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CLS-700
Operations Manual

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P/N 10193-4

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Hazardous Material Leakage Procedure

In case of a spill or leak of any corrosive or otherwise hazardous sample fluid please refer to the following procedure:

1. If the hazardous contaminant is an acid or base, spray exterior and/or interior of instrument with the appropriate neutralizing agent.

2. Test with litmus paper—continue neutralization until neutral pH (7) is achieved.

WARNING

Do not ship contaminated instruments to PMS for repair without first draining and flushing the instrument with large amounts of water!

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3. If allowed by local environmental regulations, flush neutralized contaminant down the drain (not a storm sewer) with a volume of clean water—at least 100 times the volume of the neutralized contaminant.

   If local regulations do not allow draining of the neutralized contaminant, contain it appropriately and have it disposed of by a hazardous waste disposal firm.

4. Following clean-up, internally-contaminated instruments must be air dried before reassembly to prevent corrosion.

5. Chlorinated solvents, organic solvents, or other chemicals should be contained for recycling or disposal by a hazardous waste disposal firm.

   Flush the instrument with clean water until it is free of chemicals.

   Be sure to air dry the instrument before reassembly, packing and shipping. Fill the sample cells of liquid particle counters with PMS-approved cleaning solution and seal. Refer to the information in the Maintenance chapter of this manual.

WARNING

PMS cannot service instruments that have been contaminated with radioactive materials.

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Introduction

The Corrosive Liquid Sampler Model 700 (CLS-700) is designed to sample liquids from unpressurized containers such as baths, drums or various-sized bottles, and deliver the liquid to the particle sensor. The CLS-700 draws a sample from the container, compresses it to remove any bubbles– either pre-existing in the liquid or caused by the extraction process– then delivers the liquid to a particle measuring sensor at a constant pressure and constant flow rate. The CLS-700 is a computer-controlled automatic instrument. The data system analyzes and displays count and size data. In addition to automatic sampling, the sampler has a manual control which allows the operator to flush the liquid lines continuously in order to evacuate liquid from the sampler.

All wetted surfaces of the CLS-700 are Teflon[1] with the exception of two Kal-Rez[2] O-rings. The LiQuilaz sensor contained within the CLS-700 chassis has Kel-F1, Kal-Rez and either glass or sapphire wetted ports. This enables the CLS-700 to handle most process chemicals. There are two limitations:

1. The viscosity of the liquid must not be so high as to limit the flow rate through the sensor to less than the specified lower limit for that sensor at the 60 psi upper pressure limit of the sampler (e.g., approximately 50 centipoise for the LiQuilaz S02).

2. Liquids which are naturally foaming are not detected reliably by the liquid level sensors used to control the sampling process.

All pressure regulator knobs, flow-limiting controls, and pressure gauge are located on the front panel. The liquid inlet, liquid outlet and gas exhaust are located on the rear panel with the pressurized gas inlet.

Figure 1-1 shows an installed CLS-700.

1 Teflon is a registered trademark of DuPont Corporation.

2 Kal-Rez is a registered trademark of DuPont Corporation.

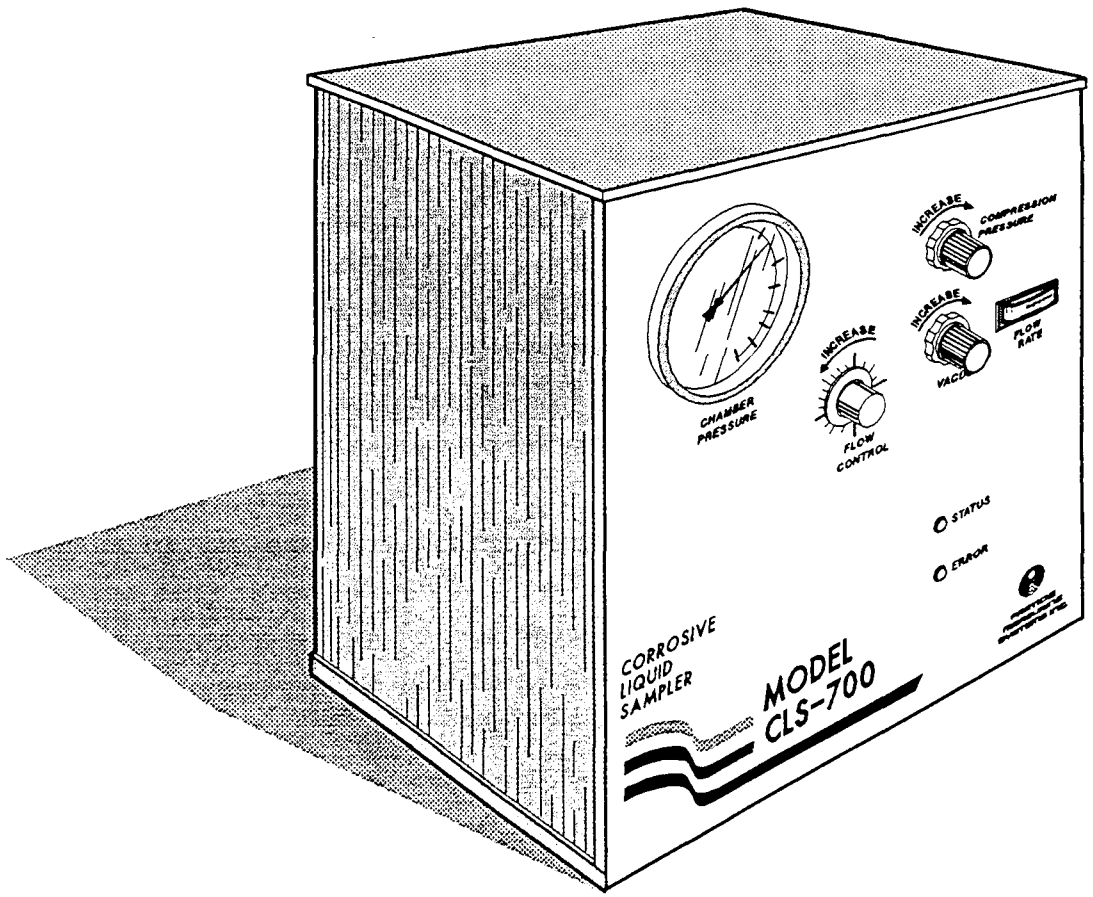


Figure 1-1. CLS-700

CLS-700 Specifications

Wetted materials	Teflon, Kal-Rez, Kel-F 1
Sensor wetted materials	Kel-F1, Kal-Rez, glass/sapphire
Gas pressure required	60 – 150 psi
Power	85 to 264 VAC, 47 to 440 Hz, 20 W
Temperature	0° to 40°
Temperature of chemical	0° to 150° C
Dimensions	15.5 in. H x 10.1in. D x 16.2 in. W
Weight	34 lb/15.3 kg
Total sample volume	60 ml
Assessed sample volume	45 ml
Flow controller flow rate	80 ml/min (S03) 50 ml/min (S02)
Maximum compression pressure	60 psi
Sampler external surfaces	polypropylene

1 Kel-F is a registered trademark of DuPont Corporation

Unpacking and Installation

Unpacking

1. Inspect the shipping container for transport damage such as water stains or excessive package deformation.
2. Open the container and carefully remove the instrument. Inspect it for damage.
3. If the instrument has been damaged in shipment, notify the shipper and PMS, and repackage the instrument in the original packing materials. If the instrument is not damaged, store the packing materials.

Installation Requirements

Power	100-250 VAC
House gas	Clean pressurized gas 60 - 150 psi, compatible with the chemical being sampled
Sample tubing	1/4-inch PFA Teflon, 0.047-inch wall
Hardware	3 Flaretek™ fittings

Note **For Flaretek™ forming tool contact Fluoroware at (612) 448-3131**

Installation

1. Connect a standard IEC AC power cord to the rear panel power module (Figure 3-1).

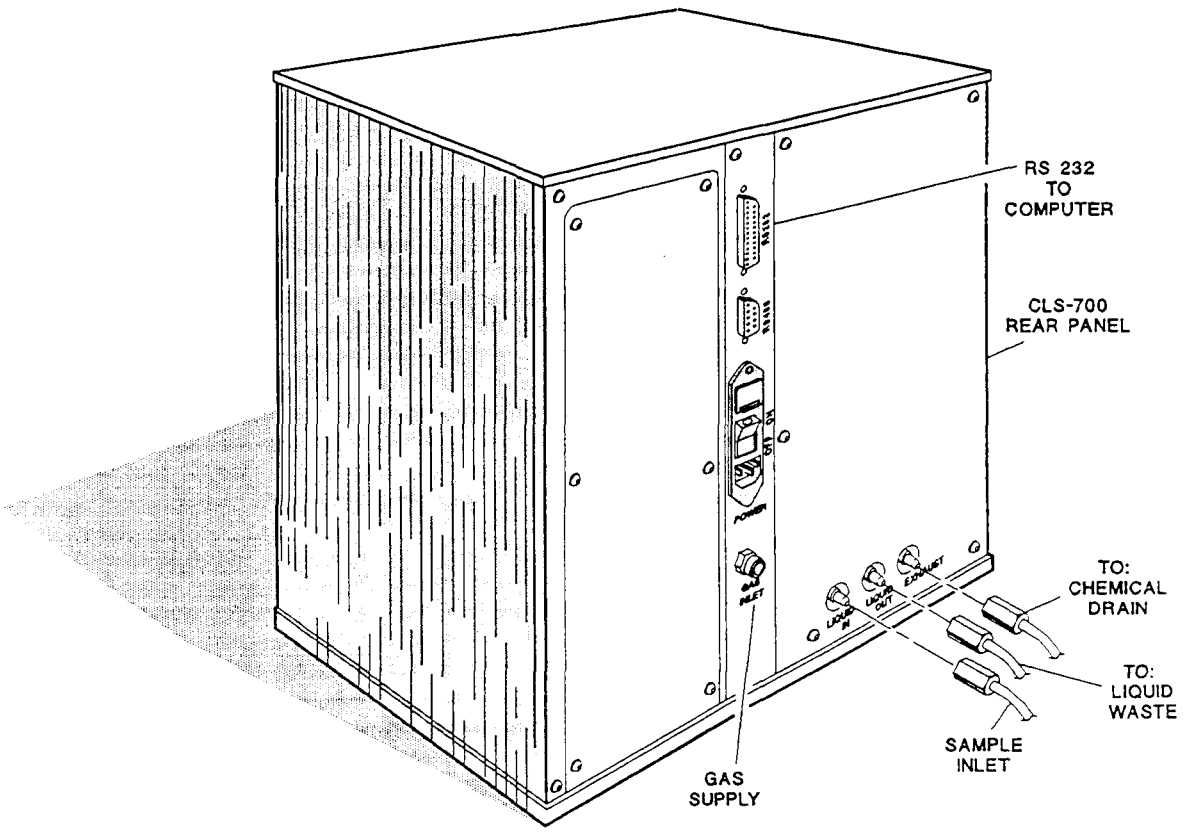


Figure 3-1. Rear Panel Connectors

2. Connect a source of clean, dry, inert gas (pressurized to a range of at least 60 psi to a maximum of 150 psi) to the 1/4-inch push-to-connect GAS INLET connector located on the back panel.

3. Connect liquid lines as shown in Figure 3-1.

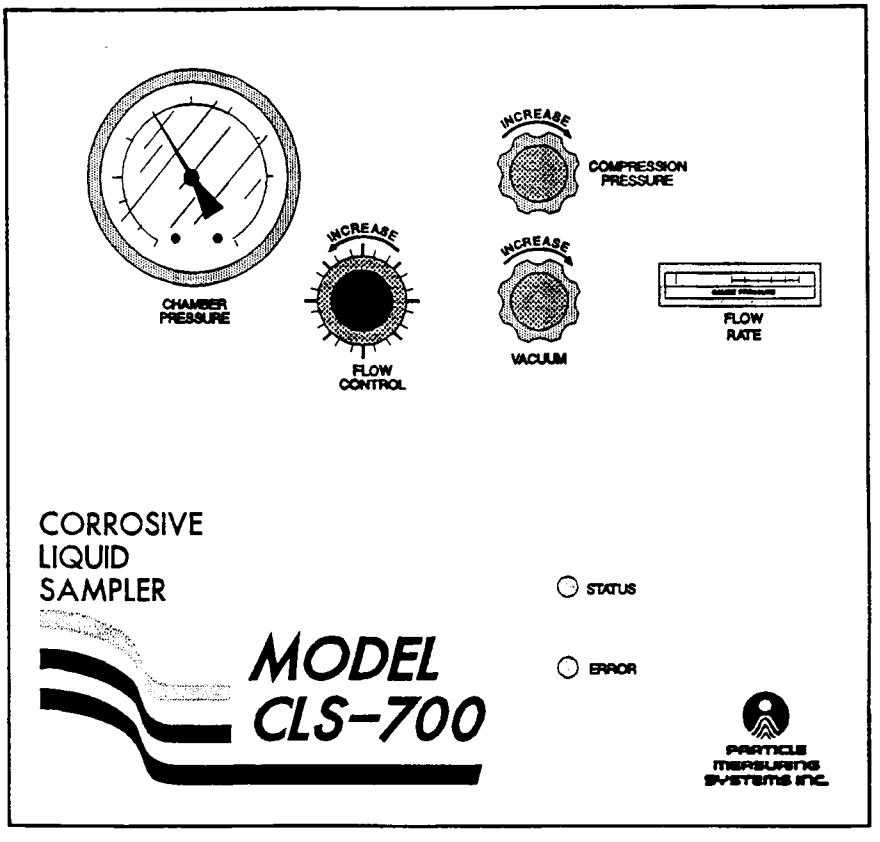


Figure 3 - 2. Front Panel Controls

The house gas used to pressurize and vacuum the system comes in contact with the chemical being sampled. This gas is vented from the EXHAUST outlet. In the case of a buret level detector failure, the sample liquid can also be discharged from this outlet. It is extremely important to route the exhaust tubing to an appropriate venting system or chemical drain.

WARNING

Corrosive liquids and gases can discharge from the EXHAUST outlet. Provide an appropriate vent and drain for their proper disposal. Check local environmental regulations.

4. Install a length of 1/4-inch PFA Teflon tubing on the EXHAUST fitting on the rear panel. Route the tubing to a venting system or chemical drain.

5. Connect either an RS232 (DB25) or RS 485 (DE9) from the CLS-700 back panel (Figure 3-1) to the control computer.

   DB25 pin designations are as follows:

Pin 1	Ground
Pin 2	Receive Data
Pin 3	Transmit Data
Pin 7	Ground
Pin 5 or 9	DAS Enable

   DE9 pin designations are as follows:

Pin 1	Gnd Ref
Pin 2	$\overline{TX}$
Pin 3	$\overline{TX}$
Pin 4	$\overline{RX}$
Pin 5	$\overline{RX}$
Pin 7	Gnd Ref
Pin 9	Gnd Ref

Theory of Operation

The CLS-700 delivers a liquid sample from a container to the particle sensor at a constant pressure and flow rate. The CLS-700 draws the sample, compresses it to remove any bubbles, then passes the liquid through the sensor. The CLS-700 is controlled by a data system which analyzes, displays and stores particle data. After removing the right cover, the sampler may be controlled manually to either sample or purge the lines of liquid without the use of electrical power.

Liquid Handling

The liquid flow system is illustrated in Figure 4-1. Liquid is drawn into the sampler by a slight vacuum generated by an air/air aspirator. This process should take approximately ten seconds. Quicker filling of the sampler can lead to cavitation, and slower sampling can cause a time-out error. The aspirator uses the same gas supply used to operate the pneumatic valves in the system. The gas is also used to compress the liquid and purge the enclosure. Gas can be supplied from a house gas supply, compressed gas bottle or a pump. The only requirements are that it be clean, compatible with the liquid being sampled and at a pressure of from 60 to 150 psi. The vacuum is controlled by the VACUUM knob on the front panel (Figure 3-2).

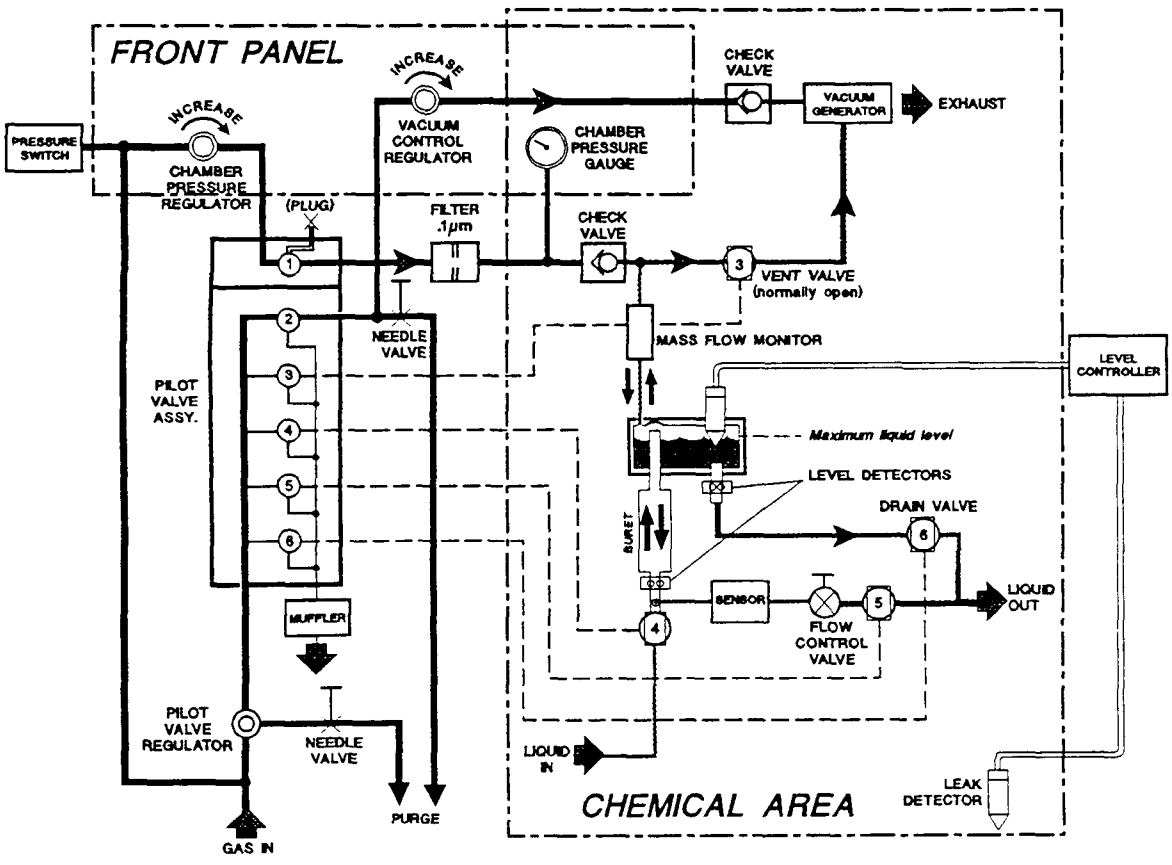


Figure 4-1. Fluidic Diagram

A 60 ml sample is drawn into the CLS-700. 45 ml is used for measuring particle contamination. The remaining 15 ml is used to overflow the sample buret, thus eliminating particles trapped in the liquid/gas meniscus. This 15 ml is subsequently discarded. Overflowing the sample buret is critical for effective sample-to-sample cleanup. After the sample has been drawn into the sampler it is compressed. The amount of pressure used to compress the sample can be controlled using the COMPRESSION PRESSURE knob on the front panel. The compression time is specified by entering the desired time into the Compression Delay field in the data system (refer to section 5).

After a suitable compression delay the sample is delivered to the sensor at the same pressure. The flow rate of the liquid through the sensor is controlled by the FLOW CONTROL knob on the front panel of the CLS-700 (Figure 3-2). The sample volume is 45 ml and the time required for the sampling process, monitored by the data system, is a function of the flow rate through the sensor. This flow rate must be within the specified limits of the sensor chosen (refer to the specification chapter of the sensor manual).

Before the sample is measured the overflow liquid in the overflow chamber (15 ml) is discarded. After sampling the chamber is vented and the sampler waits for a command from the data system to proceed with another sample. When this signal is received the process starts over again. System status is continuously displayed through 700-View.

Particle Traps and Particle Generation

The CLS-700 is designed to minimize dead volume areas where particles could become trapped. To minimize the possibility of particle generation, the measured liquid sample comes in contact only with PFA Teflon until it reaches the sample capillary. The single pneumatic valve in the sample inlet line has little dead volume and good demonstrated cleanup qualities.

The most difficult particle trap to eliminate is the meniscus between the liquid and the gas in the sampler. This meniscus is eliminated by overflowing the sample buret. The size of the plumbing has been selected to keep flow velocities high enough to facilitate cleanup. The liquid does not come in contact with threaded connections before it is sampled. All sample handling valves are pneumatic, which have shown a decided lack of particle shedding, unlike electronically controlled valves. These characteristics make the non-contaminating sample process possible.

Materials

With the exception of two Kal-Rez O-rings ,all surfaces wetted by the liquid and the gas that comes in contact with this liquid are made of Teflon (PFA and PTFE). All wetted surfaces which come in contact with the sample liquid passing through the sensor are PFA or FEP Teflon and Kel-F and the capillary material. PFA was chosen because of its cleanup characteristics. It is recommended that PFA also be used for the liquid handling lines.

Self-Diagnostics

The CLS-700 constantly monitors the level detectors for consistency, gas input pressure, and timing functions to assure that they are within reasonable limits. If an error occurs, the sampler is vented and reset. The CLS-700 is equipped with a leak detector for safety in case of an internal liquid leak.

CLS-700 Major Components

Buret

The sample buret is molded from PFA Teflon. PFA Teflon's ability to clean up between samples makes it the best material available. Two halves are accurately measured and welded together, providing a strong and clean buret with a precise 45 ml volume.

Sample Overflow Chamber

The liquid sample drawn into the sampler is allowed to overflow the sample buret. This removes the liquid/gas meniscus. The overflow portion of the sample is contained in an overflow chamber. The gas connection to the chamber and the sample level detector are located in this chamber. Neither of these is located where it can come in contact with the actual liquid sample delivered to the sensor, thus avoiding sample contamination. The two O-rings in the CLS-700 are in this chamber: one seals the sample buret and the other seals the chamber liquid outlet tube.

Pneumatic Valves

All valves which come in contact with the sample liquid, or gas which has come in contact with this liquid are pneumatic PFA Teflon valves. These valves are controlled by the pilot valves. They are limited to 60 psi pressure at the outlets and 60 psi at the inlets.

Pilot Valves

The pilot valves are electronically controlled and they, in turn, control the pneumatic valves. The pilot valves may be accessed by removing the right side cover. Pneumatic valves may be controlled by pushing the pilot valve knobs, allowing control of the system without electrical power. This safety feature allows the operator to purge the sample without electrical power. Gas pressure is, however, required. Refer to Figure 4-2.

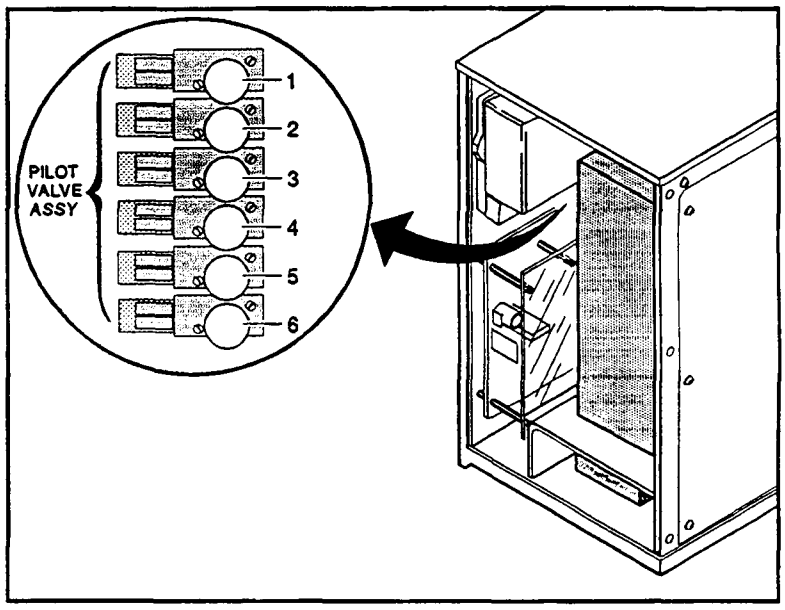


Figure 4- 2. Pilot Valve Location

Filter

A 0.1-micron filter ensures that there are no large particles in the compression gas. This filter is located upstream of the gas check valve, and does not come in contact with sample gas. The filter will turn purple if water vapor is detected in the supply gas.

Check Valve

The compression gas inlet is protected with a check valve to ensure that no gas that has come in contact with the sample liquid can come in contact with the compression gas regulator, the pressure gauge or the gas filter, and consequently, that neither liquid nor liquid-tainted gas comes in contact with anything other than Teflon or Kal-Rez.

Pressure Regulators

Three pressure regulators are used to control gas pressure in the system.

The gas used to control the pneumatic valves is controlled by an internal regulator which is set for 60 psi at the factory.

The gas used for the vacuum generator and the gas used to pressurize the sample chamber are controlled by regulators on the front panel. The outer portion of the control knobs on these regulators must be pulled out, then turned to adjust. When the outer portion is pushed back in the knob cannot be turned accidentally.

Pressure Gauge

The chamber pressure is shown on the front panel pressure gauge. This gauge reads in psi for positive pressures and inches of mercury for vacuum.

Purge Valve

The CLS-700 enclosure is purged with supply gas. The amount of gas used is controlled by two purge gas valves. One valve supplies a continuous flow and the other is activated only when the chamber is filling. Both valves are set at the factory one-half turn open, yielding approximately 0.1 cfm purge gas flow. If this proves to be excessive or if the unit will never be operated in a corrosive environment, the valves may be closed to reduce gas consumption. Refer to Figure 4-3.

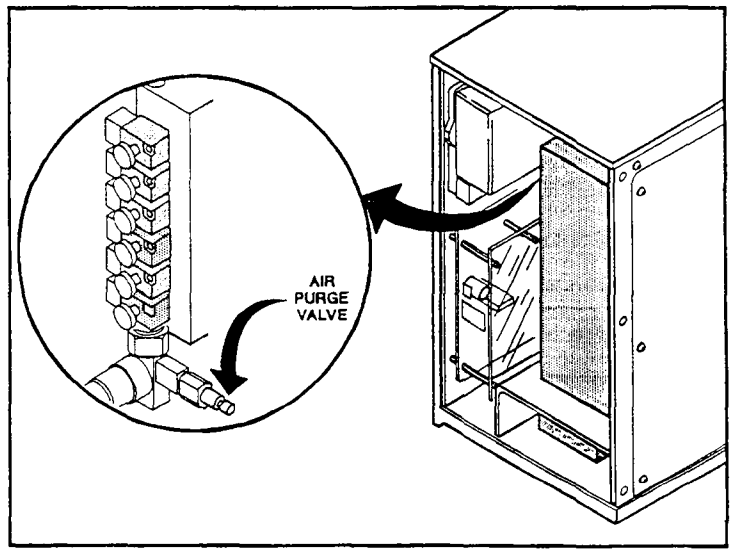


Figure 4 - 3. Purge Valve Location

Pressure Switch

The incoming gas pressure is monitored by a pressure switch. If the pressure drops below 50 psi, the switch opens. The CLS-700 stops and the operator is notified of the error condition. The switch will not close again until the pressure rises above 56 psi. Once pressure is restored, the CLS-700 will continue the sample.

Chamber Level Detector

A Teflon optical detector is used to determine when the overflow chamber is full. This type of detector was chosen because of its inherent reliability. Failure of this detector to reliably detect the presence of liquid has been found to occur with foaming liquids when repeatedly sampled. After repeated use, the liquid forms bubbles on the detector and the detector may fail to sense that the overflow chamber is full. This results in liquid draining out the exhaust line. This will not damage the sampler, because all of the wetted surfaces in the CLS-700 are Teflon. Depending upon where the exhaust line is placed, however, the chemical may spill onto the surrounding surface. It is strongly recommended that the exhaust line be placed in the chemical drain along with the liquid outlet line.

Sample/Drain Level Detector

Optical detectors are used to sense when the sample and overflow chambers are empty. These detectors are dual liquid/gas sensing devices.

Flow Control Valve

The sample flow control valve is a custom-made Teflon needle valve which shows precise monotonic flow response between 10 and 200 ml/min.

Power Supply

A switching multiple-output power supply is used to provide the various voltages needed by the control system.

Microprocessor Control Board

Electronic control and communications are accomplished by the microprocessor control board. Four jumpers are used to program the on-board DS5000 and control the operation of the instrument. J1, J3 and JX4 are used to control the programming while J2 selects the CONTINUOUS MODE or SAMPLE MODE of operation. The following tables list the configuration of the jumpers for the desired operation.

	J1	J3	JX4
RUN MODE	CD	CD	CD
PROGRAM MODE	AB	AB	AB

When J2 is set to the CONTINUOUS MODE the instrument will run a fixed sampling routine. In the SAMPLE MODE the instrument is under the control of the commands that are issued over the serial communication link.

	J2
CONTINUOUS MODE	AB
SAMPLE MODE	CD

J1

J1 is the reset signal source for the 8751 microprocessor. This jumper allows in-circuit programming of DS5000 microprocessors in the U3 socket.

- Normal operation: J1-1 to J1-6 connect
  J1-2 to J1-5 open
  J1-3 to J1-4 open

This puts the hardware watchdog chip U1 (DS1232) in the position to be the source of the reset. If the 5-volt supply drops below 4.75 volts at U1, reset is driven high (active). If the ALE signal from U3 fails to toggle within 600 msec, reset is also driven high.

- Manual reset: J1-1 to J1-6 open
  J1-2 to J1-5 connected
  J1-3 to J1-4 open

This forces an active reset to U1.

- AD5000 program: J1-1 to J1-6 open
  J1-2 to J1-5 connected
  J1-3 to J1-4 connected

This places the DS5000 in U3 socket into serial programming mode in-circuit. The serial port of U3 (Rxd and Txd signals) are then used to program the battery- backed memory of the DS5000.

J2

When closed, this jumper places the CLS-600 under the control of the data system's sampling routine. When the jumper is opened, sampling stops. A serial port command is needed to begin subsequent sampling.

J3

This jumper determines the serial port electrical mode.

- J3-1 to J3-2 connect RS485
- J3-2 to J3-3 connect RS232

Power Entry Module

Power is supplied through an IES power entry module. This module contains the system 1.0 A fuse.

Sensors

The CLS-700 is designed for use with PMS' LIQUILAZ line of sensors. Because PMS' volumetric sensors sample 100% of the liquid passing through them and count 100% of the particles above the minimum sensitivity threshold, calculation of the concentration of particles in the 45 ml liquid sample is straightforward, and is automatically done by the PMS data system.

Data Interface

An RS232 communication line is provided between the CLS-700 and the display computer. The sampler notifies the data system of the start and finish of the actual (45 ml) sampling process and status. The data system starts the sampling process and tells the CLS-700 sampling parameters to use.

Controls

Refer to Figure 3-2 for the location of the three controls on the front panel of the CLS-700 and to Figure 3-1 for the controls on the rear panel. The amount of pressure used to compress the sample is controlled by the regulator knob labeled COMPRESSION PRESSURE. The VACUUM knob is used to provide the vacuum necessary to draw the sample into the sampler. The FLOW CONTROL knob controls the flow rate of the liquid delivered to the sensor. If the compression pressure is changed it may be necessary to adjust the flow control to bring the flow rate to within the limits of the sensor.

Flow Rate Meter

The flow rate meter on the front panel is used to quickly adjust the chemical flow rate. The flow rate display on the data screen is very precise and should be used for accurate flow rate measurements. The panel meter is used to quickly adjust the flow rate to within the specification limits for the sensor.

Meter settings for flow rate adjustment

The flow rate is measured using a mass flow monitor on the gas going into the buret displacing the liquid in that chamber. Because this is a measure of the mass flow it has to be corrected by the actual pressure in the buret which is adjustable. The scale on the meter has been carefully calibrated to read in chamber pressure rather than flow rate. This was done to remove the burden of manually calculating the volume flow rate by the operator. This also makes the adjustment quite easy, simply adjust the chamber pressure to be equal to the actual chamber pressure selected and the flow rate will be accurate for the sensor used in the CLS-700. The control system display shows this flow accurately at the end of a sample. The reason for measuring flow rate in this manner is to remove the sensor from the corrosive gas or liquid environment. The sensor is in the gas input line and is protected by a Teflon check valve. This system is not only very accurate but robust. A summary of the adjustment procedure is:

During the sampling phase, adjust the flow control valve so that the front panel meter reads the chamber pressure. This will insure quick, accurate flow rate adjustment.

CAUTION

Hazardous chemicals may spray or splash out of the exhaust and/or sample outlets when the system is purged. Reduce the gas pressure and make sure exhaust and outlet tubing is properly routed before performing this procedure.

The pilot valves that control the pneumatic valves are accessed by an removing the cover on the CLS-700. The number of the valve corresponds to the valve numbers in Figure 4-1. By depressing the appropriate pilot valve override buttons the CLS-700 can be completely controlled without electrical power; you do, however, need gas pressure. Refer to Figure 4-2 for information about which pilot valve controls which system valve.

Indicator Lights

Figure 3-2 shows the location of the two indicator lights on the CLS-700 front panel.

- The green STATUS light is on continuously during normal operation. If a communications problem arises, the light will flash on and off until the situation is corrected.

- The red ERROR light is illuminated when a leak is detected by the CLS-700.

Other types of errors are reported through 700-View.

Internal Controls

The CLS-700 enclosure is purged with a portion of the gas supplied at the gas inlet fitting. Two separate purge flow control needle valves are mounted on the pilot valve assembly providing both a constant and an intermittent purge, each of which can be adjusted independently. The intermittent purge valve operates when the chamber is being filled.

The constant purge valve is mounted on the regulator attached to the bottom of the pilot valve assembly. The intermittent purge valve is mounted near the top of the pilot valve assembly adjacent to pilot valve # 2. Refer to Figure 4-3.

Operating Instructions

The CLS-700 is designed to be automatically operated and controlled from the information display and control computer through the 700-View software. Refer to Figure 5-1 for illustration of the display. The instrument can be operated in either automatic or manual mode. In the automatic mode, any number of samples are taken and the particle concentration and sizes are displayed and stored. The operation of the CLS-700 is constantly monitored in this mode. 700-View offers control of:

- number of samples
- compression time
- vacuum time
- tare time
- inter-sample time
- time-outs
- threshold sizes

700-View offers display of:

particle concentration for chosen bin sizes. This data may be viewed in three formats: tabular, histogram, and sequential line graph.

- fill time and rate
- system status
- error conditions
- liquid flow rate

In the manual mode, proper menu selections allow direct control of instrument flushing. This includes flushing the CLS-700 for clean-up.

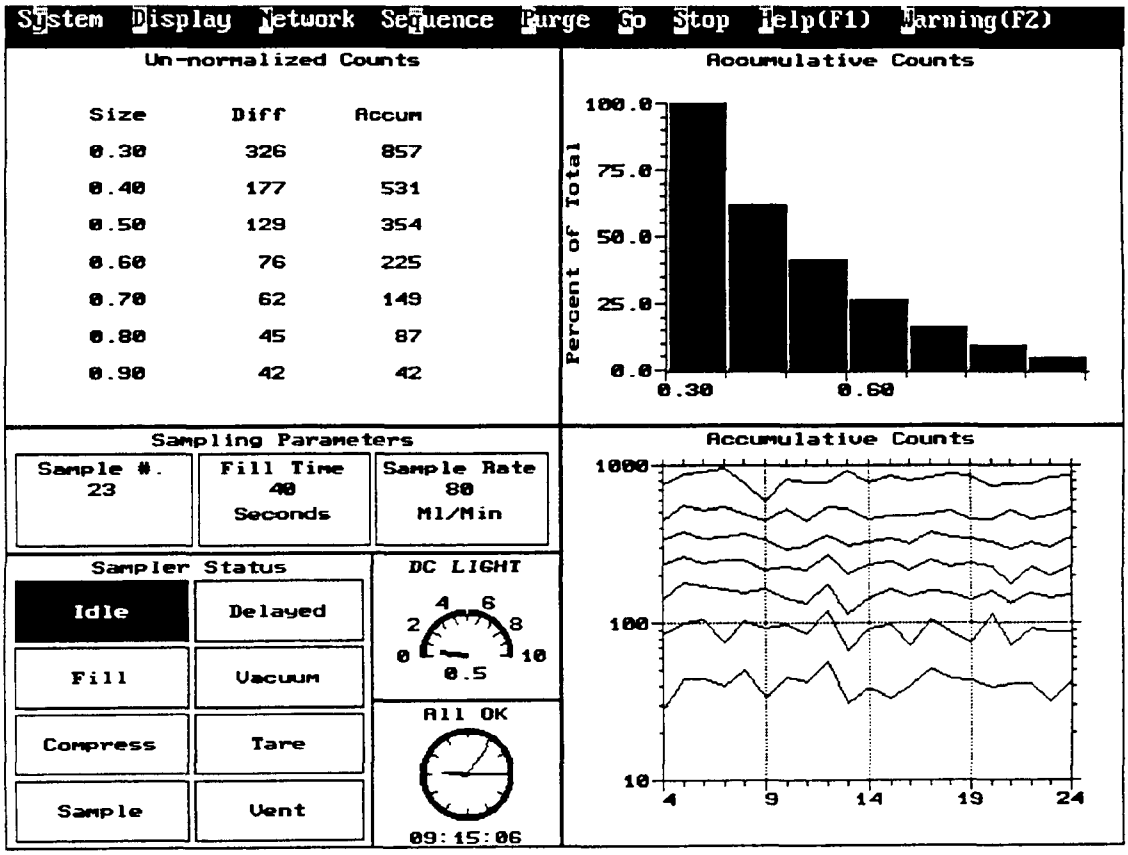


Figure 5-1. Main Display Screen

Operational Check and Sampling Procedure

Prior to beginning sampling make sure you have completed the installation procedures described in Chapter 3. The first sample run through the CLS-700 should be clean DI water. This will allow you to check for leaks and other operational considerations so that when you sample other liquids you can do it efficiently, safely and with confidence. Controls can be set and experimented with to gain familiarity with the instrument.

WARNING

Corrosive liquids and gases can discharge from the EXHAUST OUTLET. Make sure the EXHAUST and LIQUID OUTLET lines are placed in an appropriate chemical drain.

---

1. Place the liquid inlet line into the sample liquid container.
2. Place the liquid outlet and vent lines in a proper drain.
3. Verify that there is adequate pressure available for operation. The pressure must be between 60 and 150 psi.
4. Press the POWER switch to ON, on both the computer and the sampler.

If there is insufficient gas pressure a warning message will appear on the screen when a sample begins. Refer to Figure 5-1 for the location on the screen of the various display and control functions. To start the sampling process press "escape" and then "G" for go. The system will start sampling according to the default settings. The sampling parameters and the sampling status are displayed on the monitor. Sampling parameters are Fill Time, Fill Rate and Sample Rate. Sampler Status displays the present state of the CLS-700.

Idle

When the sampler is waiting for a sample command it is in the idle state. During this state this field is activated.

Delayed

When the system is waiting between samples, this state is shown. The amount of time between samples is controlled by the "Delay Time" menu item under "Sequence."

Fill	This field is activated during buret filling.
Vacuum	This state indicates that the sample is being exposed to a vacuum to help remove bubbles.
Compress	This field is activated during compression.
Tare	The tare state allows a small amount of liquid to flow through the Liquilaz before sampling is actually started. The amount of time spent in the tare state is controlled by the "Tare time" menu item under "Sequence."
Sample	This field is activated during actual particle counting.
Vent	The chamber is vented after each sample. While this is happening this field is activated.

CLS-700 Operation and Display Control

	To activate the control bar at the top of the CLS-700 display, press "escape." Use the arrow keys and "ENTER" or type the highlighted letter in a control selection to choose a control function. For example pressing "G" for go will initiate sampling. The following is a description of each function displayed on this control bar.
System	Refer to Figure 5-2. When System is selected five options are offered:
Exit	Exit to DOS

Auto Print	This option allows you to specify that the results of each sample should be printed.
Print Last	This allows you to manually print a sample. It must be used before the next sample completes.
Location Id	This allows you to enter any text which will be saved and printed along with the sample.
About	Displays the 700-VIEW version and the kind of LiQuilaz being used.

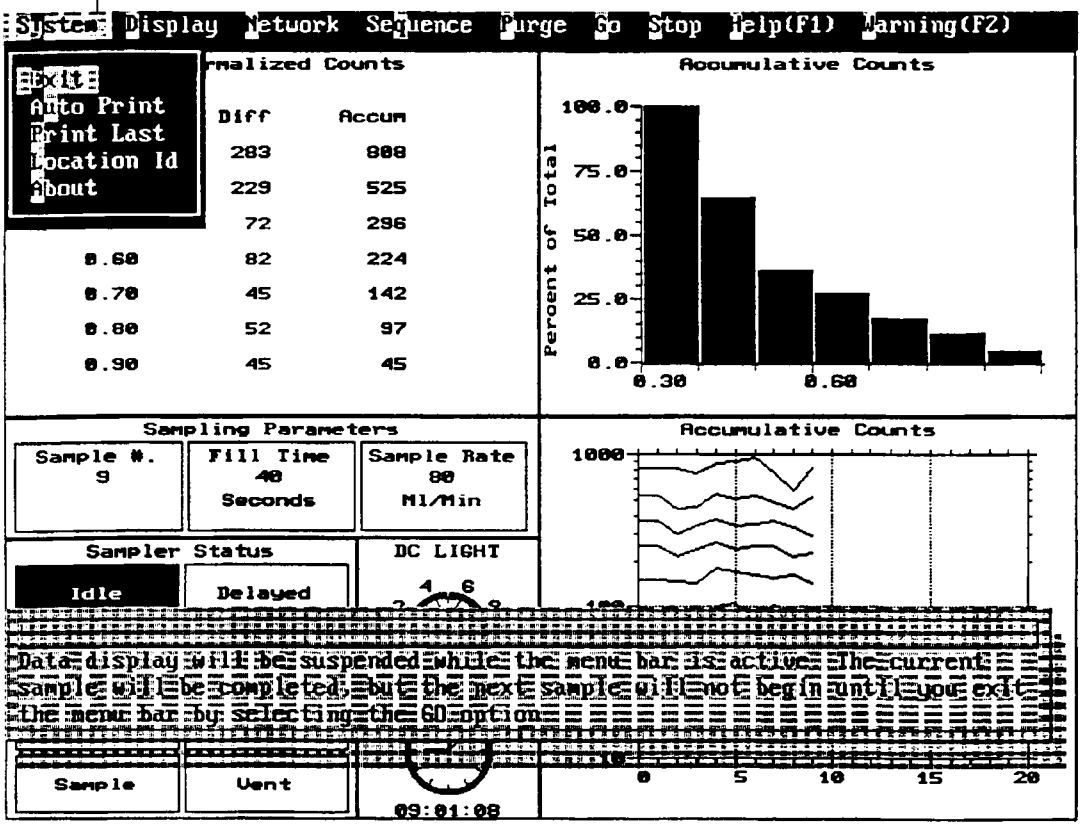


Figure 5-2. System

Display	Refer to Figure 5-3. When Display is selected the following choices are available:
Normalize	Selects between Raw counts and counts per ml.
Number of channels	Selects the number of channels of data to be collected.
Sizes	This option allows you to select the LIQUILAZ size thresholds.
Diff/Accum	This allows you to select between Differential and Accumulative display modes for the Histogram and Time series.
Histogram Scale	The histogram vertical axis displays % full scale. This can be changed from 0 to 100%.
Time Series Max	The time series vertical maximum scale can be changed with this selection.
Time Series Min	The minimum value displayed on the time series plot can be selected.
Time Series Channels	The channels chosen for display can be selected through this entry.

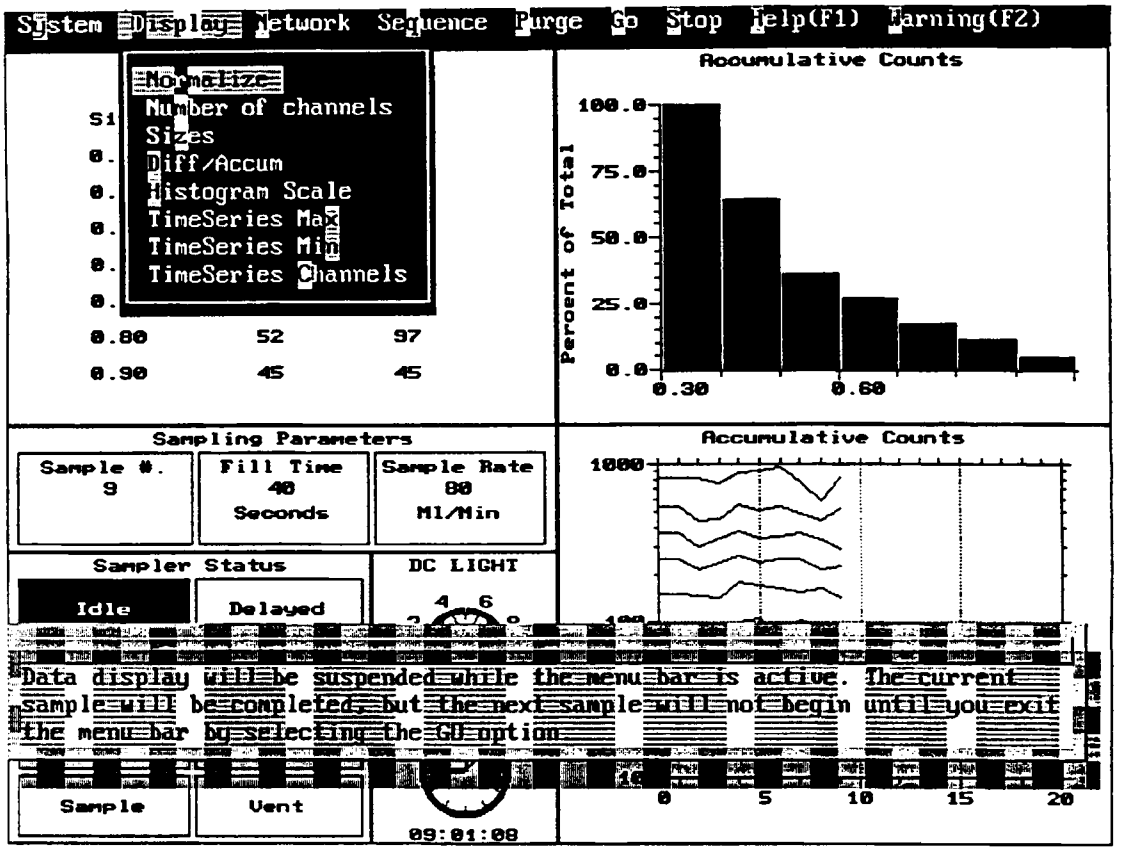


Figure 5-3. Display

Network

Refer to Figure 5- 4.

Define LIQUILAZ Address

The LIQUILAZes are identified by a unique address which is printed on the serial tag on each LIQUILAZ. For the CLS700 system to communicate to the LIQUILAZ it must be aware of the correct address of the LIQUILAZ used with the sampler. This address is entered with the "Define LIQUILAZ Address selection" in the event that the LIQUILAZ is removed and exchanged with a different one.

Read LIQUILAZ Version

The software version in the LIQUILAZ can be read using this selection.

Define CLS-700 Address

The CLS-700s are identified by a unique address that is printed on the serial tag on each CLS-700. For the CLS-700 system to communicate to sampler it must be aware of the correct address of the CLS-700 sampler. This address is entered with the Define CLS-700 Address selection in the event that the sampler is removed and exchanged with a different one.

Read CLS-700 Version

The software version in the CLS-700 can be read using this selection.

Read CLS-700 Status

When this option is selected a number is displayed representing the status of the CLS-700. This number is interpreted by using the following table.

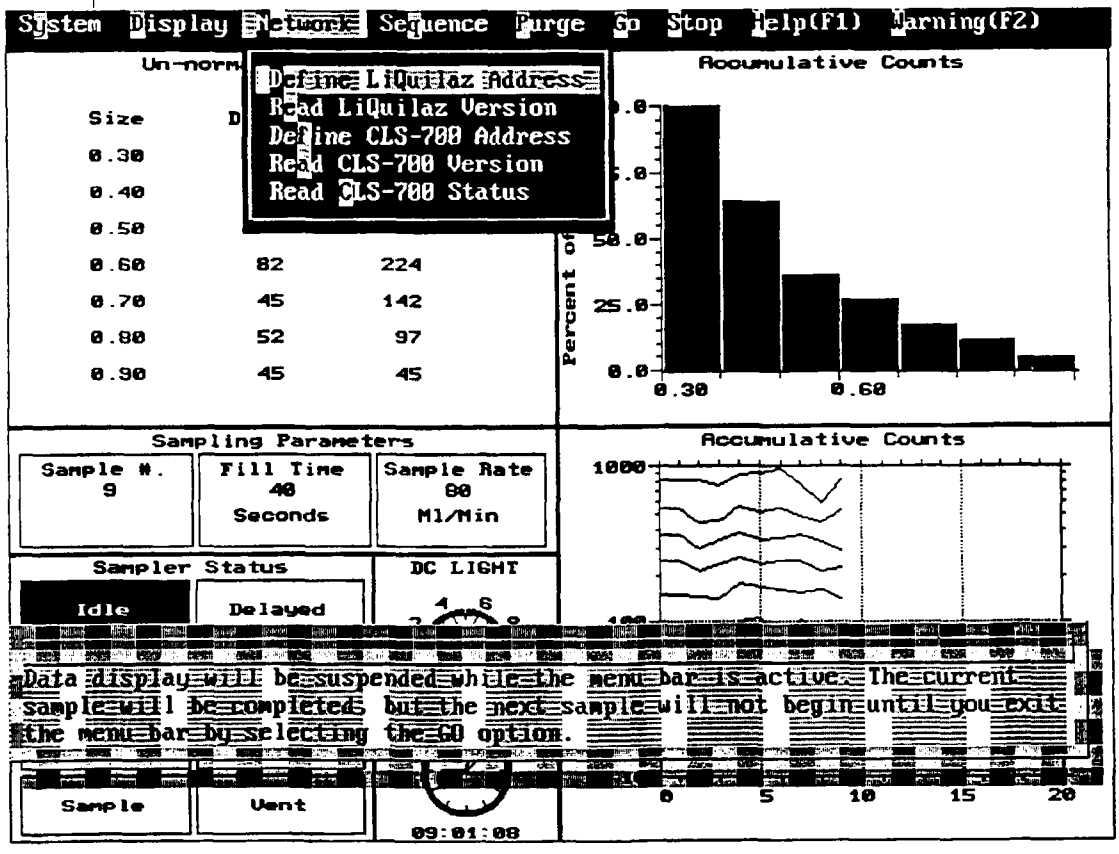


Figure 5-4. Network

Sequence	Refer to Figure 5-5.
Continuous Operation	This allows you to put the CLS-700 in a continuous mode. If you select continuous, the Number of Samples field is ignored.
Number of samples	The number of samples in a continuous run can be selected here.
Inter-sample Delay	The delay between samples can be selected here.
Compression Delay	The time that the sample is user compression before sampling starts is selected here.
Vacuum Time	Selects the amount of time the sample is held with vacuum applied before compression begins.
Tare Time	A small amount of liquid (less than one ml) is left in the sampling inlet tube to the LIQUILAZ from the previous sample taken. The particles in this liquid are not counted because counting does not start until this small amount of liquid is flushed through the sensor first. The time for this to happen is the Tare Time and should remain set at one second.
Fill Time Out	The amount of time for filling should be relatively constant. If the inlet tube becomes obstructed or there is no liquid available for sampling and consequently no liquid is drawn into the sampler, the CLS-700 will display a warning message after the Fill Time Out has been met. This parameter can be changed here.

Sample Time Out

The amount of time for sampling should be relatively constant. If the outlet tube becomes obstructed or the control valve has been set too low, insufficient liquid flow rate results, the CLS-700 will display a warning message after the Sample Time Out has been met. This parameter can be changed here.

Drain Time Out

The amount of time for the overflow chamber to be drained should be relatively constant. If the overflow chamber outlet tube becomes obstructed insufficient liquid flow rate results, the CLS-700 will display a warning message after the Drain Time Out has been met. This parameter can be changed here.

Continue

If any sampling parameters are changed the display stops updating. To restart the displaying of data Continue is selected by either pressing "C" or selecting Continue and pressing "ENTER".

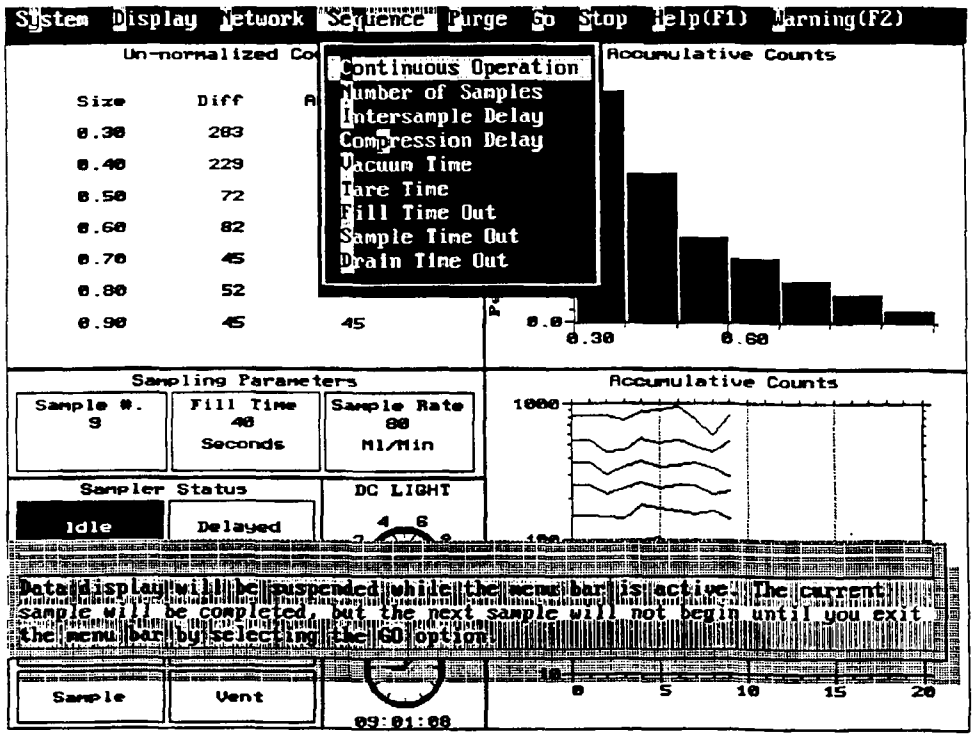


Figure 5-5. Sequence

Purge

Refer to Figure 5-6.

WARNING

When Purge Inlet is selected and "ENTER" is pressed sample chemical is blown back out of the inlet tube. Extreme care must be exercised to avoid inadvertent exposure to potentially dangerous chemicals during this process!

Purge Inlet

When changing chemicals to be sampled, chemical reactions between these chemicals may occur. To minimize effect of this occurrence the CLS-700 allows most of the chemical last sampled to be removed from the system. There are three areas in the sampler where traces of chemical can remain after sampling. These are the inlet tube, the sample tubing and the overflow chamber drain tubing. To remove chemical from the inlet, Purge Inlet is selected. The inlet valve is opened and air is introduced into the sample chamber. This blows out the chemical from the inlet sample tube back out the tube. **Extreme care must be taken during this process as sample chemical is blown back out of the inlet tube**. Reduce the compression pressure before Purge Inlet is selected. This will reduce the rate at which the chemical is discharged from the inlet tube.

Purge Drain

When changing chemicals to be sampled, chemical reactions between these chemicals may occur. To minimize effect of this occurrence the CLS-700 allows most of the chemical last sampled to be removed from the system. There are three areas in the sampler where traces of chemical can remain after sampling. These are the inlet tube, the sample tubing and the overflow chamber drain tubing. To remove chemical from the overflow chamber drain, Purge Drain is selected. The overflow chamber drain valve is opened and air is introduced into the sample chamber. This blows out the chemical from this drain tube out the sample outlet. **Extreme care must be taken during this process as sample chemical is blown back out of the outlet tube.** Reduce the compression pressure before Purge Drain is selected. This will reduce the rate at which the chemical is discharged from the outlet tube.

Purge Sensor	When changing chemicals to be sampled, chemical reactions between these chemicals may occur. To minimize effect of this occurrence the CLS-700 allows most of the chemical last sampled to be removed from the system. There are three areas in the sampler where traces of chemical can remain after sampling. These are the inlet tube, the sample tubing and the overflow chamber drain tubing. To remove chemical from the sensor tube, Purge Sensor is selected. The sensor valve is opened and air is introduced into the sample chamber. This blows out the chemical from this sensor tube back out the sample outlet. **Extreme care must be taken during this process as sample chemical is blown out of the outlet tube.** Reduce the compression pressure before Purge Sensor is selected. This will reduce the rate at which the chemical is discharged from the outlet tube.
Flush	The CLS-700 system provides for continual flushing of the system for clean up with DI water. A source of DI water at a pressure of 10 to 60 psi is connected to the inlet of the CLS-700. When "Flush" is selected the proper valves in the system are opened to allow a continuous flow of water through the system.
GO	To initiate sampling using the selected control parameters "GO" is selected by either using the arrow keys to highlight GO and pressing "ENTER" or by simply pressing "G".
STOP	STOP will cause the 700 View system to stop sampling after the current sample is done.
Help (F1)	For context sensitive help press "ESC", select the function by using the arrow keys and "ENTER" when the function for which help is desired press "F1".
Warning (F2)	Selecting this option, or pressing F2 when the system is running, will explain any currently active warnings.

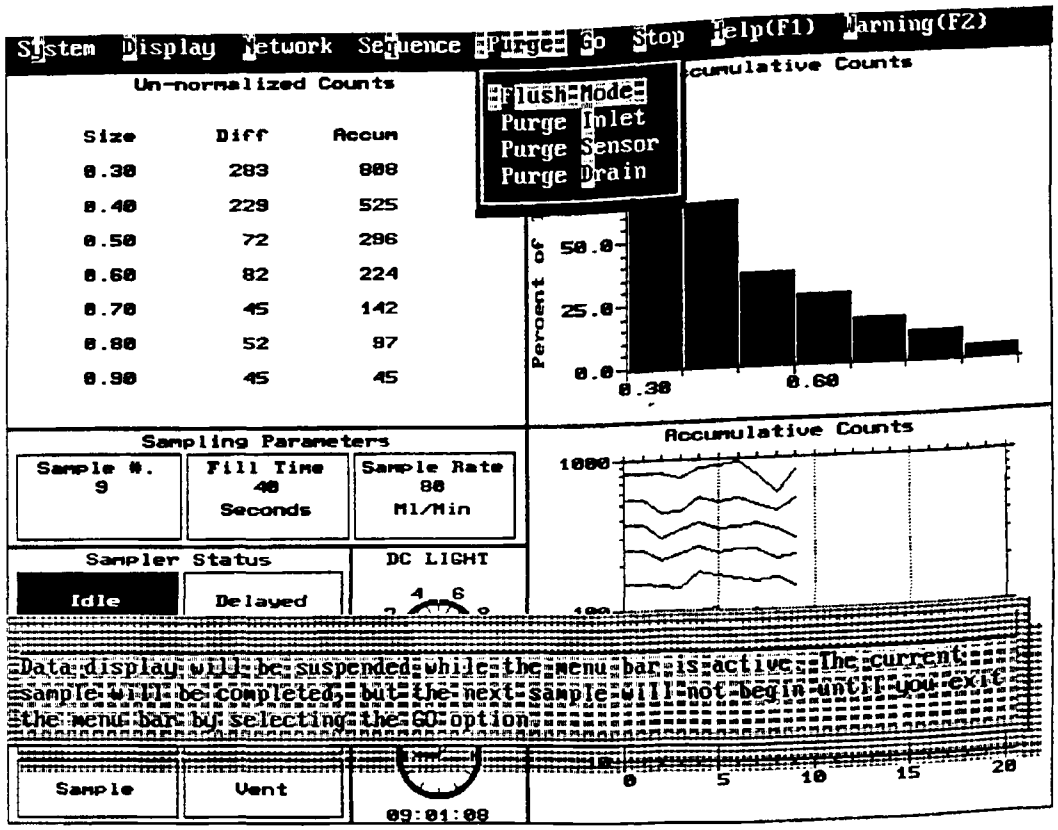


Figure 5-6. Purge

Particle Information Display Description

The particle information display is separated into three basic areas. The first is located in the upper left portion of the screen and is the tabular display of particle size, concentration and alarm condition. A particle size histogram is displayed in the upper right corner of the display. The vertical scale on this display is % full scale and can be changed through the Display selection on the menu bar (press "ESC"). A time series of counts is displayed in the lower right portion of the display. The vertical scale of this display can be changed through use of the display function in the menu bar.

CLS-700 Sampler Controls and Indicators

Refer to Figure 3-2. There are three controls on the front of the sampler: Compression Pressure, Vacuum and Flow Control.

Compression Pressure

The pressure at which the sample will be compressed for bubble removal is controlled by a pressure regulator. The control for this regulator is on the front panel labeled Compression Pressure. Pulling out on this control releases the safety and allows adjustment. Press the control in after adjustment to prevent inadvertent changing.

Vacuum

The vacuum at which the sample is drawn into the buret is controlled by this pressure regulator. Pulling out on this control releases the safety and allows adjustment. Press the control in after adjustment to prevent inadvertent changing.

Flow Control

The flow rate of the liquid sample is controlled by this knob. Actual flow rate is displayed on the display computer after each sample.

There are two indicators on the front panel of the CLS-700 sampler. One LED indicates power. The other LED flashes when the computer is disconnected or when there is an internal leak and the sampler has automatically been shut down.

Refer to Figure 3-1. On the back panel of the CLS-700 are located the liquid interconnections, the exhaust connection, the gas inlet quick connect, the power input module with power switch and the RS232 connector for communications to the information display computer. An additional RS485 connector is provided if multiple CLS-700 samplers are to be controlled by one display and control computer. The liquid connectors and exhaust connector are clearly labeled as is the gas inlet.

Manual Control without Power

The pilot valves in the CLS-700 have a manual override which allows operation without power. Any of the pneumatic valves can be activated by pressing the manual override on these valves. Figure 4-2 shows the location of these valves if the left side panel has been removed. By referring to the fluidic diagram Figure 4-1 and Figure 4-2 showing the location of the valves, the system can be manually operated without power. It is necessary however to have gas pressure.

For example to flush out the inlet liquid tube, press valve # 4 to open the inlet valve along with # 1 to apply pressure and # 3 to close the chamber vent.

To blow out the sensor lines press numbers 1,3 and 5.

To blow out the overflow drain press numbers 1, 3 and 6.

Data Files

Whenever 700-View detects a diskette in the A drive, CDV-format data files are written to disk at the end of each sample. The data fields follow:

Sample ID	Location the sample was taken
Date	Date the sample was taken
Time	Time sample was taken
Sample#	
DC Light	DC Light level at time of sample
Fill Time	Amount of time to fill buret
Flow Rate	

.3µm counts	Number of particles counted in the first size bin
.4µm counts	.
.5µm counts	.
.6µm counts	.
1.7µm counts	Number of particles counted in the last size bin

When examined with a text editor, the data format on diskette will appear like this:

"SAMPLE ID","DATE","TIME", "SAMPLE # ","DC Light", "FILL TIME","FLOW RATE","0.300µ","0.400µ","0.500µ","0.600µ","0.700µ","0.800µ","0.900µ","1.000µ","1.100µ", "1.200µ","1.300µ","1.400µ","1.500µ","1.600µ","1.700µ",
"this is a test of the location id ","06/11/93","07:46:08",1,
0.00,10.00,80.00,16,5,10,17,31,5,23,7,16,4,2,12,9,12,32
"this is a test of the location id ","06/11/93","07:46:34",2,
0.00,10.00,80.00,17,25,21,25,25,26,4,20,10,11,30,17,13,19,25
"this is a test of the location id ","06/11/93","07:46:34",3,
0.00,10.00,80.00,30,28,28,22,24,19,12,11,6,27,13,15,32,4,6
"this is a test of the location id ","06/11/93","07:46:36",4,
0.00,10.00,80.00,31,24,13,25,24,31,0,10,24,7,19,1,31,10,1
"this is a test of the location id ","06/11/93","07:46:37",5,
0.00,10.00,80.00,14,29,18,3,18,8,16,7,15,13,28,13,11,12,1
"this is a test of the location id ","06/11/93","07:46:38",6,
0.00,10.00,80.00,5,17,22,3,13,25,8,11,7,9,9,29,1,21,13
"this is a test of the location id ","06/11/93","07:46:39",7,
0.00,10.00,80.00,22,24,30,7,27,31,25,14,22,26,5,9,4,28,24
"this is a test of the location id ","06/11/93","07:46:40",8,
0.00,10.00,80.00,6,4,9,26,7,18,23,6,32,8,14,24,28,29,32
"this is a test of the location id ","06/11/93","07:46:41",9,
0.00,10.00,80.00,12,14,4,14,7,32,21,19,7,14,25,2,15,5,8
"this is a test of the location id ","06/11/93","07:46:41",10,
0.00,10.00,80.00,30,20,32,15,26,24,12,15,17,3,19,11,4,25,23
"this is a test of the location id ","06/11/93","07:46:42",11,
0.00,10.00,80.00,14,23,3,31,18,24,18,20,25,6,9,9,22,9,18
"this is a test of the location id ","06/11/93","07:46:43",12,
0.00,10.00,80.00,13,10,14,18,15,19,13,4,8,1,32,3,12,21,11

This data can be used in software applications (e.g., a spreadsheet or database) to allow various analyses.

Troubleshooting

This chapter describes the warning messages produced by the CLS-700 display computer.

System Warnings

no status light	check power cable, on/off switch, fuse
blinking status light and 700-View reports no communications	check RS-232 and RS-485 cable connections
ERROR light on front panel	CLS-700 has detected an internal leak. Contact PMS for service.
700-View not recording	verify diskette in drive A check that diskette is formatted and not full.
700-View reports warning: gas pressure low	check house gas for 60psi, fittings on house gas supply, and push-to-connect gas fitting on CLS-700

FILL MODE Warnings

700-View reports warning: fill rate too high	check CLS-700 chamber pressure gauge in fill mode; reduce vacuum control until fill time is greater than 10 sec.
700-View reports warning: fill timeout	check inlet tube connection; tube end should be on bottom of sample container

Note **Timeouts are viscosity-dependent, and are programmable for high viscosity liquids.**

SAMPLE MODE Warnings

700-View reports sample timeout	check flow control valve. set for correct ml/min flow rate for sensor
	check chamber pressure gauge for pressure indication.
	check for liquid blockage in system drain. (see note on viscosity above)
700-View reports sample flow rate too high	check flow control valve (decrease); set for correct ml/min flow rate for sensor
700-View reports sample flow rate too low	check chamber pressure gauge for pressure indication. Increase pressure if necessary
	increase flow control valve (Set for correct ml/min flow rate for sensor)
	check for liquid blockage in system drain
700-View reports sampling error	retry sample; if same error occurs contact PMS Service

DRAIN MODE Warning

	700-View reports drain timeout	check chamber pressure increase drain time (through 700-View) to eliminate drain timeout. (See note on viscosity above).

Glossary

assessed sample volume	that part of the sample which is examined by the sensor for the prescense of contamination. The remainder of the sample (the **meniscus** and **tare**) is discarded.
buret	a cylindrical container used to deliver a specific quantity of liquid to the sensor for sampling.
cavitation	formation of partial vacuums in a liquid.
clean gas	a gas which is uncontaminated by vapor or particles.
clean-up	the process of flushing liquid and particulate materials from the plumbing and capillary tube between samples.
compression delay	the amount of time between compression of a liquid by the sampler (to remove bubbles) and the counting of particles by the sensor.
effervescent	a liquid that releases gas trapped in bubbles. (cf: **foaming**)
foaming	a mass of fine bubbles formed on the surface of a liquid. (cf: **effervescent**)
histogram	a graphic representation of frequency distribution.
house gas	a gas supplied by in-house plumbing for use in liquid sampling. House gas should be clean, dry, and inert.
inter-sample delay	the amount of time between two samples passing through the plumbing of the liquid sampler.

meniscus	the surface of a liquid contained in a buret which comes in contact with ambient air. The meniscus is typically discarded in liquid sampling.
monotonic flow	a flow rate that increases continuously with an increase made to the control for valve aperature size.
particle trap	an area in tool plumbing where particles tend to accumulate due to a lack of laminar flow.
particle generation	the creation of particles by components of tool or in-house plumbing, resulting in erroneous particle counts and distribution.
sample overflow chamber	container for that part of the sample which overflows from the **buret**.
supply gas	gas from a pump, bottle, cylinder, or in-house plumbing which is used to pressurize the sampler. Pumps or compressors tend to produce "dirtier" gas than other mechanisms of gas production.
tare time	the amount of time required for the tare to overflow the buret and be discarded.
tare	a volume of liquid discarded from the sample prior to examination by the sensor.
time out	an automatic shutdown of the sampler when the prescribed time for an event to occur is exceeded.
total sample volume	the entire volume of liquid sampled. Typically, part of this is discarded (see **meniscus, assessed sample volume).**
wetted surface	those surfaces which come in direct contact with the sampled liquid, of interest where material compatibility is an issue.

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