Operations Manual

Series SP®
Version SP2006HgT Probe
For The Thermo Scientific Mercury Freedom System

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1-24-2016

Dear customer,

We have made up this operating manual in an attempt to have all necessary information about the SP2006HgT in one easy to locate document. The goal is to have the information easy to locate and understand. If you have any comments or suggestions, please feel free to contact us so that we can try to incorporate your ideas into our manual. Our goal is to assist you.

This Manual addresses the use of the SP2006HgT for Hg applications but does not address the communication or software issues with its use in the Thermo Scientific Mercury Freedom System. Questions on communication or software issues, should be directed to your local Mercury Freedom System provider or directly to Thermo Fischer Scientific Environmental Instruments Division.

Should you still have any question, please do not hesitate to contact M&C directly or go through your appointed dealer. Respective contact information is located in the appendix to this operating manual.

Please, also feel free to contact our homepage www.mc-techgroup.com for further information about our products. There, you can read or download the data sheets and operating manuals of all M&C products as well as further information in German, English, Spanish, or French.

Thank you for putting your trust into M&C TechGroup.

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U.S. Head Quarters
6019 Olivas Park Drive/Suite G
Ventura, CA 93003

SP2006 HgT Probe Power Configuration For Thermo Scientific Mercury Freedom System

Stinger Power

220 Volts	**240 Volts**
58 Ohm Heater	**58 Ohm Heater**
1000 Watt Heater	**1000 Watt Heater**
Actual – 840 Watts	**Actual - 1000 Watts**
3.8 Amps	**4.2 Amps**

Probe Filter Power

220 Volts	**240 Volts**
70 Ohm Heater	**70 Ohm Heater**
800 Watt Heater	**800 Watt Heater**
Actual 690 Watts	**Actual 800 Watts**
3.1 Amps	**3.4 Amps**

IMPORTANT NOTE:

When using bundle B of the Thermo Scientific Wiring bundles, ensure your Stinger Power Wires are of sufficient gauge to handle current load of the stinger. An external power source for Stinger Power may be required to complete replacement installation.

1 GENERAL INFORMATION

The product described in this operating manual, has been examined and gone through our QA procedures prior to shipping. The SP2006HgT left our facility in perfect condition related to safety regulations. In order to keep this condition and to guarantee a safe operation, it is important to heed the notes and recommendations made in this operating manual. Furthermore, attention must be paid to appropriate transportation, correct storage, as well as professional installation and maintenance work. All necessary information a skilled staff will need for appropriate use of this product is included in this operating manual.

2 DECLARATION OF CONFORMITY

CE - Certification

The product described in this operating manual complies with the following EC directives:

EMV-Instruction

The requirements of the EC directive 89/336/EWG "Electromagnetic compatibility" are met.

Low Voltage Directive

The requirement of the EC directive 72/23/EWG "Low Voltage Directive" are met.
The compliance with this EC directive has been examined according to DIN EN 61010 (corresponds to IEC 61010) as well as DIN 57721 for the voltage test of heating elements.

Declaration of conformity

The EU Declaration of conformity can be downloaded from the M&C TechGroup homepage or directly requested from M&C TechGroup.

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www.mc-techgroup.com

3 SAFETY INSTRUCTIONS

Please take care of the following basic safety procedures when mounting, starting up or operating heeded.

Any work on electrical equipment is only to be carried out by trained specialists as per the regulations currently in force.

Attention must be paid to the requirements of VDE 0100 (IEC 364) when setting high-power electrical units with nominal voltages of up to 1000 V, together with the associated standards and stipulations.

Check the details on the type plate to ensure that the equipment is connected to the correct main voltage source.

Protection against touching dangerously high electrical voltages:
Before opening the equipment, it must be switched off and hold no voltages. This also applies to any external control circuits that are connected.

The device is only to be used within the permitted range of temperatures and pressures.

Check that the location is weather-protected. It should not be subject to either direct rain or moisture.

The gas sample probes version SP2006HgT Must NOT Be Used In Hazardous Areas.

Installation, maintenance, monitoring and repairs may only be performed by authorized personnel, with respect to the relevant stipulations in this manual.
this equipment:

Read this operating manual before starting up and use of the equipment. The information and warnings given in this operating manual must be

4 WARRANTY

If the equipment fails, please contact M&C directly or else go via your appointed M&C dealer. We offer a one year warranty as of the day of delivery as per our normal terms and conditions of sale and assuming technically correct operation of the device. Consumables are not included in this warranty. The terms of the warranty cover repair at our factory and are at no cost to the end user. In addition, if replacement is the best solution, that shall also be at no cost to the end user. Return shipment to the user location is also at no cost. Return items, must be shipped in sufficient and proper protective packaging. Any questions regarding any warranty specifications may be addressed to:

M&C TechGroup
6019 Olivas Park Drive/Suite G
Ventura, CA 93003
805-654-6970 Phone
805-654-6971 Fax

5 USED TERMS AND SIGNAL INDICATIONS

DANGER!

This means that death, severe physical injuries and/or important material damages will occur in case the respective safety measures are not fulfilled.

WARNING!

This means that death, severe physical injuries and/or important material damages may occur in case the respective safety measures are not fulfilled.

CARE!

This means that minor physical injuries may occur in case the respective safety measures are not fulfilled.

CARE! — **Without the warning triangle means that a material damage may occur in case the respective safety measures are not met.**

ATTENTION! — **This means that an unintentional situation or an unintentional status may occur in case the respective note is not respected.**

NOTE!

These are important information about the product or parts of the operating manual, which require user's attention.

SKILLED STAFF — **These are persons with necessary qualifications, who are familiar with installation, use and maintenance of the product.**

6 INTRODUCTION

The M&C gas sample probes type SP2006HgT are based on the patented probe SP2000-H and are used for continuous gas sampling and dilution.

6.1 Serial Number

The type plates are located where the electrical connection box is placed.

NOTE!

Please indicate the serial number of the equipment in case of any question and when ordering spare parts.

7 APPLICATION

The electrically heated M&C dilution probe is applicable for use with the Thermo Scientific Freedom System, where the measuring procedure or the handling of the process gas requires the dilution and transport of the sample to be measured. This probe and filter configuration have been designed for the transport of Hg in flue gases with minimal loss of sample. The M&C dilution probe SP2006HgT is based on the well tested M&C gas sample probe SP2000-H. This enables the user to adapt the probe to nearly every application, using for example special filter techniques or special materials.

8 TECHNICAL DATA

Series SP	Version gas sample dilution probe SP2006-H/DIL ...
Insitu sample tubes and pre filters optional on request	see leaflet 2-1.1a; 2-1.5.1; 2-1.6.1; 2-1.9.5
Dilution rates with the critical orifices "a" - "g" [3)]	a = 500 b = 200 c = 100 d = 50 e = 30* f = 20 g = 10 : 1
Sample flow rate depending on the critical orifices "a" - "g"	a = 1,4 b = 2,7 c = 5,5 d = 11 e = 19* f = 28 g = 55 l/hr [1)]
Possibility to adapt the dilution factor	with dilution gas pressure-adjustment -5% to +30% [2)]
Dillution gas flow rate with injector version I or II	I: 480 - 600Nl/hr, optional for higher dilution rates II: 1800-3000 Nl/hr
Dilution gas pressure on inlet of pressure controller	min. 4,5 bar g, max. 16 bar g
Bypass injector /B: gas pressure-gas flow rate-sample gas flow rate	at approx. 2 bar g - injector gas approx. 300 l/hr - sample gas approx. 150 l/hr
Process pressure	0,9 up to 2 bar abs.
Fault caused by process temperature variations	operation independent from process temperature
Fault caused by process low or overpressure	no fault as long as the differential pressure ΔP at the dilution unit is >0,5 bar g and test gas is given to the probe under process conditions
Fault caused by atmospheric pressure variations	<1% with a variation of 50 mbar
Materials in contact with the sample gas	Hastelloy & Stainless with Silco coatings and Titanium
Weight	approx. 66 lbs

*Standard, others to be indicated along with order, intermediate values possible. 1) approx. at 3 bar dilution gas behind pressure controller. 2) -5% not possible for orifice „g". 3) with injector version I. Further technical data see leaflet SP2000, 2-1.1a.

9 DILUTION PRINCIPLE

The functional principle of the dilution unit is based on ultrasonic flow through a critical orifice (see Fig. 1). The flow through the orifice is constant when the differential pressure via the orifice is higher than 500 mbar. For the atmospheric inlet pressure (Pin = 1020 mbar), this means a pressure at the orifice outlet (Pout) of less than 520 mbar absolute. The necessary vacuum at the orifice outlet is produced by an injector operated with dilution gas. The dilution gas is serviced through the Thermo Scientific Mercury Freedom System Air Clean Up Module to ensure no Hg is present in the dilution gas.

Depending on the critical orifice selected, dilution rates can be between 10:1 and 500:1. The table below gives an overview of the dilution factor and sample gas volume using the injector I (480 – 600 Nl/h):

Orifice type	A	b	C	d	e	F	G
Dilution ratio*	500:1	200:1	100:1	50:1	30:1	20:1	10:1
Volume flow through the orifice [Nl/h]	1,4	2,7	5,5	11	19	28	55

*** with Injector II 50:1 to 2000:1**

The typical Dilution Ration when used with the Thermo Scientific Mercury Freedom System is less than 50:1. The typical is 30:1 or 40:1.

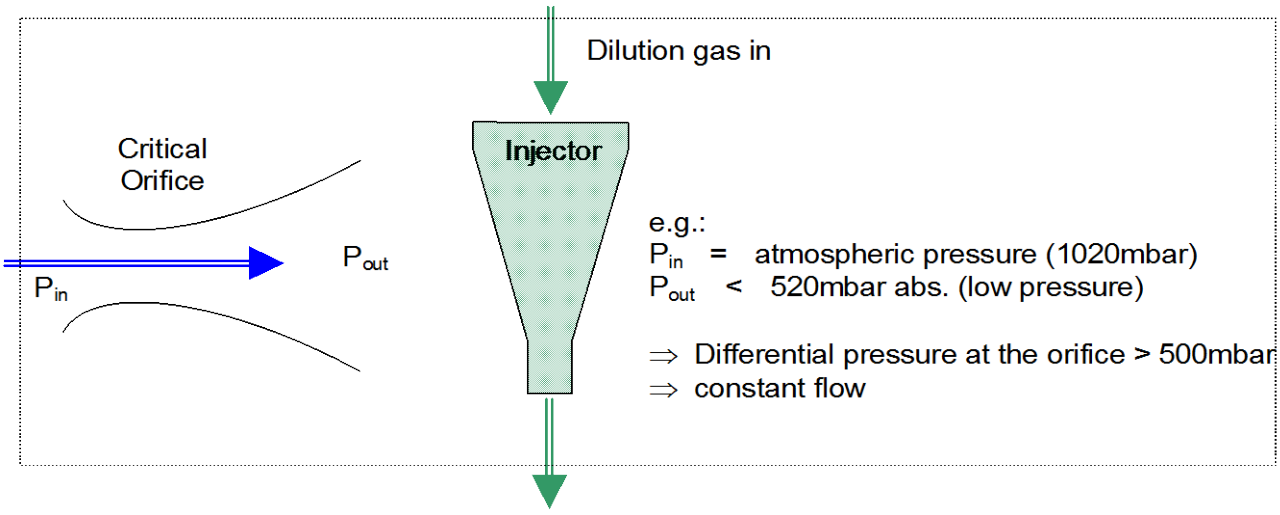


Figure 1: Dilution principle

10 DESCRIPTION

The dilution unit including the critical orifice is mounted directly to the probe body and therefore heated up with the probe to a stable temperature. The incorporated pre-heater heats up the dilution gas to the probe temperature. Both steps ensure that sample gas decreases under the dewpoint are minimized. Calibration gas enters the probe via an integrated connection.

The probe can be heated from 180 °C to 280 °C. The typical operational range with the Thermo Freedom System is 200 °C. These Temperature Controls may be either local or remote. As an option a heated manual operated 2 way ball valve is available. It is integrated in the sample gas inlet and shuts off the probe head from the process, for example during the change of the filter element. Additional the option 'blow back in front of ball valve' via the probe flange is available.

Through high flow rate check valve /BB, which is fixed to the internal probe area, blow back of the filter housing area and the insitu probe tube will be done. Through the high flow rate check valve /BB/F, which is fixed to the filter housing wall, blow back of the incorporated titanium filter will be done including the filter area and the insitu probe tube. This is standard on the Thermo Freedom System. The optional isolation valve /I shuts off the sample outlet from the internal filter area.

To optimize the blow back, an incorporated accumulator tank with a volume of two liters is standard. To drive this tank two solenoid valves are used to control the blowback feature. The typical blowback sequence is filter, stinger, and then filter. The duration should not exceed 10 seconds on any single component of the blowback sequence. These events are controlled and configured for your application with the Thermo Freedom System 82i Probe Controller.

The 82i Probe Controller provides dilution gas pressure for dilution and bypass eductors, measures Orifce inlet and outlet pressures, measures delivery pressure, purges sense lines during blowback functions, and can optionally house probe and stinger temperature controllers. In addition the 82i shuts down delivery air if probe is off temperature set point or if communications are lost as a failsafe operation feature.

The construction of the probe guarantees an operation which is independent from the process temperature and is easy to maintain as well.

The standard SP2006HgT has all sample contact points silco coated for minimal Hg loss. The Filter used in conjunction with the Thermo Freedom System is Titanium, because of its ability to resist the absorption of Mercury. The probe is a low flow filtered separator with dilution of sample at the probe. It incorporates automated filter and stinger blowback along with through the probe multi-level calibration capabilities. All gasket materials used are kalrez. The filter and stinger temperatures can be locally or remotely controlled. The eductor pressure is monitored and used to control eductor pump flow. The critical orifice differential pressure is continuously monitored along with the upstream absolute pressure for density correction. The entire assembly is temperature controlled within 1 °C. The unit also incorporates the ability to calibrate pre filter, to ensure filter integrity is maintained. The sample is then carried, via heated sample line in a vacuum to the Thermo Freedom System for further conditioning and final measurement.

10.1 Options and Variations

The following list shows the probe types and options available. The diversity of options and the modular design of the M&C gas sample probes ensure optimum probe selection to suit the particular process and ambient conditions.

Part No.	Type	Description
740-20S4424 HgT	SP2006-HgT	The unit is designed for a single or dual umbilical configured system. The unit is made up of in a 2 individual Aluminum boxes. The configuration of the boxes is deteremined by the umbilical configuration of the system. A hot box (Heated Probe Filter) and a cold box (umbilical connection point) make up the 2 boxes. The gas sample dilution probe SP2006HgT comes with bypass-injector and gas recirculation. All sample contact points are Silco coated including the 2µm critical orifice perfilter. The probe comes with an internal titanium filter. Filter is electrically heated and temperature is maintained at 200°C. The entire assembly is temperature controlled within 1 °C. The titanium filter porosity is 2µm. A paper filter can also be used when desired. Air for the Bypass and Dilution Eductors are preheated as well. Calibration Gases are introduced directly into the probe prior to the titanium filter. The unit also provides a pressure port to monitor density for correction factors. The unit is configured for Filter and Stinger Blowbacks. All probe gasket materials are kalrez. Integrated in the housing are the terminal connections for power to the Probe Heater, Stinger Heater, Solenoid valve control, and thermocouple connections. The 2 liter surge tank for filter and stinger blowback and its control solenoids, are also housed in the enclosure. The system is wired to communicate and be controlled by the Mercury Freedom System in conjunction with the Model 82i Probe Controller. There are 2 temperature controllers when stinger heat is required. One is for the Probe Head and the other is for the Stinger if needed. These controllers can be located locally or remotely as specified by the end user. An optional Probe Box Heater and temperature controller may be installed if application requires. The Stinger is Hastelloy with all sample contact points Silco or Teflon coated. The stinger will have an impingement shield on the end for stinger particulate control. The stinger assembly will be temperature controlled when required by the application and heated to the required temperature. All power is 220/ 60 Hz and/or 115v/60Hz. The standard Mounting flange is 3” 150lbs. Additional flange sizes are available to accommodate specific applications.

The SP2006HgT Probe is connected to the Thermo Model 82i Probe Controller with the following features:

- **Dilution Air**
- **Bypass Air (Note: It is important if you do not have upgraded software from Thermo that Supports the M&C Probe, you will have to disable or bypass the solenoid valve that controls the Bypass Air. This is to ensure that the Bypass Air does not go into a reduced flow Mode during calibrations)**
- **Orifice Inlet & Outlet Pressures**
- **Delivery Air Pressures**
- **Purges Sense Lines During Blowback**
- **Provides Fail Sate Operation Of Probe In Case Non-Communications Or Temperature Alarm Condition**
- **Displays Bypass Loop Excitation Air Flow**

Figure 2: 19" Rack Mounted Thermo Scientific Model 82i Probe Controller

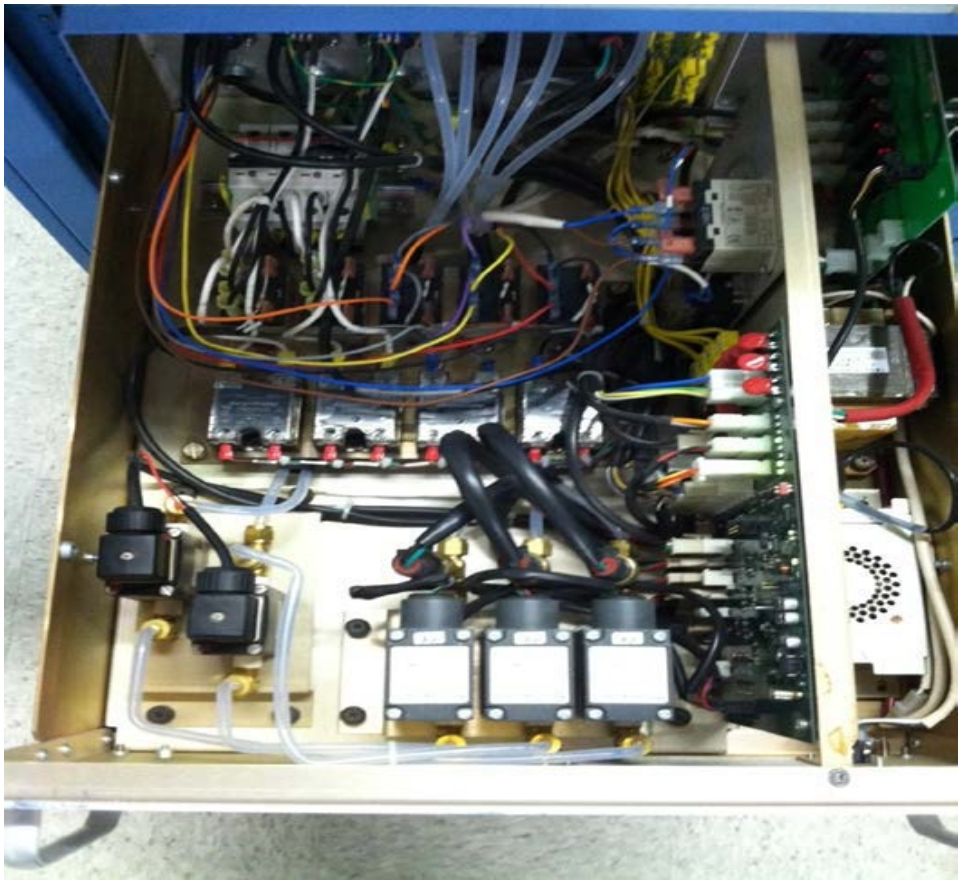


Figure: 3 Top Inside View Of Thermo 82i Probe Controller

Note:
If you have upgraded Software from Thermo Fisher that Supports the M&C Probe (Firmware Version V.020104, you will not be required to make any modifications to the probe controller.

It is important to note, if you do not have upgraded software from Thermo Fisher that Supports the M&C Probe, you will have to disable or bypass the solenoid valve that controls the Bypass Air, so that the By-pass Air does not go into a reduced flow Mode during calibrations or blowback operations.

<u>IMPORTANT</u>
You want to ensure that Bundle B of the Thermo Fisher wiring bundles, are of sufficient gauge to handle the current load of the stinger. An external power source for Stinger Power may be required to complete your installation upgrade. If notified, M&C can configure the system for an external power source application.

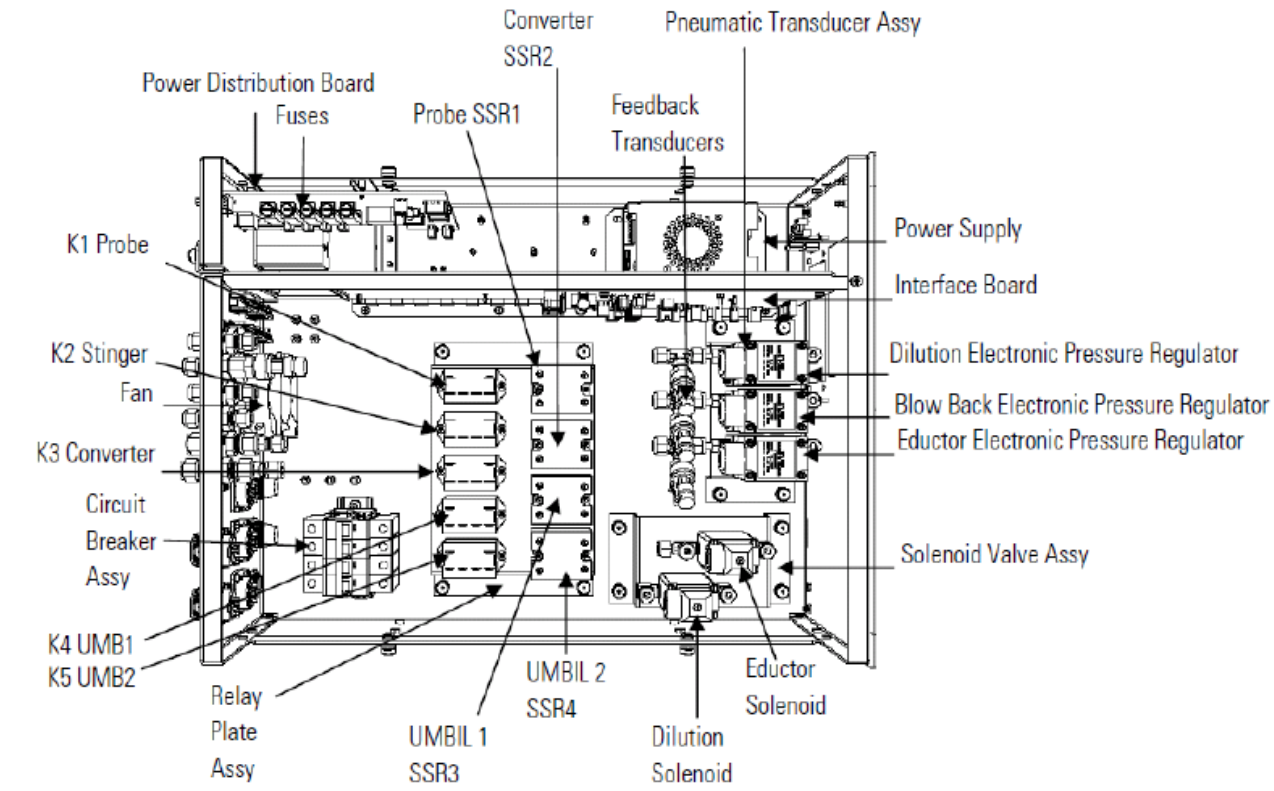


Figure 4: Model 82i Probe Controller Layout

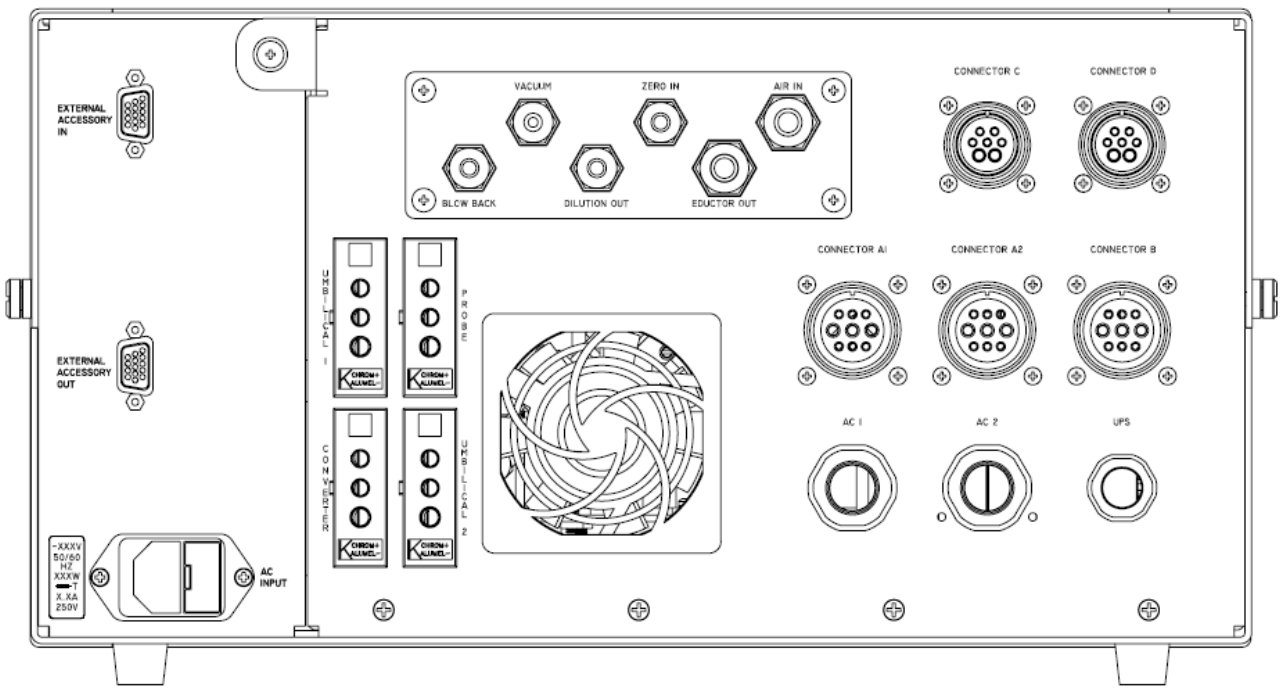
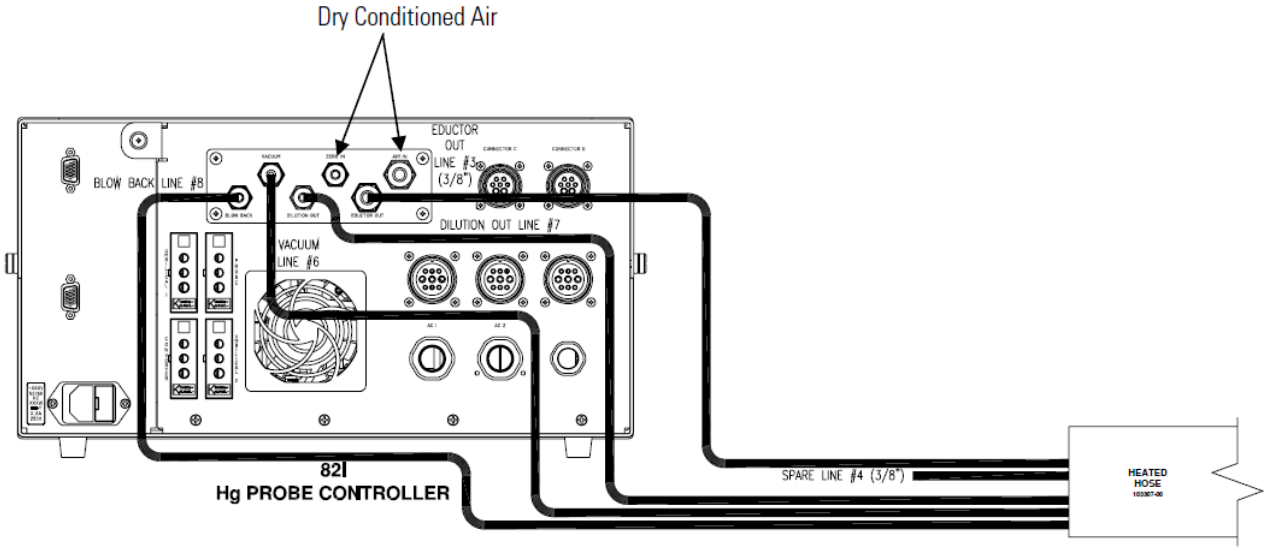


Figure 5: Model 82i Probe Controller Rear Panel Lay Out

Model 82i Probe Controller Umbilical Connections



Connection Type	Label	Connection
3/8-inch Teflon line	3	EDUCTOR OUT
1/4-inch Teflon line	6	VACUUM
1/4-inch Teflon line	7	DILUTION OUT
1/4-inch Teflon line	8	BLOW BACK
Canon Plug	A1	CONNECTOR A1
Canon Plug	B	CONNECTOR B
Canon Plug	C	CONNECTOR C
Canon Plug	D	CONNECTOR D
Thermocouple	TC1	TC1
Thermocouple	TC2	TC2
Thermocouple	TC3	TC3

Figure 6: Model 82i Probe Controller Umbilical Connections

11 RECEIPT OF GOODS AND STORAGE

- Please take the probe and possible special accessories carefully out of the packaging immediately after receipt and compare the goods with the items listed on the packing list.
- Check the goods for any damage caused during delivery and, if necessary, notify your transport insurance company without delay of any damage discovered.

The probe must be stored in a weather-protected and frost-proof area !

12 INSTALLATION AND DIMENSIONS

During installation, the prescriptions for accident prevention and safety instructions for mounting and operation have to be heeded.
Please strictly observe the notifications of chapter 3 „Safety Instructions“. And review the SP2006HgT Layout Drawings in Figure 5 on Page 16.

In addition, you have to consider the following:

- Select the optimum sampling point according to the prescriptions actually valid and coordinate with the responsible persons.
- Place the sampling point in such a way that sufficient space for mounting and dismounting of the probe is available. Also consider the insertion length of the sample tube.
- Take care of easy access to the probe in order to enable you to execute any maintenance work necessary in future without problem.
- The bleeder connection must be prepared so that the temperature of the connection piece remains above the acid dew point in order to avoid problems due to corrosion and obstruction.
- In case the temperature in the area of the connection piece is >60°C due to radiant heat, you have to mount a device of sheet steel in order to reflect the radiant heat.
- The mounting flange of the connection piece should be connected with size 3” 150lbs. Should you desire other dimensions, we can provide you suitable adapter intermediate flanges as required for your configuration. The minimum flange size or connection piece diameter respectively is determined by the sample tube diameter, and length or pre-filter diameter you specify.
- We recommend the mounting of the probe horizontally with an angle of not more than 10° inclination to the process.

Before mounting the probe, you have to check its suitability on the basis of the given operating parameters (see type plate).

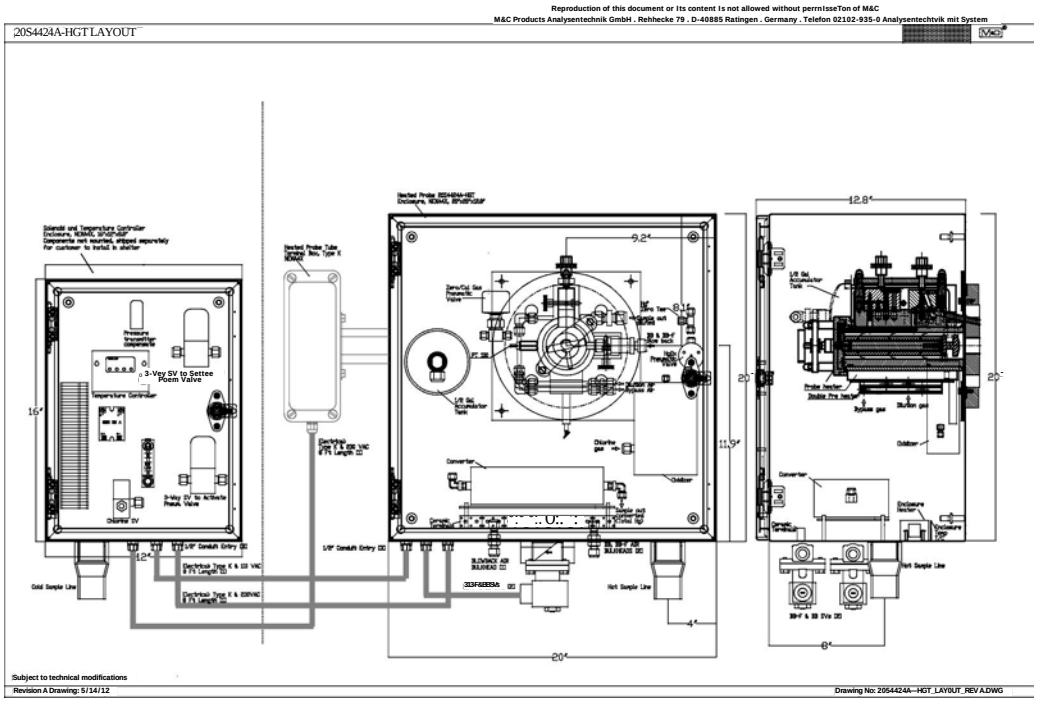


Figure 7: Construction and dimensions of the SP2006HgT Dual Umbilical Configuration

13 MOUNTING

The M&C SP2006-HgT Probe is designed for stationary use and provides a long service life and a minimum of maintenance work under the premise of professional selection of the sampling point and professional mounting.

13.1 Installation information

The safety rules and regulations for the prevention of accidents must be observed during installation and also subsequent operation. The information in chapter 3 “Safety Instructions“ must be observed.

The following also applies:

- **Select the optimum sampling point according to the generally applicable directives or coordinate with the responsible departments.**

The dilution probe must be checked for its suitability for use with the available operating parameters prior to installation (see type plate).

13.2 Mounting of the prefilter respectively the sample tube

The pre-filter (impingement shield or centered filter) is mounted together with a suitable sealing by screwing into the G ¾“ thread end of the stinger flange assembly.

13.3 Mounting of the probe

- Put the flange sealing on the bleeder connection.
- Fit the mounting piece and the probe flange by means of the attached screws and/or screw nuts.

It is recommended to mount the probe with its sample gas outlet showing at the 3 O’Clock position (not necessary for perfect function).
Further it is recommended to mount the probe with a slight descending gradient downwards so that possible deposited drops may flow back into the process.

13.4 Checking the filter element

The filter housing cover is dismounted as follows:

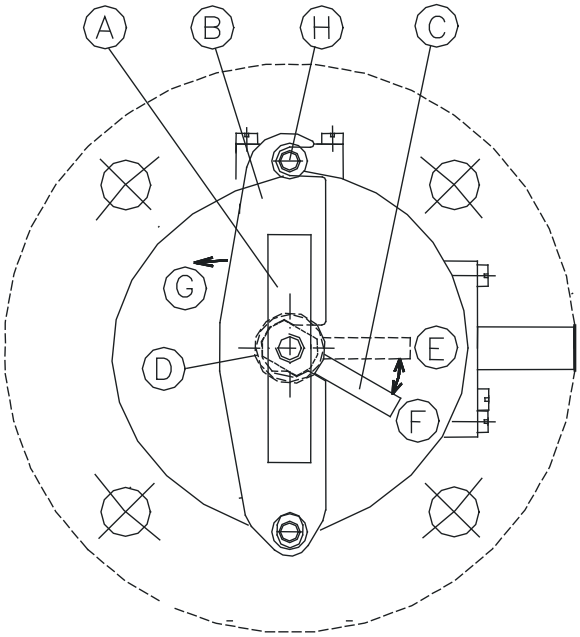
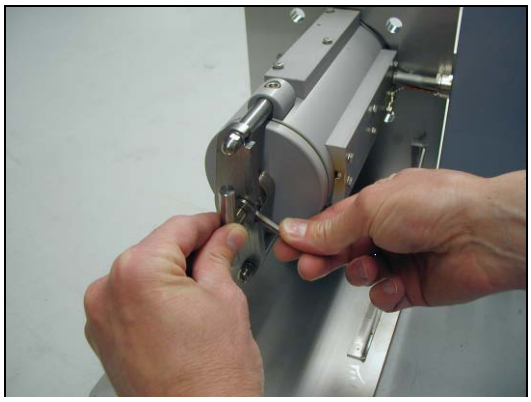


Figure 8: Schematic drawing of the filter housing cover

- Turn the toggle handle **A** approximately one rotation to the left side so that the cover is lifted;
- Put the handle **C** into position **E**;
- Turn the clamp clip **B** to the left side (direction **G**);
- Pull out the filter housing cover with the toggle handle **A.**

The photos below shall illustrate the above mentioned steps.

1.



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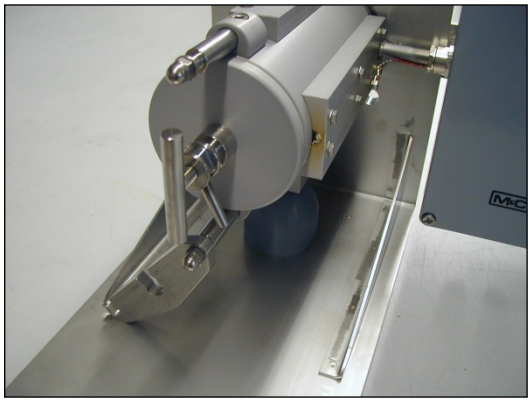

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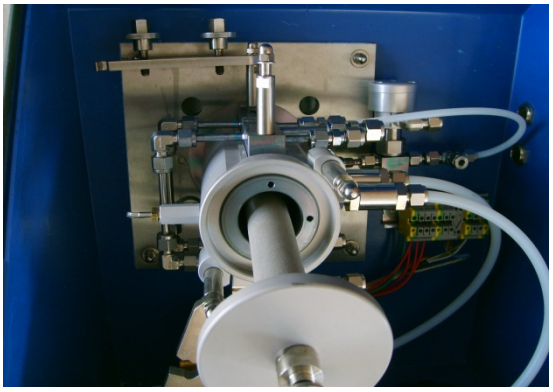


Figure 9: Dismounting of the filter housing cover

Now, the filter element is visible.

- **Check on the filter pressing screw whether the filter element is screwed on tightly.**
- **Push the cover with filter element into the probe again.**
- **Turn the clamp clip B to the right side and bring the ring bolt D into position E by using the handle C so that the clamp clip locks into place of the ring bolt D and the threaded bolt H. For this purpose, you may push in or pull out a little the filter housing cover by means of the straining screw A; afterwards, turn the handle C into position F and screw the toggle handle A hand-tight by turning to the right.**

14 INSTALLATION

The M&C SP2006-Hg probe is designed for stationary use. With correct selection of the sample point and proper installation, they will work for many years with a minimum of maintenance required.

14.1 Connection of the supply and sample lines

All pneumatic lines have to be inserted through the CES cable entry, size 5, with an operative range of 36 – 70mm. It is located in the bottom of the FRP-housing. After insertion and connection of all lines the CES cable entry can be shrinked by an air heater. Depending on customer configuration specifications, there may be 2 CES cable entry points located in the bottom of the FRP-housing (1 for Heated Umbilical – 1 for Non-heated & power).

Increases of pressure due to use of long sample gas lines at the outlet may have a great influence on the measuring result. For this reason, we recommend the following nominal widths and lengths for the sample lines in dependence on the type of injector:

Injector type I:
$\varnothing_i$ 1/4” max. 50m
$\varnothing_i$ 3/8” max. 150m

Injector type II:
$\varnothing_i$ 8mm max. 15m
$\varnothing_i$ 10mm max. 40m
$\varnothing_i$ 12mm max. 80m

14.2 The connections for the supply and sample lines are as follows:

Connection	Dimension
Calibration gas in	Tube 3/8”
Dilution air In	Tube 1/4”
Low pressure manometer	Tube 1/4”
Sample gas Out (diluted)	Tube 1/4”
Bypass air In	Tube 1/4”
Bypass gas Out (diluted)	Tube 1/4”
Sample gas Out (undiluted)	Tube 1/4”

¼” Sample lines in the umbilical can be used for diluted Elemental and Total Hg Sample Transport.

14.2 Connection of sample lines

All connections for the sample lines or tube connectors at the probe are made out of stainless steel, suitable for connection of stainless steel or Teflon tubes with 1/4" dimension. Only the inlet of the Zero & Span Hg gas is dimensioned for 3/8" Teflon tube.

When connecting tubing to stainless steel fittings, a supporting sleeve must always be used. The connection must be checked for tightness.

In dependence on the water vapour content respectively the dew point of the sample gas it is necessary to connect a heated sample line at the undiluted sample gas outlet.

For connection of the 1/4" sample line or tube, connectors available. Please act as follows:

Open the Probe Door, if this is your beginning point. Connect the 1/4" sample line or tube to the respective fitting (see drawings in the annex) Close the Door, if this is your final connection.

Ensure prior to operation that the corresponding marked connector for the sample line provided at the probe, match the connection at the Thermo Model 82i Probe Controller.

14.3 Connection of dilution air, bypass air or blow back air

For connection of the 1/4" supply lines or tube, connectors are available. Please act as follows:

Open the Probe Door, if this is your beginning point. Connect the 1/4" dilution, bypass, and blow back air to the respective fitting (see drawings in the annex) Close the door, if this is your final connection

Ensure prior to operation that the corresponding marked connectors for the dilution, bypass, and blow back air supply lines provided at the probe, match the connections at the Thermo Model 82i Probe Controller. See figure 7, page 17.

14.4 Connection of calibration gas

For all versions, a 3/8" line or tube connector is available for connection of the calibration gas.

Open the diagonal FRP-housing, if this is your beginning point. Connect the 1/4" calibration gas line or tube to the respective fitting (see drawings in the annex) Close the door, if this is your final connection.

Ensure prior to operation that the corresponding marked connector for the calibration gas provided at the probe, match the connection at the Thermo Model 82i Probe Controller.

14.5 Connection of the vacuum gauge

The Vacuum Line at the Probe should correspond to the connection point at the 82i Probe Controller located in the Thermo Freedom System CEM Rack.

For all versions, a 1/4" line or tube connector is available for connection of the vacuum gauge.

Open the Probe Door, if this is your beginning point, Connect the 1/4" vacuum line or tube to the respective fitting (see drawings in the annex). Close the door, if this is your final connection

Ensure prior to operation that the corresponding marked connector for the vacuum line provided at the probe, match the connection at the Thermo Freedom System..

14.6 Electrical connection

The temperature setting of the dilution probe SP2006HgT is made on the electronic controller.

The incorrect mains voltage can destroy the unit. Check the type plate for the correct voltage prior to connection!

The dilution probe must be mounted in such a way that touching the live parts is excluded!

In any case, we recommend the use of temperature resistant cables!

The alarm contact for low temperature must be controlled!

In case of a low temperature alarm (failure of heating or sensor) the dilution gas or bypass gas supply must be interrupted to avoid serious damage of the dilution probe. We recommend to switch the low temperature alarm on to external solenoid valves that provide the above mentioned function! This is part of the Failsafe Feature in the 82i.

For the erection of power installations with nominal voltages of up to 1000V, the requirements of VDE 0100 and its associated standards and specifications must be observed.
A mains switch must be provided externally.
The supply circuit of the unit must be equipped with a fuse with the correct rating (over current protection); the electrical details see technical data.

- **Remove cover of the controller.**
- **Insert the mains cable (min. 3 x 1,5 mm^2) through the cable gland and connect to the appropriate terminals (1 = ground, 2 = N, 4 = L).**
- **Insert the signal cable (low temperature alarm) through the cable gland and connect to the appropriate terminals 11 and 12 (contact position T_u shows alarm event).**
- **Screw cover back in place.**

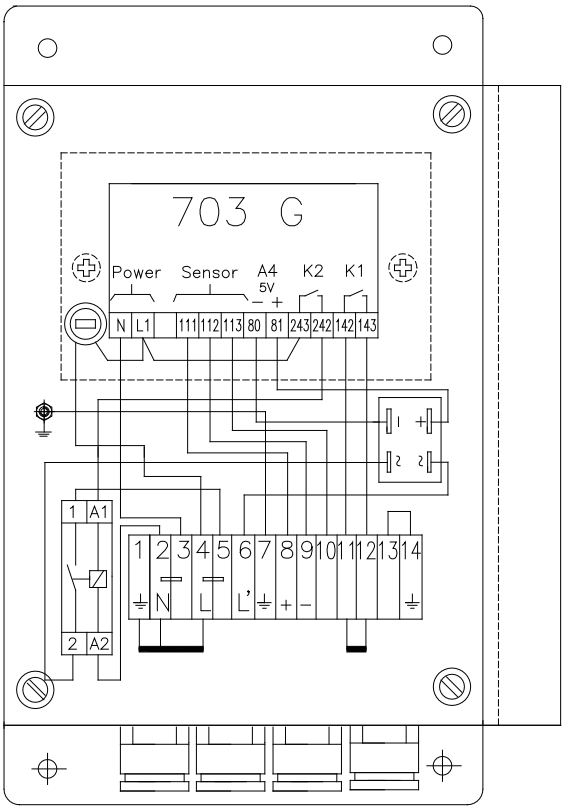


Figure 10: Electrical connection for SP2006HgT

We recommend the use of temperature resistent cables!

15 INITIAL STARTING

Prior to initial use, system and process-specific safety measures must be observed.

The relevant safety requirements and procedures for the medium to be sampled must be heeded.

The supply of gas to the injectors is only allowed when the heated dilution probe has reached its operating temperature (see technical data).

Prior to initial use, make sure that the mains voltage corresponds to the voltage indicated on the type plate!

Do not touch the surface of the heated dilution probe during operation. Due to its high surface temperatures, it may cause burns. Protective gloves must be worn and the dilution unit must be protected against unauthorized access!

The following step-by-step procedure is recommended

If so equipped, isolate the dilution probe from the sample point, eg. close the ball valve. If not equipped with isolation ball valve, DO NOT TURN ON DILUTION OR BYPASS AIR UNTIL MINIMUM TEMPERATURE IS REACHED. Check the set temperature on the installed temperature controller (see manual 2-5.1ME). Switch on the main voltage.

The total heating time is about 2 hours. After about 1 hour, the lower threshold value (30°C below set value) is exceeded.

Open the valve for the dilution gas when minimum temperature is reached. Set the precision pressure reducer to the pressure specified on the enclosed injector data sheet (see figure 13).

For safety reasons, the low pressure gauge must show a low pressure of >-0,6 bar. With a low pressure of < -0,6 bar, the critical orifice will not function properly. If the necessary low pressure will not be reached, the dilution gas supply pressure must be increased.

The following table shows an extract from an injector data sheet.

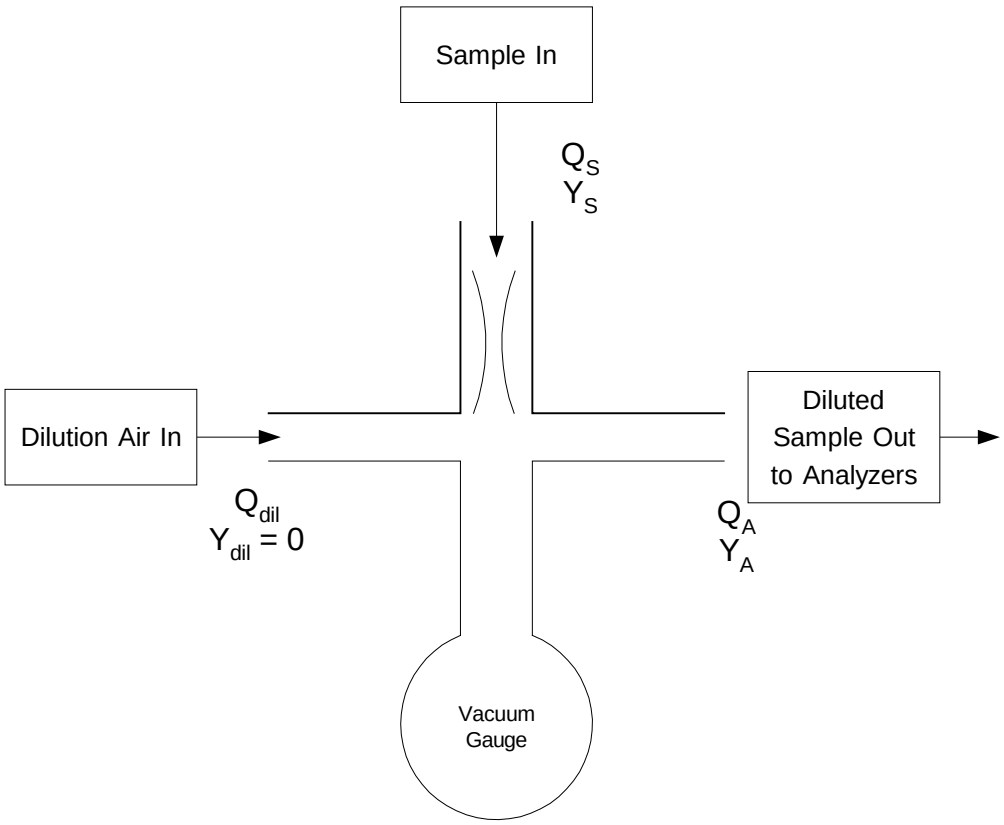
Injektortyp Injector type	I	Injektor-Nr. Injector No.	.....	Für Verdünnungssystem-Nr. For dilution system No.	...../.....	Typ Type	SP2006-H/DIL

Betriebsdruck Operating pressure [bar]	Durchfluss Flow [l/h]	Unterdruck ohne kritische Düse Vacuum without critical orifice [bar]	Unterdruck mit kritischer Düse Vacuum with critical orifice 5,1l/h [bar]
2,4	415	-0,62	-0,61
2,6	435	-0,65	-0,64
2,8	460	-0,68	-0,67
3,0	490	-0,80	-0,77
3,2	510	-0,79	-0,77
3,4	535	-0,79	-0,77
3,6	560	-0,78	-0,76
3,8	585	-0,77	-0,76
4,0	605	-0,77	-0,75

Überprüfung des Verdünnungsfaktors Check of the dilution ratio			Messgasdruck Sample gas pressure	atmosphärisch atmospheric	
Kritische Düse Critical nozzle	Verd.gas Dilution gas	Verdünnungsgasdruck Dilution gas pressure	Messgas Sample	Verdünnung Dilution	Messwert d. verd. Gases Meas. value of the dil. gas
5,1 l/h	100% N_2	3,2 bar	100% O_2	100:1	1,0 % O_2

Figure 11: Extract from an injector data sheet

“Dilution Cross” Eductor with Orifice



For the operation of an installed bypass injector, the necessary pressure must be set on the pressure regulator (see figure 10).

The attached bypass injector table shows the suction flows at corresponding bypass gas pressures for two different process pressures, 1 bar and 0,9 bar absolute (see figure 14).

Bypassgas / Bypass gas		Prozessgas / Sample gas	
Betriebsdruck Operating pressure [bar]	Durchfluss Flow [l/h]	Ansaugvolumenstrom bei 1bar abs. Suction flow at 1bar abs. [l/h]	Ansaugvolumenstrom bei 0,9bar abs. Suction flow at 0,9bar abs. [l/h]
0,5	110	45	-
1,0	155	115	-
1,5	190	200	65
2,0	235	250	135
2,5	270	300	200
3,0	310	350	250
3,5	355	370	270
4,0	395	390	305
4,5	430	425	350

Figure 12: Suction Flow @ 0.9/1bar abs. independent of the bypass gas pressure

In the event of low temperature, the supply of dilution gas must be interrupted! This is part of the Failsafe Feature of the Thermo Model 82i Probe Controller.

14.7 Calibration

A calibration of the downstream analyser system or checking the dilution factor must always be performed under operating conditions.

Test gas can be feed to the probe at the Calibration Gas Connection Port. A 10 psi check valve is installed on this port as well.

The procedure for calibration or checking the dilution ratio is as follows:

- **Supply test gas of a known concentration.**
- **Check the dilution ratio on the downstream analyser and, if necessary, correct the pressure on the pressure regulator of the dilution gas.**

Test gas feeding without bypass injector
In order to assure that sufficient test gas is available, the test gas quantity should be at least three times the flow quantity passing through the critical orifice (see injector data sheet).

Test gas feeding with bypass injector
The test gas quantity must be approximately 10% above the quantity of the volume flow passing through the bypass (see figure 14) and the critical orifice (see figure 13).

15 CLOSING DOWN

Before closing down, i.e. switching off the heating, the probe should be purged with inert gas or air (placed in zero mode) in order to avoid condensation and the aggressive components of the gas sample.

17 MAINTENANCE AND REPAIR

Before carrying out any maintenance and repair work, the specific installation and process safety measures are to be observed.

Aggressive condensate (acid gases) is possible. Wear protective glasses and appropriate protecting clothes !

Attention must be paid when touching the probe surface during operation. Due to the high surface temperatures, you may suffer from burnings. Protective gloves have to be worn, and the probe must be protected absolutely against unauthorized access!

Before carrying out any maintenance work on electrical equipment, the mains voltage must be switched off on all poles. The same is valid for eventually connected alarm and control circuits!

We cannot give any recommendation regarding maintenance cycles. This must be determined specifically depending on the process conditions and is included in your Thermo Scientific Technical Training.

The principal maintenance work of the probe is changing the filter element and control of the seals.

When carrying out any maintenance or repair work, the probe does not need to be REMOVED FROM THE INSTALLATION.

17. 1 Change of the filter element and the seals

Please ensure that no contaminations that are bad for one's health remain on the probe before carrying out any maintenance or repair work. An appropriate measure is to flush the probe with inert gas.

Before changing the filter element, the dilution air must be Turned OFF!

The following steps are recommended when changing the filter element or the seals:

Run zero gas thru the system.
Turn off the bypass and dilution air supplies.
Remove the protection cap after having opened the bent-lever closures;
Dismount the filter housing lid according to 13.4;
Screw out the filter pressing screw, check the filter element and exchange it if necessary;
Remove and Replace the filter element seals. DO NOT ATTEMPT TO REUSE.
Remove and Replace the O-rings inside the lid. DO NOT ATTEMPT TO REUSE.
Clean the filter chamber. DO NOT USE ANY MATERIAL THAT COULD DAMAGE THE SILCO COATING INSIDE THE FILTER CHAMBER.
Mount again the filter housing lid in reverse order and put it into the filter head;
Bolt the filter housing lid according to 13.4;
Replace the protection cover.

Pay attention that after reinstalling the filter housing lid the strap bolt (see fig.15) is screwed down HAND TIGHT in a cold condition and then TIGHTENED AGAIN AFTER THE OPERATING TEMPERATURE IS REACHED. This will ensure a good seal.

NOTE:

The Titanium filter may be cleaned and reused after proper servicing. Refer to your Thermo Scientific Technical Training for instructions on cleaning and conditioning the filter prior to reuse.

The Thermo Scientific Technical Training will provide you in depth servicing requirements for your specific application. The procedures detailed in this manual reflect only the specific operations of the SP2006HgT probe and the maintenance performance it requires.

17.2 Disassembly of the dilution and bypass block

For disassembling of the dilution and the bypass block, the system should be placed in zero calibration mode to flush the system of potential harmful gases to the system and the servicing personnel, the heater should be switched off so that the probe can cool down as well as the dilution and bypass air being turned off prior to removing blocks to ensure minimal contamination of lines.

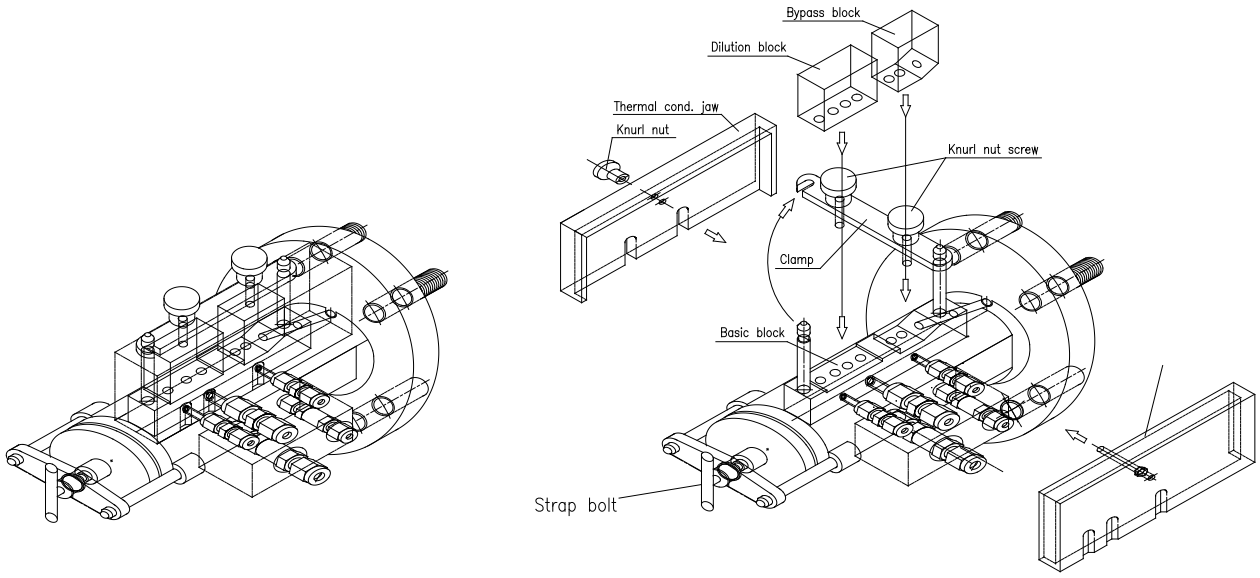


Figure 14: Drawing of the dilution and bypass block

For Block removal We recommend to proceed according to the following steps:

NOTE: The removal of the blocks for any reason will require the replacement of the Kalrez "O" Rings because of the damage they incur during operation. Once heated, they WILL TYPICALLY NOT RESEAL, because they have become hardened and will not be pliable enough to make the required seal. If either of the eductors or the orifice is removed for inspection, the replacement of those "O" Ring components will also require to be changed prior to placing unit back in service. It is because of this we do not recommend checking of the blocks or filter components on any regular basis that is more frequent than quarterly and would recommend the inspection be as infrequent as possible unless filter integrity or some other operational issue is diagnosed to be at the Probe Head. Ideally, once every 6 months or annual inspections would be our 1st choice but more frequent checks may be required because of the application you are operating in.

Open the Door on the Heated Filter Probe Box.
Remove the knurl nut screw at the side and remove the thermal conducting jaws
Loosen the knurl nut screws on the top and turn the clamp to the side
Now it is possible to remove the dilution and/or the bypass blocks.

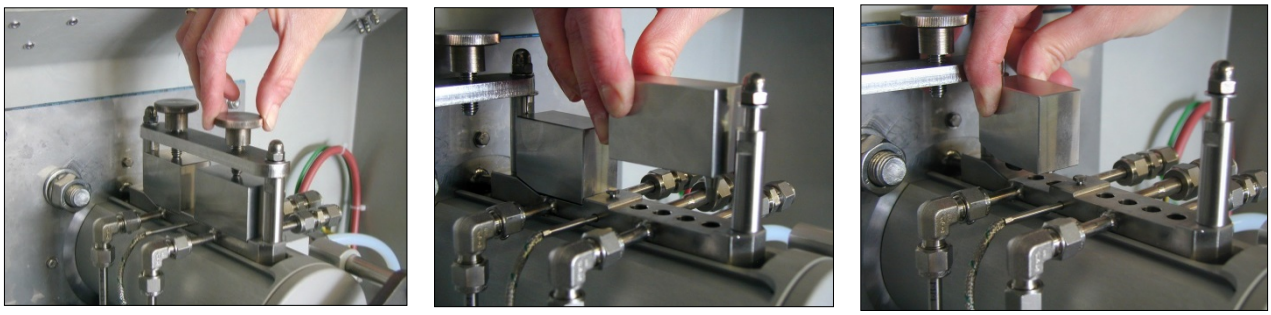


Figure 14: Block Removal

Do not clean the critical orifice and the eductor mechanically.
Cleaning should be effected in an ultrasonic bath!

Orifice & Eductor Tool For Removal & Installation With Dilution Block & Bypass Block Assemblies

Figure 15: Dilution & Bypass Block Assembies

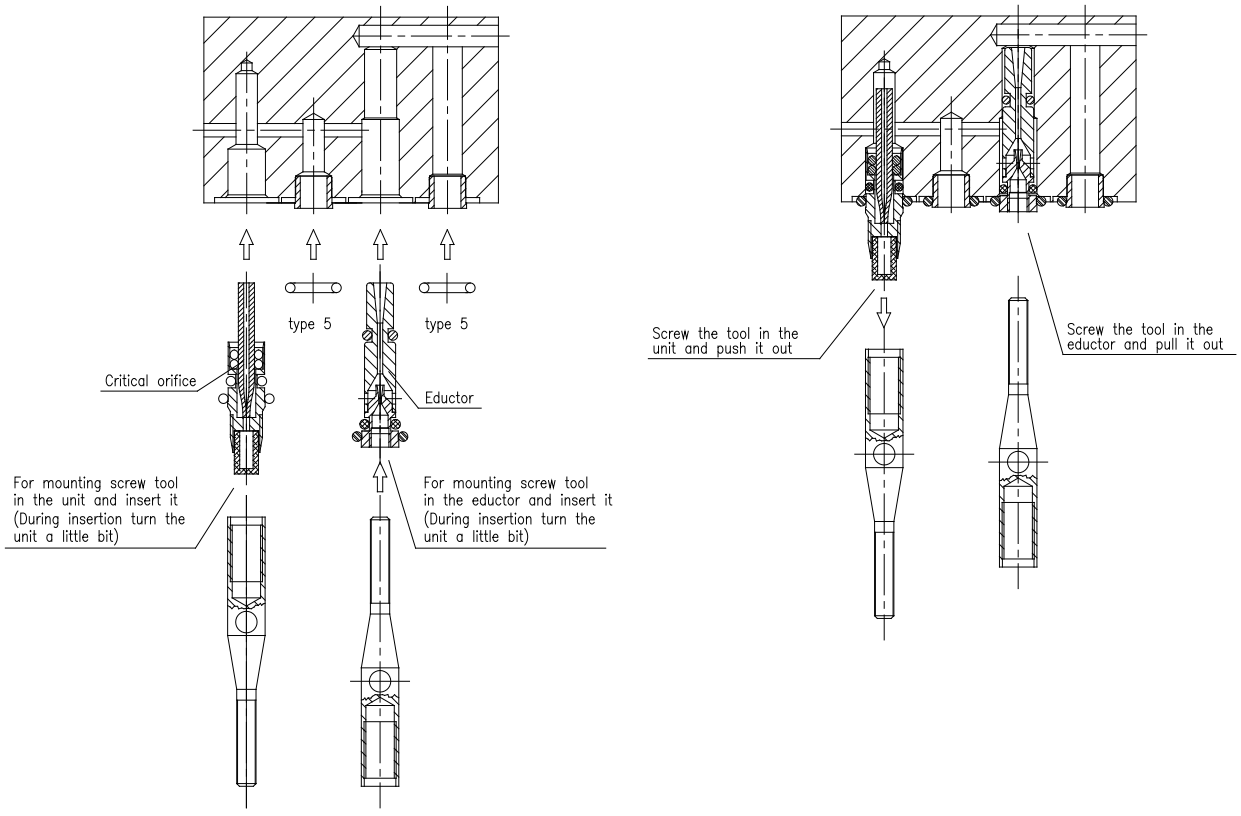


Figure 16: Shows the position of the orifice, the eductor and the O-ring seals in the dilution block

Tool Installed For Orifice Removal

Tool With, Removed Orifice Assembly

Figure 18: Dilution block with critical orifice, eductor, O-ring seals and tool

Please proceed as follows:

Use the delivered special tool to remove the critical orifice and/or the eductor from the block as described in figure 16 or 17
Clean the orifice and/or the eductor in an ultra sonic bath
Check the o-rings and change them if necessary (see figure 18 and 19)
Push the critical orifice and eductor with its nozzle seat and o-ring carefully back into the block by using the special tool as described in figure 16 or 17

Now, the dilution unit can be reassembled in reverse order.

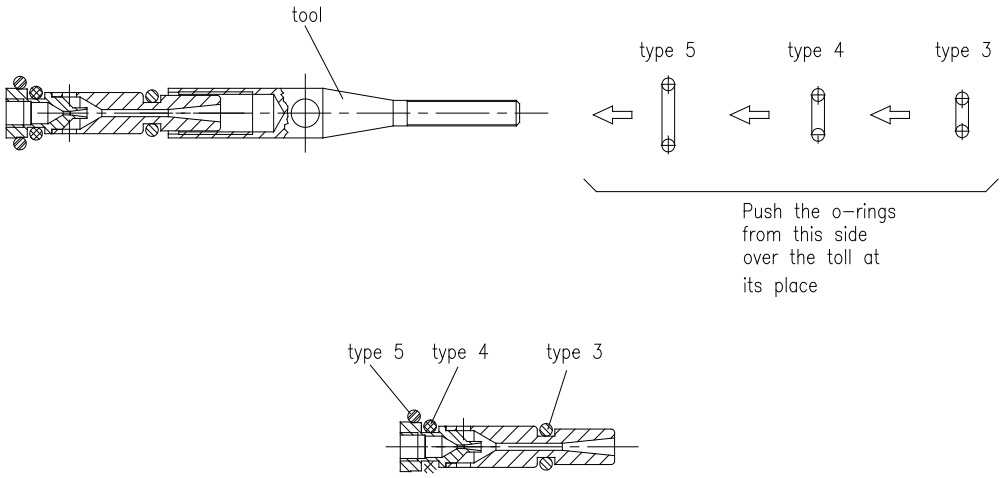


Figure 18: Eductor and O-rings

Complete Orifice Assembly **Orifice Removed With 1 O-Ring On**

Pointed Portion Of Orifice Inserts Into Prefilter Assembly & 2 O-Rings Required On Orifice

Figure 20: Orifice and Suction Tube

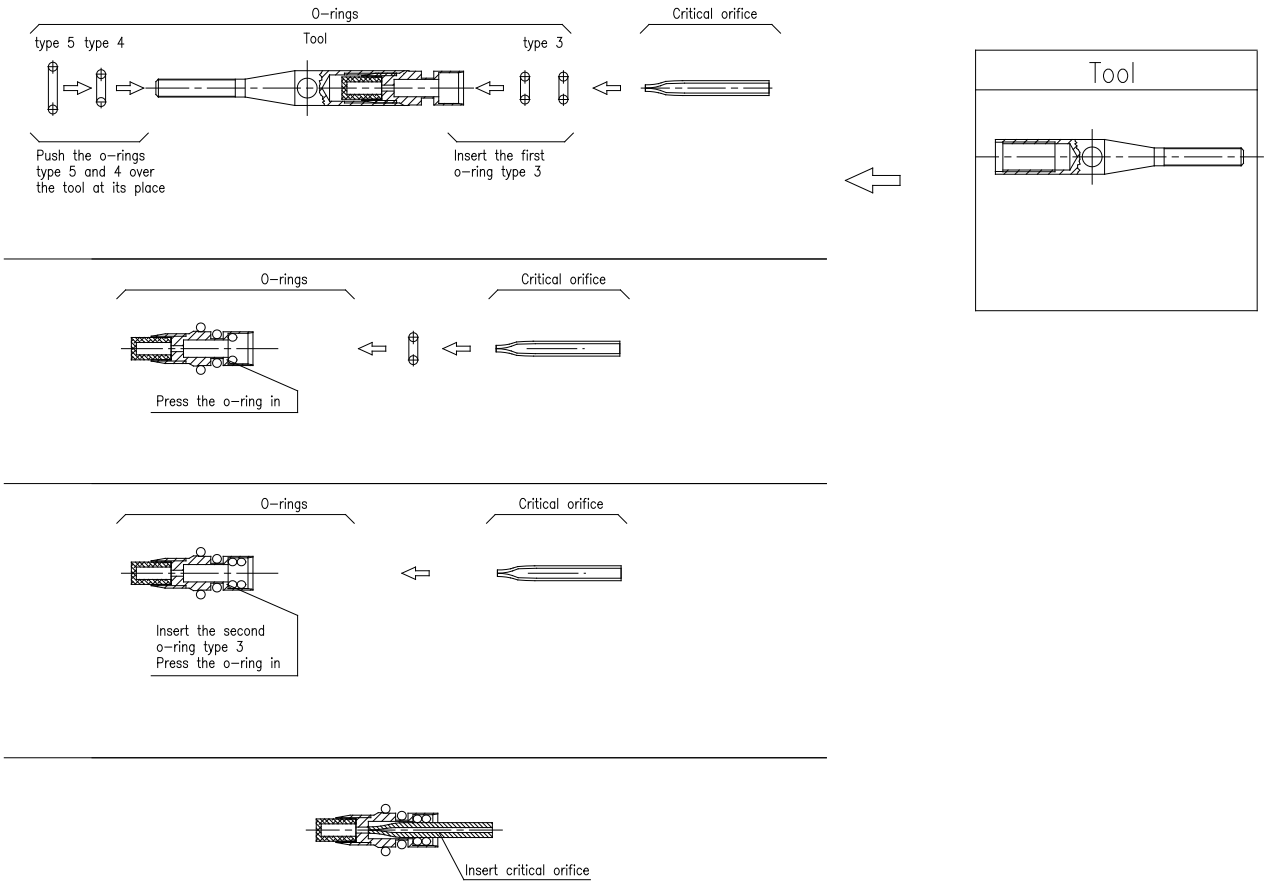


Figure 20: Critical orifice and o-rings

Notice: The Orifice has the pointed end always pointed toward the centered filter which goes into the 1st hole closest to the filter handle and the flat portion of the Orifice is inserted into the Probe Head Block.

Tool Set For Removal Of Eductor From Dilution Block

Eductor Removed From Dilution Block

Eductor Removal From Bypass Block

Eductor Removed From Bypass Block

All Block Components Removed

Dilution & Bypass Eductors Removed

Figure 21: Continued: Dilution Blocks & Assemblies

Eductor Assemblies

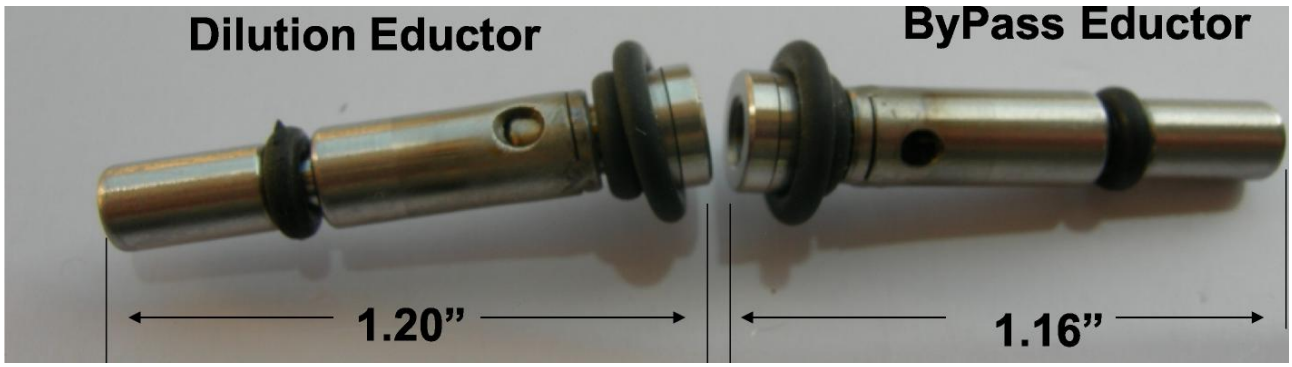


Figure 22: Eductor Assemblies

Notice that the Dilution Eductor is 0.04 inches longer than the Bypass Eductor. They appear very similar but must not be interchanged. The Dilution eductor is a low flow high pressure device. The Bypass eductor is a high flow low pressure device.
If interchanged, they will cause the system to operate in a very poor manner and cause the system to appear to have major operational issues.

18 SPARE PARTS LIST

Wear, tear and replacement part requirements depend on the specific operating conditions. The following table shows an extract of the recommended spare parts for probe of type SP2006-HgT.

Spare Parts List For SP2006HgT Probe

1 Year Consumable Parts

Quantity	Part Number	Description
2	90F0126T1	2 micron Filter Element Type F-2T 150 For Hg Sampling Applications
8	93S0046	30 mm PTFE-Goretex Filter Element Gasket
2	XO-1545	55 mm Kalrez ID O-ring
2	XO-1546	39 mm Kalrez ID O-ring

Recommended Spare Parts

Quantity	Part Number	Description
1	ORK0001	Kalrez O-ring For Dilution And Eductor Blocks For SP20006Hg
1	ORK0006	Kalrez O-ring For Critical Orifice & Eductor For SP2006HgT
1	ORK0007	Kalrez O-ring For Suction Tube Seal, Dilution, & Bypass Eductor
1	93S0015	220 Volt Heater Cartridge
1	93S4415	High Temperature O-ring Set. Constructed Of Chemraz. Includes O-rings For Dilution Eductor Block, Bypass Eductor Block and Lid Seals 4 Each – Type 3 O-rings 3 Each – Type 4 O-rings 7 Each – Type 5 O-rings
1	20S4300-30Hg	Critical Orifice Set. Comes With 2 Kalrez O-rings & 30:1 Orifice
1	93S4420Hg	Spare Dilution Eductor Assembly. Includes Eductor Nozzle, Orifice, Block With Fused Silica Coating. High Temperature Seals, Specify Dilution Ratio.
1	93S4425Hg	Complete Spare Bypass Eductor Assembly. Includes Eductor Nozzle, Block, & High Temperature Seals.
1	93S4406Hg	Spare Dilution Unit Eductor Block. Empty Without Inserts. Does Not Include Eductor Nozzle, Critical Orifice, Or O-rings. Sample Wetted Parts Coated With Fused Silica coating.
1	93S4416	Spare Bypass Eductor Unit Block. Empty Without Inserts. Does Not Include Eductor Nozzle Or O-rings.
1	93S4401Hg	Complete Dilution Eductor Nozzle Assembly With Fused Silica Coating On Sample Wetted Parts.
1	93S4411HT	Complete Bypass Eductor Nozzle Assembly
1	93S1985Hg	Filter Housing Lid Assembly With Fused Silica Coating Of Metallic Sample Wetted Parts. Includes High Temperature O-rings. Does Not Include Filter Element.

Spare Parts List For SP2006HgT Probe Continued

Recommended Spare Parts Continued

Quantity	Part Number	Description
1	93S0150-06	Blow Back Check Valve
1	93S0061	Type “K” Thermocouple
1	93S4440	Orifice/Eductor Maintenance Tool
1	740-SVBB-120	Normally Closed Blowback Solenoid Valve For Filter Blowback Or Stinger Blowback. 120 VAC 2-way
1	740-SVCAL-120	Normally Closed Calibration Actuator Solenoid Valve. 120 VAC 3-way
1	740-9352350BR	3” ANSI 150 lb Flange Gasket
1	740-XO-1689HgT	6” Hastelloy Impingement Shield w/PTFE Coating
1	740-93S1500Hg	Normally Closed Bellows Valve
1	740-90K6041	CL2 PVDF Solenoid Valve. 120 VAC

For Spare Parts Call:
Art Vance: 805-654-6970 ext. 100
avance@mac-products.com

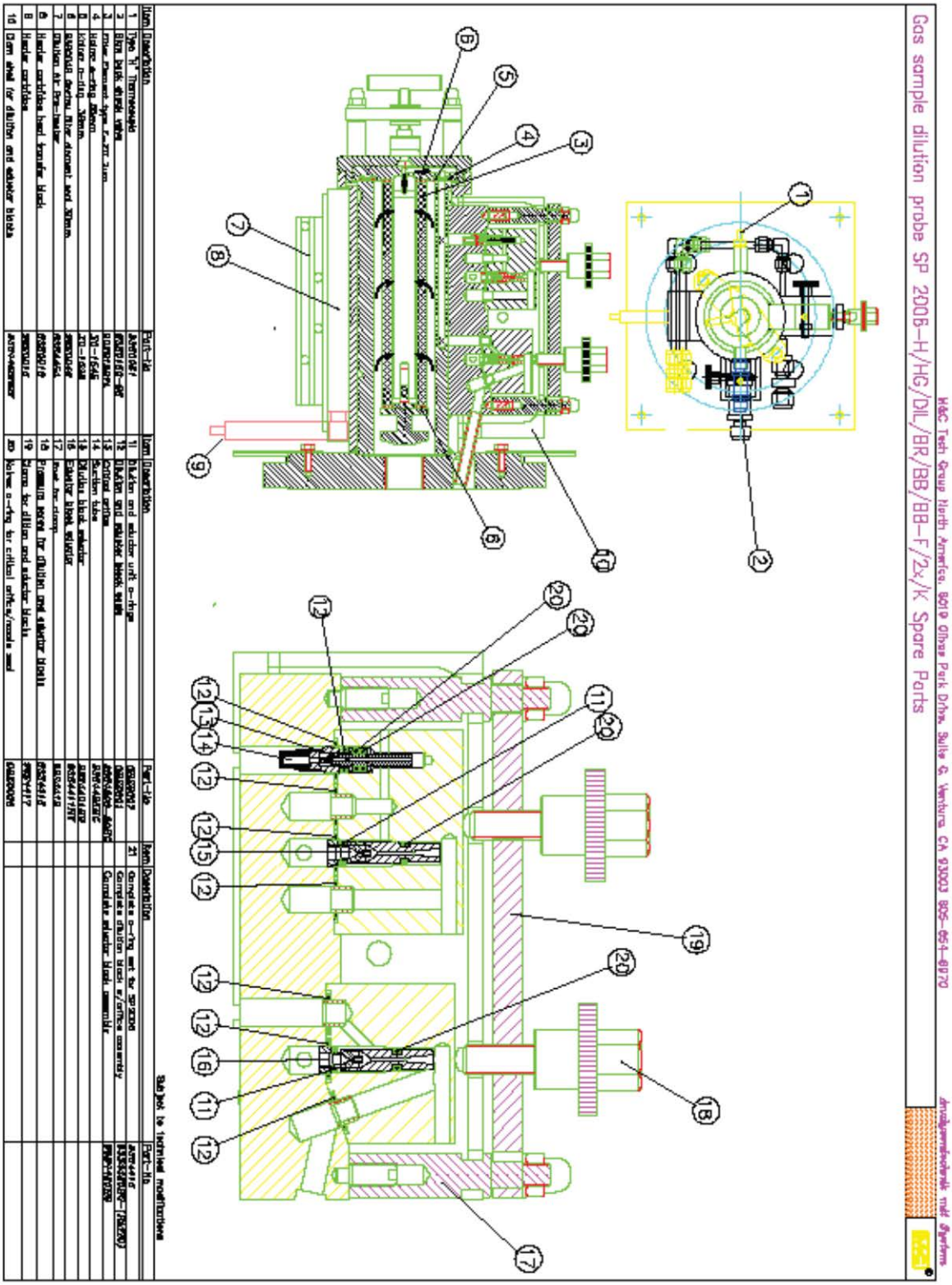


Figure 23: Detailed Visual Part Number Location In SP2006HgT Probe

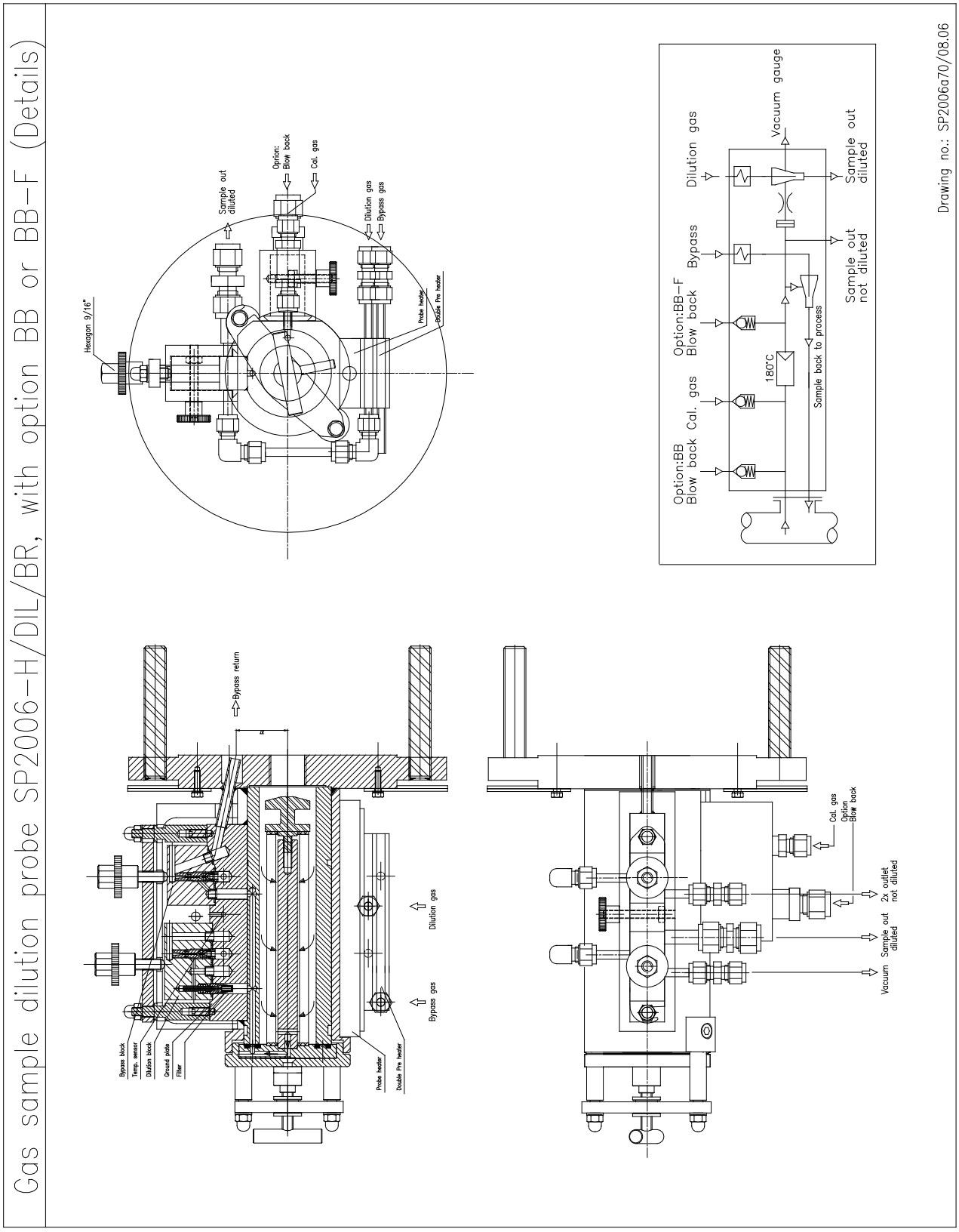


Figure 24: Detail Drawing Of SP2006 Hg Probe

This may not be required if Firmware version V.020104 or greater is installed and M&C is selected as Probe of choice in Menu per Thermo Fisher Scientific.

Some customers have experienced overpressure issues in the calibration gas hydrator plumbed on the outlet of the Thermo Model 81i Hg Calibrator. When insufficient blowback air pressure exits the Thermo Model 82i Probe Controller can allow air to enter the calibration gas line and pressurize the Hydrator. The M&C SP2006HgT probe utilizes pneumatic calibration gas valves located in the heated area of the sample probe assembly. These valves are driven by 3 way solenoid valves in the M&C probe auxiliary enclosure assembly (referred to as the Cold Box). The pneumatic valves receive their air from the blowback airline and require 40 psig of air pressure to open. If the blowback air supply pressure falls below 40 psig the pneumatic valves will not open while the calibrator is sending calibration gas to the probe. This can result in excessive pressure build up in the hydrator, which potentially, can damage the Hydrator and/or the Model 81i Hg Calibrator.

This still has occurred on some units even with new version software updates so we recommend the following:

M&C and Thermo Environmental recommend the installation of a 25 psig check valve on the calibration gas exit line running to the hydrator (Hydrator Inlet). This can be accomplished utilizing a fused silica coated ¼" union tee or a ¼" Teflon Union tee fitting and an uncoated 25 psig check valve. The output of the check valve should be plumbed to the system exhaust line.

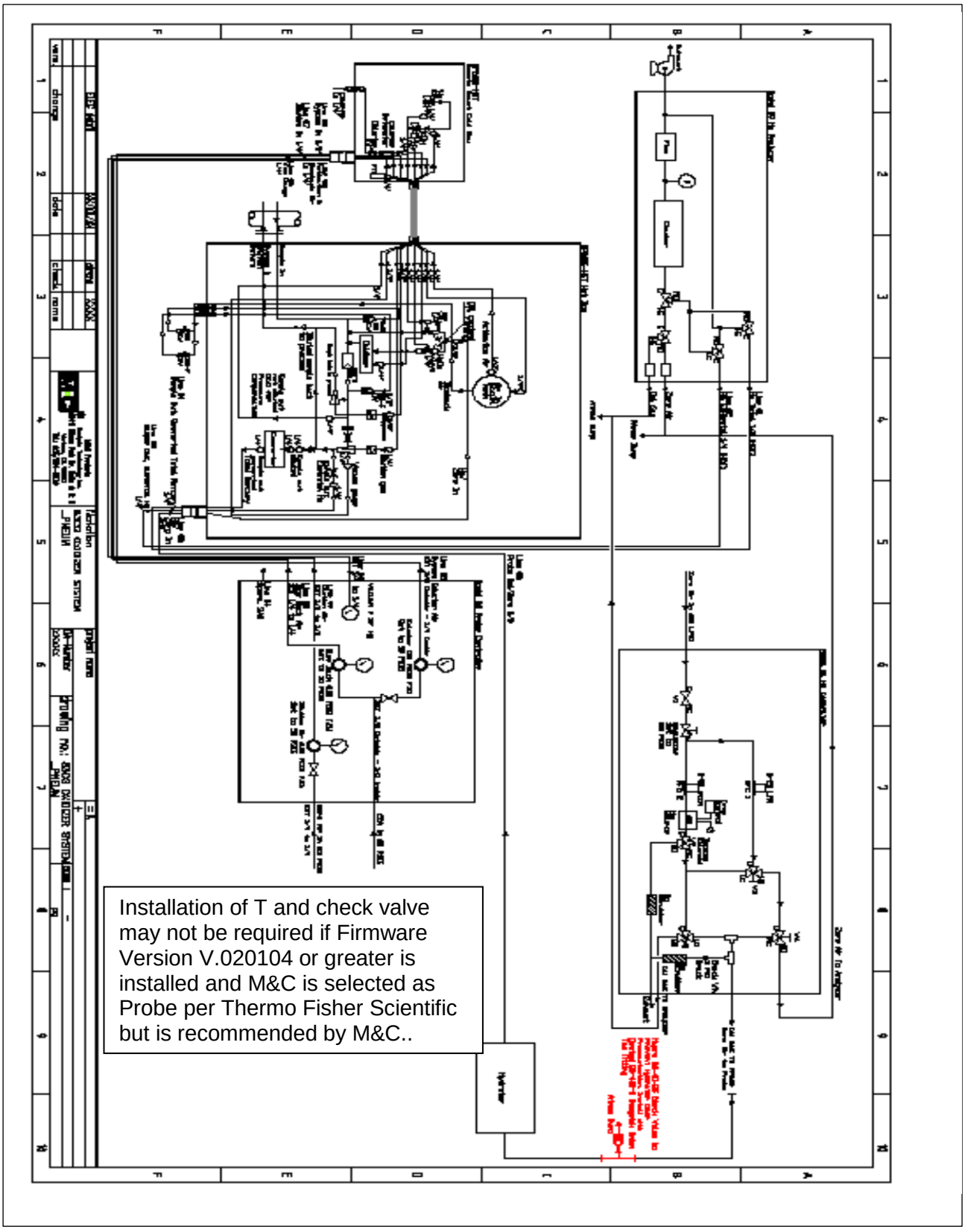

Installation of T and check valve may not be required if Firmware Version V.020104 or greater is installed and M&C is selected as Probe per Thermo Fisher Scientific but is recommended by M&C..

Figure 25

SP2006 Orifice Block Calibration Device (P/N XO-2499)

It allows you to work on the Block Assemblies while they are cool to the touch in your Lab and increase data capture. It is a direct emulation of the flow path of the SP2006 Probe Head. The SP2006 Orifice Block Calibration Device is designed to perform verification checks on new or serviced Dilution Orifices, Blocks, and Eductor Assemblies. It is used to establish the desired sample flow rate through the stinger, verifying sample flow rates, and dilution ratios. It is the ideal tool for lock checkout after servicing or prior to installation of new Block Assemblies. All you need to complete the system, is a flow measurement device for final flow verifications.

21. Standard Recommended Setup for SP2006HgT Probe

- Air/Nitrogen Pressure should not be less than 80 PSI
- Bypass air pressure set at 8 to 10 PSI
- Dilution air pressure set to Orifice Specifications provided with Orifice
- Blowback Pressure for Filter set to 60 PSI
- Blowback Pressure for Stinger set to 60 PSI not to exceed 80 PSI
- Dilution Ratio 30:1
- Stinger Operation set to 180° C
- Probe Filter Holder set to 225°C to 240°C
- Converter Temperature 720°C to 760°C
- Oxidizer Temperature 380°C to 450°C
- Optimal Chlorine flow should be from 100 cc to 400 cc (Optimize for your installation) and maybe varied dependent upon condition of Filter
- Chlorine Bottle Pressure should be set for around 15 PSI not to exceed 35 PSI

Note:
If you have the Thermo Orifice installed on the Chlorine Bottle outlet, remove same.

Blowback duration should not exceed 10 seconds. Recommended duration is 2 to 5 seconds.

Blowback Sequence

1. It is recommended that you blowback the filter, wait 15 seconds to allow surge tank to refill, and then blowback the stinger.
2. Perform step 1 again after allowing 15 seconds for surge tank to refill.
3. Perform step 2 again.

Sequence would be as follows:

- Filter Blowback (3 seconds)
- Surge Tank Refill (15 seconds)
- Stinger Blowback (3 seconds)
- Surge Tank Refill (15 seconds)
- Filter Blowback (3 seconds)
- Surge Tank Refill (15 seconds)
- Stinger Blowback (3 seconds)
- Surge Tank Refill (15 seconds)
- Filter Blowback (3 seconds)
- Surge Tank Refill (15 seconds)
- Stinger Blowback (3 seconds)

Total time: 93 seconds (1 min 33 seconds)

Typical application uses a Blowback Sequence once every 3 hours. Your application may require more/or less frequent Blowback events.

Note: Be sure to observe your Hydrator if you did not install check valve as indicated on page 40 and illustrated on page 41.

XO-2640 HSL
Set Up Page For Stinger PID Controller

Program: PM3C-AAAABAA
PID Programming instructions for the Standard Program for the HgT stinger
Navigation: THERE ARE 2 MENU LEVELS TO CONFIGURE SETUP AND OPERATIONS.
There are 4 keys, ADVANCE(Green Button), INFINITY(2nd From Left), and UP and DOWN ARROWS.

To enter SETUP, Hold the UP and DOWN arrows simultaneously for 3 seconds."5 LoC" will appear in the display.
To ADVANCE to the next setting within the menu, press ADVANCE.
To CHANGE value, use the up and down arrow keys.
To EXIT menu levels, press the INFINITY key (2nd from Left). Anytime during SETUP, the INFINITY key will return PID to default display.

Configure SETUP 1st, following instructions below'
Operational values of setpoints and alarms are then entered in the operations once the controller has been configured in SETUP.

SETUP MENU CONFIGURATION INSTRUCTIONS
Hold UP & DOWN arrow keys simultaneously for 3 seconds. When, 5 LoC is displayed follow steps below.

Press to ADVANCE	Parameter	Set this VALUE	Default
ADV	SEn	1C	
ADV	LIN	H	
ADV	dEC	O	
ADV	C_F	C	
ADV	r.Lo	-18	det.
ADV	r.hi	320	
ADV	Fn1	ALM	
ADV	Fn2	hEAt	
ADV	h.AD	PId	
ADV	A.fY	Pr.AL	
ADV	A.hY	2	
ADV	A.L9	ALo**	det.
ADV	A.LA	nLAt	det.
ADV	A.bl	oFF	det.
ADV	A.Sl	oFF	det.
ADV	A.rSP	on	det.
ADV	rP	both	
ADV	r.rt	5**	
ADV	o.hl1	100	det.
ADV	o.hl2	100	det.
ADV	PAr1	AC.Pu	det.
ADV	PAr2	AC.SP	det.
ADV	AdS	1	det.

SETUP is complete. Press INFINITY Key to return to default display, then proceed to OPERATIONS value entry.>>>
****Note 1: r.rt is ramp rate. A higher rate can be used to expedite startup. Recommend 5 or less to minimize the chance of overshooting control temperature of sitnger if built with high wattage heater.**
****Note 2: A.Lo sets alarm N.O. Set N.C. at customers request.**

Set Up Page For Stinger PID Controller Continued:

Operations Menu and Settings Instructions

Access From DEFAULT Page. Pressing ADVANCE brings up the parameter to be adjusted. Arrows change values, ADVANCE stores and boves to next parameter.

PRESS	PARAMETER	SET THIS VALUE	DEFAULT
ADV	A.LT	no	det.
ADV	C.M.	no	det.
ADV	h.Pb	14**	det.
ADV	tI	180**	det.
ADV	td	0**	det.
ADV	o.tb1	20	det.
ADV	o.tb2	1	det.
ADV	A.Lo	150	
ADV	A.hI	800	
ADV	I.CA	0	det.

****Note: Values may change if controller is autotuned. These values can generally be left as found. If control is unstable, adjust values or perform an autotune to let the PID tighten the control loop.**

LOCKOUT INSTRUCTIONS (OPTIONAL)
If control is critical or subject to damage due to customer settings change, re-enter the SETUP Menu and restrict the access level in 'LoC'.
Level ACCESS Summary is as follows:

LoC	Level of ACCESS
1	Operations, READ ONLY
2	Operations, Setpoint R/W
3	Operations, Setpoint Control Mode R/W
4	Operations, Enter Menu R/W Access
5	ALL SETUP and OPERATIONS Menus R/W Access

23. Trouble shooting M&C SP2006HgT Probe

Remember the Thermo Fisher Scientific Mercury Freedom System Analyzer measures ONLY Elemental Hg. Always observe the Hg values as well as the HgT value of interest. If the Hg value during calibration is reading correctly and the HgT value is NOT, the problem is NOT a malfunctioning Probe. The problem may be contamination of components, leaks, and/or converter failure.

Define Integrity Check:
Integrity check is simply a means to ensure that the chlorinated Hg is not being scrubbed (lost) on the particulate accumulated on the heated Titanium Filter, Orifice Prefilter, or any surface areas in can contact in transport to the converter. It also ensures the converter is properly converting the chlorinated Hg to elemental for transport to the analyzer.

System fails integrity check:
System Hg (Elemental) drops but HgT does not increase. The oxidizer is functioning properly (not the problem). Potential causes for HgT not properly responding.

Contaminated Titanium Filter
Contaminated Orifice Prefilter
Contaminated Dilution Block Assembly
Contaminated Vacuum Orifice (Part of Thermo original design for sample control (located external to probe on left hand side of probe head and connects to transport line to converter)
Contaminated surface areas that chlorinated Hg comes in contact with (sample transport tubing from Vacuum Orifice to Converter, and/or sample transport tubing from converter to analyzer, and/or sample transport tubing connections internal to analyzer
Leaks in system (at converter connections, in sample transport to analyzer chamber (connections in analyzer, solenoids leaking, etc….)
Converter Failure
Contaminated HgT sample line

Trouble shooting M&C SP2006HgT Probe Continued:

Corrective actions:

Contaminated Filter: Clean in Sonic Bath and/or replace with an already cleaned filter. Inspect O-rings and replace if necessary.

Contaminated Lid Assembly: Clean in Sonic Bath for no more than 1 minute and/or replace with an already cleaned Lid Assembly. Inspect O-rings and replace if necessary. See Cleaning procedure document

Contaminated Prefilter: Clean in Sonic Bath for no more than 1 minute and/or replace with an already cleaned Prefilter. Inspect O-rings and replace if necessary. See Cleaning procedure document.

Contaminated Dilution Block Assembly: Clean Dilution block assembly including orifice, eductor, and all passages. Inspect O-rings and replace if necessary. See Cleaning procedure document.

Contaminated Vacuum Orifice: Clean and/or replace with an already cleaned orifice. Ensure proper orientation of orifice. See Cleaning procedure document.

Converter Failure: Replace converter cartridge and ensure proper temperature setting

Leaks: Correct/Fix leak – Place System in HgT and Hg Only Modes and Check Flows in HgT Line and Hg Line, Check Chamber Pressure in each mode of operation

Contaminated HgT Sample line: Clean line (If you clean one line it is wise to clean all lines)

Things you can do to assist in determining which is potential issue:

For Filter (Probe and all associated components) you can take outlet of Oxidizer and feed directly into converter sample transport line (This will be undiluted so you will get high values). Disconnect the Vacuum Orifice from probe and connect output of oxidizer to the Vacuum Orifice (be sure to include a "T" for a vent and vent so you are not breathing the vented portion). If this works you know the Vacuum Orifice and converter are good, there is no contamination in HgT sample line, nor do you have a leak in the HgT sample portion. If this does not work, you know it is the Titanium filter, Lid Assembly, Prefilter, Dilution Block Assembly Including Orifice, and/or any components in the probe that is in contact with the sample prior to the Vacuum Orifice.

Trouble shooting M&C SP2006HgT Probe Continued:

<u>If the issue is in the Probe</u>, you then can clean and/or replace the Titanium filter, clean and/or replace the Lid Assembly, clean and/or replace Orifice Prefilter, clean and/or replace block assembly and its components, and/or any of the surface areas and probe surface areas if the cause was proven to be in the probe. We suggest that you replace one item at a time. Replace and/or clean the Titanium filter 1st and wipe out interior area of heated filter body as well as clean the sample transport and surface areas of the filter lid assembly. If this does not provide complete desired results, clean and/or replace Orifice Prefilter and Dilution Block Assembly including orifice and eductor. Note you can possibly have a leak at the Dilution Block Assembly due to aged O-rings failing. Be sure to inspect all O-rings when you remove a block and replace all that appear to have lost sealing ability. Also replace as necessary, any O-rings used in the block assembly internals as well.

<u>If the issue is a leak</u>, fix the leak.

<u>For contaminated sample line:</u> You can switch the elemental sample line and the Hgt lines and see if that corrects the issue (noting that both lines maybe contaminated with the same sample product) or just improves the problem. If that is your problem clean sample line and be sure to TURN OFF the Sample Line heaters prior to pouring ANY CLEANING LIQUID into the line. You also want to ensure you have the lines disconnected from the analyzer so that you don't hate yourself later. Rinse lines with deionized or distilled water and thoroughly dry lines prior to returning to sample modes. It is a good idea to run an elevated elemental Hg cal for 30 minutes or longer (the longer you can run in this mode the quicker the lines will become equalized) prior to returning to sample run mode.

Any questions please feel free to contact:

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Roy Vincik: 225-241-6803 – rvincik@mac-products.com

When do you perform cleaning?

Cleaning would be recommended by application requirements. There is NO one step that fits all applications.

Cleaning would be recommended when:

- RATA testing data is in question and all indications are not with the testers results

  Results may be altered by:

  1. Stinger contamination
  2. Scratches in Stinger from improper cleaning procedures
  3. Leaks in flange assembly seal
  4. Scratches in Probe Body from improper cleaning procedures
  5. Potential contamination of probe body and/or probe components
  6. Including potential issues associated with weekly integrity checks

- Weekly integrity check failed when daily calibration is valid

  Results may be altered by:

  1. Contaminated Probe Filter
  2. Contaminated Filter Lid Assembly
  3. Contaminated Probe Body
  4. Scratches in Probe Body from improper cleaning procedures
  5. Contaminated Orifice Filter
  6. Contaminated Dilution Block
  7. Contaminated Thermo Orifice for Hg Total and Elemental Hg
  8. Contaminated Sample Transport Lines
  9. Converter core and/or heater malfunction

Replacement and/or resurface coating of contaminated/damaged component would be required when after completion of cleaning, there is no improvement of operation and/or when replaced with known proper coated components, the operation was returned to normal.

HgT Probe Cleaning Procedures

HgT Probe is Silco Coated and the coating must be preserved. The thickness of the coating may vary from 100nm to 1600nm and is solidly bounded to the probe surface. All metal surfaces of the probe that are in contact with the transported measured sample are treated. All surfaces that make up the HgT Probe that come in contact with the transported measured sample will be treated, titanium, or Teflon.
That includes the:

- Stinger
- Probe Body
- Filter Lid Assembly
- Dilution Block Internal Ports
- Orifice Prefilter
- Dilution Block Eductor
- Contaminated Thermo Orifice for Hg Total and Elemental Hg

<u>These surfaces must be treated with care.</u>
It is recommended that you rinse with a high purity solvent, such as a nonpolar solvent that will dissolve ONLY surface contaminants. An example would be pentane or hexane to remove hydrocarbon contaminants. You may use a more polar solvent such as acetone to remove more active contaminants. Use nothing that is stiffer than a soft nylon bristle brush when using any material in scrubbing. Use a light pressure action in the process of scrubbing. Be sure to thoroughly rinse any cleaned parts with deionized or distilled water and thoroughly dry all ports and parts of the components prior to reuse or reassembly.

Surfaces that are not coated may be cleaned in a Sonic Cleaner or other abrasive cleaners/solvents.

- Dilution Orifice
- Bypass Block and components (these parts are not in contact with measured Hg sample)
- Main Body Filter (it is Titanium)

For Coated Surfaces which include the Stinger, you should NOT do or use any fo the following for cleaning:

- Do not use any metal brushes or other abrasives that can scratch the surface
- Do not use any cleaners/solvents that contain abrasives
- Do not sonicate any coated surface for more than 1 minute
- Do not use basic solutions or soaps with a pH greater than 8.0
- Do not Steam Clean any coated surfaces
- Do not use any metal material that will make direct contact with any coated surface, be it in the stinger, probe body, or probe components

To service/clean the stinger a soft nylon bristle brush may be used along with a high purity solvent that will dissolve ONLY surface contaminants. A Teflon rod/extension may be used to hold the bristle brush or wipe rag. Using a bristle brush or rag soaked in a nonpolar solvent, such as pentane or hexane, can be used to remove hydrocarbon contaminants. You may use a more polar solvent like acetone to remove the more active contaminants. Do not use any cleaners containing any abrasives that may scratch the coated surfaces. Do not use any basic solutions or soaps with a pH greater than 8.0 or attempt to steam clean the inner portions of the stinger. When cleaning is complete, use deionized or distilled water to thoroughly rinse the cleaned areas and then dry prior to any attempt to reuse in the monitoring process.

This is not a gun, so leave your gun cleaning kit at home.

HgT Point To Point Pneumatics For Local Cold Box

Figure 28: Layout Of HgT Probe In Local Cold Box Configuration Page 50

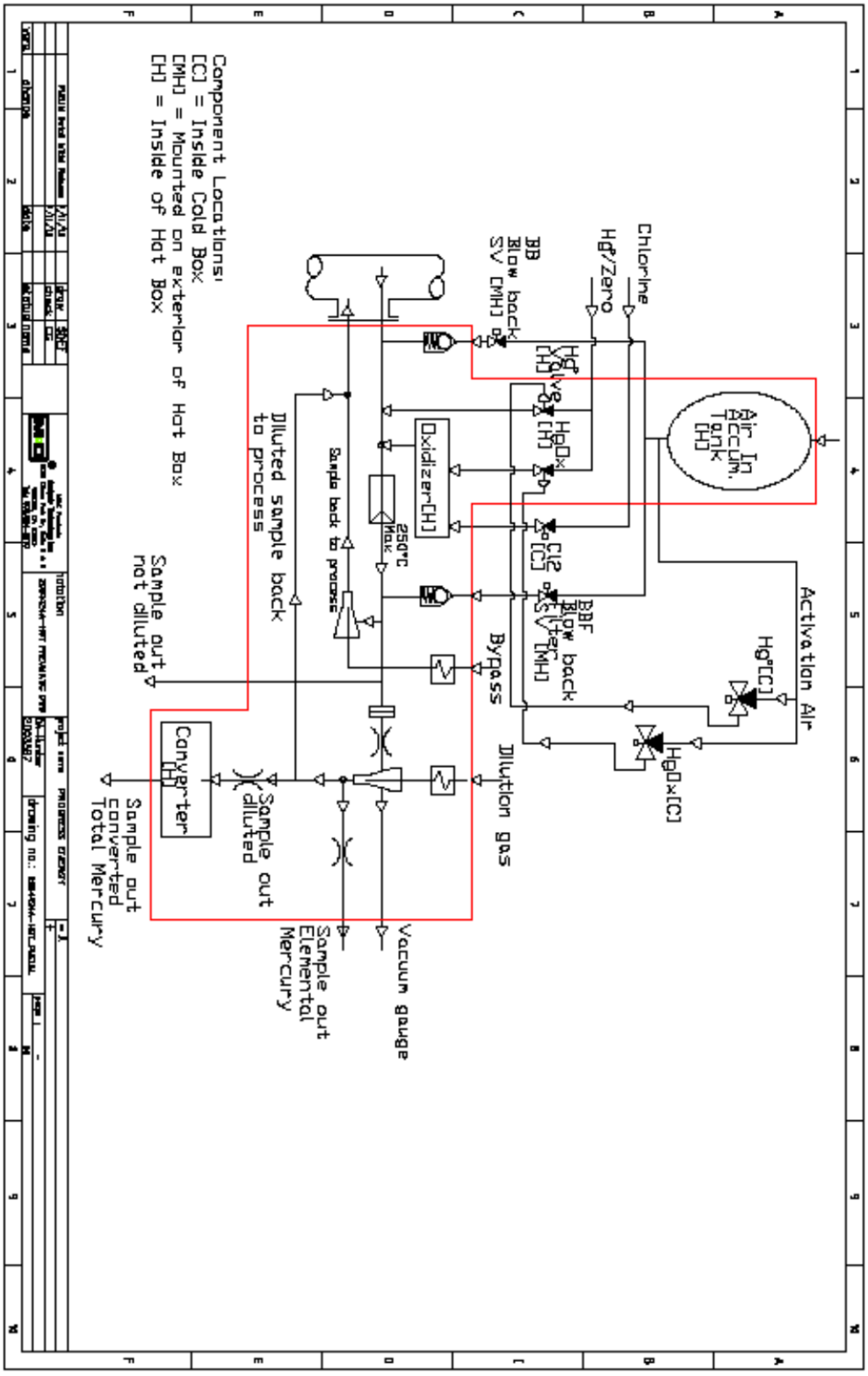

Figure 29: HgT Pneumatics For Hot Box/Cold Box Seperation

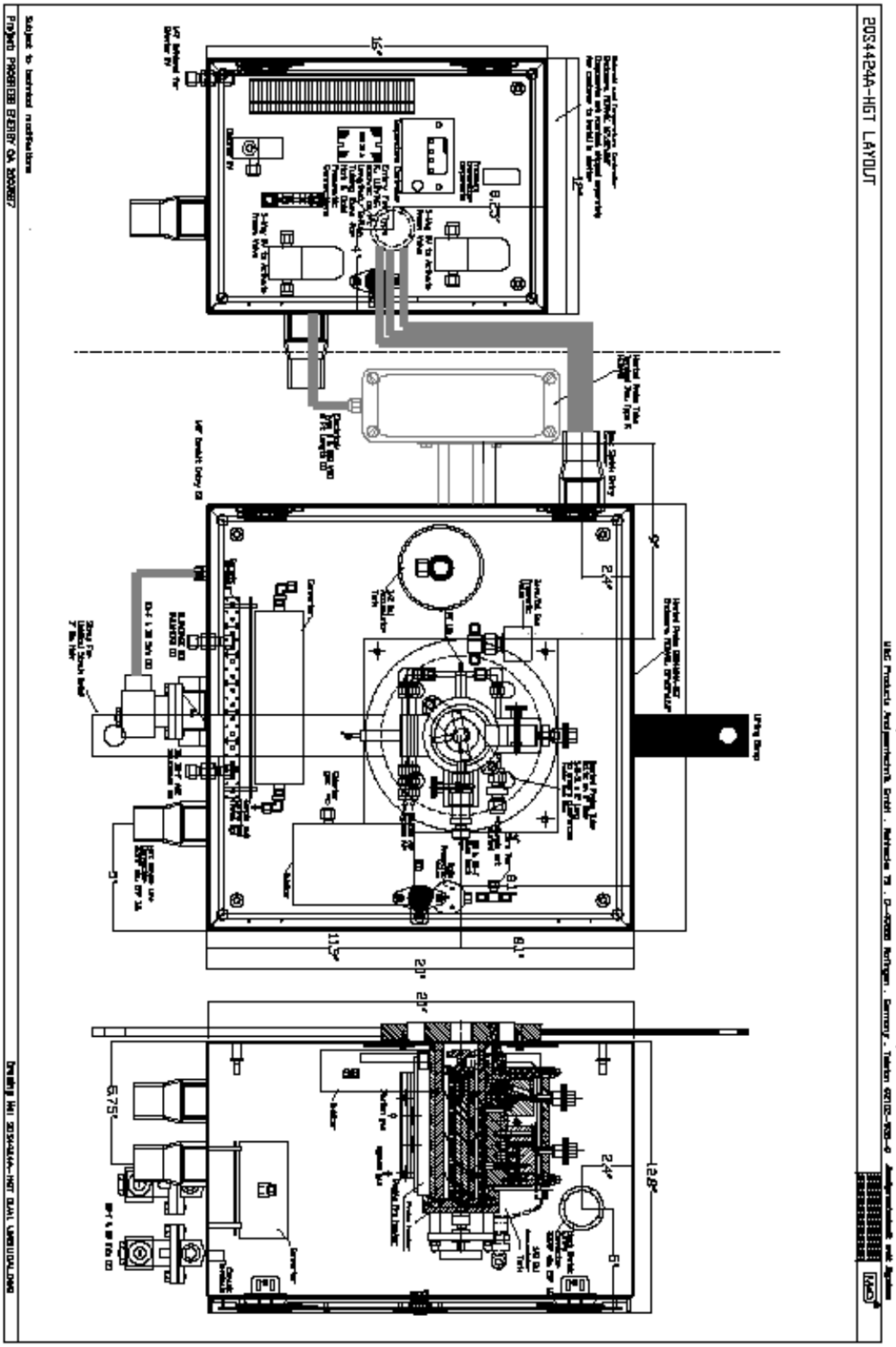

Figure 30: Layout Of HgT Probe In Hot Box/Cold Box Seperation Configuration

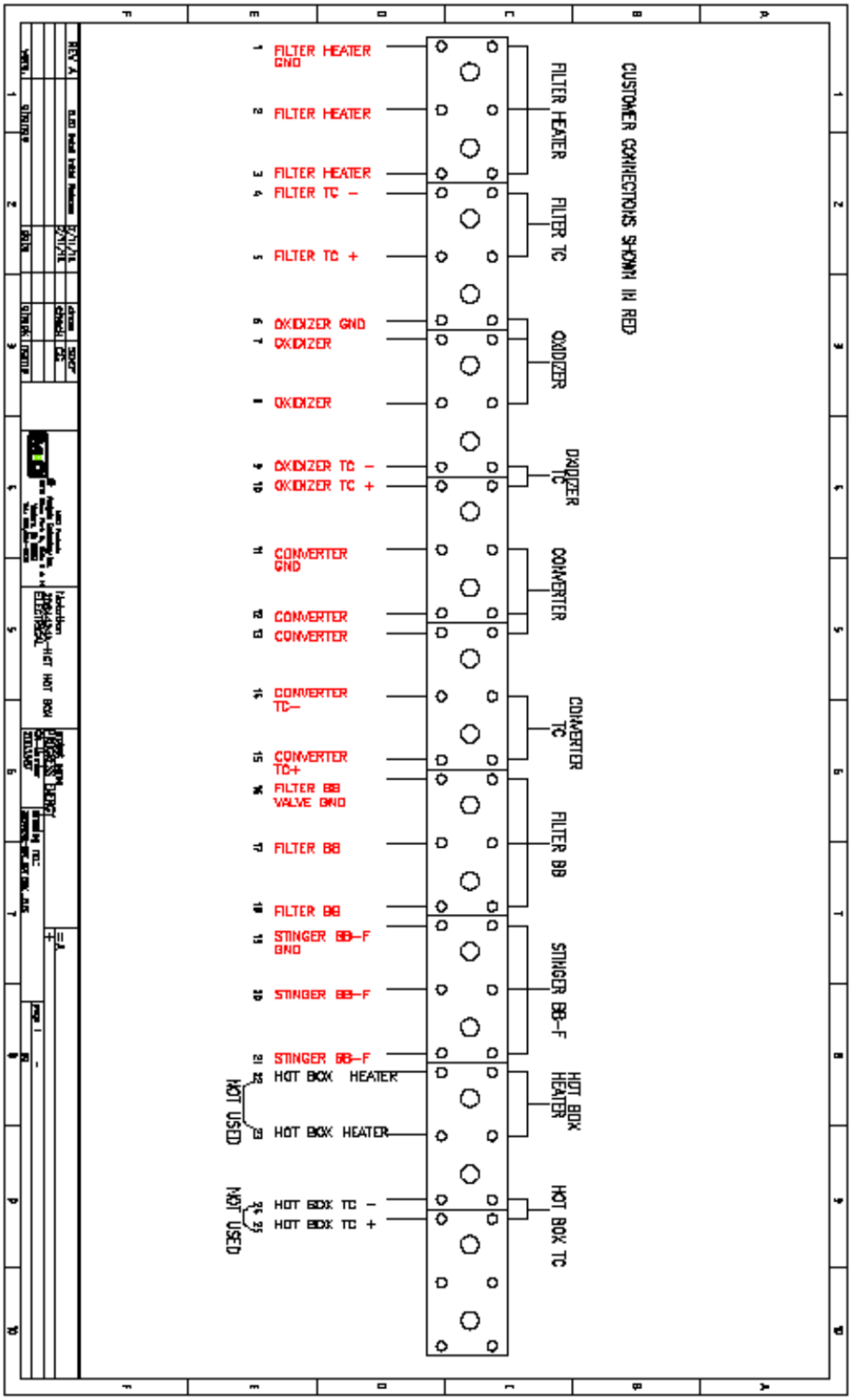

Figure 31: HgT Probe Hot Box Terminal Strip (When Used)

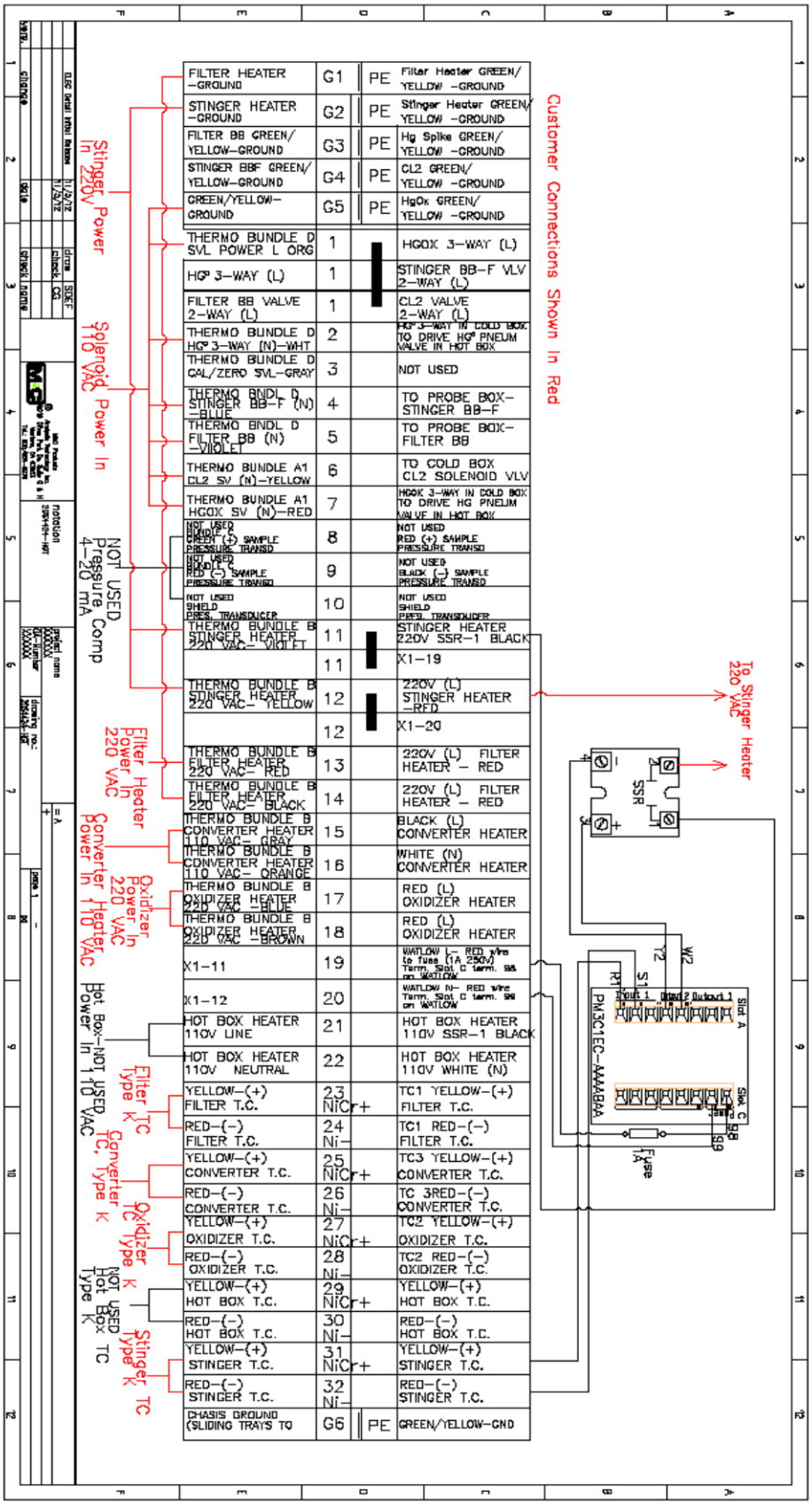
Customer Connections Shown In Red
Stinger 220V Power In
Solenoid 110 VAC Power In
NOT USED Pressure Comp 4-20 mA
Filter Heater Power In 220 VAC
Converter Heater Power In 110 VAC
Oxidizer Power In 220 VAC
Hot Box Power In 110 VAC
NOT USED
Filter TC Type K
Converter TC, Type K
Oxidizer TC Type K
NOT USED Hot Box TC Type K
Stinger TC Type K
To Stinger Heater 220 VAC
SSR
PM3C1EC-AAAABAA
Fuse 1A
FILTER HEATER -GROUND G1 PE Filter Heater GREEN/YELLOW -GROUND
STINGER HEATER -GROUND G2 PE Stinger Heater GREEN/YELLOW -GROUND
FILTER BB GREEN/YELLOW-GROUND G3 PE Hg Spike GREEN/YELLOW -GROUND
STINGER BBF GREEN/YELLOW-GROUND G4 PE CL2 GREEN/YELLOW -GROUND
GREEN/YELLOW-GROUND G5 PE HgOx GREEN/YELLOW -GROUND
THERMO BUNDLE D SVL POWER L ORG 1 HGOX 3-WAY (L)
HG° 3-WAY (L) 1 STINGER BB-F VLV 2-WAY (L)
FILTER BB VALVE 2-WAY (L) 1 CL2 VALVE 2-WAY (L)
THERMO BUNDLE D HG° 3-WAY (N)-WHT 2 HG° 3-WAY IN COLD BOX TO DRIVE HG° PNEUM VALVE IN HOT BOX
THERMO BUNDLE D CAL/ZERO SVL-GRAY 3 NOT USED
THERMO BNDL D STINGER BB-F (N) -BLUE 4 TO PROBE BOX-STINGER BB-F
THERMO BNDL D FILTER BB (N) -VIOLET 5 TO PROBE BOX-FILTER BB
THERMO BUNDLE A1 CL2 SV (N)-YELLOW 6 TO COLD BOX CL2 SOLENOID VLV
THERMO BUNDLE A1 HGOX SV (N)-RED 7 HGOX 3-WAY IN COLD BOX TO DRIVE HG PNEUM VALVE IN HOT BOX
NOT USED SHIELD GREEN (+) SAMPLE PRESSURE TRANSD 8 NOT USED RED (+) SAMPLE PRESSURE TRANSD
NOT USED SHIELD RED (-) SAMPLE PRESSURE TRANSD 9 NOT USED BLACK (-) SAMPLE PRESSURE TRANSD
NOT USED SHIELD PRES. TRANSDUCER 10 NOT USED SHIELD PRES. TRANSDUCER
THERMO BUNDLE B STINGER HEATER 220 VAC- VIOLET 11 STINGER HEATER 220V SSR-1 BLACK
11 X1-19
THERMO BUNDLE B STINGER HEATER 220 VAC- YELLOW 12 220V (L) STINGER HEATER -RED
12 X1-20
THERMO BUNDLE B FILTER HEATER 220 VAC- RED 13 220V (L) FILTER HEATER - RED
THERMO BUNDLE B FILTER HEATER 220 VAC- BLACK 14 220V (L) FILTER HEATER - RED
THERMO BUNDLE B CONVERTER HEATER 110 VAC- GRAY 15 BLACK (L) CONVERTER HEATER
THERMO BUNDLE B CONVERTER HEATER 110 VAC- ORANGE 16 WHITE (N) CONVERTER HEATER
THERMO BUNDLE B OXIDIZER HEATER 220 VAC -BLUE 17 RED (L) OXIDIZER HEATER
THERMO BUNDLE B OXIDIZER HEATER 220 VAC -BROWN 18 RED (L) OXIDIZER HEATER
X1-11 19 WATLOW L- RED Wire to fuse (1A 250V) Term. Slot C term. 98 on WATLOW
X1-12 20 WATLOW N- RED Wire Term. Slot C term. 98 on WATLOW
HOT BOX HEATER 110V LINE 21 HOT BOX HEATER 110V SSR-1 BLACK
HOT BOX HEATER 110V NEUTRAL 22 HOT BOX HEATER 110V WHITE (N)
YELLOW-(+) FILTER T.C. 23 NiCr+ TC1 YELLOW-(+) FILTER T.C.
RED-(-) FILTER T.C. 24 Ni- TC1 RED-(-) FILTER T.C.
YELLOW-(+) CONVERTER T.C. 25 NiCr+ TC3 YELLOW-(+) CONVERTER T.C.
RED-(-) CONVERTER T.C. 26 Ni- TC 3RED-(-) CONVERTER T.C.
YELLOW-(+) OXIDIZER T.C. 27 NiCr+ TC2 YELLOW-(+) OXIDIZER T.C.
RED-(-) OXIDIZER T.C. 28 Ni- TC2 RED-(-) OXIDIZER T.C.
YELLOW-(+) HOT BOX T.C. 29 NiCr+ YELLOW-(+) HOT BOX T.C.
RED-(-) HOT BOX T.C. 30 Ni- RED-(-) HOT BOX T.C.
YELLOW-(+) STINGER T.C. 31 NiCr+ YELLOW-(+) STINGER T.C.
RED-(-) STINGER T.C. 32 Ni- RED-(-) STINGER T.C.
CHASIS GROUND (SLIDING TRAYS TO G6 PE GREEN/YELLOW-GND

Figure 32: Cold Box Terminal Strip Wiring Page 54

NOTES: TERMINAL 1 – GREEN or ORANGE Dependent upon Vintage of unit