MAKE CERTAIN THE INFORMATION
CONTAINED IN THIS MANUAL REACHES EACH
PERSON WHO MAY OPERATE OR PERFORM
SERVICE ON THIS EQUIPMENT

Model P-6708D
8" Desk-Top Precision
Spin Coating System

User's Manual

Manual Serial Number: 972310     Rev E
Volume 1 of 1

System Serial Number: 136062 - 8  Date: 9/1/00
Customer: Thayer School of Engineering

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<td>Electrical Schematic 220VAC</td>
</tr>
<tr>
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SECTION 1 SAFETY

1.1 General Hazards

Improper operation or service of this equipment can result in serious injury or death. Read and understand this manual before operating or servicing this equipment.

1. The P-6708D series spin coater is equipped with a ground type power plug, which MUST be connected to a grounded outlet to prevent electrical shock.

2. WARNING: To avoid severe injury, DO NOT touch or hold the shaft or chuck while rotating.

3. DANGER: DO NOT operate without Bowl cover in place to protect operator and others from injury as substrates may fly off of rotating chuck.

4. WARNING: To avoid electrical shock or injury, DO NOT remove cover or reach through cover, when bowl is removed, while unit is still plugged in. Before servicing the P-6708D, DISCONNECT power cord from outlet.

5. DANGER: This unit is not classified as "Intrinsically Safe." DO NOT use the P-6708D series spin coater in the presence of an explosive atmosphere.

6. IMPORTANT: If the system is equipped with the drain option, do not operate the spin coater with the drain hose disconnected from the bottom of the bowl. Operating the instrument without the drain hose will cause the material to drain into the instrument and may cause serious damage to the instrument and possible injury to the operator.

7. CAUTION: If the system is purchased with a vacuum pump, oil has to be added to the pump. Let the pump sit for six hours with the oil prior to starting the pump. See the pump manual for additional details. Pump seals will burn out if proper instructions are not followed.

Labels
Written hazard information is provided where appropriate throughout the manual and on labels on the equipment. SCS recognizes three levels of warning, that affect personnel safety. In addition, there is a warning that deals with the possibility of damaging equipment or data. Not all manuals define these terms exactly the same way; study the notices below so that you will know the importance of the written warnings as you see them.

DANGER (white on red background): Indicates high probability of death or severe injury. OSHA: “...immediate danger... special precautions necessary.”

WARNING (black on orange background): Indicates some probability of death or severe injury. ANSA: “...potentially hazardous situation... if not avoided, could result in death or serious injury.”
CAUTION (yellow on black background): Indicates possibility of moderate or minor injury. OSHA: “...warn against potential hazards or caution against unsafe practices.”

NOTICE or IMPORTANT (white on blue background): States company policy for the protection of personnel or property. Not for use with a physical hazard. OSHA: “…general instructions relative to safety measures.”

1.2 Servicing

Before servicing, remove all power. If it becomes necessary to perform diagnostic service, with certain areas of the instrument powered, use only qualified personnel. Follow all normal industrial safety practices when dealing with electrical components. Review and understand the electrical schematic before attempting any electrical diagnostic service.
SECTION 2 OVERVIEW

2.1 Description

The 6708D is a compact desktop spinner for low production spin coating applications. This model can store up to three product recipes and offers three ramp-up-and-hold steps and one ramp-down step for each recipe. The P-6708D series offers control of these parameters during a cycle:

- Spinning speeds from 100—8000 rpm,
- Ramp-Up times from 1 —30 sec,
- Ramp-Down time from 1 —30 sec,
- Hold time up to 999 sec.

Operation of the spin coater is controlled by a Programmable Logic Controller. The product recipe number, spinning speed, and process time remaining are displayed on a user interface screen. Acceleration and deceleration rates are calculated by the Programmable Logic Controller (PLC) to provide various ramp profiles.

The unit has provisions to connect a foot pedal to start the process.

Optional equipment available for the P-6708D series can provide precise control of three different coating material dispensing valves. Also available are interchangeable vacuum chucks.

Use of this instrument for anything but its intended purpose may create a safety hazard and void the equipment warranty.

2.1 About this Manual

This manual is organized as shown in the Table of Contents. Each section will be numbered and titled; the number and title will be shown on the bottom of each page to help identify where you are at any time.

A Table of Figures follows the Table of Contents to help find a figure even if the section location for the figure is not known.

An index is included at the back of the manual to help locate specific terms and concepts that might not be easily found using the Table of Contents.

These conventions may be used in this manual:

- This symbol (§) means "section." If there is a instruction to "See §3.2," that means Section 3.2.
- Special fonts may be used in the manual to mean special things.
  - Words typed LIKE THIS in capital letters refer to the name of a control as it is shown on the control panel/instrument, or the setting for the control. Example: "Press the START button."
  - Words typed Like This normally indicate words that will show up on a display screen. Example: "The display will show Repeating Cycles as long as the control is set.
  - Words typed Like this will usually refer to an entry you must type in. Example: "Enter CCW 100 when the screen asks for rotational speed."
SECTION 3 SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>100 - 8000 RPM</td>
</tr>
<tr>
<td>Acceleration</td>
<td>1 - 30 Seconds</td>
</tr>
<tr>
<td>Deceleration</td>
<td>1 - 30 Seconds</td>
</tr>
<tr>
<td>Spin Time (each step)</td>
<td>Up to 999 Seconds</td>
</tr>
<tr>
<td>Dispense times</td>
<td>1 - 10 seconds</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Depth 17&quot; (43.2cm)</td>
</tr>
<tr>
<td></td>
<td>Width 13.25&quot; (33.6cm)</td>
</tr>
<tr>
<td></td>
<td>Height 12&quot; (30.5cm)</td>
</tr>
<tr>
<td>Weight</td>
<td>52 Lbs. (23.6kg)</td>
</tr>
<tr>
<td>Power Input</td>
<td>120VAC, 60Hz, 8A, 1 Phase</td>
</tr>
<tr>
<td></td>
<td>220VAC, 50Hz, 4A, 1 Phase</td>
</tr>
<tr>
<td>Vacuum Input</td>
<td>430 to 635 mm Hg</td>
</tr>
<tr>
<td></td>
<td>(17&quot; to 25&quot; Hg)</td>
</tr>
<tr>
<td>Purge Input</td>
<td>0.5 cfm - at 2 psi Air or Nitrogen</td>
</tr>
<tr>
<td></td>
<td>5 psi maximum</td>
</tr>
<tr>
<td>Optional Features:</td>
<td></td>
</tr>
<tr>
<td>Exhaust (Hood)</td>
<td>0.5 cfm 0.5&quot; ID Tube</td>
</tr>
<tr>
<td>Drain</td>
<td>3/8&quot; OD Teflon Tube</td>
</tr>
<tr>
<td>Vacuum Pump</td>
<td>115VAC 60Hz 5.5A 1 Phase</td>
</tr>
<tr>
<td></td>
<td>220VAC 50Hz 6.2A 1 Phase</td>
</tr>
</tbody>
</table>

Note: Vacuum and purge air are required for the spin coater to operate. For safety reasons, instrument will not power up with purge air pressure of less than 2 psi.
SECTION 4  OPERATION

4.1  Control Panel

START/STOP Buttons:
Starts or Stops the spin cycle.

DV1000 User interface:
Monitors the process by displaying the Product number, RPM and the process time remaining. User can input the product recipe data through the interface keypad.

Figure 1: Start & Stop Buttons

DV-1000 User Interface

Keypad
The keypad contains ten keys, located along the right side of the DV-1000. The primary keys on the unit have a blue colored background, and are dedicated for changing the operational modes of the display. The secondary keys have a gray colored background, and are multipurpose keys used for cursor movements and incrementing or decrementing values in the display.

Figure 2: User Interface
CHG PRE (Change Preset Mode)
Press the Change Preset key to allow you access the product recipe setup parameters or select a different recipe.

MSG (Message Mode)
Press the Message key to view the process status. (Default Screen)

STAT & OPT
These keys are for diagnostic purposes only.

CURSOR ← & →
The Cursor Right and Left keys move the cursor on the numerical portion of the top line.
Note: If cursor keys are pressed in “Message Mode,” the text “TIMER” and “COUNTER” will be displayed on the screen. They serve no function in the spinning process.

+ and − Keys
After you press CHG PRE, the Plus (+) and Minus (−) keys will scroll up and down the settable variables on the display screen. Once a variable is selected (by pressing ENT) the cursor moves to the numerical data and the + and − keys will increment or decrement the setting.

ENT (Enter)
The Enter key is active when you are changing settings. It will move the cursor from the left to the right column. When the cursor is in the right column, the key will program/accept the setting and move the cursor into the left column.

CLR (Clear)
Pressing CLR will clear the screen after an error message.
4.2 Facilities Panel

**POWER:**
The switch turns the instrument power ON and OFF.

**FUSE F2:**
Replace with only an exact electrical equivalent.

**AIR 5 PSI MAX:**
This is the connection for supply air or N₂ to maintain positive pressure in the enclosure (0.5 cfm at 2 psi air or nitrogen).

**FOOT PEDAL / DISPENSER:**
1. Accepts a foot pedal to start the process.
2. Provides signals for a P-6700 material dispensing unit for dispensing up to three different materials. Note: Foot pedal may be connected through the P-6700.

**VACUUM:**
The vacuum supply connects here—1/4” OD tube fitting (430 to 635 mm Hg or 17 to 25 inches Hg).

**IMPORTANT:** See the following notice on the next page.
4.3 Vacuum Chuck

The chucks are machined to close tolerances and provide an exceptionally flat, rigid surface for mounting substrates of different sizes, weights, and shapes. The cross scroll pattern distributes the vacuum over the chuck surface to hold the substrate while spinning at high RPM. This pattern also allows rapid vacuum release.

Proper chuck selection should be based upon substrate size and rigidity. The proper chuck diameter is 1/4 to 1 inch (0.6 to 2.5cm) smaller than the substrate diameter. The entire substrate should be supported if it is flexible, fragile, or when it is to be wiped or brushed during cleaning. Proper centering is done manually, but the use of templates and measurements can aid in this operation.

4.4 Pre-Start

1. Connect vacuum and air purge supply. (See technical section, and pump operation instructions for starting the vacuum pump.)
2. Attach spin coater (and vacuum pump, if so equipped) power cord to properly grounded outlet.
3. Verify that the vacuum chuck is secure.
4. Turn power ON using the POWER switch located on the rear panel.
5. If equipped with exhaust option, attach the exhaust hose to the bowl.

4.5 Process Setup

When the instrument is turned on the following message will appear on the screen:

SPECIALTY COATING SYSTEMS
VERSION 2.0
MODEL P-6708D

After five seconds the display will change to:

| RECIPE | 1 | (Current product recipe) |
| RPM | 0000 | (Current RPM of the chuck) |
| TIME | 0000 | (Time remaining to complete the process) |
| PRESS START/ TO INITIATE | (To start the process, push the process START pushbutton) |

See the following section of this manual for instructions on selecting an existing recipe or entering/revising a recipe.
If the recipes are already stored, the desired product recipe can be selected; a new recipe or a revision can be initiated by pressing the CHG/PRE button on the keypad.

Understanding Recipe Parameters
The following are the parameters you can change. Refer to the figures on the following pages to see where the parameters apply in typical spin cycles.

- **RECIPE #** is the name given to a set of parameters. Selecting a recipe will select all the timing and rpm settings that go with that recipe.
- **RPM1, RPM2, and RPM3** set how fast (revolutions per minute) the chuck spins during each of the three segments of the cycle.
- **TIME1, TIME2, and TIME3** set how long (in seconds) the chuck will hold each speed.
- **RAMP1, RAMP2, and RAMP3** set approximately how long (in seconds) it will take the chuck to reach each speed. **RAMP4** tells how long it will take the chuck to slow down to a complete stop.
- **SOLVENT, N2, and COATING** set how long (in seconds) the cycle will spend to allow dispensing these three materials. (An optional precision dispensing device is available from SCS. It responds to the settings of the spin coater.) If a parameter is set to zero, that operation will be skipped.

**NOTE:** Before actually setting any recipes, refer to the programming section, which follows this one. There are programming interactions and options that can effect the actual cycle results.
Setting The Parameters

You can set the parameters using the 10 keys next to the display screen. This procedures

tells how to change the recipe or its parameters or to view the current settings:

1. To enter the programming mode, press **CHG PRE**. This changes the display

   screen to a parameters display. A flashing cursor will be in the left column, at the

   word RECIPE.

   ![Parameter Display]

   Figure 4: Parameter Display

2. To locate a specific parameter line, press the + and - keys. This moves up or
down to the desired parameter. (But only if the cursor is in the left column.)

3. To access the parameter numbers, press **ENT**. This moves the cursor to the right
column where the numbers are.

4. To select parameter digit, use the arrows to move the cursor. (To change an rpm
   from 2000 to 4000, put the cursor on the "2.")

5. To raise or lower a value, use the + or - keys. The number will count up or down.

6. Repeat for other digits in that parameter. (If necessary to change other numbers.)

7. To accept the new setting press **ENT**. The cursor will move back to the left
column. (You can only go up and down to other parameters if the cursor is in the
   left column.)

8. Move to another parameter use the + and - keys OR... (if you are done making
   changes)

9. To accept and return to operation mode, Press **MSG**

When you return to normal operation and the display changes back to Message mode, the
system will be set to the Recipe and parameters that were last on the display. If you made
changes to Recipe 3 and exited, the system will be set to run Recipe 3; if you modified
Recipe 3 but intend to run Recipe 1, then you must set to Recipe 1 before you press **MSG**.
Programming Spinner Cycles
The following pages deal with more about how to set (or “program”) instructions into the spin coater, and how the instrument responds under different circumstances.

Example: Cycle Without Dispensing
If SOLVENT*, N2*, and COATING* are set to zero, the spin coater rotation will follow the simple cycle chart (Figure 5). Each of the labels on the chart is the name of a parameter that you can set by editing/programming the Recipe.

*Note: The spin coater can control an optional precision dispensing device available from SCS.

Note the limits for the different variables. You cannot program numbers that are outside these ranges.

RPM1 must be between 100 and 2000 rpm.
RPM2 must be equal to, or larger than, RPM1, with a maximum of 4000 rpm.
RPM3 must be equal to, or larger than RPM2, with a maximum of 8000 rpm.
TIME1, TIME2, TIME3 can be set from 1 to 999 seconds.
The RAMP variable settings can be from 1 to 30 seconds to allow the chuck to speed up (or slow down for RAMP4 only) to the next RPM.

Figure 5: Cycle Without Dispensing
Example: Cycle With Dispensing

If the dispensing equipment is installed, the dispensing options (SOLVENT, N2, and COATING) can be enabled. To enable an option, set it to a number that is not zero (numbers 1 through 10 seconds are acceptable). Figure 6 shows the cycle that would occur if all options were enabled.

Note that the cycle returns to RPM1 a second time [TIME1(B)] for N2 and/or COATING.

Figure 6: Cycle With Dispensing

In this configuration, some of the timing of the different parts of the cycle are more complex to figure out. The “limits” are still true; but in addition, TIME1(A) and TIME1(B) are affected by the settings of the options. Each time must be long enough to allow the Option(s) to run completely. The table shows how the time is determined, and where the selected dispense options occur in the cycle.

<table>
<thead>
<tr>
<th>Options Enabled</th>
<th>The PLC automatically makes TIME1(A) to be the longer of these two...</th>
<th>The PLC automatically makes TIME1(B) to be the longer of these...</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLVENT, N2, COATING</td>
<td>SOLVENT or TIME1</td>
<td>(N2 + 2* + COATING) or TIME1</td>
</tr>
<tr>
<td>SOLVENT, COATING</td>
<td>SOLVENT or TIME1</td>
<td>COATING or TIME1</td>
</tr>
<tr>
<td>SOLVENT, N2</td>
<td>SOLVENT or TIME1</td>
<td>N2 or TIME1</td>
</tr>
<tr>
<td>COATING (only)</td>
<td>COATING or TIME1</td>
<td>Not Used**</td>
</tr>
<tr>
<td>SOLVENT (only)</td>
<td>SOLVENT or TIME1</td>
<td>Not Used**</td>
</tr>
</tbody>
</table>

*When N2 and COATING are both enabled, 2 seconds are required between the operations.

**When only using COATING or SOLVENT the chart looks like the first chart (without the “valley”).
In the following cycle example: the TIME settings are all set to 8 seconds; SOLVENT, N2, COATING are all set to 5 seconds; and RAMPs are all set to 4 seconds.

- The first period, TIME1(A), on the chart must be long enough to allow the option time setting. (In this example, TIME1 is set to 8 seconds and SOLVENT is set to 5 seconds, so TIME1(A) will remain at 8 seconds.) If SOLVENT were 10 seconds, TIME1(A) would have to extend to 10.
- The same requirement is true for TIME1(B). It must be long enough to allow the N2, plus two seconds between operations, plus COATING, since both options are chosen. (if N2 is set for 10 seconds and COATING is set for 10 seconds, the total time for TIME1(B) will be at least 10+2+10=22 seconds; if TIME1 is set for some number larger than the operation(s) require, it will not be changed.)
- Note that TIME1 is on the chart twice. These may be different, and larger than the TIME1 setting if required. For the first TIME1(A), the system chooses the longer period–either TIME1 or SOLVENT. Similarly, for the second TIME1(B) the system

Special Programming Notes:
1. If a RAMP time is set to “1,” the coater treats it as a “0” (or instant speed change).
2. If RPM1 and RPM2 are set to the same speed, RAMP2 will not be needed or used.
3. Selecting only the COATING option (or only SOLVENT) will cause that operation to occur during TIME1(A) and there will be no TIME1(B) (“valley”) portion to the cycle.
4. Remember that a TIME1(B) with both N2 and COATING will also require 2 seconds between those two operations. (This is handled automatically.)
5. Do not rely on the time (countdown) display. The controller’s primary job is the control functions; any time display is done “when convenient” and will be inexact.
6. The actual cycle timing is very repeatable. If you decide that you need to lengthen or shorten some part of the cycle, simply edit the variables as needed and retry

### 4.6 Process Start

1. Locate substrate on the vacuum chuck (substrate must be centered for proper operation).
2. Place cover tightly over bowl.
3. Press START (Green light illuminates). The instrument will take a few seconds to check the vacuum. If the vacuum is present, spin coater will start. Spin rate is indicated on the display.
4. When the cycle time is complete, the Start LED will extinguish.
   
   **Note:** The process can be stopped at any time by pressing the STOP button.
5. Remove bowl cover.
6. Remove substrate from vacuum chuck.
7. If process is to be repeated, go to step 1.
4.7 Error Messages

If the display light does not come on after connecting the power and turning on the power switch, check that the purge air is connected and has a pressure of at least 2 psi.

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Reason</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHECK VACUUM</td>
<td>Unable to hold vacuum.</td>
<td>Make sure substrate is on the chuck.</td>
</tr>
<tr>
<td></td>
<td>No vacuum present.</td>
<td>Check the Vacuum line connection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If vacuum is lost during the cycle, instrument will stop immediately.</td>
</tr>
<tr>
<td>SHORT CYCLE</td>
<td>Unable to complete the process.</td>
<td>Loss of Vacuum.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stop button is pushed during a cycle.</td>
</tr>
</tbody>
</table>

4.8 Shutdown

1. Turn power OFF with the POWER switch located on the rear panel.
2. Carefully remove vacuum chuck.
3. Clean vacuum chuck and bowl thoroughly using the proper solvents.
SECTION 5  MAINTENANCE

5.1 Cleaning

Clean the lid and the bowl with a solvent compatible with the coating being used. When using solvents such as N-Methylpyrrolidone (NMP) take care to avoid contact with the painted surfaces. These solvents will damage/remove the paint.

5.2 Drain Option

If the spin coater is equipped with drain option, use small amount of solvent to clean the leftover material in the hose. If the material in the hose has cured, replace the hose. To replace the hose, the top cover must be removed along with the bowl. Make sure to use material-compatible hose to replace the existing hose.

! Never operate the spin coater with the hose disconnected from the bowl. It may cause serious damage to the instrument and possible injury to the operator.

5.3 Servo Amplifier

Dip Switch Setting for normal operation.

SCS setup for SW1 ➔

For more information, refer to technical manual of the servo amplifier.

5.4 Maintenance Schedule

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Task</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>Clean, Check air connections</td>
<td>Operator</td>
</tr>
<tr>
<td>Weekly</td>
<td>Check hoses &amp; fittings, electrical connections</td>
<td>Maintenance</td>
</tr>
<tr>
<td>As Needed</td>
<td>Refer to vendor literature to maintain associated components</td>
<td>As appropriate</td>
</tr>
</tbody>
</table>
SECTION 6  TROUBLESHOOTING

6.1 Possible Problems & Solutions

Refer to the following for the problem that you have encountered; the Cause/Solution portion will list possible areas that could cause the problem, or possible steps to take to correct the problem. The Problems are arranged beginning with those you would encounter when first powering up, and moving through ones you might encounter later during operation.

WARNING: Never work on the electronics of the instrument until you have first disconnected the electrical power.

Problem: Time shown on the display is inaccurate
Cause/Solution: The display time is only shown as a convenience and is not expected to provide exact information. The system internal timing is accurate however, and the operation timing in each cycle are very repeatable. Use external timers to measure system operation; if you wish to modify any timing in the cycle adjust the recipe to lengthen or shorten parts of the cycle as desired.

Problem: Instrument will not power up.
Cause/Solution: For safety reasons, the instrument will not power up with purge air pressure less than 2 psi.

Problem: System does not start after START button is pressed.
Cause/Solution: Vacuum must be present or system will not start.

Problem: Error message.
Cause/Solution: See §4.7 for error messages.

Problem: Error message “CHECK VACUUM.”
Cause/Solution: If §4.7 error messages do not point to problem, check vacuum switch VS1.

Problem: Time shown on the display is inaccurate
Cause/Solution: The display time is only shown as a convenience and is not expected to provide exact information. The system internal timing is accurate however, and the operation timing in each cycle is very repeatable. Use external timers to measure system operation; if you wish to modify any timing in the cycle adjust the recipe to lengthen or shorten parts of the cycle as desired.

Problem: Spin motor does not stop completely, or “wanders.”
Cause/Solution: Servo driver may need adjustment. See following § 6.2.

Problem: Spin Motor does not turn a exact speed.
Cause/Solution: Servo driver may need adjustment. See following § 6.2.

Problem: Spin Motor does not turn at all.
Cause/Solution: Check connections to the motor and tach.

If there are problems with the instrument review the information provided here. If assistance is not found here, contact Customer Service at (317) 244-1200 or (800) 356-8260.
6.2 Servo Amp Adjustment

If the spin motor does not stop completely or fails to turn at the correct speed, adjust the servo amp. Use the following procedure to correct for this problem.

Note: The servo board may be mounted in a different position (turned) than the one shown in the drawing. Note the position of your servo board and the location of the potentiometers; they may be adjusted from the top or from the end, depending on the position of the board.

**WARNING:** Before beginning, disconnect the electrical power to the spin coater. After step 2 you will reconnect power; those steps **MUST** only be done by qualified personnel.

1. Temporarily alter the switch wiring to the Vacuum Switch VS1 and Pressure Switch PS1. On each, change the wire from the normally open (N.O.) contact to the normally closed (N.C.) contact. This will allow operation with the covers off and without pressure and vacuum. See Figure 7.

2. Set all the SW1 dip switches to Off.

3. Turn POT5 (stability) CW until the motor becomes unstable (oscillates). Then turn POT5 CCW until the motor stabilizes. Turn the POT5 another ½ turn CCW.

---

**Figure 7: Pressure & Vacuum Switches**

2. Set all the SW1 dip switches to Off.
3. Turn POT5 (stability) CW until the motor becomes unstable (oscillates). Then turn POT5 CCW until the motor stabilizes. Turn the POT5 another ½ turn CCW.
4. Check to see if the motor shaft is stationary. If not, adjust **POT1** (offset) until the shaft stops completely. Run the motor (4000 - 5000 rpm) for 30 minutes and readjust **POT1** as needed to stop the shaft again.

5. Set for an RPM3 of 8000 rpm and a long run time, and run the cycle. Check the motor speed; if the speed is not 8000 rpm, adjust **POT2** (gain) to get the proper speed.

6. With the motor running, turn **POT3** (current limit) CCW until the motor starts to slow down. Then turn **POT3** CW 2 turns.

**Figure 8: Servo Board**

7. Recheck the speed at 8000 rpm. If necessary, readjust **POT2** to set the speed within ±25 rpm.

8. Start a cycle. Push **STOP** while the motor is running. The display should show the "SHORT CYCLE" error message.

9. **WARNING**: DISCONNECT POWER. Then reconnect the VS1 and PS1 wiring to the Normally Open (N.O.) contacts.

10. Return power to the instrument.
## SECTION 7 SPARE PARTS

### REPLACEMENT PARTS LIST

<table>
<thead>
<tr>
<th>SCS PART#</th>
<th>DESCRIPTION</th>
<th>MANUFACTURER</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>269-042</td>
<td>MAIN FUSE 8A</td>
<td>BUSSMAN, MDA8</td>
<td>1</td>
</tr>
<tr>
<td>269-1003</td>
<td>FUSE 3/8A</td>
<td>BUSSMAN, MDA3/8</td>
<td>1</td>
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<tr>
<td>PP-106-1033-0</td>
<td>ON/OFF SWITCH WITH FUSE</td>
<td>PANEL COMPONENT</td>
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<tr>
<td>490-043</td>
<td>MOTOR DC PM</td>
<td>DYNETICS, 22083</td>
<td>1</td>
</tr>
<tr>
<td>PP-742-1003-0</td>
<td>PRESSURE SWITCH **</td>
<td>DWYER, 17110-0</td>
<td>1**</td>
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<tr>
<td>PP-742-1005-0</td>
<td>PRESSURE SWITCH</td>
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<tr>
<td>PP-780-1001-0</td>
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<td>PP-146-1004-0</td>
<td>SOLENOID VALVE 24VDC</td>
<td>MAC, 35A-AAA-DDAA-1BA</td>
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<tr>
<td>PP-137-1001-0</td>
<td>FREQUENCY TO VOLTAGE CONVERTER</td>
<td>CALEX, F-V8509</td>
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</tr>
<tr>
<td>PP-209-1006-0</td>
<td>DIGITAL DISPLAY</td>
<td>PLCDIRECT, DV1000</td>
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<td>PP-744-1023-0</td>
<td>START/STOP PUSHBUTTON</td>
<td>A-B, 800EP-LU2C23</td>
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<td>PP-744-1026-0</td>
<td>LED 24VDC</td>
<td>800E3DL3GX11</td>
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<td>447-006</td>
<td>RUBBER FEET</td>
<td>HH SMITH, 2135</td>
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<td>431-007</td>
<td>PORCELAIN KNOB</td>
<td>PORCELAIN, 70634-30</td>
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<tr>
<td>951-650</td>
<td>8&quot; BOWL TEFLOWNATED</td>
<td>SCS</td>
<td>1</td>
</tr>
<tr>
<td>951-651</td>
<td>8&quot; SPINNER BOWL COVER</td>
<td>SCS</td>
<td>1</td>
</tr>
<tr>
<td>837-1001</td>
<td>3/8&quot; OD Teflon Tube</td>
<td>SCS</td>
<td>4 ft</td>
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<tr>
<td>131-010</td>
<td>Delrin Insert for vac. chuck</td>
<td>Headway</td>
<td>1</td>
</tr>
<tr>
<td>131-011</td>
<td>Insert Pin</td>
<td>Headway</td>
<td>1</td>
</tr>
<tr>
<td>131-024</td>
<td>Skirt, Chuck</td>
<td>Headway</td>
<td>1</td>
</tr>
</tbody>
</table>

** Ref. Only (part was used on older unit)
APPENDIX

LIMITED WARRANTY POLICY

I. Subject to the limitations hereinafter set forth, SPECIALTY COATING SYSTEMS ("SCS") warrants that all component parts manufactured by SCS are free from defects in materials and workmanship for a period of twelve (12) months from the date of shipment. SCS will replace materials for a period of twelve (12) months from the date of shipment, and provide labor, if required, for a period of six (6) months from the date of shipment to correct warranty defects.

II. Components such as instruments, pumps, motors and valves are warranted by their respective manufacturers and these warranties are extended to the end user.

III. If, within the warranty period, any equipment or components manufactured by SCS shall prove to SCS’s satisfaction to be defective, such equipment or parts shall be replaced or repaired, at SCS’s option, at SCS’s expense. Installation of replacement equipment or parts shall be at the Purchaser’s expense.

IV. The foregoing warranty shall be limited with respect to parts which are subject to wear or chemical reactions or which have a variable life expectancy, including but not specifically limited to, protective coatings, thermocouples, heaters, seals, o-rings, drive belts, relays, lamps and bearings (but not including filters) to a period of ninety (90) days from the date of shipment.

V. SCS’s obligation hereunder shall be limited to repair or replacement, F.O.B. SCS’s factory, and shall be conditioned upon receipt of written notice of such defect within ten (10) days after its discovery. Prior written approval is required, for return shipment of equipment or components to SCS at SCS’s expense.

VI. This warranty shall not apply to equipment or parts which have been repaired or altered by any party other than SCS as, in SCS’s judgment, adversely affects the same, or which shall be subject to negligence, accident, damage or circumstances beyond SCS’s control (including fire, earthquake, flood or other acts of God), or improper operation, maintenance or storage, or to other than normal use of service. Improper operation of equipment or any part thereof shall include, without limitation, operation under loads, speeds, pressures or electrical current characteristics, or with supplies not complying with SCS’s specifications.

VII. SCS will not accept responsibility for repairs or the cost of any work done without specific written SCS authorization.
VIII. This warranty does not apply to used or second-hand equipment, nor does it extend to any person other than the original Purchaser.

IX. This warranty does not apply to equipment which is broken or damaged in transit. In no event shall SCS be responsible for any liability, loss or damage of such equipment delivered in good order and condition to a carrier or carriers at any point of shipment.

X. This warranty shall not cover, and SCS shall not be liable for, losses of supplies or time, damages to materials, or consequential damages of any nature, arising from or attributable to equipment sold to the Purchaser by SCS. This warranty is strictly limited to the replacement or repair of the equipment or parts purchased.

XI. SCS's liability to the Purchaser arising out of the supplying of this equipment or its use, whether based on warranty, contract, or negligence, shall not in any case exceed the cost of correcting defects in the equipment as herein provided, and upon expiration of the applicable warranty period as aforesaid, all such liability shall terminate.

XII. EXCEPT AS OTHERWISE SET FORTH IN THIS LIMITED WARRANTY, THE EQUIPMENT AND PARTS SOLD BY SCS TO PURCHASER ARE SOLD "AS IS" AND "WHERE IS" AND "WITH ALL FAULTS," AND SCS DOES NOT MAKE AND SHALL NOT BE DEEMED TO HAVE MADE, AND SCS HEREBY DISCLAIMS, ANY REPRESENTATION OR WARRANTY, EXPRESSED OR IMPLIED, REGARDING THE DESIGN, CONSTRUCTION OR CONDITION OF, OR THE QUALITY OF MATERIAL OR WORKMANSHIP IN, THE EQUIPMENT OR PARTS, AND SCS MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS OF THE EQUIPMENT OR PARTS FOR ANY PARTICULAR PURPOSE.

SPECIALTY COATING SYSTEMS
5707 West Minnesota Street
Indianapolis, IN 46241

Telephone: 317-244-1200
Fax: 317-240-2073
Forms

TO SAVE YOUR OWN TIME...

please refer to the following questionnaire before contacting SCS for customer assistance. It tells you what information you will need in order to complete any transactions with SCS. Fill it out even if you intend to communicate by phone; this will enable you to have all the necessary information available to complete the transaction on the first call. REMEMBER you need authorization before attempting a return.

About You...

Company Name __________________________
Address __________________________________________
City ___________________ State ____ Zip _______

Contact Name ________________________________
Position/Title __________________________________
Phone (____) ________________

About the Equipment...

Equipment Type/Model __________________________
Serial Number _________________________________
Specialty Coating Systems representative (if known)

About Us...

Before taking any other steps, call or fax this information to Specialty Coating Systems, Customer Service.
Voice: (317) 244-1200 or (800) 356-8260
FAX (317) 240-2739

Address:
Specialty Coating Systems
5705 W. Minnesota Street
Indianapolis, IN 46241
Vendor Literature

SERVO AMPLIFIER
VACUUM PUMP

DYNETIC 701
GAST
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   Voltage-to-Current Amplifier Mode  
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1.0 DESCRIPTION:

Dynetic 700 Series Servo Amplifiers are Pulse Width Modulated (PWM) and designed to drive our Dynetic D.C. servo motors.

All models are fully protected against over-voltage, over-current, overheating, and short circuits.

Operating efficiency is over 95%.

The amplifiers can operate in Current (Torque), Velocity or Voltage modes.

A potentiometer slot on the side of the module is provided for compensation or tuning.

1.a. Terminal Identification:

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>+10V outputs. P2-3 is signal ground.</td>
</tr>
<tr>
<td>P3, P4, P5</td>
<td>-5 &amp; -6  Differential signal inputs to the pre-amp.</td>
</tr>
<tr>
<td>P3, P4, P5</td>
<td>-3 &amp; -4  Tachometer inputs.</td>
</tr>
<tr>
<td>P3, P4, P5</td>
<td>-7  Inhibit—it turns off all four mosfets of the &quot;H&quot; bridge when activated. Connecting it to +5 or +15 Volts disables the amplifier module.</td>
</tr>
</tbody>
</table>

2.0 SPECIFICATIONS:

The data sheets in the appendix define the performance specifications of these amplifiers and also provide technical and descriptive information about the products.

3.0 MODE SELECTION:

Dynetic 700 Series Amplifiers operate in the following modes:

- Voltage-to-VOLTAGE Amplifier Mode
- Voltage-to-SPEED Amplifier Mode
- Voltage-to-CURRENT Amplifier Mode (Torque Mode)
- Digital Position Loop Mode.

3.a. Voltage-to-Voltage Mode:

In the voltage-to-voltage mode, the reference input voltage commands a motor voltage. However, if there is a load torque variation, the motor current will vary, as torque is proportional to motor current. Since the motor windings have resistance, the actual motor voltage is reduced by the product of motor current and resistance. Thus, motor speed—which is proportional to motor voltage (terminal voltage minus IR drop)—varies with the load torque.
In order to compensate for the internal motor voltage drop, a voltage proportional to motor current can be added to the reference voltage. The amount of compensation is adjusted inside the amplifier. Be very careful when adjusting the IR compensation level. If the feedback voltage is high enough to cause a rise in motor voltage with increased motor current, instability occurs. Such result is due to the fact that increased voltage increases motor speed and thus load current which, in turn, increases motor voltage.

If a great deal of motor torque change is anticipated, it may be wise to consider the addition of a tachometer to the motor.

Voltage mode can be selected for Dynetic 700 Series by setting SW3, SW7 or SW11 ON. IR compensation is selected by setting SW4, SW8, or SW12 ON. Adjust the IR compensation with P4, P9, or P14, respectively.

3.b. Voltage-to-Speed Mode:

The addition of a tachometer to the motor shaft produces a voltage proportional to speed. With this addition, the tachometer output voltage is replaced by the motor terminal voltage as the controlled variable. Since this voltage is proportional to the motor speed, the operating mode is voltage-to-speed.

Note that the speed is dependent on terminal voltage and motor current. The motor current is, in turn, dependent on the load torque, which includes both constant friction torque and the torque to accelerate or decelerate the load. Thus, the inclusion of these parameters in the control loop may give rise to instability. In general, compensation of a tachometer feedback system is more complex than that of the voltage-to-voltage mode. This is the default mode of these amplifiers. See "Compensation Adjustments" section for procedure.

3.c. Voltage-to-Current Mode (Torque Mode):

The voltage-to-current mode produces a torque output from the motor proportional to the reference voltage input. D.C. motor torque is always proportional to the motor current. This mode is particularly important if the servo amplifier is used with a position controller (under this condition, a movement of the motor shaft from the desired position causes a large correcting torque or "stiffness"). This mode can be selected by setting SW2, SW6 or SW10 ON.

3.d. Digital Position Loop Mode:

When connecting the amplifier to any position controller, the type of command from the position controller must be known, i.e., velocity command, current command, or voltage command. Select the required mode.
4.0 WIRING INSTRUCTIONS:

4.a. Precautions:
Do not install the amplifier without first determining that power has been removed for at least 10 seconds. Never remove an amplifier from an installation with power applied. The following sections must be reviewed before installing it to ensure reliable operation.

4.b. Minimum Inductance Requirement:
Dynetic Systems Servo Amplifiers deliver a pulsed output that requires a minimum amount of series inductance to ensure that the D.C. motor current is properly filtered. The minimum inductance value is 200 micro-Henries. All Dynetic Systems motors recommended for use with this amplifier already meet this requirement.

4.c. Motor Wiring:
Use of a twisted, shielded pair for the motor power cables is recommended but not necessary. Ground the shields at both ends to the amplifier's power ground pin P2-3 and the motor frames. The motor itself is connected to amplifier output pins P2-1 and P2-2. If the motor case is not connected to an earth ground or safety ground, please consider connecting it in order to minimize electrical noise and reduce shock hazards.

4.d. Tachometer Wiring:
Use of a twisted, shielded pair for the tachometer wires is recommended but not mandatory. Ground the shield at one end only to the amplifier's signal ground pin P2-3. Connect the tach wires to pins P3, P4, and P5, -3 and -4, respectively.

4.e. Reference Input Wiring:
Use of a twisted, shielded pair for the reference input wires is recommended but not mandatory.
5.0 AMPLIFIER ADJUSTMENT (TUNING) PROCEDURE:

5.a. Initial Power-On Test:

**CAUTION:** THESE INITIAL ADJUSTMENTS SHOULD BE PERFORMED WITH THE MOTOR UNCOUPLED FROM THE MACHINE.

With a zero speed command applied, momentarily apply power to the amplifier. If, upon application of power, the motor rapidly accelerates, a runaway condition exists, due most likely to the reversal of either motor or tachometer wiring. If the motor and tachometer are properly connected and the amplifier is functioning normally, the motor shaft will remain stationary. The shaft can drift slightly in either direction. Trim the "offset" (balance) potentiometer for minimum amplifier output current by observing motor drift with REF inputs grounded.

If the motor does not run away but emits a high pitched squeal, turn loop gain potentiometer (on the side of the module) CCW until it stops.

5.b. Compensation Adjustments (Voltage-to-Speed Mode):

Servo system performance can be judged by the following three characteristics:

- Stability
- Accuracy
- Responsiveness without overshoot

It is a short and straightforward process to meet all three of these criteria. The process involves obtaining a stable servo using the compensation adjustment while optimizing the response of the system.

For this purpose, it is necessary to be able to feed in a small step at the reference input and observe the feedback signal on an oscilloscope at pins P3-3, P4-3, or P5-3. Set the compensation adjustment to obtain a properly compensated response. This will be the fastest response without overshoot. If the system is under-compensated (slow response without overshoot), turn the compensation pot (on the side of the module) CW. If it is overcompensated (overshoot and oscillation), turn the compensation pot CCW.

**NOTE:** In most applications, the compensation can be adjusted by rotating the potentiometer on the module CW until the motor oscillates audibly and then backing off until it stops. This simple procedure also applies to voltage-to-voltage mode.

Contact factory for custom compensation.

5.c. Current Limit Adjustments:

If overheating occurs due to extremely harsh operating conditions, the internal analog temperature sensor automatically reduces the current limit to a safe level without interrupting operation or damaging the amplifier.
It is important to set the current limit so that the instantaneous motor current does not exceed the specified motor peak current. Should this occur, the motor magnets can be demagnetized.

The current limit can be reduced by connecting an external resistor between pins P1-8 and P1-9 (see data sheets for values).

6.0 TROUBLESHOOTING:

6.a. Overload Fault:

1.) Verify to see if the motor shaft rotates freely with no power applied. The load on the motor must be free of jams.

2.) Verify that the minimum inductance requirement is met.

6.b. Case Temperature:

Verify that the case temperature is less than 75 °C.

6.c. Over-Voltage Shutdown:

1.) Check the power input voltage for a value in excess of those listed in data sheets. If larger than listed, check the A.C. power line connected to the power supply for proper value.

2.) Check the regenerative energy absorbed during deceleration. This is done with a voltmeter or scope monitor of the power supply voltage. If the supply voltage increases above 85 Volts, then additional power supply capacitance is necessary. Additional capacitors must be electrolytic type and located as close to the amplifier as possible.

6.d. Under-Voltage Shutdown:

Verify power supply voltages for minimum conditions.

6.e. Short Circuit Fault:

1.) Check each motor lead with respect to motor housing and power ground for shorts.

2.) Measure motor armature resistance with the amplifier disconnected between motor leads.

6.f. Status: Check inhibits for proper input.
6.g. Causes of Erratic Operation:

1.) Improper grounding.
2.) Noisy command signal. Check for system ground loops.
3.) Mechanical backlash, deadband, slippage, etcetera.
4.) Excessive tachometer noise.

7.0 CAUTIONARY NOTES:

7.a. DO NOT REVERSE THE POWER SUPPLY LEADS!

7.b. DO NOT SPIN THE MOTOR WITHOUT POWER!

If the motor shaft is rotated without amplifier power applied, the motor acts as a generator and will charge up the power supply capacitors in the amplifier. A high motor speed may cause over-voltage breakdown in the power transistors. Note that an amplifier having an internal power converter that operates from the high voltage supply will become operative.

7.c. DO NOT SHORT THE MOTOR AT HIGH SPEED!

When the motor is shorted, its own generated voltage may produce a current flow as high as 10 times the amplifier peak current. The short itself should not damage the amplifier but may be bad for the motor. If the connection arcs or opens while the motor is spinning rapidly, this high current flows back into the amplifier due to stored energy in the motor's inductance and may damage the amplifier.

8.0 MOUNTING DIMENSIONS:

[Diagram showing mounting dimensions]
9.0 WARRANTY:

Dynetic Systems Company warrants its product to be free from defects under normal use and is limited to replacing or repairing at its factory any of its products which are returned to the factory of origin within one (1) year after shipment, transportation charges prepaid, which are disclosed to Dynetic Systems Company's satisfaction to be defective. This warranty supersedes all other warranties, expressed or implied, including any implied warranty or fitness for a particular purpose, and all other obligations or liabilities on the part of Dynetic Systems Company and it neither assumes nor authorizes any other person to assume for the seller any other liabilities in connection with the sale of the said articles.

The original warranty period is not extended by the above mentioned provisions for any replaced or repaired articles. This warranty shall not apply to any products that have been subjected to misuse, negligence, or accident.

10.0 APPENDIX:

See data sheets beginning on Page 9.

<table>
<thead>
<tr>
<th>OPERATING MODES</th>
<th>AMP #1</th>
<th>AMP #2</th>
<th>AMP #3</th>
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<td>Current Mode</td>
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<tr>
<td>Voltage Mode</td>
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</tr>
<tr>
<td>IR Compensation</td>
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<td>Tachometer Mode</td>
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<td>Test Mode</td>
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</tr>
<tr>
<td>Position Mode</td>
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</tbody>
</table>
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0823 and 1023 Exploded View and Parts Ordering Information .................................. 5
Kit Installation, Troubleshooting, and Service Facilities ........................................... 6

KEEP THIS DOCUMENT FOR FUTURE REFERENCE
This is the hazard alert symbol: ▲ When you see this symbol, be aware that personal injury or property damage is possible. The hazard is explained in the text following the symbol. Read the information carefully before proceeding.

The following is an explanation of the three different types of hazards:
- ▲ DANGER: Severe personal injury or death will occur if hazard is ignored.
- ▲ WARNING: Severe personal injury or death can occur if hazard is ignored.
- ▲ CAUTION: Minor injury or property damage can occur if hazard is ignored.

GENERAL INFORMATION
This pump is only to be used for the purpose of pumping air and under no circumstances be used with any other gases. The pump must not be used for the pumping of fluids, particles, solids or any substance mixed with air, particularly combustible substances likely to cause explosions. Your rotary pump is a precision product with only .0015” - .005” total clearance at the top and ends of the rotor (depending on the model). The unit is built of steel and cast iron and is designed for pumping dry air. Protect it from excessive dirt and moisture, give it proper lubrication and care, and you will receive years of trouble free service.

▲ DANGER: Do not pump flammable or explosive gases or operate the unit in an atmosphere containing them.
▲ CAUTION: The exhaust air of this pump can become very hot. Do not direct exhaust air towards property that is temperature sensitive.
▲ CAUTION: The pump is designed for air only. Do not allow corrosive gases or particulate material to enter the pump. Water vapor, oil-based contaminants, or other liquids must be filtered out.

Ambient temperature should not exceed 40°C (104°F). For operation at higher temperatures, consult the factory. Performance is reduced by low atmospheric pressure found at high altitudes. Consult a Gast distributor for details.

This unit requires lubrication. Failure to properly lubricate will cause pump failure. Use of the correct oil and the proper amount of oil is important. Excessive lubrication rarely does as much harm as inadequate lubrication. Gast AD220 Oil is available in convenient quart containers from the factory or through a Gast representative. A high detergent (10 wt. high detergent) automotive engine oil may be used as an equivalent to Gast part# AD220. In a high ambient location a 20 wt. oil may be used.

INSTALLATION
▲ CAUTION: Do not lift the unit by the fan shrouds. The unit should be lifted by means of the eye bolt.
▲ WARNING: To avoid risk of electrocution do not use this product in an area where it could come in contact with water or other liquids. If exposed to the elements it must be weather protected.
▲ CAUTION: Do not block the flow of cooling air over the pump in any way.
▲ WARNING: Some models are equipped with glass jars. Proper measures should be taken to guard against the fragmenting or braking of glass if an alternative material is not used.

MOUNTING THE PUMP
The pump and its solid base (preferably metal) should be anchored to either a shelf, the floor, or another piece of machinery. To save time and avoid inconvenience, position the pump to provide easy access to all lubricators, filters, and mufflers.

PLUMBING
To prevent air flow restriction, use pipe and fittings that are the same size or larger than the threaded ports of the pump. The ports are marked "IN" and "OUT". If the distance is great, use lines with a larger diameter than the connections. Give lines a uniform slope, place drain cock at low point, and avoid extra elbows. For ease of servicing, use a union or hose with clamps near the pump (a hose helps eliminate noise and vibration). If a vacuum/pressure supply tank is used, slope the line towards tank, provide a drain at the bottom, and place a check valve between the tank and pump so the pump will not run backwards when turned off.

ACCESSORIES
Intake and exhaust filters are external to the pump and will provide adequate filtration for most applications. Check filters periodically and replace when necessary. Consult a Gast Representative for additional filter recommendations. Install relief valves and gauges at the inlet or outlet, or both, to monitor performance. Check valves may be required to prevent backstreaming through the pump.

WIRING
▲ WARNING: Incorrect wiring can result in electric shock. Wiring must conform to all required safety codes and be installed by a qualified person. Grounding is required. All power to the motor must be de-energized and disconnected when servicing.
ELECTRIC MOTOR CONTROL
The motor must be protected against short circuit, overload, and excessive temperature rise. Fuses, motor protective switches, and thermal protective switches provide the necessary protection in these circumstances. Fuses only serve as a short circuit protection of the motor (wiring fault). Fuses in the incoming line should be chosen so as to be able to withstand the starting current of the motor, not as a protection against overload. Motor starters, incorporating thermal magnetic overload or circuit breakers protect the motor from overload or reduced voltage conditions. Selection of the correct overload setting is required to provide the best possible protection. Refer to the motor starter manufacturer's recommendations.

ELECTRIC MOTOR CONNECTION
Refer to the motor nameplate for wiring diagram. If the motor fails to start or slows down under load, shut the pump off and unplug. Check that the supply voltage agrees with the motor nameplate. Be sure the three-phase motor turns in the proper direction of rotation after installation. Turning in the wrong direction will drastically reduce vane life.

OPERATION
\[\text{WARNING}\] Solid or liquid material exiting the unit can cause eye or skin damage. Keep away from air stream.

\[\text{WARNING}\] Always disconnect the power before servicing. The motor may be thermally protected and will restart automatically when it cools if the thermal protection switch is tripped.

\[\text{WARNING}\] Do not operate without the shroud in place. Failure to do so could result in severe personal injury.

\[\text{CAUTION}\] Do not operate units above recommended pressures or vacuum duties. To do so will damage the unit.

\[\text{WARNING}\] Beware of any exposed and/or movable part. Proper guards should be in place to prevent personal and/or property damage.

STARTING
If the pump is extremely cold, let it warm up to room temperature before starting. If motor fails to start or hums, pull plug and check for correct current as shown on motor nameplate. If the pump does not operate properly, see the troubleshooting guide.

MAINTENANCE AND INSPECTION
Regular inspection can prevent unnecessary damage and repairs. The intake and exhaust filters require periodic inspection and replacement. Initial inspection is suggested at 500 hours, then the user should determine the frequency.

Most problems can be prevented by keeping filters clean. Dirty filters decrease pump performance and can decrease pump service life.

FILTER INSPECTION AND REPLACEMENT
\[\text{WARNING}\] The pump surfaces may become very hot during operation. Do not touch these parts until the pump has been turned off and allowed to cool.

Refer to the proper exploded view during the following procedure.

With the pump turned off and isolated from power supply, and all pressure and vacuum is released from the pump, remove the filters from the intake and exhaust filters and wash them in a solvent. When clean and dry, replace them.

FLUSHING
Flush of the pump is accomplished by removing the filter assemblies and while the pump is running, add several tablespoons or spray solvent directly into the intake port. Recommended is Gast flushing solvent part# AH2558.

\[\text{DANGER}\] Do not use kerosene, gasoline or any flammable liquid to flush unit.

\[\text{WARNING}\] Flush unit in a well ventilated area. Eye protection is recommended. Keep face away from exhaust port.

After solvent has passed through the pump, replace the filter assemblies. Before putting the pump back into service, ensure that any external accessories such as relief valves and gauges have not been damaged.

SHUTDOWN PROCEDURES
Proper shutdown procedures must be followed to prevent pump damage. Failure to do so may result in premature pump failure. The Gast Manufacturing rotary vane lubricated vacuum pumps and compressors are constructed of ferrous metals or aluminum which are subject to rust and corrosion when pumping condensable vapors such as water. Follow the steps below to assure correct storage and shutdown between use:

1. After using the pump, disconnect plumbing and allow the pump to run "open" for at least 5 minutes before shutdown.
2. Cover inlet port (vacuum side) and run pump for 1-3 minutes. Shut the pump down under vacuum.
3. This unit requires lubrication. Refill oil reservoir to proper level before storage.
4. Be sure to plug open ports so dirt and other contaminants do not enter the unit. It is now ready for shutdown.
Lubrication

Series 0323 and 0523: These models use a siphon oiler. The lubrication rate is determined by the temperature, the operating vacuum or pressure, and the siphon jar oil level. Keep the siphon jar filled to the line shown on the jar. Either unscrew the jar or fill through the spring-loaded cap.

All Models: The oil wick should be folded in half, with the two ends submerged in the oil at the bottom of the jar, and the folded center inserted into the connector approximately 3/8” past the two breather holes in the connector (but not touching the feed hole leading to the pump). Both the breather holes and the feed hole must be unrestricted.

*Consult the factory.

---

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* Denotes parts included in the Service Kit.

When corresponding or ordering parts, please give complete model and serial numbers.
Parts listed are for stock models. For specific OEM models consult the factory.
Lubrication

**Series 0823 and 1023:** These models use a constant level oiler. The lubrication rate is determined by the temperature, the vacuum or pressure at which the pump is operating, and the siphon jar oil level (determined by the vertical position of the tube in the jar).

The lower end of the tube should be 1/4" from the bottom of the oil jar for normal lubrication. To reposition the tube, loosen the locknut and adjust the sleeve up or down. Lock the new position with the locknut. For faster lubrication, raise the reservoir tube away from the bottom of the oil jar. For slower lubrication, lower the reservoir tube toward the bottom of the jar.

To replenish the oil, pull the reservoir upward out of the adjusting sleeve and turn it over. Add oil through the tube. When the upper reservoir is filled, replace it through the adjusting sleeve and firmly seat it against the top of the sleeve.

**All Models:** The oil wick should be folded in half, with the two ends submerged in the oil at the bottom of the Jar, and the folded center inserted into the connector approximately 3/8" past the two breather holes in the connector (but not touching the feed hole leading to the pump). Both the breather holes and the feed hole must be unrestricted.

### PARTS ORDERING INFORMATION

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*Denotes parts included in the Service Kit.

When corresponding or ordering parts, please give complete model and serial numbers. Parts listed are for stock models. For specific OEM models consult the factory.

*Consult the factory.
**Service Kit Installation**

NOTE: Gast will not guarantee the performance of a field rebuilt pump. You can return the pump to a Gast authorized service facility, or perform the rebuild procedures described below.

Each service kit contains most or all of the following: vanes, gaskets, oiler wick, and filter elements. Follow these general steps to install the kit:

**PUMP DISASSEMBLY:**

1. Disconnect the pump from the electrical power.

   **WARNING** You must disconnect the pump from electrical power before servicing it. Failure to do so can result in severe personal injury or death.

2. Vent all air lines to the pump to remove pressure.

   **WARNING** You must vent all air lines to the pump to remove pressure before servicing it. Failure to do so can result in severe personal injury.

3. Remove the End Plate bolts. DO NOT at any time remove the rotor or loosen any of the electric motor thru-bolts.

4. Remove End Plate and check for scoring on End Plate, Rotor, and Body. Surfaces should be smooth. If severe scoring is visible contact an Authorized Service Facility.

5. Remove vanes.

6. Clean all surfaces with Gast recommended Flushing solvent Part# AH255B and dry well.

**PUMP RE-ASSEMBLY**

7. Apply a light coat of Gast recommended Oil part#AD220, (an equivalent 10wt. high detergent oil can also be used) to the vanes.

8. Re-install vanes, noting the proper direction of the beveled edge (Refer to exploded view).

9. Install End Plate and tighten End Plate Bolts.

10. Install new cover gasket on Filter/Muffler Assembly and Lubricator.

11. Before putting the pump into service, ensure that any external accessories have not been damaged.

If the pump fails to produce proper vacuum or pressure, or is excessively noisy, turn off and return unit to an Authorized Service Facility.

**TROUBLESHOOTING GUIDE**

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<th>Reason for Problem</th>
<th>Low Vacuum</th>
<th>Low Pressure</th>
<th>High Vacuum</th>
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<th>Pump Overheating</th>
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<td>Vanes sticking</td>
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<td>Vanes worn (replace)</td>
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**AUTHORIZED SERVICE FACILITIES**

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<th>Gast Manufacturing Corp</th>
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<th>Brenner Fiedler &amp; Assoc.</th>
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<td>2900 Highway M-139</td>
<td>505 Washington Ave</td>
<td>13824 Bentley Place</td>
<td>Beech House, Knaves Beech</td>
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<tr>
<td>Benton Harbor, MI 49023</td>
<td>Carlstadt, NJ 07072</td>
<td>Campton, CA 90701</td>
<td>Business Centre, Louchwater</td>
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<tr>
<td>Tel: 616-925-6171</td>
<td>Tel: 201-933-9844</td>
<td>Tel: 800-982-5558</td>
<td>High Wycombe, Bucks HP 10 9SD</td>
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<tr>
<td>FAX: 616-327-0106</td>
<td>FAX: 201-933-5545</td>
<td>Tel: 310-404-2721</td>
<td>Tel: 44 628 522600</td>
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<td>FAX: 310-404-7975</td>
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<td>215 Brunswick Blvd.</td>
<td>5709 Coopers Avenue</td>
<td>Central PO Box 1451</td>
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<tr>
<td>Point Claire, Quebec</td>
<td>Mississauga, Ontario</td>
<td>Tokyo, 100-91 Japan</td>
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<td>Canada H9R 4T7</td>
<td>Canada LAZ 356</td>
<td>Tel: 81-3-3573-5421</td>
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<td>Tel: 514-697-9910</td>
<td>Tel: 416-213-7202</td>
<td>FAX: 81-3-3571-7865</td>
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<tr>
<td>FAX: 514-697-3070</td>
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NOTE: General Correspondence should be sent to Gast Manufacturing Corp. P O Box 57 Benton Harbor, MI 49023-0097
Product Specifications

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SOUND LEVEL: LESS THAN 70 dB(A)

NORMAL AMBIENT: 5°C - 40°C

RELATIVE HUMIDITY: 8% - 100% NON CONDENSING

ENVIRONMENT: CLEAN DUST FREE

TECHNICAL DATA SUBJECT TO CHANGE WITHOUT NOTICE.
DIMENSIONS ARE FOR REFERENCE ONLY UNLESS OTHERWISE TOLERANCED.

PART NUMBER: STD249
REVISION: B
Drawings

The following drawings/schematics are provided on the next pages, in the order listed here.

ES-810-1006-1  Schematic 120 VAC
ES-810-1006-2  Schematic 220 VAC
NOTE 1. ALL WIRES #24 AWG UNLESS NOTED

NOTE: SET SWITCHES SW1-4 "OFF"
Please note that the Index is not a substitute for the Table of Contents. Refer to the Table of Contents to locate major sections of the manual. Refer to the Table of Figures (right after the Table of Contents) to locate the pictures and charts used in the manual. Use this Index to locate special words or concepts that may be found throughout the manual.

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<tr>
<td>Cycle Without Dispensing</td>
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<td>Dispensing Options</td>
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THAYER SCHOOL PRELIMINARY PURCHASE ORDER

VENDOR: Specialty Coating Systems
ADDRESS: 5707 Minnesota St.
INDIANAPOLIS IN 46221

PURCHASE ORDER NUMBER: 60487

SALESPERSON: Len
TELEPHONE: 800-356-8260
FAX: 317-240-2739 X 284

DATE OF ORDER: 8/31/00

Description (size, cat. no., part no., etc.) Quantity Unit Price Total Price

**Please include shipping amount in total. If you do not know the exact amount please estimate.

(YOUR NAME)
Thayer School of Engineering
Dartmouth College
Hanover, NH 03755

Faculty Advisor Order and Safety Approval:

Thayer Account #: 423156-Eng189

Important-------- Please complete the section below:

☑ No hazardous materials or chemicals in this order.
☐ This order may include hazardous materials. I accept responsibility for safe use and disposal.
☐ Is this a component/fabricated piece of equipment? No ______ Yes ______ if yes, Room # ______

NOTE: Disposal costs can be many times the purchase price. Any MSDS information you receive on this order should go to the Accounting Office; please write the PO number on the top, and also keep a copy for your lab.

Have you placed the order? YES ✅ NO ❌

Does the vendor require written confirmation? YES ✅ NO ❌

This form must be returned to the Accounting Office as soon as the order has been placed. Please advise if you do not use this Purchase Order number.

Revised 2/00