CIRCUIT AUTOMATION

DP-1500-2X

OPERATION MANUAL

CIRCUIT AUTOMATION

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CONVENTIONS

In this manual, left and right always refer to orientations facing the machine. The front of the DP-1500-2X is the side with the control panel. The other side is the back. Circuit Automation's standard machine is often called a right handed machine in that, when facing the front side of the machine, an operator places a panel in the right side load/unloading section. The diagram on page 6 is a right handed machine. Circuit Automation also produces a mirror image left handed machine if requested. When a specific switch or control is referred to, it will appear highlighted, e.g., MODE. The specific position of a switch will be italicized, e.g., *Flood Only*.

Table of Contents

DEFINITION OF MACHINE TERMS

Automatic Mode - coaters are programmed with automatic sequence cycles. These cycles are started by pushing the cycle start button on any machine or by pressing the foot switch on a DP-10 or DP-1000.

Clear Loader - an alarm circuit that indicates that a panel was not properly transferred into or out of the coating chamber. This alarm also indicates if a panel was dropped from the board guide.

Coating Chamber - area in the machine where the actual coating takes place.

Cycle Start - a function of the machine that clears the machine after an *Interlock*. Cycle Start also starts an automatic program.

Deflection - the difference of displacement caused from force of a known weight on the surface of a screen.

Double Print - an *automatic program* that allows the machine to load a panel, flood the screen, print the panel, reflood the screen, reprint the panel, reprint the panel for the third time without reflooding then exit the panel.

Dynamic Pressure - the combination of *Pressure setting* + *Angle setting* + *Squeegee blade characteristics* + Squeegee Speed = Dynamic Printing Pressure.

Fixed Distance - the preset distance that the a squeegee or flood bar travels.

Floating Distance - the self centering function that allows the squeegee or flood bar to compensate for irregularities in the panels, plating height or mesh tension and to self align.

Flood/Print - an *automatic program mode* that allows the machine to load a panel, flood the screen, coat the panel then exit the panel.

Flood/Print/Print - an *automatic program* that allows the machine to load a panel, flood the screen, print a panel twice without reflooding the screen then to exit the panel.

Flood Bar - the device that applies soldermask to the screen in a prior to printing.

Flood Only - a cycle that floods the screen then *Resets* the machine to the *Home* position

Flood Speed - the speed which the flood bar travels reported in inches/second (ips).

Front - the side of the machine with the electrical control panel.

Home Position - the position when both squeegee heads are in their lowest position, the

interlocks are closed, and the shuttle is in the panel load area of the machine able to accept a new panel. The machine is set in an *automatic mode.* The *Ready* light will illuminate.

Ink Trough - the reservoir for fresh soldermask and recycled soldermask.

Interlock - all coaters have indicators of doors being open or closed. Most movements of the machine will be interrupted when a door is opened. In older models when the door is closed, the machine will continue with the active cycle. In current models the machine will continue to cycle when the *Start* switch is pressed. DP-1500-2X machines have a light curtain that also acts as an interlock.

ISOprint System - a machine cycle that forces residual ink from a print, back to the front side of the screen, where it is incorporated in the next flood stroke.

ISOprint Head - the assembly that houses the ISOprint cleaning squeegees and the printing squeegees. In retrofit model the ISOprint heads also incorporate the flood bars.

ISOprint Speed - the speed which the ISOprint squeegee wipe the screen clean of residual soldermask between prints.

Jogger - this mechanism varies the panel registration in the coating chamber. Subsequent panels are positioned differently in the coating chamber to avoid redepositing ink from previous panels onto the subsequent panels. The distance of the movement is variable from 0 to 0.50" (0 - 12mm). Current machines utilize a servo motor and single axis cotroller to adjust the stopping distance of the panels.

Loading Chamber - area where the panels are loaded and unloaded.

Manual Mode - machine functions are affected by individual switch action. The *cycle start* switch is not activated on the DP-10, DP-1000, and DP-1500-2X in *Manual*. On the DP-4000 the *cycle start* switch has limited functions for machine set up.

Mesh Count - the amount of threads per square inch. In metric, the amount of threads per square centimeter. For example, 110 mesh in inches means that there are 110 threads per square inch in the weave, which equals 43 mesh in metric.

Micron - a metric unit representing one millionth (1/1,000,000) of a meter or 0.000039 of an inch.

Mil - an English unit representing one thousandth of an inch or 25.4 microns.
Moire - a pattern of discoloration and uneven coating on a screen printed panel. Caused by the harmonic vibrations of the screen mesh across a raised surface. Also known as "tiger Stripes". This phenomenon is more noticeable on large grouping of fine traces running together on a panel.

No Flood Mode - a print mode that deposits LPI ink at the top of the screen in front of the squeegee without preflooding the screen. The squeegee will push the ink down the screen as it prints down the screen.

Off Contact - the distance from the screen chase to the substrate. Circuit Automation equipment has three standard off contact distances. 0.375", 0.50" and 0.690". Custom off contacts are available.

Open Area - the amount of area between the threads. Open area is effected by thread count and thread size or diameter. For soldermask application the more open area the better.

Panel Centering - the effect of holding a panel equidistance between the two screen chases while printing. This is the ideal situation allowing the panel to be coated with equal amounts of soldermask on both sides without *screen sticking.*

Peel Off - an adjustable function of the machine that opens the *screen chases* before the print cycle has completed. The function is designed to reduce screen sticking to the panel.

Pressure Setting - the amount of force exerted on the squeegee blade holder or the flood bar.

Print/Print/Flood - an *automatic program* that allows the machine to load a panel, print the panel, return to the top, print the panel, then exit the panel and flood the screen.

Print Speed - the speed of which the squeegee travels reported in inches/second (ips).

Rear - the side of the machine opposite the electrical control panel.

Repeatability - the closeness of agreement between test results obtained under repeatable conditions.

Reset - a function that returns the machine to the *Home position* and also clears the computer memory. On DP-1000, DP-10 and DP-1500-2X this function is not active in *Manual* modes.

Rheology - the science of flow and deformation of fluid matter under pressure. Theoretical characteristics of liquids include viscosity, plasticity, elasticity and rigidity.

Screen Chase - the device that holds the screen mesh at the proper tension. Also know as a screen frame. Circuit Automation uses both self- tensioning and "stretch and glue" type frames.
Screen Sticking - a function in the print cycle when the screen does not cleanly break away from the board when printing. This effect allows ink to be removed from the panel causing either thin coverage or a smeared appearance.

Screen Tension - a measure of a tightness of the mesh when placed in a screen frame. The common unit of measurement is Newton/cm^2.

Shear - the relative movement of adjacent layers in a liquid or plastic during flow.

Shrink Factor - a factor determined from the average percentage decrease in wet to dry ink deposit thickness.

Shuffle - a machine function that steps or jogs a panel between print strokes in Flood, Print, Print or Double Print.

Shuttle - the transfer device that moves a panel into and out of the coating chamber. On DP-1500-2X's there is one fixed overhead shuttle with holding pins. On the other coaters, there are multiple shuttles supplied for bottom transport. Shuttles are constructed with different thickness and heights to assist the machine in coating a variety of panel types.

Skew - the ability to modify the angle of travel of the squeegee blade during a print cycle. Also known as snow plough or tilt. CAI machines can skew up to 3° angle and alternate the angles between prints.

Skew Plate - the *Squeegee head* is attached to this plate. Two air cylinders control the motion. CAI coaters have the ability to skew both left and right and also print with no skew.

Squeegee - the combination of the squeegee rubber and the squeegee rubber holder.

Squeegee Angle - the angle at which the squeegee contacts the screen mesh and subsequently the panel.

Squeegee Head - the assembly that houses the squeegee and flood bar assemblies and the adjustment controls and gauges for the squeegee and flood. There are two heads per unit designated *front* and *rear heads*.

Stop Block - the device that stops the shuttle inside the coating chamber. Found on DP-2000, DP-4000, DP-10 and DP-1000. This device also contains the *jogger* mechanism. This device is adjustable to help located the panel in the coating chamber with relation to the screen window.

Warp - the horizontal threads in a woven fabric

Weft - the vertical threads in a woven fabric

INSTALLATION

The DP-1500-2X is shipped bolted to a wood frame, wrapped in bubble pack and stretch wrap. Accessories and small parts are wrapped within the machine.

The DP-1500-2X has a rigid steel frame that allows it to be moved with a forktruck. Carefully position the blades at least four feet apart. The coating section end is much heavier than the load station end; consequently, the DP-1500-2X should be lifted with one blade about one foot from the left end (facing the front) and the other blade about one foot to the right of the right end of the coating section. After removing from the wood skid, carefully install the adjustable leveling feet.

Locate the DP-1500-2X so that there is at least four feet (1.2 meters) of clear area front and back, and so that there are no obstructions to walking completely around the machine. Level the DP-1500-2X with a machinist's level placed in the center of the ground steel plate that forms the base of the coating section.

The DP-1500-2X operates on 110 Volt, 10 A electrical service, and 100 psi (5 m^3/hr @ 7 bar) compressed air. Other electrical services are available on request such as 220 Volt, 5 A.

Before plugging in the DP-1500-2X, ensure that ON/OFF (located on the control panel) is *Off* and that the CIRCUIT BREAKER is *Off* (down). The electrical and air connections are located on the end nearest the loading section. After completing the electrical hookup, turn the CIRCUIT BREAKER *On*. If the electrical current is subject to fluctuation, a spike suppressor is recommended to protect the DP-1500-2X's computer controllers. The air connection is made with a 1/4" quick disconnect.

The DP-1500-2X must be vented for operator safety and comfort. A six inch round cutout is provided above the load station along with a 5" connection on the coating section. Connect to building exhaust with six inch galvanized or PVC ducting (see following diagram). A minimum of 250 cfm is recommended.

After completing the utilities hook-up, turn power on to the DP-1500-2X with the ON/OFF switch. If the LED display does not light, ensure that the CIRCUIT BREAKER on the lower left rear of the machine is *On* (up).

INTRODUCTION TO THE DP-1500-2X

(NOTE: Your machine may not have all the functions listed in this manual. Such funtions can be upgraded on your machine at a later date. Such funtions often include the ISOprint System, No Flood Mode and Shuttle Servo Position Controller.)

The DP-1500-2X is a double-sided LPI coating machine. It can be used with all screenable photoimageable solder masks. The DP-1500-2X is very versatile, featuring the ISOprint System for cleaning the screens, QC (Quick Change) Technology for rapid changeover of ink and screens, and thin/thick panel capacity (0.002" - 0.400" (0.05mm - 10mm)).

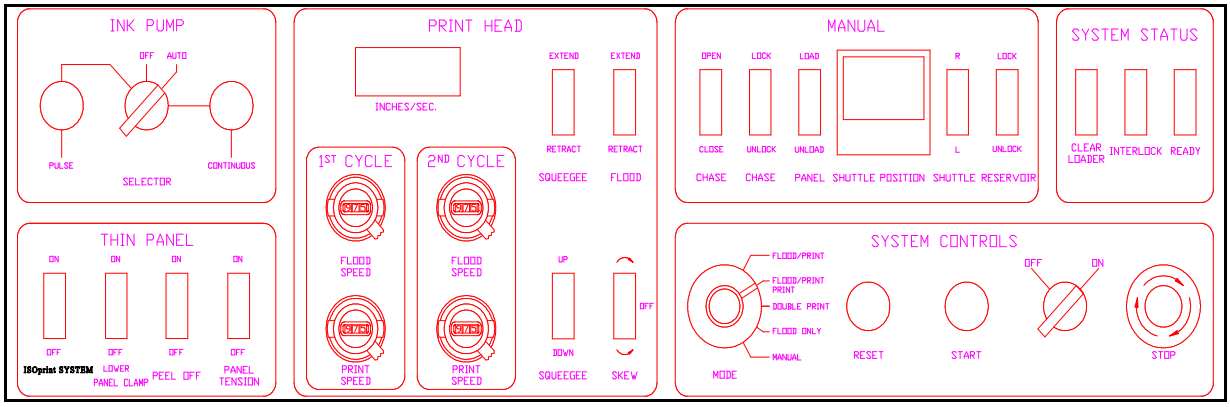
The DP-1500-2X has three operating areas: the load/unload station, the coating chamber, and the control panel. The load/unload station is the section where a panel is placed inside the DP-1500-2X. The coating chamber is accessible from front and back through the glass doors and is the section where the panel is coated. The control panel is on the front of the DP-1500-2X above the coating section.

The load/unload station consists of a bottom board guide, upper board guide, and board clamp. The board clamp holds a circuit board, moves to the coating section for coating. After coating, the board returns to the load station.

The coating chamber consists of front and back print heads, the drive and support system for the print heads, and the screens. When a board is clamped by the operator and a cycle is started, the circuit board moves to the center of the coating section. In the flood/print mode, the screens close and the print heads flood the screens on the upward stroke. The print heads stop, reverse direction, and print the circuit board on the downward stroke. (In the No Flood Mode, the ink bar will carry the ink to the top of the screen where the ink is deposited for the squeegee to push down on the squeegee stroke.) The board returns to the load station. Other print modes can be selected to print twice, with or without a second flooding of the screen.

The control panel allows selection and control of all manual and automatic operations of the DP-1500-2X. Additional controls are: an EMERGENCY STOP above the coating section doors on the back of the DP-1500-2X, a CIRCUIT BREAKER on the end below the loading section, and a foot switch which functions as a PANEL CLAMP OPEN/CLOSE switch.

DP-1500-2X SWITCHES and CONTROLS



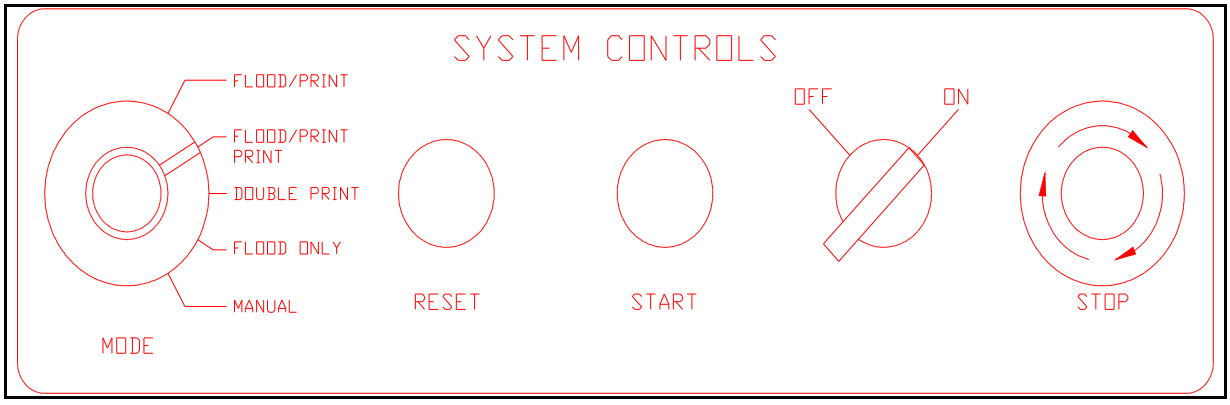
The DP-1500-2X control panel is located on the front of the machine above the coating section. In addition to the control panel, there is an EMERGENCY STOP above the coating area doors on the back of the DP-1500-2X, LIGHT CURTAIN INTERLOCK in front of the loading section, a CIRCUIT BREAKER on the end of the unit below the load/unload area, and a foot switch which functions as a START switch.

The control panel is divided into six areas:

1. Ink Pump controls (optional feature)
2. Thin Panel controls
3. Print Head controls
4. Manual controls
5. System Status indicators
6. System controls

System controls include ON/OFF, START, RESET, and EMERGENCY STOP. Mode control selects between manual and one of four automatic screening modes. Set-up controls are used to install screens and to align the transport system. Print head controls activate the flood bars and squeegees, as well as adjust the print speeds.

SYSTEM CONTROLS



ON/OFF

ON/OFF controls the electrical and pneumatic systems. In the *Off* position, these systems will not operate, however, the computer is wired directly to the CIRCUIT BREAKER in the rear of the machine and is powered as long as the CIRCUIT BREAKER is *On*. In the *On* position, all electrical and pneumatic functions operate. Select *On* or *Off* by rotating ON/OFF. If the electrical and pneumatic systems do not function with ON/OFF *On*, check that EMERGENCY STOPS have not been activated, the that the CIRCUIT BREAKER is *On*.

EMERGENCY STOP

EMERGENCY STOP turns off all electrical and pneumatic systems. To operate EMERGENCY STOP, depress the switch. To restart after EMERGENCY STOP has been pressed, rotate EMERGENCY STOP clockwise until it releases. There are two EMERGENCY STOPS: one on the control panel and one above the coating section doors at the back of the DP-1500-2X. If EMERGENCY STOP has been activated while the machine is in an AUTOMATIC MODE, RESET must be activated to return the machine to an operational condition.

If the machine is stopped by the LIGHT CURTAIN restart by removing the obstruction and the machine will continue.

START

In one of the four automatic modes, pressing START, starts operation of the DP-1500-2X. A cycle consists of six steps:

1. A board is placed in the load section on the Upper Shuttle (or Pin Bar). Release the Foot Switch to close the hinged board retainer plate.
2. The transport moves to the coating section and positions the board for screening.
3. The flood bar extends, floods the screen with ink on an upward stroke, and retracts (or in the No Flood Mode, places a long bead of ink across the top of the screen for the squeegee to push down).

4. The selected print cycle is executed.
5. The transport moves to the load/unload section and positions the circuit board for unloading.
6. Step on the Foot Switch to open the hinged retainer plate at the Upper Shuttle. Remove the coated board from the machine.

NOTE: START will not operate if MODE is set to *Manual*.

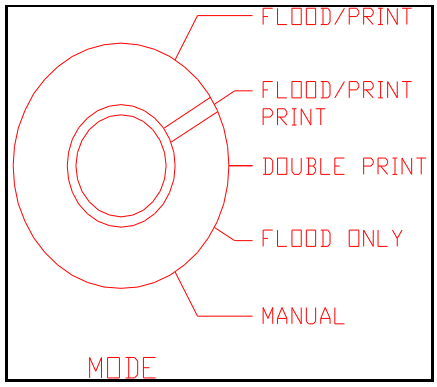
The START switch is also used to reset the interlock mechanism. When one of the five interlocks (one on each door and the light bar) are broken, the machine will not proceed to the next function until the interlocks are cleared. The green Ready light will blink until the start switch is pushed.

RESET

RESET returns the machine to a ready position after automatic operation of the DP-1500-2X has been interrupted by activation of EMERGENCY STOP. When RESET is pressed, the print heads will return to the bottom position with squeegees and flood bars retracted. The shuttle will move to the board load/unload area.

RESET also functions to reset the machine when MODE is changed. To ensure proper operation, always press RESET after changing modes.

MODE CONTROL



MODE is a five position switch. It selects between manual operation and the four automatic modes. In MANUAL, all functions are active, except START. In any automatic mode all MANUAL functions are overridden.

In automatic printing modes, when START is activated, a circuit board is loaded into screening position and the screen flooded. The flood bar retracts and the squeegee is positioned to begin a print stroke. The DP-1500-2X floods with the print head moving from the bottom position upward and prints on the downward stroke. (In the No Flood Mode, the ink bar will carry the ink to the top of the screen where the ink is deposited and pushed down the screen by the downward squeegee print stroke.)

Action then is governed by which mode has been selected:

1. *Flood/Print*
   The squeegee extends, prints on the down stroke, and retracts. The circuit board is unloaded.
2. *Flood/Print/Print*
   The squeegee extends, prints on the down stroke, retracts, returns to the upper position, prints a second time, and retracts. The circuit board is unloaded.
3. *Double Print*

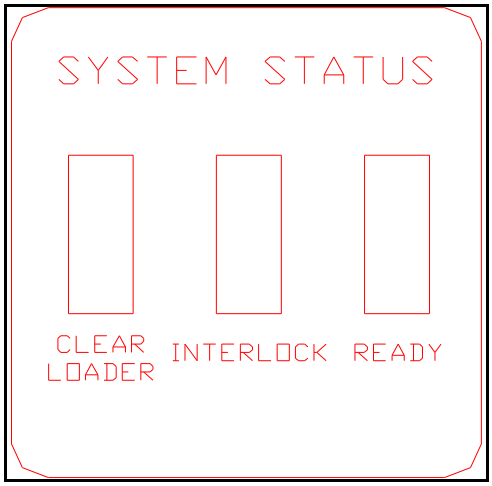
The squeegee extends, prints on the down stroke, and retracts. The flood bar extends, floods the screen on an upward stroke, retracts, and the squeegee positions for printing. The squeegee extends, prints a second time, and retracts. The print head returns to the upper position, prints a third time without flooding, and retracts. The circuit board is unloaded.

Selection of the proper print mode depends on the ink used, the circuit geometry and height, the screen mesh, and the result desired.

The fourth automatic mode is *Flood Only*. When START is pressed in *Flood Only*, the flood bar extends and the print head moves to the upper position, flooding the screen. The flood bar retracts and the print head returns to the lower position. The transport functions do not operate in *Flood Only*. To continue printing after *Flood Only* has been activated, select another automatic mode, load a board into the machine and press START to continue coating.

Select a mode by rotating the switch to point to the desired mode.

SYSTEM STATUS INDICATORS



CLEAR LOADER

The CLEAR LOADER indicator will blink to indicate a fault in the PANEL TENSION mode. If, during a print cycle, the upper board shuttle indexes up too far, a fault routine will stop the current print cycle. This is generally an indication that the board being screened is not properly clamped in the lower board guide. The board in process will need to be unloaded from the coating area manually. To unload a board manually:

1) Turn the MODE switch to MANUAL.
2) Press PANEL *Unload* or SHUTTLE *R*

The CLEAR LOADER light will be illuminated continuously if a panel does not travel from the load section to the coating chamber.

INTERLOCK

A safety interlock system prevents movement of the squeegee heads, load cylinder, or shuttle in any automatic mode if any door is not closed completely. If a door is open, INTERLOCK will be lit. If the machine is interrupted by a door opening, the machine will stop and then restart when the door is closed.

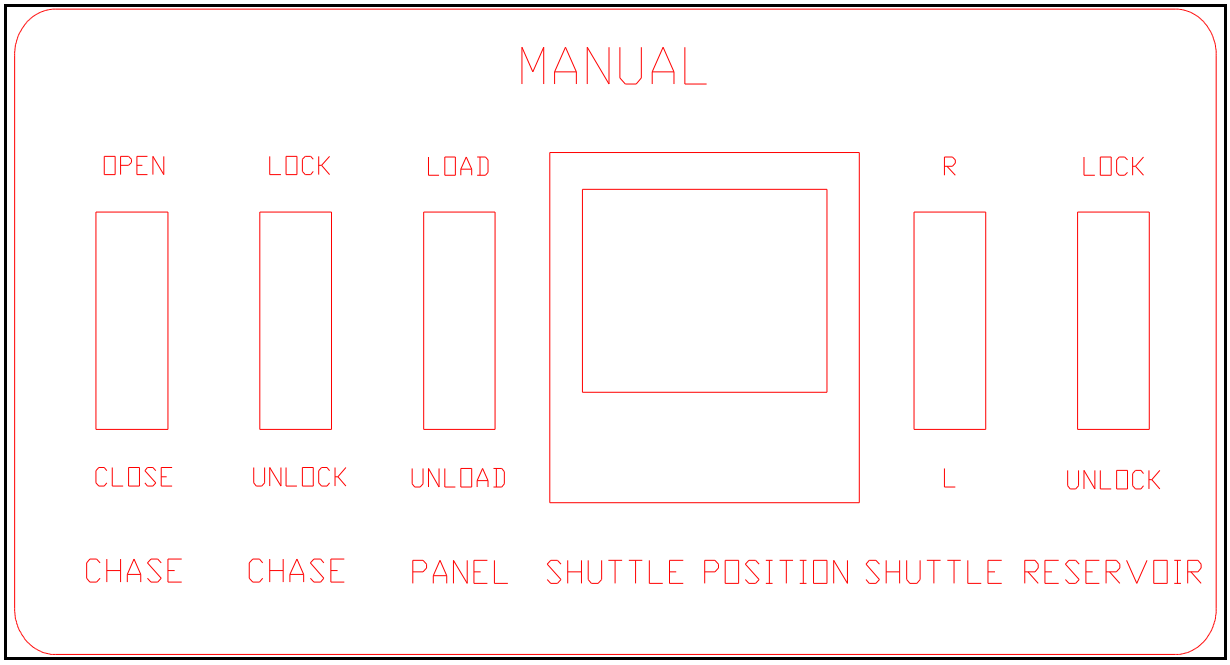
> **CAUTION:** The interlock system does not lockout pneumatic functions in manual mode. When operating in manual mode, make certain that there is no possibility of accidental contact of any moving parts of the DP-1500-2X with personnel.

The INTERLOCK light *blinks* when the squeegee head pivot assembly or the ink reservoirs at the front or rear of the machine are not locked in place.

An Interlock Override switch is located in the lower electrical cabinet. Using this Interlock Override switch anables an operator to use the machine without the saftey interlock stops. All three interlock lights should light when this Interlock Override switch in inabled. This funtion only works in Manual Mode.

READY

The DP-1500-2X has an indicator light to indicate when the system is ready to accept a board. READY will be lit when the print heads are in the bottom position and the shuttle is properly aligned. In MANUAL Mode, this indicator will illuminate when a board is loaded in the upper shuttle and the panel height is adjusted to the proper height. Blinking Ready indicates that the interlock circuit needs to be reset. This is accomplished by pressing the Start switch.



MANUAL CONTROLS

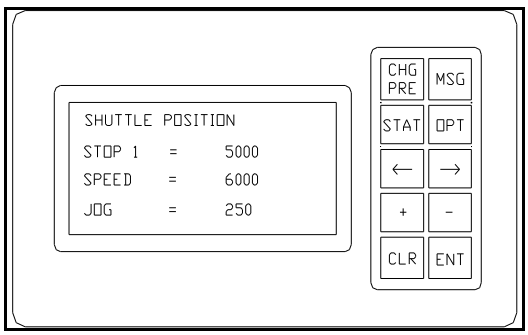
SHUTTLE

SHUTTLE *R* and *L* switch is not available on machines equipped witth a servo driven shuttle motor.

SHUTTLE POSITION/PANEL JOG/SHUFFLE

Panel Position Set Point

Panel position in the coating chamber is set at the Operator Interface. Three panel positioning parameters, Stop 1, Speed and Jog are set at this Interface as described below.



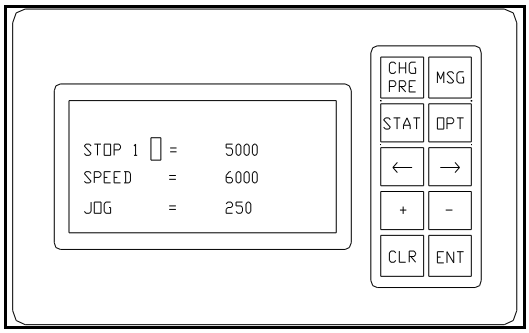


Figure 7 indicates the Message Screen. No changes can be made from this screen. To access the Edit screen indicated at Figure 2 *Press* the **Chg/Pre** button.

Figure 8 indicates the Change/Preset or Edit screen at which the shuttle control parameters can be changed. To access this screen *Press* the **Chg/Pre** button. Note the cursor indicated to the right of the STOP 1 text. To return to the Message Screen *Press* the **MSG** button.

STOP 1

STOP 1 is the panel position stop point in the coating chamber. The number indicated, is the theoretical panel shuttle move distance required to travel from the Load area to the center of the screen frames at the coating chamber. To change this set point from the message screen:

1. Press Chg/Pre - Cursor will be positioned to the right of STOP 1.
2. Press ENT - Cursor will move to data value for STOP 1.
3. Press ➔ - Press right or left arrow to position cursor at place value to be changed.
4. Press + - - Press + or - key to increase or decrease data value.
5. Press ENT - Press ENT (Enter) to accept new data value.
6. Press MSG - Press MSG to return to Message Screen.

JOG

The data value at JOG is the differential shuttle stop position for every other panel. If this data value is set to zero every panel will move to the same position. This data value adds to the STOP 1 position for every other panel, thus, moving the panel farther into the coating area. Generally this value is set between 100 and 250. These numbers represent a jog or offset distance of approximately 1mm (.040 in.) to 2.5 mm (.100 in.). This data value may be set higher or lower as desired. To change this set point from the message screen:

1. Press Chg/Pre - Cursor will be positioned to the right of STOP 1.
2. Press + - - Press + or - key to move cursor to JOG.
2. Press ENT - Cursor will move to data value for JOG.
3. Press ➔ - Press right or left arrow to position cursor at place value to be changed.
4. Press + - - Press + or - key to increase or decrease data value.
5. Press ENT - Press ENT (Enter) to accept new data value.
6. Press MSG - Press MSG to return to Message Screen.

SPEED

The data value at SPEED represents the speed of shuttle movement into and out of the coating chamber. The maximum value for shuttle speed is 6000. The minimum practical number is approximately 2000, however, any number larger than zero will allow shuttle movement. To change this set point from the message screen:

1. Press Chg/Pre - Cursor will be positioned to the right of STOP 1.
2. Press + - - Press + or - key to move cursor to SPEED.
2. Press ENT - Cursor will move to data value for SPEED.
3. Press ➔ - Press right or left arrow to position cursor at place value to be changed.
4. Press + - - Press + or - key to increase or decrease data value.
5. Press ENT - Press ENT (Enter) to accept new data value.
6. Press MSG - Press MSG to return to Message Screen.

Shuffle Distance

Shuffle is activated by setting the Squeegee switch to the *Extend* position in Flood, Print, Print or Double Print Mode.

When the Shuffle function is activated, a panel being coated will step or jog between print strokes in the Flood, Print, Print or Double Print Mode. The shuffle distance is the set as the same value as Jog.

CHASE LOCK

The screen chases are held in place at the bottom by pneumatic cylinders in locating blocks. CHASE LOCK controls these cylinders. In the *Unlock* position, the cylinders are retracted and the

chase can be inserted or removed. In the *Lock* position, the cylinders extend to lock the chase in place. CHASE LOCK operates only in manual; in any automatic mode, the chases will be locked automatically and CHASE LOCK will have no effect on operation. Do not attempt to flood or print in *Manual* without locking the chases.

NOTE: The CHASE LOCK also enables or disables the compressed air supply to the CHASE OPEN/CLOSE air cyliners. Without the CHASE LOCK in the *Lock* position, the CHASE OPEN/CLOSE function will have no compressed air and the cylinders (located at the top of the chases) will allow the chases to be floating. Therefore, you can easily pull or push the cylinder open when changing screen chases.

CHASE OPEN/CLOSE

In a automatic mode the CHASE OPEN/CLOSE air cylinders (located at the top of the chases) operate as necessary automatically. During the Flood/Print functions, the cylinders will be in the *closed* position. During board transport into or out of the coating area, the cylinders will be in the *open* position. You can open or close these cylinders with this switch only in MANUAL

MODE and when the CHASE LOCK is *locked*.

LOAD/UNLOAD

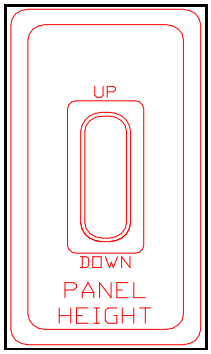
LOAD/UNLOAD activates the shuttle system to move a circuit board into, or out of, screening position. When *Load* is pressed, the shuttle moves from the board load area into the screen coating area. When *Unload* is pressed, the shuttle moves from the screen coating area into the load station. This funtion works in manual mode only.

INK RESERVOIR

LOCK/UNLOCK activates the clamping device that locks the ink reservoir trough against the screen chase. The ink reservoir needs to be LOCKED for the machine to operate. If the ink reservoir is not in the lock position, a red interlock indicator light will blink.

PANEL HEIGHT

PANEL HEIGHT *Up* and *Down* raises and lowers the upper board shuttle to accommodate different board heights. This switch is located near the load chamber away from the control panel. PANEL HEIGHT will **ONLY** operate in *Manual* MODE. This switch works in conjunction with the PANEL HEIGHT MODE switch for either coarse or fine adjustment. This allows the DP-1500-2X to accommodate circuit boards from 8 to 30 inches high (203mm - 762mm). The Panel Height Mode does not operate if the shuttle is in Load position or if the squeegee head is at the top position.

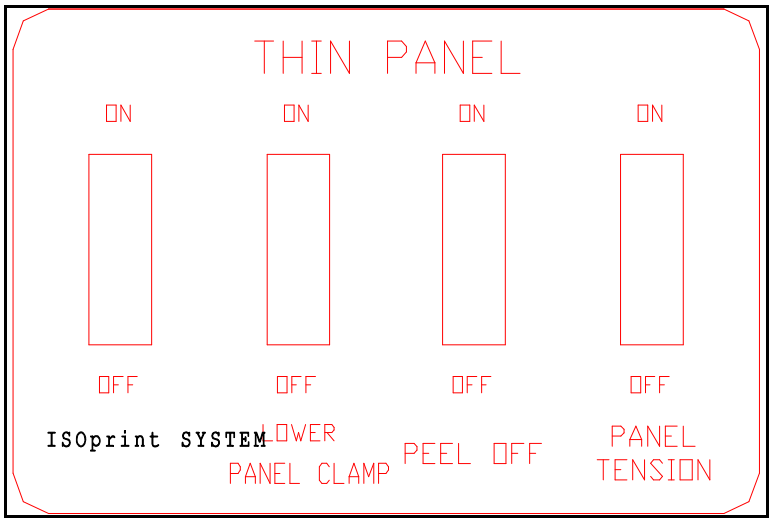


THIN PANEL CONTROLS

ISOprint SYSTEM

The ISOprint SYSTEM is a dual squeegee stroke cycle to remove the ink that remains on the back of the screen, for example, over holes or slots. ISOprinting forces the residual ink back to the front side of the screen, where it is incorporated into the next flood stroke.

This system utilizes a second set of squeegee blades to redistribute the ink on the proper side of the screen



for printing. The two squeegees press the screens together and wipe the screens without a panel in between them to smear the ink back to the front side of the screen. The system can be easily engaged or disengaged depending on the types of panels being produced or the soldermask characteristics.

The recommended angle for the ISOprint squeegee is set so that the top beveled edge of the squeggee is parallel to the screen. We recommend that 70 durometer squeegees are used with the "V" groove cut.

PANEL CLAMP LOWER

PANEL CLAMP LOWER *On* and *Off* operates in *Manual* MODE. PANEL CLAMP LOWER *On* opens and closes the lower panel guide clamp. PANEL CLAMP LOWER must be set to the *On* position whenever PANEL STRETCH *On* is selected. PANEL CLAMP LOWER will cycle the lower panel clamp on and off in *Manual* MODE.

> **Note:** When PANEL CLAMP UPPER or LOWER *On* is selected in *Manual* MODE, the upper shuttle will not move left or right.
>
> A set of pressure gauges and regulators labeled PANEL CLAMP LOWER and PANEL CLAMP UPPER located above the board load area, is utilized to regulate and monitor the air pressure for the clamps. Effective clamping pressure is generally 20 to 30 PSI.
>
> **THIS PRESSURE SHOULD NOT BE SET ABOVE 35 PSI.**

PEEL OFF

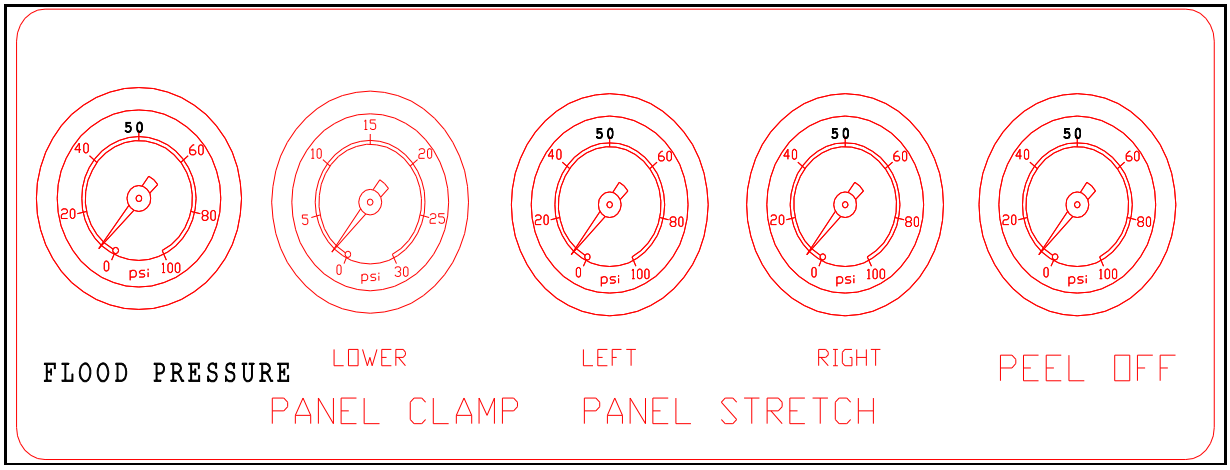
PEEL OFF *On* and *Off* sets peel off to be active or inactive in the selected Print mode. PEEL OFF *On* allows the screen chases to open during a print stroke. When PEEL OFF is set *On*, screen chase opening positioning during the print stroke is dependent on Peel Off limit switch position. PEEL OFF *Off* will prevent the screen chases from opening until a board print mode has been completed. PEEL OFF operates in Automatic mode only.

PANEL TENSION

PANEL TENSION *On* and *Off* sets board "stretch" to be active or inactive. PANEL TENSION *On* allows the upper board shuttle to index up during the print cycle. This applies tension or "stretches" a board during the selected print cycle. PANEL TENSION *Off* prevents the upper board shuttle from indexing up during a selected print cycle. PANEL TENSION operates in both Automatic and Manual mode.

> **Note:** When PANEL TENSION *On* is selected, PANEL CLAMP LOWER *On* must also be selected. The lower panel clamp causes the lower board guide to clamp a board. This prevents the upper shuttle from lifting a board.

PNEUMATIC GAUGES



The pneumatic control panel is located at the upper left side of the board load area. Each control consists of a pressure gauge and pressure regulator to monitor and control various functions listed below.

FLOOD PRESSURE GAUGE

FLOOD PRESSURE controls the pressure exerted to the flood bars. The pressure effects the thickness of the ink on the flooded screen. The approximate pressure set point is 25 to 30psi.

PANEL CLAMP LOWER GAUGE

PANEL CLAMP LOWER controls pressure at the lower panel guide clamp bladder. The lower clamp is utilized to hold a board in the lower board guide during a print cycle. Approximate pressure set point is *20* to *25 psi*. A low pressure setting will cause the clamp to close too slow and will not provide enough pressure to hold a panel in position during the "stretching" operation. If a panel lifts rather than stretching during a print cycle, the CLEAR LOADER indicator will blink, indicating a fault. If this occurs, the board being coated must be unloaded from the coating area in MANUAL MODE.

PANEL STRETCH LEFT GAUGE

PANEL STRETCH LEFT controls lifting pressure at the left end of the upper shuttle. Approximate pressure set point is *60 psi*. A low pressure set point will not properly "stretch" or tension a board. Too high of a set point may lift a panel from the lower board guide/clamp.

PANEL STRETCH RIGHT GAUGE

PANEL STRETCH RIGHT controls lifting pressure at the right end of the lower shuttle. Approximate pressure set point is *45* psi. A low pressure set point will not properly "stretch" or tension a board. Too high of a set point may lift a panel from the lower board guide/clamp.

PEEL OFF GAUGE

PEEL OFF controls the opening pressure at the CHASE OPEN/CLOSE air cylinders during a print stroke. PEEL OFF pressure control is only active when PEEL OFF *On/Off* is set to the *On* position. Approximate pressure set point is *60* to *70 psi*. When PEEL OFF is set *On*, the Peel Off limit switch will determine the point, during the Print Stroke, at which the Chase Open air cylinder will be pressurized.

INK PUMP CONTROLS

SELECTOR

SELECTOR *Off* turns the ink pump off.

SELECTOR *Auto* turns the ink pump on. When *Auto* is selected, ink will be pumped every second time the squeegee head leaves the home position.

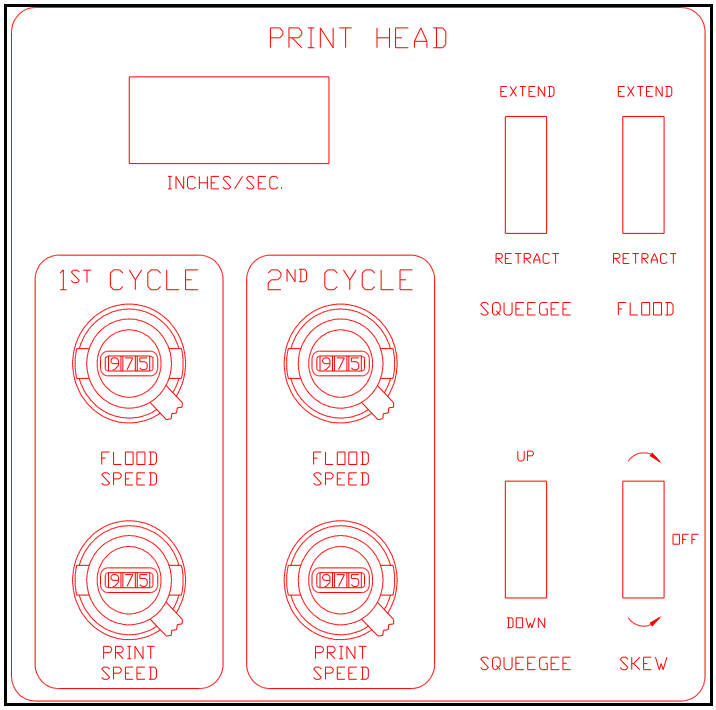
Pulse pumps the ink pump once for every push of the blue push-button. This allow the operator to add ink to the DP-1500-2X without risking overflowing the ink troughs.

Continuous cycles the ink pump until *Off*, *Auto*, or *Pulse* is selected. Rotate SELECTOR to *Continuous* and turn the key lock to activate the continuous mode.

> **CAUTION:** Do not run the ink pump in *Continuous* without constant supervision. This mode should be used only for cleaning the ink pump (see ink pump manual for instructions. If Continuous is used to fill the ink troughs, do so only under direct supervision or overflowing the ink troughs may result.

PRINT HEAD CONTROLS

SKEW



SKEW is a three position switch that determines if the squeegee will skew to the printing direction, and in which direction. In the *Off* position, the squeegees will be perpendicular to the print direction. In *Clockwise* (upper position) squeegees will skew clockwise on the first print stroke, and counterclockwise if there is a second print stroke. In *Counterclockwise* (lower position) the action is reversed.

In general, coverage is improved if the squeegee is skewed. In *Flood/Print/ Print* or *Double Print*, the initial direction is usually irrelevant, but if only one print stroke is used, then there may be a preference for *Clockwise* or *Counterclockwise* due to the geometry of the circuits.

FLOOD

FLOOD extends or retracts the flood bars. It is used to flood the screen in manual mode. *Extend* extends the flood bars, putting them in contact with the screen. *Retract* retracts the flood bars. FLOOD is overridden by automatic operation.

Regardless of which automatic print mode you are operating in, you may choose to preflood the screen and wait for the next panel to be loaded, or it can flood only after a panel is loaded and the start button is pushed. By preflooding, you are helping to ensure that the screen will not dry with a dot pattern before the next panel enters the coating chamber. This problem is significaltly avoided by using the ISOprint System to clean the screen after a printing.

If you have the FLOOD switch in the *extend* mode, an automatic print mode will interpret that you prefer to preflood the screen and wait for the next panel. If you have the FLOOD switch in the *retract* mode, an automatic print mode will interpret that you prefer NOT to preflood the screen.

SQUEEGEE *Extend/Retract*

SQUEEGEE *extends* or *retracts* the squeegees. It is used to position the squeegees to print in manual operation. *Extend* puts the squeegees in contact with the screen, and *Retract* retracts the

squeegees. SQUEEGEE is overridden by automatic operation.

When SQUEEGEE is set to the *extend* position in Flood, Print, Print or Double Print mode, shuttle positioning is set for *Shuffle* mode. *Shuffle* will step or jog a panel between print strokes.

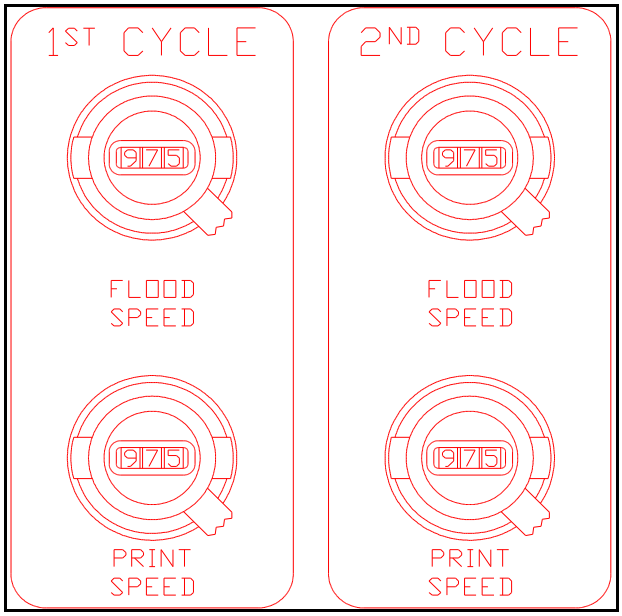
> **CAUTION:** Always position the *Extend/Retract* in the *Retract* position when not in use in *Manual*. The Shuttle will not load panels in *Manual* or mode with the SQUEEGEE in the *Extend* position.

SQUEEGEE UP/DOWN

SQUEEGEE *UP/DOWN* drives the print heads *up* or *down*. In combination with LOAD, FLOOD and SQUEEGEE, *Up/Down* may be used to manually coat a circuit board.

SQUEEGEE *Up/Down* is overridden in automatic modes.

1st CYCLE - FLOOD SPEED, PRINT SPEED
2nd CYCLE - FLOOD SPEED, PRINT SPEED



Generally, the DP-1500-2X floods on the upward stroke and prints on the downward stroke. Using the No Flood Mode, the DP-1500-2X will place the ink at the top of the screen in front of the squeegee and the squeegee starts its downward stroke. This takes relatively the same amount of time. In automatic modes with two flood or print strokes, the speed of the second flood or print stroke may be controlled independently of the first. The two Print Speed and two Flood Speed knobs are used to set the speed of the print heads.

Rotation clockwise increases the speed, while rotation counter clockwise decreases the speed. It is not possible to flood or print slower than one inch per second (2.5cm/sec), nor possible to flood or print faster than 10 inches per second (20 cm/sec).

The speed (in/sec or cm/sec) at which the print head is actually moving is indicated by the digital LED display. The set speed (in arbitrary units) of each stroke is indicated by the dial in the center of each speed control knob.

FLOOD SPEED between 6 inches and 8 inches per second (15-20 cm/sec) is recommended for both 1ST CYCLE and 2ND CYCLE. PRINT SPEED between 4 inches and 8 inches per second (10-20 cm/sec) is recommended for 1ST CYCLE and 2ND CYCLE. The print speed is determined by the type of ink being printed and the geometry of the panel.

NO FLOOD MODE

No Flood Mode is an alternative flood mode to the standard flood mode. The No Flood Mode switch can be located in the lower electrical panel. No Flood Mode has been found to drastically reduce LPI ink plugging component holes.

The standard flood mode uses the flood bar to pick-up the LPI ink at the ink trough and spread the ink up the screen, flooding the screen. The head then reverses direction and prints down over the flooded screen.

On the contrary, when No Flood Mode is *on*, the ink bar will pick-up the LPI ink at the ink trough, but it will carry the ink to the top of the screen where it will deposit a bead of ink in front of the squeegee. It does not flood the screen on the way up. The squeegee then prints on the way down, pushing the LPI ink in front of the print stroke.

SET UP OF THE SQUEEGEES AND SQUEEGEE HEADS

SQUEEGEE SET-UP

Choose appropriate squeegee/flood bar/ink trough for the size panel(s) to be coated, 20" (508mm) or 26"(660mm).

THE PRINT STROKE

Unique to Circuit Automation coaters is the way the squeegees attack the screen mesh and subsequently the panel. We utilize the *Trailing edge* first method of applying the squeegee to the panel. Traditional flat bed screen printer and both competitive double sided screen printers utilize the *Leading edge* method of printing. The *Trailing edge* method is also known as the *Push stroke or* as the *Surf stroke.* The *Leading edge* method is also known as the *Pull stroke.*

The difference in the method of application is the single biggest reason why Circuit Automation Products can coat high traces fill areas between close traces and coat consistently even across the panel.

SQUEEGEE ANGLE AND PRESSURE

SERVICE ON/OFF

The SERVICE ON/OFF switch enables the **SERVICE PANEL** switches for manual testing (along with the MODE switch to MANUAL. (The SERVICE ON/OFF switch is not required for the ISOprint, PEEL OFF, NO FLOOD MODE OR INTERLOCK OVERRIDE switches.) The SERVICE switch must be in the *OFF* position for the DP-4000 to operate in the regular modes.

ISOprint SYSTEM

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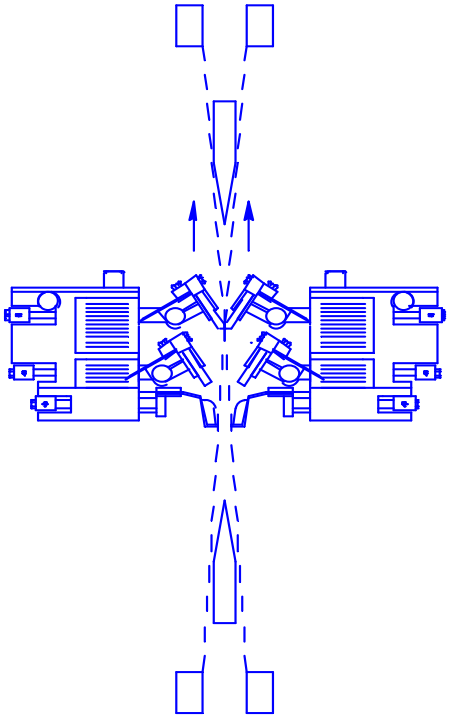
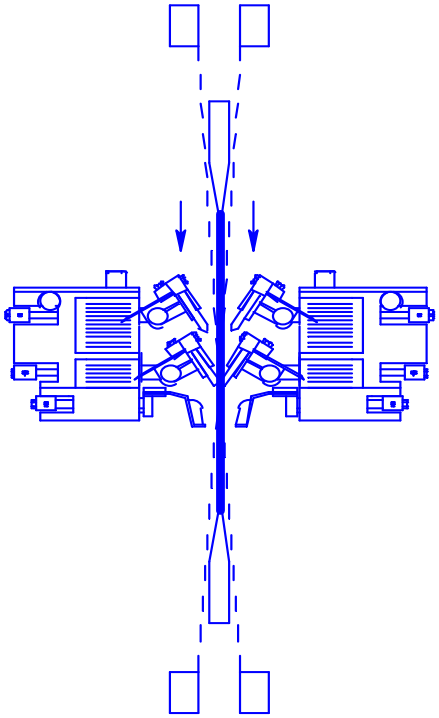


ISOprint System pushing screens together, without a panel in between, to smear the residual LPI ink to the front side of the screen where it is incorporated into the next flood.



Standard downward print stroke.

This system utilizes a second set of squeegee blades to redistribute the ink on the proper side of the screen for printing. The two squeegees press the screens together and wipe the screens without a panel in between them to smear the ink back to the front side of the screen. The system can be easily engaged or disengaged depending on the types of panels being produced or the soldermask characteristics.

The recommended angle for the ISOprint squeegee is 45#SYMBOL \f "Symbol"176. We recommend that 70 durometer squeegees are used with the "V" groove cut.

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PEEL OFF

Found in the lower electrical panel, PEEL OFF *On* and *Off* sets peel off to be active or inactive in the selected Print mode. PEEL OFF *On* allows the screen chases to open during a print stroke. When PEEL OFF is set *On*, screen chase opening positioning during the print stroke is dependent on Peel Off limit switch position. PEEL OFF *Off* will prevent the screen chases from opening until a board print mode has been completed. PEEL OFF operates in Automatic mode only.

CYCLE STOP

CYCLE STOP button will stop the printing cycle wherever it is at the time. It works similar to an EMERGENCY STOP button.

J32

J32 is a cable disconnect. This cable carries the electrical wires to the **SERVICE PANEL.**

INFEED TILT

INFEED TILT allows the operator to activate the tilt that places the panel in the shuttle. The pressure regulator can then be set for maximum efficiency and proper placement on the shuttle.

OUTFEED TILT

OUTFEED TILT allows the operator to adjust the force that is used to place the panel back into the rack. Too much force or speed can cause the panel to tough the panel being loaded which may cause damage to wet LPI coating.

FLIPPER UP

FLIPPER UP is located in the rack conveyor. It comes up to separate the panels and position them to be picked up and placed in the shuttle. This adjustment is made in the factory and need not be adjusted by the operator, however it must be up to make the flipper rotate adjustment.

FLIPPER ROTATE

FLIPPER ROTATE will need to be adjusted for the thickness and size of the panel. To adjust the rotation of the flipper (after panel height has been set), place a panel in the rack and slide it to the load position. Rotate the UP/DOWN so that the flipper is in the up position. Rotate the flipper. It should hold the panel in place but should not cause the panel to warp. To adjust the rotation, there is a regulator and gauge just below and to the right of the panel being loaded. They are mounted in the rack drive assembly.

SHIFT IN/OUT

SHIFT IN/OUT feature enables the service person to adjust the speed and force that the loader/unloader assembly moves from the load to the unload position (THIS SHOULD NOT BE DONE BY THE OPERATOR).

PCB PUSH IN/OUT

PCB PUSH IN/OUT is used to align the panel with the back bar, (the back bar aligns the panel to the left end of the shuttle). The pusher is located to the right of the load area and about three inches from the bottom of the panel. With the panel in the rack and in the upper shuttle clamp in position, the PCB pusher should slide the panel left against the back bar. If it does not move it far enough, loosen the locking knob. If the panel moves with too much force, tighten the knob to the right. The panel should not move with extreme force.

UPPER CLAMP ON/OFF

UPPER CLAMP ON/OFF will turn *on* or *off* the upper clamp in the coating chamber that clamps the panel at the top of the panel.

INFEED GUIDE OPEN/CLOSE

INFEED GUIDE OPEN/CLOSE will *open* or *close* the infeed guide clamp that holds the panel while removing the panel from the rack to insert the panel in the shuttle.

OUTFEED GUIDE ON/OFF
OUTFEED GUIDE OPEN/CLOSE will *open* or *close* the outfeed guide clamp that holds the panel while removing the panel from the shuttle to insert the panel in back in the rack.

RACK STOP ON/OFF
RACK STOP ON/OFF will stop the rack from proceeding forward under the Load/Unload Section.

SET UP OF THE SQUEEGEES AND SQUEEGEE HEADS

SQUEEGEE SET-UP

Choose appropriate squeegee/flood bar/ink trough for the size panel(s) to be coated, 20" (508mm) or 26"(660mm).

THE PRINT STROKE

Unique to Circuit Automation coaters is the way the squeegees attack the screen mesh and subsequently the panel. We utilize the *Trailing edge* first method of applying the squeegee to the panel. Traditional flat bed screen printer and both competitive double sided screen printers utilize the *Leading edge* method of printing. The *Trailing edge* method is also known as the *Push stroke or* as the *Surf stroke.* The *Leading edge* method is also known as the *Pull stroke.*

The difference in the method of application is the single biggest reason why Circuit Automation Products can coat high traces fill areas between close traces and coat consistently even across the panel.

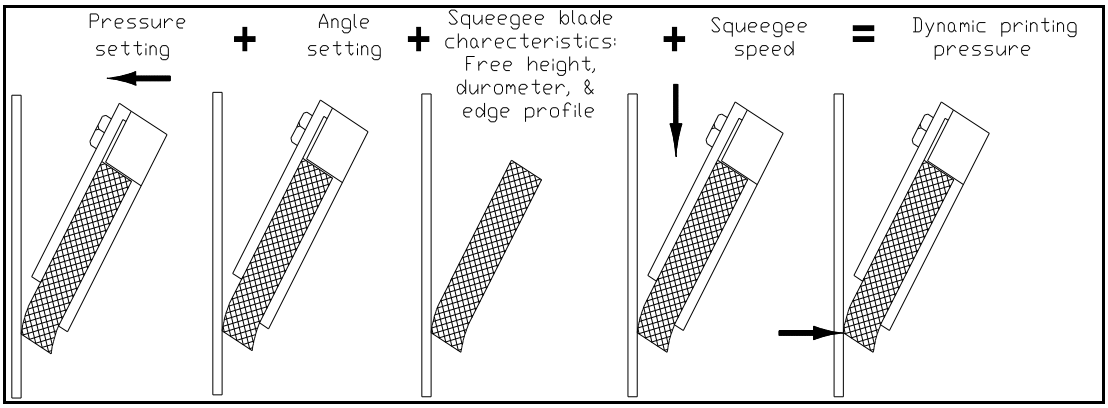
SQUEEGEE ANGLE AND PRESSURE

Circuit Automation equipment has an adjustable angle of attack for the squeegee. The adjustment varies from 20#SYMBOL \f "Symbol"176 to 45#SYMBOL \f "Symbol"176. Research has shown that the higher the squeegee angle the bet

Note: Squeegees and flood bars are supplied in sets. There are two standard sizes that are shipped with the machine. 26" (660mm) for panels up to 24" (610mm) wide and 20" (508mm) for panels up to 18" (457mm) wide. Choose the flood bar to match the squeegee selected.

Pressure on the squeegee vs. dynamic squeegee pressure
Although Circuit Automation coaters have three separate squeegee-function adjustment (angle, speed and pressure) each on affects the action of the other two. The net result of adjusting one or more of these variables determines the ultimates, or

dynamic printing pressure on the substrate. *This pressure is not the same as the pressure adjustment on the squeegee (see following figure).*



For example, if the dynamic squeegee pressure on the panel is 1 lb/in at 35#SYMBOL \f "Symbol"176 squeegee angle, the pressure on the squeegee may be 60 psi (4.1 bar) at a squeegee speed of 3 in/sec (ips). The same dynamic pressure could also be achieved at 27.5#SYMBOL \f "Symbol"176 angle 100 psi (7.0 bar) at 5 in/sec. All other things being equal, if the dynamic squeegee pressure is the same in two different setups, the soldermask deposit will be also the same.

Unfortunately, while the affects dynamic pressure of the squeegee are known, setting the dynamic pressure is done by trail and error. While it is possible to get the same dynamic pressure by adjusting the three squeegee functions, we don't exactly know how since we have no feed back.

Following are steps for Squeegee setup:

#SYMBOL \f "Symbol"183 Set the squeegee angle at 27.5#SYMBOL \f "Symbol"176 - 37.5#SYMBOL \f "Symbol"176

#SYMBOL \f "Symbol"183 Set the squeegee speed to 3 in/sec (ips)

#SYMBOL \f "Symbol"183 Start with 80 psi (5.5 bar) front (for both fixed/floating and floating/floating)

#SYMBOL \f "Symbol"183 Start with 100 psi (7.0 bar) rear for Fixed/Floating (80 psi (5.5 bar) rear for floating/floating)

#SYMBOL \f "Symbol"183 Increase front squeegee pressure until there are no thick areas on the edges of the panel.

#SYMBOL \f "Symbol"183 Increase print speed until moire pattern disappears.

#SYMBOL \f "Symbol"183 Decrease print speed if micro bubbles appear along the traces.

#SYMBOL \f "Symbol"183 Decrease squeegee angle if excesses ink is in the holes.

#SYMBOL \f "Symbol"183 Increase squeegee angle if skips develop.

Squeegee pressure and length vs. ink-deposit thickness

Research indicates that squeegee length affects the ink-deposit variations that normally a function of squeegee-pressure variations. Sizing the squeegee for the panel helps reduce variations. The same squeegee pressure setting utilizing different squeegee lengths will produce different ink-deposits.

SQUEEGEE HEAD SET-UP

The heart of all Circuit Automation equipment is the squeegee heads. These are the devices that hold the squeegee assemblies and flood bars. Proper alignment and adjustment of the heads is critical to produce consistent, repeatable acceptable panels at the desired coverage of soldermask.

The basic principle behind our coaters is:

#SYMBOL \f "Symbol"183Panels are held vertical
#SYMBOL \f "Symbol"183The screen mesh and chase are equidistant from the vertical panel
#SYMBOL \f "Symbol"183Both squeegee heads are at the exact same position on opposite sides of the panels
#SYMBOL \f "Symbol"183The squeegee angle of attack is the same for both squeegees
#SYMBOL \f "Symbol"183The squeegees exert the same dynamic pressure on both sides of the Panels.
#SYMBOL \f "Symbol"183The flood bars exert the same force to evenly flood the screen mesh.

The DP-4000 is designed to operate on a range of panel thicknesses and panel sizes. The maximum panel thickness ranges from a minimum of 0.002" (0.05mm) to a maximum of 0.400" (10mm). The tension on the screen mesh is changeable depending on prints and the squeegee rubber wears.

To design a machine that could automatically adjust to variations in panel thickness, mesh tension, squeegee rubber wear, air pressure changes, different print speeds, and a whole host of other variables we designed the squeegee heads to be self adjusting.

We have defined the self-adjusting feature as **FLOATING / FLOATING POSITION.**

If the squeegees or flood bars are in a non-adjustable position we define that as being **FIXED / FIXED POSITION.** There are three possible combination to operate the **SQUEEGEE HEADS** we define them as:

SQUEEGEE HEAD OPERATION

Position #1 FIXED/FIXED

Front squeegee head	**FIXED POSITION**
Rear squeegee head	**FIXED POSITION**

This operational position forces the front and rear squeegee to the maximum travel position. This head position in **NOT RECOMMENDED** under any situations. It is possible to exert the same dynamic pressure on both sides of a panel and achieve good printing however, if any variable changes then the pressures to each side of the panel would be different and the printing would not be even. For example, if the mesh tension on the rear screen changed 2 N/cm then the printing would be not equal.

Cause: Both squeegee drive bars bottom out while printing

Common symptoms of printing in the Fixed/Fixed position.
#SYMBOL \f "Symbol"183Panel coverage is very thick on one side normal on the other side
#SYMBOL \f "Symbol"183Panel appears to be shear coated on one side with all holes plugged
#SYMBOL \f "Symbol"183Panel appears to have very thick coating on both sides.
#SYMBOL \f "Symbol"183Thick panels coat OK thin panels are unacceptable

Position #2 FLOATING/FLOATING

Front squeegee head	**FLOATING POSITION**
Rear squeegee head	**FLOATING POSITION**

This operational position allows the front and rear squeegees to both self center at less than the maximum travel position. This head position is **RECOMMENDED** under most situations. This position makes the air pressure to the individual squeegee critical. This position set up is used mostly in three circumstances:

Shops that do not allow operators to use tools.
For very thick panels >0.150"
For very thin panel <0.010"

Customers who use this position adjust the air pressure setting on the squeegee heads. One advantage of this position is that the heads are self adjusting, generally squeegee head adjustments are not necessary for varying panel thickness. To use this setting critical care must be given to screen make up and screen tension.

Cause: Both squeegee drive bars do not bottom out while printing, squeegee stroke is dependent on front and rear air pressure set point.

Common symptoms of printing in the Floating/Floating position.

#SYMBOL \f "Symbol"183Panel tends to stick to the screens while printing.
#SYMBOL \f "Symbol"183Adjustment to keep the panel centered is may be difficult.

Position #3 FLOATING/FIXED

Front squeegee head	**FLOATING POSITION**
Rear squeegee head	**FIXED POSITION**

This operational position allows the front to self center at less than the maximum travel position while the rear squeegee travels to a fixed position. This head position is **RECOMMENDED** under certain situations. This position allows the maximum flexibility and requires the minimum operator interface to the machine. **NOTE:** It doesn't matter which side is fixed or which sides floats. By convention the rear squeegee fixed and the front floating.

This allows the dual sided coaters to print like a conventional screen printer. The rear squeegee acts like the base of a flat bed making the panel firm and the Front squeegee adjust to the panel thickness, trace height, warp, off contact, mesh tension etc. Cause: The Rear squeegee travel to the fixed position while the front drive bars do not bottom out while printing.

While printing in this position the air pressure setting for the squeegee are used to create a even coating across the panel, not to center the panel in the coater.

SQUEEGEE HEAD PRESSURE ADJUSTMENT

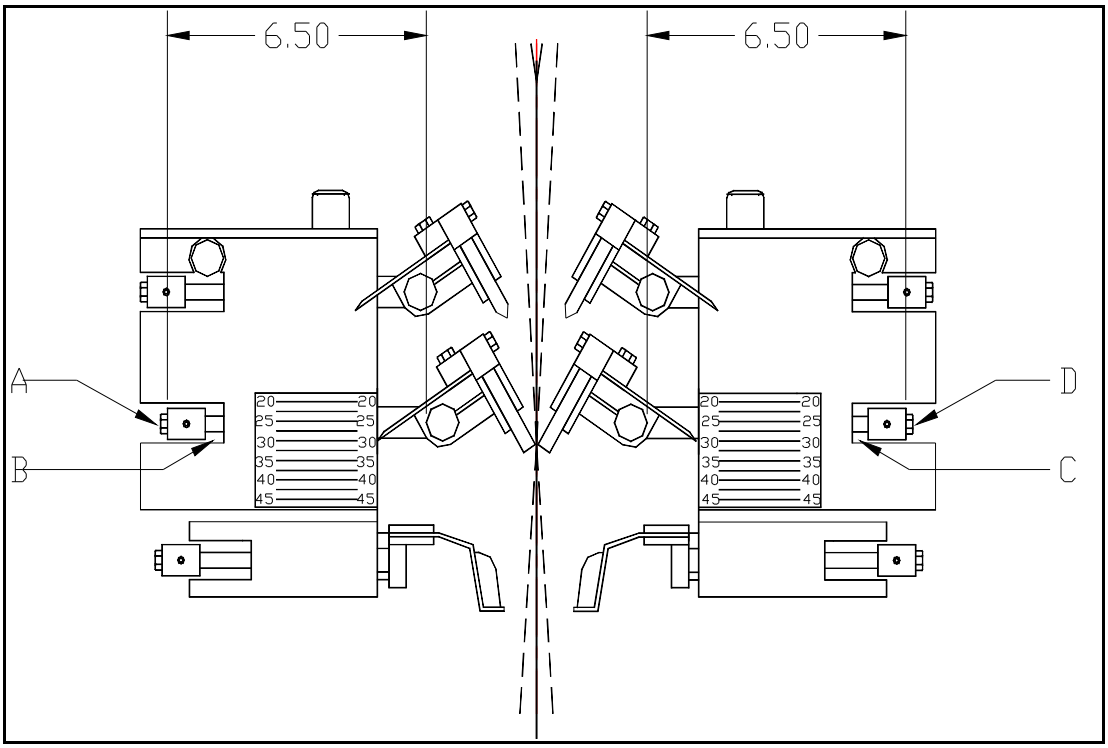


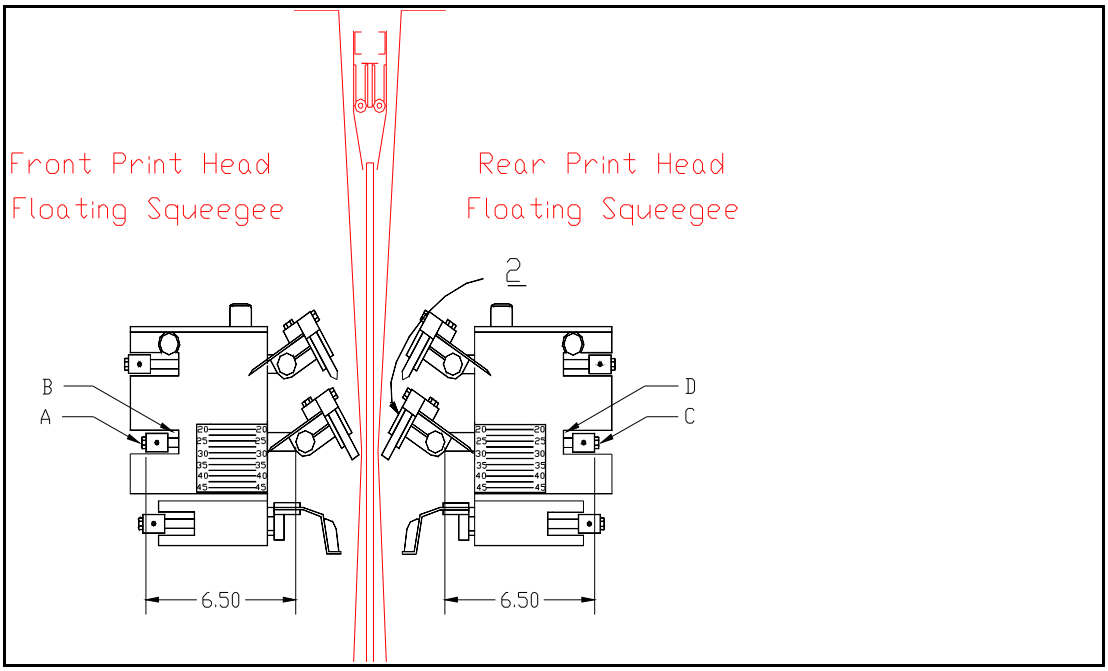
Figure 1, above, indicates approximate squeegee stroke lengths when using a **"Floating/Floating"** squeegee set-up.

FLOATING SQUEEGEE SET-UP

When utilizing a "Floating /Floating" squeegee set-up the floating squeegees set the reference to keep a panel centered between the front and rear screen chase. Figure 1 depicts squeegees extended against a panel as they should be during a print stroke.

Compressed air set point at the Squeegee air gauge should be nominally 80 psi (5.5 bar). It is extremely important that the squeegee pressure is set to achieve even pressure at the front and rear squeegee head. This must be verified prior to making any stroke length adjustments to insure both squeegees will move a equal distance to the center line of the front and rear screen chase.

Note: Verify front and rear screens for proper tension. Screen tension will have a direct impact on floating squeegee stroke length.



Floating Squeegee cont.

Squeegee stroke length is adjusted at the hex head bolts, Item A and C, Fig.1A, located at each side of the squeegee drive bar. The stroke length measurement indicated must be checked at both sides of the squeegee drive bar to insure the squeegee extends parallel to the screen and panel. Turn the indicated hex bolts counter-clockwise to increase the stroke length or clockwise to decrease the stroke length.

Adjustments should not be necessary at the squeegees to compensate for panel sticking to either the front or rear screen after the floating squeegees have been set up properly. The floating squeegees should be set with sufficient clearance at squeegee drive bar slot, Item B and D, Fig.1A, to automatically compensate for minor adjustments to the air pressure settings.

> **Note: Prior to adjusting squeegee stroke length for process problems check front and rear squeegee pressure and screen tension. Incorrect pressure differential or low screen tension often resembles problems associated with squeegee stroke length.**

In general, the floating squeegee stroke length should not have to be changed after the initial set-up procedures have been done.

As with any adjustment to the stroke length of the flood bars or squeegees, always take measurements at each end of the flood or squeegee drive bar to maintain parallel of the flood bar or squeegee with the screen and panel.

Figure 3 and Figure 4 are examples of incorrect squeegee pressure and stroke length adjustment. In the example shown in Fig. 3 the rear or fixed squeegee pressure is set too high. Note that the rear squeegee has extended too far, forcing the panel off center to the front side of the machine. At Item C in Fig. 3 the squeegee drive bar has moved too far and bottomed in the drive slot due to high squeegee air pressure at the rear print head. The rear squeegee is no longer floating.

- This will probably result in the panel being coated sticking to the front screen.

To correct this:

- **Adjust the rear squeegee stroke length by reducing the pressure setting at the rear squeegee head.**

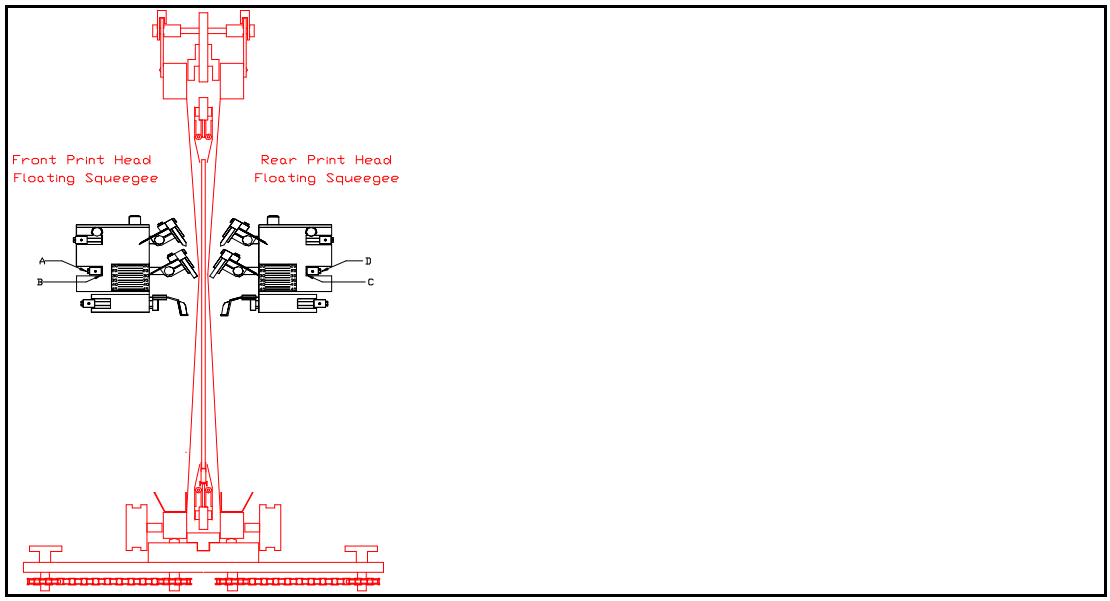


Figure 4 is an example of the front and rear squeegee stroke length set too short. In this example note that both squeegees are extended to the bottom of the squeegee drive bar guide slot at Item B and C, Fig. 4. The front and rear squeegee have both moved to the fixed position. In this instance:

- The soldermask coating will not be uniform due to a lack of uniform squeegee pressure across the panel surface. This is due to both squeegee drive bars bottoming in the guide slot, Items B and C.

To correct this:

- Adjust the front and rear or squeegee stroke length by turning hex adjusting bolt, Item A and D, counter-clockwise. This will increase the stroke lengths and force the panel to the center of the screens

FLOOD BAR ADJUSTMENT

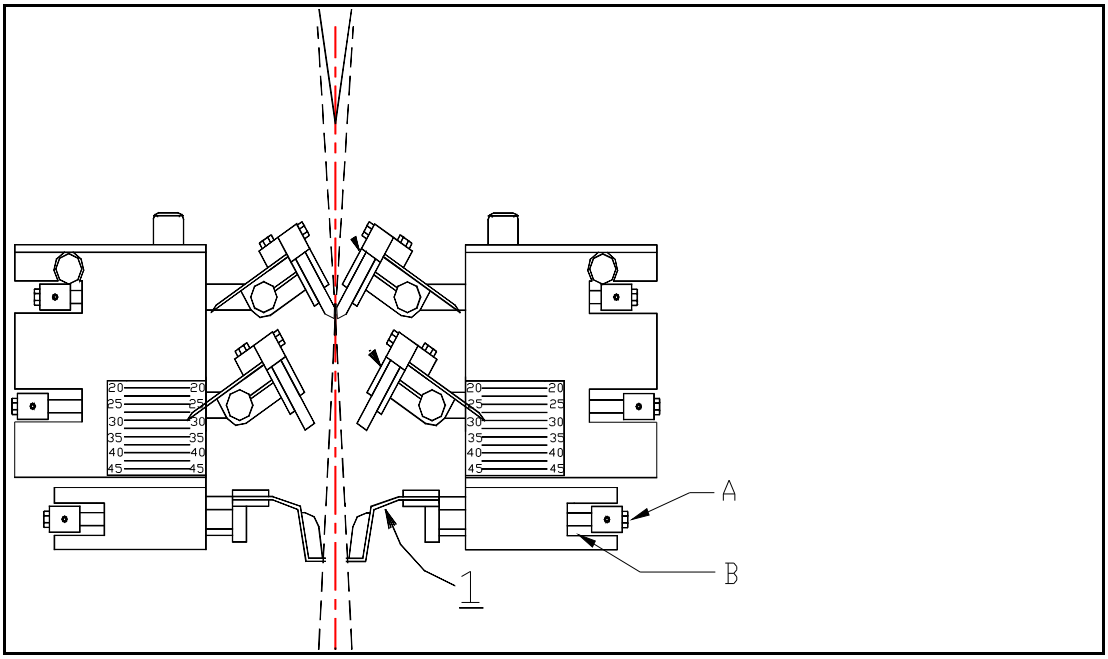
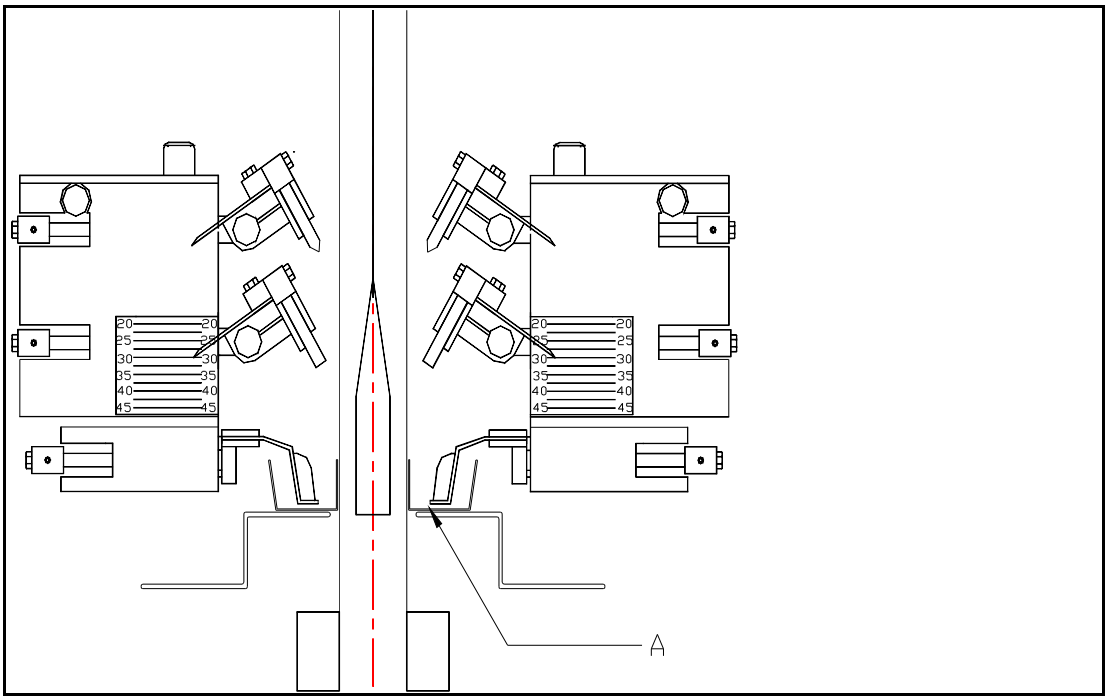


Figure 5 indicates approximate Flood Bar stroke length.

The Flood Bar stroke length is factory set and should not require adjustment. It is, however, a good practice to verify that the stroke length is correct. During the flood stroke, as indicated in Figure 5, clearance must be maintained between the flood drive bar (Fig.5, Item A) and bottom of the guide slot at Fig. 5, Item B. This ensures the tip of the Flood Bar is always in firm contact with the screen mesh.

Note: Prior to making any adjustments to flood bar stroke length, check the flood bar air pressure set point. Pressure should be 20 psi to 30 psi.

FLOOD BAR RETRACT LIMIT



The Flood Bar retract limit is factory set and should not require adjustment. As part of the Flood Bar stroke length check, it is important to verify that the Flood Bar is retracting back far enough that ink will be scooped into the Flood Bar when it extends forward. As indicated in Fig. 6 at Item A, the Flood Bar is positioned with space to move forward and scoop ink into the Flood Bar prior to starting the flood stroke.

FLOOD BAR LOWER LIMIT

The Flood Bar Lower Limit is set by adjusting limit switch 5Prx. This limit switch should be adjusted to set the Flood Bar lower limit in the Ink Reservoir. For machines equipped with screen chase height adjusters, set the chase height prior to adjusting 5Prx. Clearance must be maintained between the Flood Bar and bottom of Ink Reservoir to allow the Flood Bar to stroke forward and scoop ink.

PANEL AND SCREEN ADJUSTMENT FEATURES

ADJUSTING THE OFF-CONTACT DISTANCE

The off-contact distance is set to either 1/2" or 11/16" (12mm or 17mm) by installing the correct off-contact adjustment blocks. Two T-shaped blocks are located in the lower chase locks, and four are bolted to the upper main support bar, two on each side. The upper blocks bolted to the main support can be changed by rotating them to

change off-contact distance. The lower off-contact can be changed by substituting the 1/2" or 11/16" (12mm or 17mm) T blocks.

ADJUSTING THE ACTIVE BOARD GUIDES

The DP-1500-2X has a active (pressurized) lower board guide in the coating chamber. This functions to firmly grip a board at the bottom during coating to enhance the quality of print. When TENSION is *On* the lower board guide clamp prevents the board from lifting as the upper shuttle indexes up. This effectively tensions boards during the print cycle. The Bottom guide can be adjusted by increasing or decreasing the pressure at the regulator. Approximately *20* to *25 psi* has proven to be the best starting pressure for clamping and holding thin panels.

TO MAKE UP SCREEN FRAMES

MESH

#SYMBOL \f "Symbol"183Polyester Monofilament, medium thread (T), Plain weave (PW)
#SYMBOL \f "Symbol"18360 inches(152 cm) wide bolt of fabric
#SYMBOL \f "Symbol"183Large open area between threads
#SYMBOL \f "Symbol"183Make sure that both screen frame are using the same mesh at the same tension.

General mesh recommendations and results:

-74 (29) mesh covers 5-8 mil high traces with .9 - 1 mil coverage
-86 (34) mesh covers 3-5 mil high traces with .7 -.9 mil coverage
-92 (38) mesh covers 2-4 mil high traces with .6 -.8 mil coverage
-110 (43) mesh covers 2-4 mil high traces with .5 -.7 mil coverage

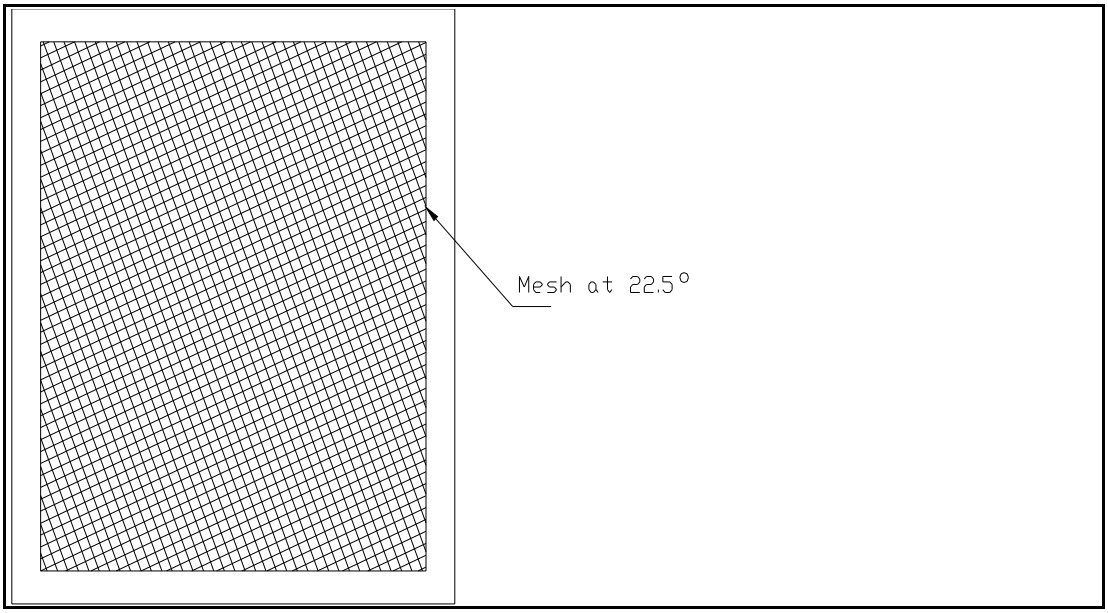
THE FRAMES

There are two types of frames available for mounting the mesh. The "static" or passive "stretch and glue" frames and the self-tensioning (active) frames.

The passive frame require that the mesh be pre-stretched on a stretch device then the frame is positioned on mesh and glued in place. The "stretch and glue" type frames have some advantage over other methods. The mesh can be held in the tensioning device in a straight form and tensioned to the proper tension very accurately. Before the frame is glued to the mesh the frame can be aligned to the proper 22.5#SYMBOL \f "Symbol"176 angle. Once glued into place the mesh can not move. The disadvantages of "stretch

and glue" is that the stretching device is quite large taking up floor space. Glue must be found that is compatible with the soldermask and also the cleaning chemicals. There is no retensioning of tweaking of the screens after make up.

The self-stretching frames are quite popular in the U.S. The biggest advantage is to allow a permanent retensioning of the fabric to keep it at a constant level. It is possible at any time, and in a few seconds to retension.



The disadvantages of these types of frames are that they are much heavier than glue type frames. It is difficult to stretch the mesh in them at a perfect 22.5#SYMBOL \f "Symbol"176 angle at the same tension across the frame. The frames tend to bow under higher tensions.

TENSION

The importance of fabric stretching cannot be over emphasized. The screen is the carrier palate in the screen printing process. It is also probably the most ignored part of the total screen process.

To be conscious of the state of the tensioning the mesh requires that we first understand how to measure it. Mesh is measured in "X" N/cm Newton/centimeter. This tension measurement has been read with an apparatus named "tensiometer".

At the level of the fabric as a whole, the threads/inch will change due to tension. For example 110 thread/inch becomes 103 thread/inch at 15 N/cm and 97 thread/inch at 25 N/cm. "Length of time" is a factor that all tensioning examples made in this area clearly demonstrate a phenomenon related to the cold flow characteristics of

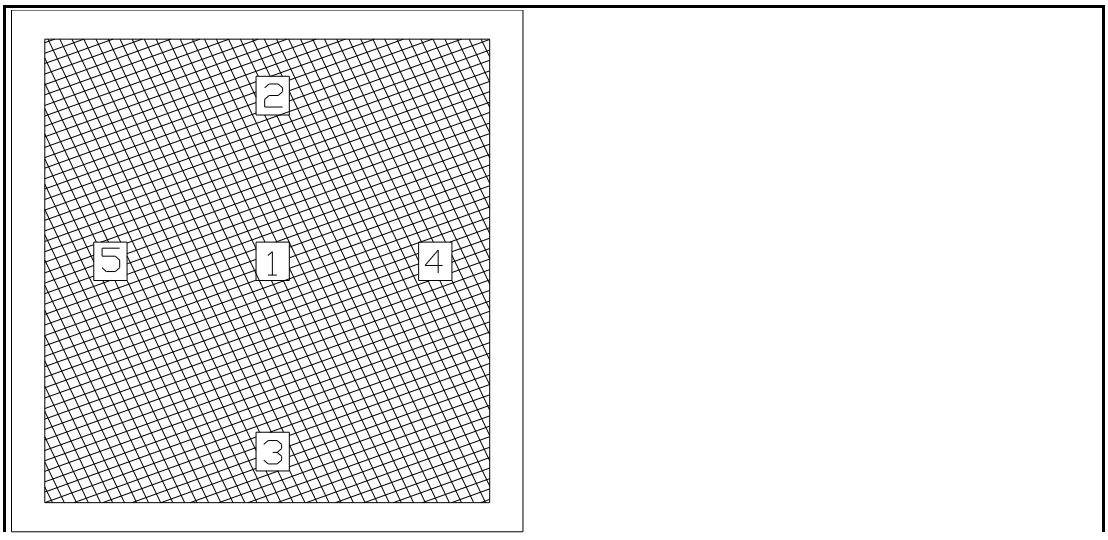
polyester. Screens will loose between 15% and 20% of their initial tension value with 48 hours. This means that a fabric tensioned at 20 N/cm will decrease to 16 N/cm. The act of printing applies certain forces to the stretched fabric which the fabric is not accustomed to. These forces are necessary to pass the ink through the mesh, resisting on the one hand the internal cohesion of the ink's molecules between themselves and, on the other hand, against the phenomenon of capillary action which causes "over adhesion" to the threads.

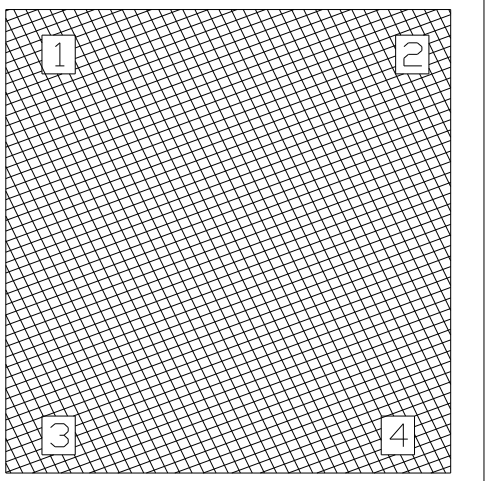
The rubbing of the squeegee and the successive "traction and retraction" causes and additional loss of 3-5 N/cm. This action occurs during the first 500 prints of a new fabric. With a fabric of the "stretch and glue" type this new loss is permanent and cannot be recovered. One of the enormous advantages with the self-tensioning frames is the ability to retension the fabric.

The tensioning operation must be done in four steps for "stretch and glue" and in five steps for self tensioning. The fifth tension consists of returning to the optimum initial tension after the first printing cycle.

The fabric must be portioned on the stretching machine or the self-stretching frame. Self tensioning frame the mesh must be 22.5#SYMBOL \f "Symbol"176 on a bias.

First axial tension in the warp and weft directions in five points (see figure 8), the measure of tension in the center of the screen is considered the reference value for the global tension. To avoid the risk of fabric failure, mostly at the corners of the self-tensioning frames. It is necessary to lower the tension here by 5-6 N/cm. under the axial tension level of reference. (Fig 9).





First Tension 110 = 16 N/cm
Relax the fabric for 45 minutes
Residual tension = 12 N/cm

Second tension = 22 N/cm
Relax the fabric for 45 minutes
Residual tension = 12 N/cm

Third Tension 110 + 26N/cm
Relax the fabric for one night
Residual tension = 21 N/cm

Fourth Tension = 28N/cm

After one hour relaxation glue the screen if it is of the "stretch and glue" type. A self-stretching frame will also have to remain in stabilization for at least on hour. After stenciling or blocking out the residual tension will be 23 N/cm.

After the first print run of 500 panels the tension value will fall again to: 19 N/cm. After several uses of the screen and more or less two weeks the polyester will reach its "stabilization point" in almost definitive manner it will remain at this level for tension during the rest of its life. About 16/17 N/cm.

By comparison the self-stretching frames are the only ones that permit the fifth step of retensioning of the mesh after the first printing and subsequent printing. This allows the maintenance of the optimum tension of 20-23 N/cm.

TO ADJUST THE MACHINE FOR A SPECIFIC PANEL

Take the panel to be coated and review it for manufacturability. The panels can be coated in either of two panel orientations (Portrait or Landscape). There are several important considerations when choosing the panel orientations for coating:

#SYMBOL \f "Symbol"183 Landscape orientation is faster allowing for more panels coated per hour.

#SYMBOL \f "Symbol"183 Border area on the panel. Generally the machine coats more reliably with the largest border area located at the top and bottom of the panel. This minimizes interference from the board guides.

#SYMBOL \f "Symbol"183 Portrait orientation locates the panel more ideally in the screen frame making coating easier and causing less squeegee wear.

#SYMBOL \f "Symbol"183 Additional types of boards to be coated. If the machine is set up minimizing the amount of changes necessary to shift from part number to part number then the machine will be more productive.

Choose the panel orientation desired. For example the board will be coated in the landscape, 18" (457mm) as vertical dimension.

Use the Panel Height indicator to adjust the machine to the correct panel height by pressing the Z Drive *Panel Height* Up or Down switch until the correct panel height is obtained.

FABRIC STRETCHING FOR A DRAW BAR FRAME

The DP-1500-2X is shipped with Diamond Chase draw bar frames with keystone type locking rods as standard equipment. Stretch and glue type frame are also available to fit the DP-1500-2X. The print quality and finished thickness of the soldermask depends heavily on the type and mesh count of the screen mesh. "T" polyester mesh stretched to 25 newtons/cm is recommended. Both the front and rear screens must be stretched to the same tension.

Stretching the screen mesh in the chases at a 22.5 degree angle with respect to the frame produces better printing results by minimizing Moire' patterns that often occur in screen printing across 90 degree angles.

Choosing the Proper Screen Mesh

The deposited ink thickness on a board will be determined by the mesh type, print speed, squeegee sharpness, squeegee pressure, and the ink percent solids. Typical values found are 0.6 mil (dry) over 2.5 mil traces using 110 mesh, and 1.0 mil (dry) over 2.5 mil traces using 86 mesh. The most common mesh counts are 86, 92 and 110. "T" version polyester mesh is preferred. Stretching the mesh on a 22.5 degree bias generally improves the cosmetics of the finished panel. Screens should be tensioned to 25 newtons.

TO CREATE A PRINGING WINDOW ON A SCREEN

The coater requires a screen with a "window" slightly smaller than the panel to be coated. For panel handling and to reduce ink usage panels must be coated with a border area clear of ink.

#SYMBOL \f "Symbol"183Install screen frames in the Coater
#SYMBOL \f "Symbol"183Manually load the frames to the screw stops
#SYMBOL \f "Symbol"183*Lock Chase*
*#SYMBOL \f "Symbol"183*Close Chase
#SYMBOL \f "Symbol"183Load the panel into the coating chamber.
#SYMBOL \f "Symbol"183Mark the screen mesh for blocking out the screen window.

Note: The machine *Jogs s*ubsequent panels, sufficient allowance in the picture window must be left to allow for this movement. With a *Manual Loaded* board the machine will left justify the panel in the frame. (Fig. 10).

#SYMBOL \f "Symbol"183*Unlock Chase*
#SYMBOL \f "Symbol"183Open Chase
#SYMBOL \f "Symbol"183Remove the screen frame to prepare print window.

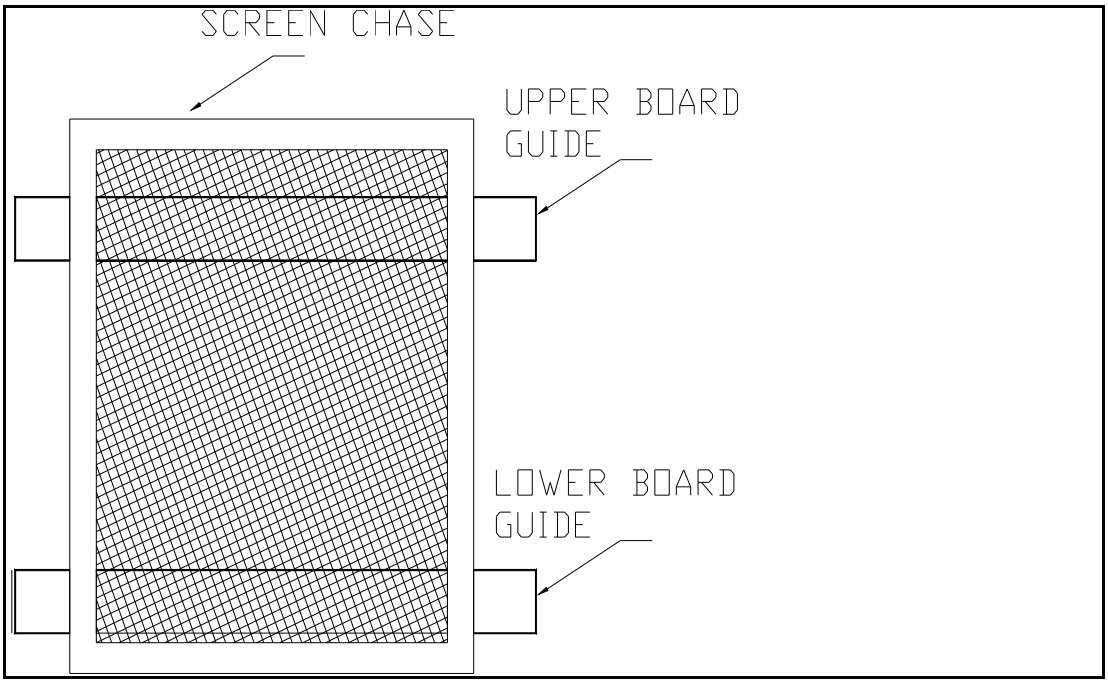
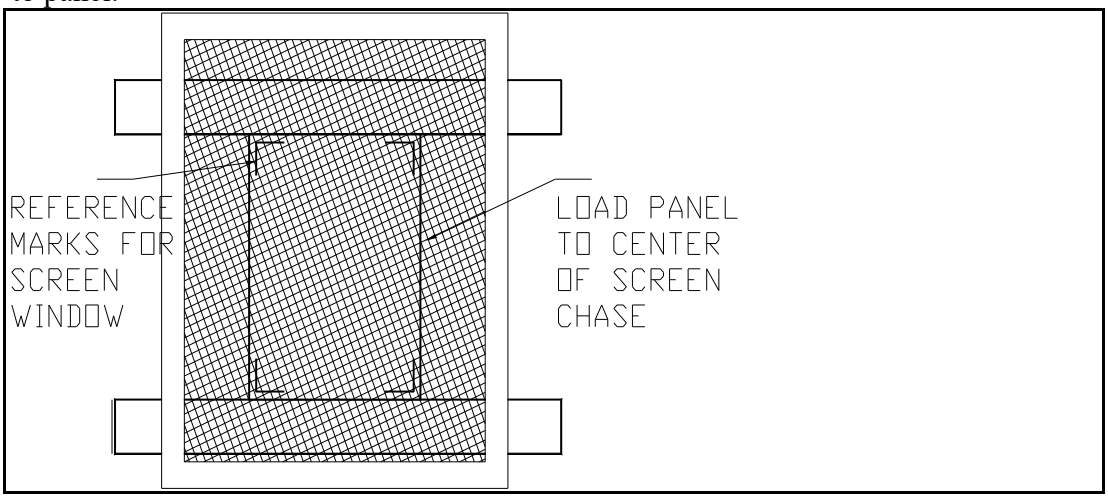


Figure 10

Install screen chase in coating area to be marked for screen window. Check front to rear screen chase alignment before marking screen window.

Note that screen mesh is installed in chase at a 22.5#SYMBOL \f "Symbol"176 angle.

Set Chase height adjustment to approximately the center of adjustment range. This will allow for chase adjustment to align top and bottom borders of the screen window to panel.



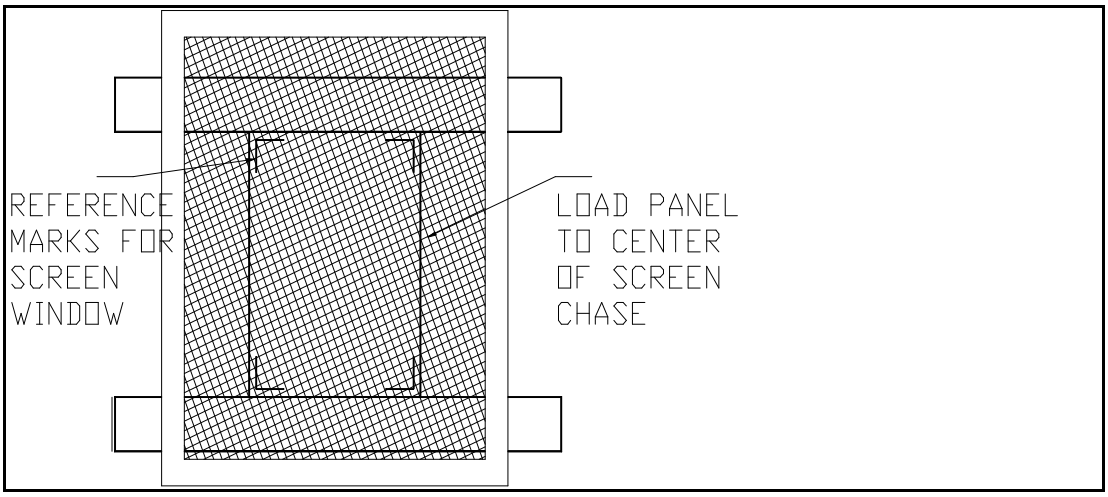


Figure 11

In Manual Mode *Load* a representative panel into the coating area. Adjust panel stop position to center panel in screen chase. Make reference marks to define screen window approximately 0.5 inch (12 mm) inside upper and lower sheet metal guides and at lateral edges of panel. This will define the screen window to be smaller than the panel to be coated.

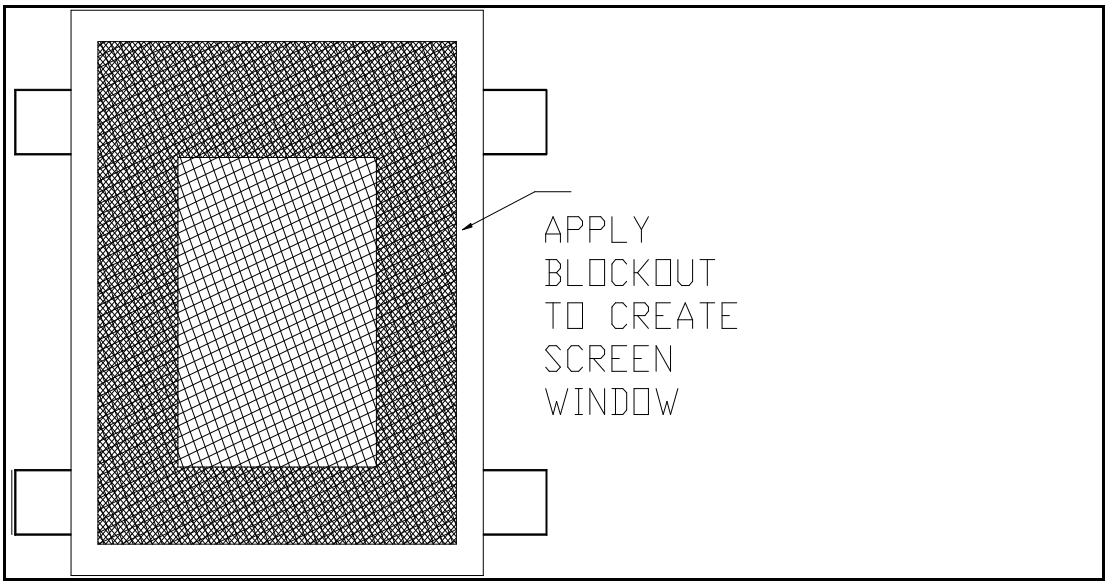


Figure 12

Remove screen chase to define print window. After blockout has dried install front and rear chase. Check front to rear screen window alignment and adjust if necessary. Load panel into coating area and check screen window alignment to panel. The front and rear screen chase may be aligned independently to match screen window to the panel image area.

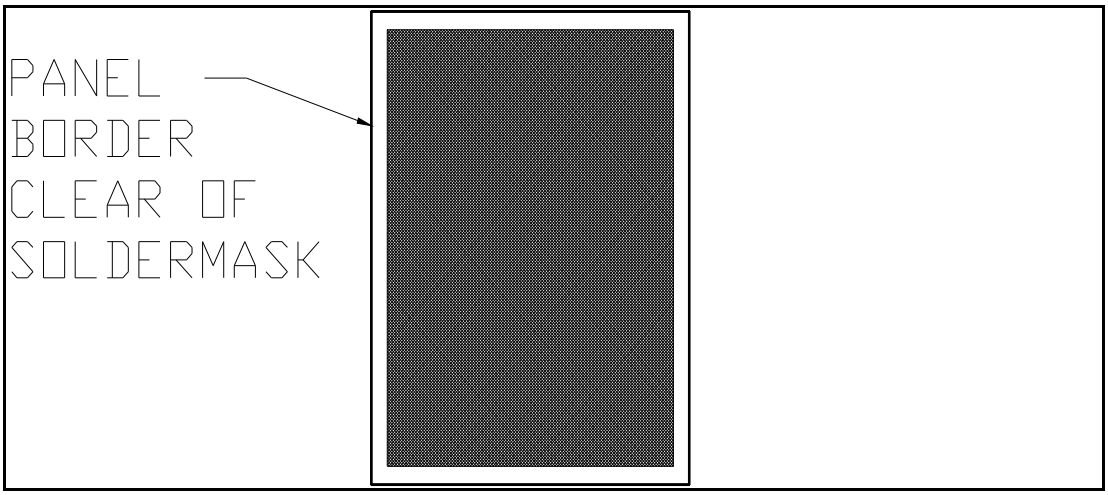


Figure 13

Figure 13 indicates a panel coated with soldermask. The panel borders are clear of soldermask. With a properly defined screen window coated panels should always have a clear border as indicated.

THE PRINT WINDOW

All Circuit Automation equipment involves the use of the flood screening technique. Flood screen is the process by completely coating a screen with soldermask then applying it evenly to the substrate. The print window needs to be defined for two reasons. First, by not covering the entire panel with soldermask a significant amount of ink can be saved. For example, a .5"(12.5mm) border on an 18" x 24" (457 x 610mm) panel represents a 9% savings in ink. Secondly, Circuit Automation equipment handle panels by their top and bottom borders and a defined print window reduces cleanup time and mishandling problems.

Dot patterns or pad masters are not required to protect the holes from plugging with ink using dual sided coaters.

INDIRECT EMULSION

For soldermask application, indirect emulsions should not be used because the pressures of the squeegees and the lack of good bond strength of the film to the mesh break the stencils down quickly.

DIRECT EMULSION

Direct emulsions are the most commonly used. They are cheap and water soluble. Direct emulsions cover and encapsulate the mesh from both sides so they offer durability. Ulano Screen Filler #60 and Blockout #10 and Superblox are examples of direct emulsions.

BLOCKOUT

On a clean and degreased screen, define the area that will transfer ink to the panel. Cover that area with masking tape. Use excess emulsion such as Blockout #10 and place on the masking tape. Using a piece of cardboard or squeegee rubber spread the blockout over the rest of the screen. Remove the tape and place in front of a fan to dry the blockout. When dry we have found that a support piece of tape placed on the inside of the screen mesh inhibits soldermask from leaking past the defined area. Drying frames in an oven causes the tension to change due to an elongation of the mesh.

DIRECT/INDIRECT EMULSION

Direct/indirect emulsion should be thought of as a process. It combines a long shelf life film with an emulsion, called a transfer emulsion. The process is quite simple. The screen mesh is laid on the unsensitized film and the sensitized transfer emulsion is squeegee through the mesh. The transfer emulsion sensitizes the film, it bonds the film to the mesh and the end result is a stencil with the durability of direct emulsions but also photo definable.

PHYSICAL BARRIER

Tape is quite often used to define the print window for printing. Mylar tape and also plating tapes have proven to be easy to apply at the coater and substantial enough to last for many prints. Care should be taken to find a tape that is compatible with the solvent system used in the soldermask. Also the adhesive used must be compatible to be clean up when changing print windows. Generally we have found that thin tapes work superior. They define the print window yet they do not adversely effect the tension of the screen

Many customers use a combination of physical barrier and direct emulsion to define the print window for screening.

> Note: A layer of tape is required on in inside of both screens at the bottom of the print window. This layer inhibits leakage of soldermask below the bottom edge.

DEFINGING THE PRINT-THROUGH WINDOW

The print-through window for the DP-1500-2X's screens may be made with block-out, permanent or temporary stencil material, tape, or a combination. The dimensions and location of the window must allow for at least one-half inch of uncoated area on the top and bottom of the panel. The window should be placed in the screen so that it is centered side to side, and the bottom edge is at least 5.0" from the lower edge of the screen. The lower screen window must be at least 1/8" above the lower panel guide. The upper screen window must be at least 1/8" below the overhead shuttle.

Using the pencil lines as a guide, tape the inside of the window on both sides of the

screen. Apply block-out and dry. Remove the tape. The lower edge of the screen window should be "back taped" to create a gasket or seal at the lower panel guide in the coating area.

INSTALLING/REMOVING ACCESSORY EQUIPMENT
(Ink Troughs, Flood Bars, Squeegee Heads, Screen Chases, etc.)

INSTALLING/REMOVING THE INK TROUGHS

The DP-1500-2X uses 22" and 26" ink troughs, for use with the 20" and 26" flood bars, respectively. Select the proper length and attach the ink troughs to the ink trough *QC (Quick Change)* arm below the *QC* print head arm. These are easily slidden on and secured with a nut.

Ink troughs come either with or without welded on tubes depending on whether they are use with or without the automatic IP-04 Ink Pump. The IP-04 Ink Pump plastic tubing should be attached to the ink trough. For more information regarding the IP-04 Ink Pump, referr to the IP-04 Ink Pump operations manual.

INSTALLING/REMOVING THE SCREEN CHASES

Installing screen chases is easy. Turn the power switch on the control panel to *OFF*. This kills the compressed air to the CHASE LOCK cylinders and the CHASE OPEN/CLOSE cylinders. Open the coating chamber doors and swing the top electrical panel up. Lift the QC (Quick Change) lever securing the print head arm. Swing the arm out of the way. Turn the chase lock clip (located on the CHASE OPEN/CLOSE cylinders) at the top of the chase out of the way. The CHASE OPEN/CLOSE cylinders will easily float open if you slightly pull the chase out of the machine. Simply lift the screen chases out of the machine. When placing a new chase into the machine, follow these instructions in reverse order. Be sure to always use the off contact blocks between the two chases at the bottom of the chases.

ADJUSTING THE SCREEN CHASES

The DP-1500-2X has an adjustment mechanism that allows the chase to be adjusted vertically to the panels being coated. This feature is especially useful when coating panels to the minimum panel border area of .4". The device allows for travel adjustment of both the X and theta axis on the screen frame. This adjustment is made by turning the four thumb wheels located at the base plate inside the coating area.

PRINT HEADS

The print heads are secured to platens by two spring-loaded bolts topped by knurled knobs. The print heads are located accurately by the bolts and two pins on the inside of the platen. To remove the print head, turn ON/OFF *Off*. Unscrew the compressed

air connector locking bolts, and pull the connector off the head. Unbolt the print head by unscrewing the two large knurled knobs on the top of the print head. Slide the print head back, and then lift it up and out to remove it. Reverse the procedure to replace the print head, taking care to slide the print head onto the locating pins before tightening the knurled knobs. Seat the air connection firmly and secure the air connector bolts.

FLOOD BARS

The flood bar is secured, to the Print Head, by two easy hand twisted knobs (screws). Once loosened, the flood bar will easily slide out due to its slotted grooves.

SQUEEGEES

The squeegee is secured to the Print Head with three nuts. To install the squeegee, place squeegee on the studs extending from the Print Head and secure with hex nuts using a 10mm box-end wrench. To replace the squeegee rubber, loosen the bolts that hold the two halves of the squeegee blade holder together. Remove the rubber. Insert new rubber and seat it carefully in the squeegee blade holder. Tighten the bolts.

The DP-1500-2X uses 20" flood bars and squeegees for screening boards up to 18" wide, and 26" flood bars and squeegees for wider boards. Do not mix long squeegees and short flood bars, or vice versa. Also make certain that the ink trough is the appropriate size for the flood bar used.

PRINTING IN MANUAL MODE

It is possible, but not desirable, to print manually. This procedure should only be used for diagnostic purposes.

1. Use PANEL *Load* to position a circuit board in the coating section.
2. Push FLOOD *Extend* to extend the flood bars.
3. Hold SQUEEGEE *Up* to drive the print head assemblies up, flooding the screen. The print head will stop when the upper limit switch is activated; release PRINT.
4. Push FLOOD *Retract* to retract the flood bars.
5. Drive the print head down approximately two inches by jogging PRINT *Down*. This positions the squeegee where the flood bar had been at the top of the stroke.
6. Push SQUEEGEE *Extend* to extend the squeegees.
7. Hold SQUEEGEE *Down* to drive the print head down, printing the circuit board. Release PRINT when the squeegee is at least one inch above the lower board guide.
8. Retract the squeegee by pushing SQUEEGEE *Retract*.
9. Drive the print head to the bottom position with PRINT *Down*; the lower

limit switch will activate to stop the print head.

10. Use PANEL *Unload* to transport the circuit board to the loading section.

CAUTION: SQUEEGEE *Up/Down* (as well as SQUEEGEE and FLOOD *Extend/Retract*) should be used only for checking set-ups. When manually printing, the print head does not align itself for printing at the top of the stroke. If manual printing is necessary, make sure that the procedure above, and especially steps 5, 7, and 8, is followed carefully.

PRINTING IN AUTOMATIC MODES

The normal way to print with the DP-1500-2X is to utilize an automatic print mode. Before printing, make certain that the instructions for squeegee setup, and board guide and shuttle alignment have been followed. Install the screens and fill the ink troughs to about 3/4" from the top.
Select an automatic mode by rotating the MODE switch to the desired print cycle (choosing between flood/print, flood/print/print, etc.) and choose between the No Flood Mode or the Flood Up Mode. Begin an automatic print cycle by placing a board in the load station and pressing START.

After the instructions above for adjusting the squeegees and flood bars have been followed, any further adjustments should only be made by adjusting the pressure of printing or flooding by means of the adjusting needle valves. Do not exceed 35 psi for the flood bar pressure.

DP-1500-2X LIMIT SWITCHES

Many functions of the DP-1500-2X are governed by magnetic proximity or mechanical limit switches. These include loading and unloading boards, and the flood and print strokes.

The limit switches are adjusted at the factory for optimum performance. Under some conditions it may be desirable to adjust the position of a limit switch to achieve a "custom" print stroke or to deal with other peculiar situations. Any limit switch can be adjusted by loosening the mounting screw(s), repositioning the switch, and tightening the mounting screw(s).

The following is a description of the various limit switches used in the DP-1500-2X and their control and adjustment.

6 PRX Flood Stroke Upper Limit

LS-3 triggers the end of an upward flood stroke, causing the flood bar to retract. LS-3 can be moved up to flood higher, or down to flood less area.

The nominal position of LS-3 is 2.3" below the top of the upper board guide centering bar. (Measure to the top of the steel plate to which the switch is attached).

7 PRX Print Stroke Start

LS-4 triggers on the downward stroke, starting a print stroke by extending the squeegees. Squeegee skewing, if activated, is also started by LS-4.

The nominal position of LS-4 is 1.7" below LS-3. (Measure from the top of the mounting plate of LS-3 to the top of the mounting plate of LS-4).

8 PRX Squeegee Skew

LS-12 triggers the print head to straighten the squeegees to a horizontal position, while the print head continues the print stroke.

9 PRX Print Stroke Stop

LS-5 triggers on the downward stroke, stopping a print stroke by retracting the squeegees. Print head travel pauses momentarily to allow the squeegees to retract before continuing the downward stroke.

Adjusting the switch down toward the base plate allows for more printing area. Care should be taken not to print on the bottom board guide because soldermask in the bottom board guide will cause the shuttle system to operate improperly.

5 PRX Lower Travel Limit

LS-6 stops the machine at the bottom of a cycle in all modes. This switch must be adjusted with the screen chases and ink troughs in place. If LS-6 is adjusted too low the squeegee print heads will crash into the ink trough causing damage to the motor, the main drive chain, or both. The normal position for LS-6 is 5.8" above the base plate. Do not set any lower.

Peel Off Start Limit

Peel off start limit switch initiates screen chase opening during the print stroke. This switch is only active when PEEL OFF is set to the *On* position. Approximate location for this switch is at the lower ½ to 1/4 of the screen window.

LS-2 Shuttle Sensor

LS-2 is a magnetic proximity sensor which stops the shuttle in the proper position to load or unload a panel. The distance between the sensor and the shuttle determines the sensitivity. If the shuttle is in position but the ready light does not light, wiggle the shuttle. If the ready light then lights, then LS-2 should be adjusted in towards the shuttle. However, care should be taken not to adjust the sensor in so far that the shuttle could hit the sensor.

LS-20 Maximum Board Size

LS-20 determines the maximum board size that the DP-1500-2X can accommodate. The DP-1500-2X's normal maximum board size is 26" high. This switch should never be set higher than 39" from the base plate (measure to the bottom of the black switch body).

LS-21 Minimum Board Size

LS-21 determines the minimum board size that the DP-1500-2X can accommodate. This switch should never be lower than 13.6" from the base plate (measure to the top of the black switch body).

MAINTENANCE

CHAIN MAINTENANCE AND REPLACEMENT

Every week examine the chain for wear. Replace if worn, every 500,000 cycles, or every six months, whichever comes first.

The four lead screws are driven by a motor via a chain. A spring operated chain tensioner takes up slack. The quality and consistency of the DP-1500-2X's printing depends on the print heads being parallel and aligned to each other, and this alignment is maintained by proper chain installation and maintenance. The DP-1500-2X uses its ground base plate as the reference for the print heads. Four leveling blocks for alignment are provided with the spare parts.

If binding or undue pressure is placed on any of the four lead screws then the chain will be thrown. This will also happen if the print heads are driven into a tool or other obstruction. This prevents damage to the machine.

If the chain is thrown, stop the machine by pushing EMERGENCY STOP. Turn ON/OFF *Off*.

CAUTION: When the chain is thrown, the print heads will usually descend under gravity to the bottom (home) position. If the chain has not been thrown completely, the print heads may remain in place above the home position. If this is the case, then the print heads must be supported while the chain is removed, and then the print heads lowered

to the home position. Exercise extreme caution in performing this procedure. Do not remove the chain without supporting the print heads.

Remove the chain from all the sprockets and inspect for any binding or misaligned links; replace with a new chain if there is any damage to the chain.

With the chain removed and the print heads resting in the home position, pick up each end of the print head support bar and place a leveling block under the bar. This aligns the print head support bars parallel to each other and to the base plate.

Reduce the spring tension by switching the CHAIN RELEASE SWITCH to the *Service* position. This switch is located on the rear of the electrical control panel and is accessed through the lower rear service door on the machine. Thread the chain around the gears and over the chain supports. Start at the motor and proceed to the two sprockets nearest the motor. Do not allow slack in the chain between the motor and the sprockets. Then work towards the sprockets farthest from the motor, taking up slack between the sprockets, and making certain that the chain runs over the chain riser blocks. Retension the chain by turning the CHAIN RELEASE SWITCH to the *Operate* position.

NOTE: The DP-1500-2X has a safety interlock that prevents the machine from operating if the CHAIN RELEASE SWITCH is in the *Service* position.

Turn ON/OFF *On* and set MODE to *Manual*. Use PRINT *Up* to move the print heads up a few inches. Remove the leveling blocks. Run the print heads up and down and check that the DP-1500-2X is operating normally.

LEAD SCREW LUBRICATION

Every week, lubricate the lead screws with NSK Grease #2,
Ball Screw grease, available from Circuit Automation. Do not substitute any other lubricant. A tube of this grease is supplied with the standard parts kit.

VERTICAL LINEAR BEARING ROD AND BEARING LUBRICATION

On a weekly basis, inspect the vertical linear bearing rods (Thompson rods) and bearings with white lithium grease. If a rod does not have a very light coating of grease along its length, then lubricate via the Zurk fittings with the grease that was supplied with the machine.

Lubricate all the rods and bearings at least every month.

SQUEEGEE HEAD LUBRICATION

There are four linear bearings (Thompson rods) on each squeegee head; two for the squeegee and two for the flood bar. On a daily basis, inspect the linear bearings. If a rod does not have a very light coating of oil along its exposed length, then lubricate with 2 drops of way lube or medium weight oil applied to the felt washers on the bearing blocks. To lubricate, stand the head on the squeegee end and apply the oil to the cavity under the outside adjusting nut or knob. Then turn the squeegee head so that the squeegee and flood bar are upright, and apply oil to the linear bearing.

SQUEEGEE EDGE

The edge on the squeegee is a very important factor with Circuit Automation equipment. Printing utilizing the *Trailing Edge stroke* makes edge management of the squeegee important. The sharpness of the edge, or the roundness greatly affects the coating thickness and quality. If squeegees are sharpened, care should be exercised maintain the same height on the front and rear squeegee. A difference in height will cause the front and rear squeegee to contact a panel being coated at different heights. Most customers keep statistical controls of the panels per squeegee to be able to maintain good repeatability of the process.

DP-1500-2X MAINTENANCE ITEMS

- Examine chain for wear. Replace if necessary.
- Lubricate chain with Petrochem Chainlife or equivalent.
- Lubricate lead screws with No. 2 white lithium grease per instruction manual.
- Lubricate bearing blocks with Lubriplate 1200-2 or equivalent grease per instruction manual.
- Check alignment of the squeegee heads per instruction manual and realign if required.
- Inspect for any worn or broken parts, repair or replace if necessary.
- Check and adjust FLOOD BAR air pressure to be equal on both sides of the machine, set to 25 psi.
- Check and tighten all electrical screw connections.
- Check and tighten if necessary all set screws.
- Check Thompson shafts for tightness, tighten if necessary.
- Clean upper and lower board guides.
- Check O-rings on air connectors, replace if worn.
- Check air regulator and filter, drain water if necessary.
- Sharpen squeegees at least every 1000 panels.
- Check timing belt on PCB drive system, replace if necessary.

FUSE LIST

DP-1500-2X ISOprint, May 1996

Part #	Fuse #	System	Amps	Type

EC-156	F1	24VDC	2 amp	SLO-BLO
EC-64	F2	12VDC	1 amp	SLO-BLO
EC-64	F3	Panel Height Motor	1 amp	SLO-BLO
EC-90	CB4	Shuttle Motor	3 amp CB	Circuit Breaker
EC-75	F5	CPU	1.25 amp	FAST
EC-156	F6	24VDC	2 amp	SLO-BLO
EC-59	F7	Motor Board	0.150	FAST
EC-3401	F8	Motor Board	10 amp	Ceramic SLO-BLO
EC-60	F9	Motor Board	20 amp	Ceramic SLO-BLO
EC-76		Relay Module 8RLY-1	5amp	BUSS PCE

REVIEW COATING OPERATION

#SYMBOL \f "Symbol"183Install the screen frames with the properly defined windows.
(see following section)
#SYMBOL \f "Symbol"183Be sure to install the frames against the aligning screws.
#SYMBOL \f "Symbol"183*Lock Chase and Close Chase.*
#SYMBOL \f "Symbol"183Reset Machine
#SYMBOL \f "Symbol"183Load a panel on the shuttle
#SYMBOL \f "Symbol"183Set machine to Manual
#SYMBOL \f "Symbol"183Press Shuttle Load.
*#SYMBOL \f "Symbol"183*With the panel in the coating chamber examine very closely the panel in the window on both sides.
#SYMBOL \f "Symbol"183Each screen frame has both X and Y axis adjustments. Adjust as necessary.
#SYMBOL \f "Symbol"183Reset Machine
#SYMBOL \f "Symbol"183Remove Panel
#SYMBOL \f "Symbol"183Push *Squeegee UP*, raise the squeegee head to the top setting
#SYMBOL \f "Symbol"183Fill the ink troughs 75% full with ink.
#SYMBOL \f "Symbol"183Turn ink pump to *Auto*
#SYMBOL \f "Symbol"183Reset Machine
*#SYMBOL \f "Symbol"183*Turn machine to desired automatic run mode (Flood/Print) for example.
#SYMBOL \f "Symbol"183Set Flood speed
#SYMBOL \f "Symbol"183Set Print speed
#SYMBOL \f "Symbol"183Load coater with a panel
#SYMBOL \f "Symbol"183*Start the machine.*

TROUBLE SHOOTING GUIDE

PROBLEM #1 MACHINE WILL NOT RUN

SOLUTIONS:

#SYMBOL \f "Symbol"183Is the *power* switch *on?*
*#SYMBOL \f "Symbol"183*Is the circuit breaker on?
#SYMBOL \f "Symbol"183Are the *emergency stop* switches out?
#SYMBOL \f "Symbol"183Is the computer on?
#SYMBOL \f "Symbol"183Are the doors closed? Check Interlocks.
#SYMBOL \f "Symbol"183Is the air line connected and on?
#SYMBOL \f "Symbol"183Is the *chain service* interlock engaged?

PROBLEM #2 MACHINE CYCLE WILL NOT START

SOLUTIONS:
#SYMBOL \f "Symbol"183Is the *machine reset?*
*#SYMBOL \f "Symbol"183*Is the machine in *manual*, the machine will not run cycles in manual mode.
#SYMBOL \f "Symbol"183Is the l*oad hinge close*d?
#SYMBOL \f "Symbol"183Is the machine at the *home* position?
#SYMBOL \f "Symbol"183Are the doors closed? Check Interlocks.

PROBLEM #3 INK IN HOLES AFTER PRINTING

COMMENT: CAI equipment utilizes the blank flood screen method of printing. There is no physical barrier keep soldermask from being placed all over a circuit board including the holes.

SOLUTIONS: To reduce the amount of ink in holes after printing
#SYMBOL \f "Symbol"183Use No Flood Mode.
#SYMBOL \f "Symbol"183Level and equalize the front and rear squeegee head assemblies with each other.
#SYMBOL \f "Symbol"183Assure the front and rear squeegee angles are the same.
#SYMBOL \f "Symbol"183Reduce the squeegee angles.
#SYMBOL \f "Symbol"183Increase print speed.
#SYMBOL \f "Symbol"183Increase the off contact distance.
#SYMBOL \f "Symbol"183Increase the viscosity of the soldermask.
#SYMBOL \f "Symbol"183Uses a softer durometer squeegee rubber.
#SYMBOL \f "Symbol"183Increase screen mesh tension.
#SYMBOL \f "Symbol"183Alternate panel orientation in the machine.
#SYMBOL \f "Symbol"183Increase Jog distance.
#SYMBOL \f "Symbol"183Sharpen the squeegees

PROBLEM #4 INK IN HOLES AFTER DEVELOPING

SOLUTIONS:
#SYMBOL \f "Symbol"183Use No Flood Print Mode
#SYMBOL \f "Symbol"183Increase tack dry time
#SYMBOL \f "Symbol"183Decrease tack dry time

#SYMBOL \f "Symbol"183Increase tack dry temperature
#SYMBOL \f "Symbol"183Decrease tack dry temperature
#SYMBOL \f "Symbol"183Increase developer time
#SYMBOL \f "Symbol"183Increase developer temperature.
#SYMBOL \f "Symbol"183Modify art work at exposure to prevent exposure in the holes.
#SYMBOL \f "Symbol"183Increase power at exposure.
#SYMBOL \f "Symbol"183Use a soldermask that develops easier

PROBLEM #5 FLOOD NOT EVEN

SOLUTIONS:
#SYMBOL \f "Symbol"183Squeegee heads are not properly aligned
#SYMBOL \f "Symbol"183Not enough ink in the ink trough
#SYMBOL \f "Symbol"183Ink troughs are not properly mounted on the chase
#SYMBOL \f "Symbol"183Flood stroke is not long enough to scoop enough ink. Adjust the flood limit mechanism.
#SYMBOL \f "Symbol"183Flood bars are not floating. Adjust to float.
#SYMBOL \f "Symbol"183Not enough air pressure on the flood to engage.
#SYMBOL \f "Symbol"183Flood bar is bent
#SYMBOL \f "Symbol"183Flood bar is nicked

PROBLEM #6 THIN INK COVERAGE AFTER COATING

SOLUTIONS:
#SYMBOL \f "Symbol"183Decrease mesh count by using a more coarse mesh.
#SYMBOL \f "Symbol"183Increase open area in a given mesh.
#SYMBOL \f "Symbol"183Increase the print speed
#SYMBOL \f "Symbol"183Increase the squeegee angle
#SYMBOL \f "Symbol"183Increase the mesh tension
#SYMBOL \f "Symbol"183Decrease the sharpness of the squeegee
#SYMBOL \f "Symbol"183Use softer squeegee rubber
#SYMBOL \f "Symbol"183Increase viscosity of the ink.

PROBLEM #7 DRIVE CHAIN PROBLEMS

SOLUTIONS:
#SYMBOL \f "Symbol"183Check for wear on the chain. Replace chain every year. If a Plastic chain is on the machine replace chain and sprockets with steel.
#SYMBOL \f "Symbol"183Check bearing block for wear and soldermask in the bearings. Clean or replace.
#SYMBOL \f "Symbol"183Check alignment of the squeegee heads.
#SYMBOL \f "Symbol"183Check switch position on the Print and Flood limit switches.

#SYMBOL \f "Symbol"183Check bearings for the lead screws.

PROBLEM #8 PANELS HAVE VERTICAL STREAKS IN THE SOLDERMASK AFTER PRINTING

CAUSES:
#SYMBOL \f "Symbol"183Nicks in the squeegees
#SYMBOL \f "Symbol"183Print stroke engages above the flood line
#SYMBOL \f "Symbol"183Barrier tape is too rough
#SYMBOL \f "Symbol"183Soldermask has large filler chunks in the mask.
#SYMBOL \f "Symbol"183Soldermask does not have enough lubricity
#SYMBOL \f "Symbol"183Screen mesh is too course for the speed and pressure.
#SYMBOL \f "Symbol"183Squeegee rubber is too soft.
#SYMBOL \f "Symbol"183Print stroke is printing too low over the bottom board guide.
#SYMBOL \f "Symbol"183Squeegee are too large for the panel size.

SOLUTIONS:
#SYMBOL \f "Symbol"183Sharpen the squeegees
#SYMBOL \f "Symbol"183Round the printing corner of the squeegee
#SYMBOL \f "Symbol"183Test different squeegee rubbers to find a more compatible rubber
#SYMBOL \f "Symbol"183Use a soldermask with better lubricity properties.

PROBLEM #9 SKIPS AND VOIDS AFTER COATING

SOLUTIONS:
#SYMBOL \f "Symbol"183Use *skew* function on the machine
#SYMBOL \f "Symbol"183Increase *Print* speed
#SYMBOL \f "Symbol"183Increase squeegee angle.
#SYMBOL \f "Symbol"183Increase *Print* pressure
#SYMBOL \f "Symbol"183Check for proper squeegee head set up
#SYMBOL \f "Symbol"183Decrease mesh count
#SYMBOL \f "Symbol"183Use a print mode that increases panel coating strokes. Use either the *Flood/print/print or Double print* program.
#SYMBOL \f "Symbol"183Insure that the panel is being held in the center of the print zone.
#SYMBOL \f "Symbol"183On DP-1000s or DP-1500-2X engage the Thin Panel Tensioner.
#SYMBOL \f "Symbol"183Flood is not adequate (see problem #5).

PROBLEM #10 THICK INK AT THE SIDES OF THE PANEL

SOLUTIONS:
#SYMBOL \f "Symbol"183Increase air pressure to the squeegees

#SYMBOL \f "Symbol"183Check alignment of the squeegee heads and print settings.
#SYMBOL \f "Symbol"183Check screen mesh tension.
#SYMBOL \f "Symbol"183Use "tweaking" mechanism on the squeegees to eliminate thick areas.
#SYMBOL \f "Symbol"183Check squeegee head bearings and alignments.

PROBLEM #11 THICK INK AT THE TOP OF THE PANEL

SOLUTIONS:
#SYMBOL \f "Symbol"183The Print engage switch PRX 6 is not properly set. Adjust either up or down to eliminate the thick bead.
#SYMBOL \f "Symbol"183The print window as defined on the screen is too high. The screen must be "blocked out" a minimum of .250" below the board guide.
#SYMBOL \f "Symbol"183The air pressure to squeegees is inadequate to overcome the resistance of the screen mesh tension.
#SYMBOL \f "Symbol"183The squeegee angles are set to low.
#SYMBOL \f "Symbol"183The board guides are not closing around the top of the panel causing the squeegees to bounce.
#SYMBOL \f "Symbol"183The skew function is engaging improperly, adjust the skew air pressures.
#SYMBOL \f "Symbol"183The print speed is too fast, slow down the print stroke.
#SYMBOL \f "Symbol"183The Flood stroke limit switch is set too high, reduce the amount of flooding.

PROBLEM #12 THICK INK AT THE BOTTOM OF THE PANEL

SOLUTIONS:
#SYMBOL \f "Symbol"183The Print stop switch PRX 8 is not properly set. Adjust the print stroke longer or shorter.
#SYMBOL \f "Symbol"183The shuttle is too thick for the panel thickness. Change to a more appropriate shuttle.
#SYMBOL \f "Symbol"183The Print window is not properly setup allowing the print to continue past the window. The screen must be "blocked out"a minimum of .250 above the board guide.
#SYMBOL \f "Symbol"183Bottom off contact is too low. Increase off contact distance.
#SYMBOL \f "Symbol"183The print window on the screens is no adequate to prevent the soldermask from leaking. Use a barrier tape as a gasket.