XC-260
Operator's Manual

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All pertinent state, regional and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer shall perform repairs to components.

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Read and understand this manual and its safety instructions before using this product. Failure to do so can result in serious injury or improper execution of sampling procedures.

Follow all relevant instructions to avoid fire, explosions, electric shocks or other hazards that may result in damage to property and/or severe or fatal injuries.

The product shall only be used by persons who have fully read and understood the contents of this user manual.

Ensure that each person who uses the product has read these warnings and instructions and follows them.

Keep all safety information and instructions for future reference and pass them on to subsequent users of the product.

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Apex Instruments, Inc. warrants products to be free from defects in materials and workmanship for a period of one year from date of delivery. During the warranty period, we will repair or replace, at our option, any component that fails due to a defect in materials or workmanship under normal use excluding installation. Items not manufactured by Apex Instruments are subject to original manufacturer's warranty. All returns must be shipped freight prepaid at the purchaser's expense.

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1 Preface

1.1 Product Introduction

The XC-260 Source Sampler from Apex Instruments is designed for manual sampling of gaseous pollutants, particularly mercury, from stationary sources, e.g. stacks, flues, vents or pipes. The console is most commonly used for EPA Method 30B.

The Source Sampler is easily adapted to test for a wide range of pollutants from stationary sources, such as analytes including mercury and many more pollutants with adaptations of the sample train, including filters, glassware and solutions used. The XC-260 is a dual sample console applicable for extracting mercury emissions using charcoal sorbent traps.

1.2 Purpose of this manual

The purpose of this manual is to provide a basic understanding of the Apex Instruments XC-260 source sampling console. The XC-260 is applicable for use with a variety of US EPA sampling methods.

Additionally, this manual provides the users with a reasonable amount of reference information on system configuration, calibration procedures, maintenance and troubleshooting as it applies to the specific product and the US EPA Regulations.

1.2.1 Relevant US EPA method descriptions

Method 30B - Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps

Detailed information on method sampling may be found through the US EPA website - please visit https://www.epa.gov/emc/emc-promulgated-test-methods for complete method descriptions

1.3 Safety Instructions

1.3.1 Safety information related to the intended use

Source sampling is intended to be performed by technicians who have been trained in source sampling methods. Personnel conducting source sampling are expected to understand basic gas laws and chemistry.

In addition, all technicians should have adequate general safety training to identify, abate and prevent job-related hazards including site-specific training.

Please visit the following link for more information on Stack Sampling Safety Procedures and Protocols: *http://www.sesnews.org/*

1.3.2 Explanation of safety warnings

⚠ DANGER

"DANGER" indicates a hazard with high level of risk which, if not avoided, will result in death or serious injury.

⚠ WARNING

"WARNING" indicates a hazard with medium level of risk which, if not avoided, could result in death or serious injury.

⚠ CAUTION

"CAUTION" indicates a hazard with low level of risk which, if not avoided, could result in minor or moderate injury.

NOTICE

"NOTICE" Indicates information considered important, but not hazard-related.

1.3.3 Electrical shock

⚠ CAUTION

Use and maintenance of the source sampling console presents potential electrical hazards.

Ensure that the console is protected from wet conditions such as rain or process emissions. If the console is wet, do not continue to operate the console until it has been adequately dried.

Do not perform maintenance on this console when it is still plugged into a power source and the main power switch is turned on.

Do not continue to use the console if wires are exposed or loose from their connectors.

1.3 Safety Instructions cont.

1.3.4 Weight

⚠ CAUTION

Although the unit is compact and lighter than previous versions, the unit itself can present risks due to its weight. When carrying the unit, make sure to use proper form to lift using your legs. Lift and carry the unit using the provided handles or by holding the entire unit close to the body. If a user is not comfortable carrying the unit, a partner may provide the necessary assistance in moving the unit around.

1.3.5 Elevated surfaces

⚠ DANGER

Use of the unit on elevated surfaces also poses risks that range from minor to fatal. Be sure to operate the unit on a level, stationary surface. If necessary, secure the unit using straps or braces to ensure that vibration or accidental contact does not knock the unit off of its surface.

1.4 What To Do When the Unit Arrives

1.4.1 Unpack and inspect

Unpack the unit from its shipping container. Inspect the exterior of the unit for visible damage or missing components. Remove the lid by using the four butterfly latches and visually inspect the front of the unit.

NOTICE

Do not tamper with the internal components unless otherwise recommended.

Check the packing list to ensure that everything has arrived. The console comes with a pre-test calibration certificate for the dry gas meter and temperature sensors. A power cord will also be included for any units that use 120V supplied power.

1.4.2 Become familiar with console operations

Perform mock sample runs to ensure operation of console follows proposed test plan and EPA Method procedures.

1.4.3 Leak checks

Perform the console leak checks as explained in *Section 3.2.2 Console Leak Check Procedure* on page 20 of this manual.

1.4.4 Calibration audits

The unit is sold with a factory dry gas meter calibration at flow rates appropriate for the unit. Apex Instruments suggests performing audits of the dry gas meter before and after each testing period and performing a full calibration on the dry gas meter, sensors and thermocouples annually. Ensure that you verify calibration standards with your local administrator.

Perform the unit calibration audits as explained in *Section 4.1 Pre-Test Calibrations* on page 25 of this manual.

1.4.5 Test plan and methods

Begin the sampling operation procedures as directed by the applicable EPA Method and local compliance regulations.

1.5 How To Transport and Store the Unit

1.5.1 Dimensions

Case: 10U
Height: 23” (58 cm)
Width: 21” (53 cm)
Depth: 12” (30.5 cm)
Weight: 39 lbs (17.7 kg)

1.5.2 Lifting and handling

⚠ **CAUTION**

Avoid dropping the unit and other forms of collision during transport. When lifting, make sure to use the handles on the sides to lift. Do not try to lift the unit by anything other than the handles or the carrying strap.

1.5.3 Storage

Store upright, if possible, in a controlled environment on a shelf off of the ground. The unit should be stored in the case with the lid attached and disconnected from power.

1.5.4 Shipping

While the unit features a rugged design, the components and integrity of the build are delicate; the unit should be treated as a lab instrument when considering transport. Sudden jarring movements or drops could damage the internal components or cause faults within the electrical subsystem and various sensors.

The unit should not be shipped independently. Ensure proper shipment of the unit by packing it in a foam-lined box or an appropriate shipping container that provides adequate protection.

2.0 Description of the Product

2.1 Intended Use and Reasonably Foreseeable Misuse

2.1.1 Source sampling

The Source Sampler Console is the operator’s control station for monitoring gas sample volumes and temperatures as well as controlling and maintaining a constant sample flow rate.

Diaphragm vacuum pumps (Sample A & Sample B) provide a vacuum to extract the samples, through the dry gas meters and flow meters (rotameter). An optical encoder is mounted integral to the dry gas meters, which provides maximum volume resolution for accuracy. Manual needle and ball valves provide control of the sample flow rates. A digital timer is used to accurately measure sample duration. A temperature controller is used to maintain the probe temperature, which is displayed on the panel-mounted temperature display along with other selectable system temperatures. A temperature selection switch defines which temperature is being displayed.

EPA Method 30B requires simultaneous samples be extracted through paired in-stack traps. The XC-260 is designed to extract two separate samples by combining two plumbing circuits in one console. The thermocouple display and circuits are consolidated.

2.1.2 Versatile use

The XC-260 console can be easily adapted to various gaseous sampling train systems. Using different configurations of sampling trains, the XC-260 console can be used as a paired sampling or a consolidated inlet and outlet sampler in VOST applications. Each side of the console can be used to sample for various gases following applicable gaseous methods.

2.2 Product Compliance

This product complies with all relevant US EPA sampling regulations and was designed based on the schematics and sampling practices established by the EPA in the Code of Federal Regulations.

2.3 System Overview

NOTICE This manual covers the sampling console part of the train. The rest of the sampling train is sold separately.

The first step to effective sampling is to become familiarized with the standard equipment. To illustrate the necessary components of source sampling, we've included an overview of the five main components of the Apex Instruments Source Sampling Train. The main components of a Source Sampling system are: probe assembly, mercury sorbent traps, sample line(s), a gas conditioner, and the console set up for paired sampling with dual pumps and dry gas meters.

2.3.1 Sampling Console (XC-260)

The sampling console houses the dual dry gas meters, dual internal sampling pumps (standard), temperature controller, dual vacuum gauges, flow adjustment valves, dual flowmeters, and the thermocouple system.

Some sampling trains use an external pump assembly to pull the sample; an external pump is not necessary when a console, such as the XC-260 uses dual, internal sampling pumps to extract the sample gas.

Sample gas enters the console from the sample line and then through the pump and dry gas meter.

The console is housed in a strong and durable polyethylene case with a carrying strap on top.

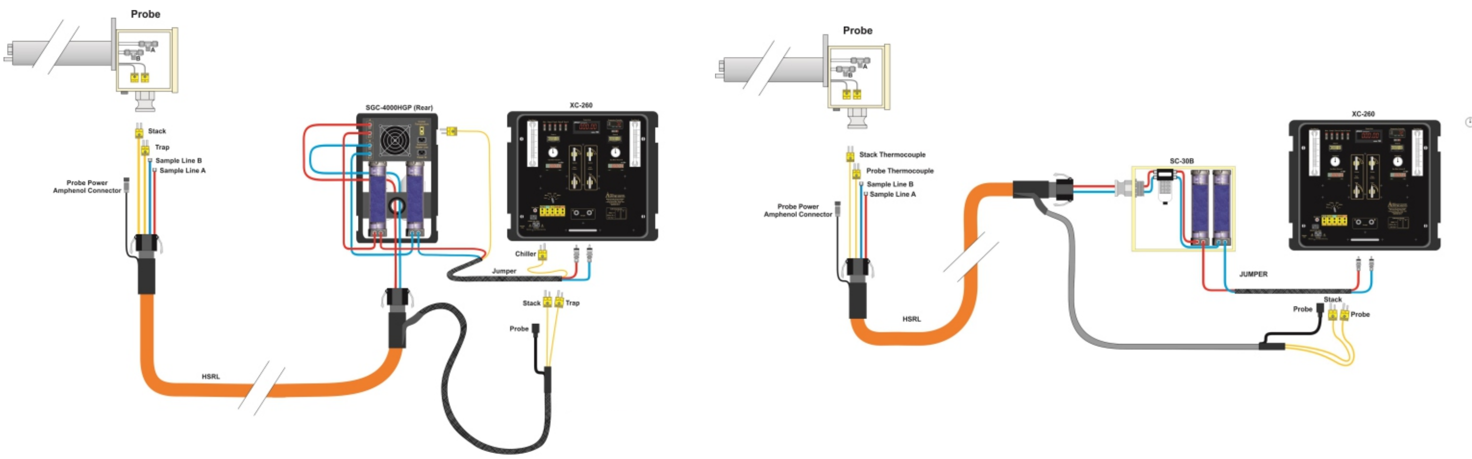

Fig. 1 Example Sampling Systems: *Ancillary components of the sampling system are sold separately.*

2.4 Technical Specifications

Dry Gas Meters
Model SK25EX-100 multi-chamber positive displacement meter (fitted with a quadrature encoder), Qmax for air 41 LPM at 150 Pa, Qmin 0.26 LPM, Resolution 0.2 Liter, cyclic volume 0.7 Liter, Type K thermocouple for meter exit temperature

Internal Sample Pumps (Standard)
Max vacuum 20” Hg, 12 VDC brushless motor

Temperature Measurement
Cold junction compensated Type K thermocouple-to-digital converter °F, -200 to 1372 °C range (-328 and 2502 °F), 7 channel rotary switch, up to 5 additional Type K thermocouple inputs, standard size jacks

Temperature Display
3.5” Digital Display °F (-157 °F to 1999 °F), display and controller configured for °C upon request (°C is standard for export)

Temperature Controller
Probe controller. Fuji PXR3 compact, 1/32 DIN self-tuning PID temperature controller with 3 button keypad, SSR driver for 25A solid state relay, Type K thermocouple jack for input

Flowmeters
Solid machined acrylic, Option A: 100 - 2500 ccm, Option B (Standard): 0.2 - 2.4 LPM. Option C: 0.5 - 4.0 LPM

Vacuum Measurement
Bourdon tube, dual-scale, 0 to -30” Hg (0 to -100 kPa)

Umbilical Connection
Electrical multi-conductor circular connector, instrumental grade stainless steel quick connects
Sample inlet - 1/2”, Type K thermocouple plugs - AUX, STACK, PROBE, FILTER, EXIT

Power
Supply 120VAC/60Hz 15 amps max. or 240VAC/50Hz 10 amps max., IEC C-14 Inlet

Dimensions and Weight:
H23” x W21” x D12” (58 cm x 53 cm x 30.5 cm), 39 lbs (17.7 kg) base configuration

2.5 Faceplate Components

Reference the image below for an introduction to the essential components of the XC-260 Source Sampling console.

For specific part numbers and a detailed look at the internal components, go to *Sections 6.3 and 6.4* on pages 35 and 36 of this manual.

Fig. 2 Front Panel Overview: Standard version shown, depiction of options may differ.

3.0 Console Operation

3.1 User Control Overview

3.1.1 General overview

The components on the XC-260 console allow the operator to control and monitor the sample parameters.

Power Switches: Individual power switches used to turn on the console, turn on each sample pump, turn on the timer, and turn on the AUX power utilized by the AUX power out on the front of the console.

Timer: Run time displayed in MM:SS format and can be started and stopped using the Timer A and Timer B switches, as well as reset using the button on each bezel.

Flowmeters: The current flow rate through the dry gas meter for both A and B sides using individual flowmeters and plumbing.

DGM Volume: The totalized DGM volume. This value can be reset by holding the Reset Timer button for 6 seconds (this will also reset the timer at the 3 second mark of the hold).

Temperature: The current temperature of the selected TC channel which is controlled by the TC switch on the console.

Flow Control: Individual sets of coarse and fine valves for the A and B sides to control the sample flow rate.

Fig. 3 User Controls

3.2 Pre-Field Test Operations

3.2.1 Sorbent trap installation

Remove the swage lock nuts from the tips of the probe. Check the ferrules for wear or damage which may affect the leak check. Replace as needed. If okay, slide the ferrules over the tip of the traps with the tapered side facing in the direction that the flow arrow points.

Fig. 4 Sorbent Trap Installation

Insert the sorbent traps (with the flow arrow pointed towards the probe) about halfway into the probe. Slide the swage lock nuts over the sorbent traps and thread onto the probe. Do not tighten at this point. Slide the sorbent traps further into the probe until about 1” of the traps are exposed. Firmly finger tighten the swage lock nuts onto the probe. Note: If you use a wrench, only tighten less than 1/4 turn of the nut or risk breaking the glass trap. Record trap identification numbers and the sample train (A or B) in which they are respectively installed.

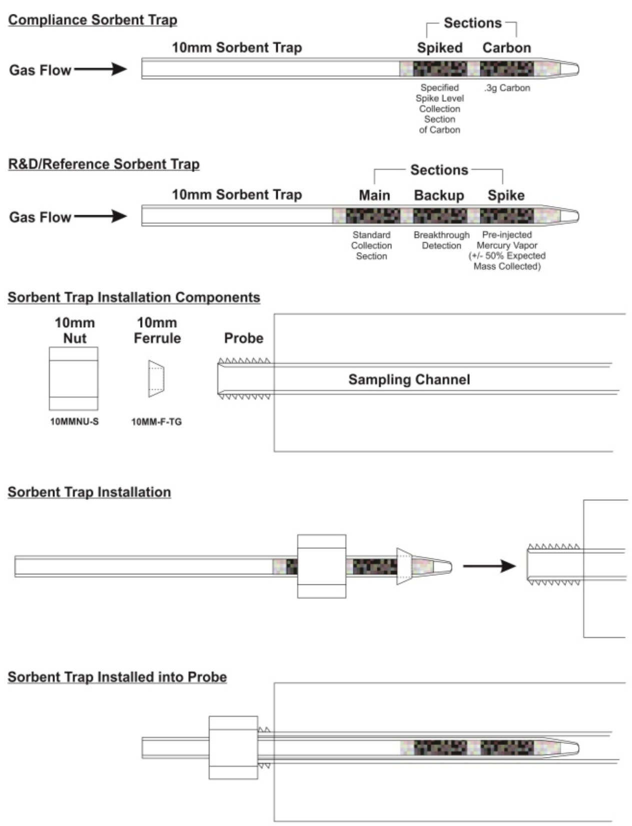

Fig. 5 Sorbent Traps

3.2 Pre-Field Test Operations

3.2.2 Console leak check procedure (front side):

NOTICE

The A and B sides can be leak checked simultaneously or individually.

1. Position the valves
    a. Close the coarse valve by turning the handle clockwise to the horizontal position ("3:00").
    b. Decrease the fine tune knob fully by turning all the way to the left (counter-clockwise).

2. Block airflow of sample inlet
    a. Insert a capped quick connect into the 1/4" sample inlet.

3. Initiate flow
    a. Turn on the pump and open the coarse valve all the way counterclockwise to the vertical position ("12:00").

4. Adjust vacuum (if necessary)
    a. If the vacuum value displayed by the gauge is below 10 inches Hg (250 mm Hg), slowly turn the fine tune knob clockwise until the vacuum is at least 10 inches Hg.

5. Monitor the console leak rate
    a. Start the timer using the Timer A and/or Timer B switches and monitor the DGM Volume value on the Red Lion totalizer for one minute. If the flow through the DGM exceeds 2% of the average sample rate (e.g. 0.02 L/min for a 1.00 L/min target sample rate), the leaks must be found and corrected. The individual flowmeters can also be used to monitor leak rates.

6. Complete the console leak check procedure
    a. Remove the plugs from the sample inlets. Be sure to return the valves to a lower flow starting position. Reset the timers by pressing the reset buttons on each respective timer. The DGM Volume readings can remain at the current values or can be zeroed by pressing the Rst button on each respective Red Lion totalizer.

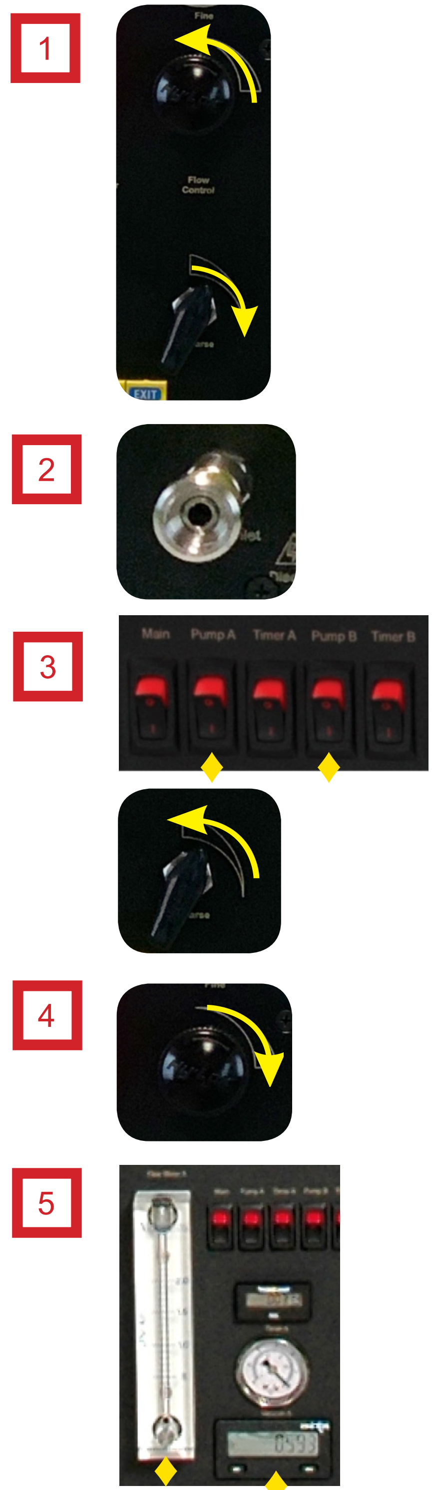

Fig. 6 Front-Side Leak Check

3.2 Pre-Field Test Operations

3.2.3 Sample train leak check procedure

A leak check before the sampling run is recommended, but not required. The leak check procedure can be performed on the A and B sides simultaneously or individually and includes the following steps:

1. Close the coarse valve by rotating the handle 1/4 turn right (clockwise) until it is horizontal or the arrow is pointing to “3:00.” Decrease the fine tune knob by rotating all the way to the left (counterclockwise).

2. Plug the sorbent trap inlet using a clean cap.

3. Turn the pump on using the switch in the upper-left corner of the console and open the coarse valve fully by turning to the left (counter-clockwise until it is pointing straight up.

4. Adjust the fine valve by rotating it clockwise to pull a vacuum of at least 10 inches Hg (250 mm Hg), which can be observed by the vacuum gauge on the console.
   a. If this vacuum level is overshot, either complete the leak check at this value or slowly release the cap from the probe or nozzle and close the coarse valve.
   b. Adjust the fine valve by rotating it counter-clockwise and then repeat the leak check process.

5. Observe the leak rate as indicated by the DGM Volume on the Red Lion totalizer for one minute and ensure that the volume is not increasing during this time. A leakage rate in excess of 4% of the target average sample rate is not acceptable (e.g. 0.04 L/min for a 1.00 L/min target sample rate). The individual flowmeters can also be used to monitor leak rates.

The operator can use the timers to track and quantify leak rates. The timers can be started or stopped by using the applicable switch. If a timer needs to be reset, the reset button on the applicable timer can be pressed once.

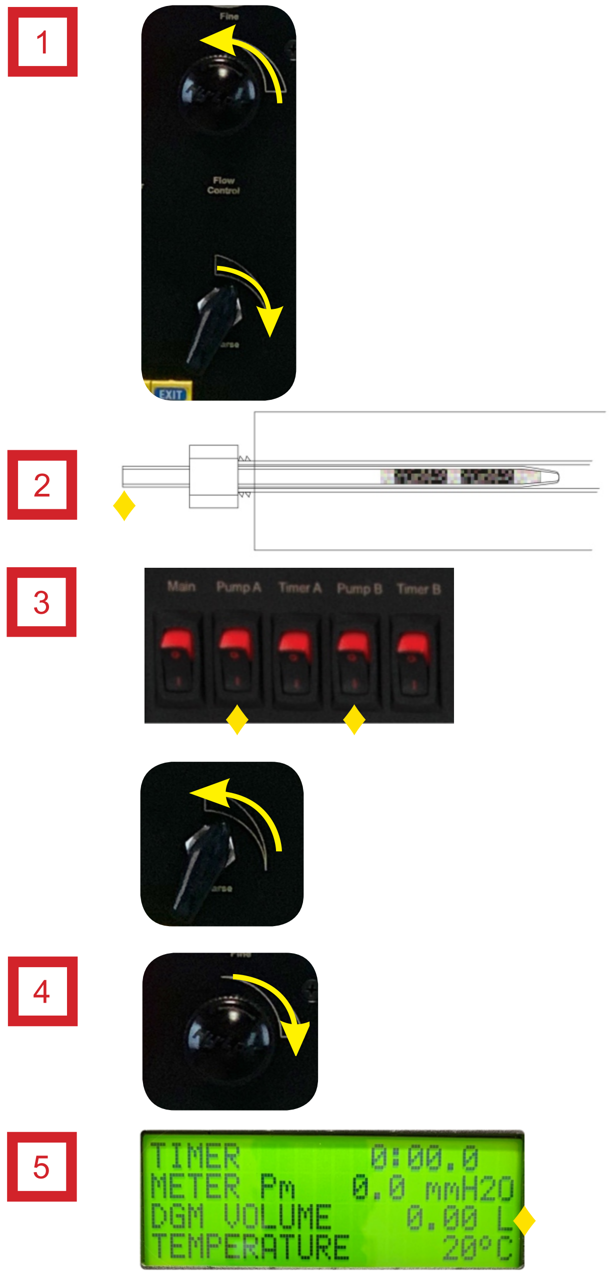

Fig. 7 System Leak Check

6. Remove the plug from the sample inlet and turn off the pump. Be sure to return the valves to a lower flow starting position. Reset the timers by pressing the reset button on each. The DGM Volume readings can remain at the current values or can be zeroed by pressing the Rst button on each respective Red Lion totalizer.

NOTICE Slowly release the sorbent trap caps before closing the coarse valve.

3.3 Field Test Operations

3.3.1 Performing a Method 30B sampling test

This operation guide is written based on US EPA Method 30B sampling. Ensure that you follow the appropriate procedures outlined in the applicable gaseous method to be performed.

Turn the probe heater on using the appropriate switch in the upper-left corner of the console and allow time to reach the set point.

Ensure that the timers are at 0:00. If they are not, press the reset buttons on each timer bezel. With the coarse valves closed, start the pumps using the switches in the upper-left corner of the console.

Record all applicable site data such as plant name, location, date, personnel, etc. Record the initial DGM readings displayed on the A and B Red Lion totalizers and barometric pressure using a local airport reading or NIST-traceable barometer adjusted for elevation on the field data sheet. The DGM readings can begin at the current values or can be zeroed before the run by pressing the Rst button on each respective totalizer. Record the trap ID for each side of the sampling train, A and B, using the ID printed on each trap or from the chain of custody form for each trap - include whether the sorbent trap is spiked or unspiked.

After the probe has reached its set point (around 250 °F), slowly remove the caps from the ends of the sorbent traps to allow air to gradually seep into the traps. Removing the caps too quickly may cause a surge that creates a bypass path in the carbon traps and could impair mercury capture. Store the caps in a clean, sealed container for use during the post-test leak check.

To begin sampling, position the tip of the probe at the sampling point. Open the coarse valve, note the clock time for the start, and turn on the timers.

Adjust the sample flow to a constant rate of approximately 1.0-1.5 L/min as indicated by the rotameters using the fine valves. Maintain this constant rate (±10 percent) during the entire sampling run. The flow may decrease and vacuum levels may increase as particulate builds up on the inlets of the sorbent traps. Adjust the fine valves, as necessary, to re-establish the desired sample flow rates.

Take readings (clock time, DGM volumes, flowmeter flow rates, vacuums, DGM outlet temperatures, stack temperature, and trap temperature) at least every 5 minutes.

At the conclusion of each run, close the coarse valves, stop the timers, and record the final readings (clock time and final DGM volumes). Now the pumps can be turned off and the probe can be removed from the stack. Once the probe has cooled down, conduct a leak check as described in *Section 3.2.3 Sample train leak check procedure* on page 21 of this manual (this leak check is mandatory). If a leak is detected, void the test run or use procedures acceptable by the administrator to adjust the sample volume for the leakage. Following a successful leak check, review the data sheet and return sorbent traps to clean, sealed storage containers along with the chain of custody for each respective sorbent trap.

Purge the remaining part of the train by drawing clean, ambient air through the system for 15 minutes at the sampling rate (typically 1.0 L/min). Clean, ambient air can be provided by passing air through a charcoal filter trap. Alternatively, ambient air without purification may be used. Before purging the train using the console's pump, be sure to record all final readings on the field data sheet. Turn the pumps on by using the appropriate switches in the upper-left corner of the console and open the coarse valves fully. The console's valves should already be adjusted to draw air in around ~1 L/min from the sample run. If the flow rates are not at 1 L/min, use the fine valves to adjust the flow rates. Once 15 minutes has passed, close the coarse valves and turn off the sample pumps using the switches in the upper-left corner of the console.

Follow applicable EPA method for post-run sample recovery procedures.

3.4 Post-Field Test Operations

3.4.1 Post-test calibration check

After each field test series, conduct a calibration check using the procedures outlined in EPA Method 30B, Section 10.2.2.5 or follow Table 9-1, except that three or more revolutions of the DGM may be used, and only one independent run needs to be made.

Determine the Y_i using both volumes and equation Y_{ref} / Y_{dgm} x 100. If the average of the two post-test calibration factors do not deviate by more than 5 percent (95% < Y_i < 105%) from Y_i, then Y_i is accepted as the DGM calibration factor (Y). If the deviation is more than 5 percent, re-calibrate the metering system as in EPA Method 30B, Section 10.2.2.1, and determine a post-test calibration factor (Y_f). Apply the new Y_f value to the gas volume measurements made during the most recent sampling test series as described in EPA Method 30B, Section 10.2.2.5.

If re-calibration indicates that the metering system was unacceptable for use, either void the test run or use methods, subject to the approval of the Administrator, to determine an acceptable value for the collected sample volume.

3.5 Setting the Temperature Controller

3.5.1 Set value setting

1. The current temperature of the equipment is shown on the Fuji controller. To change the set value (SV) press SEL once.

2. Current value is displayed and SV is lit. Press the ∧ ∨ to increase or decrease the displayed value (set value).

3. After the new setting is entered, press SEL to lock in the value and return to the C1 (control 1) display.

Repeat procedure to check value if necessary.

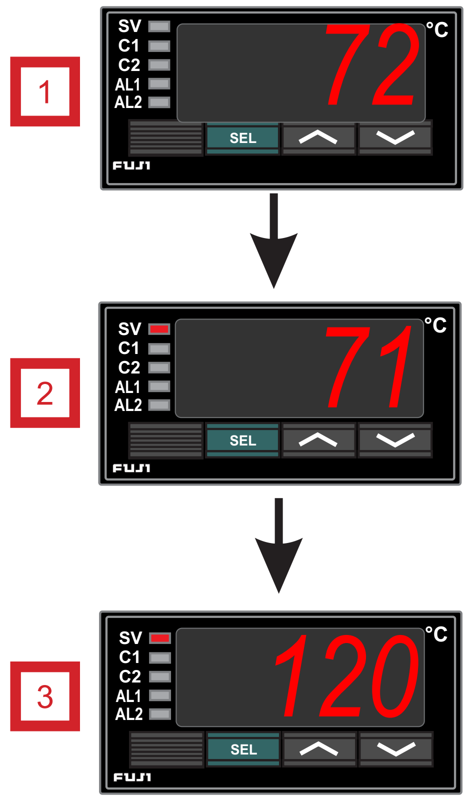

Fig. 8 Temperature Controller Configuration

3.6 Operation using software (reserved)

The XC-260 does not currently use software for operation, all functions are controlled on the console itself.

4.0 Maintenance

4.1 Pre-Test Calibrations

4.1.1 Factory meter calibration

Apex Instruments performs an initial 5-point calibration following the procedures outlined in EPA Method 30B. The result of the calibration is an average calibration factor Yi (Vw / Vm, adjusted to a standard reference temperature and pressure) that is used as the calibration factor for subsequent test runs. Calibration flow rates are performed at 5 points dependent upon the rotameter of the model of console purchased (can be specified by the customer):

XC-260-A☐☐ = 1.0, 0.8, 0.6, 0.4, 0.3 L/min = DGMC-5A-LFA Calibration

XC-260-B☐☐ = 2.5, 2.0, 1.5, 1.0, 0.5 L/min = DGMC-5A-LFB Calibration

XC-260-C☐☐ = 4.0, 3.0, 2.0, 1.0, 0.5 L/min = DGMC-5A-LFC Calibration

4.1.2 Initial end user audits

Apex Instruments suggests that the end user perform audits using a critical orifice (rated for approximately 1.0 L/min) plugged in to the sample inlet on the console. Run the audit at 1-2 in. Hg (25-50 mm Hg) above the calculated critical vacuum. Calculate the Y (Gamma) using the standardized orifice's flow rate and compare this value to the standardized flow rate metered by the dry gas meter after a minimum of 10 minutes using this formula:
$(Q_{cr(std)} / Q_{m(std)}) \times 100$

If these values differ by more than 5%, check the integrity of the console before beginning sampling.

To audit the thermocouples, use a calibrated temperature simulator (NIST-traceable preferred) to simulate a known temperature and compare the value on the simulator to the console's displayed value by plugging in directly to one of the thermocouple jacks on the front of the console. If the displayed value on the console does not match the simulator, use the adjustment screws on the console's Jenco display to offset the values as necessary.

Another quick check is done by taking the TC out of the dry gas meter outlet and dipping it in an ice bath that also has a calibrated thermometer dipped inside. Ensure the dry gas meter thermocouple channel reading matches the calibrated thermometer at or near freezing, 32 °F (0 °C). If it is not, adjust the console reading to match the ice bath's thermometer.

4.2 Post-Test Calibrations

4.2.1 Dry gas meter

Apex Instruments and the EPA recommend that the user perform post-test audits following a field test series using the procedures outlined in EPA Method 30B, Section 10.2.2.5 Post-Test Calibration Check. This procedure closely mirrors the pre-test calibration, except only three or more revolutions of the reference meter are required and only one independent runs needs to be made that is at or near the sample rate metered during the test.

The average of the post-test audit factors, Y, is not allowed to deviate more than 5% from the pre-test calibration factor Y_i. If this deviation is greater than 5%, a post-test calibration factor needs to be redetermined using the Pre-Test Calibration procedure. This new post-test calibration factor is then applied to the sample volume from the most recent sampling test series.

Conduct a post-test audit using the audit procedure outlined in *Section 3.4 Post-Field Test Operations* on page 23 of this manual. If the $Q_{m(std)}$ obtained before and after the test differs by more than 5%, void the test run; if not, calculate the volume of the gas measured with the critical orifice.

If re-calibration indicates that the metering system is unacceptable for use, void the test results or use approved methods by the administrator to determine an acceptable value for the collected sample.

4.2.2 Temperature sensors

Audit against mercury-in-glass thermometers. An alternative thermometer may be used if the thermometer is, at a minimum, equivalent in terms of performance or suitably effective for the specific temperature measurement application (EPA Method 5, Section 10.5).

The user can also audit the temperature sensors following the procedure outlined in Section 4.1.2 Initial end user audits on page 26 of this manual.

4.3 Post-Test Maintenance

4.3.1 Purging

At the conclusion of a test series, it is highly recommended to “purge” the console plumbing by drawing in clean, ambient air for 10 minutes or greater. This process will extend the life of the internal tubing, fittings, dry gas meter and flow meter. The purge can be conducted by turning the internal sample pumps on and opening the valves to draw air through the inlet of the sample ports on the front of the console when it is not connected to other equipment or a sample train.

4.3.2 Cleaning

Maintaining the cleanliness of the console will also extend the life of its components. The outside of the case and console can be cleaned with a non-abrasive, weak degreaser or soapy water. Ensure that exposed electrical components are not sprayed during this process.

⚠ **CAUTION**

Never clean the console while it is connected to power or powered on.

4.3.3 Inspections

⚠ **CAUTION**

Periodically inspect components of the console to ensure everything is in working order and nothing is exhibiting a sign of future issues. Check for things such as exposed or frayed wires, melted or damaged electrical components, discolored or cloudy tubing, and any sign of oil or moisture. The console can be safely vacuumed out while disconnected from power in a dry location. Vacuuming the internals of the console will remove any dust or particulate buildup that could cause issues in the long term. Any signs of damage to the internal or external components of the console should be replaced immediately.

4.4 Semi-Annual Maintenance

All components of the console should be audited and evaluated on a semi-annual schedule (once a quarter or every six months). This comprehensive procedure should include audits of the dry gas meter thermocouples and electrical components. Post-test calibrations and audits satisfy this suggestion.

4.5 Annual Maintenance

Apex Instruments highly recommends that the console be returned to Apex Instruments on an annual basis. The Technical Services Group will perform an evaluation of all components of the system including functionality and build-integrity checks. All sensors and the dry gas meter can also be calibrated at this time.

4.6 Manufacturer Support for the Product

4.6.1 Technical services

Our knowledgeable service staff includes skilled industry professionals, stack testers and technicians ready to help with specific service needs. From basic troubleshooting to full equipment overhauls and repairs, our technical service team can help.

Phone: (919) 346-5754, Toll Free (877) 726-3919
Email: support@apexinst.com

4.6.2 Calibration services

Apex Instruments offers dedicated, climate-controlled precision calibration services for a variety of measuring instruments to help keep all equipment up to date and within US EPA calibration requirements. Calibration services are available for consoles, reference meters, critical orifice, orifice sets, pitot tubes (geometric and wind tunnel) and thermocouple simulators.

Please contact the service department or a sales representative for more details on our calibration services. Certification of calibration available upon request. The part number for the annual calibration is as follows:

XC-260-A☐☐ = 1.0, 0.8, 0.6, 0.4, 0.3 L/min = DGMC-5A-LFA Calibration

XC-260-B☐☐ = 2.5, 2.0, 1.5, 1.0, 0.5 L/min = DGMC-5A-LFB Calibration

XC-260-C☐☐ = 4.0, 3.0, 2.0, 1.0, 0.5 L/min = DGMC-5A-LFC Calibration

4.6.3 Obtaining documentation and information

Internet

Detailed product information, firmware and/or software, stack sampling guides and EPA regulation references are available on our website: https://www.apexinst.com

Support and service

Any requests for field data sheets, calibration spreadsheets, diagrams or component supporting documentation, please reach out to our Technical Services Group for assistance.

5.0 Troubleshooting

5.1 Screens and Displays

5.1.1 No power to Jenco temperature display screen

⚠ **CAUTION**

1. Connector or wires in the bottom-right corner of the rear of the temperature display unit are not secure
   Resolution - Ensure that all wires are firmly clamped inside of the connector and that the connector is plugged into the unit

2. Console main power switch is not turned on
   Resolution - Turn on the main power switch

3. Console is not plugged in to a working power outlet
   Resolution - Find an appropriate power source with the correct voltage output and plug the power cord in to the outlet

4. Main circuit breaker on the front of the console is extended out showing red shank
   Resolution - Push in the main circuit breaker. If this is happening repeatedly, turn the console off immediately, disconnect power and remove from service until the console is inspected and repaired.

5.1.2 No Power to Red Lion totalizer display screen(s)

1. Connector or wires in the bottom-right corner of the rear of the temperature display unit are not secure
   Resolution - Ensure that all wires are firmly clamped inside of the connector and that the connector is plugged into the unit

2. Console main power switch is not turned on
   Resolution - Turn on the main power switch

3. Console is not plugged in to a working power outlet
   Resolution - Find an appropriate power source with the correct voltage output and plug the power cord in to the outlet

4. Main circuit breaker on the front of the console is extended out showing red shank
   Resolution - Push in the main circuit breaker. If this is happening repeatedly, turn the console off immediately, disconnect power and remove from service until the console is inspected and repaired.

5.2 Pressures

5.2.1 Vacuum gauge non-zero

⚠ **CAUTION**

1. Vacuum gauge reads a non-zero value with no flow going through the system
   Resolution - Replace the vacuum gauge
   Resolution - Check the tubing connections between the inlet to the console and the vacuum gauge

5.2.2 Pump motors running abnormally

1. Console is not plugged into a working outlet of the correct voltage
   Resolution - Ensure the console is powered off and then plug into a working outlet of the correct voltage

5.2.3 DGM volume not increasing or is decreasing

1. Console is not being operated upright
   Resolution - Reposition the console to be standing upright

⚠ **CAUTION**

2. Console has a leak
   Resolution - Check all fittings and tubing inside of the console for a leak, repair if necessary

3. Console scaling factor is not correct or is set at 0.0000
   Resolution - Find the scaling factor on the most recent full calibration and input this value into the applicable Red Lion totalizer

5.2.4 Rotameter ball bouncing

1. In-line filter (or pipe cleaner) is not installed before the rotameter
   Resolution - Replace the filter with a new, or clean, filter

2. Exhaust tubing is not installed on the rotameter outlet
   Resolution - Place a length of tubing on the on the rotameter outlet barb (4” minimum recommended) with the exit of the tubing vented to ambient air

5.3 Temperatures

5.3.1 TC displayed values are changing too quickly to read

1. TC values are too sporadic
   Resolution - Check that wires are not loose anywhere between the TC jacks, temperature selector rotary switch, temperature controller, and temperature display.
   Resolution - Check that no TC wires are broken or pinched

5.3.2 TCs reading inaccurately (or not reading at all)

1. TC channels reading inaccurately
   Resolution - Adjust TC offset with Jenco offset screws using calibrated temperature simulator

⚠ CAUTION

2. TC channels not reading
   Resolution - Ensure all TC wires are connected at the rear of the TC jacks inside of the console
   Resolution - Ensure all TC wires are in good condition and are in their plugs on the umbilical and other sampling equipment

5.3.3 Probe not heating or receiving power

1. Temperature controller or power switch for appropriate equipment is not turned on
   Resolution - Turn on the switch for the appropriate temperature controller

2. Power output is not connected or secure on the console and the umbilical power adapter
   Resolution - Make sure the power output is connected securely on the console faceplate and the umbilical cable

3. Temperature controller is not setup properly
   Resolution - Verify that the Fuji controller settings are correct and adjusted to the correct set point

5.4 Additional Common Console Problems

⚠ CAUTION

Issue	Resolution
Maximum vacuum or flow rate decreases	- Filters are dirty and need to be replaced - Obstruction in sample flow path - Blockage or kinks in plumbing - Leak in console plumbing or sample train
Pump motor fails to start or hums	- Check for correct current (5 to 6 Amperes) - Check to see if fuse is blown - Unit has frozen due to ambient temperature, move pump to a warmer environment to “heat” it up and then return to the sampling location - Unit has overheated - Console is connected to incorrect voltage power source (240V console powered by 120V power source, for example)
Probe doesn’t heat or heats slowly	- Verify that the correct thermocouple is plugged in - Verify that the Fuji controller settings are correct and adjusted to the correct set point - Auto-tune the temperature controller - Check all connections for probe power (output on console end, output on oven end, power plug from probe to oven, and TCs)
Jenco display doesn’t power on	- Check connections on the board for proper power input - Ensure console is being used in operational range -13 to 158 °F (-25 to 70 °C)
Console doesn’t power on	- Check the position of the circuit breaker switch, if pop-out switch is popped out and red is showing, push it back in - Check to make sure the console is plugged in to a working power source

6.0 Diagrams and Schematics

6.1 Electrical Diagram (XC-260 120V Shown)

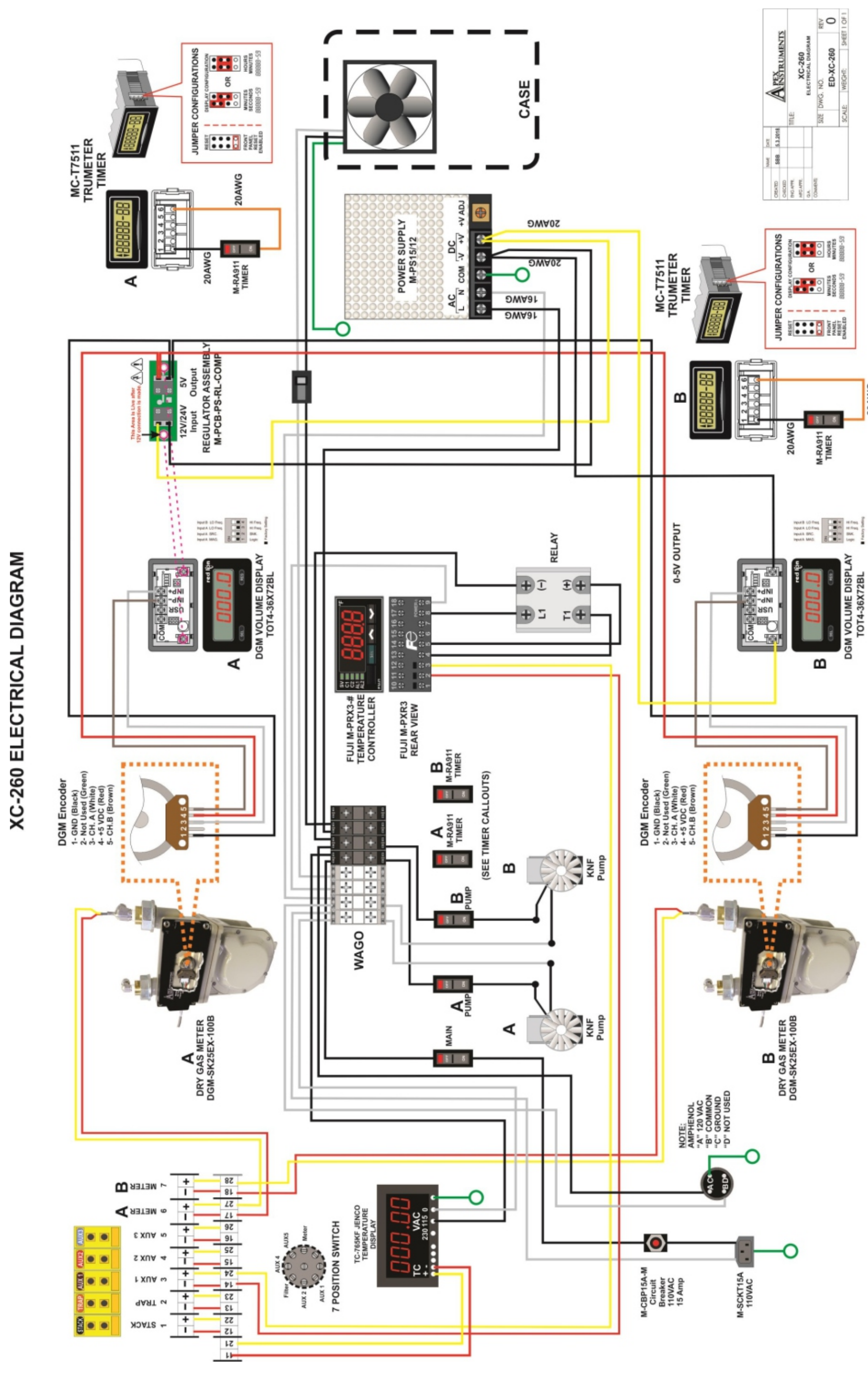

Fig. 9 Electrical Diagram

6.2 Plumbing Diagram

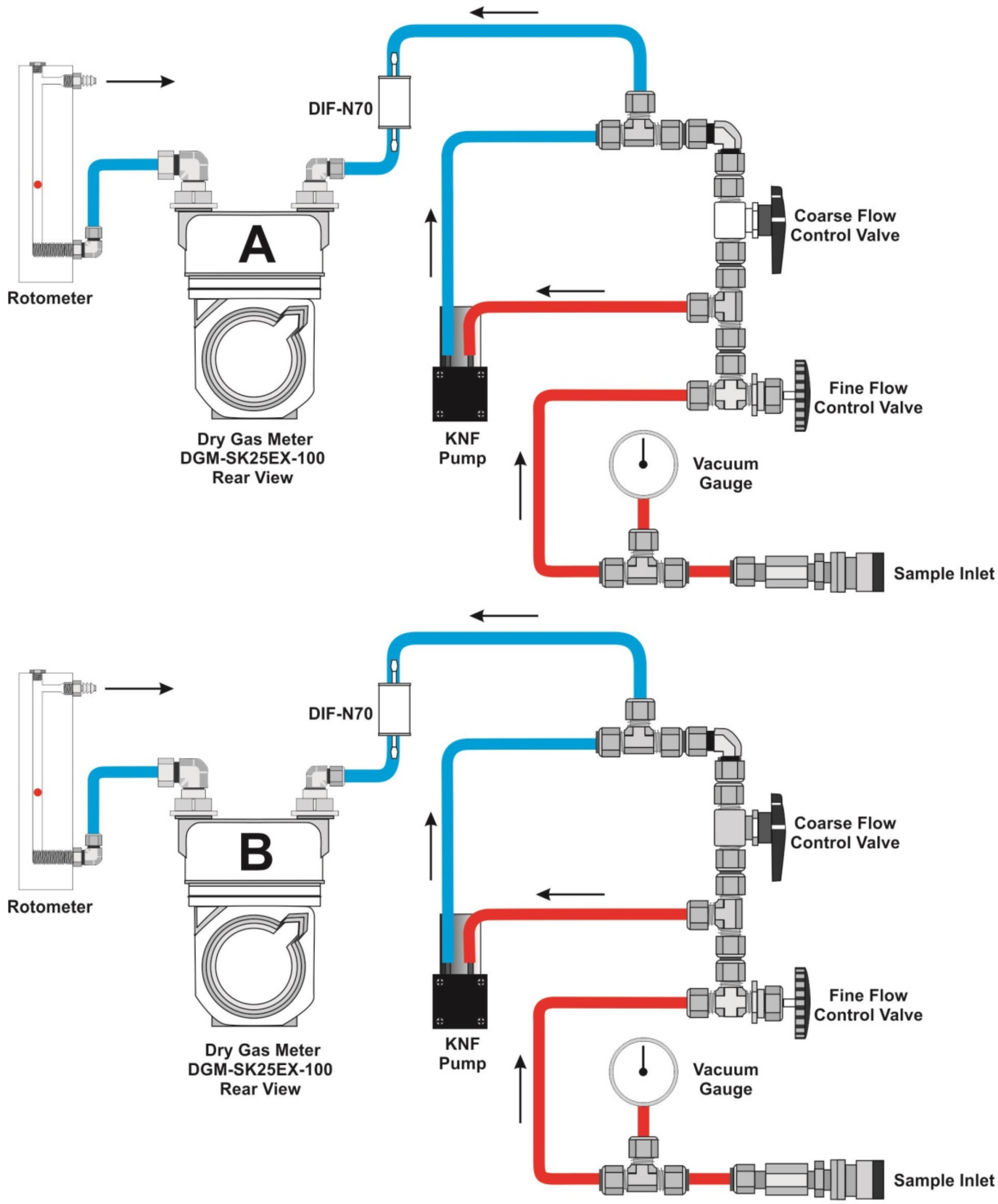

Fig. 10 Plumbing Diagram

6.3 Parts List - Front Panel (XC-260-C 120V Shown)

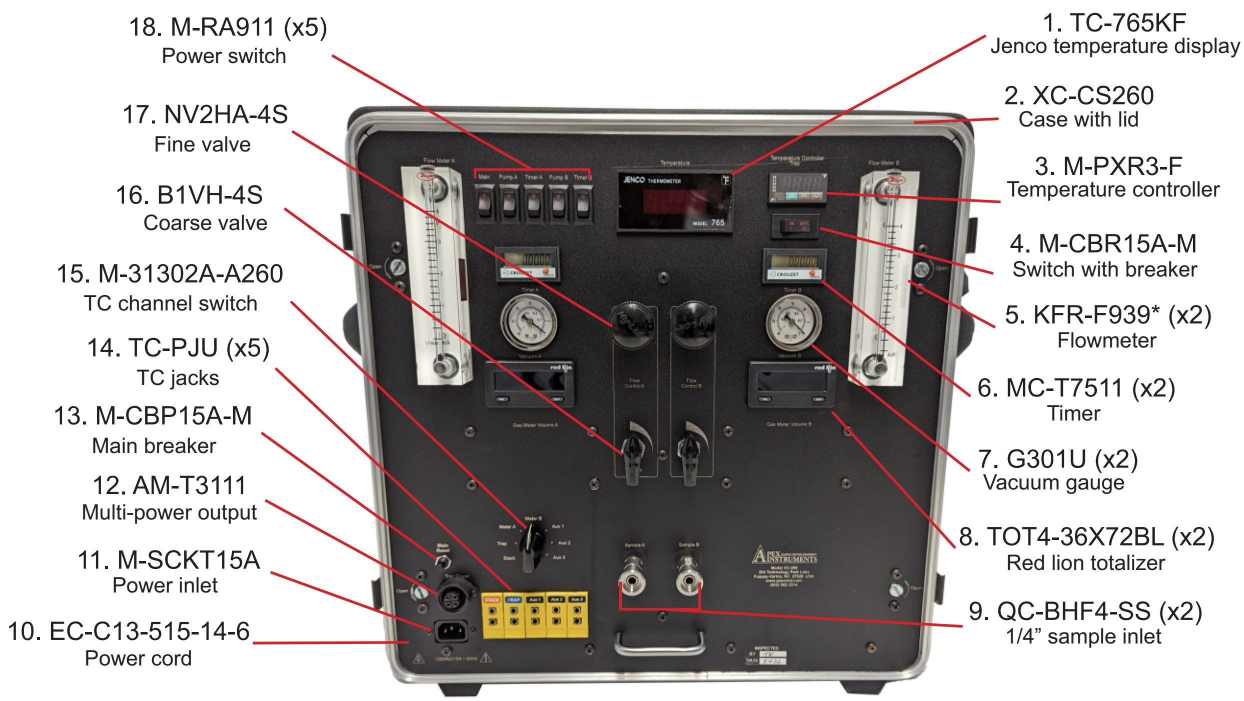

Fig. 11 Parts List - Front Panel: *Standard version shown, depiction of options may differ*

<u>*Rotameter Options</u>

F-VFB-60SS (Console A 1L)
KFR-F939 (Console B 2.5L)
F-VFB-65SS (Console C 4L)

6.4 Parts List - Interior (XC-260-C 120V Shown)

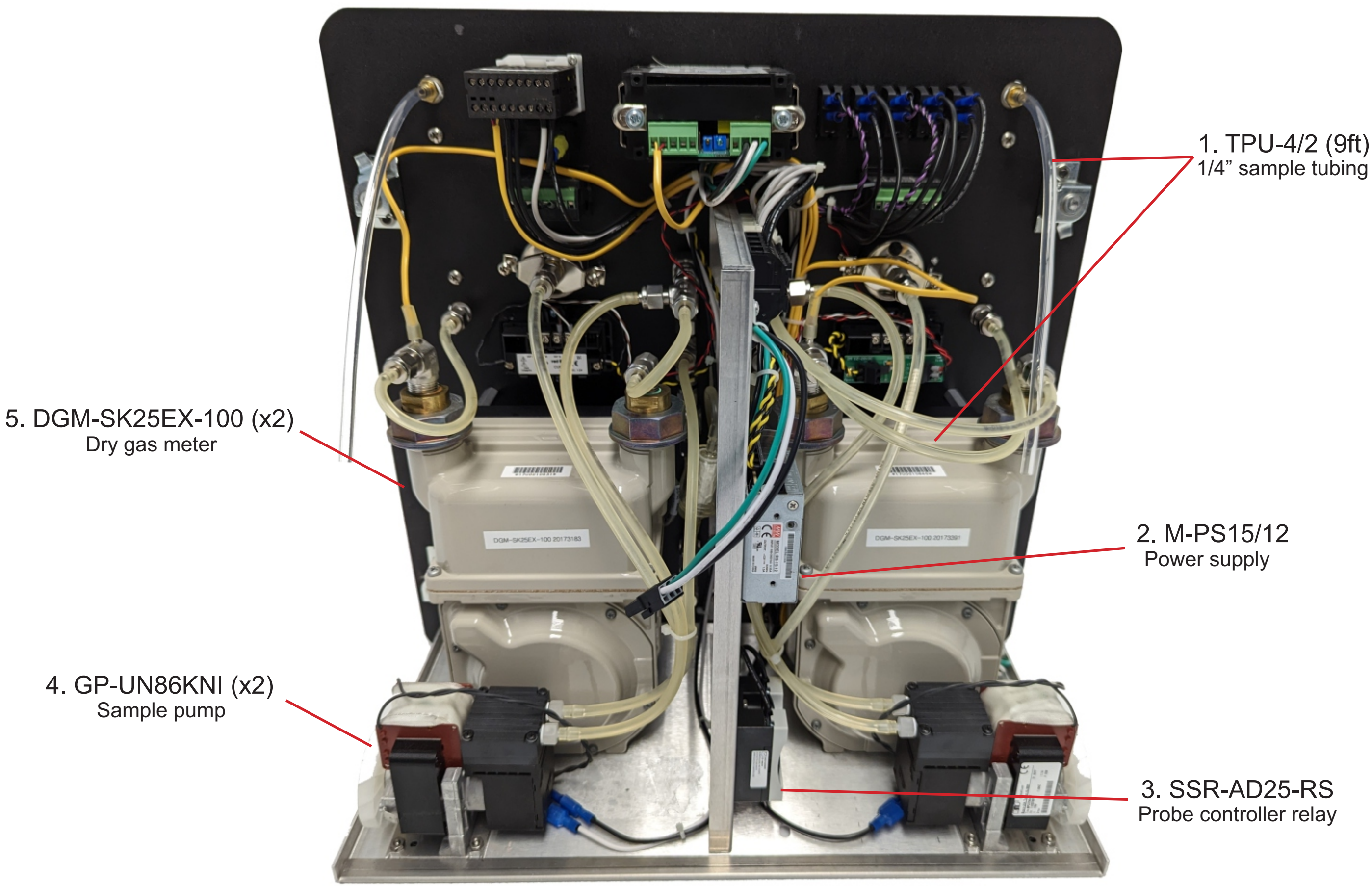

Fig. 12 Parts List - Interior: *Standard version shown, depiction of options may differ*

7.0 References and Related Documentation

7.1 References

7.1.1 EPA and CFR

EPA EMC Promulgated Test Methods
    Method 30B
Code of Federal Regulations (CFR) 40 Part 60

7.2 Related Documentation

7.2.1 Apex Instruments documentation

Apex Instruments Gaseous Sampling Handbook

APEX INSTRUMENTS

Hg Sorbent Trap Sampling Data

Client Information	
Company	
City, State	
Operator(s)	
Test Location	

Test Information	
Project ID	Hg Sorbent Test
Sampling Type	Constant
Run ID	
Start Date	
Barometric Pressure	

Test Equipment Information			
Console ID	A/B		
DGM Mech Cal Fact.	(Y)		
DGM Elec. Cal Fact.	(Y)		
Pitot Tube Coeff			
Sorbent Trap ID			
Trap Size	Large / 10mm		
Spike Mass			

Leak Checks					
Pre	A	/B	cc/min @ A	/B	in. Hg
Post	A	/B	cc/min @ A	/B	in. Hg
Q_m Allow Pre/Post	A	/B	A	/B	

Sampling Time	Clock Time	DGM A Elec. Index	DGM A Mech. Index	DGM B Elec. Index	DGM B Mech. Index	Stack Temp	Probe Temp	Chiller Temp	Meter A Temp	Meter B Temp	Pump Vacuum	Velocity Head ΔP	Sample Flow Rate
min	hh:mm:ss	L	L	L	L	°F	°F	°F	°F	°F	in. Hg	in. H_2O	cc/min
Test Start													
15													
30													
45													
60													
75													
90													
105													
120													
						Avg	Avg	Avg	Avg	Avg	Max	Avg Sqrt ΔP	Avg

Chain of Custody

Relinquished by: ______________________ Date: ____________

Received by: ______________________ Date: ____________

Relinquished by: ______________________ Date: ____________

Received for Lab by: ______________________ Date: ____________

APEX INSTRUMENTS SOURCE TESTING EQUIPMENT

Updated: 2020/06/11

Console Calibration

Pre-Test - 5-Point Metric Units (Critical Orifice)

Meter Console Information

Model #:	
Serial #:	
DGM Model #:	
DGM Serial #:	

Calibration Conditions

Bar. Press. (mm Hg):	
Relative Humidity (%):	
Ambient Temp. (ºC):	

Factors/Conversions

Std. Temperature (°K):	293.15
Std. Pressure (mm Hg):	760.0
K_1 (°K/mm Hg):	0.3857

Orifice Information

Orifice Set ID:	
Cal. Due Date:	
Theoretical Critical Pressure (in. Hg)[1]:	

Calibration Data

Console Test Meter (DGM)							Critical Orifice				
Run Time[5]	Meter Pressure[6]	Volume			Outlet Temperature		Serial Number	Coefficient[2]	Actual Vacuum[1]	Ambient Temperature	
		Initial	Final	Total	Initial	Final				Initial	Final
Θ (minutes)	P_m (mm H_2O)	V_{mi} (m^3)	V_{mf} (m^3)	V_m (m^3)	t_{mi} (ºC)	t_{mf} (ºC)	# (ID)	K' (Metric)	P_w (mm Hg)	t_{ai} (ºC)	t_{af} (ºC)

Calibration Results

Standardized Data					Calculated Results				
Dry Gas Meter		Critical Orifice			Gamma		Flowrate	$\Delta H_@$	
Std. Volume	Std. Flow Rate	Std. Volume	Std. Flow Rate	Raw Volume	Value	Variation[3]	Std & Corr	@ 0.0212 SCMM	Variation[4]
Vm_{std} (m^3)	Qm_{std} (m^3/min)	Vcr_{std} (m^3)	Qcr_{std} (m^3/min)	V_{cr}(m^3)	Y	ΔY	$Qm_{std/corr}$ (m^3/min)	$\Delta H_@$ (mm H_2O)	$\Delta\Delta H_@$ (mm H2O)
						Y Avg.			$\Delta H_@$ Avg.

Initial Scaling Factor

New Scaling Factor[7]

Notes

[1] For valid test results, the Actual Vacuum during calibration should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.

[2] The Critical Orifice Coefficient, K', must be entered in Metric units, [(m3)(°K)1/2)]/[(mm. Hg)(min)].

[3] For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

[4] For $\Delta H_@$, orifice pressure differential that equates to 0.75cfm (0.0212m^3/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2in (5.1mm) H_2O.

[5] Recommended minimum run time per orifice is 10 minutes.

[6] Theoretical meter pressure (gauge) ΔH: 09 orifice - ~0, 40 orifice - ~7, 48 orifice - ~13.5, 55 orifice - ~27, 63 orifice - ~43, 73 orifice - ~76 (mm H2O).

[7] For a digital console calibration, enter the initial scaling factor for the console to get an updated scaling factor after the completed calibration. With the new scaling factor, the Y (Gamma) is now 1.0000.

Technician: ____________ Signature: ____________ Date: ____________

I certify that the above Dry Gas Meter was calibrated in accordance with US EPA Methods, CFR 40 Part 60.

7.3 Equations and Nomenclature

7.3.1 Equations

- $$V_{m(std)} = \frac{(V_m Y T_{std} P_{bar})}{(T_m P_{std})}$$

- $$C_{SO_2} = \frac{K_2 N (V_t - V_{tb})(V_{soln}/V_a)}{V_{m(std)}}$$

- $$V_{sb(std)} = V_{sb}(T_{std}/T_{amb})(P_{bar}/P_{std})$$

- $$Q_{std} = \frac{V_{sb(std)}}{\theta}$$

- $$V_{m(std)} = \frac{\bar{Q}_{std}\theta_s(1 - B_{wa})(P_{bar} + P_{sr})}{(P_{bar} + P_c)}$$

- $$V_{m(std)} = \frac{\bar{Q}_{std}\theta_s(1 - B_{wa})(P_{bar} + P_{sr})(M_a/M_s)^1}{(P_{bar} + P_c)}$$

7.3.2 Nomenclature

acf = actual cubic feet
acfm = actual cubic feet per minute
A = effective area of flue in square feet
acm = actual cubic meters
acmm = actual cubic meters minute
A_n = inside area of sampling nozzle in square feet
B_{ws} = water vapor in gas stream, proportion by volume
%C = percent carbon by weight, dry basis
%CO = percent carbon monoxide by volume, dry basis
$\%CO_2$ = percent carbon dioxide by volume, dry basis
C_p = pitot tube coefficient
D_I = dust loading per heat input in pounds (grams) per million Btu (calories) per Fr constant
D_I^3 = dust loading per heat input in pounds (grams) per million Btu (calories) per Fr calculated
dscf = dry standard cubic feet
dscfh = dry standard cubic feet per hour
dscm = dry standard cubic meters
dscmh = dry standard cubic meters per hour
fps = feet per second
F_r = ratio factor of dry flue gas volume to heat value of combusted fuel in dry standard cubic feet (meters) per million Btu (calories)
gms = grams
gm-mole = gram-mole
grs = grains
ΔH = orifice pressure drop in inches water, average
%H = percent hydrogen by weight, dry basis
H_c = heat of combustion in Btu per pound, dry basis
hr = hour
%I = percent isokinetic
in. Hg = inches mercury
lbs = pounds
lbs-mole = pound-mole
%M = percent moisture by volume
mmBtu = million Btu
mmcal = million calories
mm Hg = millimeters mercury
mps = meters per second
M_s = molecular weight in pound (gram) per pound (gram) mole (wet basis)
%N = percent nitrogen by weight, dry basis
$\%N_2$ = percent nitrogen by difference, dry basis
%O = percent oxygen by difference, dry basis
$\%O_2$ = percent oxygen by volume, dry basis
P_b = barometric pressure in inches mercury
P_{std} = standard absolute pressure (29.92 in Hg)
P_s = absolute pressure in flue in inches (millimeters) mercury
P_f = static pressure in flue in inches water, average
$\sqrt{\Delta P}$ = square root of velocity head in inches water, average
%S = percent sulfur by weight, dry basis
scf = standard cubic feet
scm = standard cubic meters
T_{std} = absolute temperature of air in degrees Rankine at standard conditions (528 degrees)
T_s = absolute temperature of flue gas in degrees Rankine, average
T_m = absolute temperature at meter in degrees Rankine, average
V_s = velocity of flue gas in feet (meters) per second
V_l = volume of condensate through the impingers in millimeters
V_{lc} = volume of liquid collected in condenser in millimeters plus weight of liquid absorbed in silica gel in grams indicated as milliliters
V_m = volume of metered gas corrected to dry standard conditions in cubic feet (meters)
V_{ms} = volume of metered gas measured at meter conditions in cubic feet
V_o = volume of flue gas at actual conditions in cubic feet (meters) per minute
Q_{sd} = volume of flue gas corrected to dry standard conditions in cubic feet (meters) per hour
V_t = total volume of flue gas sampled at actual conditions in cubic feet (meters)
V_w = volume of water vapor in metered gas corrected to standard conditions in cubic feet (meters)
V_{wc} = volume of water condensed in impingers corrected to standard conditions
V_{wsg} = volume of water collected in silica gel corrected to standard conditions
W_a = total weight of dust collected per unit volume in grains (grams) per actual cubic feet (meters)
W_d = total weight of dust collected per unit volume in pounds (grams) per dry standard cubic feet (meters)
W_g = total weight of dust collected in grams
W_h = total weight of dust collected per unit volume in pounds (grams) per hour, dry basis
W_p = total weight of dust collected in pounds
W_s = total weight of dust collected per unit volume in grains (grams) per dry standard cubic feet (meters)
W_{sg} = impinger silica gel weight gain in grams
Y = metered gas volume correction factor
θ = total elapsed sampling time in minutes

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