Carbon Monoxide (CO) Monitor

The Westinghouse Carbon Monoxide Monitor is a heavy-duty industrial package designed to measure Carbon Monoxide concentrations in the flue gas from combustion processes.

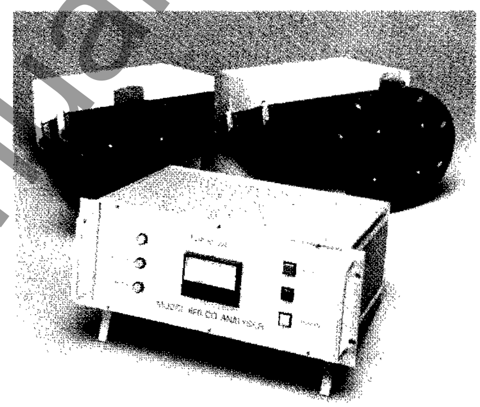
The monitor transmits a beam of infrared (IR) light across the stack or duct into the monitor module, which uses high-resolution absorption spectroscopy to determine the difference between the intensities of the light transmitted and of that received.

This information is fed to a microprocessor based unit which accurately calculates the amount of Carbon Monoxide concentration. The microprocessor also produces an isolated control output which can be used either for a chart recorder or as an input to an automatic, closed-loop control system for optimum combustion conditions and fuel economy. System status is conveniently displayed on the front of the control room unit.

The reference gas correlation technique used in the wavelength discrimination module ensures that the instrument is automatically and continuously calibrated to an internal standard, and allowance is made both for variations in the intensity of the infrared source and any background IR in the flue gases.

Because the Westinghouse in situ CO monitor has been designed for rugged industrial use, it provides long term reliability and exceptional low maintenance with most of the electronics located in the processor unit.

Typical applications include: conventional power and industrial boilers, steel mill furnances, refinery process heaters, pulp and paper industry bark boilers, incinerators and marine boilers.



Features	Benefits
Control Room Module	
• Continuous output reading across flue stack	• Can be used for automatic control
• Standard 19" rack (3u high) mounting unit	• Easily mounted in control room
• Isolated control output 4-20mA, 0-10V	• Signal can be input to recorder, controller, computer
• Automatic, continuous calibration	• Checks that instrument is still in calibration and giving accurate results
• 40 character, 2 line alphanumeric display	• Indicates full status of system including CO value, alarms present and parameter values
• Microprocessor status indicator	• Indicates the integrity of electronics
• Adjustable signal dampening, 4-255 seconds	• Signal smoothing for use in closed loop control
• Multi-language capability	• Can be configured on-site to display messages in one of five national configurations
• Alarm LED	• Displays acknowledged and unacknowledged alarms
• 115 or 220V operation	
• Eraseable EEPROM with removeable keylock	• Stores all parameter information against accidental or unauthorized erasure
• Adjustable ranges	• Can be configured to different ranges on-site
• Modular design	• Field replaceable electronics modules
• RS 232 port	• Process information can be printed out at specified intervals
Stack Mounted Units	
• Continuous, across the stack reading	• Integrates CO reading across whole stack, does not suffer misinterpretation of single point sampling
• IR beam windows	• Will not scratch on cleaning or degrade in use
• Majority of electronics remote from stack	• Longer life for electronics
• Minimal number of moving parts	• Maximum reliability
• Miniature, electronically cooled lead selenide detector	• Accurate over a wide range of ambient conditions
• Automatic gas correlation	• No calibration gases are consumed
• High efficiency isolating Air Lens/Purge system	• Facilitates the removal of either transmitter or receiver while boiler is operating and prevents dirt and dust from clouding windows when stack pressure is positive.
• Adjustable mounting	• Easy installation, overcomes inaccuracies in locating mounting flange
• IR chopper at source	• Monitor selects only chopped signal originating from source; rejects signals from other sources
• Stack mounted equipment in fully sealed, lightweight enclosures designed to IP65/NEMA 4 requirements	• Splashproof, light, easy and inexpensive to install

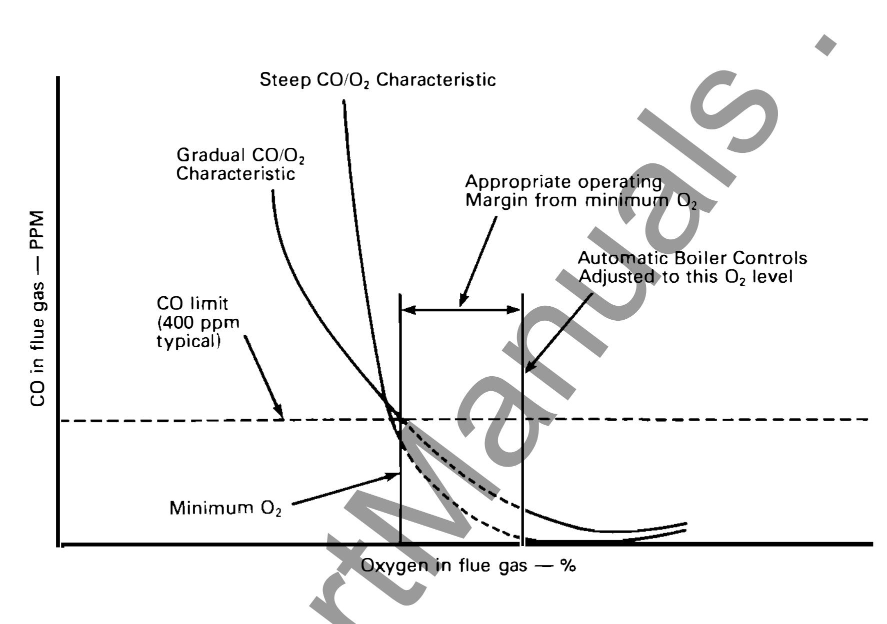
Why Measure CO?

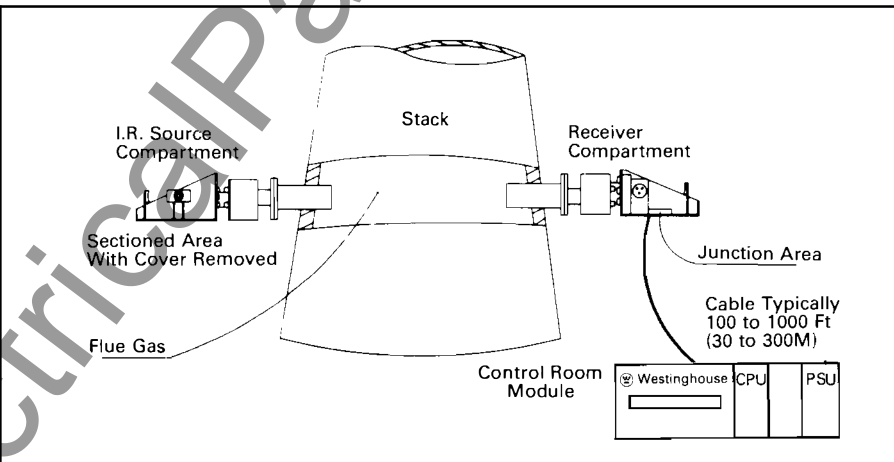
In years past, when fuel was inexpensive, it was economical to operate the boiler at high excess air to eliminate the possibility of developing potentially hazardous levels of combustibles in the combustion chamber and to prevent smoking. The lost heat up the stack was of little importance in terms of cost. The situation is drastically different today! Fuel costs are high and will remain high for the foreseeable future. With today's fuel costs, there is an incentive to reduce costs by increased combustion efficiency. In the process of combustion, each unit of fuel requires a certain number of oxygen units to burn it. The oxygen is supplied as air. The theoretical perfect ratio of the exact amount of air to burn a given amount of fuel is the stoichiometric ratio. If it were possible to operate a boiler at this perfect ratio, the fuel combustion efficiency would be 100%. However, it is not possible to operate at this perfect ratio because of the inability to provide perfectly uniform mixing of the fuel and air in the combustion chamber and because of the inefficiencies in today's burner technology. In addition, for safe boiler operation, excess air must be added in the combustion chamber. Hence, real world combustion is less than 100% complete.

When burning any fossil fuel, a major product of incomplete combustion is Carbon Monoxide. When fuel is burned in the presence of insufficient oxygen or without uniform mixing, large amounts of Carbon Monoxide are generated, and the unburned fuel is lost up the stack. Obviously, this wastes fuel and can produce smoke. Conversely, if there is an over abundance of oxygen (excess air) supplied to the combustion process, the Carbon Monoxide level will be very low, but the excess air must be heated, and this heat is lost up the stack.

Fuel is wasted by incomplete combustion on the one hand or as heated air going up the stack on the other. The boiler must be operated at a point where these losses are minimal, which is also the point of maximum fuel efficiency.

Carbon Monoxide is always present in the combustion process, no matter what the level of excess air. At high levels of excess air, CO typically is in the range of 5-20 parts per million (ppm). If the excess air is decreased and the oxygen level approaches stoichiometric, the CO level will suddenly start to increase. Figure 1 illustrates the relationship between unburned CO and excess O_2 in the flue gas. The fuel/air ratio which occurs over the dotted portion of the curves will minimize the fuel cost wasted as either unburned fuel or as unnecessary heated air going up the stack.





Typical Stack Installation of 620A CO Monitor

Operator Configurable Parameters

The 620A has an extensive list of operator adjustable parameters including the following:

- CO zero value .... Set at calibration
- CO span value.......................... Set at calibration
- Low CO alarm level...................... Communications baud rate
- High CO alarm level .... Language version
- CO display full scale .... Beam path length
- Analog output format.................... Alarm delay
- Analog output damping.................. Stack temperature value
- Time between printouts.................. IR absorption

All of these messages are displayed on the LCD display according to the value selected in the language parameter. The languages include UK English, US English, French and German.

Model 620A Principle of Operation

Carbon Monoxide absorbs a specific wavelength of infrared radiation, and this property is the basis of the spectroscopy technique used in the Westinghouse CO Monitor.

A polychromatic beam of radiation is emitted by a Globar source and is mechanically chopped and directed to a collimating mirror. The beam is transmitted through a window, across the stack or duct, through a duplicate window and onto a collimating mirror. The mirror directs the beam onto a rotating unit containing three references, one of 100% nitrogen, one of a known calibration value of CO and one of 100% CO respectively.

The Model 620A air lens has two primary functions: First, to provide a mechanical barrier between the stack and either the source, the receiver or both. This is used when the operator wants to dismantle the source and the receiver from the stack or where the windows need to be cleaned. The second, and more important function, is to create a vacuum in front of the window with the purpose of preventing dirt build up and to protect the equipment against stack overpressure. If this takes place it would impair the performance of the unit. The air lens air supply is provided either via an externally mounted blower or alternatively via a local, clean and dry instrument air supply.

After the cell wheel, the beam falls onto a narrow band pass filter which eliminates all wavelengths but the one absorbed by CO. The beam passes into an electronically cooled lead selenide detector which gives a readout of the IR intensity passing through each gas cell. The three waveform signal is then amplified and passed to the microprocessor.

The mechanical chopping of the beam enables the microprocessor to calculate an offset to allow for background IR radiation given off by hot flue gases. The three signals, one from each gas cell, are exactly representative of CO concentration in the flue gas. The 100% cell absorbs in effect, all the radiation corresponding to CO absorption line on the IR spectrum. This will, therefore, not be altered by the CO concentration in the flue gas. The signal level from the 100% N_2 and the calibration CO cells will vary according to a given relationship with the total CO concentration in sample and cell. This enables the CO concentration to be calculated in a manner which is independent of electronic limitations and radiation intensity. This technique discriminates between CO concentrations of water vapor and Carbon Dioxide, both of which are very close to the CO absorption band.

The microprocessor also takes into account the temperature in the stack which is preset on the panel. However, in cases where flue gases are expected to vary considerably, an optional temperature compensation package is available.

Specifications①

Electrical

Input Voltage Requirements	115 VAC ±10% 50/60 Hz.
Power Requirements	250 watts each to source analyser compartments. Optional 150 watt heater in each compartment.

Operational

Range	0-1000 PPM as standard. Other ranges to 0-20000 PPM can be programmed depending upon application.
Alarms	Displayed on alphanumeric display for the following conditions: High Carbon Monoxide; Low Carbon Monoxide; Low signal intensity; High signal intensity; Zero procedure error; Signal failure; EEPROM fault; accompanied by a red LED which will flash until all alarms are acknowledged.
Alarm relays	An optional alarm relay card is available
Zeroing	Performed by operator from front panel. An optional manual zero assembly is available to enable zeroing to be carried out in the presence of carbon monoxide.
Accuracy	±30 PPM at Ref temp.
Response Time	Adjustable from 4 to 255 seconds
Repeatability	±2%
Standardization	Performed by microprocessor using self-contained standards

Flue Gas

Temperature	Maximum 600°F (316°C)
Pressure	Maximum 10 in (254mm) W.G. with optional Westinghouse supplied blowers
Path Length	Min 3' (910mm) Max 30' (9.1m)
Output	4-20 mA into 750 ohm max load, or 0-10 v, isolated
System location	In clean gas stream after particulate removal 50% Maximum Opacity Source and receiver mounting surfaces must be free of vibration and must not move relative to each other.

Westinghouse is not responsible for installations that are improper and require relocation of any of the components.

Physical

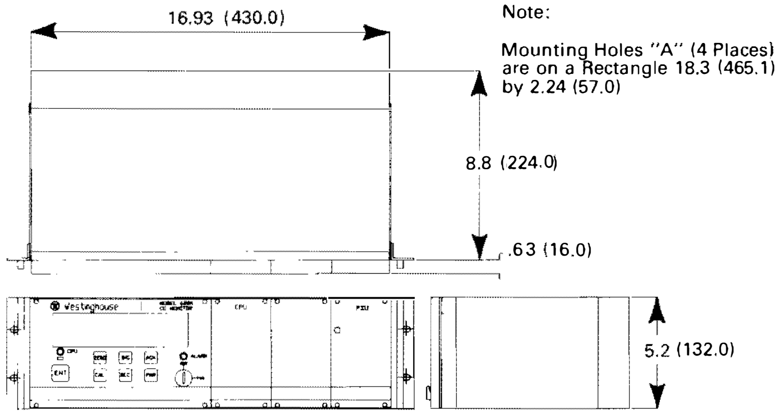
Source and Receiver	Moisture-proof enclosures
Compartments	Designed for NEMA 4 (IP65) operation
Dimensions	H 8.5 in (216mm), W 12.75 in (324mm) D 14.5 in (368mm)
Weight	30 lbs (13 kg) each enclosure
Air Lens Assembly	Flange mounted to source and detector compartments and stack duct.
Dimensions	Dia 11.0 in (280mm), L 6.0 in (150mm)
Weight	18 lbs (8 kg)
Control Room Unit	
Dimensions	H 5.3 in (133mm), W 19 in (483mm), D 10.25 in (260mm)
Weight	9 lbs (4 kg)
System shipping weight	110 lbs (50 kg)

Environmental

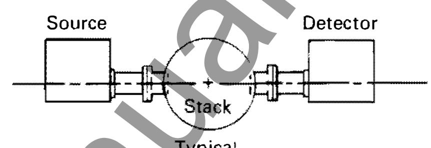
Ambient Operating Temperatures	
Source and Receiver Compartments	40°-125°F (5°-52°C)
Control Room Unit	32°-110°F (0°-43°C) (ambient relative humidity 10-85% non-condensing)

① Equipment ordered utilizing this document as reference will be supplied to the U.S.A. standard design. Customers requiring EEC standard design should request EEC documentation and utilize its ordering data.

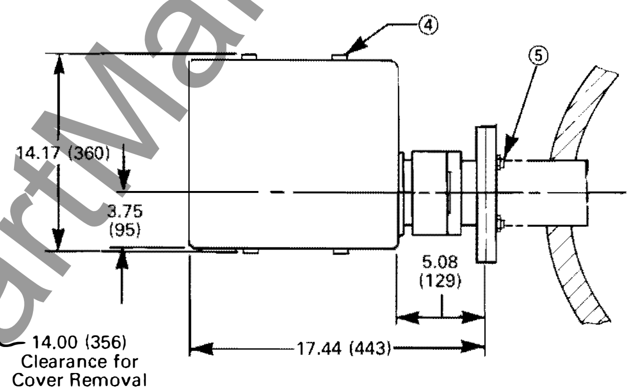
Installation Dimensions

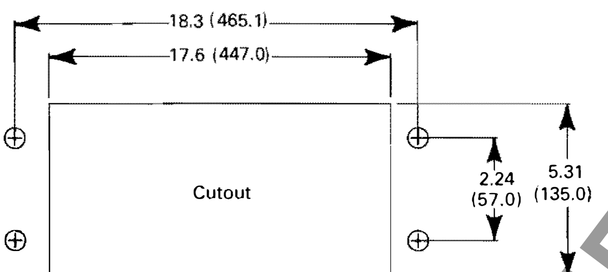


Model 620A CO Monitor



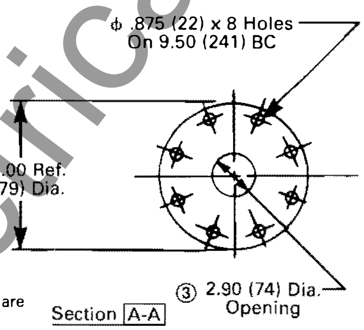
Typical Plan View



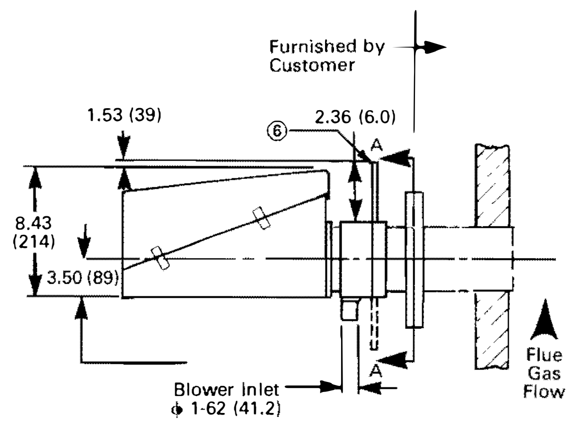


Note: All Holes 6.5 mm. Dia.

Panel Mounting Details



Section A-A



Notes

- ● Design dimensions are in inches. Dimensions in ( ) are millimeter equivalents.
- ② Unless otherwise specified tolerances are .12 (3).
- ③ Shutter opening to stack.
- ④ Four toggle clamps are provided to attach cover to chassis.
- ⑤ .75-16 UNF x 3.0 (M20 x 75mm) hex head bolts with washers and nuts are provided to attach instrument to a 6 IPS 150 lb ASA flange.
- ⑥ Shutter extends above cover 2.12 (54) when open. Closed, the shutter is 3.00 (76) below base. Provide clearance.

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Printed in U.S.A.

May, 1988