APPENDIX A
CONTROL PANEL LED
OPERATING AND ERROR CONDITIONS

A.1 INTRODUCTION

The control panel LED indicators display various operating and error conditions. A summary of the displays are listed in Table A-1. The conditions are explained in the following paragraphs.

NOTE

This section uses three different graphic symbols to illustrate the status of an LED. The □ symbol means that the LED is off, and the ■ symbol means that the LED is on. If an LED is flashing on and off, the ✸ symbol is used.

Table A-1.
LED INDICATOR CODE SUMMARY

LED INDICATOR				CONDITION AND REFERENCE SECTION
RESET	LOAD	LOCAL	ENTER	
Normal Operation				
☐	■	☐	☐	Remote mode, A.2
✸	✸	☐	☐	Out of media, A.3.1
☐	■	■	☐	Local mode, A.2
☐	■	☐	■	Menu mode, A.2
☐	■	■	■	Window mode, A.2
☐	■	■	✸	Digitizer mode, A.2
✸	☐	✸	☐	Pen pause, A.2

☐ = LED off ■ = LED on ✸ = LED flashing

Table A-1 (Continued).
LED INDICATOR CODE SUMMARY

LED INDICATOR				CONDITION AND REFERENCE SECTION
RESET	LOAD	LOCAL	ENTER	
Error Conditions				
☐	✱	☐	✱	Window error, A.3.2
✱	☐	☐	✱	Pen changer status change, A.3.3
✱	☐	✱	✱	Pen changer error, A.3.3.1
☐	☐	☐	✱	NVRAM error, A.4.1
☐	☐	✱	☐	ROM error, A.4.2
☐	☐	✱	✱	RAM error, A.4.3
☐	✱	☐	☐	Communication error, A.5
✱	✱	✱	☐	Voltage error, A.6.1
✱	✱	✱	✱	Current error, A.6.2
☐	✱	✱	☐	Extended buffer error, A.7
☐	✱	✱	✱	RS-232-C loopback test error, A.8

A.2 NORMAL OPERATION LED DISPLAYS

The following LED displays occur during normal operation.

Remote Mode

This code indicates that the plotter is ready to operate in remote mode (see Section 2.2).

Local Mode

The control panel keys can be used to manually operate the plotter when this code is displayed (see Section 2.3).

Menu Mode

This code indicates that the plotter is presently in menu mode (see Section 2.4).

Window Mode

This code indicates that the plotter is in window mode (see Section 2.5).

Digitizer Mode

□ ■ ■ ✸

If this code is displayed, the plotter has received a DM/PL Digitize command and is ready to transmit x-, y-coordinate data (see Section 1.10).

Pen Pause

✸ ⊏ ✸ □

This code indicates that the plotter is being operated as a single-pen unit (or the multi-pen changer accessory is configured for single-pen operation) and is waiting for a manual pen change. To continue plotting, manually change pens and then press the LOCAL key. The pen pause feature can be disabled in the Menu by selecting the pen pause *ignore* option (see Section 2.4).

A.3 NONFATAL OPERATING CONDITIONS

The flashing LED codes listed below occur if a nonfatal operating condition is detected by the plotter. (A nonfatal flashing LED code may, however, be caused by a fatal steady state LED code as described in the following paragraphs.) A nonfatal operating condition requires operator attention to continue normal plotting activities. If a nonfatal condition occurs, correct the problem and then press the LOCAL key to continue plotting.

A.3.1 Nonfatal Chart Media Operating Conditions

The following codes are displayed if the plotter detects a nonfatal chart media operating condition.

✸ ✸ □ □

In most instances, this code simply indicates that media is not presently installed in the plotter. If media is not installed, load the plotter with a chart and then press the LOCAL key. The plotter will automatically execute a load and will then continue.

If the new chart size is changed by more than one-quarter inch when plotting media is installed, the plotter will execute a reset rather than a load. This is because the present windowing is no longer valid for the new size.

This error code has an LED steady state feature. The exact cause of the error condition can be checked by pressing the ENTER key. After the ENTER key is pressed, the plotter will exit the present flashing error code and will display a steady (non-flashing) error description code. The particular LED that remains on identifies the condition error that the plotter has detected. To return to the original flashing error code, press the ENTER key again. To resume plotting after changing charts, press the LOCAL key. The steady state LED codes are explained below.

Media Not Detected

□ □ □ ■

The above code indicates that the plotter does not detect plotting media. If media is installed, the plotter may have a hardware problem in its chart sensors and service is required (see Section 3.3).

Illegal X-axis Chart Length

□ □ ■ □

The above code indicates that the plotter does detect plotting media, but did not detect a rear chart edge within the limits of the plotter's maximum X limit. The chart presently loaded therefore has an illegal x-axis length. A hardware problem with the plotter's chart sensors can also cause the above error code. If the chart presently loaded is legal size, then service is required.

Paper Drive Hardware Failure

□ ■ □ □

This error occurs if there is a hardware problem in the paper drive mechanism or electronics. Service is required (see Section 3.3).

Optical Paper Sensor Failure

■ □ □ □

This error occurs if the optical paper sensor fails. Service is required (see Section 3.3).

A.3.2 Window Error Code

The following code is displayed if an error is detected while operating the plotter in window mode.

Illegal Clip Limits

□ ✸ □ ✸

This illegal clip limit condition occurs if the clip limits are set to less than two dimensions. This is caused by specifying one point as both the lower left and the upper right corner points of a window. To recover, either press LOCAL and specify the clip limits again or power down/up the plotter. (The window limits default to maximum at power up.)

A.3.3 Multi-Pen Changer Accessory LED Condition Codes

The following LED codes may be displayed during operation if a problem occurs with the multi-pen changer accessory.

Change in Status of the Multi-Pen Changer

✸ □ □ ✸

When the plotter is reset, it checks whether the multi-pen changer accessory is connected or not and if its pen stable assembly is in the upper or lower position. This condition occurs if the status of the pen changer has changed since the last reset.

To correct the condition, either configure the pen changer unit as it was at the last reset and then press LOCAL, or configure the pen changer to the way you want it and then press RESET or LOAD.

A.3.3.1 Multi-Pen Changer Pen Error Codes

This error condition can occur only if the multi-pen changer accessory is installed and the plotter is being operated in multi-pen mode.

The LED error code listed below indicates that the multi-pen changer unit has some type of malfunction.

✸ □ ✸ ✸

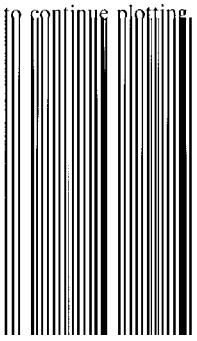
This error code has an LED steady state display. If the ENTER key is pressed one time, the plotter will display the type of error that has occurred. The four possible error types and recovery instructions are explained below. (This error code does have a second LED steady state level which displays whether the stable was moving in or out at the time of the error. If the ENTER key is pressed a second time, the code 0001 indicates that the stable was moving in, and the code 0010 indicates it was moving out. This information is useful only to service personnel.)

Overcurrent Detected During Stable Move-in

□ □ □ ■

This code indicates that the plotter detected overcurrent as the pen stable assembly was moving in toward the pen holder.

If there is a foreign object that is preventing the pen stable assembly from traveling the required length to the pen holder, then remove the object. A pen that is accidentally placed in the plotter's pen holder will also cause this error condition. After correcting the situation, refer to the recovery instructions, which follow the error type codes, to continue plotting.



Optical Sensor Error During Move-in

□ □ ■ □

This error code indicates that the optical sensor inside the pen changer unit has failed to report a pen stable move-in to the plotter.

Check the continuity of all of the wires in the cable that connects the pen changer unit and the plotter and be sure the pen changer's arm assembly is in the down position. (The optical sensors can be tested as explained in Appendix B.) After correcting the situation, refer to the recovery instructions, which follow the error type codes, to continue plotting. If the error condition continues to occur on pen changes after checking the cable and making sure the arm assembly is in the down position, then service is required (see Section 3.3).

Overcurrent Detected During Stable Move-out

□ ■ □ ⌐

This code indicates that the plotter detected overcurrent as the pen stable assembly was moving away from the pen holder.

If there is a foreign object that is preventing the pen stable assembly from returning to its home/rest position, then remove the object. After correcting the situation, refer to the recovery instructions, which follow the error type codes, to continue plotting.

Optical Sensor Error During Move-out

■ □ | | □

This error code indicates that the optical sensor inside the pen changer unit has failed to report a pen stable move-out to the plotter.

Check the continuity of all of the wires in the cable that connects the pen changer unit and the plotter and be sure the pen changer's arm assembly is in the down position. (The optical sensors can be tested as explained in Appendix B.) After correcting the situation, refer to the recovery instructions, which follow the error type codes, to continue plotting. If this error condition continues to occur on pen changes after checking the cable and making sure the arm assembly is in the down position, then service is required (see Section 3.3).

Multi-Pen Changer Pen Error Recovery Instructions

If you found that the plotter or the pen changer unit requires service to recover from a pen error, power down the plotter and refer to Section 3.3. If you have identified the cause of the error condition and fixed the problem, then follow the instructions below.

After any type of pen error, the plotter will not retry an aborted pen operation. You must manually perform the pen operatiion yourself. After using the LEDs to identify the type of error that has occurred, note the present location of the plotter pen and then refer to the following chart to determine what action is required.

Condition	Overcurrent or Optical Failure Error During Move-in	Overcurrent or Optical Failure Error During Move-out
No pen in pen holder— No pen in stall	see note 1	see note 2
No pen in pen holder— Pen in stall	see note 3	see note 4
Pen in pen holder— No pen in stall	see note 4	see note 5
Pen in pen holder— Pen in stall	see note 6	see note 7

Notes:

Note 1: Place a pen in the pen holder and then press LOCAL.

Note 2: Place a pen in the empty pen stall for future use, and then press LOCAL.

Note 3: Remove the pen from the pen stall and place it in the pen holder, and then press LOCAL.

Note 4: Press LOCAL.

Note 5: Remove the pen from the pen holder and place it in the pen stall, and then press LOCAL.

Note 6: Remove the pen from the pen stall, and then press LOCAL.

A.4 FATAL LED ERROR CODES

The following LED codes are displayed if the plotter detects a fatal error or an error condition in which the plotter cannot be properly operated. Service is required to correct the conditions listed below (see Section 3.3).

A.4.1 NVRAM Errors

□ □ □ ✸

The NVRAM is the plotter's *N*on-*V*olatile *R*andom *A*ccess *M*emory chip. This chip contains the menu-selectable parameters and certain factory-set plotter control parameters.

The above code indicates that a NVRAM error has occurred. The plotter will not operate in this condition. If this error condition occurs after the next power up, then set the power switch to off and refer to Section 3.3.

A.4.2 Fatal ROM Error

□ □ ✸ □

This code indicates that a ROM error has occurred and the ROM data is corrupted. The plotter will not operate in this condition. If this error condition occurs after the next power up, then set the power switch to off and refer to Section 3.3.

A.4.3 Fatal RAM Error

□ □ ✸ ✸

This code indicates that a RAM error has occurred and there is at least one dead cell in the system RAM. The plotter will not operate in this condition. If this error condition occurs after the next power up, then set the power switch to off and refer to Section 3.3.

A.5 COMMUNICATION ERROR CODES

The following codes are displayed if communication errors occur between the plotter and the computer. These errors are not fatal; however, the plotter cannot properly respond to computer control if communication errors occur.

Communication error checking by the plotter is useful when you are first setting up a plotter/computer interface. Communication errors most often occur when the plotter and a computer are first connected to each other. These errors are rare after a good communication link is established between the two devices.

Communication error checking must be enabled by selecting the *REPORTED* option for the menu *COMM ERRORS* parameter. After establishing a good communication link between the computer and the plotter, it is recommended to disable the communication error checking in the menu by selecting the *IGNORE* option for the menu *COMM ERRORS* parameter. A computer program that uses auto-baud will trigger errors in the plotter as it attempts to match baud rates.

If communication error checking is enabled in the menu and the following LED error code is displayed, then some type of communication error has occurred.

□ ✸ □ □

This error code has an LED steady state feature. The exact cause of the error condition can be checked by pressing the ENTER key. After the ENTER key is pressed, the plotter will exit the present flashing error code and will display a steady state LED code. The particular LED that remains on identifies the error that the plotter has detected. To return to the original flashing error code, press the ENTER key again. The steady state LED codes are explained in the following paragraphs.

Note that if multiple errors are detected, more than one LED will remain on.

It is also possible that no communication errors are reported by the plotter but the plotter still fails to respond to the host computer. This type of problem usually results from improper wiring in the computer/plotter data cable. If you suspect this is the problem, refer to your computer and software documentation and be sure that the handshake lines used by your computer and software are properly connected. This type of problem can usually be fixed by "looping back" certain lines on the computer connector end of the cable so that the computer is essentially handshaking with itself on those lines not required by the plotter but used on the computer.

Buffer Overflow

□ □ □ ■

This error occurs if a handshaking problem exists between the host computer and the plotter. The code indicates that the main data buffer in the plotter is near overflow and unprocessed buffer data will be destroyed. This is a result of the computer not acknowledging the plotter's signal to stop sending data.

If this error occurs, check the handshaking lines in the software/computer/plotter interface cable and make sure they are connected to the correct connector pins. Be sure to check the software documentation to see if it requires a specific cable configuration.

Some software use only hardware handshaking. If this applies to your software, be sure the plotter *handshake RTS/DTR* menu parameter has the *TOGGLE* option selected.

If DM/PL Mode Two communication protocol (software handshake) is being used, be sure the computer is sending 256 bytes of data (or less) between requests for room in the buffer. Also, if you wrote the plot code program, be sure you did not select illegal characters for the prompt enable or prompt request characters. DM/PL Mode One and Mode Two and the prompt enable and prompt request commands are discussed in the *DM/PL Command Language Manual* (part number MI-1044), which is supplied with your plotter.

Since this error code indicates that data corruption has most likely occurred, it is best to reset the plotter (or power down/up) before continuing.

General interface configurations are provided in this manual. Interface configurations for specific computer models are listed in Appendix E. Before building or ordering a cable, be sure to check your software documentation for possible cabling

Framing Error

□ □ ■ □

This error code indicates that a transmitted character was not framed by a stop bit. This is usually caused by the computer and the plotter having different baud rates selected. Match the baud rates by either reprogramming the baud rate in the computer or by changing the baud in the plotter menu mode.

Parity Error

□ ■ □ □

This error indicates that the transmitted parity and the received parity are mismatched. Check to be sure that the computer and the plotter are using the same type parity.

Overrun Error

■ □ □ □

An overrun error indicates that a byte of data was not read by the plotter before another byte of data was transmitted by the computer. This type of error condition is usually caused by a hardware failure and service may be required (see Section 3.3).

A.6 VOLTAGE/CURRENT ERROR CODES

The following error codes protect the plotter from damage which may result from low voltage or high current.

A.6.1 Line Voltage Too High or Low

✸ ✸ ✸ □

Your plotter is designed to operate within a window of ±10% of the allowed line voltages. If the line voltage falls below or exceeds the window allowance, the above error code is displayed.

To recover, power down the plotter and have a certified electrician inspect the ac power source from which your plotter operates.

A.6.2 High Current Detected

✸ ✸ ✸ ✸

This error code is displayed if the plotter detects high current in its electronic circuitry. To prevent damage to its electronic components, the plotter will shut down and control panel operation is inhibited.

A typical cause of a high current error code is a bind in either the pen or chart drive mechanisms. To recover from the error code, power down the plotter and correct the condition which caused the binding problem. Install a new chart and power up the plotter.

If this error occurs without apparent reason, the plotter may have an electrical or mechanical problem and requires service (see Section 3.3).

This error code has an LED steady state display. If the ENTER key is pressed one time, the plotter will display the circuitry in which the high current occurred.

High Current Detected in X-Axis

□ □ □ ■

This code indicates that high current is detected in the plotter's x-axis drive circuitry.

High Current Detected in Y-Axis

□ □ ■ □

This code indicates that high current is detected in the plotter's y-axis drive circuitry.

High Current Detected in Multi-Pen Changer

□ ■ □ □

This code indicates that high current is detected in the multi-pen changer circuitry.

A.7 EXTENDED BUFFER REPORT CONDITION

□ ✸ ✸ □

This error code can occur only if the plotter has the extended buffer board accessory installed and if an error occurs during the automatic extended buffer board RAM

A.8 RS-232-C LOOPBACK TEST CONDITION

□ ✸ ✸ ✸

This code indicates that the plotter has been placed in the RS-232-C loopback test routine. This feature is explained in Appendix B.

A.9 PLOT CODE PROGRAM ERROR

✸ ✸ □ ✸

This error code occurs if the plot code in a program contains a bug that confuses the plotter's processor. Review the plot code for errors.

A.10 PLOT COMMAND CONDITION CODES

✸ □ □ □

This code indicates that the plotter has recognized an illegal code sequence or set of command parameters, or has received a command which places the plotter in a state for operator attention.

This error code has an LED steady state display. If the ENTER key is pressed one time, the plotter will display the type of error or condition that has occurred.

Illegal Command Code

□ □ □ ■

This code indicates that the plotter has received a DM/PL closed figure (CF) command with parameters that exceed a 2500-byte limit. (The CF command is explained in Section 4.4.5.) The limit is due to the plotter's internal memory, and use of the extended buffer

If this error occurs, you can divide the CF command figure into smaller figures that contain fewer parameters. To compute the maximum number of vectors or arcs allowed in a CF command, add the required bytes for each data type and compare the sum to the maximum limit of 2500 bytes. Each vector is eight bytes, an embedded CP parameter is two bytes, and an embedded CM parameter is 22 bytes.

To recover from this error code, you can press the LOCAL key, which causes the plotter to either ignore the command or process as much of it as possible, or you can abort the plot by pressing either the RESET key or the LOAD key.

End of Plot Command Received

□ □ ■ □

The above code indicates that the plotter has received a DM/PL end of plot (e) command (see Section 4.4.9). To resume plotting after changing plotting media, first press the ENTER key to return to the original flashing code, and then press the LOCAL key. The plotter will then track the media and immediately begin plotting the next buffer file.

Reserved

□ ■ □ □

and

■ □ □ □

These codes are reserved. If for some reason one should appear, press the LOCAL key

APPENDIX B
MANUFACTURING SETUP MODE (MSM)

B.1 INTRODUCTION

Manufacturing setup mode (MSM) provides you with eight different test and demonstration routines which can be initiated from the control panel. Normal operation of the plotter, such as remote mode, menu mode, and temporary velocity settings, is inhibited while the plotter is operating in MSM.

MSM has two levels of operation—level one and level two. MSM level one (MSM L1) enables you to select one of the eight MSM routines that you want to run. MSM level two (MSM L2) is the actual execution of the selected MSM L1 routine.

Instructions on how to operate the plotter in MSM L1 and MSM L2 are explained in the following paragraphs. A summary of the instructions is listed below.

1. Set the power switch to off and install a chart and a pen into the plotter.
2. To initiate MSM L1, press and hold the RESET and the LOAD keys while powering up the plotter. Release the keys after the plotter beeps one time.
3. Use the ◄ and the ► keys to select an MSM L1 routine.
4. After selecting a routine, press the ENTER key to initiate MSM L2 to execute the routine.
5. After the routine completes, press the RESET key to return to MSM L1.
6. Press the RESET key once more to return to remote mode for normal operation.

B.2 MSM L1 INITIATION

Before initiating MSM L1, install a chart of any size and a pen.

To initiate MSM L1, first set the power switch to off. With the power off, press and hold the RESET and the LOAD keys, and then power up the plotter *while holding* the two keys. After the plotter beeps one time, release the two keys.

The plotter will then find the X and Y limits of the chart as in normal operation; however, the pen will park at plot origin right (large chart) regardless of the chart size installed. After the chart limits are found and the pen parks at plot origin right, all four LED indicators will turn off.

CAUTION

Manufacturing setup mode inhibits the chart sensing of the plotter, therefore you must exercise care when operating your unit in this mode. The plotter sizes the chart that is installed at the initialization of MSM and it expects you to use that chart during MSM routines. If you install a different size chart without pressing either the RESET or the LOAD key, then a pen crash may occur. Lifting the pinch rollers and manually moving a chart with your hands may also cause a pen crash.

B.2.1 Local and Reset Key Functions in MSM L1 and L2

If the LOCAL key is pressed while the plotter is in MSM L1, the plotter enters MSM L1 local mode. MSM L1 local mode enables you to use the ▲, ►, ▼, and ◄ keys to move the pen to any location on the chart. Normal windowing operations can also be performed at the control panel as explained in Section 2.5. To exit MSM L1 local mode and return to MSM L1, press the LOCAL key again.

If the plotter is in MSM L1 local mode and the RESET key is pressed, the plotter will return to the initial MSM L1. This enables you to reset the plotter in MSM L1 local mode without having to initiate manufacturing setup mode using the power switch again. However, if the RESET key is pressed while the plotter is in the initial MSM L1, the plotter will return to normal remote mode operation.

B.3 MSM L1 ROUTINE SELECT PROCEDURE

The ◄ and ► keys are used to select MSM L1 routines. The present MSM L1 routine is displayed in binary code on the control panel LEDs. Use the ► key to increment the routine numbers and use the ◄ key to decrement the routine numbers. The binary LED code for each MSM L1 routine is listed in Section B.4.

B.4 MSM L2 ROUTINE EXECUTION PROCEDURE

After the desired MSM L1 routine number is displayed on the control panel LEDs as described in Section B.3, press the ENTER key. This causes the plotter to enter MSM L2 and execute the selected MSM L1 routine. It is important to note that once the plotter enters MSM L2 and is running a routine, the control panel LEDs may or may not display the present MSM L1 routine number. This is because the plotter uses the LEDs in some MSM L2 routines to display information to you. It is your responsibility to keep track of the MSM level in which you place the plotter. To exit MSM, press the RESET key.

The following paragraphs provide the binary MSM L1 code number and describe each corresponding MSM L2 routine.

B.4.1 Service Plot

□ □ □ □

The service plot provides you with two lines of information about the plotter's configuration.

The first line of information provides the model identification and the revision numbers of the installed ROMs, the present baud rate menu selection, and the present addressing resolution.

The second line of information provides the DM/PL buffer size and whether or not the plotter has the extended buffer board accessory installed.

B.4.2 Europlot

□ □ □ ■

This routine causes the plotter to draw the Europlot design that is described in Section 2.3.2.

B.4.3 Font Demonstration

□ □ ■ □

The font demonstration routine causes the plotter to draw a demo plot of the two fonts (F0 and F1) that are stored in the plotter's ROM.

B.4.4 Multi-Pen Changer Setup Test

□ □ ■ ■

This routine enables you to test the multi-pen changer accessory unit. Execute this routine only after installing the unit as described in its operation manual.

If the ENTER key is pressed, the pen holder will move in front of pen stall one, and then the plotter will beep. If the pen holder favors one side or the other of pen stall one, the rear support screws that secure the pen changer to the plotter can be loosened and the pen unit moved slightly left or right. (This is explained in the unit's operation manual.)

Testing of the optical sensors in the pen changer requires you to manually move the arm assembly forward and backward. To prevent permanent damage to the the plotter's beam assembly, grasp the pen changer base unit with one hand and push or pull the arm assembly with the other hand.

To test the optical sensors in the pen changer, manually slide the the arm assembly forward until you see the following LED display code on the control panel:

□ □ ■ □

This code indicates that the unit's rear sensor is uncovered and the front sensor is covered.

Manually push the arm assembly backward until it is centered between full out and full in. The control panel LEDs should display the following code:

□ □ ■ ■

Manually slide the changer arm assembly backward until you see the following LED display code on the control panel:

□ □ □ ■

This code indicates that the front sensor is uncovered and the rear sensor is covered.

If you received the correct LED codes during this test, the optical sensors in the pen changer are operating correctly.

If all of the control panel LEDs turned off during any part of this test, then a hardware error occurred with the pen changer unit. The error condition may be caused by either a faulty cable or a cable that is incorrectly installed, or an optical sensor or control panel LED may be burned out. If the error cannot be corrected at the cable level, then service is required (see Section 3.3).

B.4.5 Lift and Lower Pen Test

□ ■ □ □

If this test is activated, the pen holder can be lowered by pressing the ▲ key and raised by pressing the ▼ key.

The auto-up time is inhibited during this routine, therefore the pen will remain in the down position until it is toggled to the up position.

The pen holder can be moved by placing the plotter in MSM L1 local mode and then using the manual movement keys.

To exit this routine, press the ENTER key.

B.4.6 Plotter Repeatability Test

□ ■ □ ■

This routine's MSM L2 is divided into two subroutines. One MSM L2 subroutine tests the repeatability of a single pen and the other MSM L2 subroutine provides a pen-to-pen repeatability test for a multi-pen changer unit.

After you press the ENTER key to place the plotter in this routine's MSM L2, the control panel LEDs will turn off. This indicates that you are presently in the single pen repeatability test. You now have the option to execute the single pen test or to toggle to the multi-pen unit test.

To execute the single pen test, press the ENTER key again and the single pen test will begin. To toggle to the multi-pen test, press either the ◄ key or the ► key and the control panel LEDs will display a binary one (0001). The multi-pen test can then be executed by pressing the ENTER key.

If the single pen test is executed, the plotter will:

- draw a border around the limits of the chart,
- over-plot the four corners of the border rectangle,
- draw a cross in the lower right area of the chart,
- draw a cross in the upper left area of the chart,
- draw a series of down vectors one-fifth the length of the chart in the X direction and 0.1 inch in width in the Y direction,

If you want to run the pen-to-pen repeatability subroutine, be sure your plotter has the multi-pen accessory unit installed and is loaded with six pens. To execute this subroutine, press either the ◄ key or the ► key to toggle the binary one (0001) pen-to-pen subroutine on the LEDs, and then press the ENTER key.

The pen-to-pen routine causes the plotter to draw a cross in the center of the chart with each pen in the multi-pen changer unit.

B.4.7 RS-232-C Loop-Back Test

□ ■ ■ □

This routine verifies that the plotter's handshaking lines are functioning properly.

Before running this routine, pin 2 must be jumpered to pin 3 on the plotter's RS-232-C connector, and pin 4 must be jumpered to pin 5. The routine causes the plotter to transmit and receive data to itself. It automatically repeats the transmission at each available baud rate. After each successful transmission at a given baud rate, the plotter emits a beep. The length of each transmission will vary because of the different baud rates.

The control panel LEDs do not illuminate during successful tests. If an error is detected, the plotter will display LED error codes, which are listed below. If all of the transmissions are successful, the plotter returns to MSM L1 and the LEDs display the loop-back test MSM L1 routine code.

The RS-232-C loop-back error codes are listed below. (If more than one type of error occurs, multiple errors codes will be displayed.)

□ □ □ ■

This error code indicates that data is received, but does not match the data that was transmitted. This implies that the line drivers are functioning properly, but excessive noise is occurring on the RS-232-C line. Service is therefore required.

□ □ ■ □

This indicates that data is not being received by the CPU. This error occurs if pins 2 and 3 are not jumpered or if there is a general UART failure. If this error code (0010) is displayed with the hardware handshake error code (0100), which will produce a (0110) code, and the correct pins are jumpered, then the UART and/or the line drivers require service.

□ ■ □ □

This error occurs if the program cannot toggle the hardware handshake line (RTS/DTR). If pins 4 and 5 are properly jumpered, then the UART and/or the line drivers require service.

■ □ □ □

This code indicates that a parity, framing, or overrun error has occurred. These errors are usually caused by a UART failure.

B.4.8 Restore Factory-Selected Menu Parameters

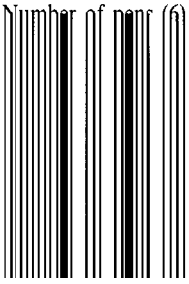
□ ■ ■ ■

This routine restores the menu parameters to the factory-selected values. These values are as follows:

DMP-61 pen up velocity (32 ips)
DMP-61 pen up acceleration (4 g)
DMP-61 pen down velocity (32 ips)
DMP-61 pen down acceleration (4 g)

DMP-62 pen up velocity (24 ips)
DMP-62 pen up acceleration (2 g)
DMP-62 pen down velocity (24 ips)
DMP-62 pen down acceleration (2 g)

Pen up delay (30 ms)
Pen down delay (50 ms)
Pen change (ignore)
Plot origin (auto)
Constant velocity option (on)
Addressing resolution (0.001 inch)
Menu units (English)
Text font (F0)
Character set (G0)
Auto-pen capping (disable)
Baud rate (9600)
UART parity (bit 8=0)
Handshake RTS/DTR (toggle)
Pass-Through port option (toggle)
Number of pens (6)



APPENDIX C
CHARACTER SETS

The character set G*n* parameter in the plotter menu and in the DM/PL Extended Text command enables you to select ten different character sets. The character sets G0 through G7 are shown below. Character sets G8 and G9 are shown on the following pages. (Character set G10 defaults to G0.)

CHARACTER SET CODES	34 22	35 23	36 24	64 40	91 5B	92 5C	93 5D	94 5E	95 5F	96 60	123 7B	124 7C	125 7D	126 decimal 7E hexadecimal	STYLE
S(GØ)	"	#	$	@	[	\	]	^	_	`	{	|	}	~	ASCII (default)
S(G1)	∫	∏	√	↑	[	α	]	^	_	β	μ	π	→	←	MATHEMATICS
S(G2)	"	#	$	§	Ä	Ö	Ü	^	_	`	ä	ö	ü	ß	GERMAN
S(G3)	"	£	$	à	°	ç	§	^	_	`	é	ù	è	¨	FRENCH
S(G4)	"	#	¤	É	Ä	Ö	Å	Ü	_	é	ä	ö	å	ü	SWEDISH
S(G5)	«	»	$		Æ	Ø	Å	°	_		æ	ø	å	–	NORWEGIAN/DANISH
S(G6)	"	£	$	§	¡	Ñ	¿	^	_	`	°	ñ	ç	~	SPANISH

The Japanese character set G8 has 64 symbols. The symbols have a decimal range from 32_{10} to 95_{10}. The first symbol 32_{10} is a "space."

If character set G8 is selected, only the characters shown below can be addressed until a different character set is selected.

	0	1	2	3	4	5	6	7	8	9
30	N/A	N/A		○	「	」	゛	゜	ヲ	ァ
40	ィ	ゥ	ェ	ォ	ャ	ュ	ョ	ッ	ー	ア
50	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ
60	シ	ス	セ	ソ	タ	チ	ツ	テ	ト	ナ
70	ニ	ヌ	ネ	ノ	ハ	ヒ	フ	ヘ	ホ	マ
80	ミ	ム	メ	モ	ヤ	ユ	ヨ	ラ	リ	ル
90	レ	ロ	ワ	ン	゛	゜				

The Greek character set G9 has 95 symbols. The symbols have a decimal range from 32_{10} to 126_{10}. The first symbol 32_{10} is a "space."

If character set G9 is selected, only the characters shown below can be addressed until a different character set is selected.

APPENDIX D
OPERATING CONDITIONS FOR PLOTTING MEDIA

Although the plotter's approved environmental operating range is 40° to 95° F (4.5° to 35° C) at 20% to 95% relative humidity, extreme high or low temperature and humidity conditions may cause the plotting media to expand or contract.

Figure D-1 shows the recommended operating range for all sizes of film and for vellum and paper chart sizes Engineering A, Engineering B, Architectural A, Architectural B, A4 DIN, A3 DIN, Oversize A4, and Oversize A3.

Figure D-2 shows the recommended operating range for vellum and paper chart sizes Engineering C, Engineering D, Engineering E, Architectural C, Architectural D, Architectural E, A2 DIN, A1 DIN, A0 DIN, B1 DIN, Architectural /Engineering F, Architectural 30 × 42 inches, Oversize A2, Oversize A1, and Oversize A0.

If the plotting media is being used in an extreme operating condition, you may have to load the larger size charts differently than explained in Section 1.7. The following paragraph explains how.

Under normal operating conditions, a chart should be aligned with the white line on the right end of the platen and the groove on the platen extension as explained in Section 1.7. However, if the chart has contracted, you must center the chart between both pinch rollers so that the pinch roller wheels make contact with the edges of the chart. If the chart has expanded, you must move the chart to the right so that it does not make contact with the left pinch roller assembly during paper shuffle.

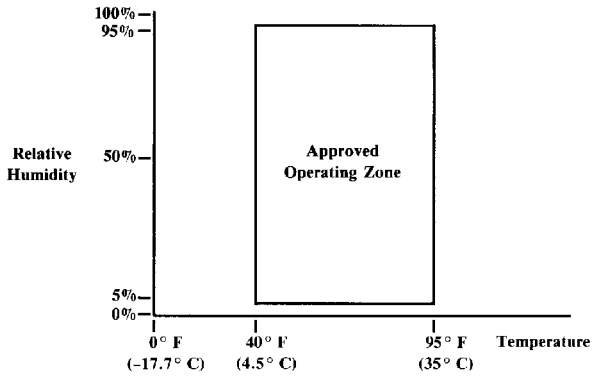
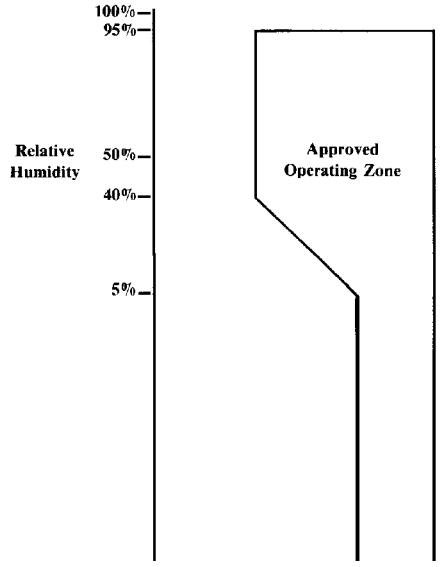


Figure D-1.
OPERATING RANGE FOR ALL FILM AND SMALL CHART PAPER



APPENDIX E
INTERFACE NOTES FOR DMP-60 SERIES PLOTTERS

This appendix helps the user establish communication between a computer and a Houston Instrument DMP-60 Series Plotter. These notes are arranged by computer configuration, and contain the following information, where pertinent.

- Cable Specifications — In this section, a cable specification is given for DMP-60 Series Plotters. The exact pin-for-pin description is detailed, as well as the types of connector needed on each cable end. These cable definitions establish a communication link between the computer and plotter and provide hardware handshake capability. Consult Section 1.9 for further information about the serial RS-232-C interface.

  NOTE

  The cable specifications described in this section may not meet the specifications of a software package. Consult the software documentation for cable specifications.

- System Setup — In this section instructions may be given to set up the computer's serial port. This setup is necessary to run a Houston Instrument plotter with a microcomputer. Information about setting up baud rate, parity, data bits, and stop bit parameters for the plotter are contained in Section 2.4.4.

- Communication and Handshaking — In this section a BASIC program may be given that will draw 1500 circles horizontally across the page. The purpose of this program is to demonstrate the communication and handshaking abilities of the Houston Instrument plotter and computer.

APPENDIX E

E.1 APPLE MACINTOSH 512K ENHANCED WITH A 9-PIN SERIAL PORT

- **Cable Specifications**

NOTE

The cable specifications described in this section are general purpose and work with most software packages. Before using these cable specifications, however, you should consult your software documentation. If the software package requires a unique cable specification, it will be listed in the software documentation.

DMP-60 Series Plotter		Computer
DB-25S connector		DB-9P connector
2 TD	———	9
3 RD	———	5
4 RTS	———	7
7 GND	———	3
(1, 5, 6, and 8–25 are not connected.)		(1, 2, 4, 6, and 8 are not connected.)

E.2 APPLE MACINTOSH PLUS, MACINTOSH SE, OR MACINTOSH II WITH AN 8-PIN SERIAL PORT

- **Cable Specifications**

NOTE

The cable specifications described in this section are general purpose and work with most software packages. Before using these cable specifications, however, you should consult your software documentation. If the software package requires a unique cable specification, it will be listed in the software documentation.

DMP-60 Series Plotter	Computer
DB-25S connector	8-pin Din (male)
2 TD	5
3 RD	3
4 RTS	2
7 GND	4
(1, 5, 6, and 8-25 are not connected.)	(1, 6, 7, and 8 are not connected.)

E.3 IBM AT OR COMPATIBLE COMPUTER WITH A 9-PIN SERIAL PORT

- **Cable Specifications**

NOTE

The cable specifications described in this section are general purpose and work with most software packages. Before using these cable specifications, however, you should consult your software documentation. If the software package requires a unique cable specification, it will be listed in the software documentation.

DMP-60 Series Plotter	Computer
DB-25S connector	DB-9S connector
2 TD	2
3 RD	3
4 RTS	8
7 GND	5
(1, 5, 6, and 8–25 are not connected.)	(1, 4, 6, and 9 are jumpered together.) (7 is not connected.)

Houston Instrument cable number HR29-483 corresponds to this cable definition.

- **System Setup**

NOTE
The following setup information assumes that you are using PC-DOS.

1. Boot up the operating system.

2. After the system prompt, issue the MODE command to configure the serial port.

   MODE COM1:9600,N,8,2,P

3. After the system prompt, issue the MODE command to redirect output to the serial port.

   MODE LPT1:=COM1:

4. The computer end of the cable must be connected to the serial port defined as COM1.

- **Communication and Handshaking**

NOTE

The following BASIC program assumes that you are using IBM's BASICa or Microsoft's GWBASIC.

1. After the system prompt, issue the command to load BASIC. For more information about loading BASIC, consult your computer documentation.

2. After loading BASIC, type in the following program:

PROGRAM	COMMENTS
10 LPRINT ":: A H O V2 P1 200,200"	*selects the plotter*
20 FOR X=300 TO 15300 STEP 10	*defines X coordinate of center*
30 LPRINT "CC ";X;",300 100 "	*outputs series of 1500 circles*
40 NEXT	
50 END	

3. To save the program, issue the following command.

SAVE "PLOTEST.BAS"

4. You may now run the program. Issue the following command.

E.4 IBM PC, IBM PC/XT, OR COMPATIBLE COMPUTER WITH A 25-PIN SERIAL PORT

- **Cable Specifications**

NOTE

The cable specifications described in this section are general purpose and work with most software packages. Before using these cable specifications, however, you should consult your software documentation. If the software package requires a unique cable specification, it will be listed in the software documentation.

DMP-60 Series Plotter	Computer
DB-25S connector	DB-25S connector
2 TD	3
3 RD	2
4 RTS	5
7 GND	7
(1, 5, and 9 through 25 are not connected.)	(6, 8, 20, and 22 are jumpered together.) (1, 4, 9 through 19, 21, and 23 through 25 are not connected.)

- **System Setup**

NOTE

The following setup information assumes that you are using PC-DOS.

1. Boot up the operating system.

2. After the system prompt, issue the MODE command to configure the serial port.

   MODE COM1:9600,N,8,2,P

3. After the system prompt, issue the MODE command to redirect output to the serial port.

   MODE LPT1:=COM1:

4. The computer end of the cable must be connected to the serial port defined as COM1.

- **Communication and Handshaking**

NOTE

The following BASIC program assumes that you are using IBM's BASICa or Microsoft's GWBASIC.

1. After the system prompt, issue the command to load BASIC. For more information about loading BASIC, consult your computer documentation.

2. After loading BASIC, type in the following program:

PROGRAM	COMMENTS
10 LPRINT ":: A H O V2 P1 200,200"	*selects the plotter*
20 FOR X=300 TO 15300 STEP 10	*defines X coordinate of center*
30 LPRINT "CC ";X;",300 100 "	*outputs series of 1500 circles*
40 NEXT	
50 END	

3. To save the program, issue the following command.

SAVE "PLOTEST.BAS"

4. You may now run the program. Issue the following command.

RUN

5. To load and run the program at a later date, issue the following command.

RUN "PLOTEST.BAS"

APPENDIX F
MATERIAL SAFETY DATA SHEETS FOR PLOTTER PENS

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List): 3080 Drawing Ink

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name: KOH-I-NOOR Rapidograph, Inc.	Emergency Telephone Number: 201-479-4124
Address (Number, Street, City, State, and ZIP Code): 100 North Street	Telephone Number for Information: Same
Bloomsbury, NJ	Date Prepared: September 16, 1986
08804	Signature of Preparer (optional):

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))		OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Carbon Black	CAS #1333-86-4		N/A		7.2
Ammonium Hydroxide	CAS #1336-21-6	50ppm (as NH_3)	25ppm (as NH_3)		1.2
Phenol	CAS # 108-95-2	5ppm	5ppm		0.45
Ethylene Glycol	CAS # 107-21-1		50ppm ceiling conc.		1.6
Water					75-85%

Section III — Physical/Chemical Characteristics

Boiling Point	215°F	Specific Gravity (H_2O = 1)	1.055
Vapor Pressure (mm Hg)	Like Water	Melting Point	25 26°F
Vapor Density (AIR = 1)	Like Water	Evaporation Rate (Butyl Acetate = 1)	Like Water

Solubility in Water: Miscible

Appearance and Odor: Black liquid, mild fusel oil odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used): [illegible]°F ASTM D56	Flammable Limits: None	LEL: N/A	UEL: N/A

Extinguishing Media: This ink will not burn or support combustion

Special Fire Fighting Procedures: High temperatures will evaporate the water and the remaining residue [illegible] burn. Water is an adequate extinguishing medium

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable	X	None

Incompatibility (Materials to Avoid): None

Hazardous Decomposition or Byproducts: None Expected

Hazardous Polymerization	May Occur		Conditions to Avoid: None
	Will Not Occur	X	

Section VI — Health Hazard Data

Route(s) of Entry: Inhalation? Unlikely | Skin? Unlikely | Ingestion? (Oral not greater than 5g/Kg) Non toxic LD_{50}

Health Hazards (Acute and Chronic): None expected, the hazardous ingredients are either very dilute or bound such that exposure to any is rather unlikely.

Carcinogenicity: No | NTP? | IARC Monographs? | OSHA Regulated?

Phenol is listed as an experimental mutagen.

Signs and Symptoms of Exposure: Irritation of eyes, nose throat. Coughing and vomiting are possible signs of exposure (from abuse).

Medical Conditions Generally Aggravated by Exposure: None expected.

Emergency and First Aid Procedures: Flush eyes with large amounts of water for at least 15 min. Wash skin with soap and water. If ingested, drink one or two glasses of water to dilute. Consult physician or poison control center immediately.

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled: Wipe up at once. Dried ink can be soaked with soap solution and rinsed.

Waste Disposal Method: In accordance with federal, state, and local regulations.

Precautions to Be Taken in Handling and Storing: Do not allow to freeze which could cause leakage.

Other Precautions: None

Section VIII — Control Measures

Respiratory Protection (Specify Type): Not Needed

Ventilation	Local Exhaust: Not Needed	Special	Not Needed
	Mechanical (General): Sufficient	Other	Not Needed

Protective Gloves | Eye Protection

APPENDIX F

F-2

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List): Brewing Inx 9066, colored

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name: PELIKAN AG	Emergency Telephone Number: 511-6960214
Address (Number, Street, City, State, and ZIP Code): Postfach 103	Telephone Number for Information: 511-69691
D-3000 Hannover 1	Date Prepared: 2/15/1988
Germany West	Signature of Preparer (optional): Dr. K. Kosswig

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
1,2-ethanediol (107-21-1)		50ppm Ceiling		5 - 10
ammonia (20 %) (7664-41-7)	50ppm	25ppm		1
sodium tetraborate decahydrate (1303-96-4)		5mg/m		0.5 - 0.6
phenol (108-95-2)	5ppm	5ppm		0.6

Section III — Physical/Chemical Characteristics

Boiling Point	ca 100 °C	Specific Gravity (H_2O = 1)	1.03-1.05
Vapor Pressure (mm Hg.)	ca 18	Melting Point	ca -2 °C
Vapor Density (AIR = 1)	0	Evaporation Rate (Butyl Acetate = 1)	1

Solubility in Water: miscible except pigments

Appearance and Odor: liquids in 5 various shades, technical odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used): n.a.	Flammable Limits	LEL: n.a.	UEL: n.a.

Extinguishing Media: n.a.

Special Fire Fighting Procedures: none

Unusual Fire and Explosion Hazards: none

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable	x	none

Incompatibility (Materials to Avoid): none

Hazardous Decomposition or Byproducts: none

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	x	none

Section VI — Health Hazard Data

Routes of Entry: Inhalation? none Skin? none Ingestion? yes

Health Hazards (Acute and Chronic): kidney injury when repeated or in large amount drunk

Carcinogenicity: None NTP? ARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure: U

Medical Conditions Generally Aggravated by Exposure: U

Emergency and First Aid Procedures: eye contact: rinse with water
ingestion: provoke vomiting

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled: spill away with water

Waste Disposal Method: according to local regulations

Precautions to Be Taken in Handling and Storing: beware of frost

Other Precautions: not required

Section VIII — Control Measures

Respiratory Protection (Specify Type): not required

Ventilation	Local Exhaust	not requ.	Special	not requ.
	Mechanical (General)	not requ.	Other	not requ.
Protective Gloves		not requ.	Eye Protection	not requ.

Other Protective Clothing or Equipment: not requ.

Work/Hygienic Practices: usual

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List): 3084 RAPIDRAW INK

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name: Koh-I-Noor Rapidograph Inc.	Emergency Telephone Number: 201-479-4124
Address (Number, Street, City, State, and ZIP Code): 100 North Street	Telephone Number for Information: 201-479-4124
P. O. Box 68	Date Prepared: July 15, 1986
Bloomsbury, New Jersey 08804-0068	Signature of Preparer (optional): Ben Apoussiciu

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Carbon Black (1333-86-4)	3.5mg/m³	3.5mg/m³		15
Ethanol (64-17-5)	1000ppm	1000ppm		< 3
Isopropanol (67-63-0)	400ppm	400ppm		< 2
1-butanol (71-36-3)	100ppm	50ppm		< 2
Morpholine (110-91-8)	20ppm	20ppm		< 3
Water				60-70

Section III — Physical/Chemical Characteristics

Boiling Point	212°F	Specific Gravity (H_2O = 1)	1.095
Vapor Pressure (mm Hg.)	Unknown	Melting Point	19-26°F
Vapor Density (AIR = 1)	Unknown	Evaporation Rate (Butyl Acetate = 1)	Like Water

Solubility in Water: Miscible in all proportions

Appearance and Odor: Black liquid. Slight fusel oil odor.

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used): 146°F ASTM D56	Flammable Limits: N.A.	LEL	UEL

Extinguishing Media: This ink will not burn or support combustion.

Special Fire Fighting Procedures: High temperatures will evaporate the liquid and the residue will burn. Water is an adequate extinguishing medium.

Unusual Fire and Explosion Hazards: None

(Reproduce locally)

Section V — Reactivity Data

Stability			Conditions to Avoid
	Unstable		
	Stable	X	None

Incompatibility (Materials to Avoid): None

Hazardous Decomposition or Byproducts: None

Hazardous Polymerization			Conditions to Avoid
	May Occur		
	Will Not Occur	X	None

Section VI — Health Hazard Data

Route(s) of Entry: Inhalation? X Skin? X Ingestion?

Health Hazards (Acute and Chronic): May be irritating to skin, eyes, and respiratory system.
LD_{50} (rats) greater than 5g/Kg

Carcinogenicity: No NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure: Unknown

Medical Conditions Generally Aggravated by Exposure: Unknown

Emergency and First Aid Procedures: INHALATION: Remove to fresh air. SPLASH (eyes): Flush immediately with large amounts of water for 15 minutes. Seek medical attention. SPLASH (skin): Remove with soap and water. INGESTION: Drink 1 or 2 glasses of water to dilute. Get medical attention.

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled: Wash with soap and water.

Waste Disposal Method: In accordance with federal, state, and local regulations.

Precautions to Be Taken in Handling and Storing: Keep from freezing.

Other Precautions: Store at room temperature.

Section VIII — Control Measures

Respiratory Protection (Specify Type): None required.

Ventilation			
	Local Exhaust: Not needed	Special: None	
	Mechanical (General): Sufficient	Other: None	

Protective Gloves: Not required	Eye Protection: Not required

Other Protective Clothing or Equipment: Not required

Work/Hygienic Practices: Wash hands before eating or smoking.

Page 2