vacuum chamber.

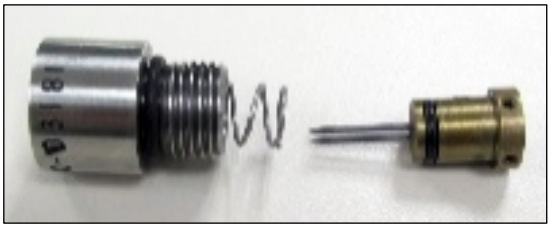


2. For both EJT and EJA styles, hold the top of the eject head body (away from the needle holes) and bottom of brass piston. Press up on the piston until the locking set screw is mid-position and remove the locking set screw using a 0.035" hex key from the slot in the threads.

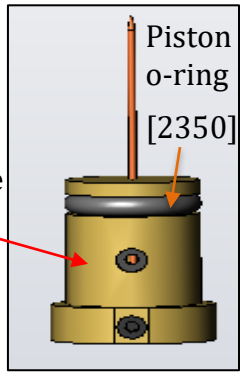




3. Ease the brass piston from the body of the eject head and remove the spring [PN 2399]. Remove the sticker [111019] from the bottom of the eject head.

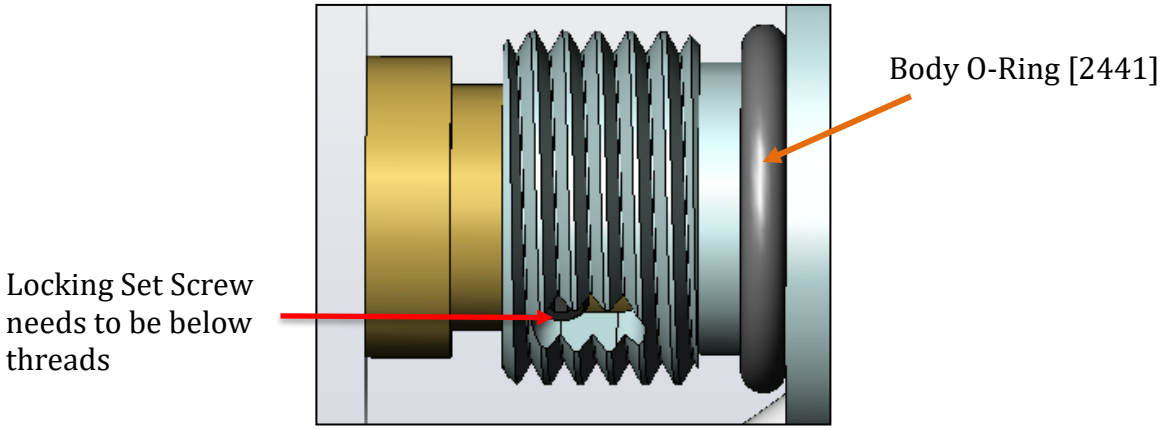


4. Each needle has a set screw that secures it in the brass piston. Locate the needle(s) that needs replacement and <u>loosen</u> the set screws. Thoroughly remove the needles.



5. Inspect piston and o-ring for debris. Wipe off the piston and replace o-ring [2350] if worn or cracked. Apply a small amount of grease [2359] around the o-ring and piston. Inspect eject body o-ring [2441] and replace if worn or cracked.

6. Return the piston into the body with spring and locking set screw, as before. Be sure that all needle holes are aligned with the holes in the eject head body. Also be sure that the mounting screw holes in the piston align with those in the eject head body. Tightened the locking set screw until it is below the threads of the eject head body.



Insertion of new needle(s) and planarization.

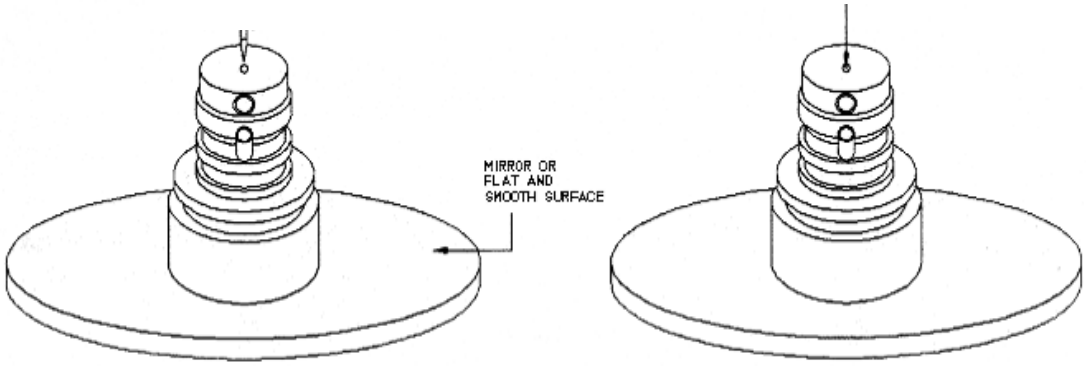
7. Place the eject head with the topside surface down (holes that the needle tip(s) exits) on the mirror. Carefully insert the new needles into the brass piston in the appropriate holes.

8. **Gently** tap the back end of the needle lightly to ensure the tip of the needle is resting on the surface of the mirror.

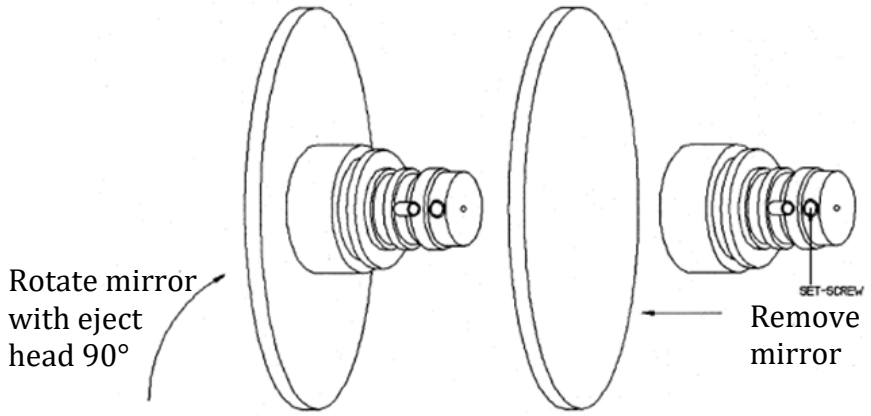
   Note: Be careful not to move or slide the eject head on the mirror when it is flipped as it may damage the needles.

Step 7:
Place eject head on a mirror surface.
Insert the needle(s) into the hole

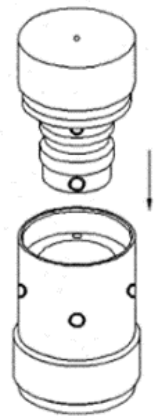
Step 8:
Gently tap the back end of the needle lightly to ensure the top of the needle is resting on the surface of the mirror



9. Be sure that all needles are resting on the mirror. Rotate mirror and eject head 90° and remove mirror. Lightly tighten each set screw(s). Needles are very easy to break if too much force is applied.



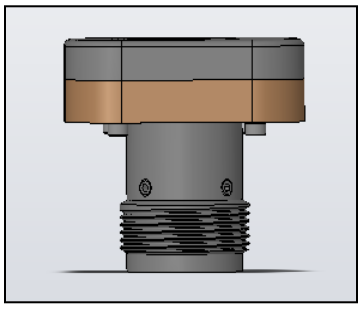
10. **EJA only:** Insert the eject head into the adapter while matching the marks on the eject head with the mark on the adapter. Secure the body and vacuum chamber together with the two screws removed in step 1, if equipped with integrated vacuum chamber (EJA).



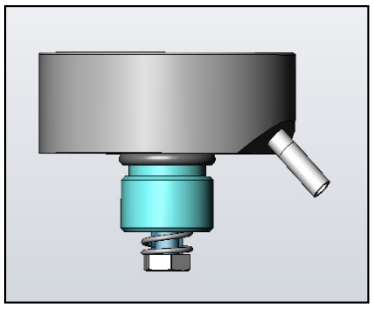
11. Check for planarization under microscope. Needles must be sub-flush to eject head surface and level to each other. If planar and sub-flush, fully tighten the set screws. Place new sticker [111019] center on bottom of piston's recessed area.

12. To checking piston motion, **carefully** hold the eject head between your thumb and forefinger making sure your finger(s) are away from the eject needles. Press up on the piston to make sure it moves smoothly.

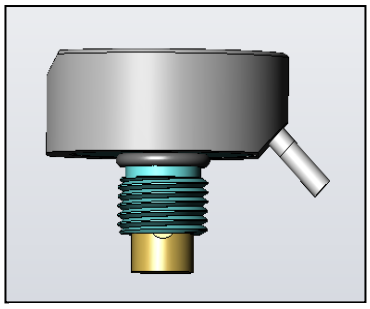
Needle Replacement and Planarization of 1.1, 1.5 and 2.0 inch diameter (large) Eject Heads



Piston style EJA



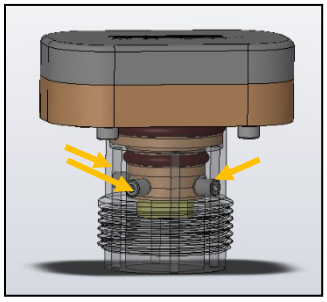
Hex style EJT

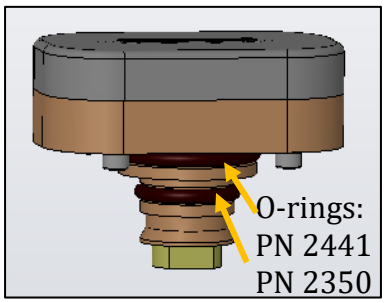


Plunger style EJT

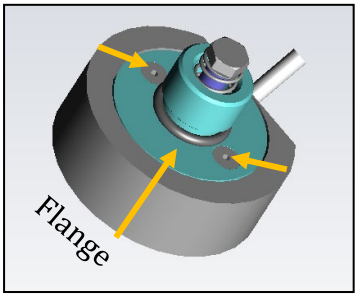
Removal of broken needles

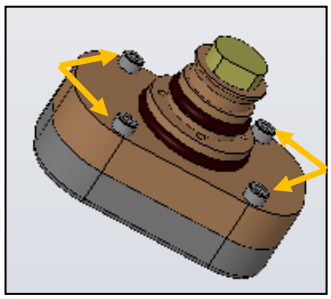
1. If the Eject Head includes Integrated Vacuum Gallery (EJA), loosen the two (or four) small set screws around the body clamping the two cylinder halves together. Remove threaded vacuum chamber adapter.



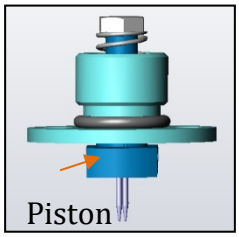


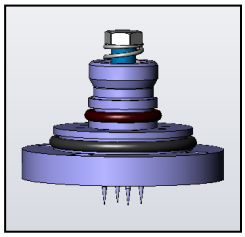
2. Place eject head facing down. Remove the screws holding the bottom flange/body in place. For eject heads that have internal springs use caution. Hold the bottom flange in place when removing the screws to prevent the flange from popping up.

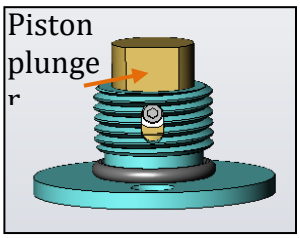


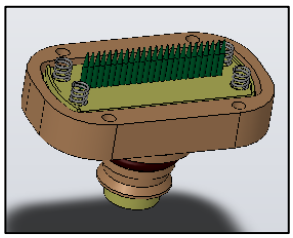


3. Carefully remove the cap/piston/piston plunger and flange from the eject body.



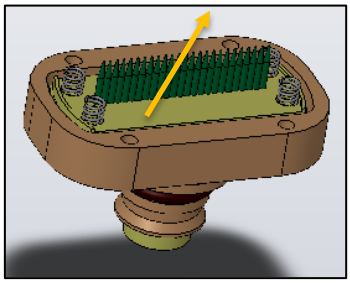


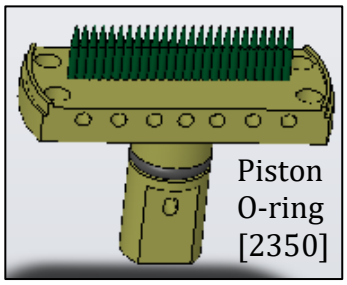




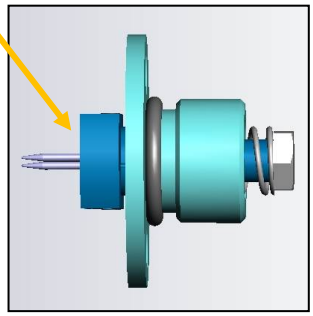
Remove piston:

a. Piston style eject heads:
   i. Carefully remove the springs and set aside. Slide the piston from the eject head body pressing up from the bottom of the piston (if present, remove any locking screws first)

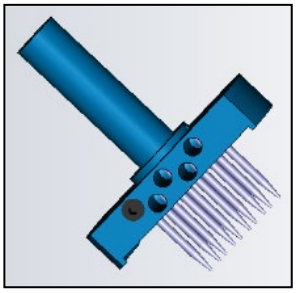




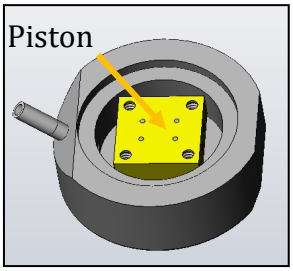
b. Hex style eject heads:
   i. Carefully hold the upper part of the piston, use a ¼" wrench to loosen and remove the hex screw at the bottom of the piston.



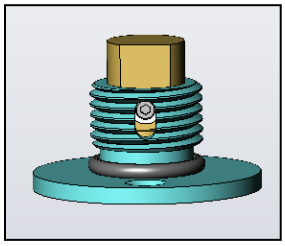
   ii. Remove spring, o-ring and slide the piston out of the flange.



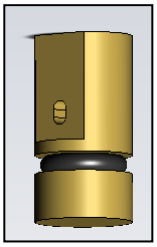
c. Plunger style eject heads:
   i. Carefully remove piston block from eject head body, take care not to lose any springs.



   ii. To check the internal o-ring, remove the locking set screw (0.035" hex key) from the slot in the threads to release the plunger.



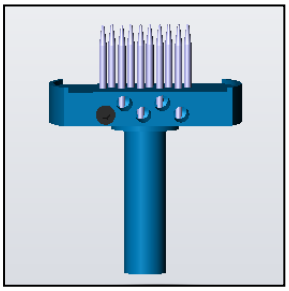
Body o-ring [2441]

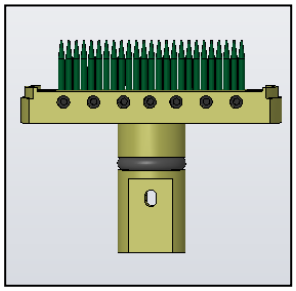


Plunger O-ring [2091] (Internal)

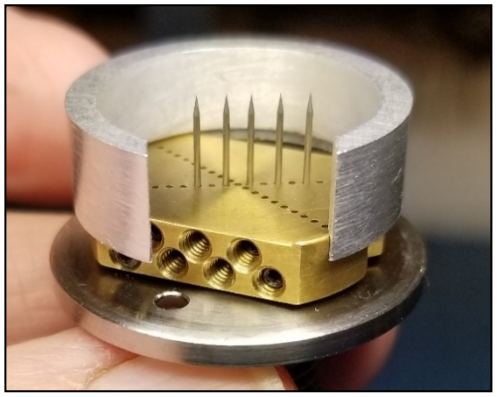
Insertion of new needle(s) and planarization

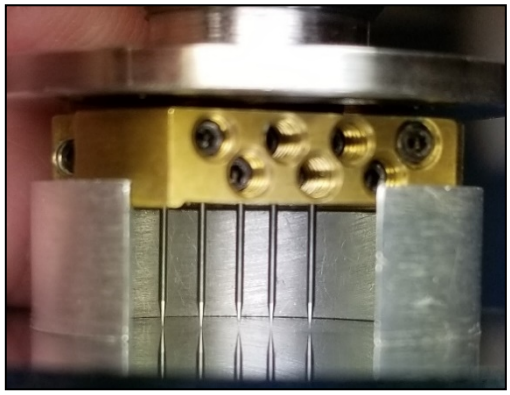
4. Each needle has a set screw that secures it in the brass piston. Loosen the set screw that corresponds to the needle requiring replacement. Remove the needle and replace with the new needle. Tighten the set screw with the needle slightly lower than the other needles.



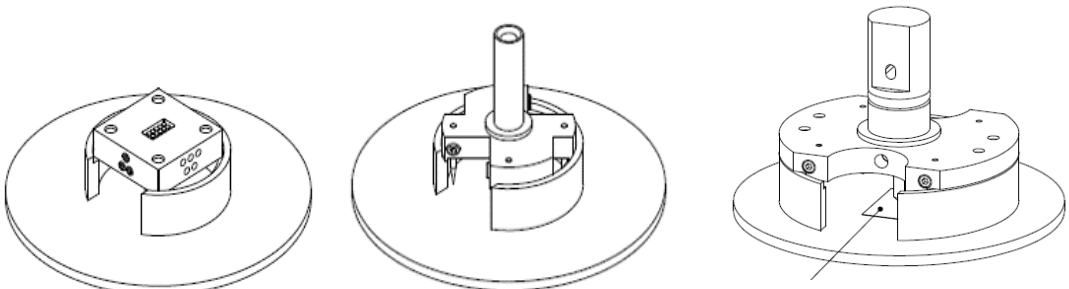


5. Place the piston into the aluminum collar from the Planarization kit with the new needle close to the opening. Gently place the piston and collar onto the mirror.





Notes: Using a 'C" ring (collar) and a mirror, all needles must be set planer to top surface of eject cap and all needles must be planer to within 0.001". If blunter NSC center needle is used, it should be set 0.002" – 0.003" lower that other needles.

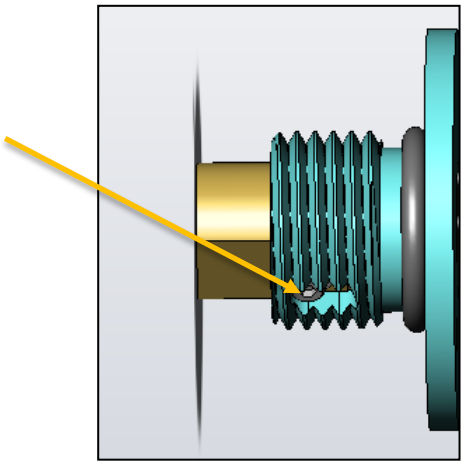


If setting NSC center needle, use a 2 – 3 mil (0.002" – 0.003") shim to set the center needle height

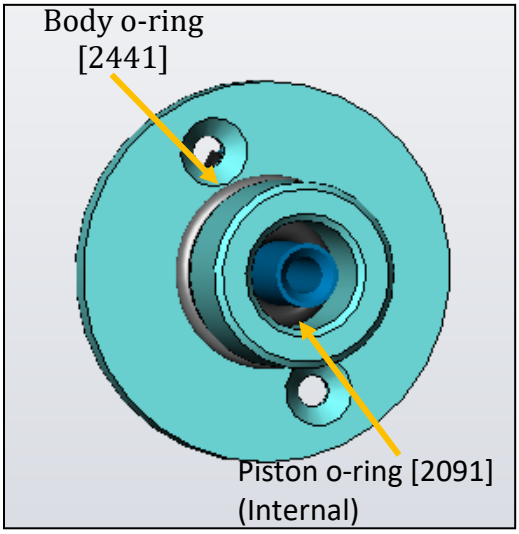
6. Loosen the set screw holding the new needle and **gently** tap the new needle down until it touches the surface of the mirror. Inspect that all needles are evenly touching the mirror's surface and secure needle in place using set screw.

7. Inspect piston/plunger and internal o-ring for debris. Wipe off the piston and replace o-ring [2091] if worn or cracked. Apply a small amount of grease [2359] around the o-ring. Inspect eject body o-ring [2441] and replace if worn or cracked.

    a. **Plunger style** eject heads, re-install plunger into flange, install and tighten the locking set screw until it is below the threads of the eject head body

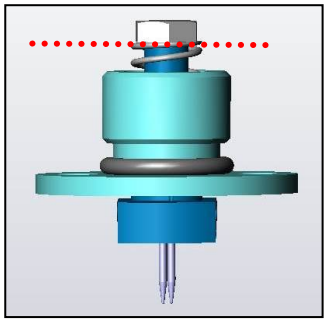


8. Reassembly:
    a. **Hex type** eject heads:
        i. Insert the piston into the flange, then the o-ring [2091] and spring on to the piston.

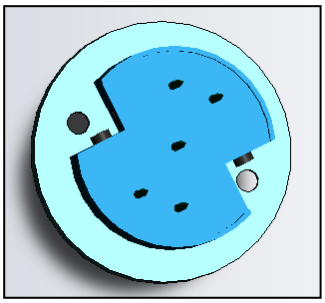


ii. Holding top of the piston, replace the hex/locking screw and tighten.

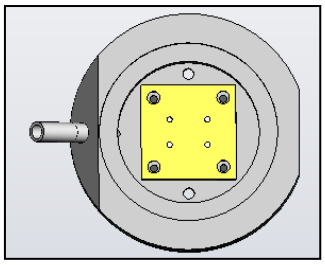
iii. Verify the spring is seated at edge of the hex nut, perpendicular to the shaft axis. The edge of the spring should not go beyond the plane edge of the hex screw.
Note: If the spring cannot be set flush to plane edge of hex screw, replace the spring [PN 2092].



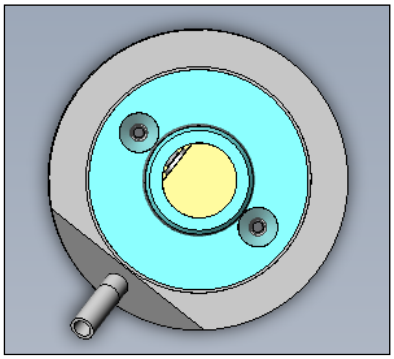
iv. Align the piston with the flange so that the screw holes are aligned to notches in piston.

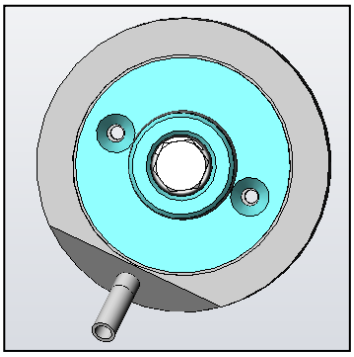


b. **Plunger style** eject heads: Insert piston into eject head body, aligning springs to alloy set screws.



9. Align the piston/flange with the eject body, making sure the needle holes and screw holes match. Gently lower the flange into the body, install the 2 screws that hold the flange to the body.





10. To check piston motion, **carefully** hold the eject head between your thumb and forefinger making sure your **finger(s) are away from the eject needles**. Press up on the piston to make sure it moves smoothly. Inspect that all the needle tips are planar.

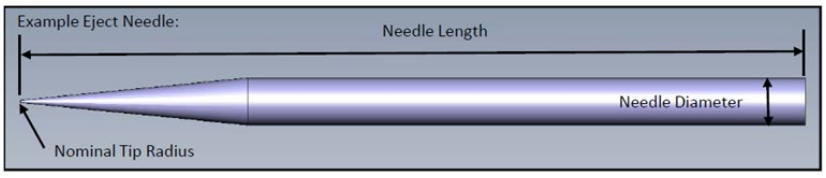
Eject Needle List

How to determine the right eject needle for your application:

1. Determine the eject head diameter and/or the needle length.
2. Determine the needle diameter.
3. Determine the needle tip radius (.001 inch is standard for most applications)
4. Select needle from list below

NOTE: *Compatibility with non-Royce eject heads not guaranteed.*

Eject Head Size	Needle Length	Needle Diameter (Inches)	Eject Needle Part Number	Nominal Tip Radius (Inches)	Notes
0.75 inch diameter	1.165 Inches	0.034	EN-1-01653	0.001	Standard Needle
			EN-1-14539	0.002	Non-Standard Needle
			EN-1-15891	0.003	Non-Standard Needle
			EN-1-14540	0.004	Non-Standard Needle
			EN-1-10922	0.005	Non-Standard Needle
			EN-1-11274	0.008	Non-Standard Needle
			EN-1-16539	0.010	Non-Standard Needle
			EN-1-11001	0.017	Standard Needle and NSC stop pin
		0.020	EN-4-01656	0.001	Standard Needle
			EN-4-24452	0.002	Non-Standard Needle
			EN-4-24453	0.003	Non-Standard Needle
			EN-4-24454	0.004	Non-Standard Needle
			EN-4-15403	0.005	Non-Standard Needle
			EN-4-14961	0.008	Non-Standard Needle
			EN-4-12894	0.010	Standard Needle and NSC stop pin
		At tip: 0.010 At base: 0.034	EN-3-01655	0.001	Standard Needle
			EN-3-15278	0.002	Non-Standard Needle
			EN-3-14542	0.003	Non-Standard Needle
			EN-3-14780	0.004	Non-Standard Needle
			EN-3-08048	0.005	Standard Needle and NSC stop pin
			EN-3-14944	0.008	Non-Standard Needle
1.5 Inch diameter	0.425 Inches	0.034	EN-2-01654	0.001	Standard Needle
			EN-2-21685	0.003	Non-Standard Needle
			EN-2-14649	0.005	Non-Standard Needle
			EN-2-14660	0.008	Non-Standard Needle
			EN-2-12806	0.010	Non-Standard Needle
			EN-2-10964	0.017	Standard Needle and NSC stop pin
		0.02	EN-7-03443	0.001	Standard Needle
			EN-7-17136	0.002	Non-Standard Needle
			EN-7-24490	0.003	Non-Standard Needle
			EN-7-24491	0.004	Non-Standard Needle
			EN-7-12604	0.005	Non-Standard Needle
			EN-7-24492	0.008	Non-Standard Needle
			EN-7-12855	0.010	Standard Needle and NSC stop pin
		0.062	EN-8-03765	0.001	Non-Standard Needle



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Appendices

Appendix A: Table of Recommended Eject Heads

Shortest Die Side	Suggested Eject Head	EJT Diameter	Eject Needle	Comments
Under 0.030 in.	EJT-001-19450	0.75 in.	EN-3	Single needle for small die
0.031 to 0.045 in.	EJT-020-02447	0.75 in.	EN-4	Quad needle, 0.020 in. sq.
0.046 to 0.080 in.	EJT-035-02448	0.75 in.	EN-1	Quad needle, 0.035 in. sq.
0.081 to 0.105 in.	EJT-060-03181	0.75 in.	EN-1	Quad needle, 0.060 in. sq.
0.106 to 0.120 in.	EJT-085-05511	0.75 in.	EN-1	Quad needle, 0.085 in. sq.
0.121 to 0.140 in.	EJT-100-02449	0.75 in.	EN-1	Quad needle, 0.100 in. sq.
0.141 to 0.170 in.	EJT-125-02450	0.75 in.	EN-1	Quad needle, 0.125 in. sq.
0.171 to 0.220 in.	EJT-150-02451	0.75 in.	EN-1	Quad needle, 0.150 in. sq.
0.221 to 0.270 in.	EJT-200-02452	1.5 in.	EN-2	Quad needle, 0.200 in. sq.
0.271 to 0.320 in.	EJT-250-02453	1.5 in.	EN-2	Quad needle, 0.250 in. sq.
0.321 to 0.400 in.	EJT-300-02454	1.5 in.	EN-2	Quad needle, 0.300 in. sq.
0.371 to 0.500 in	EJT-350-02455	1.5 in.	EN-2	Quad needle, 0.350 in. sq.
0.421 to 0.550 in.	EJT-400-02456	1.5 in.	EN-2	Quad needle, 0.400 in. sq.
0.471 to 0.700 in.	EJT-450-02457	1.5 in.	EN-2	Quad needle, 0.450 in. sq.
0.521 to 0.800 in.	EJT-500-27064	1.5 in.	EN-2	Quad needle, 0.500 in. sq.
Length > 2x width	Custom			Discuss with factory
Major width > 20x thickness	Custom			Discuss with factory
Die under 0.0005 in. thick	Custom			Discuss with factory
GaAs microwave die	Custom			Discuss with factory
Pressure sensors	Custom			Discuss with factory
For pyramid die collets	Custom			Discuss with factory

These suggested eject head sizes should be used as “rules of thumb”. There may be considerable latitude in eject head choice depending on the machine in use and special customer needs.

The choices above will perform well using silicon die where thickness to major width ratio is under 20:1. (Note that this is **not** the same as the die aspect ratio.)
For larger die thickness ratios, for GaAs die, special structures, non-surface contact, or for use with pyramid-style die collets, please consult the factory.

Above listed eject heads contain needles with a 0.001 inch (25 micron) needle tip radius. Blunt eject needles are available and can be quoted upon request.

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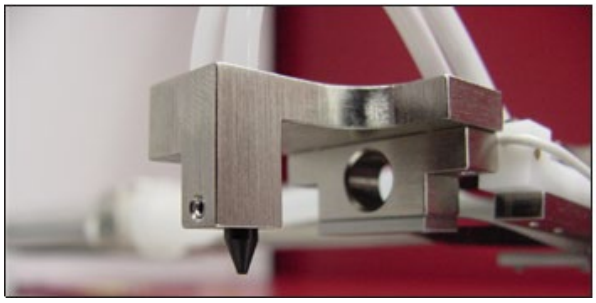
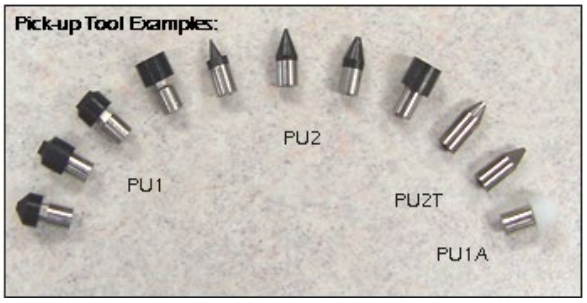
Appendix B: Table of Recommended Pick-Up Tips

Royce Instruments pick-up tools are compatible with all Royce DE35, AP+, MP300 and A45 systems. Vacuum is applied through the pick-up tip to hold the die in place during contact. Pick-up tools differ in material and geometry in order to meet varying die transfer needs. All pick-up tools are designed for quick changeover, and attach to the pick-up head with a simple set screw. Standard pick-up tip materials and dimensions are listed below. Custom pick-up tools are also available in customer-specified dimensions upon request. When selecting a pick-up tip, the tip inner diameter should be smaller than the device width and the outer diameter should not more than 0.002 inch larger than the die width.





PU1 Series*
Soft black Nitrile Rubber (NBR) pick-up tips for common die transfer applications.
Packs of 5 tips.

Part Number	ID/Cavity (in/mm)	OD (in/mm)
PU1-010-21411	.006 / .15	.010 / .25
PU1-020-16021	.010 / .25	.020 / .51
PU1-025-14910	.015 / .38	.025 / .64
PU1-030-14911	.015 / .38	.030 / .76
PU1-040-14912	.015 / .38	.040 / 1.02
PU1-050-14913	.025 / .64	.050 / 1.27
PU1-060-14914	.035 / .89	.060 / 1.52
PU1-080-14915	.035 / .89	.080 / 2.03
PU1-110-14916	.090 / 2.29	.110 / 2.79
PU1-120-14917	.100 / 2.54	.120 / 3.05
PU1-140-26811	.120 / 3.05	.140 / 3.56
PU1-160-26813	.140 / 3.56	.160 / 4.06
PU1-180-26815	.160 / 4.06	.180 / 4.57
PU1-200-26817	.100 / 2.54	.200 / 5.08
PU1-300-26821	.16 x .1 / 4.1 x 2.5	.300 / 7.62
PU1-400-26823	.24 x .14 / 6.1 x 3.6	.400 / 10.2

PU2 Series
Vespel pick-up tools for common die transfer applications. Vespel is a hard, statically dissipative plastic.

Part Number	ID(in/mm)	OD (in/mm)
PU2-010-01998	.006 / .15	.010 / .25
PU2-015-02513	.011 / .28	.015 / .38
PU2-035-02514	.015 / .38	.035 / .89
PU2-050-02515	.035 / .89	.050 / 1.27
PU2-060-25059	.040 / 1.02	.060 / 1.52
PU2-080-25060	.060 / 1.52	.080 / 2.03
PU2-100-24810	.060 / 1.52	.100 / 2.54
PU2-130-24808	.100 / 2.54	.130 / 3.30
PU2-140-25061	.110 / 2.79	.140 / 3.56
PU2-160-25062	.130 / 3.30	.160 / 4.06
PU2-180-25063	.140 / 3.56	.180 / 4.57
PU2-200-25064	.160 / 4.06	.200 / 5.08

PU2T Series
Tungsten carbide pick-up tools for common die transfer applications.

Part Number	ID (in/mm)	OD (in/mm)
PU2T-006-06567	.004 / .10	.006 / .15
PU2T-010-06646	.006 / .15	.010 / .25
PU2T-015-06647	.011 / .28	.015 / .38
PU2T-035-06648	.015 / .38	.035 / .89
PU2T-050-06649	.035 / .89	.050 / 1.27

Also Available:

PU1A Series — Very soft white thermoplastic elastomer pick-up tips for handling non-flat die surfaces, especially bumped die.

PU6 Series — Channel pick-up tools for applications where topside die touch is not acceptable, but top edge touch is acceptable. Vespel or tungsten carbide.

PU14 Series — 4-edge contact pick-up tools for small die or for die where additional vacuum force is needed. Tungsten carbide.

PU22 Series — Custom geometry to meet challenging die pick applications with no touch/no vacuum areas. Vespel or tungsten carbide.

PU26 Series — Perimeter contact pick-up tools maximize vacuum force while avoiding contact with the active area or centrally located raised surface or sensitive features. NBR, Vespel, or Tungsten Carbide.

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Appendix C: Recommended Spare Parts

Note: To order process specific parts such as Eject Head parts, contact Royce Customer Service at customerservice@royceinstruments.com, phone: (707) 255-9078

Immediate Production Back Up Spare Parts

These items should be readily at hand for immediate replacement and constitute consumable items.

PART NUMBER	DESCRIPTION	SUGGESTED QUANTITY
	Mainframe	
6672	Fuses 5 Amp	1
15399	Replacement Pickup Cantilever (flexures)	1
6655	Y-axis drive belt	1
20881	Inline Air/Vacuum Filter	2
2359	Magnalube (for z-axis worm gear)	1
	DES X-Y Input Stage	
2439	O-Ring, hand wheels	2
2440	O-Ring, hand wheel drive shaft	6
2240	Retainer clip, drive shafts	2
2134	Y-Axis Handwheel belt (DES-8 only)	1
3883	X-Axis Handwheel belt ((DES-8 only)	1
	Eject Heads	
2441	O-Ring, eject head body	5

Production Back Up Spare Parts

These items should be available to minimize production downtime.

PART NUMBER	DESCRIPTION	SUGGESTED QUANTITY
	Mainframe	
6655	Y drive belt	1
2337	Solenoid valve	1
24770	Replacement Z-Drive Gear Set	1

	DES X-Y Stage	
2336	Spring, eject head position adjustment	2
1024	Pneumatic ejector diaphragm	5
2310	Pneumatic ejector diaphragm spring	6
14305	AUM motorized ejector drive belt	1
	Wafer Holder	
16158	Replacement Destaco wafer holder clamp	1

Long Term Spare Parts

These items are not expected to require replacement for several years, however due to the high speed of technological change; these parts may be obsolete or otherwise unavailable when required.

PART NUMBER	DESCRIPTION	SUGGESTED QUANTITY
	Mainframe	
15007	Modified PCB, Keyboard Interface	1
1434	Small Step Driver PCB	1
15683	Replacement Large Step Driver	1
26145	Limit Switch CBL Left & Right Side	1
25132	Replacement Circuit Board Assembly, CPU and I/O PCB's	1
25330	Solenoid Driver PCB	1

Appendix D: Table of Fluoroware Waffle Pack Dimensions

The following table lists the dimensions of many common FLUOROWARE H20 (2 in. square) waffle packs. The list covers most of the Waffle Packs listed in the 1987 catalog and is shown in catalog order. Royce Instruments takes no responsibility for the accuracy of this list, although it was compiled from Fluoroware drawings.

NOTE: *The dimensions shown assume that Waffle Pack is loaded with flat at bottom left corner.*

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-002	10	0.1667	10	0.1667
H20-003	10	0.1667	10	0.1667
H20-004	3	0.5550	4	0.4500
H20-010	12	0.1580	12	0.1580
H20-015	20	0.0850	20	0.0850
H20-018	10	0.1600	10	0.1600
H20-018-09	20	0.0860	20	0.0860
H20-018-12	20	0.0720	20	0.0720
H20-021	22	0.0790	22	0.0790
H20-021-12	22	0.0720	22	0.0720
H20-025	20	0.0840	20	0.0840
H20-025-06	20	0.0840	20	0.0840
H20-026-15	20	0.0850	20	0.0850
H20-030-10	20	0.0850	20	0.0850
H20-030-14	20	0.0840	20	0.0840
H20-030-16	20	0.0840	20	0.0840
H20-030-24	20	0.0833	20	0.0833
H20-032	10	0.1667	10	0.1667
H20-034	20	0.0840	20	0.0840
H20-035	20	0.0840	20	0.0840
H20-037	20	0.0840	20	0.0840
H20-039	20	0.0840	20	0.0840
H20-040-15	10	0.1670	10	0.1670

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-040	20	0.0840	20	0.0840
H20-040-24	20	0.0840	20	0.0840
H20-045	20	0.0833	20	0.0833
H20-045-24	20	0.0840	20	0.0840
H20-047	20	0.0833	20	0.0833
H20-048	10	0.1667	10	0.1667
H20-049	25	0.0630	25	0.0630
H20-050-16	20	0.0833	20	0.0833
H20-050-24	20	0.0833	20	0.0833
H20-050-08	10	0.1667	10	0.1667
H20-051	19	0.0840	19	0.0840
H20-055-24	20	0.0840	20	0.0840
H20-055-18	20	0.0880	20	0.0880
H20-059	20	0.0840	20	0.0840
H20-060-18	20	0.0840	20	0.0840
H20-060-24	20	0.0833	20	0.0833
H20-061	19	0.0840	19	0.0840
H20-065-11	10	0.1667	10	0.1667
H20-065-24	10	0.1660	10	0.1660
H20-070-18	10	0.1667	10	0.1667
H20-070-24	10	0.1667	10	0.1667
H20-070-16	10	0.1667	10	0.1667
H20-070-11	10	0.1667	10	0.1667
H20-070-45	10	0.1667	10	0.1667
H20-070-35	10	0.1660	10	0.1660
H20-071	9	0.1670	9	0.1670
H20-075-11	10	0.1667	10	0.1667
H20-075-30	15	0.1170	15	0.1170

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-075-17	16	0.1100	16	0.1100
H20-075-18	18	0.0930	18	0.0930
H20-075-24	18	0.0930	18	0.0930
H20-080	10	0.1667	10	0.1667
H20-080-11	10	0.1667	10	0.1667
H20-080-50	10	0.1680	10	0.1680
H20-080-24	13	0.1340	13	0.1340
H20-081	9	0.1670	9	0.1670
H20-085-18	10	0.1667	10	0.1667
H20-085-24	10	0.1660	10	0.1660
H20-090-11	10	0.1667	10	0.1667
H20-090-16	10	0.1667	10	0.1667
H20-090-24	10	0.1667	10	0.1667
H20-090-35	10	0.1660	10	0.1660
H20-091	10	0.1660	10	0.1660
H20-095-17	16	0.1100	16	0.1100
H20-095-24	10	0.1660	10	0.1660
H20-095-11	10	0.1667	10	0.1667
H20-099	14	0.1150	14	0.1150
H20-099-32	12	0.1400	12	0.1400
H20-100-11	10	0.1667	10	0.1667
H20-100-32	10	0.1667	10	0.1667
H20-100-35	10	0.1660	10	0.1660
H20-105-11	10	0.1667	10	0.1667
H20-110-16	10	0.1667	10	0.1667
H20-110-24	10	0.1667	10	0.1667
H20-112	11	0.1590	11	0.1590
H20-120-20	10	0.1750	10	0.1750

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-120-24	10	0.1670	10	0.1670
H20-122	11	0.1600	11	0.1600
H20-124	11	0.1400	11	0.1400
H20-130-16	10	0.1667	10	0.1667
H20-130-24	10	0.1667	10	0.1667
H20-130	10	0.1667	10	0.1667
H20-136	9	0.1940	9	0.1940
H20-141	9	0.1940	9	0.1940
H20-150-16	10	0.1667	10	0.1667
H20-150-24	10	0.1667	10	0.1667
H20-150-35	10	0.1667	10	0.1667
H20-155	9	0.1960	9	0.1960
H20-165	7	0.2350	7	0.2350
H20-165-24	7	0.2350	7	0.2350
H20-168	8	0.2130	8	0.2130
H20-169	7	0.2500	7	0.2500
H20-175	8	0.2150	8	0.2150
H20-175-32	8	0.2150	8	0.2150
H20-176	8	0.2170	8	0.2170
H20-180-16	7	0.2500	7	0.2500
H20-180-24	7	0.2500	7	0.2500
H20-191	7	0.2500	7	0.2500
H20-192	7	0.2490	7	0.2490
H20-196	7	0.2500	7	0.2500
H20-200	7	0.2440	7	0.2440
H20-203	7	0.2483	7	0.2483
H20-210-16	7	0.2500	7	0.2500
H20-210-24	7	0.2500	7	0.2500

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-215	6	0.2870	6	0.2870
H20-219	6	0.2900	6	0.2900
H20-220	6	0.2960	6	0.2960
H20-229	6	0.2930	6	0.2930
H20-230	6	0.2700	6	0.2700
H20-232	6	0.2790	6	0.2790
H20-240	6	0.2880	6	0.2880
H20-250-24	6	0.2970	6	0.2970
H20-250-30	5	0.2500	5	0.2500
H20-258	5	0.3120	5	0.3120
H20-269	4	0.4600	4	0.4600
H20-280-16	6	0.2970	6	0.2970
H20-280-24	6	0.2970	6	0.2970
H20-287	5	0.3470	5	0.3470
H20-298	5	0.3510	5	0.3510
H20-300	5	0.3500	5	0.3500
H20-300-20	5	0.3500	5	0.3500
H20-300-45	5	0.3500	5	0.3500
H20-300-11	5	0.3400	5	0.3400
H20-310-32	5	0.3450	5	0.3450
H20-310-42	5	0.3450	5	0.3450
H20-312	4	0.4224	4	0.4224
H20-320	4	0.4200	4	0.4200
H20-330	4	0.3800	4	0.3800
H20-360	4	0.4300	4	0.4300
H20-360-11	4	0.4100	4	0.4100
H20-385	4	0.4370	4	0.4370
H20-401	10	0.0833	10	0.0833

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-404	10	0.1667	10	0.1667
H20-405	10	0.1667	10	0.1667
H20-409	20	0.0833	20	0.0833
H20-410	7	0.2500	7	0.2500
H20-411	4	0.4220	4	0.4220
H20-414	10	0.1667	10	0.1667
H20-414-60	10	0.1667	10	0.1667
H20-414-24	10	0.1667	10	0.1667
H20-417	7	0.2500	7	0.2500
H20-420	3	0.5550	3	0.5550
H20-425	6	0.2970	6	0.2970
H20-425-24	6	0.2970	6	0.2970
H20-426	3	0.5560	3	0.5560
H20-426-24	3	0.5500	3	0.5500
H20-430	3	0.5000	3	0.5000
H20-430-24	3	0.5000	3	0.5000
H20-434	3	0.5460	3	0.5460
H20-450	3	0.5000	3	0.5000
H20-450-11	3	0.5620	3	0.5620
H20-450-25	3	0.5620	3	0.5620
H20-485	3	0.5710	3	0.5710
H20-530-45	3	0.5800	3	0.5800
H20-551	3	0.5880	3	0.5880
H20-573	3	0.5930	3	0.5930
H20-22029	20	0.0840	20	0.0840
H20-40055	20	0.0850	18	0.0960
H20-42102	20	0.0850	10	0.1660
H20-45110	20	0.0850	10	0.1660

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-48088	17	0.1020	12	0.1450
H20-59046	20	0.0840	20	0.0850
H20-59109	12	0.1400	9	0.1900
H20-59157	16	0.1090	8	0.2170
H20-60090	10	0.1700	10	0.1800
H20-63077	18	0.0940	16	0.1080
H20-63650	15	0.1100	2	0.9000
H20-65125	17	0.1000	10	0.1700
H20-68078	14	0.1230	15	0.1130
H20-72090	16	0.1014	12	0.1250
H20-73091	12	0.1440	10	0.1720
H20-73103	17	0.0950	13	0.1240
H20-74099	17	0.0950	13	0.1240
H20-74104	17	0.0950	13	0.1240
H20-74149	17	0.0900	10	0.1650
H20-78110	14	0.1230	11	0.1550
H20-156175	8	0.2160	7	0.2470
H20-159334	7	0.2460	4	0.4350
H20-159509	8	0.2180	3	0.5700
H20-160200	7	0.2100	7	0.2500
H20-160205	5	0.3300	4	0.4200
H20-79053	15	0.1130	20	0.0840
H20-80225	15	0.1150	6	0.2900
H20-89114	15	0.1160	12	0.1410
H20-90115	15	0.1160	12	0.1410
H20-90130	13	0.1350	10	0.1750
H20-91116	12	0.1450	10	0.1750
H20-93103	15	0.1180	14	0.1260

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-95235	12	0.1450	6	0.2950
H20-99144	14	0.1260	10	0.1760
H20-99174	14	0.1150	8	0.1900
H20-99199	10	0.1667	5	0.3750
H20-100120	12	0.1460	10	0.1740
H20-100145	14	0.1250	10	0.1760
H20-101146	14	0.1250	10	0.1750
H20-100220	10	0.1500	6	0.2700
H20-110145	10	0.1740	8	0.2160
H20-113122	10	0.1750	10	0.1740
H20-114284	10	0.1760	5	0.3480
H20-115312	10	0.1740	5	0.3520
H20-118177	6	0.2950	6	0.2950
H20-118246	10	0.1730	5	0.3410
H20-120160	10	0.1740	8	0.2180
H20-120185	12	0.1470	8	0.2210
H20-121186	7	0.2500	5	0.3400
H20-123198	11	0.1600	8	0.2230
H20-124347	10	0.1640	4	0.4090
H20-124199	11	0.1600	8	0.2230
H20-125230	10	0.1750	6	0.2800
H20-129181	11	0.1600	8	0.2230
H20-130182	11	0.1600	8	0.2230
H20-130300	10	0.1800	5	0.3500
H20-135170	10	0.1750	8	0.2100
H20-136266	7	0.2400	5	0.3400
H20-140147	9	0.1940	9	0.1940
H20-140190	8	0.2160	6	0.2840

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-140250	9	0.1900	6	0.2900
H20-142173	8	0.2190	10	0.1770
H20-145245	7	0.2500	5	0.3450
H20-149199	7	0.2400	6	0.2900
H20-149249	5	0.3300	3	0.5000
H20-150250	7	0.2400	5	0.3400
H20-150285	9	0.1950	5	0.3350
H20-155117	8	0.1760	7	0.2190
H20-160335	5	0.3300	2	0.8100
H20-162299	8	0.2030	5	0.3290
H20-165149	6	0.2950	6	0.2950
H20-166256	6	0.2910	4	0.4250
H20-166306	8	0.2030	5	0.3320
H20-169219	7	0.2500	6	0.2900
H20-169269	7	0.2500	4	0.4600
H20-169369	7	0.2500	4	0.4400
H20-169469	7	0.2500	3	0.5700
H20-170190	4	0.3600	5	0.3300
H20-170210	5	0.3300	4	0.4200
H20-170270	7	0.2500	4	0.4600
H20-179329	7	0.2500	4	0.4200
H20-180270	7	0.2500	5	0.3400
H20-181244	6	0.2920	8	0.2200
H20-181271	7	0.2500	5	0.3400
H20-191234	6	0.2950	6	0.2950
H20-191350	4	0.4300	8	0.2210
H20-194210	6	0.2870	7	0.2490
H20-199242	6	0.2950	6	0.2950

PART NUMBER	FRONT/BACK POCKETS	FRONT/BACK SPACING	LEFT/RIGHT POCKETS	LEFT/RIGHT SPACING
H20-200244	6	0.2950	6	0.2950
H20-200265	6	0.3400	5	0.3440
H20-200530	7	0.2500	3	0.5820
H20-201248	6	0.2850	5	0.3400
H20-250750	5	0.3400	2	0.8500
H20-279359	5	0.3450	4	0.4300
H20-284296	5	0.3400	5	0.3280
H20-300850	5	0.3500	2	0.8800
H20-310460	5	0.3500	3	0.5000
H20-345445	3	0.5000	3	0.5000
H20-500600	3	0.5700	2	0.8000
H20-547844	3	0.5940	2	0.8910
H20-710830	2	0.8360	2	0.8760