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# CLS-700 T
# Liquid Particle Sampler

## Operations Manual

**Without measurement there is no control.**

PARTICLE MEASURING SYSTEMS
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P/N 1000004967

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# CLS-700 T
# Liquid Particle Sampler

# Operations Manual


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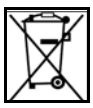
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## Quality Statement

The Quality Policy of Particle Measuring Systems is to strive to meet or exceed the needs and expectations of our customers, and to align the activities of all employees with the common focus of customer satisfaction through continuous improvement in the quality of our products and services.

## Environmental Information



This equipment must be properly disposed of at end-of-life by means of an authorized waste management system. Contact our Customer Response Center at (877) 475-3317 or (303) 443-7100 (International Telephone +1 3034437100) for dismantling and disposal information.

## Manual Conventions

**WARNING**

A warning in the text is used to notify the user of the potential for bodily injury or death.

**CAUTION**

A caution in the text is used to highlight an item that if not done, or incorrectly done, could damage the instrument and/or any materials or devices affected by the instrument.



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**– — NOTICE — –**

A notice in the text is an instructional communication regarding requirements or policies issued by Particle Measuring Systems.

**NOTE:** A note in the text is used to highlight an item that is of operational importance to the user.

It is important that you observe cautions and warnings while performing the procedures described in this manual. Caution and warning labels are located on and inside the instrument to alert you to potentially hazardous conditions. Please familiarize yourself with this information.



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## CE – Declaration of Conformity

# CE - Declaration of Conformity

| | | |
|---|---|---|
| **Application of Council Directive(s):** | 2004/108/EC, 2006/95/EC | |
| **Standard(s) to which Conformity is Declared:** | **EMC** | EN 61326-1: 2006 |
| | **Safety** | EN 61010-1: 2010 |
| **Manufacturer's Name:** | Particle Measuring Systems, Inc. | |
| **Manufacturer's Address:** | 5475 Airport Boulevard, Boulder, CO 80301 USA | |
| **Manufacturer's Telephone/FAX:** | +1 3034437100 / +1 3034496870 | |
| **Distributor's Name:** | Particle Measuring Systems, Inc. | |
| **Distributor's Address** | Grovewood Road, Enigma Business Park | |
| | Malvern, WR14 1XZ | |
| | Worchestershire, United Kingdom | |
| **Distributor's Telephone/FAX:** | 011-44-1684-581000 / 011-44-1684-560337 | |
| **Type of Equipment:** | Corrosive-Liquid Sampler | |
| **Model No:** | CLS-700 T | |

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

| | | | |
|---|---|---|---|
| **Signature:** |  | Signature: |  |
| **Full Name** | Kathy Campitelli | Full Name: | David Hall |
| **Position:** | Director of Engineering | Position: | Managing Director |
| **Place:** Boulder | **Date:** November 12, 2012 | **Place:** Malvern | **Date:** November 12, 2012 |

## CAUTION

All I/O cables and accessories must meet current factory specifications in order for this unit to remain in compliance with CE marking requirements. Consult the factory for details.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



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## Hazardous Material Leakage Procedure

The following information applies to the CLS-700 T liquid particle sampler.

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 the exterior and/or interior of the instrument with the appropriate neutralizing agent.
2. Test with litmus paper and continue neutralization until neutral pH (7) is achieved.

**– — NOTICE — –**

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

3. If allowed by local environmental regulations, flush the 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.
4. 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.
5. Chlorinated solvents, organic solvents, or other chemicals should be contained for recycling or disposal by a hazardous waste disposal firm.
6. Flush the instrument with clean water until it is free of chemicals.
7. After clean-up, internally-contaminated instruments must be air-dried before reassembly. This will help to prevent corrosion.
8. Before packing and shipping, fill the sample cells with Particle Measuring Systems-approved cleaning solution and cap the sample inlet and outlet connections.

**– — NOTICE — –**

Particle Measuring Systems cannot service instruments that are contaminated with BIOHAZARD, RADIOACTIVE, or TOXIC materials.



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# Chapter 1
# Getting Started

The CLS-700 T liquid particle sampler, a corrosive-liquid sampler with trigger option, draws sample liquids from un-pressurized containers such as baths, drums, or various-sized bottles. After drawing a sample, the CLS-700 T liquid particle sampler compresses it to remove any bubbles, either pre-existing or caused by the extraction process. It then delivers the liquid to a LiQuilaz® particle counter.

The CLS-700 T liquid particle sampler is typically operated as a computer-controlled automatic instrument. The data system analyzes and displays particle count and size data.

The liquid particle sampler may be manually controlled, allowing the operator to purge residual sample from the sampler's liquid lines.

The primary controls are located on the front panel of the instrument for convenient access. Adjustments will need to be made if sampling a different chemical is required or if there are physical changes to sampling setup. **Figure 1-1** shows the front panel and primary controls for the CLS-700 T liquid sampler. Adjusting the fill time, flow rate and compression pressure is accomplished with front panel controls. Setting compression delay, tare and intersample delay is usually made in software.




**Figure 1-1** CLS-700 T liquid particle sampler (front)



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All wetted surfaces of the CLS-700 T liquid particle sampler are Teflon® with the exception of two Kalrez® 4079 O-rings. The LiQuilaz particle counter sensor, contained within the CLS-700 T liquid particle sampler, has KEL-F®, Kalrez 4079, and sapphire wetted parts. This enables the CLS-700 T liquid particle sampler to sample most process chemicals.

The process chemicals to be sampled are subject to the following limitations:

- The chemicals must be compatible with the system's wetted surfaces.

**NOTE:** Due to the variety and complexity of chemical usage in industry today, Particle Measuring Systems is unable to test every possible combination for compatibility. It is, therefore, the customer's responsibility to verify compatibility of their fluids and processes with the wetted surfaces of the CLS-700 T.

- Each sensor has a specific lower limit of flow rate at the maximum sampler compression (pressure). The liquid being sampled must not be so viscous as to reduce the flow rate below its minimum.
- The chemicals must not be naturally foaming. Naturally foaming chemicals are not detected reliably by the liquid level sensors used to control the sampling process.

All operational controls and indicators are located on the front panel.

The liquid inlet, liquid outlet, pressurized gas inlet, gas exhaust, and communication connectors are located on the rear panel.

## Location Considerations

The location of the sampler relative to the liquid that will be measured will have a significant influence on the resulting data. In many instances adequate space is not available near the vessel where the measurement is to take place. Long lengths of tubing are then used to deliver the sample to and from the instrument. This is less than desirable because a fairly large volume of liquid can reside inside the tubing between the sampler and vessel.

For example, a 4m length of 6mm diameter tubing will contain approximately 50ml of fluid. Unless the sampler is designed to discard the first 50 ml of fluid before drawing in the actual sample the measurement will include some of the fluid drawn from the bath during the last sample.

This can also create timing problems. For instance, if the sampler must take two samples before it receives a representative sample from the vessel, but the product was in the vessel during the first sample, how does one correlate the particle data to process events.

Probably the most significant problem with long lengths of tubing is contamination remaining after the measurement is completed. The amount of time needed for tubing to clean up after a measurement is directly related to its length. Since the volume of liquid sampled in a batch mode is generally low, clean-up times can be significant after sampling dirty chemistries. Since the clean-up time is the limiting factor of testing throughput, this type of occurrence needs to be minimized. In some instances contaminated tubing is simply removed and disposed of rather than wasting the time to reduce background particle counts to acceptable levels. Tubing lengths less than 2m are generally suggested.



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Equally important is sample location selection. In some wet bench processing, the particles generated are lighter than the fluid causing them to float. Monitoring for these particles anywhere but near the surface will result in artificially low readings. If the chemical contains heavy metallic particles, then the sample tubing should be placed near the bottom of the container. In most cases a general rule of thumb cannot be determined because too many variables exist. The only rule of thumb of value is to carefully consider the particles of interest and how to best find them.

# Specifications — CLS-700 T Liquid Particle Sampler

| CLS-700 T Liquid Particle Sampler | |
|---|---|
| **Assessed volume** | 48 ml nominal |
| **Maximum compression pressure** | • 60 psi at 120 °C or less<br>• Maximum of 45 psi at 150 °C |
| **External surfaces** | Polypropylene, which meets flame retardant specification FM4910 |
| **Wetted surface materials** | Teflon, KEL-F<br>(See the *LiQuilaz Particle Counter Operations Manual* for other wetted surfaces.) |
| **Sample temperature** | 10 – 150 °C at 45 psi or less (Maximum 120 °C at 60 psi)<br>Sulfuric acid 100 °C maximum |
| **Dimensions (l, w, h)** | 16 × 10 × 16 in (41 × 26 × 39 cm) |
| **Weight** | 34 lb (15.5 kg) |
| **Communications** | RS-232 or RS-485 |
| **Environment** | Temperature: 10 – 35 °C; Humidity: non-condensing |
| **Software** | SamplerSight |
| **Sampling** | Controlled by means of software and/or external trigger |
| **Zero count** | < 1 count/ml ≥ 0.3 µm |
| **Installation Requirements** | |
| Indoor use only<br>Pollution degree 2<br>Over-voltage Category II<br>Ordinary protection (Not protected against harmful ingress of moisture.)<br>Class I Equipment (Electrical grounding is required for safety.) | |
| **Facility Requirements** | |
| • Power: 85 – 130 VAC, 0.75 A or<br>200 – 265 VAC, 0.5 A<br>• Gas pressure: 70–150 psi<br>• Liquid connections: Flaretek® 1/4-inch<br>• Voltage fluctuation: AC input voltage fluctuation shall not exceed ± 10% | |
| **Fuses** | • For ~ 85 – 130 V units: 250VAC, 3AG SB, 0.75 Amp<br>• For ~ 200 – 265 V units: 250VAC, 5x20mm, T, 0.5 Amp |



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# Specifications — Liquilaz Particle Counter Sensors

| | LiQuilaz S02 | LiQuilaz S03 | LiQuilaz S05 |
|---|---|---|---|
| **Size range** | 0.2 – 2.0 µm | 0.3 – 3.0 µm | 0.5 – 20 µm |
| **Channels** | 15 | | |
| **Flow rate** | 50 mL/min | 80 mL/min | 80 mL/min |
| **Sample volume** | Volumetric<br>50 mL/min (100%) | Volumetric<br>80 mL/min (100%) | Volumetric<br>80 mL/min (100%) |
| **Maximum concentration**[a] | 10,000 particles/mL | | |
| **Sample temperature** | • 10 – 150 °C, (maximum 45 psi @ 150 °C, 60 psi @ 120 °C)<br>Sulfuric acid: 100 °C maximum | | |
| **Maximum pressure** | 100 psi | | |
| **Wetted surface materials** | Sapphire, Teflon®, KEL-F®, Kalrez® 4079 | | |
| **Laser source** | Laser diode | | |
| **Weight** | 6 lb (2.7 kg) | | |
| **Calibration** | Calibration materials are traceable to USA National Institute of Standards and Technology (NIST) | | |
| **Laser classification** | • Class I, complies with US 21 CFR 1040.10 and EN60825-1.<br>• Internally an enclosed Class 3B laser is used per EN60825-1. | | |

**Installation Requirements**

Indoor use only
Pollution degree 2
Over-voltage Category II
Ordinary protection (Not protected against harmful ingress of moisture.)
Class I Equipment (Electrical grounding is required for safety.)

| **Utility Requirements** | |
|---|---|
| **Electrical rating** | • ~ 85 – 125 V, 50 – 60 Hz, 0.75 A<br>• ~ 220 – 240 V, 50 – 60 Hz, 0.63 A |
| **Voltage fluctuation** | AC input voltage fluctuation shall not exceed ± 10% |
| **Fuses** | • For ~ 85 – 125 V units: 250VAC, 3AG SB, 0.75 Amp<br>• For ~ 220 – 240 V units: 250VAC, 5x20mm, T, 0.63 Amp |

a. Greater than 90% accuracy (less than 10% coincidence loss) at maximum recommended concentration.



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# Chapter 2
# Unpacking and Installation

## Unpacking

**>> To unpack the liquid particle sampler:**

1. Open the container and carefully remove the CLS-700 T liquid particle sampler. Inspect it for damage.
2. If the sampler has been damaged in shipment, notify the shipper and Particle Measuring Systems. Repackage the instrument in the original packing materials.
3. If the instrument is not damaged, store the packing materials.

## Installation Requirements

| | |
|---|---|
| **Power** | See Specifications — CLS-700 T Liquid Particle Sampler on page 1-3. |
| **Power cord** | Standard IEC AC. |
| **House gas** | Clean, pressurized gas, compatible with the chemical being sampled. |
| **Communications cables** | RS-232: provided. This is the only cable necessary when the control system is controlling one CLS-700 T liquid particle sampler.<br>RS-485: used when the control computer is controlling several CLS-700 T liquid particle sampler systems. |
| **Sample tubing** | 1/4-inch O.D. PFA Teflon, 0.047-inch wall. |
| **Flaring tool for 1/4-in tube** | Flaring tools are available from tubing suppliers. |
| **Connector hardware** | 3 Flaretek fittings. |



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# Installation

Installation is the process of completing all the required physical connections. All connections are made on the back panel. See **Figure 2-1**.

An RS-485 connector is provided if multiple CLS-700 T liquid particle samplers are to be controlled by one control computer. All connections are clearly labeled.




**Figure 2-1** CLS-700 T Liquid Particle Sampler rear panel connectors

## Installing the Power Cord and Handling Tubes

**>> To install the power cord and fluid handling tubes:**

Follow these steps to install the power cord, liquid handling tubes, and gas handling tube.

1. Connect a standard IEC AC power cord to the power module. See **Figure 2-1**.
2. Connect a source of clean, dry, inert gas to the 1/4-inch push-to-connect Gas Inlet connector. Ensure that the gas is pressurized to the system specifications.
3. Cut two pieces of 1/4-inch PFA Teflon tubing long enough to reach from the Exhaust fitting to a hazardous waste drain or hazardous waste container.
4. Flare one end of each tube, and place the provided Flaretek connectors over the flared ends of the tubes.
5. Secure the tubes to the **Liquid Out** and **Exhaust** connections.
6. Direct the Exhaust and Liquid Out tubing to an appropriate waste drain or container.



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7 Secure the Exhaust and Liquid Out tubing so they will not become free-moving.

8 Ensure that the tube-ends are above the level of the liquid in the waste drain or container.

**WARNING**

House gas (used to create system pressure and vacuum) contacts the chemical being sampled. This gas is vented from the exhaust outlet. If the burette level detector fails, the sample liquid can also be discharged from the exhaust outlet. To protect personnel and equipment from corrosive liquids, it is extremely important to route the exhaust tubing to an appropriate venting system, chemical drain, or waste collection container. Check your local environmental regulations.

9 Cut a piece of 1/4-inch PFA Teflon tubing long enough to reach from the Liquid In connector to the source of the sample liquid.

10 Flare one end of the tube, and place the provided Flaretek connector over the flared end.

11 Secure the tube to the Liquid In connection.

All liquid plumbing connections are made from the rear of the unit (see **Figure 2-1** on page 2-2).

## Installing the Communication Cable

**>> To install the communication cable (controlling one sampler):**

An RS-232 cable is provided and is the only cable needed when controlling one sampler. An RS-485 connector is provided if multiple CLS-700 T liquid particle samplers are to be controlled by one control computer. All communication connections are clearly labeled.

1 Connect the RS-232 (DB25) cable from the RS-232 connector on the sampler's back panel to the control computer.

2 If it is necessary to fabricate a new RS-232 cable, see the cable specifications below.

**>> To install the communication cable (controlling more than one sampler):**

1 An RS-485 cable is required when several samplers are controlled by one control system. Call Particle Measuring Systems Instrument Service & Support at 1-800-557-6363.

## Cable Specifications

**Table 2-1** RS-232 (DB25) Pin Designations

| | |
|---|---|
| Pin 2 | Receive data |
| Pin 3 | Transmit data |
| Pin 7 | Ground |
| Pin 4 or 9 | RTS |

**Table 2-2** RS-485 (DE9) Pin Designations

| | |
|---|---|
| Pin 2 | $\overline{TX}$ |
| Pin 3 | TX |
| Pin 4 | $\overline{RX}$ |
| Pin 5 | RX |



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## Installing a Trigger System

The following material is relevant only when external hardware will be used to coordinate the sampling operation.

**>> To install a Trigger system:**

**1** Connect the trigger activating signal cable to the Trigger input connector.

**Table 2-3** Trigger Connector Pin Designations

| | |
|---|---|
| Pin 1 | +12V |
| Pin 2 | Trigger level |
| Pin 3 | Trigger level |
| Pin 4 | Trigger activate |
| Pin 5 | Trigger activate |
| Pin 6 | GND |

Both the Trigger level and Trigger activate inputs require a DC voltage between 5 and 24 volts for high voltage input operation and 0 volts (or no connection) for low voltage input operation. The input voltage can be applied in either polarity at the inputs.

If a high voltage is sensed between the Trigger level inputs, the system will start sampling when a high voltage is sensed between the Trigger activate inputs.

If a low voltage (or no connection) is sensed between the Trigger level inputs, the system will start sampling when a low voltage (or no connection) is sensed between the Trigger activate inputs.

**WARNING**

Do not connect the Trigger input to a device that does not have a Class I or Class II insulation rating.



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# Chapter 3
# Operations

## SamplerSight[1] Control Software

Operate and control the CLS-700 T liquid particle sampler with SamplerSight software. See the *SamplerSight User's Manual* (included in the software).

### Sampler State (Status) Display

SamplerSight displays the state (status) of the sampler unit. The various states are listed below.

| State Name | Description |
|---|---|
| **Idle** | When the CLS-700 T liquid particle sampler is waiting for a Start Sample command, it is in the idle state. |
| **Fill** | This state is activated during burette filling. |
| **Vacuum** | This state indicates that the sample is being exposed to a vacuum to help remove bubbles. |
| **Compress** | This state is activated during sample compression. |
| **Tare** | The tare state allows a small amount of liquid to flow through the LiQuilaz particle counter before particle sensing and counting starts. |
| **Sample** | This state is activated during particle sensing and counting. |
| **Vent** | The chamber is being vented. This occurs after each sample. |
| **Trigger** | This state indicates that the sampler is waiting for a Trigger Active hardware indication to automatically start a sample. |

1. This manual references SamplerSight as the control software; however, you can also use the Particle Measuring Systems Facility Net or Pharmaceutical Net software when seeing this reference.



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# Controls and Indicators

Use the following controls and indicators (located on the front of the CLS-700 T liquid particle sampler) to set and adjust the instrument for the sampling process.




**Figure 3-1** Controls and Indicators

# LED Indicators

## STATUS

This green light is on continuously during normal operation. If a communications problem occurs, the light will flash on and off until the problem is corrected.

## ERROR

This red light illuminates when a leak is detected.



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# Fill

Vacuum is used to draw the chemical from the source into the sampler. Increasing the vacuum reduces the time required for sample intake, or enables the sampler to aspirate more viscous fluids, such as sulfuric or phosphoric acid.

Changing the height of the sample, i.e., from a container located on the floor to a container located at tabletop level or vice versa, may require changing the vacuum setting.

The time required to fill the compression sample's internal sample burette is the primary control of the vacuum adjustment common to all compression samplers. Filling too fast can cause splashing, which could trigger the level detector before the burette is actually full, resulting in an inaccurate sample volume. Alternatively, it can also cause cavitation points that may not be flushed properly to eliminate residual contamination from previously sampled chemicals. Both of these situations will result in unpredictable data variability. On the other hand, filling too slowly reduces throughput. A general rule of thumb is to adjust the sampler fill time to approximately 10 to 15 seconds using the vacuum control. The fill time is controlled by adjusting the **Vacuum** valve on the instrument's front panel (see **Figure 3-1** on page 3-2).

# Compression

Compressing process chemicals prior to measuring particle concentration eliminates bubbles that would otherwise invalidate the resulting data or make interpretation of the data a more difficult task than it needs to be. This is particularly true for wet etch applications and chemistries with ozone or peroxide additives.

It is important to note that noneffervescent chemistries may still suffer from bubble formation. For instance, overflowing wet benches often entrain air in the fluid. The liquid particle counter counts these micro-bubbles as if they were particles. Therefore, it is always necessary to have some pressure on all samples, and to be prepared to adjust it based on the chemistry. There will always be a greater number of smaller particles than larger ones given an ambient distribution. Any time a liquid particle counter displays a particle size distribution that includes more large particles than smaller size particles it is reasonable to expect that bubbles are present.

There are two parameters associated with the compression mode of a sampler: compression pressure and compression delay. A reasonable approach when working with a new chemistry is to start with a nominally low compression pressure and a short (15 seconds) compression delay. A good starting point for the pressure setting is 10 to 15psi. If the particle size distribution looks like **Figure 3-2** on page 3-4 after a few samples, bubbles are likely still present is the liquid.



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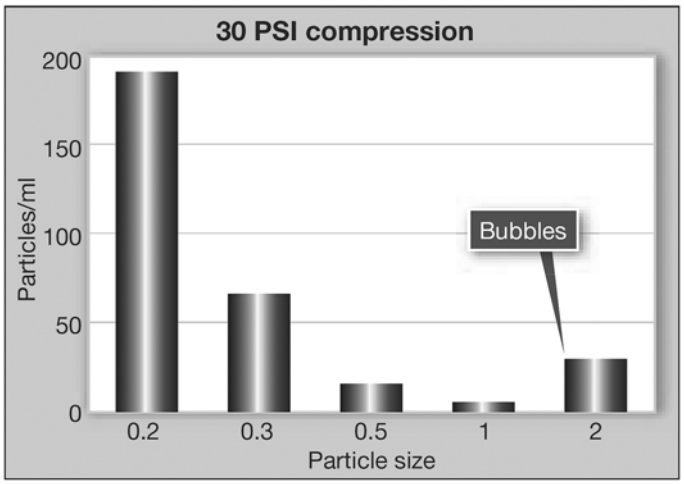



**Figure 3-2** Particle Distribution Affected by Bubbles

To determine if this is the case, the compression pressure on the sampler should be increased using the dial on the instrument. In an unknown situation, it is suggested that the pressure be increased a significant amount initially, i.e., from 15 to 50 psi. The pressure can be reduced until the distribution changes and bubbles just begin to form. It is a good rule of thumb to add an additional 5 psi to assure bubbles will be eliminated as a final optimization step and establish this value as the pressure setting for the chemical under test. **Figure 3-3** shows a particle size distribution optimized using the process described.

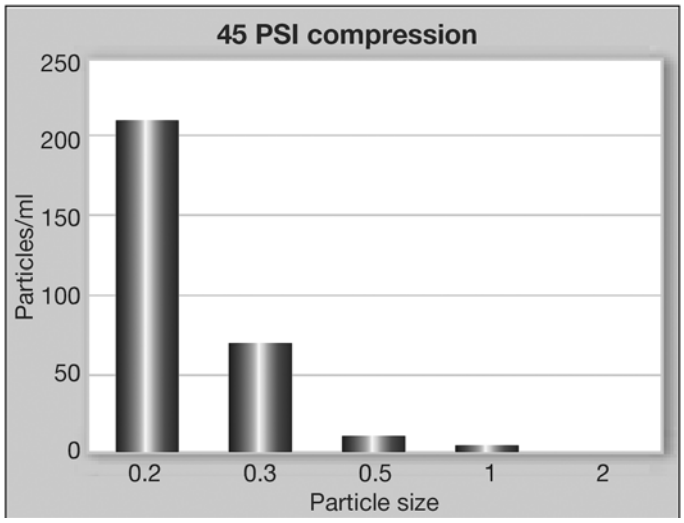



**Figure 3-3** Particle Distribution Free from Bubbles

It should be noted that compression delay has less of an impact on eliminating bubbles than compression pressure, but is still an important part of optimizing a sampler's settings. The following example illustrates the interaction between compression pressure and compression delay. As stated previously, the first step to take when bubbles are present is to increase the compression pressure for several samples while monitoring the resulting distribution. Short compression delays (15 seconds) facilitate rapid sampling so more data can be generated.



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If bubbles are still suspected to be present after reaching the maximum pressure the sampler allows, increasing compression delay is the next step. The quickest way to find the optimum setting that eliminates the bubbles is to increase the compression delay from 15 seconds to several minutes.

Again observe the size distribution for several samples. If the size distribution does not change, the sample does not contain bubbles. Return to the shorter delay time and continue sampling with confidence that bubbles are not affecting the results. If the distribution gets worse, additional bubbles are forming because of chemical reaction time, and a shorter delay time should be chosen than the original starting point. If the distribution changes for the better, begin reducing the compression delay until the bubbles reappear.

For best results, use a divide and conquer approach. Cut the compression delay in two, and observe several samples. If the sample distribution continues to look good cut the delay in half again. Continue in this fashion until reaching the point that bubbles are just beginning to form. Then add a 10% margin for variations between samples

Finally, consider the application where viscous chemicals need to be sampled. Compression liquid samplers have been proven to sufficiently suppress bubble formation from occurring when dissolved gases are present. There have been instances where viscous chemicals were either aggressively agitated, or forcefully aspirated into the sample container. In these cases the bubbles formed were not the result of a natural occurrence, but artificial introduction. It is unlikely that any amount of compression pressure or delay will adequately suppress these bubbles to prevent the particle counter from reporting them. Only time to allow the bubbles to rise to the surface and exit the fluid will stabilise the data. A better solution is to transfer the fluid more carefully to prevent the introduction of the bubbles in the first place.

The most desirable plan when setting the compression pressure utilizes the lowest pressure that will provide accurate data. This reduces stress on the internal components of the liquid sampler thereby reducing maintenance. **Table 2** summarizes liquid compression sampler settings for some of the more common chemicals used in the semiconductor Industry.

**Table 3-1** Suggested Industry Compression Settings

| *Chemistry* | *Fill Time* | *Compression Pressure* | *Compression Delay* |
|---|---|---|---|
| DI Water | ≥10 seconds | 30psi | 10 seconds |
| Dilute HF | ≥ 10 seconds | 30psi | 15 seconds |
| B.O.E. | ≥10 seconds | 55psi | 60 seconds |
| SPM and SOM | ≥10 seconds | 55psi | 5 seconds |
| Nitric | ≥10 seconds | 30psi | 15 seconds |
| Phosphoric | ≥10 seconds | 50psi | 30 seconds |
| SC-1 | ≥10 seconds | 45psi | 15 seconds |
| SC-2 | ≥10 seconds | 45psi | 15 seconds |



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## Tare Time

The tare time is the delay between when the sample begins to flow through the particle sensor and when the sensor begins recording particle counts. The purpose of this parameter is twofold. First, it is to allow the short piece of tubing between the sample burette and the particle sensor to clear itself of the previous sample and present the particle counter with fluid from the current sample. Second, it allows the sample fluid to accelerate to the sensor's calibrated flow rate. This ensures that the sensor accurately reports particle size information during the particle counting interval. Generally, one to two seconds is sufficient for viscosities less than 10 centipoise. Experience has shown that five seconds works well for chemistries having viscosities greater than 10 centipoise.

## Sample

All optical particle counters are calibrated at a particular flow rate that optimizes the particle size measurement. Operating at flow rates other than that specified by the manufacturer will invalidate the measured data and make the overall task more difficult and confusing than it needs to be. Setting and maintaining the desired flow rate is straightforward for most online applications. It can be quite difficult however in a batch sampling mode with viscous process chemicals.

Experience suggests that the flow rate be confirmed for each liquid that is sampled after the fill and compression configuration steps have been completed. The flow rate should be adjusted to ±5% of the manufacturer's specification for best results using the **Flow Rate** knob on the instrument's front panel (see **Figure 1-1** on page 1-1).

## Inter-Sample Delay

This delay (set in the software sample configuration) will cause the sampler to delay between the starts of each sample for a designated length of time. The purpose of this delay is to reduce the number of samples taken in a given length of time, for instance, samples per day. It is an artificial method of slowing down the sampler from taking as many samples as it could normally take without the delay. This is probably the only parameter whose setting is completely arbitrary and depends upon the specific application.



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# Purge Process

When sampling a chemical that is different from the one previously sampled, you MUST be concerned about possible strong chemical reactions between the new chemical and residual chemical left in the sampler from the previous sample.

Traces of sample can remain in the sampler in the following three areas:

- Liquid in tube
- Sample tube between the burette and the liquid particle sampler
- Liquid out tube

To minimize chemical reactions, the CLS-700 T liquid particle sampler allows most of the chemical last sampled to be removed from the system by means of the following purge processes:

- Purge Inlet
- Purge Drain
- Purge Sensor

**WARNING**

Exercise extreme care during the following purge operations. Fluid and gas will be ejected from the inlet and outlet tubes with a force that is dependent on the Compression Pressure setting. Take precautions to contain splashing. Securing the tubes to the waste drain or container (above the fluid level) is a wise precaution.

## Purge Inlet

**>> To remove residual sample from the inlet:**

1. Pull the **Compression Pressure** control knob out to enable it for adjusting.
2. Adjust the **Compression Pressure** control knob to reduce the force at which the chemical will be discharged from the inlet tube.
3. Ensure that the inlet tube is directed to an appropriate chemical drain and is secured to prevent free movement during the purge process.
4. On the SamplerSight main display, click **Configure, Instrument**. The **CLS-700** window appears.
5. Click **Manual**. The **CLS-700 Manual Control** window appears.



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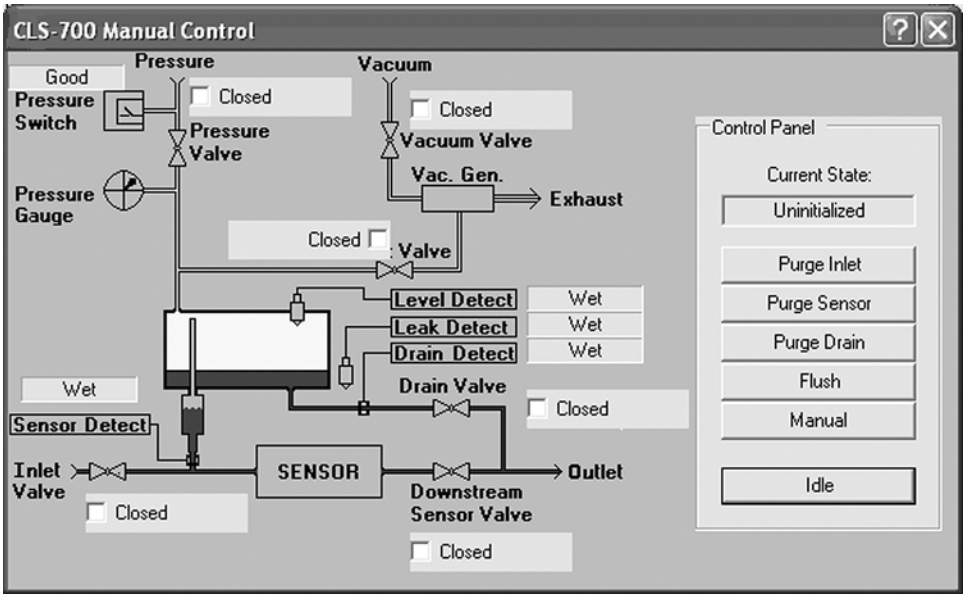



**Figure 3-4** Manual Control Window

**6** In the **Control Panel** area, click **Purge Inlet**. The inlet valve will open, allowing air and residual sample to blow through the sample chamber and out of the sample inlet tube.

## Purge Drain

**>> To remove residual sample from the overflow chamber drain:**

**1** Pull the **Compression Pressure** control knob out to enable it for adjusting.

**2** Adjust the **Compression Pressure** control knob to reduce the force at which the chemical will be discharged from the inlet tube.

**3** On the SamplerSight main display, click **Configure, Instrument**. The **CLS-700** window appears.

**4** Click **Manual**. The **CLS-700 Manual Control** window appears.

**5** In the **Control Panel** area, click **Purge Drain**. The overflow chamber drain valve opens and air enters the sample chamber, blowing the residual sample from the drain tube and out of the sample outlet.

## Purge Sensor

Use the **Purge Sensor** command at specific times, such as when you intend to use the CLS-700 T liquid particle sampler immediately after the purge, or to prepare the unit for shipment to Particle Measuring Systems for service.



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| CAUTION |
| --- |
| Consider your options carefully when using the **Purge Sensor** command. The **Purge Sensor** has a tendency to dry the sensor's capillary tubing, resulting in the need for service. The volume of sample remaining in the sensor tubing is limited to 4.5 ml. Balance the need to remove this small volume of sample against the need to manage maintenance costs. |

**>> To remove residual sample from the sensor tube:**

1. Pull the **Compression Pressure** control knob out to enable it for adjusting.
2. Adjust the **Compression Pressure** control knob to reduce the force at which the chemical will be discharged from the inlet tube.
3. On the SamplerSight main display, click **Configure, Instrument**. The **CLS-700** window appears.
4. Click **Manual**. The **CLS-700 Manual Control** window appears.
5. In the **Control Panel** area, click **Purge Sensor**. The sensor valve opens allowing air into the sample chamber. This blows the residual sample from the sensor tube and out of the sample outlet.

## Flush

The CLS-700 T Particle Sampler can continuously flush the system. This operation is typically used when you have finished sampling and want to keep the sensor ready for its next use. Using Flush in this manner reduces the need for maintenance. The Flush function runs continuously until stopped by the user.

If the only goal is to flush all traces of sample from the system, flushing for 30 minutes should be adequate.

**>> To flush the liquid particle sampler**

1. On the CLS-700 T liquid particle sampler, connect a source of deionized water at a pressure of 10−60 psi to the **Liquid In** connection.
2. Direct the **Liquid Out** tube to an appropriate container or drain.
3. On the SamplerSight main display, click **Configure, Instrument**. The **CLS-700** window appears.
4. Click **Manual**. The **CLS-700 Manual Control** window appears.
5. In the **Control Panel** area, click **Flush**. The proper valves in the system open to allow a continuous flow of water through the system.



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# Chapter 4
# Troubleshooting and Fuse Replacement

## Troubleshooting

Particle Measuring Systems engineers have selected components, materials, and design elements that provide high reliability as well as superior function. Anything, however, can eventually fail. This chapter is for those times when something unexpected happens and you don't know how to proceed.

If the troubleshooting tips do not solve the problem, call Instrument Service and Support at Particle Measuring Systems: 1-800-557-6363.

### System Warnings

**>> To troubleshoot a non-illuminating LED Status light:**

**1** Ensure that the power cable is connected and receiving power.

**2** Ensure that the On/Off switch is in the **On** position.

**3** Test the fuse for continuity.

**>> To troubleshoot a "No Communications" message:**

Try the following when the status light blinks and the host reports "No Communications."

**1** Test the connection of the communications cable at both ends of the unit.

**2** Verify that the software address settings match the CLS-700 T and Liquilaz addresses.

**3** If the connections appear to be fitted correctly, replace the cable with a known-good cable.

The communication cable will be either an RS-232 or an RS485 depending on your installation. Use the RS-232 cable when one control computer is controlling one CLS-700 T liquid particle sampler. Ensure that it is wired according to **Table 2-1** RS-232 (DB25) Pin Designations on page 2-3.

**>> To troubleshoot an illuminated error light:**

This indicates that an internal leak has been detected. Occasionally, a small drop of liquid will drop from the end of the sample tube when it is removed from the CLS-700 T liquid particle sampler.

**1** If you have removed the sample tube, or suspect liquid has entered the chassis from the outside, do the following. Otherwise, go to step 2.



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**a.** Remove the liquid-section rear cover and dry the leak detector well.

**b.** Inspect for any additional signs of leaks.

**c.** Replace the rear cover before attempting to restart the sampler.

**2** If a leak is suspected after you have performed step 1 (or if step 1 does not apply), stop operation and contact Particle Measuring Systems for service.

**>> To troubleshoot a "Warning: gas pressure low" message:**

**1** Check the house gas pressure. It should be 70–150 psi.

**2** Check for a leak at the house gas supply connection. Correct any leak.

**3** Check the push-to-connect gas fitting on the back of the CLS-700 T liquid particle sampler. Correct any leak.

**NOTE:** The CLS-700 T liquid particle sampler constantly monitors its gas pressure.

## Fill Mode Warnings

**>> To troubleshoot when the fill rate is too high:**

**1** Use the Vacuum control to reduce the vacuum.

**2** Ensure that the fill time remains greater than 10 seconds.

**>> To troubleshoot when a fill time-out[1] occurs**

**1** Check the inlet tube connection.
The tube-end should be lying on the bottom of the sample container.

**2** Adjust the Vacuum control until the fill time-out no longer occurs.
Ensure that the fill time remains greater than 10 seconds.

**NOTE:** It may be necessary to adjust the vacuum and compression settings when the sample's viscosity changes.

## Sample Mode Warnings

**>> To troubleshoot when a sample time-out[2] occurs:**

**1** Turn the Flow Control knob to increase the flow rate until the Chamber Pressure indicator reads the same as the Flow Rate indicator.

**2** Check for blockage in the system drain. See the high-viscosity footnote above.

1. Time-outs are viscosity-dependent and are programmable for high-viscosity liquids.
2. Time-outs are viscosity-dependent and are programmable for high-viscosity liquids.



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**>> To troubleshoot when the sample flow rate is too high:**

If the software indicates that the sample flow rate is too high, do the following:

1. Use the Flow Control knob to reduce the flow rate until the Chamber Pressure indicator reads the same as the Flow Rate indicator.
2. Make minor adjustments using the Flow Control knob until the software displays the sensor flow rate.

**>> To troubleshoot when the sample flow rate is too low:**

If the software indicates that the sample flow rate is too low, do the following:

1. Use the Flow Control knob to increase the flow rate until the Chamber Pressure indicator reads the same as the Flow Rate indicator.
2. Make minor adjustments using the Flow Control knob until the software displays the sensor flow rate.
3. Check for blockage in the system drain.

**>> To troubleshoot a reported sampling error:**

1. Try sampling again.
2. If the same error occurs, contact Particle Measuring Systems' Service.

## Drain Mode Warnings

**>> To troubleshoot a drain time-out[1]:**

1. Use the **Compression Pressure** knob to increase the Chamber Pressure.
2. After changing the Chamber Pressure, adjust the **Flow Control** knob to make the Flow Rate reading the same as the Chamber Pressure (as read during the Sampling state).
3. Increase the drain time-out setting to eliminate the time-out.

1. Time-outs are viscosity-dependent and are programmable for high-viscosity liquids.



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# Using Electrical Power Overrides

Use this section ONLY if a failure prevents software-controlled purging.

The pilot valves in the CLS-700 T liquid particle sampler have manual override buttons that enable operation without electrical power. It is necessary, however, to have gas pressure.

**>> To locate and identify the pilot valves:**

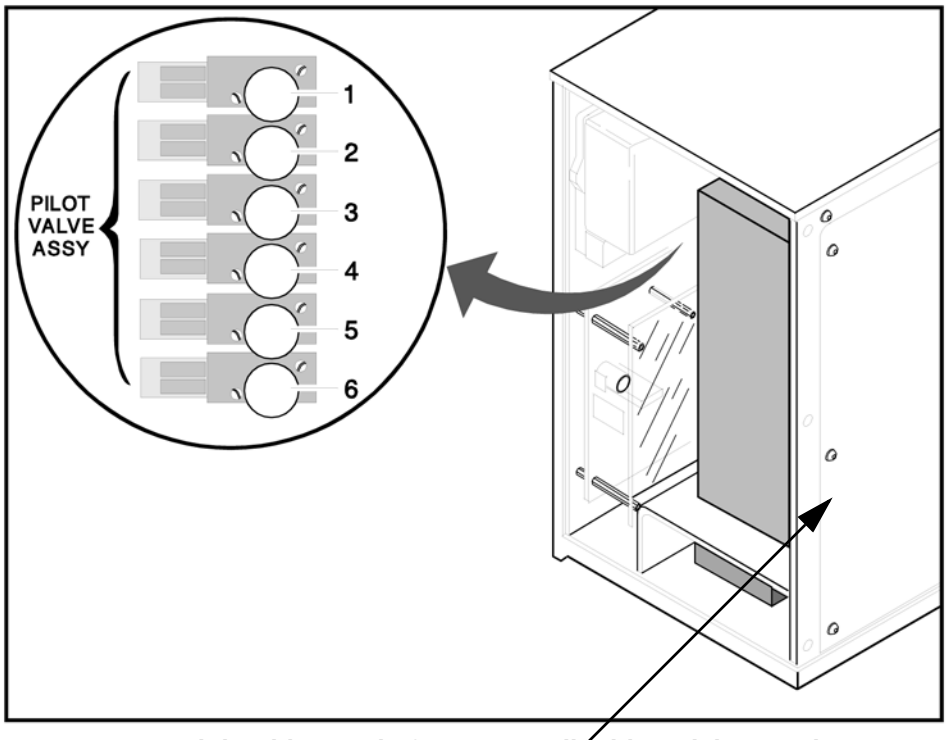
**1** Remove the right-side panel (when viewed from the front).

**2** See **Figure 4-1**.

**NOTE:** The valves are numbered 1 through 6 from top to bottom.

**WARNING**

Exercise extreme care during the following purge operations. Fluid and gas will be ejected from the inlet and outlet tubes with a force that is dependent on the Compression Pressure setting. Take precautions to contain splashing. Securing the tubes to the waste drain or container (above the fluid level) is a wise precaution.




**Front, Right-side panel of CLS-700 T liquid particle sampler**

**Figure 4-1** Pilot Valve Location



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**>> To purge the liquid inlet tube:**

1 Pull the **Compression Pressure** control knob out to enable it for adjusting.

2 Adjust the **Compression Pressure** control knob to reduce the force at which the chemical will be discharged from the inlet tube.

3 Press and hold down the following valve control buttons: #1 + #3+ #4.

**>> To purge the sensor lines:**

1 Pull the **Compression Pressure** control knob out to enable it for adjusting.

2 Adjust the **Compression Pressure** control knob to reduce the force at which the chemical will be discharged from the inlet tube.

3 Press and hold down the following valve control buttons: #1 + #3 + #5.

**>> To purge the overflow drain:**

1 Pull the **Compression Pressure** control knob out to enable it for adjusting.

2 Adjust the **Compression Pressure** control knob to reduce the force at which the chemical will be discharged from the inlet tube.

3 Press and hold down the following valve control buttons: #1 + #3 + #6.

## Manual Control with SamplerSight

The CLS-700 T liquid particle sampler can operate automatically based on its configuration parameters, or you can operate the unit manually with the user interface in the SamplerSight software. This feature is intended for use by those who have a complete understanding of CLS-700 T operations.

**WARNING**

To avoid accidental exposure to potentially dangerous chemicals, use this manual control with extreme care.



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# Replacing Fuses

| WARNING |
| --- |
| Disconnect the power cord from its power source. |

The instrument fuse drawer (in the power entry module) permits the use of either 3 AG, UL/CSA or 5 × 20 mm IEC style fuses.

**>> To replace a fuse:**

1. Disconnect the unit from its power source.
2. Use a small blade screwdriver or similar tool to remove the cover/fuse drawer from the power entry module located on the rear panel.
3. Remove the old fuse(s).
4. See the power label on the instrument's rear panel to determine the type of fuse being used.

| Voltage | Fuse |
| --- | --- |
| For ~ 85 – 130 V units | 250VAC, 3AG SB, 0.75 Amp |
| For ~ 200 – 265 V units | 250VAC, 5x20mm, T, 0.5 Amp |

5. Install the new fuse(s).
6. Reinstall the cover/fuse drawer assembly.
7. Restore power to the unit and check its operation.

# Getting Technical Support

In the United States, call Instrument Service and Support at Particle Measuring Systems at 1-800-557-6363. Outside of the United States, contact your sales representative.



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# Appendix A
# Glossary

**assessed sample volume**

That part of the sample that is examined by the sensor for the presence of contamination. The remainder of the sample (the meniscus and tare) is discarded.

**burette**

A cylindrical container used to deliver a specific quantity of liquid to the sensor for sampling.

**cavitation**

Formation of areas of partial vacuum in a liquid.

**clean gas**

A gas that 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. (e.g., foaming).

**foaming**

A mass of fine bubbles formed on the surface of a liquid.
(e.g., 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.



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**inter-sample delay**

The interval between two samples passing through the liquid sampler's plumbing.

**meniscus**

The surface of a liquid contained in a burette that 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 aperture size.

**particle generation**

The creation of particles by tool components or in-house plumbing, resulting in erroneous particle counts and distribution.

**particle trap**

An area in the plumbing where particles tend to accumulate due to a lack of laminar flow.

**sample overflow chamber**

A container for that part of the sample that overflows from the burette.

**supply gas**

Gas from a pump, bottle, cylinder, or in-house plumbing that 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 liquid to flow between the burette and the sensor.

**tare**

A volume of liquid discarded from the sample prior to beginning 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 required to complete a sample. Typically, part of this is discarded (see meniscus, assessed sample volume).

**wetted surface**

Those surfaces that come in direct contact with the sampled liquid. This is relevant when material compatibility is an issue.



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# Appendix B
# International Precautions

## Hazard Symbols

The meaning of hazard symbols appearing on the equipment is as follows:

| Symbol | Nature of Hazard |
|---|---|
|  | Attention, consult accompanying documents. |
|  | Dangerous High Voltage |

## Symboles de risque

Des symboles représentant les risques sont placés sur l'appareil. Leur signification est la suivante:

| Symbole | Nature du risque |
|---|---|
|  | Attention, consulter les documents d’accompagnement |
|  | Danger Electricite |



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## Warnschilder

Die, an dem Gerat angebrachten Warnschilder haben folgende Bedeutungen:

| Symbol | Gefahrenart |
|---|---|
|  | Achtung! In den beiliegenden Unterlagen nachschlagen |
|  | Achtung Hochspannung |

## Simboli di pericolo

Il significato dei simboli di pericolo che appaiono sugli strumenti il seguente:

| Simbolo | Natura del pericolo |
|---|---|
|  | Attenzione. Consultare i documenti allegati |
|  | Tensione Pericolosa |

## Simbolos de peligro

Los simbolos de peligro que aparecen en el equipo significan:

| Símbolo | Naturaleza del Peligro |
|---|---|
|  | Atención, consultar los documentos adjuntos. |
|  | Peligro alto voltaje. |



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# Appendix C
# 有毒或有害的物质和元素

| Part Name<br>部件名称 | 有毒或有害的物质和元素 | | | | | |
|---|---|---|---|---|---|---|
| | 铅<br>(Pb) | 汞<br>(Hg) | 镉<br>(Cd) | 六价铬<br>(Cr(VI)) | 多溴联苯<br>(PBB) | 多溴联苯醚<br>(PBDE) |
| 电源供应 | X | O | X | O | X | X |
| 印刷电路装配 | X | O | X | O | X | X |
| 机械部件 | X | O | X | X | X | X |
| 电缆 | X | O | X | O | X | X |
| 机电 | X | O | X | X | X | X |

O: 表示用于部件的所有同族物质中所含的有毒或有害物质低于 SJ/T11363-2006 规定的限度要求。

X: 表示用于部件的至少一种同族物质中所含的有毒或有害物质高于 SJ/T11363-2006 规定的限度要求。



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