INSTRUCTION MANUAL

MODEL 120

DIGITAL ETCHANT CONTROL/MONITOR

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INTRODUCTION

1.1 Description

The Model 120 Digital Etchant Control/Monitor consists of three pieces: the Etchant Control, the Etchant Monitor and the Power Module. The Control unit contains a hydrometer to measure etchant specific gravity. Electronics in the control read hydrometer position, encode the information and transmit it to the Monitor. The Monitor displays the measured Baume value, outputs it thru both chart recorder and computer RS-232 ports, makes control decisions to maintain etchant within about +0.1 degree Baume of the desired set point, and set off visual and audible alarms if the etchant density deviates more than +0.3 degree Baume from the set point. The Power Module has system low voltage power supplies and the replenisher pump control power relay.

Plug-in cables about 12 feet long are provided to connect the Monitor to the Control and Monitor to Power Module.

1.2 Principle of Operation

The Control consists of two compartments, one wet and dry. The wet compartment contains a hydrometer which responds to etchant density. Hydromenter motion in transmitted by a pivoted beam thru a isolating elastomeric diaphram into the dry compartment. Optical sensors in the dry side detect pivot beam position and thus hydrometer position, frictionlessly. The optical position sensor is an optical encoder which passes between light emitting diode-phototransistor pairs to cut the infrared optical beams passing between them.

During operation the etchant continuously flows into the bottom of the wet inner chamber, over the dam and out the wet chamber drain. An eighth inch drain hole at the bottom of the dam allows the inner chamber to drain when the etchant supply turns off. The gas bubbles in the solution leave the wet chamber thru a vent pipe on the bottom of the Control unit. The encoder can measure deviations as much as +2 degrees Baume from the set point. The 120-9 encoder in the Control unit dry side is designed to reset the display to the set point value and turn on the replenisher pump whet the float rises above the position which makes the beam horizontal. It tracks deviation away from the set point, encodes the information, and sends it to the Monitor.

The Monitor stores the set point Baume value in a battery backed memory, adds it to the deviation value from the Control, and displays the resulting Baume value determined for the etchant. When the etchant density stays above the set point for a few seconds the replenishment pump is turned on for at least 10 seconds and continues to run until the etchant density returns to the set point. The delays in pump turn on and off minimize relay and pump wear due to excessively rapid cycling. Pump lights on Monitor and Power Module inform the operator when power is delivered to the pump terminal.

High and Low lights and an alarm alert the operator if etchant density deviates more than +0.3 degrees Baume from the set point. The alarm also sounds if the pump runs continuously more than 5 minutes. The operator can silence the alarm for 5 minutes while the situation is corrected.

1.3 Performance Capability

The Model 120 Etchant Control/Monitor will hold the density of the etchant in its measuring chamber within +0.1 degrees Baume of the set point if the etcher replenishment feed pump and sump mixing pumps are large enough to keep up with the work load. With the unit correctly standardized the set point Baume value will read correctly +0.1 degree and other displayed values above and below the set point will be accurate within +2% of reading.

OPERATING INSTRUCTIONS

2.1 Switch Operation

The switch on the Power Module has three positions: MANUAL, OFF and AUTO. In the OFF position power to the Control, Monitor, and replenisher pump(s) is off. In the MANUAL position the replenisher pump(s) run continuously without any control if the power source to the Power Module is energized. In the AUTO position the automatic control part of the Etchant Control/Monitor is activated and the replenisher pump(s) will be turned on and off as needed to maintain the specific gravity of the etchant solution at the desired set point.

There are two different installation wiring situations to be considered: Case I and Case II. In Case I the power source to the Power Module is energized only when solution is being fed to the Etchant Control and the switch can be left in the AUTO position all the time. In Case II the installation wiring allows the Power Module to be energized when solution is not being fed to the Etchant Control. In Case II when the etcher is not etching the Control will sense that the hydrometer float is on the bottom of the inner chamber, interpret this as low density, and turn on the alarm. To prevent this false alarming in Case II turn the Power Module switch OFF when solution is not being fed to the Etchant Control. Turning the power off also avoids all the inherant hazards of leaving any equipment powered and unattended.

2.2 Indicators

The PUMP lights on the Power Module and Monitor turn on whenever the replenishers pump(s) are energized whether by the MANUAL switch position or by the control relay in the AUTO switch position. The AUTO lights on the Power Module and Monitor indicate that the AUTO switch is on. The HIGH DENSITY light on the monitor indicates that the etchant density is 0.3 degrees or more above the desired set point. THe LOW DENSITY light indicates either that the etchant is 0.3 degrees or more below the desired set point or that the Control's solution chamber is not full. The Baume display gives etchant density in a range +2 degrees about the set point. The digital display is blanked if there is no solution in the float chamber or if the density cannot be determined accurately because it is more than 2 degrees away from the set point. A blanked display and HIGH DENSITY indication means that the solution density is more than 2 degrees above the set point. A blanked display with LOW DENSITY indication means either that the solution chamber is not full or that the solution density is beyond 2 degrees below the set point.

2.3 Alarm

The alarm sounds immediately if high or low limits lights are on and replenisher pump(s) run continuously for more than five minutes. The alarm will normally be heard only at start up as the inner chamber fills and the LOW DENSITY light comes on. This serves to verify that the alarm is functioning properly. If the HIGH DENSITY light is on and the replenisher pump(s) are running, the control waits five minutes to give the system a chance to correct itself automatically before sounding the alarm. The operator can silence the alarm for a five minute interval by pressing the ALARM CANCEL button on the Monitor.

3. INSTALLATION

3.0 Locations

The Control and Power Module are connected to the Monitor unit by cables about 12 feet long. The Monitor must be where the operator can see, hear and touch it. The Power Module must be accessible enough to allow switch operation and fuse replacement. The Etchant Control must be securely mounted to a vertical surface with the drain in the bottom high enough above the etcher sump to allow proper drainage. The top of the Control must be level.

3.1 Etchant Control

3.1.1 Mounting

Mount the Etchant Control securely to a vertical surface using corrosion resistant bolts thru the mounting flanges on the sides of the unit. Four quarter inch flange holes are provided. Shim between the mounting flanges and "vertical" surface as required to give a secure mount and make the top of the Etchant Control level.

Remove the covers and carefully take the packaging material out from around the dry chamber pivots and from the float in the inner wet chamber. Replace the left cover to prevent etchant droplets from settling on the circuit board in the dry chamber.

3.1.2 Plumbing Connections

Use quarter inch high pressure plastic tubing to connect between the etch machine spray manifold and the Etchant Control inlet at the bottom of the inner chamber. Make sure connections are secure and tube routing will not be subject to damage or cause hazard. Use three-quarter inch plastic drain hose to connect the drain on the bottom of the Etchant Control to the etcher sump. Make sure the drain hose routing always slopes away from the Control and does not cause a hazard. If the drain hose is allowed to sag so that the etchant must flow uphill in some section, then a trap is formed which can become plugged. Clamp the drain hose securely so that it cannot become plugged.

Turn on the etcher spray pump and observe the time required to fill the inner chamber to overflowing. If it is less than 20 seconds reduce the flow by increasing the length of quarter inch tubing used. If the fill time is over two minutes then increase the flow by shortening the tubing used, changing the tap location on the etcher, or by using appropriate adapters and a larger diameter high pressure tubing. Carefully observe all plumbing connections and correct any leaks found. Turn the etcher off.

The vent pipe on the bottom of the Etchant Control releases the gas from the bubbles in the solution entering the Control. The vent can ordinarily simply vent to the room air, but if desired it can be indirectly connected to the etcher venting system. Do not simply run a closed tube from the Control vent to the vent vacuum. The vacuum created in the Control could distort the elastomeric diaphram and cause problems. Indirect venting in which a tube connected to the vent vacuum draws room air past the open end of the vent pipe can be used.

3.1.3 Optical Encoder Adjustment

Replace the right cover, remove the left cover and turn on the etcher spray pump. With etchant in the solution chamber press down on the beam to make the encoder pass thru thr slot in the circuit board. Check to make sure the encoder is vertical, approximately centered in the slot, and swings freely without rubbing on anything. If the encoder is not vertical, loosen the encoder set screw which fastenes the encoder bracket to the beam, twist the encoder to vertical, and tighten the set screw. Do NOT loosen the bottom screw which clamps the encoder to the encoder bracket. If the bottom screw is loosened the encoder alignment procedure in Section 4.2 must be performed. The position of the encoder in the circuit board slot can be adjusted if necessary by loosening the screws which hold the circuit board. Position the board and retighten the screws. Turn the etcher spray pump off.

3.2 Power Module

3.2.1 Mounting

Loosen the four cover screws and remove the Power Module cover. There is a mounting hole at each corner of the Power Module. Use screws thru these mounting holes to secure the Power Module to any suitable vertical or horizontal surface.

3.2.2 Electrical Connections

Look at the voltage written on the main circuit board in the Power Module to verify that it matches the line voltage (either 120 or 230 volts, 50 or 60 Hz) which you intend to use.

A 7/8 inch diameter hole is provided for 1/2 inch conduit or a standard cable clamp. Turn the Power Module switch OFF. Turn off the power source you intend to use. The power AC connections are to the 8 position terminal strip near the 7/8 inch hole. Connect the P, N, and G terminals to the replenisher pump(s)' Power Neutral and Ground connections respectively. If a solder conditioner/brightener solution replenisher pump is also connected to the P, N, and G terminals then conditioner solution replenishment can also be automatically controlled. Connect terminal L to the AC power source line. If possible create the more convenient and efficient Case I in Section 2.1 by connecting L to an AC power source which goes on and off with the etcher's main etch

pump. This power can be tapped directly off the line that supplies the etch spray pump if the voltage is correct and the line current is less than 50 amps. Line currents over 50 amps may cause the Power Module fuse to blow occasionally from the inductive kick when the spray pump turns off. Connect the power source Neutral to N and non-current carrying Ground to a G terminal. If sealed conduit is not used for AC leads then the hole they come thru into the Power Module should be sealed with silicone RTV to keep out moisture and corrosive fumes.

Turn on the AC power source and with a suitable test instrument verify that the L, N, and G connections are correct. Flip the Power Module switch to MANUAL and verify that the replenisher pump(s) run. Turn the Power Module switch OFF and the AC power source off. Replace the Power Module cover correctly oriented to the indicator lights and tighten the cover screws.

3.3 Etchant Monitor

Plug the cable from the Etchant Control into the Etchant Monitor. Set the Monitor where it faces the operator and can be reached to actuate the ALARM CANCEL button. Loop any excess length of the cable around the cable windes on the bottom of the Control and wire tie them to the holes provided. Two wire ties are conveniently taped to the bottom of the Control for this purpose. Plug the 6 conductor cable with the circular plastic connector into the Power Module.

3.3.1 Chart Recorder

The 3 conductor cable with tinned ends is for an optional chart recorder. The BLACK lead is chassis ground. The WHITE lead is signal ground. The RED lead has a signal which varies from 0 to 1 volt DC as the displayed Baume values go from the minimum to the maximum values which can be displayed. The output is 0.5 volts at the control set point and varies linearly 0.25 volts per degree Baume for +2 degrees about the set point. The source impedance is 1K ohms.

3.3.2 Serial Port

The cable with the DB-9 connector will plug into a standard matching serial port on a computer if one is to be used for data collection. The signals provided are consistent with the RS-232 standard. The software provided runs on IBM PC compatible machines.

3.4 Installation Checkout

Set the Power Module switch to AUTO and turn on the etcher spray pump. If the starting etchant density is above the set point the replenisher pump(s) will run until the Etchant Controller is satisfied. When the controller turns off the replenisher pump(s) the etchant density in the sump can be measured with an accurate, expanded scale hydrometer. The hydrometer should read between 20 and 30 degrees Baume with 0.1 degree resolution. The density thus measured is the controller's set point. If the starting density is below the set point then some work will have to be fed thru the etcher until the replenisher pump(s) begin to cycle on and off. The set point of a virgin controller will drift up about 1 degree Baume during the first few hours of use as the plastic surface of the float cures in the etchant and fewer bubbles cling to it. After curing the set point stabilizes and the performance outlined in Section 1.3 will be obtained. The stabilized set point as shipped from the factory is approximately 25.7 degrees Baume. To change the set point see Section 4.1.

Replace all covers that are off and tighten cover screws.

4. SERVICE PROCEDURES

4.1 Set Point Adjustment

Remove the left (dry) compartment cover of the Etchant Control. The PVC weight between the optical encoder and the pivot assembly is used to adjust the set point. Moving the weight one inch toward the optical encoder lowers the set point about 3 degrees Baume. To move the weight loosen its set screw, slide the weight to the desired place, and tighten the screw. An auxiliary PVC weight has been provided which can be added to either the dry of wet side of the beam to increase the adjustment range. Replace any covers that have been removed.

After adjusting the set point weight the displayed Baume value must be standardized to the new set point. To do this carefully measure the new set point Baume value using the procedure in Section 3.4. With the new set value measured using an accurate hydrometer, the etch spray pump on, Control/Monitor in AUTO, feed pump not on, and Control at the set point; adjust the digital display to read the new set point value. To adjust the display press the ALARM CANCEL button continuously and hold it in. After about 5 seconds the standardize buttons behind the small circles under the digits are activated. Continue to hold the ALARM CANCEL button and operate the display standardize buttons one at a time to correct the displayed value.

4.2 Encoder Alignment Procedure

There are two set screws which determine the position of the encoder. The top screw controls position and twist upon the beam. The bottom screw controls tilt for proper counting. Loosen the top set screw and adjust the encoder mounting bracket to make the encoder card vertical as it swings through the slot in circuit board 120-9. Make sure the encoder does not rub against the edges of the slot. Move the bracket until the outside row of stripes (narrowest stripes) runs between the outside sensor pair (left end). Tighten the set screw but don't overtighten.

With the unit powered swing the beam and observe the Baume numbers displayed. If it counts properly in sequence up and down, no further adjustment is needed. If there are missing or out of sequence numbers displayed as the beam is moved to move the encoder thru the slot, then the encoder optical card needs adjusting with the following procedure:

1) With the float at the bottom of it' travel look directly down along the optical card's edge checking to see that the card is centered through the slot in the 120-9 board. The set screw on the top of the card mounting bracket allowt the cart to be moved along the beam or twisted about it. Center the card in the slot making sure it is vertical. The card should not wander front to back in the slot as the beam is moved up and down.

2) The front to back position of the slot can be adjusted by loosening the two 120-9 circuit board mounting screws along the back edge of the board. The board can be repositioned to center the optical card in the slot front to back. Once the card is centered with the float at its lowest position, tighten the two board mounting screws.

3) Gently raise and lower the float to make sure the card swings vertically and does not drag against the circuit board.

4) To adjust the tilt on the optical card toward or away from the pivots, loosen the clamping screw at the bottom of the card. Raise the float and tilt the card until the edge of the left most dark stripe aligns with the silver arrow on the circuit board. For proper alignment this arrow should continuously point to the strip's edge as it passes by when the float is lowered.

5) Power up the unit and raise and lower the float. The displayed value should increase smoothly with no missing numbers as the float is raised. Look for excessive blanking, missing numbers, and reverse counting in which the displayed value goes down as the float comes up. If the display does not count properly, the card tilt needs to be adjusted slightly. If there are missing counts try tilting the card slightly to the right. If the count seems sluggish and the display fails to count as far as it should before blanking, try moving the card slightly to the left.

4.3 Routine Maintenance

The unit requires no routine maintenance except replacement of the memory lithium battery at approximately 10 year intervals. However, if the etchant is allowed to sludge in the etch machine sump then excessive sludge may also accumulate in the Etchant Control wet chamber. In that event the Etchant Control wet chamber should be cleaned. If excessive sludge has accumulated in the wet chamber then be sure the 1/8 inch drain hole in the bottom of the dam is clear. The hole is at the bottom of the dam near the 3/4 inch drain.

4.4 Trouble Shooting

4.4.1 No Power

If none of the indicator lights light and the replenisher pump(s) don't run in MANUAL then check the 5 amp slow blow fuse, the power source to the Power Module and the wiring connections. If the fuse is blown it must be replaced with a fuse no larger than a 5 amp slow blow.

4.4.2 Mechanical Operation

The beam should pivot freely when the hydrometer is floating in the etchant filled solution chamber. If you raise or lower the beam slightly to decrease or increase the displayed Baume a few tenths, the reading should return to within 0.1 degree of the initial displayed value when you release the beam. If the beam does not move freely check the adjustment of the optical encoder to make sure it is not rubbing on something.

4.4.3 Electronic Parts

There are seven circuit boards is the system identified by numbers 120-1, 120-2,and 120-3 in the Power Module; 120-9 in the Control unit; and 120-5, 120-6, and 120-7 in the Monitor.

4.4.3.1 Power Module Boards

Board 120-1 is the large mother board in the bottom of the Power Module box. It has the transformer, surge suppressors, and interconnections for boards 120-2 and 120-3. Board 120-2 has the LED's and the + and - 12 VDC power supplies. With the system powered there should be 10 VAC on the right ends of the two diodes just below the red LED. Be careful making measurements on any of the Power Module boards since they all have full power line voltage at some points on them.

Board 120-2 is ok if with Control and Monitor connected:

1. There is + 12 to + 14 VDC on the yellow lead into the AMP connector on the Power Module,

2. There is - 12 to -14 VDC on the white/red lead,

3. The green LED lights in the AUTO mode,

4. The red LED lights whenever the pump is powered,

5. The white/blue lead is less than 0.5 VDC when the AUTO light is on and over 2 VDC when the AUTO light is off and the PUMP light is on, and

6. The gray lead is less than 0.5 VDC when the PUMP light is on and over 2 VDC when the PUMP light is off and AUTO light is on.

Board 120-3 has the power relay to switch line power to the replenisher pump(s). Board 120-3 is ok if in the AUTO mode the pumps are powered when the orange lead at the AMP connector is over 2 VDC and the pumps are off when the orange lead is under 1 VDC. There should be a 2 to 3 second delay between the time the voltage on the orange lead starts to rise and the relay switches. A guick relay test in AUTO when the pump is off is to unplug the Power Module cable at the AMP connector; the relay should pull in and the PUMP light on the Power Module come on after a 2 to 3 second delay.

4.4.3.2 Encoder

The small encoder circuit board 120-9 in the dry side of the Control unit sends beam position information to the Monitor. The pertinent signals are at the places shown in Figure 4.4.3.2. The Monitor produces a clock signal at CLK which is at about 500 Hz. When the beam is positioned so that the encoder can produce valid

data the Monitor produces signal S which goes low for 8 clock cycles and the encoder produces signal SO which contains the beam position information coded in 8 sequential bits. The first bit is always high. The next 6 bits are signals A, B, C, D, E, and F in that order (see Section 4.4.3.4). The final bit is always low. Bit to bit transitions occur when the CLK line transitions from high to low. When S is not low SO is a constant high. By observing S and SO with an oscilloscope while raising and lowering the beam, proper encoder board operation can be verified. Trigger the scope from the S line.

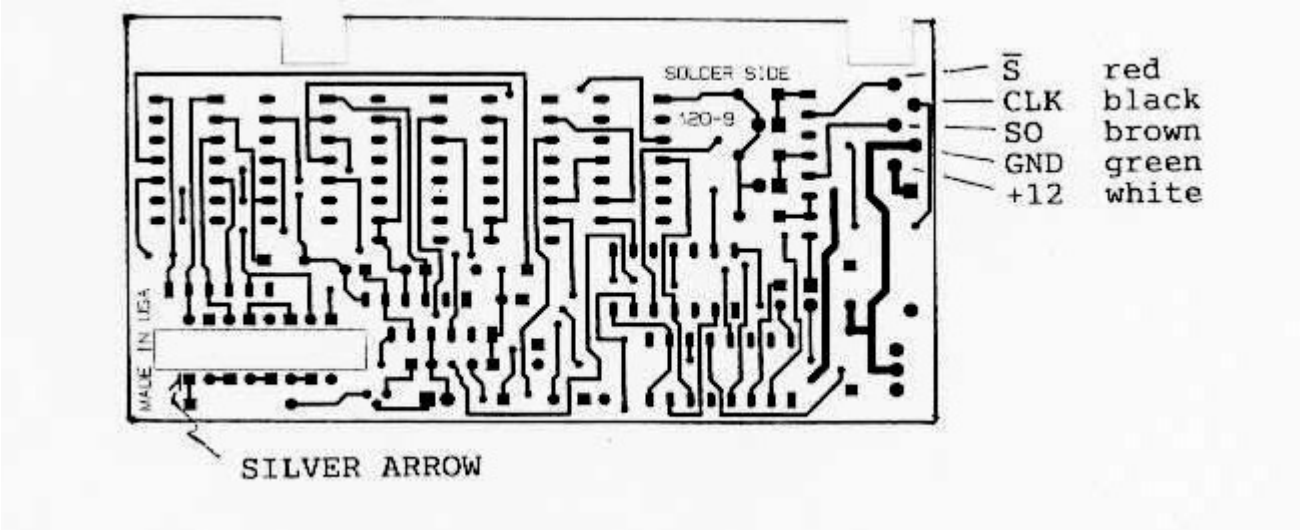

Figure 4.4.3.2 Test points on encoder board 120-9.

4.4.3.3 Monitor

The Monitor contains circuit boards 120-5, 120-6, and 120-7 which can be accessed by removing the back of the Monitor box. The front board is 120-5 and has the display devices, display decoder-drivers, push button switches, and edge connectors for the other two boards. Board 120-7 is on top and has the set point offset memory and its backup lithium battery, the adders which add the offset to the beam position data, the chart recorder circuitry, and most of the RS-232 circuitry. The battery will power the set point memory for about 10 years with no power to the unit. The remainder of the decision making and control circuits are on board 120-6 on the bottom of the Monitor.

4.4.3.4 RS-232 Port

The port is configured for 600 baud, no parity bit, 8 data bits, and 2 stop bits. There are three data bytes available that can be obtained by sending their addresses to the Model 120 serial port. The binary data addresses are 00, 10, and 11.

The Model 120 ignores the first 6 bits of the 8 data bits sent to it as an address. Thus for example if it receives any ASCII character whose 8 bit binary pattern ends in 10 it sends back the data at address 10. The available data is:

Address	Data Bits
00	D1 C1 B1 A1 D.1 C.1 B.1 A.1
10	C D E F 0 0 B10 A10
11	1 FD IA AL AP PP A B

The first 6 bits of the 11 word has system status bits:

1 = spare line always 1

FD = logical feed pump turn on-signal
IA = alarm not inhibited
AL = alarm on
AP = auto power detected off in Power Module
PP = AC power delivered to pump terminal in Power Module off

A,B,C,D,E,and F are encoder output bits in BCD format with F the most significant bit having weight 2 and A the least significant bit having weight 0.1. The displayed Baume value is BCD encoded:

Baume display = 20(B10)+10(A10)+8(D1)+4(C1)+2(B1)+1(A1)+
0.8(D.1)+0.4(C.1)+0.2(B.1)+0.1(A.1)

The QBASIC program SEND-RX on the disk supplied is a useful and convenient utility to verify RS-232 port proper operation. For convenience it is also on the disk in a compiled and executable form. To run it simply type SEND-RX at the DOS prompt. If you LIST the basic program you will note that each OPEN statement is soon followed by a CLOSE. This is because the encoder output is frozen while the port is open to prevent it from changing while it is being read out. Since the encoder output cannot change, the control cannot respond to etchant changes while the port is open. Thus the port must be closed promptly to allow normal control action and changing display values. The entire OPEN, read and CLOSE is over in a fraction of a second and has no effect on the precision of the system. However if the CLOSE is omitted the Model 120 Control/Monitor locks up and stays in the mode it was in and keeps the display value it had when the OPEN was applied. The unit detects the Data Terminal Ready line on pin 4 of the DB-9 connector to freeze the encoder output

5. PROCESS CONTROL

5.1 Monitor Indicators

The monitor functions can be very useful in detecting and correcting many etcher situations which can cause quality and yield problems. Table 5.1 summarizes these functions and what they tell about the etching process.

Table 5.1 Process monitor functions

AUTO PUMP	HIGH	LOW	ALARM	SITUATION DETECTED AND possible corrective actions
on				NORMAL OPERATION, ETCHANT DENSITY IN BALANCE no action required
on	on			NORMAL REPLENISHER FEED no action required
on	on		on	INSUFFICIENT REPLENISHER REACHING SUMP AND PUMP HAS RUN MORE THAN 5 MIN. CONTINUOUSLY check replenisher supply, plumbing, pump, pump size
on	on	on	on	INSUFFICIENT REPLENISHER REACHING SUMP, PUMP HAS RUN 5 MIN. AND DENSITY IS 0.3 DEGREES BAUME ABOVE SET POINT check replenisher supply, plumbing, pump, pump size
on		on	on	DENSITY ABOVE SET POINT BUT PUMP NOT POWERED check pump relay
on		on	on	LOW DENSITY 0.3 DEG. BAUME BELOW SET POINT DUE TO: NO OR LOW SOLUTION IN CONTROL cancel alarm and wait for control tank to fill or if that doesn't work check etchant connection to control

ETCHER SUMP HAS BEEN OVER REPLENISHED
check for excessive manual operation
check for possible replenisher syphoning and if
found install a check valve or a syphon vacuum
break
WATER INTRUSION INTO ETCHER
check for leaks, rinse spray being drawn into
etchant, or excessive water on parts being fed in
LARGE AMOUNT OF AMMONIUM HYDROXIDE ADDED TO SUMP
correct excessive ammonia loss or use anhydrous
ETCHANT CONTROLLER TURNED ON DURING HEAT-UP PROCESS
instruct operator

on MANUAL MODE OF OPERATION
none

on on MANUAL OPERATION FOR OVER 5 MIN.
instruct operator

5.2 Chart Recorder

If the chart recorder output is connected to a recorder, the plots can be used to track the process and optimize etcher usage. When an etcher is started for the first time in a day the etchant chemistry normally takes a few minutes to stabilize to its steady state condition and nearly constant Baume with small fluctuations as the replenisher pumps cycle on and off. For this reason it is a good idea to run less critical work during the stabilization period and save the most critical work with the finest lines for the later part of an etcher run cycle. The chart recorder will help reveal how long the etchant takes to stabilize.

5.3 Process Data Collection Software

The Optrol Etchant Control/Monitor Process Data Collection Software offers the ability to collect and display data on the process to help better manage it.

As long as the software is running and the controller is turned on and properly connected, data is being fed from the process to the PC recording the Baume reading from the monitor and the status signals (high, low, auto, pump, alarm).

At any point in the data collection process you may invoke a series of menus that allow you to view, sort, and display the data in chronological order or broken down by shift. Data from a user-selected time period can be printed in the form of a strip-chart to be used for analyzing production or as a proof of process control precision for customers.

5.3.1 Computer System Requirements

To run this software you must have the following:

1 - IBM-compatible personal computer (XT, AT, or PS/2)*
2 - One (1) serial port, 9-pin
3 - One floppy or hard disk drive
4 - One Optrol Model 120 Etchant Control/Monitor

* IBM, XT, AT, and PS/2 are registered trademarks of International Business Machines, Incorporated. QBASIC is a registered trademark of Microsoft Corporation.

Hookup Procedure

Be sure the Optrol Model 120 Etchant Control/Monitor is connected according to its instructions and seems to be functioning properly. There should be two unused cables coming from the back of the monitor. Select the unused cable that terminates in a 9-pin DIN (D-shaped) connector and insert it into the matching receptacle on the back of your computer. If there is no matching receptacle, attach a 9-pin to 25-pin converter between the cable and computer. If there is no receptacle to match either the 9-pin or 25-pin connector, see Section 5.3.1.

If the computer is located a long distance from the monitor, you may purchase an extension cable from your local computer dealer.

5.3.3 Program Installation

The program can be installed to run from a hard drive, from a single floppy drive, or from 2 floppy disk drives.

5.3.3.1 Hard Drive Installation

Create a directory for the PDC program and data.
at the C:\> prompt type

MD PDC <enter>

Get into the PDC directory by typing

CD PDC <enter>

Insert the program disk supplied into the A drive. Copy the files onto the hard disk by typing

COPY A:*.* <enter>

You can verify that the files have been copied by typing at the C:\PDC> prompt

DIR <enter>

You should see the following files

PDC.EXE
PRNCODES.OKI
SEND-RX.EXE
SPC.DAT
SEND-RX.BAS

To run the program type

PDC <enter>

5.3.3.2 Floppy Drive Installation - One Drive

Start up the computer with a system boot-up disk. To make a working copy of the PDC program disk, insert a blank disk into the A drive and type

FORMAT A:/S <enter>

Insert your formatted PDC working disk in the drive and press any key. Then copy the PDC program files to the working disk. Insert the original PDC program disk supplied into the drive and type

COPY *.* B: <enter>

Insert your working PDC disk into the drive and follow the instructions on the screen. To verify file copying with

your working PDC disk in the drive type

DIR <enter>

You should see
COMMAND.COM
PDC.EXE
PRNCODES.OKI
SEND-RX.EXE
SPC.DAT
SEND-RX.EXE

To run the program put your working PDC disk into the drive and start or reset the computer. When the DOS prompt comes up on the screen type

PDC <enter>

You will find it very useful to have a backup copy of your working disk. To make one put your working disk into the drive and type

DISKCOPY A: A: <enter>

and follow the instructions on the screen. Put the original PDC disk and your backup working disk in a safe place.

5.3.3.3 Floppy Drive Installation - Two Drives

Start up the computer with a system boot-up disk in the A drive, insert a blank disk in the B drive and type

FORMAT B:/S <enter>

Leave your formatted working disk in the B drive. Insert the original PDC program disk supplied into the A drive and type

COPY A:*.* B: <enter>

To verify copying type

DIR B: <enter>

You should see the same files as in Section 5.3.3.2. The computer starts and the program runs as in Section 5.3.3.2.

Make a backup copy of your working disk. Insert your working disk into drive A and a blank disk into drive B and type

DISKCOPY A: B: <enter>

Put the original PDC disk and your backup working disk in a safe place.

5.3.3.4 Data File

The startup data file SPC.DAT supplied has some data points from 1039 to 1140 on 08/23/91. You can use these to get a feel for the program operation. Future real data is simply added to the file up to the maximum capacity of the disk. Data should be transferred to backup media and the SPC.DAT file erased and recreated empty before the data collection disk gets completely full. If you are using floppy disks a simple method is to just use DISKCOPY to make a fresh working copy of your backup working disk. The old full disk can be stored in a safe place and easily used anytime to view historical process data.

5.3.4 General Features

5.3.4.1 User-Selected Options

Every time you run this software after it has been properly installed, you will be prompted for two pieces of information: whether or not to use sound effects, and the time interval to be used for storing control information to the disk.

If you would like the computer to mimic the monitor's alarm, answer Y to the first question. Once the software is running this sound effect can be turned off. If you choose not to have an audible alarm, it will not affect the real monitor. You may toggle the computer's alarm on and off whenever the program is on the data collection screen.

If you plan to leave the time interval at its default value of one minute (recommended), press <Enter> when asked for a new time. If you would like to change it, type the new time in minutes and press <Enter>.

5.3.4.2 Common Features

Reports are available from a hierarchy of menus. Most share certain common features that are explained below.

Dates and times

Most menu options require you to enter a range of dates and times. When requested, you have two options.

1 - You may request data from some time (military time - 1300 = 1:00 pm) on one date to any other time on a later date. If you choose this option, process data will be considered if it was collected after the first date and before the second date.

2 - You may also request data between two dates for any one of three shifts. The beginning and ending times of each shifts is entered by the user at installation.

All dates and times are checked for validity. If a date or time is entered that is non-existent, such as 02/29/91 or 07:62, it will be erased and the user will be allowed to try again.

You will also be asked whether you wish to only view a report on the screen or if a print-out will be necessary. Type P for a print-out or S to see the report on the monitor.

5.3.4.3 Entering Commands

All menus have the option to return to the previous menu by pressing Q. If Q is pressed accidentally from the initial screen, return immediately to the software by typing: run <Enter>. This must be done or data will be lost during the time the software is inactive.

All questions and menus are hot-key controlled, except when requesting the sampling interval at the beginning of the program, meaning that no <Enter> is necessary.

Pressing function key F10 will return you to the main menu from anywhere in the program.

5.3.5 Reports and Features Available

After the first time this software is run and the configuration file is in place, the screen will open up in Data Collection mode if the Model 120 is connected and powered. A simulation of the Etchant monitor will be visible. This screen constantly mocks the operation of a real monitor including flashing lights, digital readout of etchant density, and audible alarm (which can be silenced). In this mode, no menu is available. To pop up the first

menu, press <Enter>. The top-level menu and its features are explained below.

5.3.5.1 View Raw Data

For a given time interval or shift, view the data that has been collected including date and time of capture, degrees Baume', difference between display and set-point, set-point (if changed), alarm status, mode (manual/auto), and pump status.

As an example, assume the user picked first shift, July 9, 1990. A portion of the report might look like the following:

Raw Data Report 07/31/90 11:25 Page 1

Date	Time	Display	Error	Standard	Alarm	Mode	Pump on
07/09/90	14:00	25.5	0.0	25.5		A	
07/09/90	14:01	25.6	0.1			A	*
07/09/90	14:02	25.7	0.2			A	*
07/09/90	14:03	25.7	0.2			A	*
07/09/90	14:04	25.5	0.0			A	
07/09/90	14:05	25.2	-0.3		!	A	
07/09/90	14:06	25.1	-0.4		!	A	

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Note the process data that is available in just these few numbers. At 0.1 error the replenisher punp turned on as it should but Baume continued to rise and the error went to 0.2 degrees indicating that the replenisher flow rate may be a little low or that sump mixing could be impaired a little. After the error drops to 0.0 and the replenisher pump shuts off as it should the Baume continues to drop and the error goes to -0.4 degrees indicating that the replenisher just added is finally being mixed in the sump. From these numbers it is likely that the etcher's mixing pump needs attention.

5.3.5.2 Plot Raw Data

Plot Raw Data may be used to graphically illustrate data from any time period. The information included in a plot is: date, time, error from set-point, mode (auto/manual), pump status, alarm status, and whether the set-point was changed.

Shown below is the same data from above represented as a plot instead of numerically:

Raw Data Plot 07/31/90 11:30 Page 1

Date	Time	Degree Baume' from set point								M	P	Alarm	O	U	C	s
		+----+----+----+----+----+----+----+----+								D	M	O	A	t		
		-2	-1	0	+1	+2				E	P	N	N	d		
07/09/90	14:00			.						A						
07/09/90	14:01			+						A	P					
07/09/90	14:02			+						A	P					
07/09/90	14:03			+						A	P					
07/09/90	14:04			.						A						
07/09/90	14:05		-							A		!				
07/09/90	14:06		-							A		x				

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