

Operations Technology, Inc.

OPTEK



OPTEK DPL-24 Users Guide

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A Differential Pressure Laminator

INTRODUCTION

The DPL-24 Differential Pressure Laminator has been designed to give the operator a superior method for laminating sheet supported emulsions such as dry film solder mask, etc. Such materials can be applied to various thicknesses and sizes of substrates. Experimentation is being done on alternative uses for this device, among them, High Vacuum, Multi-Layer, Pressing of Printed Circuit Boards and microBGA interconnects.

The substrate, prelaminated either manually, or utilizing the A cold-roll lamination technique, is placed on the vulcanized rubber platen mounted in the drawer and positioned in the vacuum chamber. Products of differing thicknesses and geometries can be intermixed during a cycle if adequate “hold-down” techniques are employed.

The massive 1000 LB chamber is constructed of Ductile Iron and uses only two o-rings. This design ensures a positive seal for best vacuum performance.

Vacuum lamination of printed circuit boards has been utilized for many years. But it was not until the development of the DPL-24 that a system provided vacuum prior to the application of positive pressure.

No pressure is applied to the product during the vacuum dwell cycle. In this way maximum evacuation of air from between the substrate and the laminate is assured.

During the pressure cycle a flexible diaphragm encapsulates the product and true isostatic lamination is achieved. Unlike roll laminators, the DPL-24's diaphragm descends directly towards the platen. No lateral stress is applied, hence less distortion of the film can occur.

Utilizing a high quality, high volume 45 CFM, 3 horsepower, rotary vane vacuum pump, an end point below two Torr is typically achieved.

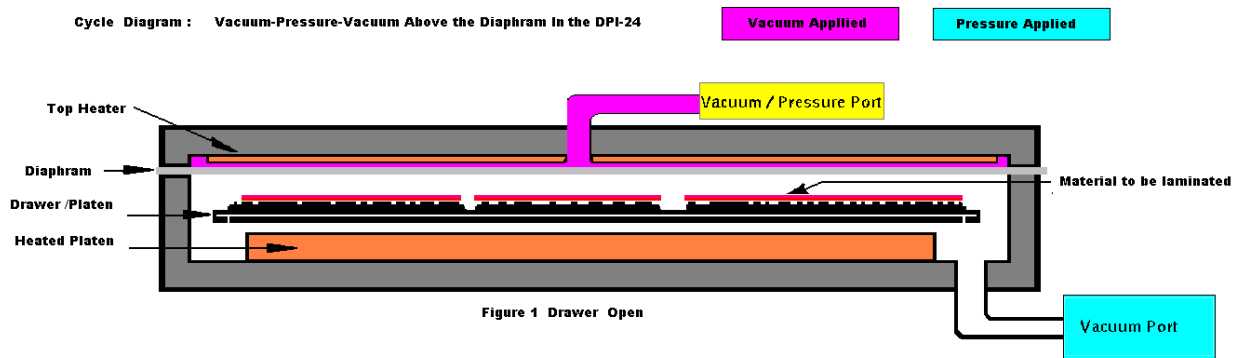
OVERVIEW

- The vacuum is displayed on a thermocouple sensing, computer calibrated, digital gauge located on the front panel.
- The substrate is exposed to this Vacuum Dwell for a time determined by a precision digital timer which is adjustable from .1 seconds to 9990 hours.
- At the end of the Vacuum Dwell, a preheated silicone rubber diaphragm descends onto the work-piece and drives the spring-mounted drawer mechanism into intimate contact with the lower heater platen.
- The temperatures of both the upper and lower heat platens are controlled independently by digital, proportional, Temperature Controllers.
- A positive pressure of up to 10 PSI is applied to the top of the diaphragm to bring the combined differential to nearly 25 PSI.
- The Pressure Dwell is adjusted by a precision digital timer identical to that employed by the Vacuum Dwell.
- Upon completion of a cycle, the drawer mechanism is retracted and the product(s) removed for further processing.
- The entire process is governed by a microprocessor driven programmable controller. Programming modifications are available from the factory.

PRINCIPLES OF OPERATION

The following is an explanation and diagram of the operation of the DPL-24 differential pressure laminator.

When the DPL-24 is turned on, two proportional controllers independently drive the top and bottom heaters to heat the diaphragm and platen to the temperatures set on the front panel. After a brief warmup time, the laminator is ready for use.

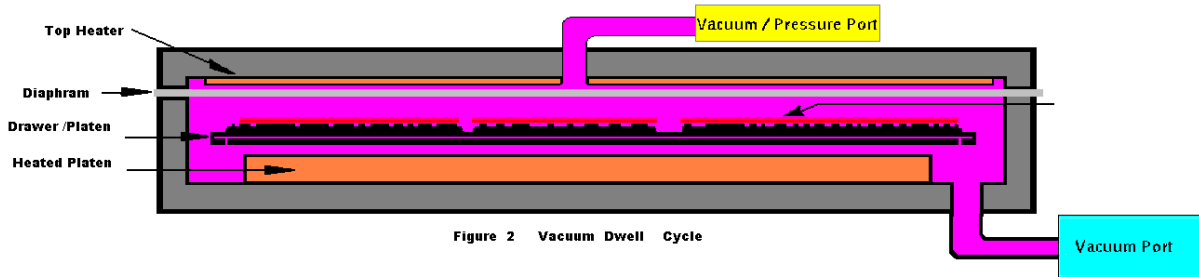


The drawer is pulled open to allow access to load the vulcanized rubber platen with materials ready for lamination. Products of differing thicknesses and geometries can be intermixed during a cycle if adequate “hold-down” techniques are employed. The layered material is placed on the platen mounted in the sliding drawer. When the drawer is closed, the platen is positioned in the vacuum chamber, and an O-ring seal on the drawer face contacts the opening in the vacuum / pressure vessel.

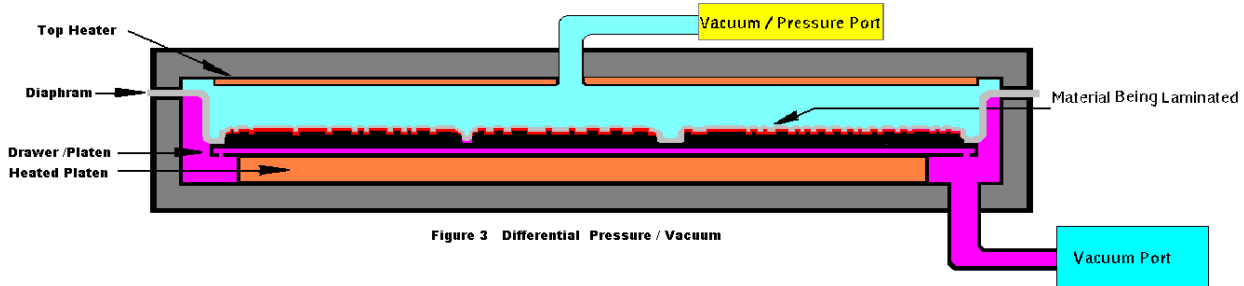
Before the beginning of the cycle there is a vacuum drawn above the diaphragm. Air at atmospheric pressure is in bottom of the vessel, pushing the diaphragm upwards. As shown in **figure 1**, the diaphragm is up above the material on the drawer platen. The drawer platen is spring loaded upwards to allow the drawer to be opened and closed.

PRINCIPLES OF OPERATION (CONTINUED)

When the cycle starts, vacuum is drawn on both ports, above and below the diaphragm. Utilizing a high volume vacuum pump, an end point approaching two Torr is achieved. This vacuum is displayed on a digital gauge located on the front panel. A programmable timer adjustable from .1 seconds to 9990 hours determines the vacuum dwell time before continuing to the next step **Figure 2**. It is important to note that this dwell time will allow air between the layers of material to be evacuated before the lamination pressure cycle begins, eliminating trapped bubbles. Because the vacuum is equal above and below the diaphragm, it does not move and does not contact the material in the drawer.

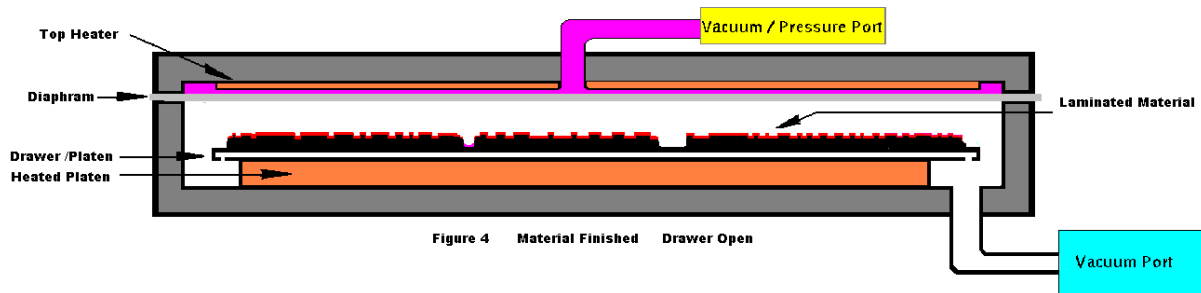


At the end of the Vacuum Dwell, positive air pressure at up to 10 PSI is applied to the port above the diaphragm bringing the pressure differential to nearly 25 PSI. see **figure 3**, The preheated silicone rubber diaphragm descends onto the workpiece. This action drives the spring-mounted drawer platen into contact with the lower heater platen. Isostatic pressure is transferred to the material by the diaphragm. The stretching effect that occurs with roll type laminators is minimized. The flexible diaphragm conforms to the surface shape assuring positive contact between the layers, thereby eliminating voids. The pressure dwell time is controlled by another timer identical to the vacuum dwell timer.



PRINCIPLES OF OPERATION (CONTINUED)

At the end of the pressure dwell cycle, the top port is connected to the vacuum pump again, and the bottom port is vented to atmospheric pressure. As shown in **figure 4**, this returns the diaphragm and drawer platen to their original positions and allows the drawer to be opened for unloading.



SITE REQUIREMENTS

Dimensions: 44" Wide X 44" Deep X 60" High, exclusive of leveling feet (1" to 2")

Weight: 2,200 LBS (shipping)

Electrical Requirements: 208/220 VAC, 3 Phase, 40 Ampere/Phase

Compressed Air: Dry, Filtered, 70 PSI, 3 CFM

SUBSTRATE SPECIFICATIONS

Productivity:

Cycle time is adjustable from 0 to infinity and is determined by application parameters such as circuit complexity, ground plane areas, circuit heights, flow temperatures, etc. Typical times for a dry-film solder mask application would be 30 seconds for Vacuum Dwell and 20 seconds for Pressure Dwell.



Substrate size:

Items up to 24" X 24" can be laminated. Smaller substrates can be processed in multiples if space permits and can be intermixed providing adequate hold-down techniques are observed.

Substrate Thickness:

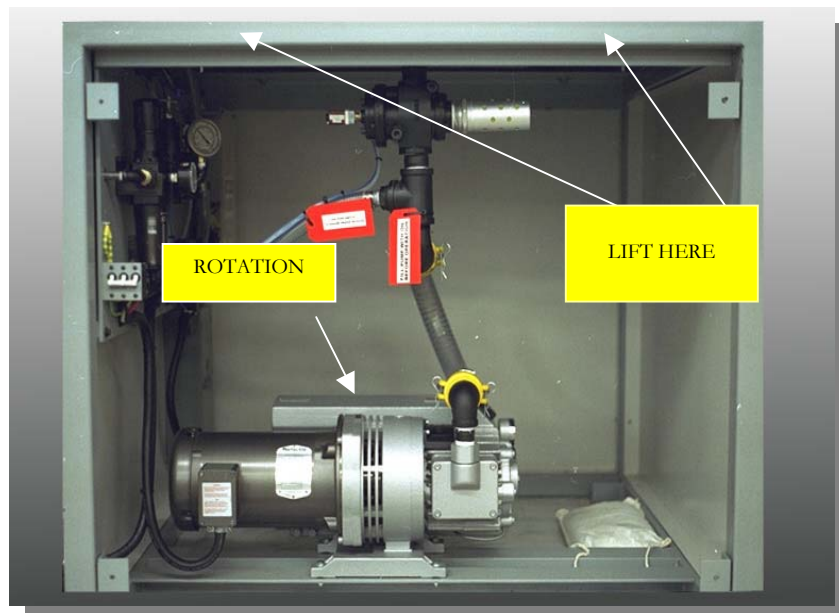
Thicknesses from .001" to .375" can be accommodated though standard board hold-down bars .

INSTALLATION

Due to the weight of the unit a forklift is mandatory for removal of the DPL-24 from the pallet and, for final positioning.

1. Upon receipt of equipment inspect for obvious external damage.
2. Remove Tri-Wall cardboard box or wooden crating and inspect for damage to the machine itself. **Do not attempt to slide the chamber drawer.**
3. Using a forklift roughly place the DPL-24 utilizing the attached pallet,
4. Remove lower back panel
5. Remove the four bolts securing unit to pallet.
6. Raise unit with forklift blades positioned under main vessel, being careful not to damage main valve. (see illustration below)
7. Install leveling feet (included) into threaded holes formerly occupied by shipping bolts.
8. Position, lower, and level the unit.

9. **WARNING: IT IS IMPERATIVE THAT OIL BE ADDED TO PUMP BEFORE OPERATION!**



INSTALLATION (CONTINUED):

10. Supply Compressed Air to input nozzle on right side rear of the machine.
11. Adjust primary regulator to 50-80 PSI.
12. Adjust secondary regulator to 5-10 PSI.

**WARNING: DO NOT ATTEMPT TO ADJUST
REGULATOR PAST STOP!!!**

DO NOT REMOVE PIN UNDER ANY CIRCUMSTANCES!!!

13. Ensure that switch on pump is in the “OFF” position.
14. Wire and Connect 220 VAC, 3 Phase, 40 Ampere power to input cable.
15. Activate “Main Power” switch on front panel.
16. Momentarily depress “Emergency Reset” switch on front panel.
17. Activate “Vacuum Pump” switch on front panel.
18. With one person at switch and one person at the pump, “JOG” the vacuum pump switch and monitor the pump to ensure proper rotation indicated by the arrow found on motor end case.

**Note: If the rotation is opposite to that indicated,
reverse any two phases of incoming power.**

19. Upon determination of proper pump rotation, leave pump mounted switch in “ON” position.

**Your DPL-24 unit is now
ready for operation.**

OPERATION

1. Insure circuit breaker is in the “ON” position.
2. Activate “MAIN POWER” switch.
3. Activate “VACUUM PUMP” switch.
4. Chamber drawer may now be opened for inspection.

WARNING: PLATEN MUST BE IN POSITION WHEN CYCLING MACHINE!

5. Return drawer to home position.
6. Activate “TOP” and “BOTTOM” Heaters by depressing and illuminating switches beneath digital controllers.

7. Press "asterisk" and "up" or "down" arrows until desired temperature is indicated on digital readout.

8. Release "asterisk" and note temperature indication on readout.



9. A flashing green light below the temperature readout indicates the controller is triggering the solid state relay to supply current to the respective heater blanket.
10. Allow 20-40 minutes for unit to reach set-point and stabilize, if (under 200 degrees F).
11. Product may now be processed through laminator.

OPERATION EXAMPLE

1. Set both Temperature Controllers to 160 Degrees F.
2. Set Vacuum Dwell to 30 Seconds.
3. Set Pressure Dwell to 20 Seconds.
4. Place Prelaminated product on Platen.
5. Slide Hold-Down Device into place.
6. Slide Drawer into Vessel.
7. Momentarily depress the “CYCLE START” button.
8. Machine will complete one “AUTOMATIC CYCLE”.
9. “CYCLE READY” Light Illuminates.
10. Slide the drawer out, and remove substrate.

NOTE: If at any time the operator desires to exit the cycle, depress the “CYCLE-RESET” button and machine will return to Step 0. Atmospheric pressure will be vented to the chamber and the drawer may be opened.

NOTE: If at any time the operator wishes to hold the cycle at a given step, depress the “CYCLE STOP” button. The machine program will hold at the present step indefinitely. To resume the program sequence, press “CYCLE START” button.

NOTE: If the operator wishes to step through the program manually, depress the “SINGLE STEP” button. Unit will advance one program step with each pressing of the button, maintaining that step’s conditions after completion of the timer setting.

PRECAUTIONS

CAUTION: NEVER ATTEMPT TO REMOVE DRAWER FROM VESSEL WITH VACUUM PUMP OFF. EMERGENCY RESET BUTTON MUST BE DEPRESSED. IN STEPS OTHER THAN STEP 0, VACUUM IS APPLIED TO THE DOOR AND WITHDRAWAL IS IMPOSSIBLE.

IF VACUUM PUMP IS OFF, THE DIAPHRAGM MAY BE IN CONTACT WITH THE VULCANIZED PLATEN AND PERSISTENT PULLING MAY CAUSE DAMAGE.

MAINTENANCE

Vacuum Pump - The 45 CFM, Rotary Vane, Vacuum Pump is supplied to you with no oil installed. The oil should be changed after every 500 hours of operation and is available directly from Operations Technology Inc.

WARNING: IT IS IMPERATIVE THAT OIL BE ADDED TO PUMP BEFORE OPERATION!

NOTE: A separate manual for the pump has been included and all maintenance directives therein should be adhered to.

Vacuum Gauge - The 0 - 20 Torr Solid State Vacuum Gauge is a precision, rugged, device used to constantly monitor the vacuum present in the vacuum chamber. A level approaching two Torr or better indicates proper machine operation.



MAINTENANCE

Digital Proportional Temperature Controllers - These devices provide precise control of temperature for the upper and lower heater platens independently. They are calibrated at the factory and should not need further adjustment.

Programmable Controller and Power Supply - These units control activation, deactivation, and timing of the various valves and lights in the DPL. A program stored in memory is utilized to direct the sequence of events. Custom programming can be accomplished by the factory for specialized applications. Neither the controller nor the power supply requires preventive maintenance.

Filter Regulator - Normally, clean, filtered, dry air should be supplied to the machine. The DPL-24, however, has an additional filter incorporated into the primary regulator. This filter requires minimal maintenance. (Open petcock and drain out water occasionally!)

Diaphragm- The 50 Durometer, .125" thick, Silicone Rubber Diaphragm is the major wear item in the system. It is advisable to keep a replacement Diaphragm on-hand in the event of a puncture or rupture. This unit is available "pre-punched" from the factory. Cleaning of the Diaphragm is accomplished with Isopropyl Alcohol only.

Platen- All work is pressed on this Vulcanized Rubber Platen. It is advisable to keep a standby Platen on hand if replacement becomes necessary due to normal wear or abrasion. Cleaning is accomplished either on or off the machine with a soft cloth, moistened with Isopropyl Alcohol only.



RECOMMENDED SPARE PARTS

PART #	DESCRIPTION	QUANTITY	PRICE	TOTAL
1007	CONTROL,TEMP,9900	1 PIECE	\$350.00/ea.	\$350.00
1008	HEATER, SILICONE	1 PIECE	\$450.00/EA.	\$450.00
1024	BULB, INDICATOR	4 PIECES	\$2.00/EA.	\$8.00
1026	DRAWER SLIDE, LARGE	1 PAIR	\$130.00/PR	\$130.00
1027	O' RING, DOOR	1 PIECE	\$38.00/EA.	\$38.00
1028	`O' RING, VESSEL	1 PIECE	\$30.00/EA.	\$30.00
1041	FAN, EXHAUST, 220V	1 PIECE	\$47.00/EA.	\$47.00
1042	RELAY, SOLID STATE	1 PIECE	\$53.00/EA.	\$53.00
1043	RELAY, MAIN	1 PIECE	\$120.00/EA.	\$120.00
1070	VALVE, ACTUATOR	1 PIECE	\$50.00/EA.	\$50.00
1077	DIAPHRAGM,	1 PIECE	\$300.00/EA.	\$300.00
1078	PLATEN, 24" X 24"	1 PIECE	\$300.00/EA.	\$300.00
1089	VACUUM PUMP OIL	5 GAL	\$15.00/GAL	\$75.00
1094	SPRING, DRAWER	4 PIECES	\$2.00/EA.	\$8.00
1113	BOARD HOLD-DOWN	1 PAIR	\$150.00/PR	\$150.00
1117	TIMER,DIGITAL	1 PIECE	\$125.00/EA.	\$125.00
			TOTAL	\$2,234.00

Pricing shown is current at the time of publishing and is subject to change.

ORDER PARTS FROM:

OPERATIONS TECHNOLOGY INC.
#30 LAMBERT ROAD
P. O. BOX 408
BLAIRSTOWN, NJ 07825
Phone (908) 362-6200
FAX (908)362-5966

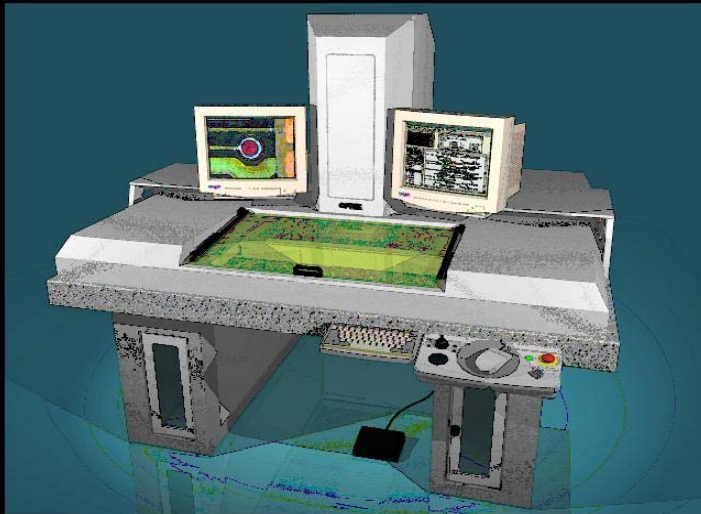
ALSO AVAILABLE FROM:

OPERATIONS TECHNOLOGY INC.

#30 LAMBERT ROAD
P. O. BOX 408
BLAIRSTOWN, NJ 07825
Phone (908) 362-6200
FAX (908)362-5966

INNERVISION

X-RAY INSPECTION AND MEASUREMENT SYSTEM



Faster, more precise multilayer printed circuit board process optimization is now possible with the **OPTEK INNERVISION**. Immediately after lamination you can measure registration error independently for each layer. No need for sectioning or drilling and plating. Determine layer locations to 0.2 mil accuracy. Accumulated errors from process factors such as etch control and drilling accuracy are included in the measurements.

The **OPTEK INNERVISION** system provides a means to measure and report the positions of internal features such as pads on inner layers of multi-layer printed circuit boards, reinforcement in gaskets, and other such encapsulated or laminated items. The measurements and images obtained by the **INNERVISION** reveal skew, shift, stretch, shrink, and other distortions that occur in imbedded layers. The data provided allows fabrication processes such as lamination, molding, and drilling to be optimized.

The system combines real time X-Ray Video Imaging with the positioning and metrology features of Operations Technology's **OPTEK Y-Series** Video Measurement and Inspection System. The result is the most sophisticated X-Ray Inspection and Measurement System available today.

OPERATIONS TECHNOLOGY, INC PO BOX 408, BLAIRSTOWN, NJ 07825 USA
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OPTEK

WARRANTY

1. PERIOD OF WARRANTY:

Operations Technology Incorporated warrants this product to be free of defects in material or workmanship for a period of 180 days commencing on the shipping date from Blairstown, New Jersey.

2. LIABILITY OF WARRANTY

Operations Technology Incorporated warrants to the original purchaser that equipment sold under this agreement shall be free from defects in material and workmanship. Defective materials will be replaced or repaired at the discretion of Operations Technology Incorporated. Liability will be determined by Operations Technology Incorporated. All liability is expressly limited to said repair or replacement of defective parts, all other damages and warranties, statutory or otherwise, being expressly waived by the purchaser. This warranty is null and void if the equipment failure is due to negligence, accident, abuse, or improper operation. It is also nullified by tampering, alteration, or unauthorized repair of subject equipment or components. This warranty does not include filters, oil, Platen, and Diaphragm as they are generally considered to be consumable items.

The user shall return all allegedly defective materials to Operations Technology Incorporated via approved routing, charges prepaid. Upon determination of liability, Operations Technology Incorporated will either submit a quotation for repairs or rectify the defect at no charge.

This warranty cannot be countermanded by the purchaser and is the only warranty relative to the transaction. No other warranty, expressed, implied or statutory shall apply.

Effective Date 1/1/96
Revised 6/1/2004

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