

CMS 1 CARBON MONOXIDE MONITOR

O. M. 23301

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WARNING

Do not proceed with these instructions until you have READ the orange cover of this MANUAL and YOU UNDERSTAND its contents. * These WARNINGS are included for the health and safety of the operator and those in the immediate vicinity.

***If you are using a Clemco Distributor Maintenance and Part Guide, refer to the orange warnings insert preceding the Index before continuing with the enclosed instructions.**

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

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⚠ WARNING

- Read and follow ALL instructions before using this equipment.
- Failure to comply with ALL instructions can result in serious injury or death.
- In the event that the user, or any assistants of the user of this equipment cannot read or cannot completely understand the warnings and information contained in these instructions, the employer of the user and his assistants must thoroughly educate and train them on the proper operation and safety procedures of this equipment.

NOTICE TO PURCHASERS AND USERS OF OUR PRODUCTS AND THIS INFORMATIONAL MATERIAL

The products described in this material, and the information relating to those products, is intended for knowledgeable, experienced users of abrasive blasting equipment.

No representation is intended or made as to the suitability of the products described herein for any particular purpose or application. No representations are intended or made as to the efficiency, production rate, or the useful life of the products described herein. Any estimate regarding production rates or production finishes are the responsibility of the user and must be derived solely from the user's experience and expertise, and must not be based on information in this material.

The products described in this material may be combined by the user in a variety of ways for purposes determined solely by the user. No representations are intended or made as to the suitability or engineering balance of the combination of products determined by the user in his selection, nor as to the compliance with regulations or standard practice of such combinations of components or products.

Abrasive Blast Equipment is only a component of the range of equipment used in an abrasive blasting job. Other products may include an air compressor, abrasive, scaffolding, hydraulic work platforms or booms, paint spray equipment, dehumidification equipment, air filters and receivers, lights, ventilation equipment, parts handling equipment, specialized respirators, or equipment that while offered by Clemco may have been supplied by others. Each manufacturer and supplier of the other products used in the abrasive blasting job must be contacted for information, training, instruction and warnings with regard to the proper and safe use of their equipment in the particular application for which the equipment is being used. The information provided by Clemco is intended to provide instruction only on Clemco products. All operators must be trained in the proper, safe, use of this equipment. It is the responsibility of the users to familiarize themselves with, and comply with, all appropriate laws, regulations, and safe practices that apply to the use of these products. Consult with your employer about training programs and materials that are available.

Our company is proud to provide a variety of products to the abrasive blasting industry, and we have confidence that the professionals in our industry will utilize their knowledge and expertise in the safe efficient use of these products.

GENERAL INSTRUCTIONS

Described herein are some, BUT NOT ALL, of the major requirements for safe and productive use of blast machines, remote control systems, operator respirator assemblies, and related accessories. Completely read ALL instruction manuals prior to using equipment.

The user's work environment may include certain HAZARDS related to the abrasive blasting operation. Proper protection for the blaster, as well as anyone else that may be EXPOSED to the hazards generated by the blasting process, is the responsibility of the user and/or the employer. Operators MUST consult with their employer about what hazards may be present in the work environment including, but not limited to, exposure to dust that may contain TOXIC MATERIALS due to the presence of silica, cyanide, arsenic or other toxins in the abrasive, or materials present in the surface to be blasted such as lead or heavy metals in coatings. The environment may also include fumes that may be present from adjacent coatings application, contaminated water, engine exhaust, chemicals, and asbestos. The work area may include PHYSICAL HAZARDS such as an uneven work surface, poor visibility, excess noise, and electrical hazards. The operator MUST consult with his employer on the identification of potential hazards, and the appropriate measures that MUST be taken to protect the blaster and others that might be exposed to these hazards.

ALL machines, components and accessories MUST be installed, tested, operated and maintained only by trained, knowledgeable, experienced users.

DO NOT modify or substitute any Clemco parts with other types or brands of equipment. Unauthorized modification and parts substitution on supplied air respirators is a violation of OSHA regulations and voids the NIOSH approval.

OPERATIONAL INSTRUCTIONS

OPERATOR SAFETY EQUIPMENT

⚠ WARNING


- Blast operators and others working in the vicinity of abrasive blasting must always wear properly-maintained, NIOSH-approved, respiratory protection appropriate for the job site hazards.
- DO NOT USE abrasives containing more than one percent crystalline (free) silica. Ref. NIOSH Alert #92-102
- Inhalation of toxic dust (crystalline silica, asbestos, lead paint and other toxins) can lead to serious or fatal disease (silicosis, asbestosis, lead or other poisoning).

- ALWAYS wear NIOSH-approved supplied-air respirators as required by OSHA, in the presence of any dust including, but not limited to, handling or loading abrasive; blasting or working in the vicinity of blast jobs; and cleanup of expended abrasive. Prior to removing respirator, an air monitoring

instrument should be used to determine when surrounding atmosphere is clear of dust and safe to breathe.

- NIOSH-approved, supplied-air respirators are to be worn ONLY in atmospheres:
 - NOT IMMEDIATELY dangerous to life or health and,
 - from which a user can escape WITHOUT using the respirator.
- Clemco supplied-air respirators **DO NOT REMOVE OR PROTECT AGAINST CARBON MONOXIDE (CO) OR ANY OTHER TOXIC GAS.** Carbon monoxide and toxic gas removal and/or monitoring device must be used in conjunction with respirator to insure safe breathing air.
- Air supplied to respirator **MUST BE AT LEAST GRADE D QUALITY** as described in Compressed Gas Association Commodity Specification G-7.1, and as specified by OSHA Regulation 1910.139 (d).
- ALWAYS locate compressors to prevent contaminated air (such as CO from engine exhaust) from entering the air intake system. A suitable in-line air purifying sorbent bed and filter or CO Monitor should be installed to assure breathing air quality.
- ALWAYS use a NIOSH-approved breathing air hose to connect an appropriate air filter to the respirator. Use of a non-approved air hose can subject the operator to illness caused by the release of chemical agents used in the manufacture of non-approved breathing air hose.
- ALWAYS check to make sure air filter and respirator system hoses are NOT CONNECTED to in-plant lines that contain nitrogen, acetylene or any other non-breathable gas. NEVER use oxygen with air line respirators. NEVER modify air line connections to accommodate air filter/respirator breathing hose WITHOUT FIRST testing content of the air line. **FAILURE TO TEST THE AIR LINE MAY RESULT IN DEATH TO THE RESPIRATOR USER.**
- Respirator lenses are designed to protect against rebounding abrasive. They do not protect against flying objects, glare, liquids, radiation or high speed heavy materials. Substitute lenses from sources other than the original respirator manufacturer will void NIOSH-approval of this respirator.

BLAST MACHINES AND REMOTE CONTROLS

 WARNING
<ul style="list-style-type: none"> • ALWAYS equip abrasive blast machines with remote controls. • Abrasive blast machine operators must wear NIOSH-approved supplied-air respirators (ref: OSHA regulations 1910.94, 1910.132, 1910.139 and 1910.244).

- NEVER modify OR substitute remote control parts. Parts from different manufacturers are NOT compatible with Clemco

equipment. If controls are altered, involuntary activation, which may cause serious injury, can occur.

- Inspect the air control orifice DAILY for cleanliness. NEVER use welding hose in place of twinline control hose. The internal diameter and rubber composition are UNSAFE for remote control use.
- UNLESS OTHERWISE SPECIFIED, maximum working pressure of blast machines and related components MUST NOT exceed National Board approved 125 psig (8.5 BAR).
- NEVER weld on blast machine. Welding may affect dimensional integrity of steel wall and WILL VOID National Board approval.
- Point nozzle ONLY at structure being blasted. High velocity abrasive particles WILL inflict serious injury. Keep unprotected workers OUT of blast area.
- NEVER attempt to manually move blast machine when it contains abrasive. EMPTY machines, up to 6 cu. ft.(270kg) capacity, are designed to be moved:
 - on flat, smooth surfaces by AT LEAST two people;
 - with the Clemco "Mule"; or
 - with other specially designed machine moving devices.
- Larger empty blast machines or ANY blast machine containing abrasive MUST be transported by mechanical lifting equipment.

AIR HOSE, BLAST HOSE, COUPLINGS, AND NOZZLE HOLDERS

- Air hose, air hose fittings and connectors at compressors and blast machines MUST be FOUR times the size of the nozzle orifice. Air hose lengths MUST be kept as short as possible AND in a straight line. Inspect DAILY and repair leakage IMMEDIATELY.
- Blast hose inside diameter MUST be THREE to FOUR times the size of the nozzle orifice. AVOID sharp bends that wear out hose rapidly. Use SHORTEST hose lengths possible to reduce pressure loss. Check blast hose DAILY for soft spots. Repair or replace IMMEDIATELY.
- ALWAYS cut loose hose ends square when installing hose couplings and nozzle holders to allow uniform fit of hose to coupling shoulder. NEVER install couplings or nozzle holders that DO NOT provide a TIGHT fit on hose. ALWAYS use manufacturers recommended coupling screws.
- Replace coupling gaskets FREQUENTLY to prevent leakage. Abrasive leakage can result in dangerous coupling failure. ALL gaskets MUST be checked SEVERAL times during a working day for wear, distortion and softness.
- Install safety pins at EVERY coupling connection to prevent accidental disengagement during hose movement.
- ALWAYS attach safety cables at ALL air hose AND blast hose coupling connections. Cables relieve tension on hose and control whipping action in the event of a coupling blow-out.

MAINTENANCE

- ALWAYS shut off compressor and depressurize blast machine BEFORE doing ANY maintenance.
- Always check and clean ALL filters, screens and alarm systems when doing any maintenance.
- ALWAYS cage springs BEFORE disassembling valves IF spring-loaded abrasive control valves are used.
- ALWAYS completely follow owner's manual instructions and maintain equipment at RECOMMENDED intervals.

ADDITIONAL ASSISTANCE

- Training and Educational Programs. Clemco Industries Corp. offers a booklet, Blast-Off 2, developed to educate personnel on abrasive blast equipment function and surface preparation techniques. Readers will learn safe and productive use of machines, components and various accessories, including selection of abrasive materials for specific surface profiles and degrees of cleanliness.
- The Society for Protective Coatings (SSPC) offers a video training series on protective coatings including one entitled "Surface Preparation." For loan or purchase information, contact SSPC at the address shown below.

TECHNICAL DATA AND RESEARCH COMMITTEES

- The following associations offer information, materials and videos relating to abrasive blasting and safe operating practices.

The Society for Protective Coatings (SSPC)
 40 24th Street, Pittsburgh PA 15222-4643
 Phone: (412) 281-2331 • FAX (412) 281-9992
 Email: research@sspc.org • Website: www.sspc.org

National Association of Corrosion Engineers (NACE)
 1440 South Creek Drive, Houston TX 77084
 Phone: (281) 228-6200 • FAX (281) 228-6300
 Email: msd@mail.nace.org • Website: www.nace.org

American Society for Testing and Materials (ASTM)
 100 Barr Harbor Dr., West Conshohocken, PA 19428
 Phone (610) 832-9500 • FAX (610) 832-9555
 Email: service@astm.org • Website: www.astm.org

NOTICE

This equipment is not intended to be used in an area that might be considered a hazardous location as described in the National Electric Code NFPA 70 1996, article 500.


WARRANTY

The following is in lieu of all warranties express, implied or statutory and in no event shall seller or its agents, successors, nominees or assignees, or either, be liable for special or consequential damage arising out of a breach of warranty. This warranty does not apply to any damage or defect resulting from negligent or improper assembly or use of any item by the buyer or its agent or from alteration or attempted repair by any person other than an authorized agent of seller. All used, repaired, modified or altered items are purchased "as is" and with all faults. In no event shall seller be liable for consequential or incidental damages. The sole and exclusive remedy of buyer for breach of warranty by seller shall be repair or replacement of defective parts or, at seller's option, refund

- of the purchase price, as set forth below:
1. Seller makes no warranty with respect to products used other than in accordance hereunder.
 2. On products seller manufactures, seller warrants that all products are to be free from defects in workmanship and materials for a period of one year from date of shipment to buyer, but no warranty is made that the products are fit for a particular purpose.
 3. On products which seller buys and resells pursuant to this order, seller warrants that the products shall carry the then standard warranties of the manufacturers thereof, a copy of which shall be made available to customer upon request.
 4. The use of any sample or model in connection with this order is for illustrative purposes only and is not to be construed as a warranty that the product will conform to the sample or model.
 5. Seller makes no warranty that the products are delivered free of the rightful claim of any third party by way of patent infringement or the like.
 6. This warranty is conditioned upon seller's receipt within ten (10) days after a buyer's discovery of a defect, of a written notice stating in what specific material respects the product failed to meet this warranty. If such notice is timely given, seller will, at its option, either modify the product or part to correct the defect, replace the product or part with complying products or parts, or refund the amount paid for the defective product, any one of which will constitute the sole liability of seller and a full settlement of all claims. No allowance will be made for alterations or repairs made by other than those authorized by seller without the prior written consent of seller. Buyer shall afford seller prompt and reasonable opportunity to inspect the products for which any claim is made as above stated.

Except as expressly set forth above, all warranties, express, implied or statutory, including implied warranty of merchantability, are hereby disclaimed.

DAILY SET-UP CHECK LIST

 WARNING
<ul style="list-style-type: none"> • ALL piping, fittings and hoses MUST be checked DAILY for tightness and leakage. • ALL equipment and components MUST be thoroughly checked for wear. • ALL worn or suspicious parts MUST be replaced. • ALL blast operators MUST be properly trained to operate equipment. • ALL blast operators MUST be properly outfitted with abrasive resistant clothing, safety shoes, leather gloves and ear protection. • BEFORE blasting ALWAYS use the following check list.

1. PROPERLY MAINTAINED AIR COMPRESSOR sized to provide sufficient volume (cfm) for nozzle and other tools PLUS a 50% reserve to allow for nozzle wear. Use large compressor outlet and large air hose (4 times the nozzle orifice size). FOLLOW MANUFACTURERS MAINTENANCE INSTRUCTIONS.

2. BREATHING AIR COMPRESSOR (oil-less air pump) capable of providing Grade D Quality air located in a dust free, contaminant free area. If oil-lubricated air compressor is used to supply respirator, it should have high temperature monitor and CO monitor or both. If CO monitor is not used, air **MUST** be tested FREQUENTLY to ensure proper air quality.

3. Clean, properly maintained NIOSH-APPROVED SUPPLIED-AIR RESPIRATOR. ALL components should ALWAYS be present. NEVER operate without inner lens in place. Thoroughly inspect ALL components DAILY for cleanliness and wear. ANY substitution of parts voids NIOSH approval i.e. cape, lenses, breathing hose, breathing air supply hose, air control valve, cool air or climate control devices.

4. OSHA required BREATHING AIR FILTER for removal of moisture and particulate matter from breathing air supply. THIS DEVICE DOES NOT REMOVE OR DETECT CARBON MONOXIDE (CO). ALWAYS USE CO MONITOR ALARM.

5. ASME CODED BLAST MACHINE sized to hold 1/2 hour abrasive supply. ALWAYS ground machine to eliminate static electricity hazard. Examine pop up valve for alignment. Blast machine MUST be fitted with a screen to keep out foreign objects and a cover to prevent entry of moisture overnight.

6. AIR LINE FILTER installed AS CLOSE AS POSSIBLE to machine inlet. Sized to match inlet piping or larger air supply line. Clean filter DAILY. Drain OFTEN.

7. REMOTE CONTROLS MUST be in PERFECT operating condition. ONLY use APPROVED spare parts, including twin-line hose. DAILY: test system operation and check button bumper and spring action of lever and lever lock. DO NOT USE WELDING HOSE.

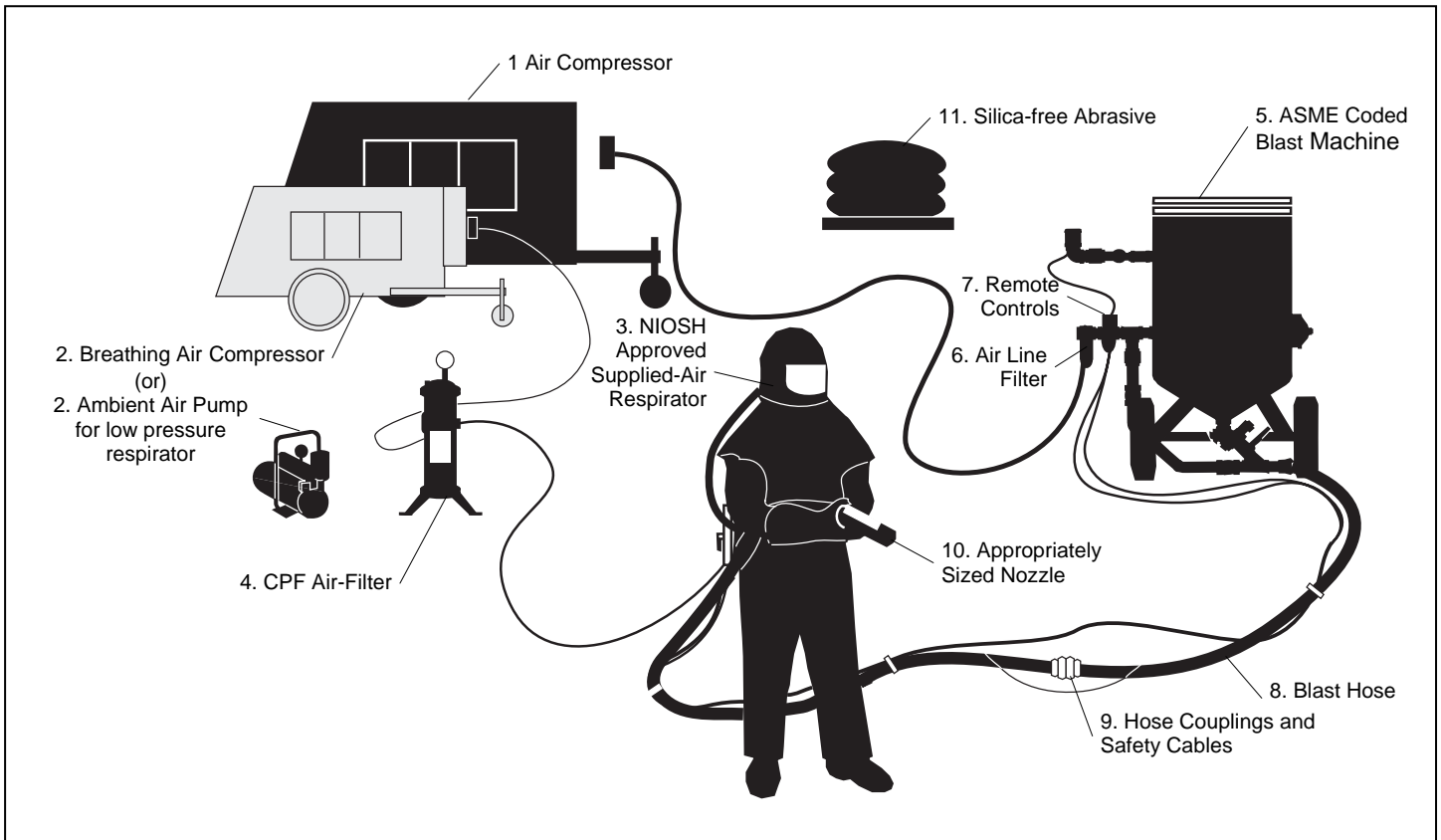
8. BLAST HOSE with ID 3 to 4 times the nozzle orifice. Lines MUST be run AS STRAIGHT AS POSSIBLE from machine to work area with NO sharp bends. Check DAILY for internal wear and external damage.

9. HOSE COUPLINGS, NOZZLE HOLDERS fitted SNUGLY to hose end and installed using PROPER coupling screws. Coupling lugs MUST be snapped FIRMLY into locking position. Gasket MUST form positive seal with safety pins inserted through pin holes. Check gaskets and replace if ANY sign of wear, softness or distortion. ALWAYS install safety cables at every connection to prevent disengagement. Check nozzle holder for worn threads. NEVER MIX DIFFERENT BRANDS OF COMPONENTS. Check each of these components DAILY.

10. Inspect NOZZLE and GASKET DAILY for wear. Replace nozzle when 1/16" larger than original size or if liner appears cracked. Check nozzle threads for wear.

11. Use abrasive that is properly sized and free of harmful substances; such as, free silica, cyanide, arsenic or lead. Check material data sheet for presence of toxic or harmful substances.

12. Test surface to be blasted for toxic substances. Take appropriate, and NIOSH required, protective measures for operator and bystanders which pertain to substances found on the surface to be blasted.



1.0 INTRODUCTION

1.1 Scope of manual

1.1.1 These instructions cover the set-up, operation, maintenance, troubleshooting, and replacement parts for the CMS-1 carbon monoxide (CO) monitor.

1.1.2 The CMS-1 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 Z535.4-1998, 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 the user of this equipment of potential personal injury hazards.

Obey all safety messages that follow this symbol to avoid possible injury or death.

CAUTION

Caution used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

CAUTION

Caution indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNING

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

DANGER

Danger indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

1.3 Components

1.3.1 The primary components are shown in Figure 1. The instrumentation is enclosed in a non-metallic case. The monitor system includes the instrument case, filter/regulator, ten feet of 1/8" ID x 1/4" OD tubing with adaptor fittings, a cylinder of 10 PPM (parts per million) test gas, and the calibration connector, which includes the connector valve and tubing.

1.4 Operating Principles

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

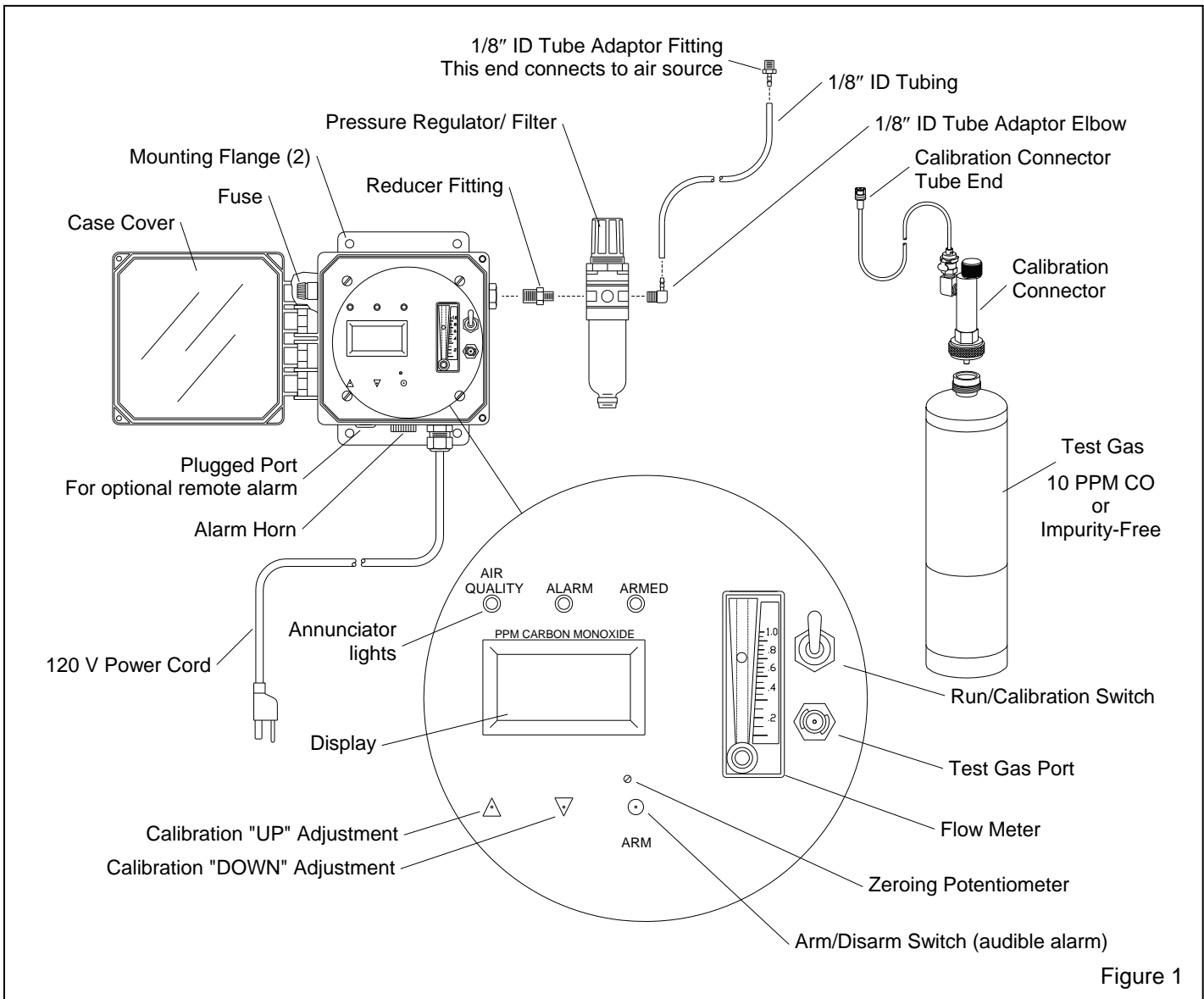
WARNING

When the CMS is correctly installed and maintained, it monitors the level of carbon monoxide in the air supply. The instrument is a monitoring device, it DOES NOT remove or convert carbon monoxide.

1.4.2 During operation, a small sample of air, referred to as "sample-air", passes through the instrument, and is continuously monitored by the chemical cell sensor. If the "sample-air" supply fails for any reason such as air blockage, loss of pressure, or excessively high pressure, an intermittent alarm horn will sound and the "Alarm Light" will illuminate yellow to alert the user.

1.4.3 In the event CO is detected in concentrations of 10 PPM or above, a continuous alarm horn sounds and the "AIR QUALITY" alarm light illuminates red. The alarms alert the user to immediately stop blasting, and remove the respirator as soon as it is safe to do so.

1.4.4 The alarm trip-point is preset at 10 parts per million (PPM), which is the maximum permissible exposure level (PEL) of CO for grade "D" breathing air.



1.5 Annunciator Lights and Audible Alarm

1.5.1 A horn (audible alarm) is provided on the exterior of the instrument case, and annunciator lights (visual alarms) are mounted on the faceplate. The lights illuminate green when conditions are safe, or yellow or red when an alarm occurs. The alarm horn sounds in conjunction with the visual alarm.

1.5.2 The alarm lights and the nature of the alarm horn indicate the condition causing an alarm. Functions of the alarm annunciators are as follows:

Armed light: This indicates whether the alarm horn is armed. Green means the alarm horn is armed, no light means it is disarmed. **NOTE: The only time the horn should be disarmed is to temporarily silence it, by the technician during calibration.**

⚠ 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.

⚠ WARNING

Do not use compressed air monitored by this instrument for breathing without checking to make sure all three alarm lights are illuminated green. Failure to heed this warning could cause death from the inhalation of carbon monoxide.

Alarm light:**Green Light - No Audible Horn**

Indicates there is correct air flow and pressure to the sensor. Correct flow is observed on the flow meter; the flow ball is usually between .5 and .8 SCFH.

Yellow Light - Intermittent Alarm Horn

(Approximately every ten seconds)

Sample-Air Failure: This alarm is due to either low flow, or high flow in the test chamber. Low flow (flow ball is low in the flow meter) is usually due to loss of pressure or plug in the sample-air line, or the external pressure regulator is set too low. High flow (flow ball is high in the flow meter) is an indication that the external pressure regulator is set too high.

Yellow Light - No Audible Horn

Warm-Up Period: During the first minute or two of operation, the monitor goes through a warm-up period while the sensor stabilizes. During the warm-up period, this alarm occurs, and all other alarms are non-operational. After the warm-up is complete, the alarm light turns green if the air is free of CO, or turns red if the air is contaminated with CO.

Air Quality light:**Green Light - No Audible Horn**

Safe Condition: This means the sample-air gas is below the permissible exposure level. **Do not use the compressed air for breathing unless the "AIR QUALITY" light is illuminated green.**

Red Light - Continuous Audible Horn Alarm

Toxic Gas Detected: This alarm occurs when the sensor detects 10 PPM of CO. **NOTE: It is not unusual for the alarm light to be briefly RED as the sensor stabilizes after the warm-up.**

1.6 Digital Display

1.6.1 The digital display shows the level of Carbon Monoxide (CO) parts per million (PPM). The sensor also responds to a Hydrogen Sulfide and limited number of other toxic gases, and may display inflated CO readings when other toxic gases are detected. **NOTE: It is not unusual for the display to be slightly high for a brief period while the sensor stabilizes after the warm-up.**

1.7 Switches

1.7.1 Run/Calibration Switch: Position the toggle 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.

1.7.2 Arm/Disarm Switch: This switch arms and disarms the alarm horn. The switch is tripped by inserting a small probe (a straightened paper clip works well) through the small access opening in the faceplate, and pushing gently until the detent is felt. It may take a couple pushes to trip the switch. The horn is armed when the "ARM" light is green. The horn is disarmed when the light is unlit. **NOTE:** The only time the horn should be disarmed is to temporarily silence it, by the technician during calibration.

1.8 Optional Accessories

1.8.1 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. It 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 ft. cable. See Accessories in Section 9.1. With additional cable the remote alarm may be placed up to 150 ft. from monitor. Consult Clemco Industries Corp. if longer length is required.

2.0 SET-UP**2.1 Assembly, Ref. Figure 2**

2.1.1 Using the screws and instructions provided in the mounting flange packet, attach the mounting flanges to the instrument case.

2.1.2 Apply Teflon thread sealing tape to the threads of the 1/4" x 1/8" reducer fitting and tubing elbow, and assemble as shown in Figure 2. Make sure the regulator is correctly installed so the air flow is toward the instrument. The tubing elbow may be rotated after the instrument is mounted, to enable the tubing to be connected with minimum bends.

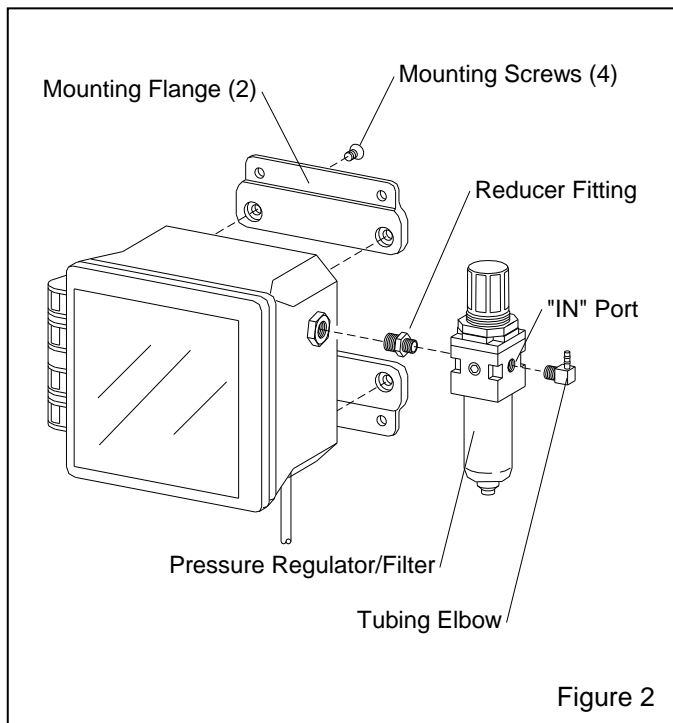
2.2 Mounting

2.2.1 The simplest way to mount the CMS-1, is with the mounting flanges provided, ref. Figure 2. Mount the monitor in convenient location that is close to the compressed air source. See Section 2.3.2. The monitor must be positioned upright and level, to ensure the flow meter responds correctly. Place the monitor on a wall or

panel, and mark the mounting hole locations. Drill appropriately sized holes, and secure with fasteners.

⚠ WARNING

DO NOT mount this instrument inside a blast room. An operator inside a blast room wearing protective clothing will not hear the alarm and may not notice when the instrument is in an alarm condition. The alarm case is not designed to withstand the continual impact of abrasive that takes place inside a blast room. **DO NOT** mount this instrument inside a paint room, or an explosive or flammable environment. This instrument is not rated for explosive atmospheres. Refer to instructions within the manual for installing auxiliary horns, lights, and safety shut-down devices.



2.3 Compressed Air Requirements

2.3.1 Air Pressure: If the compressed air source is between 55 psi and 145 psi, no line pressure adjustment is required. If line pressure is above 145 psi, a regulator is required in the air line, (before the monitor's regulator) to reduce pressure within the 55 to 145 psi operating range.

2.3.2 Air Connection

CAUTION

NOTE: Do not use pipe joint compound to seal pipe fittings. Use Teflon tape for pipe thread sealer. Do not use any silicone based lubricants up-stream of this instrument.

2.3.2.1 To ensure accurate and rapid air monitoring, the instrument must be placed as close to the compressed air source as practical. Ten feet of 1/8" ID tubing with one 1/8" NPT elbow adaptor and one 1/8" NPT straight adaptor are furnished, to be used between the compressed air source and monitor inlet. Larger diameter tubing or pipe, or longer lengths, increases the time it takes for the sample-air to reach the monitor.

2.3.2.2 Locate a suitable place to tap into the compressed air supply. Do not tap into a dead-end air line. The tap location must be where moving air is assured. The tap location should be within 10 feet of the monitor, and the monitor placed in a location that permits continual observance of the visual and audible alarms.

⚠ 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, to additionally safeguard against an unobserved alarm.

2.3.2.3 Place a tee in the air supply line, and use a bushing or other adaptor, to connect the 1/8" NPT tube adaptor supplied. Install an isolation valve at the source to enable depressurization to remove the monitor. Typical set-ups are shown in Figure 3.

2.3.2.4 The air supply line tee should face upward to prevent water from accumulating in the sample-air line. If the tap cannot be up, install a short 1/4" NPT drop pipe and drain to prevent water from entering the monitor.

2.3.2.5 Attach the urethane tubing between the air supply tube adaptor fitting and monitor inlet tube adaptor fitting. Cut-off excess tubing.

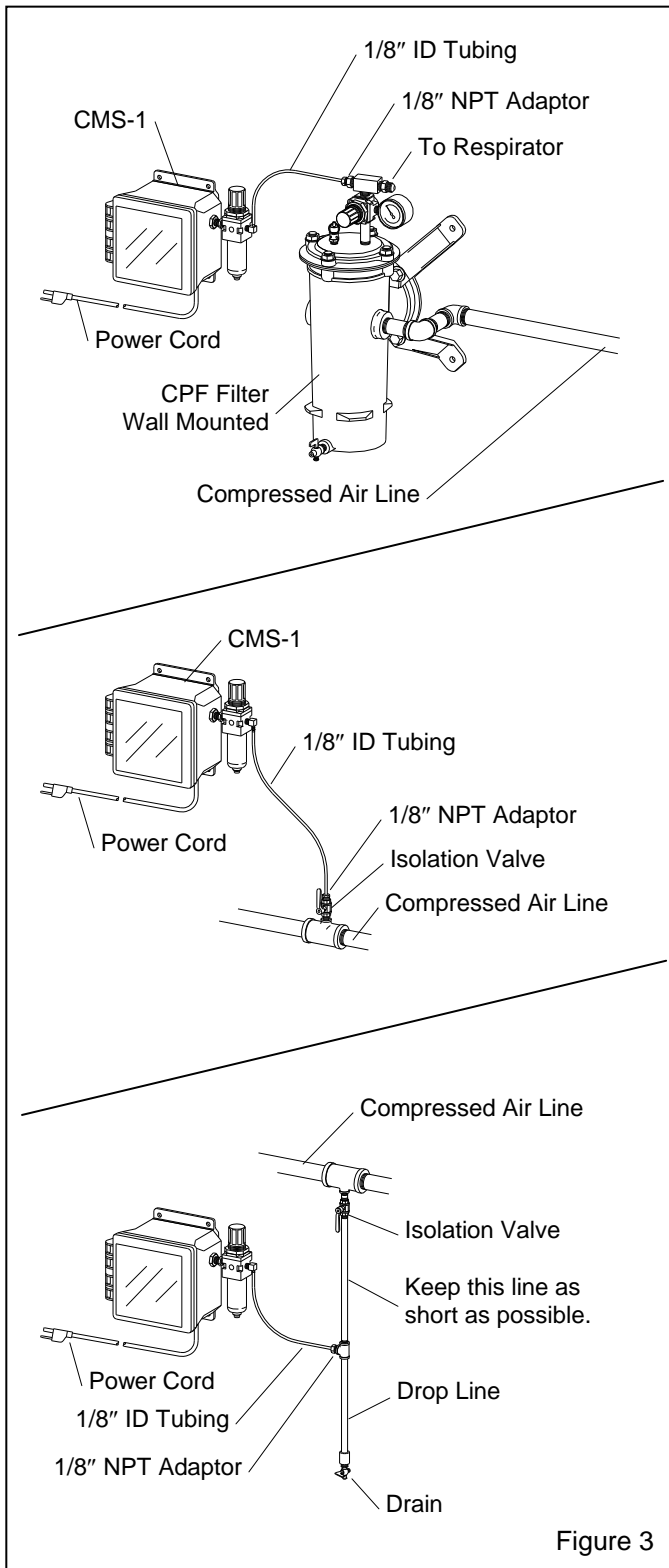


Figure 3

2.4 Electrical Requirements

2.4.1 120-Volt AC: Monitors are supplied with a 120 volt AC power cord, and can be plugged into a 120 volt grounded electrical outlet. Electrical power may be

rewired with conduit that conforms to applicable codes, by a qualified electrician.

2.4.2 12-Volt DC: Although monitors are furnished with a 120 volt AC power cord, they are easily converted to operate on 12 volt DC. The following instructions explain the conversion. Use the supply cord provided with the monitor, or use another 2 wire cord if a longer one is required using the same process, but with 12 volt color codes, using red as positive. Refer to Figure 4.

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

2.4.2.2 Loosen the two case-cover screws and open the case cover.

2.4.2.3 Remove the four faceplate screws, and carefully remove the faceplate, being careful not to disconnect any wires or tubing. **NOTE: The screws on one side are shorter than the other side, replace accordingly.**

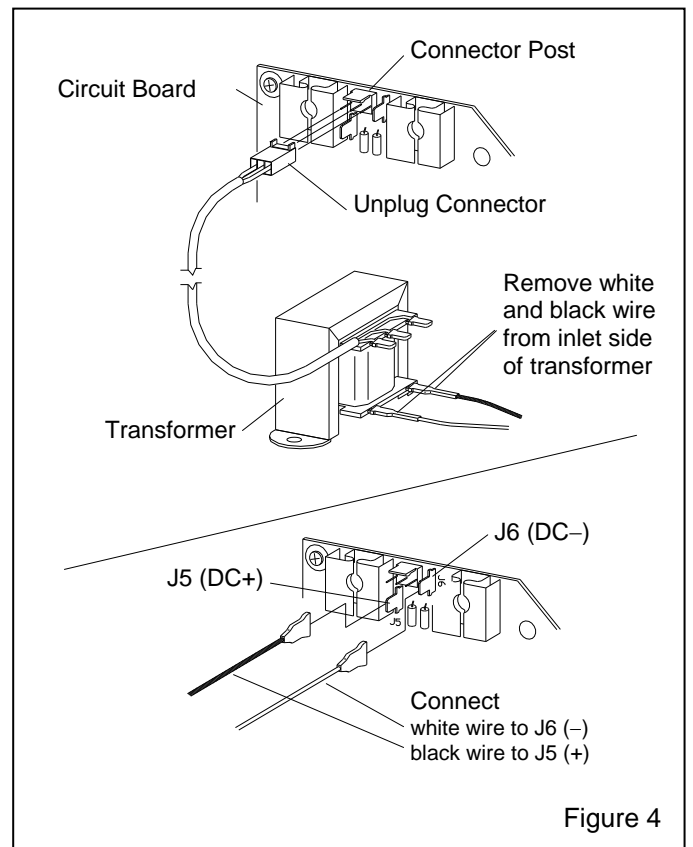


Figure 4

2.4.2.4 Unplug the terminal connector from the connector post (located on the circuit board), leading from the outlet side of the transformer, as shown in Figure 4. If the monitor is to be permanently converted to 12 volts, remove the three wires from the transformer and discard the wire.

2.4.2.5 Remove the white and black wire terminal connectors from the inlet side of the transformer. Ref. Figure 4.

2.4.2.6 Plug the black wire connector to the terminal marked J5 (positive +) on the upper edge of the circuit board, and the white wire connector to the terminal marked J6 (negative -).

2.4.2.7 Reposition the faceplate, ensuring that all internal air lines are free of interference, binding or kinks, and that all tube connections are secure. Tighten the faceplate screws finger-tight to ensure they are threading correctly, then tighten to barely snug with a screwdriver.

2.4.2.8 Close and secure the instrument case cover, tightening the screws to a maximum of 20-inch lbs.

2.4.2.9 Remove the U-ground plug from the other end of the cord.

2.4.2.10 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.

CAUTION

Use any terminal connectors that are compatible with the 12 Volt DC system. However, take care to ensure that the connectors are clearly marked positive (+) and negative (-). Attach the positive connector to the wire leading to the DC+ terminal, and the negative connector to the DC- terminal on the circuit board. The monitor will not operate if wires are reversed.

2.5 Connecting External Alarm and Shut-Down Device. Ref. Figure 5.

Note: External alarms require external power. Do not confuse an external alarm with the optional remote alarm, which does not require external power.

2.5.1 A relay contact is mounted on the circuit board (Ref. Figure 5), for use with external alarms and shut-down devices. These contacts are rated at 5 amperes. Use the contacts to operate relays for external devices.

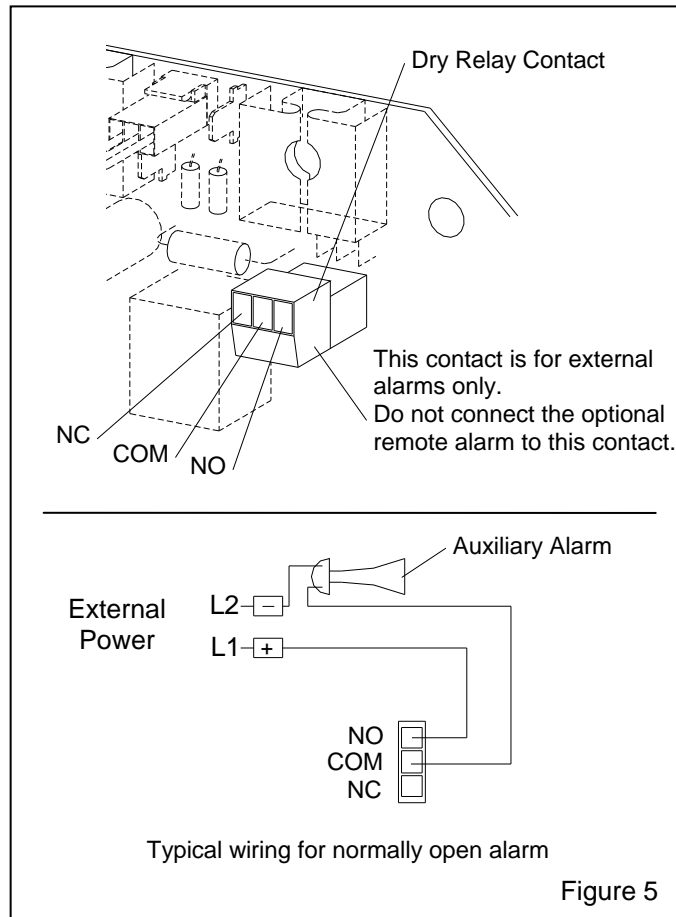


Figure 5

3.0 OPERATION

⚠ WARNING

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

3.1 Set-Up 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 air to the monitor.

3.1.3 Observe the flow meter ball, and adjust the pressure regulator until the ball remains between .5 and .8 SCFH.

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

3.2 Warm-Up Period

3.2.1 With electrical power applied and sample-air flow set between .5 and .8 SCFH, the monitor goes through a warm-up period of approximately one minute.

3.2.2 During the warm-up period, the alarm horn is disabled and the "ALARM" light is yellow.

3.2.3 At the end of the warm-up period the alarm horn is reactivated, and all the annunciator lights will be green indicating the following:

- "ARMED": The alarm horn is armed, to provide an audible alarm if CO reaches the permissible limit of 10 PPM.
- "ALARM": There is correct sample-air flow to the sensor.
- "AIR QUALITY": The sample-air at the sensor does not exceed the permissible contamination limit.

3.2.4 Insure alarms function per Section 6.4. If the alarms function as described, proceed to place the instrument in operating mode, per Section 3.3.

3.2.5 If the instrument goes into any alarm mode (any annunciator light is any color other than green, or any audible alarm) after the warm-up, re-initiate the warm-up by terminating and restarting power. If the "ARMED" light is not lit, or the "ALARM" light is yellow with an intermittent horn proceed as follows:

"ARMED" light is not lit: The alarm may be disarmed. Arm the alarm by inserting a probe (straightened paper clip) through the small access opening in the faceplate, pushing gently until the detent is felt. It may take several pushes to trip the switch.

"ALARM" light is yellow with an intermittent horn: This usually means low or high flow through the sensor. Generally, with the correct flow, the ball will be between .4 and .9, in some cases slightly higher or lower flow is required. Increase or decrease pressure at the pressure regulator in half turn increments until the horn silences. Approximately one minute later, the "ALARM" light should change from yellow to green.

3.2.6 A continuous alarm with red "AIR QUALITY" light indicates that the sample-air exceeds the permissible contamination level (the digital display confirms the contamination level), or the instrument requires a calibration test. 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 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; all three alarm lights must be lit green, and no audible alarm.

WARNING

Do not use compressed air monitored by this instrument for breathing without checking to make sure the instrument is in full operating mode, and all the annunciator lights are illuminated green. Failure to heed this warning could cause death from the inhalation of carbon monoxide.

3.4 Shut-down

3.4.1 If the instrument is in a facility that has 24 hour compressed air and electrical power, there is no need to shut the monitor off. If the compressed air system is shut-down, the electrical power must also be turned off, by unplugging the power cord, or disengaging power if the monitor is permanently wired.

CAUTION

If the compressed air source is shut-down without shutting off electrical power, the monitor will go into low flow alarm, sounding an intermittent alarm and displaying a yellow "ALARM" light.

4.0 CALIBRATION TEST and CALIBRATION

Note: Thoroughly review the calibration test and calibration process before testing or calibrating the instrument.

⚠ WARNING

The following calibration instructions are written for 10 PPM Test Gas. To avoid confusion, do not test or calibrate the instrument with any other test gas concentration. Using other concentrations, while following the calibrating instructions, will place the monitor out of calibration, and may fail to alert the user of toxic gases. Breathing toxic gases could cause death.

The following materials are required for tests and calibration

- 10 PPM Test Gas Stock No. 22865
- Impurity-Free Test Gas Stock No. 11132
(when required, see Section 4.8)
- Calibration Connector Stock No. 23011
- Small probe such as a straightened paper clip
(only when calibration is required)

4.1 Testing and Calibration

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

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

4.1.3 Calibration: Calibration means adjusting the instrument. Calibration should be done only when the instrument does not respond during calibration testing, or remains in alarm at start-up.

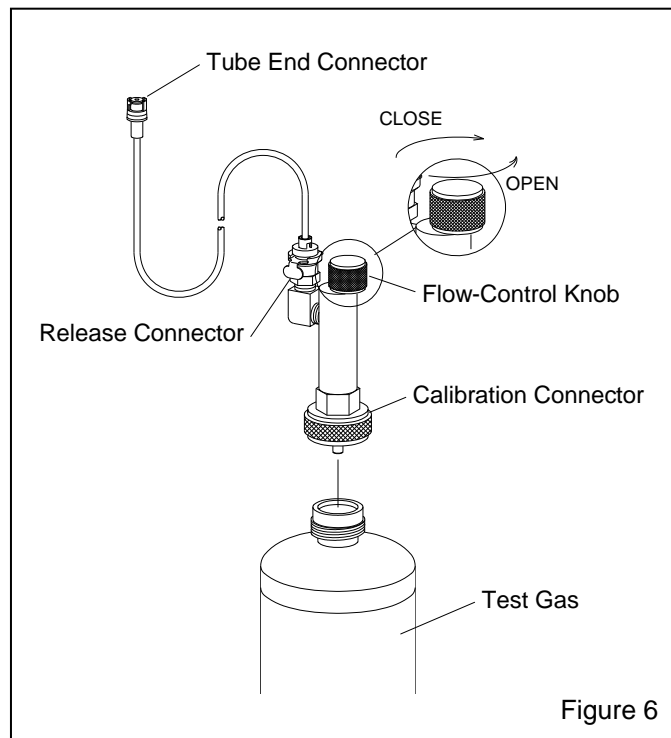
4.2 Stabilization

4.2.1 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.

4.3 Prepare Calibration Connector

4.3.1 Make sure the flow-control knob is fully clockwise to the "OFF" position.

4.3.2 Thread the calibration connector onto the bottle of calibration gas.



4.4 Prepare Instrument

4.4.1 Open the instrument case cover to access the faceplate. Refer to Figure 7 for faceplate-calibration and testing callouts.

4.4.2 Connect the tube end connector to the "Test Gas Port", by aligning the tabs and inserting the tube end connector into the port and turn it clockwise to lock.

4.4.3 Place the Run/Calibration toggle toward "CAL" (calibration). The "ALARM" light will immediately turn yellow, and within a few seconds the intermittent alarm horn will sound. Disarming the alarm per Section 1.7.2 will silence the horn during calibration tests.

4.5 Calibration Testing

4.5.1 Gently pull the tubing side of the release connector to make sure it is correctly seated in the body. Slowly open the calibration connector valve 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 is probably empty.

4.5.2 Adjust the flow-control knob until the flow meter ball remains between .5 and .8 SCFH. The valve is extremely sensitive. Minor adjustments may be required to correctly position the ball.

4.5.3 Allow test gas to flow through the instrument until the digital readout stabilizes (about one minute).

4.5.4 If the display stabilizes between 9 PPM and 11 PPM (10 PPM plus or minus one), the calibration test is complete. Return to operating mode per Section 4.7.

4.5.5 If the display stabilizes at any value other than between 9 PPM to 11 PPM, and if the instrument has been in operation for at least 30 minutes, calibrate the instrument per Section 4.6. If the instrument has not been in operation for 30 minutes, return it to operating mode per Section 4.7, and operate with sample air for at least 30 more minutes. Re-test the calibration. If the display stabilizes at a value other than 10 PPM plus or minus one, calibrate the instrument per Section 4.6

4.5.6 When test/calibration is completed, return the instrument to operating mode per Section 4.7.

4.6 Calibration

4.6.1 Do not calibrate the instrument unless it has gone through two stabilizing periods and calibration tests, per Sections 4.2 and 4.5, and only if the digital display is other than 09, 10, or 11 (10 PPM plus or minus one).

4.6.2 If the number in the display is lower than 10 PPM, calibrate through the upright triangle. If the number is higher than 10 PPM, calibrate through the inverted triangle. Calibrate by inserting a straightened paper clip through the small access opening in the appropriate triangle, pushing gently until the detent is felt. It takes several gentle pushes to change the display. Repeatedly and slowly press the switch until the display registers 10 PPM.

4.6.3 When the display shows 10 PPM, the monitor is calibrated. Return the instrument to operating mode per Section 4.7.

4.7 Return to Operating Mode

4.7.1 Close the connector's flow-control valve.

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

4.7.3 Place the Run/Calibration toggle switch to the "RUN" position. The flow meter ball should rise to .5 to .8 SCFH. After the warm-up, the "ALARM" light should change from yellow to green. If the light does not change to green, increase or decrease flow by adjusting the pressure regulator as required.

4.7.4 Make sure the "ARM" light is lit. See Sec. 1.7.2.

4.7.5 Close the instrument case cover and tighten the screws to a maximum of 20-in-lbs.

4.7.6 Remove the calibration connector from the bottle of test gas. The test gas cylinder has a positive seal, whereas the calibration connector valve does not. If the connector is not removed from the test gas cylinder, over a period of time the cylinder will empty.

4.7.7 If for any reason the tubing needs to be removed from the calibration connector, press and hold the release button and gently pull the tubing side of the connector out of the body.

4.7.8 Store all material in a clean, dry area.

4.8 Impurity-Free Air (zero contamination) Test

4.8.1 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 a malfunctioning monitor.

4.8.2 Follow the steps in Section 4.5 "Calibration Testing", except use impurity-free test gas in place of the 10 PPM gas.

4.8.3. If the monitor is correctly calibrated and in working order, the display will show 00 PPM. This means the monitor was accurately reading contaminated air. **DO NOT USE THE COMPRESSED AIR FOR BREATHING.**

WARNING

Do not use compressed air that this instrument has identified as toxic for breathing until the source of contamination is identified and corrected. Breathing toxic gases could cause death.

4.8.4 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.

4.8.5 If the monitor is out of adjustment or not in good working order, the display will show other than 00 PPM. Zero the instrument per Section 5.0.

4.8.5.1 Re-calibrate the monitor per Section 4.6 and reapply impurity-free gas. If the display is other than 00 PPM, the monitor requires service.

⚠ 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 could permit undetected CO to enter the breathing-air lines. Breathing toxic gases could cause death.

5.0 ZEROING DIGITAL DISPLAY

The following materials are required before zeroing the display:

- Impurity-Free Gas Stock No. 11132
- Calibration Connector Stock No. 23011
- Medium size screwdriver

- Miniature screwdriver

5.1 The monitor must be in operation for at least 30 minutes before zeroing. NOTE: If the zeroing follows sensor replacement, repeat the process after two days of operation.

5.2 Open the instrument case cover to access the faceplate. See Figure 7 for callouts.

5.3 Attach the calibration connector to the impurity-free gas, per Section 4.3.

5.4 Connect the calibration connector to the "Test Gas Port" on the faceplate, by aligning the tabs and inserting the tube end connector into the port and turning it slightly clockwise to lock.

5.5 Place the Run/Calibration toggle toward "CAL" (calibration). The "ALARM" light will immediately turn yellow, and within a few seconds the intermittent alarm horn will sound. Disarming the alarm per Section 1.7.2 will silence the horn during the adjustment.

5.6 Gently pull the tubing side of the release connector to make sure it is correctly seated in the body. Slowly open the calibration connector valve 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 is probably empty.

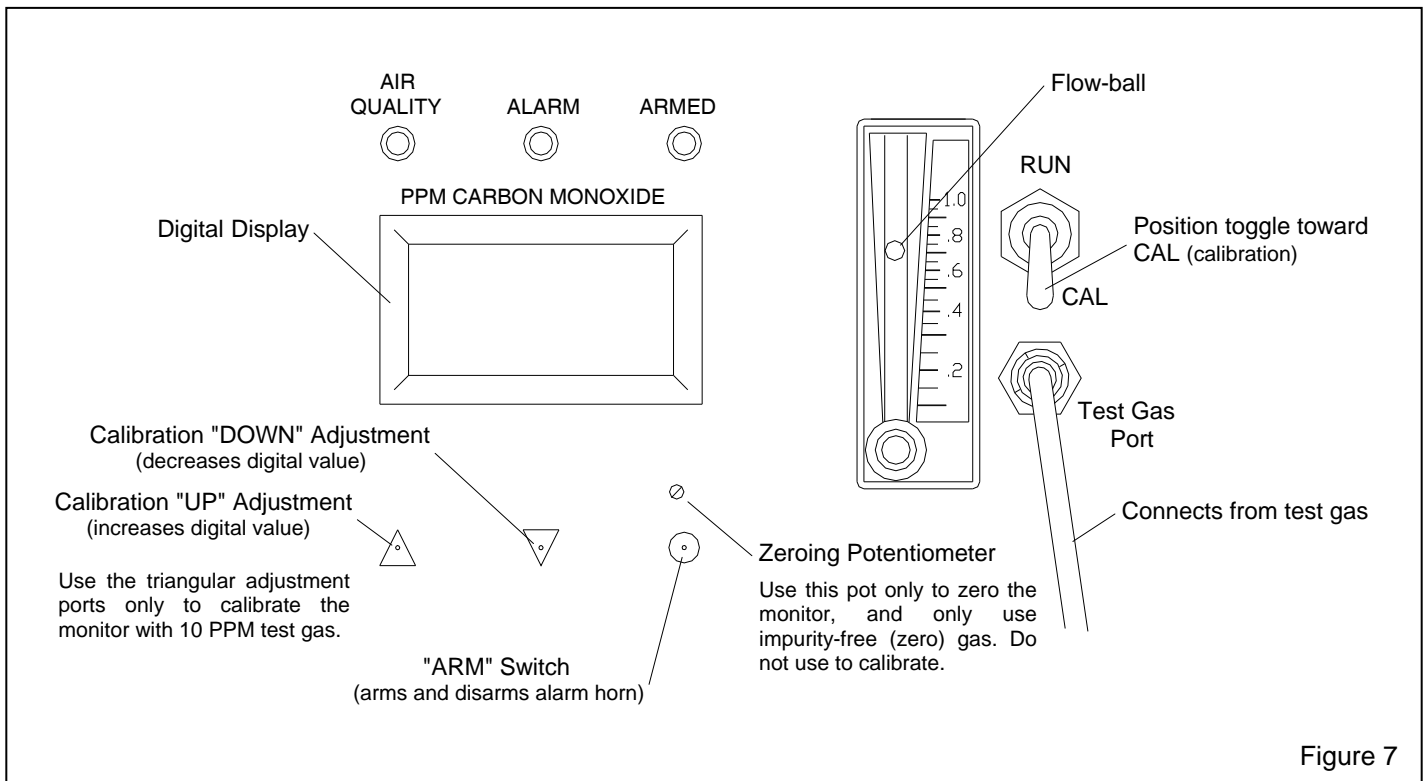


Figure 7

5.7 Adjust the flow-control knob until the flow meter ball remains between .5 and .8 SCFH. The valve is extremely sensitive. Minor adjustments may be required to correctly position the ball.

5.8 Allow test gas to flow through the instrument until the digital readout stabilizes (about one minute).

5.9 Using a miniature screwdriver inserted through the zeroing potentiometer opening, adjust the potentiometer until the display reads ".00" (decimal, zero, zero) **NOTE: The readout responds slowly to the potentiometer adjustment. Turn it slowly when making adjustments.**

5.10 After the display shows ".00", slowly turn the potentiometer clockwise until the decimal disappears.

5.11 Return to the instrument to operating mode per Section 4.7.

6.0 GENERAL MAINTENANCE

6.1 Cleaning

6.1.1 The need to open the case periodically to calibrate the instrument subjects it to external contamination. Take care to insure that no contaminants are introduced into the instrument when the case is open.

6.1.2 Clean the exterior of the case with a cloth soaked in a solution of water and mild detergent. Do not clean with solvent cleaners.

6.2 Calibration Test Schedule

6.2.1 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. See Section 4.0 for test procedure.

6.3 Calibration Schedule

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

6.4 Alarm Tests

6.4.1 Although uncommon, alarm lights and horns do fail. Check their function before each use by placing the Run/Calibration toggle toward "CALIBRATION". The "ALARM" light will immediately turn yellow, and within a

few seconds the intermittent alarm horn 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; all three annunciator lights must be green, with no audible alarm.**

7.0 SERVICE MAINTENANCE

NOTE: Do not attempt to repair or replace any item that is not listed in this section, or that requires parts not shown in Section 9.0. Contact an authorized distributor of Clemco products for authorization to return the instrument for evaluation or service.

7.1 Sensor Replacement

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

7.1.2 The following materials are required before replacing the sensor:

- 10 PPM Test GasStock No. 22865
- Impurity-Free GasStock No. 11132
- Calibration ConnectorStock No. 23011
- SensorStock No. 23015
- Medium size screwdriver
- Small screwdriver

7.1.3 Open the instrument case and remove the four faceplate screws. NOTE: The screws on the left are shorter than those on the right, replace accordingly.

7.1.4 Carefully lift the faceplate, to expose the instrumentation, using care not to disconnect any wires or tubing.

7.1.5 Locate the clear-plastic sensor housing, shown in Figure 8, and remove the mounting screws. The screws are easily removed, do not press hard against the screw-heads; excessive pressure could damage the board.

7.1.6 Carefully lift the sensor housing out of the way.

7.1.7 Pull straight up to remove the sensor.

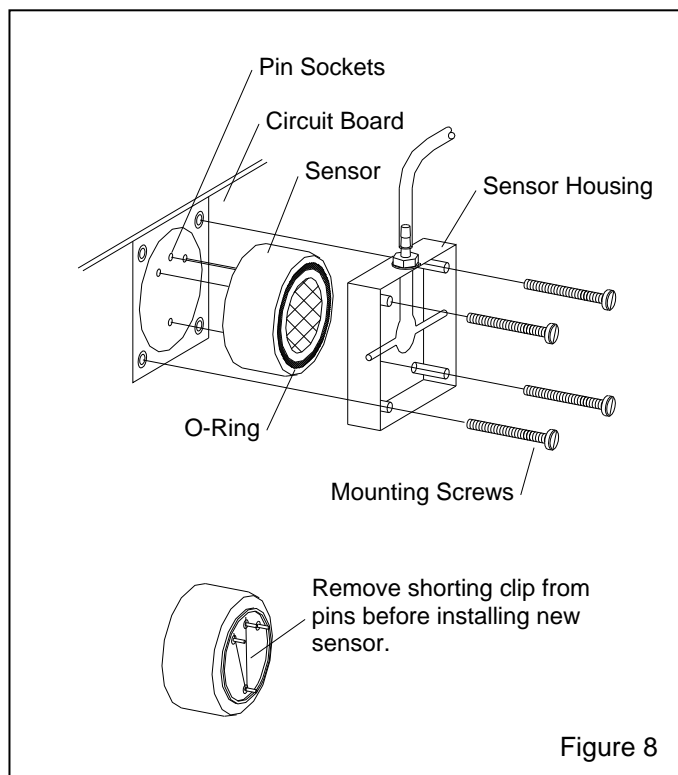
7.1.8 Discard the old sensor to avoid attempts to reuse.

7.1.9 Handle the new sensor with care. Remove the shorting clip from the pins, as shown in Figure 8, and plug the sensor into the sockets.

7.1.10 Make sure the O-ring is in place when positioning the sensor housing over the sensor. Align the mounting screw holes, and alternately tighten the screws until snug. **Do not push hard on the screw heads when tightening. Do not over-tighten.**

7.1.11 Replace the faceplate, ensuring that all internal air lines are free of interference, binding or kinks, and that all tube connections and wire connections are secure. Tighten the faceplate screws finger-tight to ensure they are threading correctly, then tighten them barely snug with a screwdriver.

7.1.12 Apply sample air and power per Section 3.0. Run the monitor in operating mode for at least four hours before calibrating.



7.1.13 Check the display to verify it reads zero (00). If not, adjust per Section 5.0.

7.1.14 Calibrate per Section 4.0.

7.1.15 Close and secure the instrument case cover, tightening the screws to a maximum of 20-in-lbs.

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

7.1.17 Follow calibration testing schedule per Section 6.2.

7.2 Fuse Replacement

7.2.1 The fuse cap is located on the side of the instrument case. Remove the cap to access the fuse. Purchase a 1-amp fuse locally.

8.0 TROUBLESHOOTING

⚠ WARNING

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

8.1 Instrument will not calibrate: If the display does not stabilize, or respond to calibration adjustments.

8.1.1 Make sure the Run/Calibration toggle switch is set toward "CALIBRATE".

8.1.2 Check flow meter. If the flow ball does not rise, the connector's slide valve may be off, or calibration bottle may be empty.

8.1.3 Faulty sensor, replace with new sensor.

8.2 Intermittent alarm: A pressure switch monitors pressure of 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, the monitor initiates an intermittent alarm.

8.2.1 Before doing pressure tests make sure the Run/Calibration toggle switch is toward "RUN". If 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.

8.2.2 Make sure the sample-air is between 55 psi and 145 psi. If the sample-air is higher than 55 psi, the restriction is internal. Proceed as follows:

8.2.3 Check flow through the flow meter. If flow ball is below .4 SCFH or above .9 SCFH adjust the pressure regulator accordingly, until the flow ball remains between .5 and .8 SCFH. In some cases slightly higher or lower flow is required. Slowly increase and decrease pressure at the pressure regulator. If the regulator pressure was outside the limits, the alarm will disengage as soon as the pressure is corrected.

8.2.4 Check internal instrumentation tubing for breaks, kinks, or disconnection. If tubing has come loose, reconnecting it will re-establish function and the monitor should operate correctly.

CAUTION

Tubing coming loose could be the result of improperly servicing the instrument with pressure much higher than operating pressure. If this type of failure occurs, the maintenance service technician should inspect the instrument as soon as practical.

8.3 No annunciator lights or alarms. This condition indicates a loss of electrical power, as it is unlikely to have audible and visual alarms fail at the same time.

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

8.3.2 Make sure the fuse, located in the case, is not blown.

8.3.3 Make sure that the power supply is on.

8.3.4 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.

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

8.4 Either alarm lights or alarm horn fails.

8.4.1 Check for loose plug connections on circuit board.

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

8.4.3 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 alarm horn, 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.

9.0 ACCESSORIES AND REPLACEMENT PARTS

9.1 Accessories

Item	Description	Stock No.
(-)	Remote alarm kit, includes: alarm, stand, wiring connector and 50 ft. cord	22909
(-)	Cable, remote alarm extension 50 feet	22910

9.2 Replacement Parts, Figure 9

Item	Description	Stock No.
(-)	CMS-1 CO monitor package, includes: monitor, calibration connector, and 10 PPM test gas	23017
1.	CMS-1 CO monitor, includes: monitor and items 4 to 10	23012
2.	Calibration connector assembly	23011
3.	Test gas	
	10 PPM	22865
	Impurity-free	11132
4.	Regulator / Filter	23013
5.	Flow meter	21376
6.	Horn w/ wire, 12-Volt DC	22922
7.	Adaptor, straight, 1/8" NPT x 1/8" barb	11732
8.	Adaptor, elbow, 1/8" NPT x 1/8" barb	11733
9.	Tubing, 1/8" urethane, per foot	12475
10.	Reducer, 1/4" x 1/8"	02026
(-)	Sensor (not shown)	23015
(-)	Orifice, .004 purple restrictor	24423
(-)	Orifice, .006 red restrictor	24424
(-)	Filter element (not shown)	23014

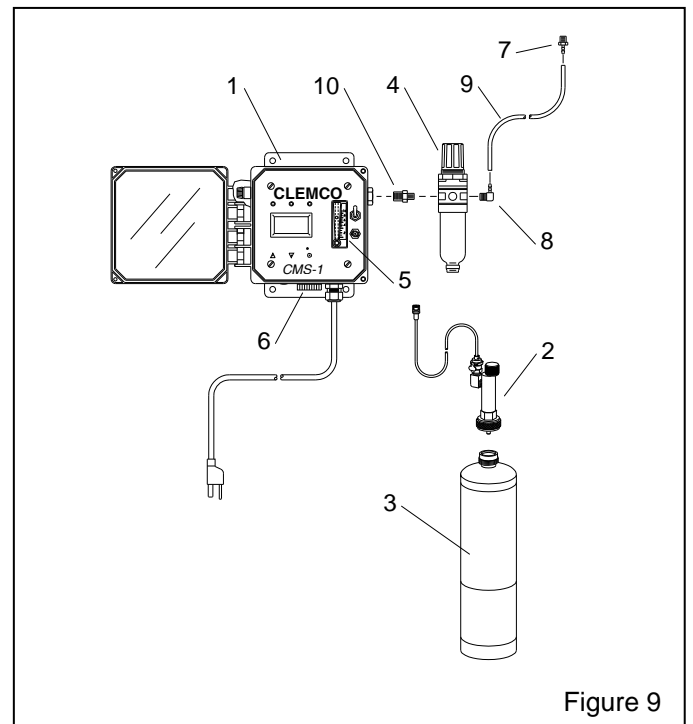


Figure 9