CMS-2
CARBON MONOXIDE MONITOR
O. M. 22925

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⚠ WARNING

Do not use this equipment before READING this MANUAL and UNDERSTANDING its contents.

These WARNINGS are included for the health and safety of the operator and those in the immediate vicinity.

Electronic files include a Preface containing the same important information as in the orange cover.

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1.0 INTRODUCTION

1.1 Scope of Manual

1.1.1 These instructions cover setup, operation, maintenance, troubleshooting, and replacement parts for the CMS-2 contractor series carbon monoxide (CO) monitor.

1.1.2 The CMS-2 monitor is manufactured by Invertech Inc. for Clemco Industries Corp. The monitor is a potential life saving instrument. To assure its performance, the monitor must be properly installed, tested, calibrated, and maintained. Before installing and using the monitor, all personnel involved with the operation and maintenance of the instrument must read this entire manual including the orange cover.

1.2 Safety Alerts

1.2.1 Clemco uses safety alert signal words, based on ANSI Z535.4-2011, to alert the user of a potentially hazardous situation that may be encountered while operating this equipment. ANSI's definitions of the signal words are as follows:

This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

NOTICE

Notice indicates information that is considered important, but not hazard-related, if not avoided, could result in property damage.

⚠ CAUTION

Caution indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

⚠ WARNING

Warning indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ DANGER

Danger indicates a hazardous situation that, if not avoided, will result in death or serious injury.

1.3 Table of Contents

1.4 Components

1.4.1 The primary components of the monitor are shown in Figure 1. The instrumentation is enclosed in a corrosion resistant polypropylene carrying case. The monitor system includes the instrument case, 10 feet of 1/8" ID x 1/4" OD tubing with fittings, a cylinder of 10 ppm (parts per million) test gas, calibration connector that includes the connector valve, tubing, and humidifier.

1.5 Operating Principles

1.5.1 The CMS monitor samples respiratory air from a breathing-air source. This enables one monitor to detect CO and other toxic gases in the entire breathing air system, not just for one respirator. The air to the respirator does not actually pass through the monitor.

⚠ WARNING

When the CMS is correctly installed and maintained, it monitors the level of CO and other oxidizable toxic gases in the air supply. The instrument is a monitoring device; it DOES NOT remove or convert CO or any other toxic gases.

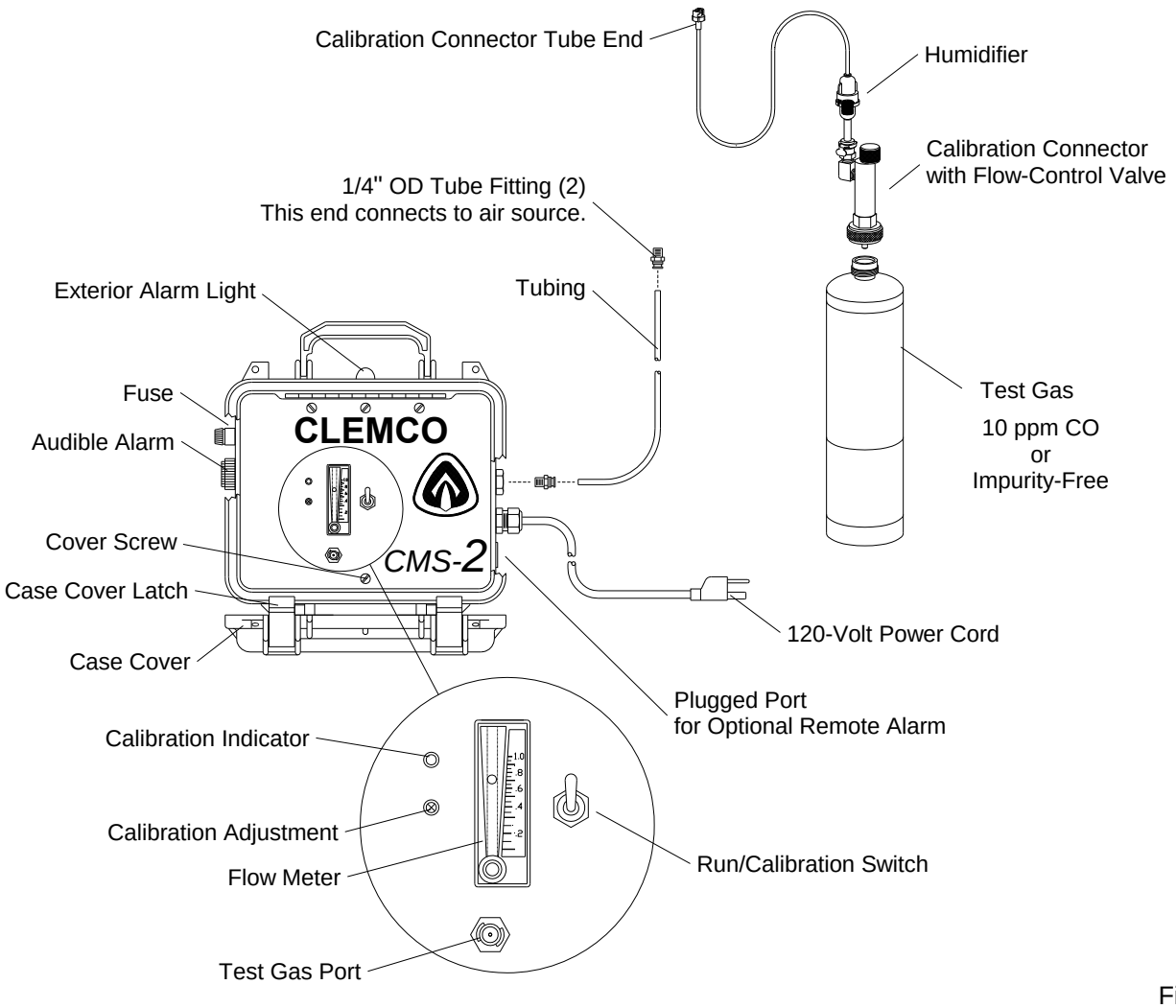


Figure 1

1.5.2 During operation, a small sample of air, referred to as sample air, passes through the instrument and is continuously monitored by the broadband MOS (Metal Oxide Substrate) sensor. Although the sensor detects CO, it also detects other oxidizable toxic gases (hydrocarbons). If the sample-air supply fails for any reason such as air blockage, loss of pressure, or excessively high pressure, an intermittent audible alarm will sound approximately every 10 seconds and the exterior alarm light will illuminate *yellow* to alert the user.

1.5.3 In the event the sensor detects CO in the concentration of 10 ppm or above, a continuous audible alarm will sound and the exterior alarm light will illuminate *red* to alert the user.

1.6 Annunciator Lights and Audible Alarms and Switches. Use and Functions

1.6.1 Audible and visual alarms are provided on the exterior of the instrument case and on the interior faceplate. The exterior light illuminates *green* when conditions are safe, or *yellow* or *red* depending on the alarm condition. The audible alarm sounds in conjunction with the visual alarm.

⚠ WARNING

All alarm conditions require the immediate attention of the user. Stop blasting immediately and remove the respirator as soon as it is safe to do so, and check the monitor to determine the cause for alarm.

1.6.2 The color of the alarm light in conjunction with the nature of the audible alarm indicates the condition causing an alarm. Functions of the alarm annunciators are as follows:

1.6.3 Interior Calibration Light

Red Light - Intermittent Audible Alarm

- The interior alarm light (calibration indicator) on the faceplate of the instrument responds to toxic gas conditions only. It is for use by the technician during calibration testing and for calibration when the instrument case is open.

1.6.4 Exterior Alarm Annunciators

Green Light - No Audible Alarm

- No Alarm, Safe Condition: Do not use the compressed air for breathing unless the exterior light is illuminated *green*.

Yellow Light - Intermittent Alarm Horn (approximately every 10 seconds)

Sample-Air Failure: This alerts the user that pressure in the test chamber is either too low or too high. Low pressure is usually due to loss of pressure in the sample-air air line. High pressure is an indication that the internal regulator is set too high. Correct flow is observed on the flow meter; the flow ball should be between 0.5 and 0.8 SCFH (standard cubic feet per hour).

- Calibration in Process: During calibration testing and the calibration procedure, this alarm is activated. The alarm will terminate when the technician has correctly returned the monitor to service.

Yellow Light - No Audible Alarm

- Warm-Up Period: During the first several minutes of operation, the monitor goes through a warm-up period while the sensor stabilizes. During the warm-up period, the *yellow* light illuminates and all other alarms are non-operational. The alarm will terminate after the warm-up is complete.

Red Light - Continuous Audible Alarm

- Toxic Gas Detected: This alarm occurs when toxic gas or CO in excess of 10 ppm is detected in the breathing air line.

1.6.5 Run/Calibration Switch: The toggle should be in the RUN position for all operations other than the actual calibration test and calibration process. If for any reason the toggle is not in the RUN position, the instrument will initiate a *yellow* light and intermittent alarm, indicating that the sample air is not reaching the sensor. Correctly positioning the toggle will terminate the intermittent alarm.

1.7 Optional Accessories

1.7.1 Remote Alarm: The 12-volt DC remote alarm is a high-intensity, red-lens strobe light and high-decibel horn. Unlike external alarms, this alarm does not require an external power source. This accessory is recommended in high noise areas or where the monitor cannot be placed in a conspicuous location. The alarm kit includes the alarm, stand, wiring connector, and 50 foot cable. See Accessories in Section 8.1. With additional cable, the alarm may be used up to 150 feet from the monitor. Consult Clemco Industries Corp. if longer length is required.

2.0 SETUP

2.1 Mounting

2.1.1 The CMS-2 does not require any special mounting, and it will operate in any position. The carrying case handle may be used to hang the monitor in a convenient location that is close to the compressed air source; refer to Section 2.3.

⚠ WARNING

DO NOT mount this instrument inside a blast room. An operator inside a blast room wearing protective clothing may not observe an alarm condition. The alarm case is not designed to withstand the continual impact of abrasive that takes place inside a blast room. Refer to instructions within the manual for installing auxiliary horns, lights, and safety shutdown devices.

2.2 Air Pressure Requirements

2.2.1 Air Pressure: If the compressed air source pressure is between 55 psi and 100 psi, no pressure adjustment is required. If line pressure is above 100 psi, a regulator is required to reduce pressure to be within the 55 psi to 100 psi operating range.

2.3 Connecting to Respirator Air Supply

NOTICE

Do not use pipe joint compound to seal pipe fittings. The monitor will respond to the gases given off by these compounds. Use Teflon tape for pipe thread sealer.

Do not use any silicone-based lubricants up-stream of this instrument. Silicone exposure will prematurely damage the sensor.

2.3.1 To ensure accurate and rapid air monitoring, the monitor must be placed as close to the compressed air source as practical. Ten feet of 1/8" ID x 1/4" OD tubing with two 1/4" NPT fittings are furnished, to be used between the compressed air source and monitor inlet. Larger diameter tubing or pipe, or longer tubing, increases the air-supply volume, and the volume determines the length of time it takes for the sample air to reach the monitor.

2.3.2 Determine a suitable place to tap into the compressed air supply. The tap location should be within 10 feet of the monitor, and the monitor must be placed in a location that permits continual observance of the visual and audible alarms.

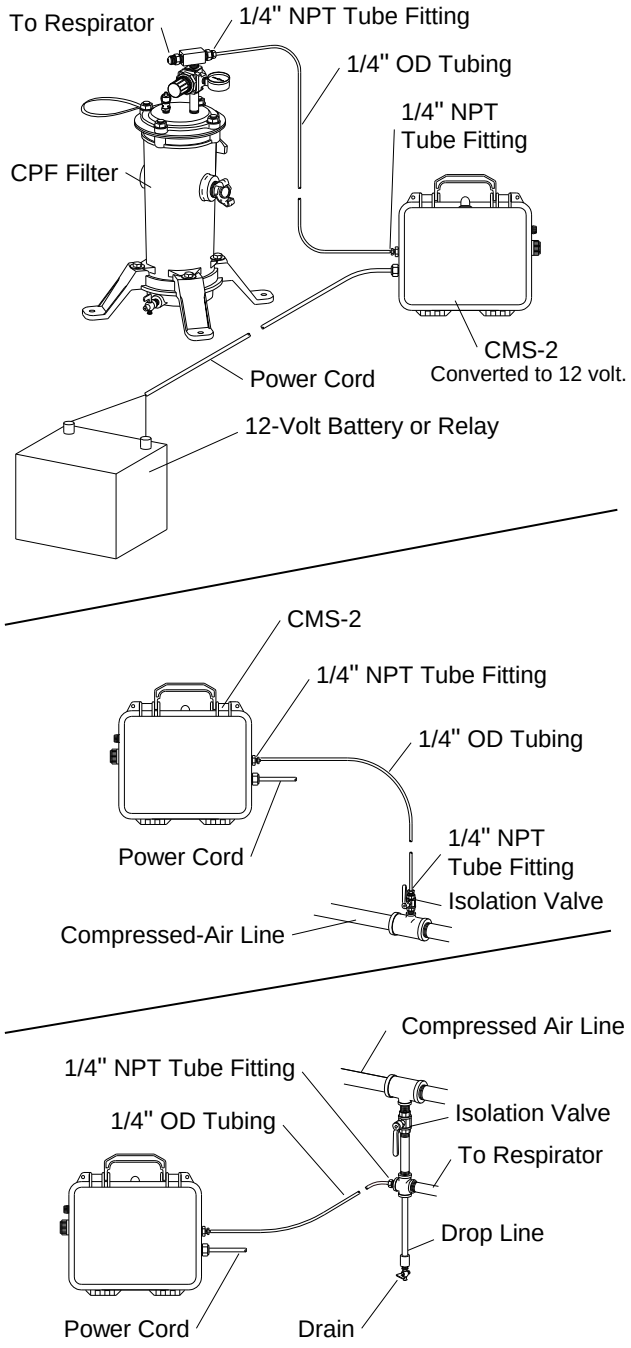


Figure 2

⚠ WARNING

The monitor or an auxiliary alarm must be in a conspicuous place to ensure that any alarm condition is observed. Using the auxiliary terminals and a relay, the monitor may be interlocked with other devices such as the compressor shut-down, as an additional safeguard against an unobserved alarm.

2.3.3 Place a tee in the air-supply line, and use a bushing or other adaptor, to connect one of the 1/4" NPT tube fittings supplied. Install an isolation valve at the source to enable depressurization for service and to remove the monitor. Typical setups are shown in Figure 2.

2.3.4 The tee in the air-supply line should face up to prevent water from accumulating in the sample–air line. If the tap cannot face upward, install a drop pipe and drain to prevent water from entering the monitor.

2.3.5 Connect the other 1/4" NPT tube fitting to the monitor's inlet port.

2.3.6 Attach the urethane tubing between the air-supply tube fitting and monitor-inlet tube fitting. Remove excess tubing.

2.4 Electrical Connections

2.4.1 120-Volt AC supply: A 120-volt AC power cord is supplied and can be plugged into a compatible AC grounded electrical service.

2.4.2 220-Volt AC, 50/60-Hz supply: The only difference between a 120-volt and 220-volt monitor is the power cord. Remove the 120-volt cord or plug and replace it with one that is compatible with a grounded 220-volt receptacle.

2.4.3 12-Volt DC supply: A DC monitor model is available from Clemco, or an AC monitor is easily field converted to operate on 12-volt DC, as noted in Section 2.4.4.

2.4.4 AC to DC field conversion (Serial No. 4446 and greater)

To convert monitors with serial numbers lower than 4446, request Manual No. 22925, Revision E or earlier.

The AC power cord provided with the monitor may be used, using *black* as the positive. A user supplied DC 2-wire cord may be used, using *red* as positive. If a new 12-volt cord is used, splice the positive through the fuse and use the spade on the outlet of the fuse to connect to the positive terminal, as shown Figure 3.

2.4.4.1 Make sure that all electrical power to the monitor is disconnected.

2.4.4.2 Open the case to access the interior faceplate.

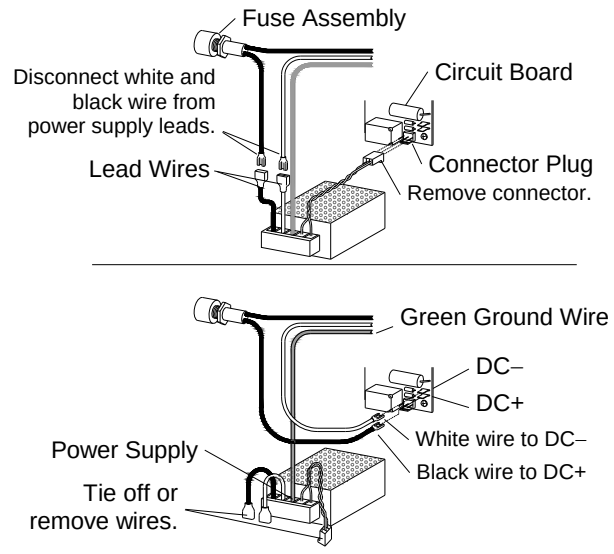
2.4.4.3 Loosen the cover screw located in the center of the lower edge of the faceplate. Refer to Figure 1.

2.4.4.4 Swing the faceplate up to access the instrumentation.

2.4.4.5 Remove the connector with *red* and *black* wires from the plug on the circuit board, as shown in Figure 3. If there is a chance the monitor will be converted back to AC power, tie the wires out of the way. If the monitor is to be permanently converted to 12 volts, pop off the clear terminal cover and remove the wires from the terminal.

2.4.4.6 Disconnect the *white* and *black* wires from the power supply lead wires at the connectors, as shown in Figure 3.

2.4.4.7 Plug the *black* wire onto the DC+ post at the lower left corner of the circuit board, as shown in Figure 3. Note the board is upside down when the cover is open. Plug the *white* wire onto the DC- post.



The green ground wire may remain connected or clipped when using the AC cord for DC applications.

Some items removed or rotated for clarity.

Figure 3

2.4.4.8 Remove the plug from the other end of the cord.

2.4.4.9 When closing the faceplate, make sure all internal air lines are free of interference, binding, or kinks and that all tube connections are secure. Tighten the cover screw.

2.4.4.10 Close the instrument case cover and latch it.

2.4.4.11 Attach a positive (+) terminal connector to the end of the *black* wire and a negative (-) connector to the end of the *white* wire. Clip the *green* wire.

NOTICE

Use any connectors that are compatible with a 12-volt DC system. Make sure the connectors are clearly marked positive (+) and negative (-). Attach the positive connector to the wire leading to the DC+ post on the circuit board, and the negative connector to the DC- post on the circuit board. The monitor will not operate if wires are reversed.

2.5 Connecting an External Alarm and Shutdown Device – Figure 4

NOTE: External alarms require external power. Do not confuse an external alarm with the optional remote alarm, which does not require external power. Instructions for the remote alarm are provided with the alarm.

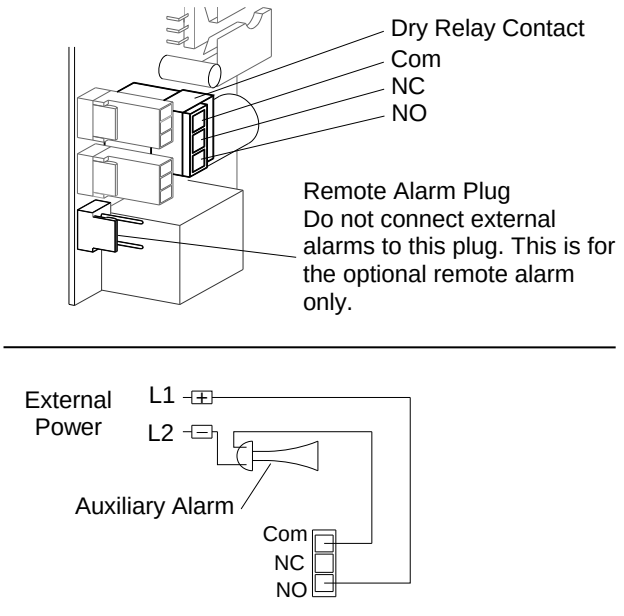


Figure 4

2.5.1 A dry relay contact, rated at 5 amperes, is mounted on the circuit board as shown in. Figure 4. An electrician will use the contacts to operate relays for external alarms and shut-down devices.

2.6 Changing Mode Select Dip Switch to Delay Alarm – Figure 5

NOTE: In areas where intermittent radio frequency transmissions cause false alarms, the monitor can be set to have a 10 second alarm delay to avoid false alarm conditions. The dip switch is mounted on the circuit board as shown in Figure 5.

⚠ WARNING

Do not change the switch positions unless there are frequent alarms from radio frequency (RF) transmissions. Do not change the switch positions to any position other than noted in Figure 5. Avoid unnecessary tampering with the circuit board; doing so can change the monitor's settings, which can affect CO alarm conditions.

2.6.1 The default and recommended setting has no delay in alarm-response time. The positions of the white mode-select switches are shown on the upper example in Figure 5 and as follows:

Switch #1 .....Off
Switch #2 .....On
Switch #3 .....Off

2.6.2 To delay the alarm by 10 seconds, set the white mode-select switches as shown on the lower example in Figure 5 and as follows:

Switch #1 .....Off
Switch #2 .....Off
Switch #3 .....Off

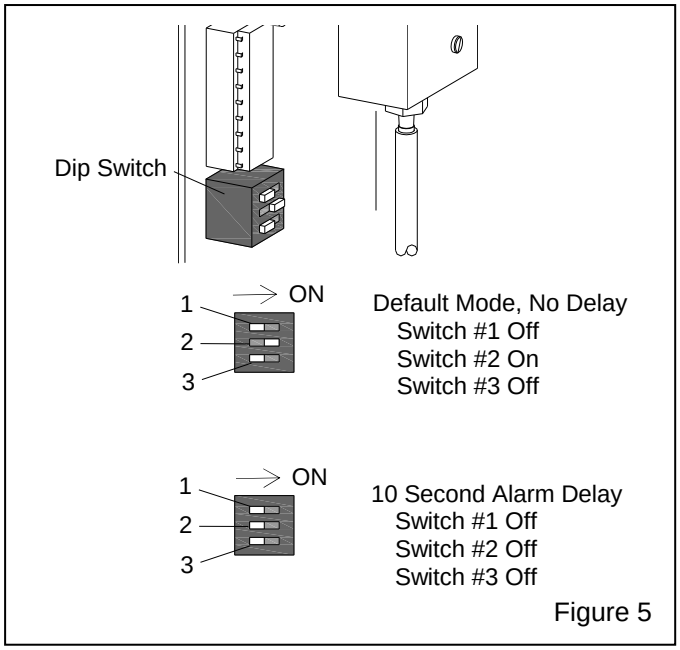


Figure 5

3.0 OPERATION

⚠ WARNING

Do not breathe compressed air that this instrument monitors unless the instrument has been calibration tested, and if needed calibrated per Section 4.0. Using a monitor that has not been calibration tested can permit undetected CO to enter the respirator air lines. Breathing toxic gases can cause death.

3.1 Setup for Operation

3.1.1 Position the Run/Calibration toggle switch to the RUN position.

3.1.2 Open the sample air isolation valve to supply test air to the monitor.

3.1.3 Plug the instrument into a grounded 120-volt AC power supply. If the monitor is converted to operate on 12-volt power, connect to a 12-volt DC power source; be certain the positive and negative leads go to the correct terminal. There is no on/off switch on the monitor; it will initiate operation as soon as power is applied.

3.2 Warm-Up Period

3.2.1 With electrical power applied and 55 psi to 100 psi sample air supplied to the inlet, the monitor will go through a five minute warm-up period.

3.2.2 During the warm-up period, the audible alarms are disabled and the external visual alarm is *yellow*. At the end of the warm-up period, the *yellow* exterior light turns *green*, indicating that the instrument is functioning and the sample air does not exceed the contamination limit. **NOTE: If the instrument has been off for a prolonged period, it is normal for the alarms to activate for a short period of time after the warm-up cycle.**

3.2.3 Make sure alarms function per Section 5.5. If the alarms function as described, proceed to place the instrument in operating mode, per Section 3.3.

3.2.4 If the instrument goes into an alarm (exterior light remains *red* with continuous audible alarm) after the warm-up, reinitiate warm-up by terminating and restarting power.

3.2.5 Continued alarm condition after several warm-up periods indicates that the sample air exceeds the permissible contamination level or the instrument requires calibration. Refer to Section 4.0.

⚠ WARNING

DO NOT use the respirator during the warm-up period. The alarms are disabled and will not warn against toxic gases.

3.3 Operating Mode

3.3.1 Following the warm-up period, with the toggle correctly positioned to RUN and the sample air flowing through the unit, the monitor is in full operating mode.

3.3.2 Before donning the respirator, verify that the monitor is in the operating mode; the exterior alarm light must be *green* with no audible alarm.

⚠ WARNING

Do not use compressed air monitored by this instrument for breathing without first checking that the instrument is in full operating mode, and the that exterior alarm light is illuminated *green*. Failure to heed this warning can cause death from the inhalation of CO.

3.4 Shutdown

3.4.1 If the instrument is not to be moved and is protected from the weather, simply shut off the isolation valve and unplug the power cord. If the unit is to be transported or if it is not protected from the weather, proceed as follows:

3.4.2 Watch the flow meter; when air flow stops, remove the urethane tubing from the supply line and monitor inlet. The tubing is easily removed by pushing in the tube fitting ring while pulling the tubing.

3.4.3 Coil the tubing and place it inside the instrument case to keep the tubing clean.

3.4.4 Place tape or other cover over the inlet fitting to keep instrumentation clean.

3.4.5 Transport the instrument in the passenger compartment of the service vehicle, not in the trunk or truck bed. See Care and Handling in Section 5.1.

4.0 CALIBRATION TEST AND CALIBRATION

NOTE: Thoroughly review and understand the calibration testing and the calibration process before testing or calibrating the instrument. Refer to Section 4.1.

⚠ WARNING

This instrument must be tested and calibrated with 10 ppm test gas. Do not test or calibrate with any other test gas concentration. Doing so will place the monitor out of calibration and may fail to alert the user of toxic gases. Breathing toxic gases can cause death.

4.1 Difference Between Calibration Test and the Calibration Process

4.1.1 It is important to understand the difference between calibration testing and the calibration process.

4.1.2 Calibration test: Calibration testing means applying 10 ppm test gas to the instrument to make sure it responds with an alarm when CO concentration reaches the maximum permissible exposure level, and that it responds with a safe signal when impurity-free air is applied. Calibration test does not include any adjustment of the instrument. Calibration (adjustments) should be done only when the calibration test shows it is necessary.

4.1.3 Calibration process: Calibration means adjusting the instrument. Calibration should be done only when the instrument does not respond during calibration testing or when it remains in alarm at startup.

4.2 Materials Required for Tests and Calibration

- 10 ppm test gas ..... Stock No. 22865
- Impurity-free test gas (when required, see Section 4.9) ..... Stock No. 11132
- Calibration connector ..... Stock No. 22893
- Distilled water
- Small adjusting screwdriver (when calibration is required)

4.3 Stabilization Period

4.3.1 The monitor must be in operation for at least 30 minutes before calibration tests. DO NOT test the instrument until it has gone through the warm-up period and has been in operation with sample air flowing through it (see Section 3.0) for at least 30 minutes.

4.4 Prepare Calibration Connector

NOTE: Unlike ambient air, calibration test gas is bone-dry. Attempts to test or calibrate the monitor without humidifying the test gas will cause significant reading errors of compressed air with normal levels of humidity.

4.4.1 Before connecting the humidifier to the calibration connector, dampen the humidifier media with distilled water (do not use anything other than distilled water) as follows:

4.4.2 Open the humidifier case by holding the assembly and rotating the top counterclockwise, as shown in Figure 6.
NOTE: The O-ring on the bottom case provides a tight friction seal; use hand force to rotate and separate the humidifier top and bottom cases. **Do not use tools that could crack the case.**

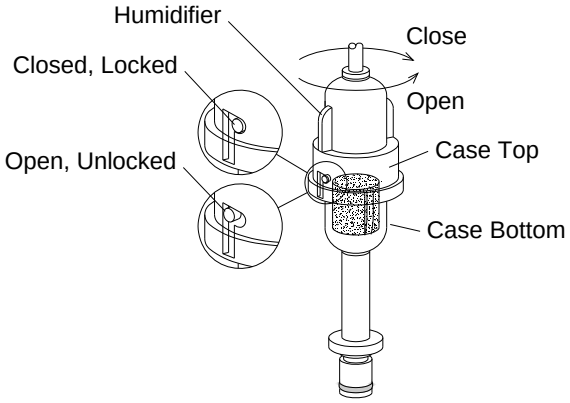


Figure 6

4.4.3 When in the unlocked position, pull the top straight UP to remove the top and access the humidifier sponge.

4.4.4 Moisten the sponge by putting in a few drops of distilled water, as shown in Figure 7. Shake out excess water. The humidifier needs only to be dampened; excess water must be removed so that it does not enter the instrument's plumbing.

4.4.5 Refer to Figure 7 and reassemble the humidifier by aligning the bottom-case lock stubs and top-case slots, push them together, and rotate the top clockwise to secure.

4.4.6 Refer to Figure 8 and insert the humidifier's tube connector into the slide release until it snaps in place. Gently pull the connector to make sure it is seated and locked.

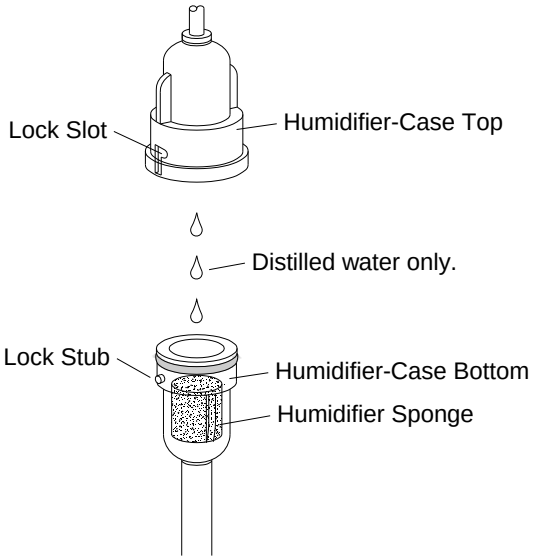


Figure 7

4.4.7 Make sure the flow-control knob is turned fully clockwise to the CLOSED position.

4.4.8 Thread the calibration connector onto the cylinder of test gas. (Use 10 ppm CO test gas to check the calibration or to calibrate the monitor. Use zero, impurity-free air to check if alarm is due to contaminated air or other condition).

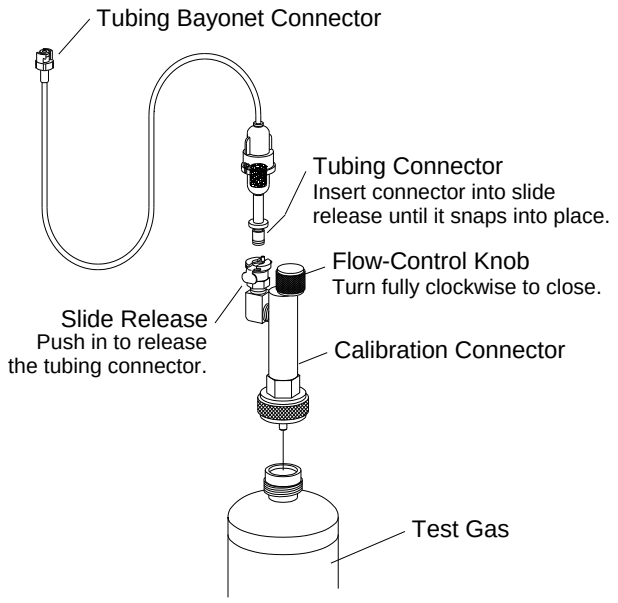


Figure 8

4.5 Prepare Monitor for Calibration – Figure 9

4.5.1 Open the instrument case cover to access the interior faceplate. Take care not to introduce blast environment contaminants into the instrument when the case is open. Refer to Figure 10 for faceplate-calibration testing and calibration callouts.

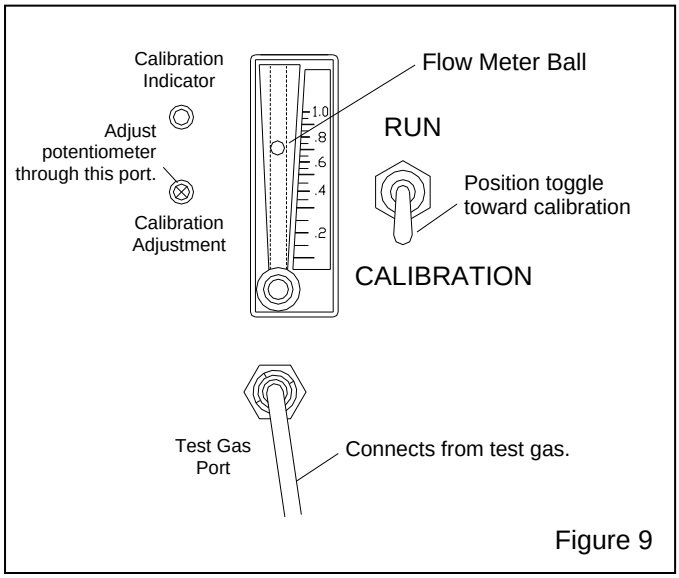


Figure 9

4.5.2 Connect the tubing's bayonet connector to the Test Gas port by aligning the tabs, insert the connector into the port, and turn it slightly clockwise until it locks.

4.6 Calibration Test

4.6.1 Connect the calibration connector and test gas per Sections 4.4 and 4.5.

4.6.2 Place the Run/Calibration toggle toward CALIBRATION. The external alarm light will immediately turn *yellow*, and within a few seconds the intermittent audible alarm will sound (the calibration indicator remains *green*).

4.6.3 With the flow meter vertical, refer to Figure 9 and slowly open the flow-control knob to introduce test gas. Test gas is entering the unit when the flow meter ball rises. If the ball does not rise when the calibration valve is opened, the test gas cylinder may be empty.

4.6.4 Refer to Figure 10 and adjust the flow-control knob until the flow meter ball remains between 0.5 and 0.8 SCFH, normally a little nearer to 0.8. The valve is extremely sensitive. Minor adjustments may be required to correctly position the ball.

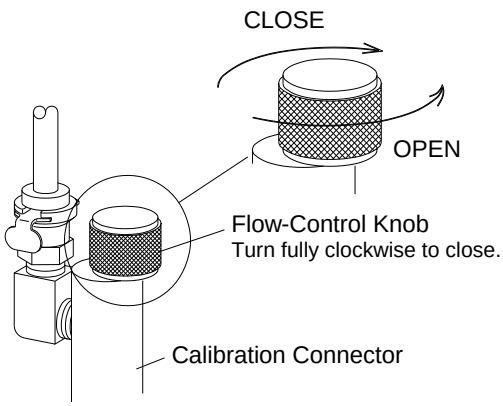


Figure 10

4.6.5 Allow test gas to flow through the instrument for about one minute, or until the interior calibration indicator light turns red.

4.6.6 After the calibration light turns red, the initial phase of the calibration test is complete. Return the instrument to operating mode per Section 4.8. If the indicator light does not turn *red,* proceed with Paragraph 4.6.7.

4.6.7 If after one minute of operation with test gas the calibration indicator light has not turned red and the instrument has been in operation for 30 minutes, calibrate the instrument per Section 4.7. If the instrument has not been in operation for 30 minutes, return it to operating mode per Section 4.8 and operate with sample air flowing through for at least 30 additional minutes. Re-test the calibration, and if the calibration light does not turn red, calibrate the instrument per section 4.7.

4.7 Calibration

4.7.1 Do not calibrate the instrument unless it has gone through two stabilizing periods and calibration tests, per Sections 4.3 and 4.6, and only if the calibration indicator light has not turned red.

4.7.2 Connect the calibration connector and 10 ppm test gas per Sections 4.4 and 4.5.

4.7.3 Place the Run/Calibration toggle toward CALIBRATION. Slowly open the flow-control knob and adjust the flow so the flow ball remains between 0.5 and 0.8 SCFH (normally a little nearer to 0.8).

4.7.4 Allow test gas to flow through the instrument for about one minute. Insert a small screwdriver into the calibration adjustment port and turn the potentiometer as follows:

- If the potentiometer is *blue***,** turn *clockwise* until the calibration indicator light turns red.
- If the potentiometer is *white*, turn *counterclockwise* until the calibration indicator light turns red.

4.7.5 Once the indicator is red, turn the potentiometer in the opposite direction until the light turns *green*. Then, slowly turn the potentiometer from *green* to *red* several times to find the trip point. The monitor is calibrated at the spot where the light turns red. Return the instrument to operating mode per Section 4.8.

4.8 Return Monitor to Operating Mode

4.8.1 Turn the flow-control knob counterclockwise to close the calibration-connector valve.

4.8.2 Remove the calibration tubing from the monitor by gripping the tube-end connector, push in lightly, turn it counterclockwise to unlock, and pull straight out.

4.8.3 Place the calibration toggle toward the RUN position. The flow meter ball should rise to 0.5 to 0.8 SCFH. After several seconds the external alarm light should change from *yellow* to *green*, and the interior light should change to *green*. If the lights respond as described, proceed with Section 4.8.4 to return the instrument to operation. If after about one minute of operation the lights do not change to *green*, do both of the following:

- Calibrate the instrument, per Section 4.7.
- Test instrument function by applying impurity-free air, per Section 4.9.

4.8.4 Close and latch the instrument case cover.

4.8.5 Remove the calibration connector from the test gas. The test gas cylinder has a positive seal, whereas the calibration connector valve does not. **NOTE: If the connector is not removed from the test gas cylinder, over time the cylinder will empty.**

4.8.6 If the tubing needs to be removed from the calibration connector, press and hold the slide-release fitting and gently pull the tubing connector from the fitting.

4.8.7 Store all material in a clean, dry area.

4.9 Impurity-Free Air (zero contamination) Test

4.9.1 This test should be done whenever the instrument stays in an alarm condition after it is returned to the operating mode. This test shows whether the alarm condition is due to contaminated air or monitor malfunction.

4.9.2 Follow the steps in Section 4.6 Calibration Testing, except use impurity-free test gas in place of 10 ppm gas. The alarm light will either remain *red* or turn *green*. Proceed as follows:

4.9.3 Alarm light turns *green*

4.9.3.1 If the monitor is correctly calibrated and in working order, the alarm light will turn *green* during this test. This means the monitor was reading contaminated air. DO NOT USE THE COMPRESSED AIR FOR BREATHING.

⚠ WARNING

Do not breathe air that this instrument identifies as toxic until the source of contamination is identified and corrected. Breathing toxic gases can cause death.

4.9.3.2 Identify the source of contamination. Do not overlook the possibility that contaminated air entered the compressor intake. The contamination could be from engine or other exhaust entering the intake. If the source of contamination is temporary, the monitor will return to a non-alarm (safe) condition after the contamination is cleared from the compressed-air system.

4.9.4 Alarm light remains red

4.9.4.1 If the monitor is out of calibration or not in good working order, the alarm light will remain red.

4.9.4.2 Calibrate the monitor per Section 4.7 and apply impurity-free gas per Section 4.9. If the alarm light remains red, the monitor requires service. Refer to Section 6.0.

⚠ WARNING

Do not use compressed air monitored by this instrument for breathing unless the instrument is in good working condition. Using a monitor that is not in calibration or not working correctly can permit undetected CO to enter the breathing-air lines. Breathing toxic gases can cause death.

5.0 GENERAL MAINTENANCE

5.1 Care and Handling

5.1.1 This monitor is designed for portable, field use and is not adversely affected by normal handling that is required of any test and measurement instrument.

5.1.2 Transport the instrument in the passenger compartment of the service vehicle.

NOTICE

Do not subject this instrument to extreme heat or cold. Placing the instrument on the dashboard of the service vehicle in direct sunlight or similar conditions will elevate the temperature, which will damage the instrument's electronic components. Temperatures at 0° F and below or case temperature at 125° F and above will damage the instruments components.

5.2 Cleaning

5.2.1 The need to open the case periodically to calibrate the instrument exposes it to potential external contamination. Take care not to introduce contaminants into the instrument when the case is open.

5.2.2 Clean the exterior of the case with a solution of water and mild detergent. Do not use solvent cleaners.

5.3 Calibration Test Schedule

5.3.1 Test the calibration when it is initially set up and again the day after. Check it once a week for the first month. Check it at least once a month thereafter. Refer to Section 4.0 for test procedure.

5.4 Calibration Schedule

5.4.1 Avoid the urge to calibrate the instrument. Calibrate only when the calibration test shows it is required. See Section 4.0.

5.5 Alarm Tests

5.5.1 Although uncommon, alarm lights and horns do fail. Check their function before each use by placing the Run/Calibration toggle toward CALIBRATION. The external alarm light will immediately turn *yellow*, and within a few seconds the intermittent audible alarm will sound. Placing the toggle in RUN position returns the alarms to their normal operation. **Never use the respirator without first verifying that the monitor is in the operating mode; the exterior alarm light must be *green* with no audible alarm.**

6.0 SERVICE MAINTENANCE

NOTE: Do not attempt to repair the instrument or replace any item that is not noted in this section or that requires parts not listed in Section 8.2. Contact a Clemco distributor for authorization to return the instrument for evaluation or service.

6.1 Sensor Replacement

6.1.1 Sensor life depends upon several factors, but in most cases the sensor should last two to three years.

6.1.2 The following materials are required before replacing the sensor:

- 10 ppm test gas ..... Stock No. 22865
- Calibration connector..... Stock No. 22893
- Sensor..... Stock No. 22919
- Standard screwdriver

6.1.3 Open the instrument case to access the interior faceplate. Take care not to introduce contaminants into the instrument when the case is open.

6.1.4 Loosen the closing screw located in the center of the lower edge of the faceplate.

6.1.5 Using the top hinge as the pivot, swing the faceplate up to expose the instrumentation.

6.1.6 Locate the clear-plastic sensor housing, shown in Figure 11, and while supporting the circuit board, loosen the two mounting screws.

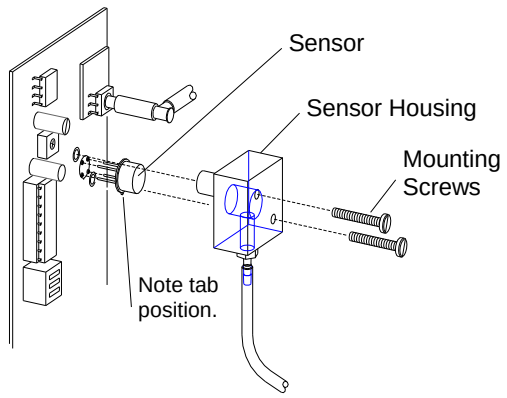


Figure 11

6.1.7 Carefully pull straight up to lift the sensor housing off the circuit board. The sensor may come off with the housing or stay plugged into the board.

6.1.8 If the sensor remains on the circuit board, note the location of the small tab, as the new sensor must be installed in the same orientation. While supporting the circuit board, carefully pull straight up to remove the sensor.

6.1.9 If the sensor comes off with the housing, note the tab location and remove the sensor by pulling on a couple of the sensor pins.

6.1.10 Discard the old sensor to avoid attempts to reuse.

6.1.11 Handle the new sensor taking care not to distort the pins. Rotate the sensor so the tab is in the same position as was the old one (as shown in Figure 11) and plug the pins into the socket. Some pin alignment may be required, and is normal. Push firmly but carefully to seat the sensor. The sensor will stand off the circuit board by approximately 1/4" when seated.

6.1.12 Place the sensor housing over the sensor, align the mounting screw holes, and while supporting the circuit board, tighten the screws snugly but **Do not overtighten as it could damage the board.**

6.1.13 When closing the faceplate, make sure that all internal air lines are free of interference, binding or kinks, and that all tube connections are secure. Tighten the closing screw.

6.1.14 Close the instrument case and apply sample air and power per section 3.0, and allow the monitor to run in operating mode for at least one hour.

6.1.15 Calibrate the monitor per Section 4.0.

6.1.16 Return the monitor to service and record sensor replacement date.

6.1.17 Follow the calibration testing schedule per Section 5.3.

6.2 Fuse Replacement

6.2.1 The fuse cap is located on the side of the instrument case. To access the fuse, push the cap in and rotate counterclockwise.

7.0 TROUBLESHOOTING

⚠ WARNING

Shorting electrical components can result in serious electrical shocks or can damage equipment. All electrical troubleshooting must be performed by a qualified electrician.

7.1 Instrument Will Not Calibrate: If the alarm sounds when test gas is applied but does not stop when gas is removed, or if response is very slow.

7.1.1 Calibration humidifier not moistened during calibration. Make sure that the humidifier sponge is dampened with distilled water before calibrating.

7.1.2 Replace sensor.

7.2 Intermittent Alarm: A pressure switch mounted on the circuit board monitors pressure of the sample air delivered to the sensor. If pressure at the switch (which is monitored by flow through the flow meter) drops below minimum requirement or rises above maximum psi, the monitor will initiate an intermittent alarm.

7.2.1 Before doing pressure tests, make sure the Run/Calibration toggle switch is toward RUN position. If for any reason the toggle is not in the RUN position, the instrument will initiate an intermittent alarm, indicating that the sample air is not reaching the sensor. Correctly positioning the toggle will terminate the intermittent alarm.

7.2.2 Make sure the pressure of the sample air is between 55 psi and 100 psi. If the sample air is higher than 55 psi, the restriction is internal. Proceed as follows:

7.2.3 Check flow through the flow meter. If the flow ball is below 0.5 SCFH or above .9 SCFH, adjust the internal pressure regulator accordingly, until the ball remains between 0.5 and 0.8 SCFH. The regulator was factory set slightly higher than the pressure switch and should rarely require adjustment. If the regulator pressure was outside the limits, the alarm will disengage as soon as the pressure is corrected. After the pressure is correctly set, close the faceplate.

7.2.4 If the flow meter ball does not raise or stays very low in the meter:

7.2.4.1 Check internal instrumentation lines for breaks, kinks, or disconnection. If a line has come loose, reconnecting it will re-establish function and the monitor can be correctly used**. NOTE: This type of failure could be the result of improper service, as the instrument is tested with pressure much higher than operating pressure. The monitor should be returned to the maintenance service technician for review as soon as practical.**

7.2.4.2 Check the purple and red orifices (usually the purple orifice) for blockage. Replace the orifice if it is blocked.

7.3 No Annunciator Lights or Alarms: This condition indicates a loss of electrical power, as it is unlikely that audible and visual alarms will fail at the same time.

7.3.1 Make sure the electrical power cord is connected to the appropriate power source.

7.3.2 Check the fuse located inside the case; make sure it is not blown.

7.3.3 Make sure the power supply is ON.

7.3.4 For 12-volt system, make sure the battery is fully charged and that the charging system is operational. Make sure the positive and negative terminals are connected correctly.

7.3.5 Check for faulty transformer or loose plug connection on circuit board.

7.4 Either Alarm Light or Audible Alarm Fails:

7.4.1 Check for loose plug connections on circuit board.

7.4.2 To test the alarm, remove the plug connection on the circuit board from the suspect alarm and apply external 12-volt power. If the alarm fails to activate, replace it.

7.4.3 To test the circuit board, remove the plug connection from the faulty alarm. Use a voltmeter to check voltage across circuit board pins. When testing an audible alarm, switch the Run/Calibration Switch to the ″Calibration″ position. This will cause an intermittent alarm and should register on the voltmeter each time the alarm activates. Monitors with faulty circuit board should be returned for service.

8.0 ACCESSORIES AND REPLACEMENT PARTS

8.1 Accessories

Item Description Stock No.

(-) Remote alarm kit, includes: alarm, stand, wiring connector and 50 ft. cable 22909
(-) Cable, 50 ft. remote alarm extension 22910

8.2 Replacement Parts – Figure 12

Item Description ..... Stock No.

(-) CMS-2 CO monitor package, includes: monitor, calibration connector, and 10 ppm test gas
120-volt AC 22894
12-volt DC 25024

120-volt AC monitors can be field converted to 12-volt DC. Refer to Section 2.4.

(-) CMS-2 CO monitor only, includes: CO monitor and items 4 through 10
120-volt AC 22892
12-volt DC 25072

120-volt AC monitors can be field converted to 12-volt DC. Refer to Section 2.4.

1. Calibration connector assembly, includes: tube, humidifier, and flow-control valve with connector 22893
2. Test gas
10 ppm 22865
Impurity free 11132
3. Tubing, clear for Item 1 and internal, per ft., specify length required 29261
4. Regulator/filter, M5 22920
5. Filter element, replacement for Item 5 22921
6. Flow meter 21376
7. Horn w/ wire and connector, 12-volt DC 22922
8. Alarm light, exterior w/ wire and connector...22923
9. Fitting, 1/4-NPT x 1/4" OD tube 22924
10. Tubing, urethane, per foot, ten feet required 12475

(-) Power supply, 120/220 AC to 12-v. DC 28011
(-) Sensor (not shown) 22919
(-) Orifice, .004 purple restrictor (not shown)..24423
(-) Orifice, .006 red restrictor (not shown) 24424
(-) Fuse, 1-amp (not shown) ..... purchase locally

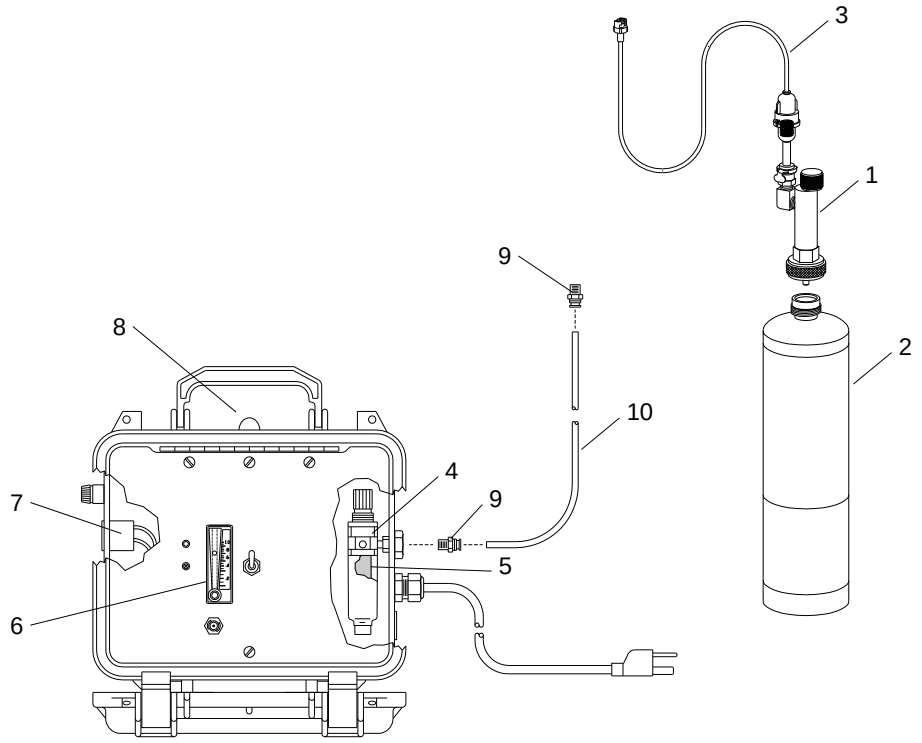


Figure 12