OPERATION/MAINTENANCE MANUAL

TRITIUM IN AIR SAMPLE COLLECTOR

MODEL TASC-HTO-HT

OVERHOFF TECHNOLOGY CORPORATION
1160 US ROUTE 50, MILFORD, OHIO, USA

SAFETY NOTICE

This Safety Notice has been included to emphasize the **DANGER OF HAZARDOUS VOLTAGES** on the **REAR TERMINAL PANEL** of your equipment. **USE EXTREME CAUTION WHEN INSTALLING OR SERVICING** your instrument. Please read the entire contents of this safety notice.

Use Extreme caution when servicing the rear terminal of the equipment

ELECTRIC SHOCK HAZARD MAY CAUSE INJURY OR DEATH. USE EXTREME CAUTION WHEN INSTALLING OR SERVICING REAR TERMINAL PANEL FOLLOW INSTRUCTIONS BELOW

Power Inputs Warning

When connecting power to the Rear Terminal Panel of your instrument, it is important to ensure that the AC mains cable has an effective ground and provide a low impedance earth ground connection prevent the possibility of electrical shock. Power is exposed inside the instrument case.

Power Requirements

The equipment operates on a voltage of **115V~.** Fluctuation in the mains supply should not exceed **±10%**. Transient overvoltages up to the levels of Overvoltage Category II (2500V).The maximum power required by the unit is 500 VA.

Power Connections

All connections to the Monitor are made to the Rear Terminal Panel. Any wiring carrying hazardous voltages must conform to all applicable local and national safety codes. AC Mains connection is via an internationally accepted IEC 320 AC mains connector,

WARNING

Ensure all mains power is turned off before proceeding with installation. This unit is provided with a mating connector for the ac power socket. Always ensure the ground pin of the plug, is connected to a low impedance safety ground (earth) within the ac power distribution system you are using. Always use the recommended mating connector and an approved three-wire cable to connect this unit to the ac mains. Always provide a low impedance safety ground wire to the ground lug on the rear panel marked.

The center pin is the ground termination. If a mating plug is provided, it will be marked with the Ground, LINE (L) or hot, and NEUTRAL (N) or return.

This unit is equipped with an AC mains fuse accessible at the rear panel. If this fuse should blow, it generally indicates a serious problem with the equipment.

THE FUSE CAN BE REPLACED BY AN OPERATOR.

The fuse is a time delay type rated at 3 Amperes 250 VAC (~) with dimensions ¼" x 1¼".

.

SAFETY NOTICE

The equipment has been designed and tested in accordance with EN 61010-1. To ensure that it is used safely, follow all safety and operating instructions in this manual. If the monitor is not used as described in this manual, the safety features of the monitor might be impaired.

- Do not use the monitor unless it is fully assembled, with all interconnecting cables attached and the case secured with the screw fasteners it was supplied with.
- Disconnect the AC power before removing servicing the rear panel terminal.
- For indoor use only, **NOT** suitable for use in wet locations
- Not suitable for use in explosion hazard environments

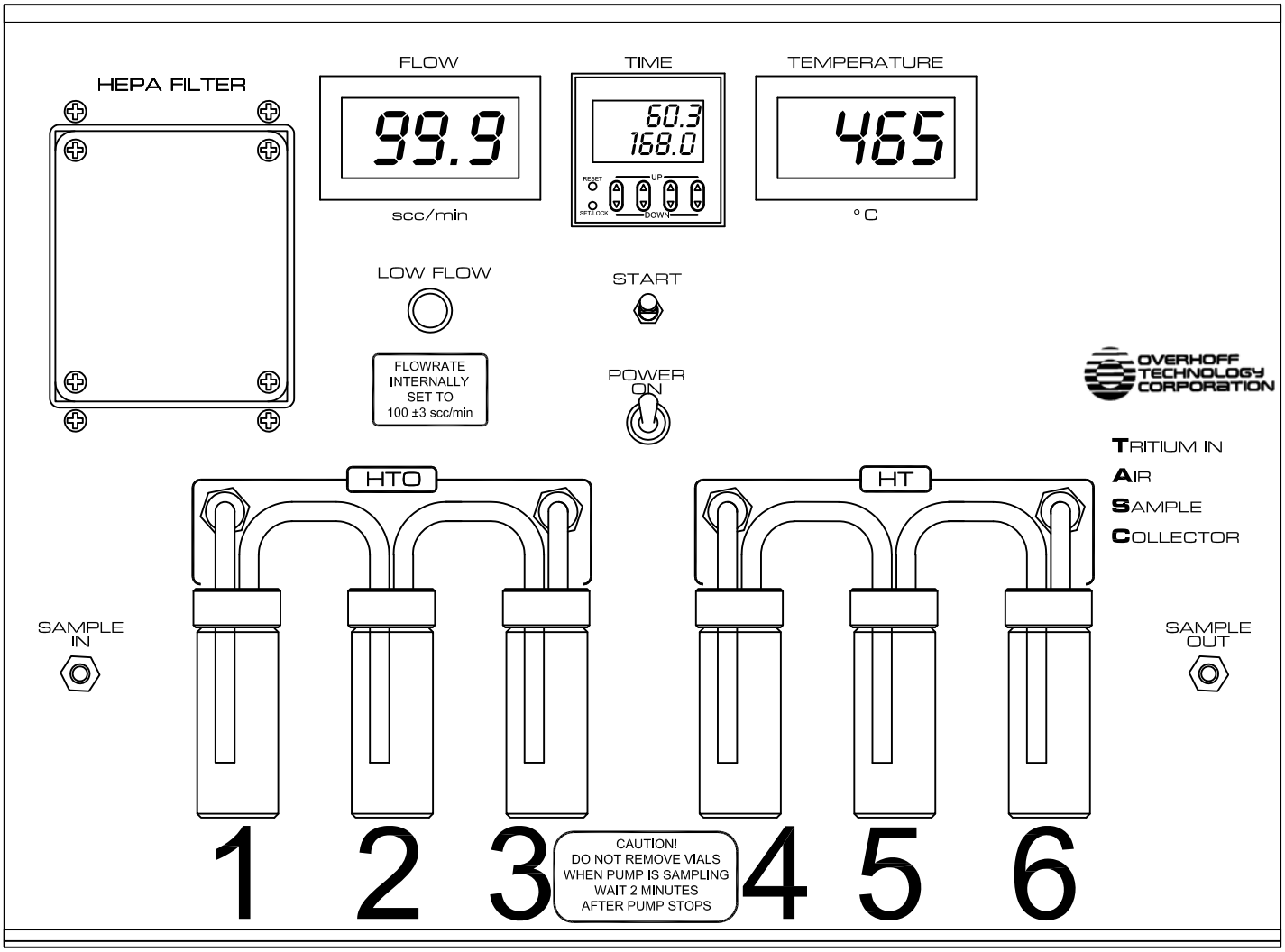
ENVIRONMENTAL CONDITIONS

The equipment has been designed for the following environmental conditions:

- Altitude up to 2,000 meters
- 5°C to 40°C
- Maximum relative humidity 80% for temperatures up to 31°C and decay linear up to to 80% relative humidity at 40°C
- Pollution Degree 2 is applicable to the intended environment

OPERATION

- Do not position the equipment in a manner that makes it difficult to access the front panel controls and the rear panel mains connection.
- Use a soft dry or slightly damp cloth for cleaning the equipment
- Sample In and Sample Out tubing connections must be connected at all times to prevent exposure to potentially harmful substances
- Do not tip the instrument on its side whenever there is collecting liquid in the vials.
- Do not transport the instrument with collection liquid in the vials.
- Do not unscrew a vial while the pump is running. Always make sure the pump is off and bubbling has completely stopped before removing a collecting vial. Wait two minutes after the pump has stopped.



IMPORTANT!!

WHEN REMOVING BOTTLES FROM THE UNIT, UNSCREW THE BOTTLES IN THE ORDER SHOWN. START ON THE LEFT AND GO TO THE NEXT BOTTLE ON THE RIGHT

TABLE OF CONTENTS

1.0. INTRODUCTION

1.1. GENERAL DESCRIPTION

Overhoff Technology Corporation's (OTC) Tritium in Air Sample Collector (TASC) is a basic and reliable line powered device for the passive sampling of very low levels of tritium.

This unit uses conventional techniques for collecting samples for any suitable length of time, as preferred by the user.

Tritium, in both elemental and oxide forms is collected in water or glycol filled vials, hence the popular description of "bubbler" is applied to these instruments.

The TASC series of instruments can be used in buildings or out of doors when suitably protected. Limits of sensitivity are typically of the order of 1×10^{-9} μCi/cc for tritium.

A regulated thermal oxidizer converts elemental tritium into its oxide form to permit separate measurement of tritium in both its oxide and elemental form.

Analyses of the collected radioactive material is performed separately by conventional scintillation counting techniques.

2.0. SPECIFICATIONS - ^{3}H SAMPLER

Sensitivity: For ^{3}H:	1 x 10^{-9} μCi/cc for 7 day sample at 100±3 scc/min
Air Flow Rate:	100±3 scc/min factory calibrated set point
Flow Meter:	Mass flow meter, 250 scc/minute full scale
Air Flow Indicator:	scc/min, Digital Display, 3½-digits, 0.1 to 199.9
Air Mover:	Continuous duty, diaphragm pump
Elapsed Time Indicator:	Multifunction timer module, with maximum time setting of 0.1 to 999.9 hours, with programmable reset
Thermal Oxidizer:	Regulated air heater range: 455° - 475°C (851° - 887°F)
Temperature Indicator:	°C, Digital Display, 3½-digits, 1 to 1999
Unit Cooling:	Continuous duty fan; 30 CFM free flow
Sample Collectors:	Two manifolds made from a silver-brazed construction of stainless steel and brass, nickel electroplated. Three polyethylene vials, 20 ml volume each mount onto each manifold for HT and HTO, total of six vials
Power Connection:	10 feet, three wire, grounded cable.
Power Requirements:	110-120 VAC, 50-60 Hz, 1 Ph, 200 Watts
Overall Dimensions:	14” deep x 19” wide x 12.2” high
Weight:	30 pounds
Sample Connections:	Inlet/Exhaust: Hose barb for 3/16” I.D. tubing

3.0. OPERATING PRINCIPLES

3.1. SAMPLE COLLECTION

The OTC TASC Sampling System operates by trapping radioactive material in vials containing absorbent material.

To ensure virtually total collection, each main vial is succeeded by a second and third vial whose purpose is to trap any of the material which was missed by its predecessor.

Six vials are therefore used to trap tritium oxide and elemental tritium.

For the collection of tritium, the vials are either filled with clean water or glycol, or they may be packed with a water absorbing medium such as drierite™ or molecular sieve. The solid materials are available with color indicators to signal saturation.

In practice, the sampled air is first filtered for dust and then passes directly through the first three vials where the tritium oxide is collected. The sample air is then treated in the tube furnace where elemental tritium and is oxidized. The elemental tritium is collected in the next three vials.

The remnant air stream passes through the flow moving system, which consists of the mass flow meter, the flow controller circuit board and the pump.

The mass flow rate is adjusted at the factory to 100±3 scc/min, and is set by a potentiometer associated with the flow controller circuit board.

3.2. FRONT PANEL FEATURES

IMPORTANT: If the flow meter display does not indicate airflow of **100±3 scc/min**, the seating of the vials should be checked. Loose seating of the vials will permit leaks in the sample flow.

The following features are found on the front face of the instrument.

1. INLET and OUTLET hose barbs for plastic tubing.
2. A dust filter which can be readily exchanged when observed to be dirty.
3. The digital mass flow rate indicator, 100±3 scc/min is internally set for 20 ml vials
4. The digital temperature indicator for the regulated thermal oxidizer
5. The collecting vials, six for tritium.
6. Timer module.
7. POWER toggle switch.
8. START locking toggle switch.
9. Low Flow Alarm visual indicator, red LED

3.3. INTERNAL STRUCTURE

The enclosure contains the following internal components.

1. Cooling fan.
2. Thermal oxidizer inside insulated housing.
3. Temperature Controller for the thermal oxidizer.
4. The airflow control P.C. board assembly (factory set to 100±3 scc/min).
5. The pneumatic components; sampling pump, vacuum reservoirs, mass flow meter and associated hoses.
6. Relief valve, solenoid controlled.

3.2. REAR PANEL FEATURES

IMPORTANT: The oxidizer operates at a very high temperature, but for safety the heat generated is well insulated from the outside surfaces of the equipment. However, the lower middle area of the rear panel will be warm and possibly hot to the touch.

The following features are found on the rear panel of the instrument.

1. AC mains power receptacle for detachable line cord.
2. AC mains fuse.
3. Intake grill with replaceable filter element for cooling fan.
4. Exhaust grill for cooling fan

4.0. USE OF INSTRUMENT

4.1. INSTALLATION AND SET-UP

1. Install the instrument in a readily accessible area, protected from accidental damage, and from the elements if stationed out of doors.

2. Supply 115VAC ±10%, 50-60Hz power (200 watts max.) to the instrument.

3. Connect power and sampling tubing as required, ensure that the air sampling inlet lines do not unduly restrict air movement (flow) by verifying that the mass flow rate of 100±3 scc/minute is maintained at all times. It is normal in the first few minutes after switching power ON, for the mass flow display to fluctuate 100±30 scc/minute.

4. Inspect the dust filter every two months and replace if dirty.

5. Fill the vials with absorbing medium, reagent material (see Section 6).

6. The main settings have been preset at the factory. The flow rate is set to 100±3 scc/min, the oxidizer temperature set-point is 455° - 475°C (851° - 887°F).

7. The timer module can be configured in accordance with the manufacturer's data at the end of this manual.

8. Do not forget to reset the timer module whenever a new sample collection period is started.

9. BEFORE Power-Up

    a. Power toggle; down position (OFF)
    b. Start Toggle; down position
    c. Vials are fully seated
    d. A logbook or some other preferred method should be used to record data referring to measured results in terms of time and dates.

CAUTION: Do not unscrew a collecting vial while the pump is on. This could cause a sudden change in pressure or vacuum in certain parts of the pneumatic system which could cause liquid to be drawn from one of the other vials into the piping. Always make sure the pump is turned off and bubbling has completely stopped before removing a collection vial.

IMPORTANT: In a worse case situation, where the sample air is totally dry, the liquid level in the first HTO vial should be expected to drop 3 - 10 cc over a seven day period. Also, it is important not to overfill the vials, because bubbling over could occur, which would result in liquid being trapped in the piping. It is recommended not to exceed 18 cc of liquid when filling each vial. If it is observed that there is a loss liquid in the first HTO vial due to evaporation, it is recommended that sample collecting is done over shorter period. For extreme cases where the sample is very dry and must be collected over longer periods of time, the system flow rate can be decreased. If the flow rate is adjusted then the manual and the analysis calculation must be changed accordingly.

4.2. OPERATING PROCEDURE

1. Power-up phase from a cold start:

   a. POWER toggle; move to up position (ON)

   Observe the following:

   b. Oxidizer temperature and Mass Flow Meter displays illuminated.
   c. Timer Module display is illuminated. The upper digit display is the current actual value, press reset to clear this value. The lower digit display is the set point value. Refer to the manufacturer's data at the end of this manual for settings.
   d. Sampling pump is not operating.
   e. LOW FLOW Alarm is illuminated.
   f. Mass flow meter display indicates ZERO flow rate. The vials are NOT bubbling.

   Begin Warm-up phase:

   g. START toggle; pull locking handle outward and lift to up position (START).

   Observe the following:

   h. Oxidizer temperature display begins to increase.
   i. Timer Module display illuminates a DOT in the upper left corner of the display to indicate that it is counting. The upper digit display is the current actual value. The lower digit display is the set point value.
   j. Sampling pump is operating continuously until mass flow meter display reaches 100±3 scc/min when it changes to intermittent duty mode as controlled by the electronic mass flow controller.
   k. LOW FLOW indicator is <u>not</u> illuminated when mass flow rate reaches 100±3 scc/min.
   l. Mass Flow meter display indicates 100±3 scc/min. flow rate. The vials are bubbling.

   This verifies that the system is in working order and in the warm up phase.

2. Normal operating mode, observe the following:

   a. Oxidizer temperature display is at the nominal operating temperature is 460° - 470°C (860° - 878°F).
   b. Timer Module display illuminates a DOT in the upper left corner of the display to indicate that it is counting. The upper digit display is the current actual value. The lower digit display is the set point value.
   c. Pump is operating in an intermittent duty mode as controlled by the electronic flow controller.
   d. LOW FLOW indicator is <u>not</u> illuminated.
   e. Mass Flow meter display indicates 100±3 scc/min. flow rate. The vials are bubbling.

NOTE: T The oxidizer temperature display reading rises as the system warms-up to the nominal operating temperature range of 455° - 475°C (851° - 887°F). When the flow rate is stopped or below specification due to a malfunction, the heating process will be interrupted. This will be indicated by the low flow indicator light and the declining temperature readings displayed on the temperature display. Check the mass flow meter display, it should indicate 100±3 scc/min. Loss of flow can be caused at the vial connection on the manifold due to loose fitting or a missing or damaged o-ring seal.

CAUTION: Do not unscrew a collecting vial while the pump is on. This could cause a sudden change in pressure or vacuum in certain parts of the pneumatic system which could cause liquid to be drawn from one of the other vials into the piping. Always make sure the pump is turned off and bubbling has completely stopped before removing a collection vial.

4.3. IMPORTANT PRECAUTIONS FOR PASSIVE SAMPLER, MODEL TASC

The collection liquid can move accidentally into parts of the system where it should not be. This is one thing that must be prevented, because the sample transport system is designed only for moving air, not liquid. It is extremely important that the collection liquid remain in the vials.

Take only the following precautions to prevent accidental movement of collecting liquid from the vials.

a. DO NOT TIP THE INSTRUMENT ON ITS SIDE WHENEVER THERE IS COLLECTING LIQUID IN THE VIALS.

b. DO NOT TRANSPORT THE INSTRUMENT WITH COLLECTION LIQUID IN THE VIALS.

c. DO NOT UNSCREW A VIAL WHILE THE PUMP IS RUNNING. Always make sure the pump is off and bubbling has completely stopped before removing a collecting vial. Wait two minutes after the pump has stopped.

d. If a hose is connected to the sample in hose barb, be certain that it does not get plugged or pinched closed, this will be indicated by the LOW FLOW indicator light on the front panel, and can cause a vacuum to form in the filter housing, thus drawing liquid into it, if the pump is stopped. In this particular situation, it is very important to RELIEVE THE VACUUM CONDITION BY REMOVING THE HOSE ON THE SAMPLE IN HOSE BARB PRIOR TO SWITCHING THE INSTRUMENT PUMP OFF.

e. The mass flow rate calibration can be verified with the vials empty or full of collecting liquid. The mass flow display on the front panel of the TASC shall indicate 100 ± 3 scc/min.

f. The liquid level first vial of the three in the HT section may increase. This is caused by condensate from the oxidizer when heating up from a cold start. Adjust the liquid level accordingly or run the system without liquid for the warm up phase.

5.0. SERVICE

Apart from the obvious periodic sample collection, which involves detaching the vials, no regular service maintenance is required.

Periodic maintenance can be restricted to replacing the dust filter every two months (depending on its condition).

The air sampling pump is a mechanical device, subject to wear. It can under optimum conditions, last two years or more, but, sooner or later it will wear out and will need to be replaced.

The same applies to the cooling fan, although this unit will exhibit a longer life.

6.0. ANALYSIS

6.1. TRITIUM ANALYSIS

Analysis of the collected samples is carried out in a conventional manner, in the sense that it is assumed that the collection efficiency is either very close to 100 %, or at least reasonably well known.

The analysis is therefore based on the assumption that the activity of 100 cc of air is accumulated every minute, thus, by reference to the observed lapsed time, it should be possible to derive the average air concentration by measuring the contents of the vials with a scintillation detector.

If liquid (water or glycol) collecting media is used, and the entire contents of the Wheaton vials will fit into the scintillation counter (together with cocktail) (see Note A below)

Then the determination of activity is straight forward.

$$C = \frac{R_s - R_b}{(2.22 * 10^6)(\in)(V)}$$

Where

C =	concentration of tritium in air in μCi/cc
R_s =	counting rate of sample (cpm)
R_b =	background count rate (cpm)
definition of Curie =	2.22×10^{12} disintegrations per minute
$\in$ =	counting efficiency
V =	volume of air in cc (product of flow rate in cc/minute times the sampling duration in minutes)

NOTE A: If only parts of the vial contents are counted, then the value of C as determined from the above ratio needs to be recalculated to take the relative aliquot quantity into account. Thus, for example, if only half the contents of the vial is actually counted, then the calculated value has to be doubled to yield the true value of airborne concentration.

7.0. MISCELLANEOUS INFORMATION

1. The efficiency of the thermal oxidizer has been determined to exceed 95 % when at the nominal operating temperature of 455° - 475°C (851° - 887°F).

2. The use of cascaded collection vials ensures a collection efficiency better than 99 % for tritium oxide.

8.0. WARRANTY

All instruments built by Overhoff Technology Corporation are warranted to perform as claimed.

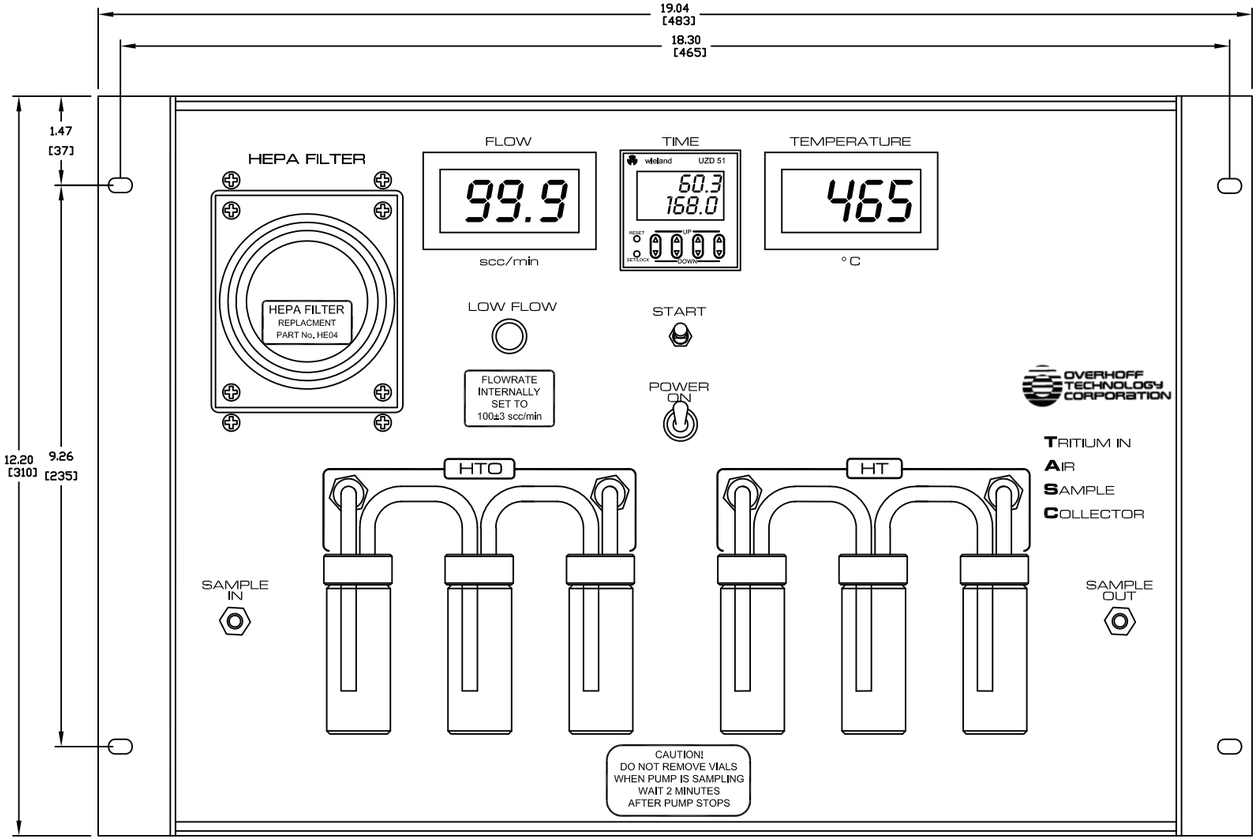
Defective components or workmanship of the instrument will be corrected free of charge for parts or labor within a period of one year form delivery. Nonperformance of the instrument as a result of negligence on behalf of the customer is not covered by this warranty.

Should it appear to be necessary to return the instrument to our factory, authorization for the return must be obtained from Overhoff Technology Corporation prior to shipping. In-freight charges will be borne by the customer.

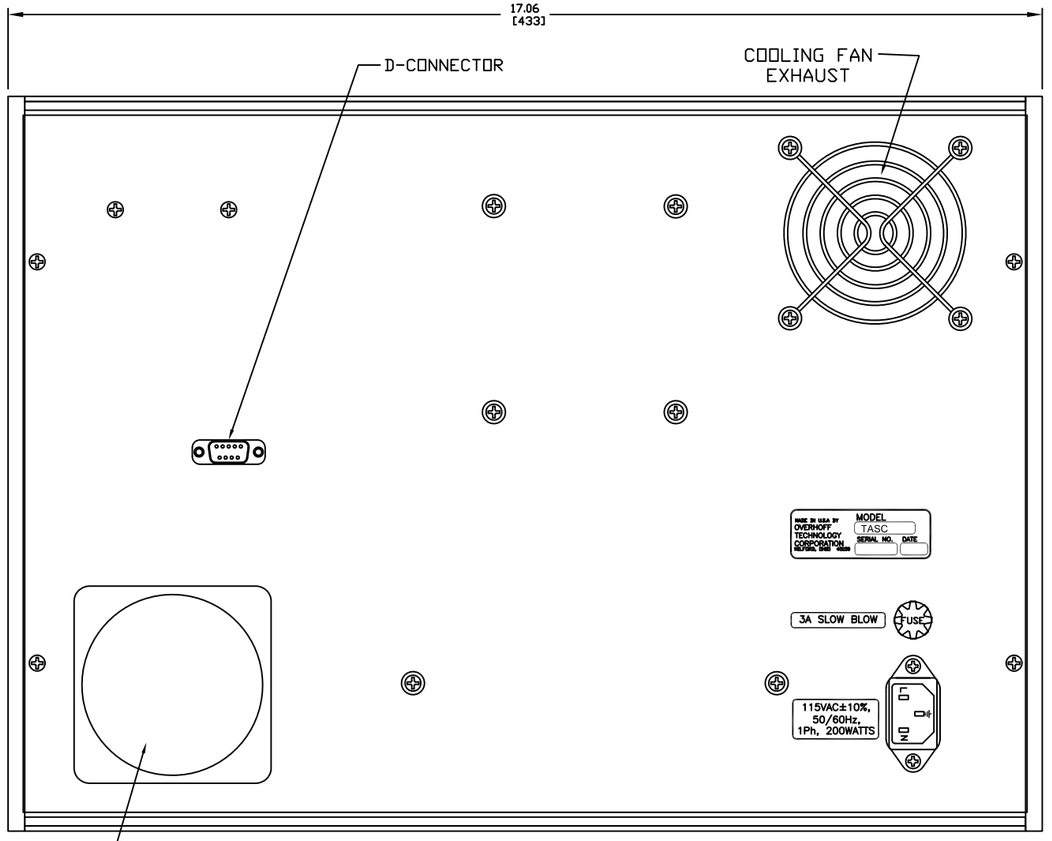
9.0. REPLACEMENT PARTS LIST

PART NUMBER	DESCRIPTION
3110SB-05W-B40-E00	Cooling Fan, Axial, 24VDC, 36 CFM
4YD95	Cooling Fan Inlet Guard with Filter
4YD92	Cooling Fan, Inlet Filter only
H050D-11	Diaphragm Pump, brushless 24VDC, 1.5 LPM max
00328-10-C45S	Pump Bracket for above item
MFM2120-BB-S2-Y	Mass Flow meter 250 scc/min. full scale
DMU-30DCV-1-DR-C	Digital Display, 3½-Digit Voltmeter
2-114-N0674	O-Ring for 20mL vial (3 req'd per sample holder assembly)
03-337-23A	Collection Vial (Polyethylene), 20 mL
1020638-3x20mL	Sample Holder Assembly
7803K13	Switch, Toggle (POWER)
MTL206N	Switch, Locking Toggle (START)
F206CR6-0004	Bulb, T-1¾, Flange Base, 28VDC, N, red LED
LT4H8-AC240V	Timer Module, Multi-function, Dual Color, 110-240VAC
1021318Rev1-ASSY	P.C. Board Assembly, Flow Control
17501 10 B1	Power Cord (US), 10ft long, detachable
HE04	HEPA Filter
RSSDN-25A	Solid State Relay, 90-280VAC, 25A
70-113	Thermocouple, Type J
70-112-115V-R1	Thermal Oxidizer Air Heater Unit, 100W, 115VAC
AHC-115V	Air Heater Controller Module, 115VAC
MDL-¼A	Air Heater Fuse 1, 250V, 0.25 Amp, time delay
MDL-2A	Air Heater Fuse 2, 250V, 2 Amp, time delay
MDL-3A	Mains Fuse, 250V, 3 Amp, time delay
EVO-3-24	Solenoid Valve, 3 way
F-2815-071-B85	Flow Restrictor, 0.007" diameter orifice
F-2815-121-B85	Flow Restrictor, 0.012" diameter orifice

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	CHANGE POWER REQUIREMENT LABEL FROM 500 TO 200 WATTS. NOMINAL TEMPERATURE WAS 443°C. FLOW TOLERANCE LABEL CHANGED, WAS 100.0±1.0.	09-11-15	JDC



FRONT PANEL



REAR PANEL

NOTES:

1. DIMENSIONS ARE FOR REFERENCE ONLY; INCHES (MILLIMETERS)
2. ALLOW FOR 15" (381mm) OF DEPTH BEHIND FRONT PANEL
   THIS INCLUDES CLEARANCE FOR LINE CORD, AND COOLING AIR.
3. USE .25" OR 6mm HARDWARE.
4. PANEL CUT-OUT REQUIRED = 17.1" x 12.3" (434mm x 312mm)
5. SAMPLE IN/OUT FITTINGS ARE HOSE BARBS FOR VINYL TUBING,
   5/16" (8mm) OD, 3/16" (5mm) ID.

MODEL TASC-HTO-HT

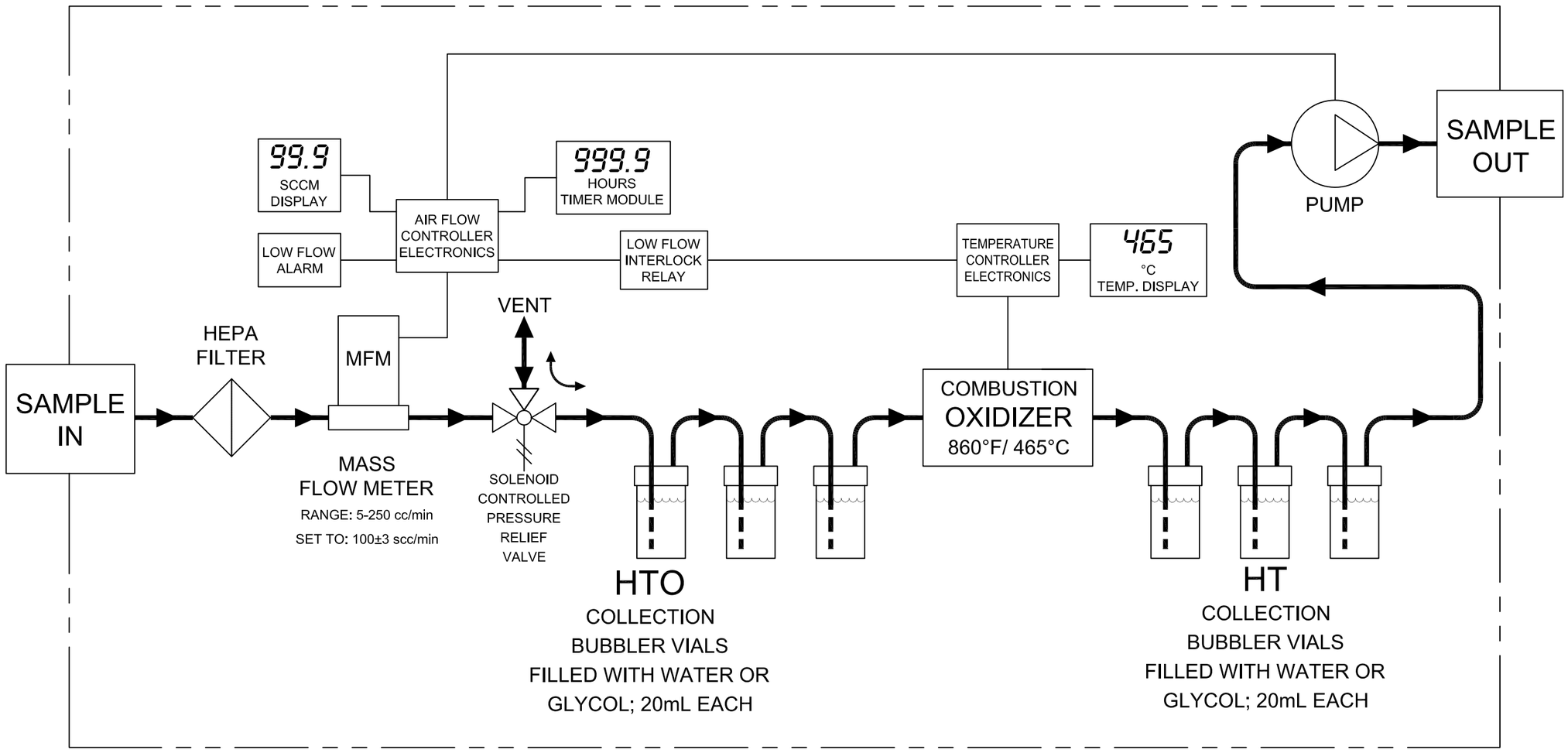
OVERHOFF TECHNOLOGY CORPORATION

MILFORD, OHIO 45150 U.S.A.

TASC MODEL HTO-HT-STANDARD
WITH MASS FLOW CONTROLLER

DRAWN I.WIBBENMEYER	DATE 12-02-13	SIZE B	FILE NAME 1021322-4143-1.DWG	DWG NO. 1021322	REV 1
APPROVED D. WILLIAMSON	DATE 12-02-13	SCALE 0.4		SHEET 1 OF 2	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	OXIDIZER NOMINAL TEMPERATURE WAS 445°C. FLOW TOLERANCE CHANGED, WAS 100.0±1.0. DISPLAY NOMINAL TEMPERATURE WAS 445°C.	09-11-15	JDC
2	MOVE SOLENOID CONTROLLED RELIEF VALVE	01-18-16	JDC
3	REMOVE FLOW RESTRICTOR BETWEEN TWO RESERVOIRS AND BETWEEN RESERVOIR TO PUMP	04-07-17	JDC



SAMPLE COLLECTOR
MODEL TASC-HTO-HT

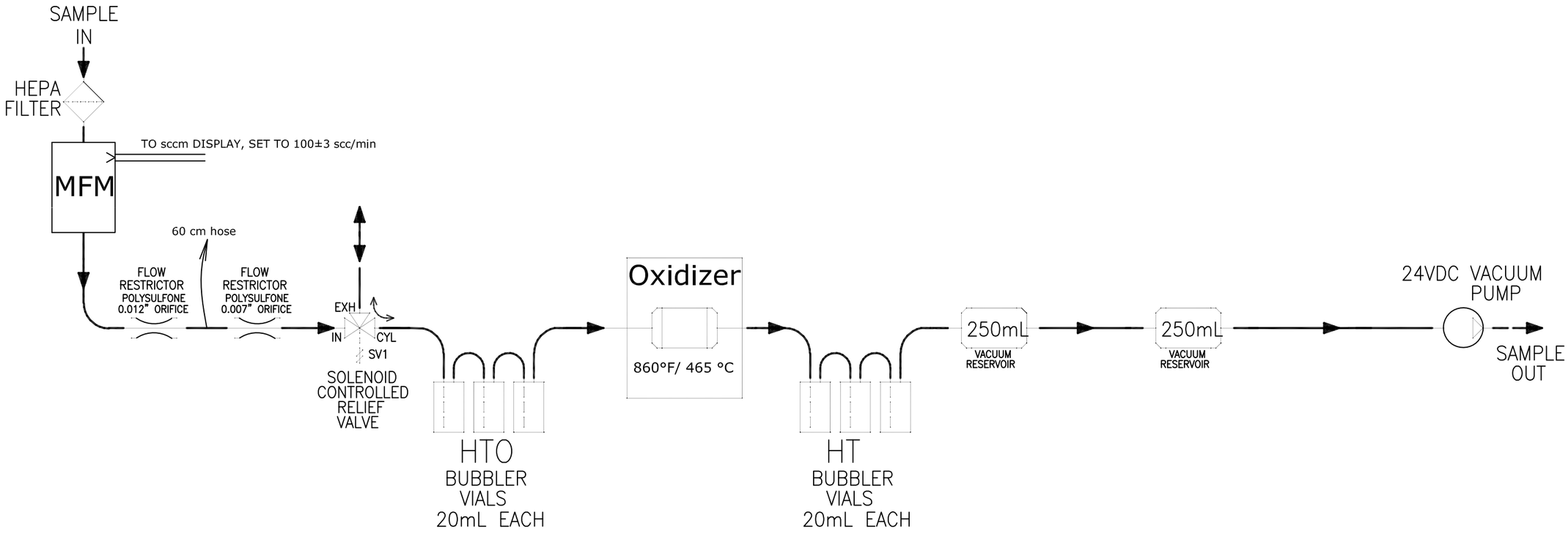
MODEL TASC-HTO-HT

OVERHOFF TECHNOLOGY CORPORATION MILFORD, OHIO 45150 U.S.A.

TASC MODEL HTO-HT,
BLOCK DIAGRAM

DRAWN	DATE	SIZE	FILE NAME	DWG NO.	REV
J. CREECH	09-09-15	B	1021429.BD.DWG	1021429-BD	3
APPROVED	DATE	SCALE		SHEET	
I. MITEV	09-11-15	N/S		1 OF 1	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	OXIDIZER NOMINAL TEMPERATURE WAS 445°C. ADD NOTE FLOW TOLERANCE 100±3 scc/min	09-11-15	JDC
2	MOVE SOLENOID CONTROLLED RELIEF VALVE	01-18-16	JDC
3	REMOVE FLOW RESTRICTOR BETWEEN TWO RESERVOIRS AND BETWEEN RESERVOIR TO PUMP	04-07-17	JDC



MODEL TASC-HTO-HT

OVERHOFF TECHNOLOGY CORPORATION MILFORD, OHIO 45150 U.S.A.

TASC MODEL HTO-HT-STANDARD FLOW DIAGRAM WITH MASS FLOW

DRAWN	DATE	SIZE	FILE NAME	DWG NO.	REV
J. CREECH	09-09-15	B	1021429.FD.DWG	1021429-FD	3
APPROVED	DATE	SCALE N/S		SHEET 1 OF 1	