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Recommended Practice

Installation, Operation, and Maintenance of Carbon Monoxide Detection Instruments (50-1000 ppm Full Scale)

ISA-RP92.02.02—Part II, Installation, Operation, and Maintenance of Carbon Monoxide Detection Instruments (50 - 1000 ppm Full Scale)

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Preface

This preface, as well as all footnotes and annexes, is included for informational purposes and is not part of ISA-RP92.02.02, Part II.

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1 Scope

1.1 This recommended practice applies to all carbon monoxide gas detection instruments that satisfy the performance requirements in ISA-S92.02.01, Part I.

1.2 Reference Clause 3 of ISA-S92.02.01, Part I, for definitions of terms as used herein.

1.3 References useful in the installation, operation, and maintenance of carbon monoxide gas detection instruments are listed in Annex C. These references are not considered to be part of this document, except for those specific sections of documents referenced elsewhere in this recommended practice.

2 Purpose

ISA-RP92.02.02, Part II establishes user criteria for the installation, operation, and maintenance of carbon monoxide gas detection instruments.

Its companion standard, ISA-S92.02.01, Part I, "Performance Requirements for Carbon Monoxide Detection Instruments," has been prepared to provide minimum requirements for the performance of carbon monoxide gas detection instruments.

3 General requirements

3.1 To assure that the instrument is suitable for the application and is compatible with its operating environment:

a) the user should provide the potential supplier with detailed information on the conditions that exist in the area(s) in which the instrument is to be used;

b) the instrument must meet the requirements of the applicable regulating agency having jurisdiction; and

c) the instrument must be compatible with the environmental conditions; e.g., relative humidity, temperature, atmospheric contaminants, etc., in which the instrument is to operate. A typical "Environmental and Application Checklist" is included as Annex A and is intended to aid users in properly specifying requirements for their specific applications.

4 Unpacking

4.1 Unpack the shipping carton(s) and determine whether the order is complete "as received." Check for main assembly, accessories, spare parts, and instruction manual. Understanding the manufacturer’s instruction manual is of vital importance to the future operation and maintenance of the carbon monoxide gas detection instrument.

4.2 In the event of shipment damage, or for purposes of future correspondence, record the following:

a) user's purchase order number and manufacturer's order number, and their respective dates;

b) carrier waybill number and date received in case of transit claim; and

c) instrument serial number and user identification (ID) number, if assigned.

5 Storage

5.1 When storing carbon monoxide gas detection instruments, leave them in their original containers or provide suitable protective covers.

5.2 Select a location that is in accordance with the manufacturer's recommendations. Store carbon monoxide gas detection instruments where environmental conditions (temperature, humidity, etc.) are within the manufacturer's storage specifications.

5.3 Before storage, inspect the instruments and remove any internal batteries that could cause corrosion. If the instruments have rechargeable or "permanent" batteries, consult the manufacturer's instructions for battery maintenance during this period.

5.4 Prepare gas detection instruments for long-term storage per manufacturer’s Instruction Manual.

6 User record keeping

It is recommended that the user:

a) assign an equipment identification (control) number to each instrument; and

b) maintain complete records including periodic performance, calibration, and maintenance checks (see Annex B).

7 Maintenance

7.1 To maintain the reliability of carbon monoxide gas detection instruments, it is recommended that the user assign responsibility for their initial inspection and subsequent use, including maintenance, to a specific qualified individual or group.

7.2 It is important that the Checkout Procedures (see Clause 10) be performed by qualified personnel trained in the operation, maintenance, and repair of carbon monoxide gas detection instruments, and that the group responsible for maintenance be defined clearly.

7.3 The user should establish responsibility for obtaining the gas mixture recommended by the instrument manufacturer for calibrating and testing.

7.4 It is recommended that when instruments are first put into use, the calibration be checked on a routine basis as prescribed by the manufacturer, but at least monthly. If experience shows minimal calibration deviation, then the period between calibration checks may be extended. Likewise, if routine checks indicate an increasing need for calibration, the period should be shortened and the cause should be investigated and the manufacturer consulted.

8 Preparing instruments for use

Read and understand the manufacturer-provided instruction manual. Particular attention should be paid to the locations and functions of all controls and readout devices.

A calibration test of the type described in 13.7 is recommended before the initial use of any carbon monoxide gas detection instrument.

9 Installation of stationary instruments

It is extremely important that the equipment manufacturer-provided instruction manual be read thoroughly and followed completely.

9.1 Installation in hazardous (classified) locations

If instruments or ancillary components are installed in a hazardous (classified) location, they must be suitable for the area in which they are installed and appropriately marked. Hazardous (classified) locations are defined by applicable national codes (e.g., the *National Electrical Code*®, NFPA 70, Articles 500 and 505, and the *Canadian Electrical Code*). Markings required by ISA-S92.0.01, Part I, Clause 6, should be visible to the operator. Installation shall be in accordance with applicable national codes (e.g., the *National Electrical Code*©, NFPA 70, Articles 500 through 505). Intrinsically safe systems also shall be installed in accordance with ISA-RP12.6, *Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations*.

9.2 Detector head locations

Many factors are involved in detector head quantity and location selection. Industry standards and applicable regulations may dictate quantities and general or specific locations. The following should be considered:

a) Density of gases to be monitored: Carbon monoxide is slightly lighter than air. However, the influence of the CO on the specific gravity of air mixtures may be negligible in the concentrations encountered in the workplace,.

b) Air movement: Air velocity and direction influence the dispersion of vapors/gases to be monitored.

c) Potential sources: The location and nature of the potential carbon monoxide sources — e.g., pressure, amount, source temperature, and distance, need to be assessed.

d) Ambient temperature: Reference 9.8.

e) Vibration: Reference 9.7.

f) Accessibility: Future maintenance and calibration requirements should be taken into consideration when selecting detector head locations.

g) Structural arrangements: Structural arrangements (such as walls, troughs, or partitions) could allow carbon monoxide to accumulate.

h) Mechanical damage and contamination: Detectors should be installed in locations to preclude mechanical damage from normal operations; e.g., cranes, traffic, exhausts, and wash-downs.

i) Potential for personnel exposure.

j) Possible sources of electromagnetic interference/radio-frequency interference (EMI/RFI).

9.3 Detector heads must be connected to their respective control units as specified by the manufacturer (observing maximum loop resistance, minimum wire size, isolation, etc.). Interconnections must be made using a cable, wire and conduit system, or other wiring system suitable and approved for the purpose and the area classification.

9.4 Equipment required to be connected to ground in order to provide protection from electrical shock hazards shall be connected effectively with the general mass of the earth through a grounding system. The grounding system shall have sufficiently low impedance and shall have a current-carrying capacity sufficient at all times, under the most severe conditions that are likely to arise in practice, to prevent any current in the grounding conductor from causing a potential of 30 V RMS or 42.4 V peak to exist between accessible conductive parts of the equipment and adjacent accessible conductive surfaces within a 12-foot (3.7m) radius. Where wet contact may occur, the maximum potential is reduced to 15 V rms or 21.2 V peak, respectively. This grounding system performance shall remain effective under all conditions. For additional information on grounding, refer to the documents listed in Annex C.

9.5 To minimize electromagnetic interference (EMI), it is recommended that properly grounded, shielded interconnecting cables (or wire and conduit) be used, and that enclosures (if of conductive material) be adequately grounded. It is recommended that cable shields be grounded at one point only — the controller end— unless otherwise specified by the manufacturer. It is recommended that splices in sensor wiring be properly soldered.

9.6 It should be ascertained that the lubricants and sealants used for threaded connection contain no substance that might adversely affect the sensors.

9.7 All instruments and detector heads should be mounted in a manner to minimize vibration.

9.8 All detector heads and instruments should be mounted in areas that ensure compliance with the manufacturer's operating temperature specifications.

9.9 Adequate drainage should be incorporated into the system design to minimize moisture and condensation in the instrument, detector head, and interconnecting cable/conduit system.

9.10 Any potentially flammable or toxic gases introduced into sampling systems should be vented in a safe manner.

9.11 When interconnecting ancillary devices, maximum current and voltage ratings of the instrument’s outputs; e.g., interposing relay contacts, must be observed. This includes barriers, isolation devices, and other intrinsically safe components.

10 Equipment checkout procedures

10.1 Portable instruments

10.1.1 With reference to the instruction manual, the following steps should be performed when applicable and necessary:

a) With the power OFF, reset the mechanical zero of any analog meters.

b) Ascertain that all electrical connections are properly tightened (remote detector head, power supply, etc.).

c) Check the battery voltage and battery condition, and make any required adjustments or battery replacements.

d) With the power ON, allow adequate warm-up time.

e) For sample-draw instruments only, check for sample-line leaks and proper flow.

Check and replace clogged, broken, damaged, or dirty splash guards, filters, and flame-arresting components. Perform a test of the failure (malfunction) circuit(s).

10.1.2 Place the detector head (integral or remote) or the sample-draw assembly in an atmosphere free of any gas to which the instrument responds, aspirate a large enough sample to purge the lines (applicable only to sample-draw instruments), and adjust the instrument to indicate zero.

10.1.3 Check the response of the instrument using a known carbon monoxide gas mixture suitable for the selected range. If the test results are not within 5 ppm or 10 percent, whichever is greater, of the applied gas concentration, re-calibrate the instrument as recommended by the manufacturer.

10.1.3.1 The concentration of the gas mixture used must be greater than the highest alarm setpoint, and all alarms must actuate.

10.1.4 If an instrument fails this procedure and corrective action suggested in the instruction manual does not solve the problem, the instrument should be referred to the responsible maintenance individual or group.

10.2 Stationary instruments

10.2.1 With reference to the instruction manual, perform the following when applicable and necessary:

a) With the power OFF, reset the mechanical zero of any analog meters.

b) Ascertain that all electrical connections are properly tightened (remote detector head, power supply, etc.).

c) Verify that all explosion-proof enclosures are provided with the correct number of proper bolts/fasteners and all required conduit/cable seal fittings. Verify that bolts/fasteners are tightened/secured to specifications and that seal fittings are properly poured.

d) Apply power to the system and verify that all indicators operate properly.

e) Allow the system to warm up for an adequate time.

10.2.2 With the sensor or sample inlet in an atmosphere free of any gas to which the instrument responds, verify proper operation of all alarm set points using the "zero" control to offset the display up-scale (or other methods as recommended by the manufacturer). Before proceeding, reset the meter to zero if it was moved.

10.2.3 Check the response of the instrument using a known carbon monoxide mixture suitable for the selected range. If the test results are not within 5 ppm or 10 percent, whichever is greater, of the applied gas concentration, recalibrate the instrument as recommended by the manufacturer.

10.2.4 If an instrument fails this procedure, and corrective action suggested in the instruction manual does not solve the problem, the instrument should be referred to the responsible maintenance individual or group.

NOTE 1: Some instruments may incorporate multiple remote detector heads. Output response from multiple heads may be singular (discrete channels) or additive, depending on the manufacturer's design. These characteristics must be taken into account when conducting response and alarm checks.

NOTE 2: When calibrating for initial equipment checkout, possible contaminating, desensitizing and interfering agents should be considered.

11 General considerations

CAUTION: CARBON MONOXIDE IS A TOXIC GAS, AND EXPOSURE TO EXCESSIVE AMOUNTS MAY RESULT IN A LOSS OF CONSCIOUSNESS OR DEATH.

11.1 General

When using carbon monoxide gas detectors, the following precautions should be observed (when applicable):

a) For sample-draw instruments, pumping time must be sufficient to draw the sample to the sensing element, and transport time should be considered. Long sample lines will introduce time delays in detection. Time delays should be determined and good engineering judgment should define acceptable limits for specific applications.

b) In areas where the atmosphere may not be uniformly mixed, checks should be made at different elevations and locations.

c) When sampling over liquids, the end of the sample line or detector head should not touch the liquid.

d) Vapor condensation may cause errors when the atmosphere to be tested is at a higher temperature than the atmosphere surrounding the gas-sensing element. Therefore, the temperature of the sampling assembly and instrument should be essentially the same as, or higher than, the temperature of the atmosphere under test, unless the vapors will remain fully vaporized at the lower temperature near the gas-sensing element.

e) To avoid sampling losses, only sample lines recommended by the manufacturer or known to the user as being compatible with carbon monoxide should be used. Some materials are sensitive to certain other gases and may deteriorate with time. Certain materials, although otherwise suitable for sample lines, may deteriorate from sunlight or other environmental conditions.

f) Detection instruments within the scope of this recommended practice might not be specific to carbon monoxide. That is, the presence of other (interference) gases, including flammable and non-flammable gases, may influence readings. Refer to the manufacturer's instruction manual for a listing of known interference gases.

   Erratic meter readings which are confirmed to be unrelated to the presence of gas typically indicate instrument malfunctions and should be reported to the maintenance group.

g) Steam, other vapors, aerosols, or other materials may coat filters, flame arresters, or splash guards, impeding or blocking sample flow to the sensor.

h) To enhance safety, suitable instruments should be provided to detect other toxic or flammable gases and vapors that may be present.

i) Unless stated otherwise by the manufacturer, units should be recalibrated after exposure to concentrations exceeding instrument range.

11.2 Atypical mixtures

Most (but not all) instruments are calibrated and intended for carbon monoxide detection in air that contains approximately 21 percent oxygen by volume. For a description of system safety and instrument response expected under deficient or enriched oxygen conditions, consult the instruction manual, or contact the manufacturer for a recommendation.

11.3 Desensitizing agents

Some materials may have a poisoning, desensitizing, or inhibiting effect on some types of detectors, resulting in a loss of sensitivity. If desensitizing materials could be present in the atmosphere being monitored, instrument sensitivity should be checked frequently using a gas mixture of a known concentration. For some applications, it may be possible to detect carbon monoxide gas in the presence of desensitizing agents; for such special applications, the manufacturer should be consulted. Refer to the manufacturer's instruction manual for a listing of known desensitizing agents.

11.4 Entering atmospheres potentially containing carbon monoxide

Any atmosphere that potentially contains carbon monoxide should be tested first from outside the area to establish safe levels before entry. In addition to testing for carbon monoxide, tests for oxygen deficiency and combustibility may be required to insure personal safety. Oxygen deficiency may alter the readings of carbon monoxide detectors (See 11.2). It may be prudent to test for oxygen content BEFORE testing for carbon monoxide. Personnel should always comply with confined space rules when entering an unknown atmosphere.

Optional attachments for portable devices that allow the users to manually draw samples from remote locations inherently prevent continuous monitoring of the local environment, and therefore fall outside the scope of this document. While such equipment cannot be certified under Part I of this standard, it can provide useful information (such as concentrations within confined spaces before entry). Users should consult the manufacturer's instruction manual to determine the proper number of bulb strokes for drawing samples when such attachments are used. The attachments should be removed after use to restore the instrument to continuous monitoring.

11.5 Use of appropriate accessories

Performance of carbon monoxide gas detection instruments may be improved in certain environments through the use of appropriate accessories. All such accessories must be installed and used in accordance with the manufacturer's instruction manual.

CAUTION — RESPONSE TIME MAY BE LENGTHENED OR ACCURACY AFFECTED BY THE USE OF SUCH ACCESSORIES.

a) If there is a danger of electrical shock while using a portable unit with a conductive sample probe, the conductive assembly should be replaced with a nonconductive sample probe.

b) A nonabsorbent coarse filter may be available for sampling in an atmosphere containing dust.

c) A probe with a special tip, a liquid trap, or both inserted in the sample line may be available to reduce the chance of liquids being ingested by instruments requiring a drawn sample.

d) Dilution assemblies are often available to permit the testing of atmospheres where concentrations are above the normal range of the instrument.

e) When long sample lines to the instrument are required, it may be desirable to install a sample valve or cock near the instrument to facilitate access to fresh air for "zero" checks. When used, such valve or cock should be of the type that automatically returns to its normal position, to assure it will not be left in the 'air' position inadvertently.

f) Accessories are often available and may be desirable for detectors installed in areas of high air velocity or liquid spray/wash-down.

g) Remote calibration accessories are often available and may be desirable for detector heads installed in locations that are difficult to access.

11.6 Electromagnetic interference (EMI)

Some carbon monoxide gas detectors are susceptible to EMI, especially radio frequency interference (RFI), which can cause malfunctions, false alarms, and zero drift. Where EMI is anticipated, suitable apparatus resistant to such interference should be selected. Also refer to 9.5.

11.7 Maintenance schedule

A regular maintenance schedule conforming to the manufacturer's Instruction Manual and any regulatory requirements should be adopted. This maintenance schedule should be the responsibility of a designated and qualified individual or operating group. Refer to Annex B for recommended typical maintenance records.

12 Operational checks

Certain minimum operational checks are necessary during the use of the instrument. These checks should include:

a) Visual check

   1) Check the instrument for abnormal conditions such as malfunctions, alarms, or non-zero readings.

   2) Assure that the detector head assembly is free of obstructions or coatings that could interfere with gas reaching the sensing element. Assure that the sample draw is proper for sample-draw systems; refer to 13.4.

   3) For sample-draw systems, inspect flow lines and fittings. Cracked, pitted, bent, or otherwise damaged or deteriorated flow lines or fittings should be replaced with those recommended by the manufacturer.

b) Response (sensitivity) check

1) Assure that the instrument indicates zero when zero gas is present. Adjust the instrument if necessary (according to the manufacturer's instruction manual).

2) Following the manufacturer's instructions, apply a known concentration test gas to the detector head. If the reading is not within specifications, adjust or re-calibrate according to the instruction manual (or refer the instrument to the group or individual responsible for such adjustments/recalibrations).

3) For sample-draw systems, calibration gas should be introduced periodically through transport lines and the results (accuracy and response time) compared to calibration results when the calibration gas is introduced directly to the sensor calibration port. This check is to verify that the transport lines, filters, etc., are not plugged or leaking.

4) Complete the maintenance records. Refer to Annex B for a typical maintenance record.

5) If an instrument fails the operational check, and corrective action suggested in the instruction manual does not solve the problem, the instrument should be referred to the maintenance group or individual responsible for repair.

13 Maintenance procedures

13.1 General

13.1.1 Maintenance procedures should be undertaken only by qualified personnel trained in the operation, maintenance, and repair of carbon monoxide gas detection instruments.

13.1.2 If the maintenance facility is not adequately equipped and/or qualified personnel are not available to perform the manufacturer's recommended checkout and maintenance procedures, the user should contact the instrument manufacturer or other qualified outlet for repair.

"Qualified" implies not only the ability to perform recommended procedures, but also knowledge and understanding of ISA-S92.02, Part I; ISA-RP92.02, Part II; and the requirements of any applicable authority having jurisdiction.

13.1.3 Complete and explicit instructions for testing and checkout of replaceable instrument components may be obtained from the manufacturer.

13.1.4 After all defective operations are corrected in accordance with the instruction manual, a full Calibration Test (as described in 13.7) should be conducted.

13.2 Preliminary checkout

> **NOTE —** Given the variety of instruments available, it is not practical for this recommended practice to tabulate each maintenance, repair, and calibration step in full detail. What follows is a listing of the principal items that all maintenance procedures should include.

13.2.1 When an instrument undergoes scheduled maintenance, the full maintenance procedure should be conducted. If specific instrument failure is a cause for maintenance, the complaint should be noted, the instrument repaired, and applicable checkout tests conducted. All instruments, however, should undergo a full calibration test before being returned to service.

13.2.2 The instrument maintenance record should be reviewed for previous service history.

13.2.3 The manufacturer's instructions should be followed when deciding whether to replace an assembly or repair it by replacing a component part. If components are replaced, the replacement components must meet the specifications and tolerances of the original components.

13.2.4 The following criteria should be considered for a scheduled maintenance procedure:

a) Test instrument response with a known concentration carbon monoxide test mixture. Readout operation, operation of controls, switches, other outputs, the flow system, etc., should be observed as provided.

b) External controls should be operated and for variations that might be a prelude to field failure.

c) Exterior housings should be examined for dents and distortions that could be a cause of nonfunctional readouts or intermittent electrical operation.

d) Circuit boards and wiring should be visually examined for burns, cracks, improper solder joint conditions; e.g., cold solder joints and inadequate conformal coating. All wiring should be checked for shorting, improper termination, and poor connection integrity.

e) Fuses (current and voltage ratings, and continuity) and fuse holders should be checked and replaced as necessary.

13.3 Detector head

13.3.1 Depending on the time interval since the last sensing element replacement, anticipated field usage, and response to the gas mixture during calibration, good maintenance practice suggests sensing element evaluation/replacement at service intervals recommended by the manufacturer. Also, unless specifically stated as unnecessary by the manufacturer, it is recommended that sensing elements be calibrated and be evaluated in accordance with the manufacturer's instructions after exposure to high concentrations of carbon monoxide.

Sensing elements generally must be replaced if the readout cannot be electrically zeroed, if the instrument cannot be adjusted to read a known carbon monoxide concentration, or if the readout is erratic.

13.3.2 If filter traps, flame arrestors, or housings are part of the assembly, they should be checked for proper attachment and fit, and signs of corrosion, dirt, and moisture. Any necessary cleaning or replacement should be in accordance with the manufacturer's instructions.

13.4 Flow system

13.4.1 This section is applicable only to those instruments utilizing aspirated sampling.

13.4.2 The flow system must be checked for leakage, restrictions, and proper pump operation. Any necessary cleaning, repair, or replacement should be in accordance with the manufacturer's instructions.

13.4.3 All filters, traps, and flame-arresting assemblies should be emptied, cleaned, or replaced in accordance with the manufacturer's instructions.

13.4.4 The flow system and sample chamber should be examined for deposits of foreign material, and steps taken to prevent future accumulations.

13.4.5 All flow connections should be tightened in accordance with the manufacturer's instructions.

13.4.6 All valves and moving pump parts should be lubricated, but only according to the manufacturer's recommendation.

13.4.7 Sample-draw systems should be adjusted to correct flow-rate values using procedures and instruments recommended in the instruction manual.

13.4.8 The trouble signals for loss of flow, as required by ISA-S92.02, Part I, 5.4.2, should be checked for proper operation.

13.5 Readout devices

13.5.1 If the instrument incorporates a meter, perform the following procedures:

a) Inspect the meter for broken or cracked lens.

b) Inspect analog meters for defects; e.g., bent pointers, loose dials, loose up-scale and down-scale stops.

c) Inspect digital meters for defects; e.g., in segments and backlights.

d) Conduct other electrical and mechanical meter tests that the instrument manufacturer deems necessary to assure proper performance.

13.5.2 If auxiliary outputs (e.g., readouts and alarms) are incorporated, they should be tested according to the manufacturer's instructions.

13.6 Alarms

13.6.1 Check all alarms for proper alarm operation by offsetting the electrical zero (or by other methods as recommended by the manufacturer) until the alarm(s) is (are) actuated. Check failure (malfunction) circuits by disconnecting components (or by other actions recommended by the manufacturer) and by confirming that the failure alarm is actuated. Restore the instrument to its original condition after checking the alarms.

13.6.2 It is desirable to provide a means that will allow the system to be tested (and calibrated) without initiating equipment shutdown (or other corrective action), but it should be evident to personnel that the system is in the test (bypass) mode.

13.7 Calibration test

13.7.1 The instrument shall be calibrated in accordance with this recommended practice, using the manufacturer's calibration equipment and specified calibration procedure. All "calibration mixtures" and associated calibration apparatus should have the following characteristics to ensure reliable results.

a) Calibration mixtures should be certified or analyzed to be accurate to at least 1 ppm or 5 percent, whichever is greater, of the actual labeled concentration.

b) A regulator assembly of sufficient sensitivity and stability should be used to reduce compressed gas cylinder pressures. The regulator and all calibration system components should be specifically suitable and conditioned for carbon monoxide service (for the applicable concentration) and should incorporate appropriate connections.

c) A direct-reading flow-rate indicator, preset regulator, expandable bladder, or other flow-controlling element should be installed in the calibration mixture supply line to permit adjustment of flow rate to the instrument manufacturer's specified value or range and accuracy.

13.7.2 For the calibration test, the mixture of gas recommended by the instrument manufacturer (and for which the instrument is factory-calibrated) should be used.

13.7.3 All tests should be conducted in a manner to ensure safe venting of calibration mixtures.

13.7.4 Instruments should be allowed to stabilize at operating temperature. Then, operating controls should be adjusted in accordance with the instruction manual.

13.7.5 The calibration system should be connected to the instrument and the stabilized reading noted. The calibration span (gain) should be adjusted, if necessary, so that the output reading equals the concentration of the calibration mixture. The calibration mixture should be removed, and it should be ascertained that the instrument returns to "zero". This procedure may require repeating if the instrument zero and span adjustments interact.

13.7.6 It should be ascertained that all alarms are actuated when the setpoint(s) is reached, following the manufacturer's recommendations.

13.7.7 The calibration test as described herein should be the last test conducted before an instrument is returned to service. It is recommended that the calibration data be recorded on the maintenance records. The maintenance record (or comparable document) should be updated before returning the instrument to service.

14 External power supply systems

14.1 General

14.1.1 Stationary gas detection systems require reliable external power supply systems, either ac or dc. A dc system may be preferred in some applications for reasons given below. Whether an ac or dc supply is required depends on the specific instrument utilized. Any peripheral external power supply equipment provided must be suitable and approved for the area where it is to be used, both for environmental conditions and for the area classification.

14.1.2 It generally is recommended (and frequently required) that electrical controls for safety systems such as gas detection systems be installed "normally energized" ("fail-safe"). This means that power is supplied continuously during normal operations to devices (such as solenoid valves) that provide equipment shutdown or other "corrective action" if gas concentrations corresponding to specific alarm set point(s) are reached. Under these conditions, interruption of power due to either deliberate safety device actuation or accidental loss of power will initiate equipment shutdown (or other "corrective action"). If continuous power is not supplied, nuisance shutdowns could result from even momentary power disruptions. Special consideration should be given to systems where unwarranted shutdowns (such as those caused by coil failure of an energized solenoid valve) could create potentially hazardous situations.

14.2 AC supplies

When reliable ac power is available, units are often furnished with ac power only. When continuous power is required, however, the ac supply usually is provided with a standby power system.

14.3 DC supplies

14.3.1 It is desirable to provide an output of battery charger status to allow the installation of a remote trouble signal.

14.3.2 It usually is desirable to utilize external dc supplies for one or more of the conditions discussed below.

a) DC power systems often are desirable to serve as buffers between ac power sources and gas detection systems to reduce the instruments' exposure to transients and short periods of time when ac power is off-voltage and/or off-frequency.

b) It generally is desirable (and frequently required) that carbon monoxide gas detection systems remain operative for limited periods of time when ac power is not available. This feature is particularly attractive for systems installed at locations that are unmanned, remote, or subject to frequent ac power failures, and is even more important if controls are installed normally energized ("fail-safe").

14.3.3 In addition to conventional ac-powered battery charger systems, users may wish to consider photovoltaic cells, thermoelectric generators and other non-conventional power sources. Environmental conditions (temperature, availability of sunlight, etc.) are influencing factors in choosing alternate power sources.

Annex A— Environmental and application checklist for carbon monoxide detectors (typical)

This annex is included for informational purposes and is not part of this recommended practice.

1) Briefly describe the application in which carbon monoxide is to be sensed. (Address: sampling methods, special environments, and locations.)

2) If monitored points are separate from the control unit, what distances are involved?

3) List toxic gases and combustible gases and/or vapors which may be present and their approximate sample composition.

Gas or Vapor		
Component*	Concentration	Special Considerations

* List also chemical name if possible.

If gases other than carbon monoxide are anticipated, indicate whether these gases or vapors will be present separately or in combination.

4) Is detection to be in normal (21% v/v oxygen), oxygen-deficient, or oxygen-enriched atmospheres?

   Estimated oxygen range of atmosphere to be sampled: ________________________

5) Required instrument measuring range(s): ___________________________________

6) Ambient temperature range in which the control unit is to be used:

   ________ °C (______ °F) minimum to °C (_____ °F) maximum

   Nominal expected temperature: _________°C (_______°F)

7) Ambient temperature range in which the detector head is to be used:

________ °C (______ °F) minimum to _________ °C (______ °F) maximum

Nominal expected temperature: _________°C (_______°F)

8) Ambient humidity range of atmosphere to be monitored:

_________% RH minimum to % RH maximum.

9) Pressure range of atmosphere to be monitored:

_________kPa (psia) minimum to kPa (psia) maximum.

10) Velocity range of atmosphere to be monitored:

_________m/sec (ft/sec) minimum to _______ m/sec (ft/sec) maximum.

11) Other pertinent conditions (presence of dusts, corrosives, fumes, mists, EMI/RFI, etc.) Please state type and amount, if possible.

____

12) Potential desensitizing agents or other materials which can affect instrument performance:

13) Classification of the location in which the control unit is to be used:

Class: _________ Division: _________ Group: __________

Classification of the location in which the detector is to be used:

Class: _________ Division: _________ Group: __________

14) Will electrical shock hazards exist in the vicinity to be tested for combustibles (requiring a nonconducting probe?) ____

15) Additional accessories required: ____

Annex B— Instrument maintenance record for carbon monoxide detectors (typical)

This annex is included for informational purposes and is not part of this recommended practice.

Manufacturer ________________________ Model No ________________________

Date Purchased ________________________ Date Placed in Service _____________

Serial No ________________________ User ID No________________________

Calibration Gas Concentration_________________ Location ________________________

Source of Calibration Gas ____________________

Maintenance other than routine calibration

	Check One		**Nature of Service**		
Date	Scheduled Maintenance	Failure	Returned By	Serviced By	Parts Replaced

1) Include modifications, adjustments, etc.

Calibration records ____

Date __________________ Comments (2) ________________________________

2) Include calibration difficulties, reading and ppm chlorine applied prior to calibration, etc.

Annex C: Reference publications

This annex is included for informational purposes and is not part of this recommended practice.

The following standards contain provisions which, through reference in this text, constitute provisions of this ISA Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

AMERICAN PETROLEUM INSTITUTE (API)

RP 14C-1984	Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms
RP 14F-1991	Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms
RP 500-1991	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities

Available from: **American Petroleum Institute**
1220 L. Street, NW
Washington, DC 20005 Tel: (202) 682-8357

BRITISH STANDARDS INSTITUTE (BSI)

BS.5345	Code of Practice in Selection, Installation, and Maintenance of Electrical Apparatus for use in Potentially Explosive Atmospheres (Other Than Mining Applications for Explosive Processing and Manufacture.) Parts 1-9

Available from: **British Standards Institute**
Newton House
101 Pentonville Road
London, N19ND
England Tel: 01 837 8801

CANADIAN STANDARDS ASSOCIATION (CSA)

C22.2 No. 0.4 (Protective Grounding)	Bonding and Grounding of Electrical Equipment
C22.2 No. 152	Combustible Gas Detection Instruments

Available from: **Canadian Standards Association**
178 Rexdale Boulevard
Etobicoke, Ontario M9W 1R3
Canada
Tel: (416) 747-4044
Telex: 06 989344

FACTORY MUTUAL RESEARCH CORPORATION (FM)

Approval Standard Class No. 3610-1988	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous (Classified) Locations
Approval Standard Class No. 3611-1986	Electrical Equipment for Use in Class 1, Division 2, Class II, Division 2, and Class III, Division 1 and 2 Hazardous (Classified) Locations
Approval Standard Class No. 3615-1989	Explosionproof Electrical Equipment General Requirements
Approval Standard Class No. 3820	Electrical Utilization Equipment

Available from: **Factory Mutual Research Corporation**
1151 Boston-Providence Turnpike
Norwood, MA 02062
Tel: (617) 762-4300
Telex: 924415

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

Std. 142-82	Recommended Practice for Grounding of Industrial and Commercial Power Systems
Std. 315-75	Graphic Symbols for Electrical and Electronics Diagrams

Available from: **Institute of Electrical and Electronics Engineers**
345 East 47th Street
New York, NY 10017
Tel: (800) 678-4333

ISA

ISA-S5.5-1986	Graphic Symbols for Process Displays
ISA-S12.1-1991	Definitions and Information Pertaining to Electrical Instruments in Hazardous (Classified) Locations
ISA-S12.4-1970	Instrument Purging for Reduction of Hazardous Area Classification
ANSI/ISA-RP12.6-1987(R)	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations
ANSI/ISA-RP12.13-1986	Part I, Performance Requirements, Combustible Gas Detectors
ISA-RP12.13-1987	Part II, Installation, Operation, and Maintenance of Combustible Gas Detection Instruments
ISA-S12.15-1990	Part I, Performance Requirements for Hydrogen Sulfide Detection Instruments (10-100 ppm)
ANSI/ISA-S51.1-1979	Process Instrumentation Terminology
ANSI/ISA-S71.04-1986	Environmental Conditions for Process Measurement and Control Systems Airborne Contaminants
ANSI/ISA-S82.01-1994 (R)	Safety Standard for Electrical and Electronic Test, Measuring, Controlling and Related Equipment — General Requirements
ANSI/ISA-S82.02-1988	Safety Standard for Electrical and Electronic Test, Measuring, Controlling and Related Equipment — Electrical and Electronic Test and Measuring Equipment
ANSI/ISA-S82.03-1988	Safety Standard for Electrical and Electronic Test, Measuring, Controlling and Related Equipment — Electrical and Electronic Process Measurement and Control Equipment

Available from: **ISA**
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, NC 27709Tel: (919) 549-8411

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 654-1	Temperature, Humidity, and Barometric Pressure

Available from: **American National Standards Institute**
1 West 42nd Street
New York, NY 10036 Tel: (212) 642-4900

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

ANSI/NFPA No. 70	National Electrical Code
ANSI/NFPA No. 496	Standard for Purged and Pressurized Enclosures for Electrical Equipment

Available from: **National Fire Protection Association**
Batterymarch Park
Quincy, MA 02269 Tel: (708) 770-3000

UNDERWRITERS LABORATORIES, INC. (UL)

UL 913	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations

Available from: **Underwriters Laboratories, Inc.**
333 Pfingsten Road
Northbrook, IL 60062 Tel: (708) 272-8800

UNITED STATES CODE OF FEDERAL REGULATIONS (CFR)

Title 29, Part 1910	Occupational Safety and Health Standards, Subpart S, Electrical
Available from:	**Superintendent of Documents** U. S. Government Printing Office Washington, D. C. 20402

MISCELLANEOUS

Threshold Limit Values for Chemical Substances in the Work Environment Adopted by ACGIH for 1996.

Criteria Documents on Carbon Monoxide and Sulfur Dioxide, National Institute for Occupational Safety and Health (NIOSH).

“Occupational Health Guideline for Carbon Monoxide” DHHS (NIOSH) Publication No. 81-123, Occupational Health Guidelines for Chemical Hazards, Jan., 1981, pp. 1-5.

Manual of Recommended Practice for Portable Direct-Reading Carbon Monoxide Indicators, American Industrial Hygiene Association, 1985.

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