

HCQ IR

Infrared Chemical Heater

Installation Operation and Maintenance Manual

This instruction manual explains the basic operation of the Process Technology quartz infrared fluid heater.

We recommend reading this manual carefully prior to operating the heater to help ensure proper use of the equipment supplied.

Please supply your in-line heater model and serial number when ordering spare parts or when requesting technical assistance.



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General considerations before using the HCQ IR Heater

This high performance patented liquid chemical heater, has been designed to meet the strict purity requirements of the semiconductor industry, and the high reliability demanded by the wafer surface preparation, equipment manufacturer. Process Technology is confident that the performance of our HCQ IR heater unit will exceed your expectations.

Complete understanding of the contents of this manual, along with careful heater handling, will help prevent potentially hazardous conditions.

A thorough evaluation of this manual will promote an accident free environment, and maximize heater performance.

Notes regarding this Instruction Manual

1. Reproduction of the contents of this manual is strictly prohibited.
2. The contents of this manual are subject to change without prior notice.
3. The reader is encouraged to notify Process Technology if any questions arise regarding to the contents of this manual, prior to using the heater unit.
4. Manual part number is TPHCQIRIM - A.

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Preliminary Safety Precautions

Chemical Handling and Compatibility

The heater chamber of the HCQ IR unit is made of semiconductor grade quartz material and an infrared heating element subassembly. Due to the material construction of the liquid heating chamber, only chemicals known to be compatible with quartz can be heated with the HCQ IR unit.

Chemical	Temperature (°C)
SC1 solution (H ₂ O ₂ , NH ₄ OH, H ₂ O)	85
SC2 solution (H ₂ O ₂ , HCl, H ₂ O)	85
Sulfuric acid (H ₂ SO ₄)	150
Phosphoric acid (H ₃ PO ₄)	165
Deionized Water (DIW or UPDIW)	95

Please consult Process Technology for the compatibility of any liquids that are not listed above.

Notes:

1. H₂O refers to DIW (Deionized Water) or UPDIW (Ultra Pure Deionized Water)
2. Heater operating temperature limit is 200°C. The temperatures listed above refer to typical process temperatures. At higher temperatures Farelock® fittings may be required. Consult with your fluoropolymer-fitting manufacturer for pressure vs. temperature fitting specifications.
3. Ensure you follow the N₂/CDA cooling flow requirement in all cases. See Appendix A, Heater Specifications, for your heater's Cooling Gas requirements.

WARNING

- **DO NOT OPERATE THE HCQ IR HEATER FOR ANY APPLICATION HEATING COMBUSTABLE OR FLAMABLE LIQUIDS.**
- **DO NOT PERMIT FLUID FLOW SHUT-OFF TO THE HCQ IR HEATER WHEN IT IS IN OPERATION. POSSIBLE DAMAGE DUE TO EXCESSIVE STEAM FORMATION MAY OCCUR.**
- **DO NOT OPERATE HCQ IR WITHOUT PRESENCE OF FLUID. A MINIMUM FLOW RATE OF 2LPM (0.5GPM) IS REQUIRED.**

Additional considerations:

- Do not service or maintenance the heater when power is on due to the danger of electric shock.
- Do not touch the heater exposed quartz surfaces during operation in order to avoid burns.
- If chemical leakage occurs, turn the power off at the main disconnect. Consult the chemical supplier's MSDS (Material Safety Data Sheet) for proper clean up and substance disposal.
- The relative high power to volume ratio of this heater can result in a fluid over-temperature condition if flow is stopped without heater shutdown.
- If the electrical terminals are loose or dirty, faulty contact may occur and premature lamp failure can result. Periodically inspect terminal connections and contact surfaces. Consult the National Electrical Code for the minimum torque requirement for all electrical connections.

Introduction and System Components

Having opened this manual, you have either purchased Process Technology's HCQ IR (Quartz IR Heater), or require specific information about an aspect of your existing heater unit.

To those just purchasing the HCQ IR Quartz Heater, congratulations on your decision! We trust you will find this product extremely reliable, and efficient. Process Technology, Inc. is confident that the HCQ IR heater will exceed your expectations.

To those that now are engaged in troubleshooting or adjustment of the heater unit, this manual has been written with you in mind. In either case, Process Technology would like to extend our best effort to assist you with any requests for assistance that you have. Please do not hesitate to call us anytime.

System Components

Item No.	Description	Quantity
1	Heater HCQ IR	1
2	Heating Element	1
3	Instruction Manual	1
4	Leak Detect Probe	1*
5	Leak Detect Amplifier	1*

Note:

Brand new heater units have the heating element subassembly installed as an integral part of the HCQ IR Heater assembly.

*Optional.

System Component Inspection

Once you have received your order, please check the following items carefully.

- a. Is the equipment ordered the correct model number?
- b. Has any damage occurred during shipment?
- c. Are all the accessories you ordered included with the shipment?

If the equipment received is not what it was ordered, or if any accessories are missing, please contact a Technical Service Engineer at Process Technology, Inc. 1-800-621-1998 (International 440-946-9500) to correct the situation. If any equipment damage is discovered occurred during shipment, it must be brought to the attention of the delivering carrier.

Heater Specification

For Heater Specifications, please refer to Appendices A and C.

Heater Outline

For Heater outline, dimensions and component identification please refer to Appendix B.

Heater Performance Data (HCQ8)

Heating Capacity

The HCQ IR's heating characteristics depend on different factors. Some of those factors are the type of chemical solution, the size of the re-circulation loop, and material of the process tank, the process length, and the insulating conditions.

The following curves are typical of the heating performance of the HCQ8 under the following conditions:

Chemistry: Ultra pure Water

Tank: 35 liters, open top

Heater Model: HCQ8

Re-circulation rate: 30 lpm

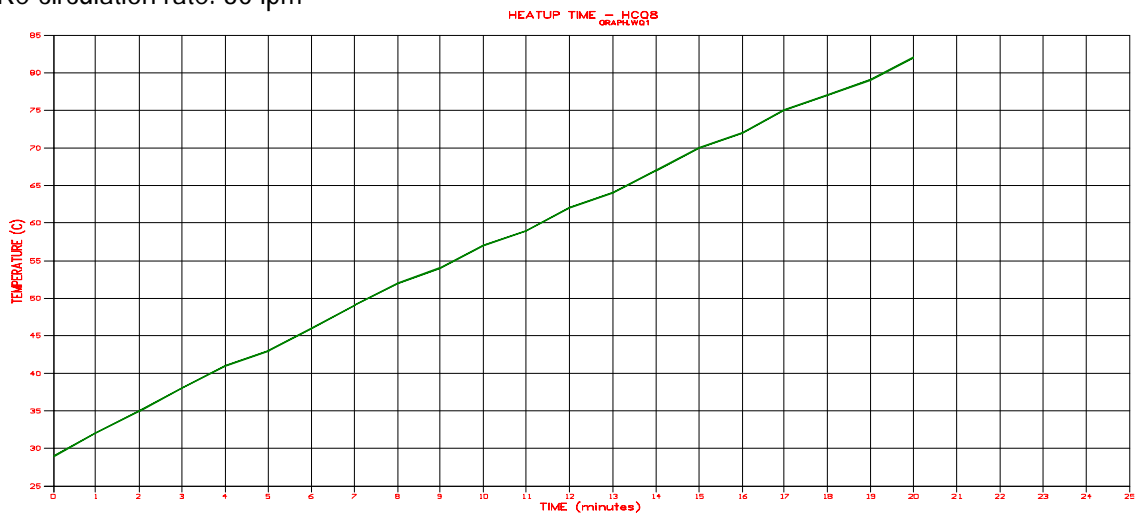


Figure #1. Heating Temperature vs. Time

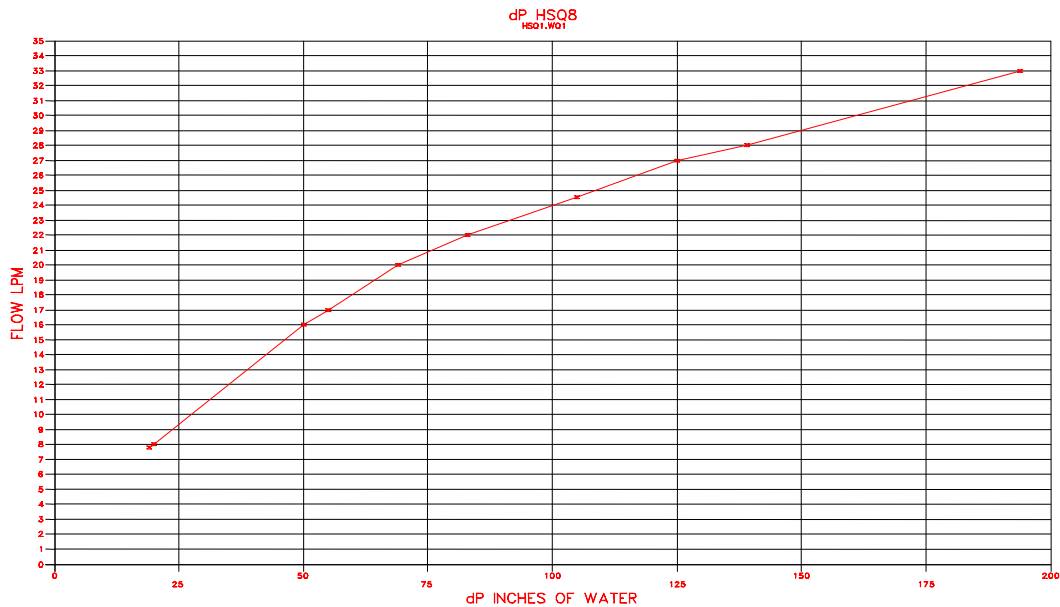


Figure #2. Liquid Flow Rate vs. Pressure Drop
PSI = Inches of water X 0.0361

Heater Installation

Before installing your new heating unit, ensure the heating element is properly mounted inside the heat exchanger. (Refer to heating element subassembly insertion section, page 8)

Heater Location

The following items should be considered when determining the location of the heater unit:

- a. Mount the heater where the user and the tubing can easily access the heater's inlet and outlet connections.
- b. Make sure that the heater element access port is fully accessible. This allows the insertion or removal of the heating element subassembly without having to disconnect any tubing or remove the heater from its location.
- c. Install the heater unit so that it will not be subjected to vibration or shock.

CAUTION

The HCQ IR heater has been designed to operate in an atmosphere that may be exposed to excessive corrosive fumes, high temperature, or humidity. When the HCQ IR heater is placed in an enclosure a minimum of twice as big as the size of the heater, the ambient temperature inside the enclosure will increase up to 80°C, if the heater process temperature is 180°C.

Tube sizing and preparation-Refer to Appendix A, Heater Specifications, for your heater's specific requirements. The heater unit is supplied with quartz standard male flare for wetted connections, and PFA compression tube fitting for the N₂/CDA inlet port. It is the User's responsibility to provide and install inlet, outlet fittings, and cooling air tubing to the heater unit. Follow the installation recommendations of your high purity fitting and tubing manufacturer, to properly outfit the heater unit. Note: The HCQ IR inlet/outlet fitting connection is Flaretek® II compatible.

In order to keep the heater unit free of vibration, thermal stressing, and tube dead loads, the tubing going to the heater unit must be fully supported. Thermal expansion of fluoropolymer tubing must be calculated and appropriate expansion loops must be incorporated. Any stresses induced on the liquid chemical lines may result in connection leaks or catastrophic heater failure due to quartz heat exchanger breakage.

Cooling Gas connection

The heater requires ultra pure N₂/CDA to provide cooling to the infrared heater subassembly socket ends. Ensure you follow the N₂/CDA cooling flow requirement in all cases. See Appendix A, Heater Specifications, for your heater's Cooling Gas requirements at the heater pressure switch.

Cooling Ventilation

A PFA male flare connection is supplied as integral part to the heater, to facilitate in venting. This vent works in conjunction with the cooling gas, keeping the heater element socket cooler, and extending the heater element life. This vent located on top of the heater should never be capped or obstructed since continuous N₂/CDA cooling flow must be maintained. See Appendix A, Heater Specifications, for your heater's Cooling Ventilation requirements.

Heater wiring

For heater unit wiring information, please refer to Appendix "D"

Onsite Heater servicing and troubleshooting

Heater Servicing

Under normal operating conditions, the HCQ IR heater unit will provide an extended service life beyond the warranty limits. The IR elements of the heater unit are considered consumable items; this is due to the nature of their operation. Even though Process Technology has designed the HCQ IR heater to maximize the life of the heater elements, their MTBF (Mean Time Between Failures) will depend of the heater cycle time and particular application. To improve the heating element MTBF, the nature of the quartz halogen cycle demands maintaining optimum halogen cycle working temperatures and cooling capability.

Note that in order to prevent premature failure of the IR bulb subassembly, it is necessary to provide a small amount of cooling gas (air or nitrogen). A ¼" PFA compression tube fitting is provided as an integral part to the heater to connect the cooling gas supply. Approximately 1.75-3.5 SCFM is required for proper lamp socket cool down. Note that the pressure switch is factory set at 15 psig minimum to close contact. Higher volumes of cooling gas can adversely affect the IR's bulb life.

***Note:** As a preventive maintenance is recommended to inspect and replace the lamp subassembly every 6 months.*

Heating Element Insertion

WARNING: *When handling the heating element subassembly, it is advisable to wear clean room grade cotton gloves. The bulb surfaces must be free from dirt, oil, or fingerprints as devitrification spots sites can occur resulting in premature bulb failure. Clean any suspected surfaces using fresh IPA, followed by wiping with a clean lint-free cotton cloth.*

- a. Remove the press fitted access panel from the heater housing. See Appendix "C".
- b. Take note of the orientation of the electrical plug, as it will have to be placed into the same position upon re-assembly of the heater. (This can be accomplished by aligning a colored mark on the electrical plug with a matching colored mark on the insulation.)
- c. Insert the heating element subassembly.
- d. Push the heater subassembly rearward, until it reaches the far end.
- e. Once the far end has been reached, gently push the heating element rearward one more time, to ensure the socket couples with the respective mating connection at the other end of the cavity. Exercise caution during this process, since the lamps are fragile and can be easily broken.
- f. Once the heating element subassembly is in place slight withdrawal and re-insertion should verify that the heating element subassembly has reached its proper operating position.

For 3 Phase Heaters Only:

When Replacing a lamp assembly, note the orientation of the electrical plug and place it in the same position upon assembly by lining up the COLORED MARK on the electrical plug with the matching COLORED MARK on the insulation.

Heater Troubleshooting

When Troubleshooting, refer to Appendix A, Heater Specifications, for your heater's specific requirements.

Problem	Cause	Solution
Heater will not turn on	<ol style="list-style-type: none"> 1. Power to the heater has not been activated 2. Incorrect heater safety over-temperature value 3. There is a faulty power connection to the heater 4. Incorrect connection between thermocouple and heater controller 5. Pressure supplied at the cooling air pressure switch is less than the minimum Cooling Gas psig. 	<ol style="list-style-type: none"> 1. Turn on the power to the heater 2. The heater safety over-temperature value is too low 3. Check power connections between heater and controller 4. Check proper thermocouple (Type "J"). Check polarity matches controller. 5. Increase pressure supplied to heater safety pressure switch.
Heater stops shortly after being turned on	<ol style="list-style-type: none"> 1. Heater over-temperature safety setting value is to low. 2. Heater is running dry. 3. Re-circulation pump has stopped or there is liquid stagnated and over heated. 4. There is a leak condition inside the heater. 	<ol style="list-style-type: none"> 1. Increase the over-temperature set value to 185°C. 2. Check chemical dispensing to re-circulation loop. 3. Check chemical flow through re-circulation loop. 4. Check for leakage source and resolve condition.
Heater will not stabilize at temperature setting	<ol style="list-style-type: none"> 1. Control PID values are not optimum 	<ol style="list-style-type: none"> 1. Reset control PID values to proper operating conditions.
Heater unit is not heating	<ol style="list-style-type: none"> 1. IR lamp failure. 2. Improper connection between heating element subassembly and socket end. 3. Under rated voltage supplied to the heater unit. 	<ol style="list-style-type: none"> 1. Replace the heating element subassembly. 2. Check heating element connection according to procedure stated in heater servicing section. 3. Check for proper voltage according to the heater requirements. See heater specifications.

Recommended PM (Preventive Maintenance), schedule and procedure

As a preventive maintenance Process Technology recommends the following procedure applicable every six months:

With the heater on and 100% duty cycle, using an Amp clamp type meter placed in one of the power wires to the heater, read the current drawn. With all the bulbs functioning, the current draw will be approximately 36 A. If the current read out is less than the indicated, chances are not all the halogen bulbs are functioning and the lamp subassembly should be replaced.

Offsite Repair and Servicing

If a problem is experienced with the HCO IR or any of its components, be sure to refer to this manual carefully while inspecting the system. If the problem cannot be corrected, it is advisable to report it to Technical Sales Staff during normal business hours, Monday through Friday between 8 to 5 Eastern Time by calling 1-800-621-1998. (International 440-946-9500).

Please have the following information available:

- a. Model, and serial number of the heater unit.
- b. Purchase order number and invoice number.
- c. Returnee's name address and phone number.
- d. The total number of hours the system has operated.
- e. Cycle time of the unit.
- f. Process temperature set point, over temperature set point.
- g. Type of the chemistry used and its properties.
- h. Liquid flow rate and pressure.
- i. Location, and description of the problem.

Heater return condition and recommendations

- a. Request a RMA number (Return Material Authorization) from Process Technology
- b. Attach MSDS information on the chemistry used with the heater.
- c. Thoroughly clean, rinse and dry the heating chamber. Note that chemical residues are not only considered a hazard condition for the repair technician, but it could also be interpreted as transporting hazardous materials that can result in legal action.
- d. Heater unit must have inlet and outlet capped and the unit must be double bagged.
- e. Wrap in several layers of corrugated paper followed by suspension in plastic bubble packing or Foam-In-Place, allowing 6" of packing space on all sides, include fitting protection when measuring packing space.

Note:

Items returned to Process Technology, Inc. for any reason shall be via freight prepaid, unless prior arrangements have been made.

Product Warranty

All Process Technology equipment, heaters and controllers have been carefully inspected before shipping and are warranted to be free from defects in workmanship and material for the period of one year from date of purchased on a pro-rated base. In the event of a component failure under proper and normal use, Process Technology, Inc. at its option will repair or replace the faulty item.

Process Technology, Inc. disclaims any responsibility for misuse, misapplication, negligence, or improper installation of equipment. Process Technology, Inc. makes no warranty or representation regarding the fitness for use or the application of its products by the purchaser.

PLEASE ENSURE SUITABILITY OF HEATER BEFORE INSTALLATION SINCE PROCESS TECHNOLOGY CANNOT WARRANTY HEATERS AGAINST FAILURE DUE TO CONDITIONS OVER WHICH PROCESS TECHNOLOGY, INC. HAS NO CONTROL SUCH AS:

- Excessive high temperatures
- The concentration of the solution in excess of recommendations
- The presence of inhibitors or accelerators that affect the corrosive effects of heated chemicals
- The presence of other acids causing a secondary reaction
- Flux floating of the surface
- The presence of dissolved gases
- Excessive sludge build-up
- Stagnant flow condition of the solution
- Aeration

Process Technology, Inc is not liable for costs incurred in removal, reinstallation, or unauthorized repair of the product or for damage of any type whatever including incidental or consequential damage.