

Nanotechnology Metal Oxide Semiconductor (NTMOS) H₂S Gas Sensor

APPLICATION

The Det-Tronics Nanotechnology Metal Oxide Semiconductor (NTMOS) Hydrogen Sulfide (H₂S) stand-alone gas sensor delivers an ideal detection solution in challenging environments where electrochemical sensing technologies are not preferred.

The NTMOS H₂S sensor uses the latest Nanotechnology (NT) to ensure the highest performance and reliability. The sensing element is packaged in a rugged housing and protected by a sintered stainless steel flame arrestor, making it suitable for installation in Class I, Division 1 locations.

FEATURES

- Fast response to all H₂S concentrations
- Linear 4-20 mA output signal corresponding to 0-100 ppm H₂S (non-isolated)
- Performance approved to ANSI/ISA 92.0.01
- Non-intrusive calibration using the internal magnetic reed switch on the GDTB or UD10, or an externally located pushbutton (not included)
- Automatic fault diagnostics via current output
- Sensor approved as a stand alone unit and provides automatic calibration initiation capability
- Easily integrated with the Eagle Quantum Premier® (EQP) system using the Analog Input Module (AIM) to provide display and control capabilities
- Easily retrofitted into existing R8471B Series control/display card systems
- Model with sinter guard provides protection for sintered filter in high impact risk installations



DESCRIPTION

The NTMOS sensor uses the latest nanotechnology for detecting the presence of hydrogen sulfide gas. The sensor provides improved accuracy, reliability, and extended calibration intervals when compared to ordinary solid state type sensors.

SENSOR OUTPUT

The non-isolated 4-20 mA dc drive circuitry is rated at a maximum 600 ohms loop resistance with 24 Vdc supply voltage. See Table 1 for a description of current output levels.

$$PPM = [(I_o - 4) / 16] \cdot 100,$$

where I_o is the 4-20 mA signal

Table 1—Status Conditions Indicated by Current Output Levels

Current Level (mA)*	Condition
4.0 - 20.0	Gas Level (0 to 100 ppm H ₂ S)
0.8	Warm-Up
1.0	Fault
1.6	Unsuccessful or Aborted Calibration
1.8	Successful Calibration
2.0	Span Calibration
2.2	Zero Calibration

*Tolerance = ±0.07mA for fault, ±0.1 mA for others.

MODEL GDTB TERMINATION BOX

When not connected directly to a transmitter/control device, the NTMOS sensor can be connected to a GDTB Termination Box. The GDTB contains a circuit board with the required connectors for proper field wiring, as well as an internal magnetic switch for non-intrusive sensor calibration and an LED to indicate calibration status.

DET-TRONICS TRANSMITTERS

The NTMOS sensor integrates easily with the following Det-Tronics transmitters:

FlexVu Model UD10

The FlexVu™ Model UD10 Display Unit is recommended for applications where a gas detector with digital read-out of detected gas levels and analog, relay contact, and/or Modbus RS485 signal outputs are required. The Model UD10 performs all the functions of a gas controller.

Gas concentrations are displayed on an alphanumeric display in ppm. The UD10 provides a linear isolated/non-isolated 4-20 mA DC output signal (with HART) that corresponds to the detected gas concentration or indicates a fault condition.

All electronics are enclosed in an explosion-proof aluminum or stainless steel housing. The display unit is used with a single sensor that may be either coupled directly to the UD10, or remotely located using a GDTB Termination Box.

The UD10 features non-intrusive calibration. A magnet is used to perform calibration as well as to navigate the internal configuration menu. Refer to the UD10 Instruction Manual (number 95-8618) for complete information regarding the FlexVu UD10 Display Unit.

U9500 Infiniti Transmitter

The U9500B Infiniti® transmitter is a single channel device. In addition to the standard 4-20 mA analog signal output, the U9500B offers 4 optional relay outputs for fault and alarm indications. The 4 outputs are: fault, high alarm, low alarm, and auxiliary alarm. The relays have form C (SPDT) contacts. The alarm relay contacts are selectable as a group for latching or non-latching. During normal operation, the fault relay is non-latching, but for initialization faults, the fault relay latches. The alarm relays are also selectable, as a group, for normally energized or de-energized (no alarms). The fault relay is always normally energized (no fault). Refer to the Infiniti Transmitter Instruction Manual (number 95-8444) for complete information regarding the transmitter.

INSTALLATION

CAUTION

The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with applicable regulations that relate to the installation of electrical equipment in a hazardous area. If in doubt, consult the authority having jurisdiction before wiring the system.

NOTE

The NTMOS sensor shall be connected to a performance certified control unit with latching alarms.

NOTE

Exposure to silicones can adversely affect the NTMOS sensor and must be avoided.

DETECTOR POSITIONING

Proper detector location is essential for providing maximum protection. The most effective number and placement of detectors varies depending on the conditions at the job site. The individual designing the installation must rely on experience and common sense to determine the number of detectors needed and the best locations to adequately protect the area. The following factors are important and should be considered for every installation:

1. Since hydrogen sulfide is a highly toxic gas, a primary consideration in determining optimum detector locations is to identify where people are most likely to first come into contact with the toxic gas. This contact point is typically a prime location for an H₂S gas detector.
2. Factors such as vapor density should also be considered when determining detector locations. Hydrogen sulfide is slightly heavier than clean air, and therefore may tend to settle near the floor or ground, unless it is heated, mixed with other gases that are lighter than air, or prevented from doing so by ambient air movement patterns.
3. How rapidly will the H₂S gas diffuse into the air? Select a location for the detector as close as practical to an anticipated source.
4. Ventilation characteristics of the immediate area must also be considered. Air movement may cause the gas to accumulate more heavily in one

area than another. Detectors should be placed where the most concentrated accumulation of hydrogen sulfide gas is anticipated. Also consider the fact that some ventilation systems do not operate continuously, and therefore areas with poor circulation should be evaluated for toxic gas accumulation.

- The detector should be located where it is safe from potential sources of contamination. Allow adequate clearance from the mounting surface to prevent rain or hosedowns from splashing onto the sintered filter.
- The sensor should always be installed pointing straight down.
- The detector must be accessible for testing and calibration. Allow adequate space for attaching the H₂S Calibration Gas Mixer. See Specifications section of this manual for dimensions.
- Exposure to excessive heat or vibration can cause premature failure of electronic devices, and should be avoided if possible. Shielding the device from intense sunlight will reduce solar heating and can improve performance and increase the life of the unit.

WIRING REQUIREMENTS

The maximum allowable distance between the NTMOS sensor and transmitter/control device is limited by the resistance of the cabling used. To ensure proper operation, a minimum of 18 Vdc is required at the sensor.

When mounted remotely from the transmitter/controller, shielded cable or dedicated conduit is required for wiring the sensor. Ground the shield at the transmitter/controller end only.

In applications where the sensor cable is installed in conduit, the conduit should not be used for wiring to other electrical equipment whenever possible. If other equipment power wiring is run in the same conduit, the sensor cabling **must** be shielded.

If an additional signal conditioning or relay output transmitter is being used along with the NTMOS sensor, refer to the specific transmitter manual for detailed wiring instructions.

It is important that moisture not be allowed to come in contact with the electrical connections of the system.

Use proper piping techniques, breathers, glands, and seals as required to prevent water ingress and/or maintain explosion-proof ratings.

Table 2—NTMOS Sensor Wiring Identification

Wire Color	Function
Red	24 Vdc +
Black	24 Vdc -
White	4-20 mA Signal
Yellow*	Calibrate Line
Orange**	Connect to Isolated Spare
Grey**	Connect to Isolated Spare

* If the yellow wire is not being used, do not connect it to dc minus.
 ** For factory use only. Connect to isolated Spare terminal or tape off to prevent contact to any conductor.

INSTALLATION AND WIRING

- Determine the best mounting locations for the sensors. Mount the sensor with the filter pointing down. The junction box (GDTB or transmitter housing) is intended for flat-surface mounting, such as on a wall or post. A spacer or stand-off (1/4 to 1/2 inch) may be needed to allow adequate clearance for the sensor and calibration cup. The junction box should be electrically connected to earth ground.

NOTE

To ease installation and future removal, use either Lubriplate grease (see Ordering Information for part number) or teflon tape to lubricate the junction box cover and sensor threads. The use of silicone grease must be avoided.

- Terminate all sensor wiring at the proper terminals and verify that bonding between sensor housing-to-ground terminal is less than 0.1 ohm. Refer to Table 2 and Figures 1 to 4 for wiring details:

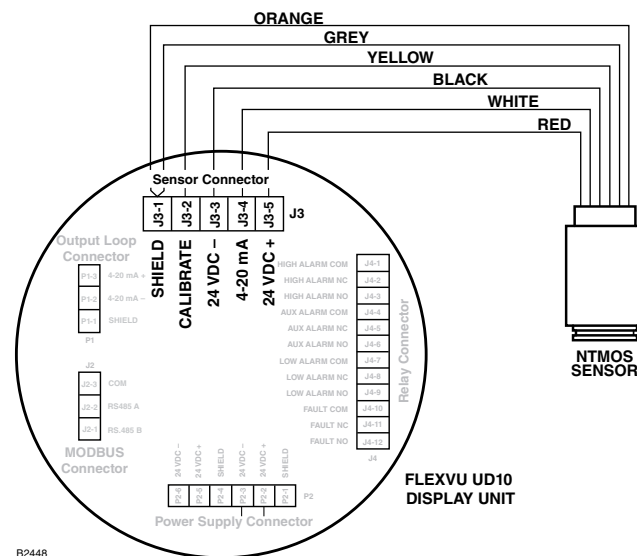


Figure 1—NTMOS Sensor Directly Wired to FlexVu Model UD10

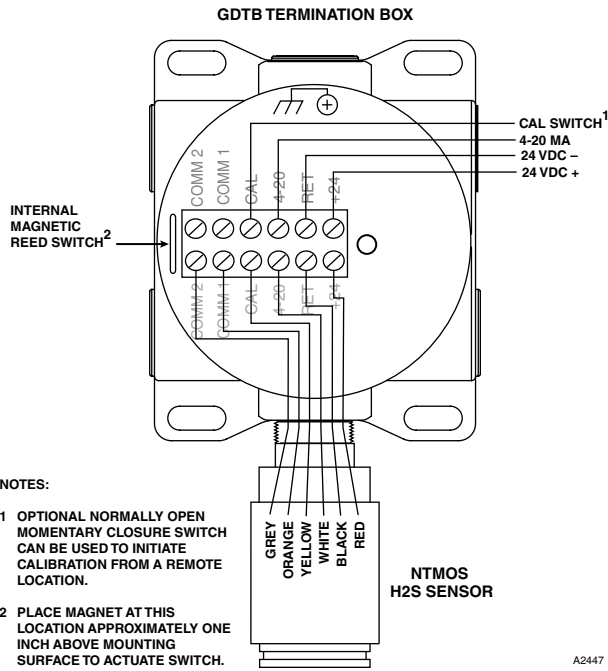


Figure 2—NTMOS Sensor Directly Wired to GDTB Termination Box

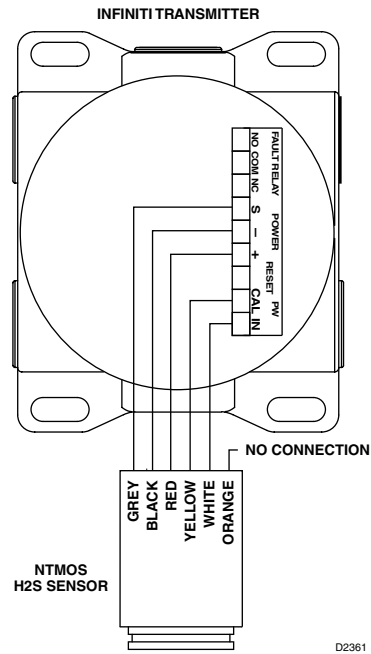


Figure 3—NTMOS Sensor Directly Wired to U9500 Infiniti Transmitter

- Confirm that the power and signal cabling for the gas detector is the proper size and type, and is appropriate for the application requirements. After all electrical connections are made, double check the terminations against the wiring diagrams to ensure that all connections are properly terminated.

- The NTMOS sensor is designed to operate at 24 Vdc. Before proceeding with complete system commissioning, measure the delivered voltage at the sensor to ensure that possible voltage drops have not compromised the necessary 24 Vdc supply voltage.

NOTE

Do not apply power to the system with the junction box cover removed unless the area has been de-classified.

- After confirming that the sensor is properly installed and wired, all electrical terminations are properly made, proper operating voltage is provided to the sensor, and all field cabling is appropriate for the application requirements, the installer may conduct the startup procedure.

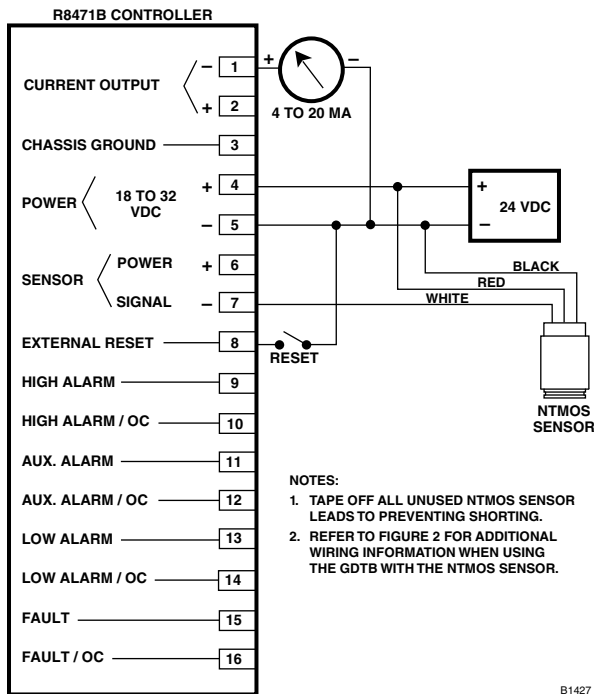


Figure 4—NTMOS Sensor Wired to Model R8471B Controller

STARTUP PROCEDURE

WARNING

Ensure that any output loads actuated by the detection system are bypassed to prevent accidental or unnecessary activation of these devices.

- Apply power to the system.

NOTE

Transmitters and display/control devices typically have a “warm-up” period to allow the sensor to stabilize before beginning normal operation (the NTMOS sensor can remain in warm-up for up to 30 minutes). After long periods without power, the sensor output may still not have returned to zero ppm by the end of the warm-up period. In some cases, an alarm level of H₂S may be indicated. Keep all output loads that are actuated by the system in bypass until all alarms clear.

2. **Allow the sensor to operate for 16 to 24 hours prior to an initial calibration**, then perform the “Calibration Procedure” as described in the following section. It may be necessary to refer to other transmitter and/or controller manuals to complete calibration.
3. Complete any additional startup/commissioning requirements as described in the manual provided with the transmitter/control device.
4. Place the system in normal operation.

CALIBRATION

FREQUENCY OF CALIBRATION

The NTMOS sensor is typically utilized to protect human life. For this reason, frequent calibration inspections are recommended. The specific frequency required in different applications can vary depending upon the amount of background gas, concentration of exposed H₂S, and ambient environmental conditions.

Calibration **must** be performed:

- When a new system is initially put into service.
- When the sensor is replaced.
- If a transmitter, controller or other device used in conjunction with the NTMOS sensor is replaced.

The following calibration schedule is recommended and will ensure reliable operation in most applications:

1. 16 to 24 hours after initial power-up.
2. Every 30 days thereafter, or as determined by the needs of the specific application.

IMPORTANT

To ensure adequate protection, the H₂S detection system must be calibrated on a regularly scheduled basis.

CALIBRATION GAS

The NTMOS H₂S sensor must be calibrated using a 50 ppm H₂S ampoule.

CAUTION

Use only the Det-Tronics 50 ppm Ampoule Calibration Kit (p/n 007098-005) with 50 ppm ampoules (p/n 225741-001). Bottled H₂S calibration mixtures (whether in air or nitrogen) are entirely devoid of humidity and will produce inaccurate calibration results, possibly resulting in a dangerous condition if the sensor under-reports the level of H₂S.

If background H₂S gas is present, it may be necessary to purge the sensor with clean air to ensure that an accurate zero or “clean air” condition is present prior to initiating calibration.

CALIBRATION PROCEDURE

The NTMOS sensor requires zero and span calibration. It is highly recommended that the FlexVu UD10 Display Unit, Model U9500B Transmitter, or Model R8471B Controller be utilized with the NTMOS sensor to enable non-intrusive field calibration. When using the UD10, U9500B, or R8471B for calibration, refer to the related manual for specific calibration instructions.

Calibrating a Stand-Alone NTMOS Sensor

1. A dc current meter capable of measuring 4-20 mA must be connected to the current loop output. This can be accomplished by connecting a dc ammeter in series with the load or by connecting a digital dc voltmeter across a known load resistance and calculating the current flow using the formula: current (I) = voltage/load resistance.
2. The sensor shall be allowed to operate for at least 6 hours (24 hours for initial power-up of a new sensor) prior to calibration.
3. Initiate calibration by activating the Calibration line.
4. The current output goes to 2.2 mA while the sensor automatically calibrates the zero output.
5. When the current output goes to 2.0 mA, apply 50 ppm H₂S gas to the sensor using the ampoule calibration kit.
6. Upon successful calibration, the current output will go to 1.8 mA. Remove the calibration gas. The output will go to 4 mA.

Calibration Sequence for NTMOS Sensor		
Current Output	Sensor Action	Operator Action
		Actuate Cal Line
2.2	Zero Cal	None
2.0	Span Cal	Apply 50 ppm
1.8	Cal Complete	Remove Gas
4.0	Normal Operation	

NOTE

If the current meter reads 1.6 mA, the calibration has failed. Replace the sensor and repeat the calibration.

MAINTENANCE

The NTMOS sensor is an industrial-grade device, suitable for a wide variety of challenging environmental conditions. However, a routine maintenance schedule is recommended to ensure that the sensor is in peak operating condition at all times. To ensure top performance, service the device as follows.

VISUAL INSPECTION

A visual inspection approximately once per week is recommended to ensure that physical obstructions such as trash, debris, mud, snow, or oil have not blocked or impeded hazardous gas access to the sensor.

SINTERED METAL FILTER

H₂S gas enters the sensor through the sintered metal filter on the front of the sensor housing. A dirty filter can significantly reduce the amount of H₂S gas that is able to reach the sensing element, thereby impairing the ability of the system to respond to a hazardous condition. If the filter becomes dirty and cannot be properly cleaned or if it is damaged, the sensor must be replaced.

NOTE

If the device cannot be calibrated or responds slowly to the calibration gas, check the condition of the filter before replacing the sensor.

FUNCTIONAL (RESPONSE) TEST

It is acceptable to perform a detector functional (response) verification test in lieu of a complete calibration if the detector output in clean air appears stable and the device has been calibrated recently.

This test involves simply applying calibration gas to the sensor while in normal operating mode and confirming correct detector response. (Use the Det-Tronics Ampoule Kit with 50 ppm ±5 ppm ampoules.) It is the operator’s responsibility to bypass any and all system alarm output devices, if necessary, prior to conducting the detector response test. If the response test results are not acceptable, then a complete calibration must be performed.

The NTMOS H₂S sensor must be “functional tested” using only Det-Tronics 50 ppm ±5 ppm H₂S ampoules (p/n 225741-001). All ampoule functional tests must be performed using the Det-Tronics H₂S Mixer with thumb screw ampoule breaker and internal mixing fan (p/n 007067-001). **Do not** use bottled 50 ppm H₂S in nitrogen.

SENSOR REPLACEMENT

The NTMOS sensor is not repairable. If calibration can no longer be properly performed, the sensor must be replaced.

The area must be de-classified or power to the detector should be removed prior to replacing the sensor in a hazardous area.

Follow the procedure below to replace the sensor.

1. Remove power to the transmitter or controller prior to replacing the sensor.
2. Remove the transmitter/termination box cover.
3. Disconnect the sensor wiring, then unscrew it from the conduit entry.
4. Thread the wires for the replacement sensor through the conduit entry and screw the sensor into the conduit entry. Connect the sensor wires to the appropriate terminals.
5. Replace the junction box cover.
6. Re-apply power. Refer to “Startup Procedure.”

An adequate supply of spare sensors should be kept on hand for field replacement. For maximum protection against contamination and deterioration, they should not be removed from the original protective packaging until the time of installation. To ensure maximum storage life, sensors should be stored in their original packaging, or if the bag has been opened, with the plastic cap and desiccant capsule in place. Always calibrate after replacing the sensor.

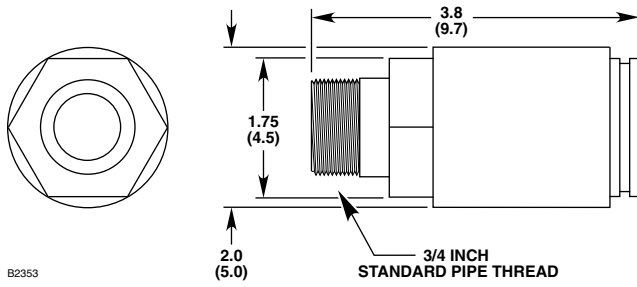


Figure 5—Dimensions of NTMOS Sensor without Sinter Guard (NTM1A10F) in Inches (Centimeters)

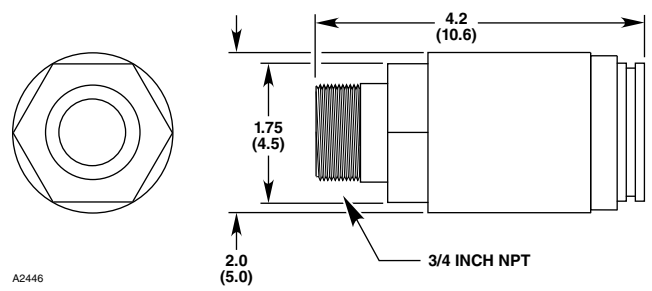


Figure 6—Dimensions of NTMOS Sensor with Sinter Guard (NTM1A10C) in Inches (Centimeters)

SPECIFICATIONS

MEASUREMENT RANGE—

0 to 100 ppm H₂S.

INPUT VOLTAGE—

18 to 30 Vdc, 24 Vdc nominal.

INPUT POWER—

2.5 watts maximum.

TEMPERATURE RANGE—

Operating: -40°F to +149°F (-40°C to +65°C).

Storage: -31°F to +149°F (-35°C to +65°C).

HUMIDITY RANGE—

5 to 95% RH.

RESPONSE TIME—

T50 ≤ 5 seconds with full scale gas applied.

T90 < 10 seconds (typical) with full scale gas applied.

ACCURACY (Linearity)—

Per ANSI/ISA-92.0.01 environmental ranges, ±10% of applied gas concentration or 2 ppm, whichever is greater.

PERFORMANCE—

Temperature Variation: Per ANSI/ISA-92.0.01 environmental ranges. ±5% full scale @ 50% applied gas concentration.

Humidity Variation: Per ANSI/ISA-92.0.01 environmental ranges. ±5% full scale @ 50% applied gas concentration.

WARM-UP TIME—

Up to 30 minutes.

CALIBRATION—

Single point, 50 ppm ampoule calibration required.

CALIBRATION CYCLE—

30 days recommended for most applications.

DIMENSIONS—

See Figure 5 for the model without sinter guard (NTM1A10F).

See Figure 6 for the model with sinter guard (NTM1A10C).

See Figure 7 for the NTMOS sensor with Calibration Gas Mixer attached.

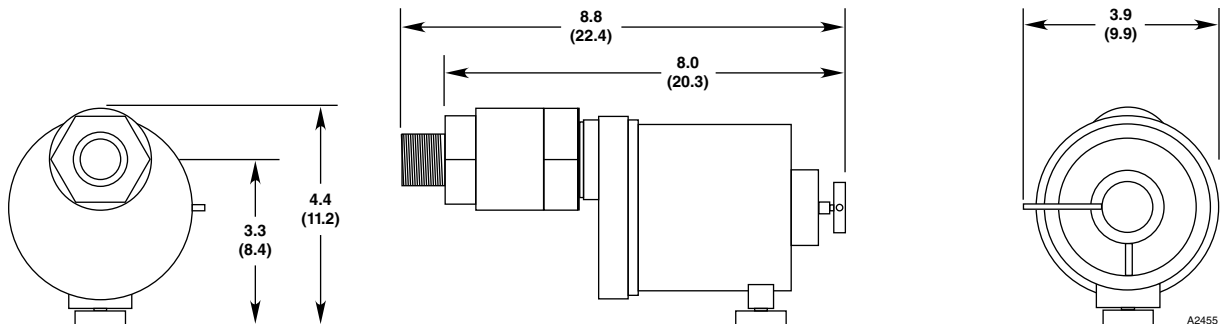


Figure 7—Dimensions of NTMOS Sensor with Ampoule Calibrator Attached in Inches (Centimeters)

WARRANTY—
2 years.

SHIPPING WEIGHT—
1.7 pounds (0.77 kilogram).

CERTIFICATION—

Model without Sinter Guard

FM: Performance tested to ANSI/ISA-92.0.01.
Class I, Div. 1, Groups B, C & D.
Class I, Div. 2, Groups A, B, C & D.
-40°C to +65°C (Performance Verified).
-40°C to +75°C (Haz. Loc. Rating).
IP53.
Acidic atmospheres excluded.

Model with Sinter Guard

CSA: Class I, Div. 1, Groups B, C & D (T5).
Class I, Div. 2, Groups A, B, C & D (T5).
Tamb = -40°C to +75°C (Haz. Loc. Rating).
IP53.
Acidic atmospheres excluded.

ORDERING INFORMATION

When ordering, please refer to the NTMOS H₂S Gas Sensor Model Matrix:

NTMOS Sensor Model Matrix

MODEL	DESCRIPTION	
NTM	Nanotechnology MOS H ₂ S Gas Sensor	
	TYPE	THREAD TYPE
	1A	3/4" NPT
	TYPE	MEASUREMENT OPTIONS
	10	0-100 PPM
	TYPE	APPROVALS
	F	FM
	C	CSA

Transmitter: U9500B Ininiti,
Specify with/without relays,
aluminum or stainless steel housing.

Display Unit: FlexVu UD10,
Includes relays, 4-20 mA w HART.
Specify aluminum or stainless steel
housing.

Termination Box: Model GDTB,
specify tall or short cover,
aluminum or stainless steel.

DEVICE REPAIR AND RETURN

Prior to returning devices, contact the nearest local Detector Electronics office so that a Return Material Identification (RMI) number can be assigned. **A written statement describing the malfunction must accompany the returned device or component to assist and expedite finding the root cause of the failure.**

Pack the unit properly. Always use sufficient packing material. Where applicable, use an antistatic bag as protection from electrostatic discharge.

NOTE

Inadequate packaging that ultimately causes damage to the returned device during shipment will result in a service charge to repair the damage incurred during shipment.

Return all equipment transportation prepaid to the factory in Minneapolis.

ACCESSORIES

Part Number	Description
007098-005	Ampoule Calibration Kit, 50 ppm H ₂ S: Used for performing functional test and calibration
225741-001	Ampoule: 50 ppm H ₂ S
007067-001	H ₂ S Mixer with thumb screw ampoule breaker and internal mixing fan
009700-001	Calibration Magnet: Used for calibrating and programming the UD10 or Ininiti Transmitter
102868-001	Lubriplate grease, 14 oz.
005003-001	Lubriplate grease, 1 oz.

Specifications subject to change without notice.

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