

Sensor Technical Data Summaries

mPower Sensor Modules

UNI and POLI sensors are smart sensors that carry with them calibration data. The connecting adapters depend on the type of instrument: 7-pin connectors for UNI, black wedge-shaped connection modules for POLI, and raw sensors for MUNI.



POLI Sensor Modules

UNI Sensor Module

Temperature, Pressure and Humidity

All electrochemical sensors can be used in the temperature range -40 to 50°C (except ClO_2 , which has a range of -20 to 40°C) and pressures deviating by up to $\pm 20\%$ from atmospheric pressure.

Humidity Requirements

All electrochemical sensors operate in the humidity range of 15 to 95% RH (non-condensing). Some humidity is required for long-term use to prevent drying out of the internal electrolyte. Humidity is not required for NDIR, PID, or LEL sensors, which thus have a range of 0 to 95% RH (non-condensing). Humidity above 50% RH can reduce PID response and may need correction for highly accurate work.

Oxygen Requirements

At least 10% by volume oxygen is required in the sampled gas for pellistor-type LEL sensors to sustain catalytic oxidation, but not for IR-type LEL sensors. A small amount of oxygen ($\geq 1\%$) is needed for nearly all electrochemical sensors except those that measure strong oxidants, i.e., O_3 , Cl_2 , and ClO_2 . Thus, most electrochemical sensors cannot be used to measure in dry, inert gases (such as nitrogen or argon) for long periods. However accurate measurements can be made in dry, inert gases for up to several minutes because the sensor electrolyte retains enough moisture and oxygen for this short time after moving from typical ambient air. Standard gases, which are often supplied in a dry nitrogen matrix, can be used for calibration because the exposure time is short enough. LEL measurements in inert gases can be made using an IR-type LEL sensor or a PID, neither of which require oxygen, as opposed to a pellistor-type LEL sensor, which needs oxygen for combustion.

Lifetime & Storage

Most electrochemical sensors should be stored at 0 to 20°C in their sealed container for up to 6 months without shorten much their operating life. The CO , H_2S , LEL, O_2 & IR sensors typically have warranties of 24 months in ambient air and expected operating lives of 36 months or more, depending on which instrument they are used in. All other electrochemical & PID sensors have a standard warranty of 12 months from the date of shipment, although the typical operating life is usually longer.

Biased Sensors (ETO, HCl, NO, THT & Lead-Free O_2)

Electrochemical sensors that use a bias voltage (e.g., HCl, ETO and lead-free oxygen) require an equilibration time of up to 12 hours after installing into an instrument (powered on or off), before zeroing and calibrating. Most other sensors are ready for use within several minutes of installation.

Instrument Limitations

The data listed below are from the supplier specification sheets and apply to the raw, 3-pin sensors without attached circuitry. In some cases the instrument limits the specifications further. For example, the temperature range for most sensors is -40 to 50°C , whereas most mPower instruments have an operating range of -20 to 50°C . In a few instances the measuring range is narrower in the instrument than for the raw sensor, and in some cases the instrument can extend the range to lower values. POLI monitors can accept at most two high-power sensors, which include PID, NDIR and LEL



3-Pin Raw Sensor (MUNI)

DISCLAIMER

Due to our continuous improvement efforts these specifications may change without notice.

Ammonia (NH₃)

SUAS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	50 ppm	0 ppm
Range	0-100 ppm	CO ₂	1000 ppm	0 ppm
Extended Linear Range	200 ppm	H ₂	1000 ppm	0 ppm
Resolution	1 ppm	H ₂ S	10 ppm	0 ppm
Deadband (UNI/POLI)	4 ppm	NO	25 ppm	0 ppm
t ₉₀ Response Time	≤90 s	SO ₂	25 ppm	65 ppm
Bias	0 mV	PH ₃	5 ppm	6.5 ppm
Temp. Range	-40 to 50°C	SiH ₄	5 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	-0.5 to 5 ppm	Isobutylene	20 ppm	Neg
T Effect on Signal (-20 to 50°C)	±40%	Methyl Mercaptan	100 ppm	0 ppm
Warranty	1 year		20 ppm	10 ppm
Default Alarms TWA/STEL	25 / 35 ppm			
Calibration Gas/Bal. Gas	50 ppm NH ₃ /Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes

Ammonia (NH₃)

SUVS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	50 ppm	0 ppm
Range	0-500 ppm	CO ₂	1000 ppm	0 ppm
Extended Linear Range	1000 ppm	H ₂	1000 ppm	0 ppm
Resolution	3 ppm	H ₂ S	25 ppm	35 ppm
Deadband (UNI/POLI)	5 / 4 ppm	Isobutylene	100 ppm	0 ppm
t ₉₀ Response Time	≤90 s			
Bias	0 mV			
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	-0.5 to 5 ppm			
T Effect on Signal (-20 to 50°C)	±40%			
Warranty	1 year			
Default Alarms TWA/STEL	25 / 35 ppm			
Calibration Gas/Bal. Gas	50 ppm NH ₃ /Air			

* Nitrogen balance gas can also be used if exposure is <5 minutes

Arsine (AsH₃)

SUSS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	H ₂ S	25 ppm	31 ppm
Range	0-1 ppm	PH ₃	20 ppm	17 ppm
Extended Linear Range	10 ppm	SiH ₄	10 ppm	5.5 ppm
Resolution	0.01 ppm	SO ₂	20 ppm	3.2 ppm
Deadband (UNI)	0.05 ppm	NH ₃	30 ppm	0.02 ppm
t ₉₀ Response Time	≤30 s	H ₂	500 ppm	0 ppm
Bias	0 mV	CO	300 ppm	0 ppm
Temp. Range	-40 to 50°C	Ethylene	10 ppm	0.01 ppm
T Effect on Zero (-20 to 50°C)	±0.03 to +0.1 ppm			
T Effect on Signal (-20 to 50°C)	±15%			
Warranty	1 year			
Default Alarms TWA/STEL	0.1 / 0.3 ppm			
Calibration Gas/Bal. Gas	5 ppm SO ₂ /Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes. See TA Note 6 for other calibration gas options.

Carbon Dioxide (CO₂)

DyMShia

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	NDIR			
Range	0-5% Vol			
Extended Linear Range	0-10% Vol			
Resolution	0.025% Vol			
Deadband (POLI)	0.02% Vol			
t ₉₀ Response Time	≤30 s			
Bias	NA			
Temp. Range	-20 to 50°C			
T Effect on Zero (-20 to 50°C)	±0.055% Vol			
T Effect on Signal (-20 to 50°C)	±15%			
Warranty	2 years			
Default Alarms TWA/STEL	0.5 / 3 %			
Calibration Gas/Bal. Gas	0.5% Vol CO ₂ /Air (equals 5000 ppm)			

Carbon Monoxide (CO) All Ranges

SuSF

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	Cl ₂	10 ppm	0.5 ppm
Range	0-1000 ppm	H ₂	50 ppm	8 ppm
Extended Linear Range	2000 ppm	NO	50 ppm	10 ppm
Resolution	1 ppm	NO ₂	30 ppm	1 ppm
Deadband (UNI/POLI)	5.5 / 3 ppm	SO ₂	20 ppm	0 ppm
t ₉₀ Response Time	≤15 s	H ₂ S	100 ppm	0 ppm
Bias	0 mV	VOC*		
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	-1 to 10 ppm			
T Effect on Signal (-20 to 50°C)	±40%			
Warranty	2 years			
Default Alarms TWA/STEL	35 / 100 ppm			
Calibration Gas/Bal. Gas	60 ppm CO/Air (0-500 ppm range) 100 ppm CO/Air (0-1000 or 1999 ppm range)			

* An internal carbon/oxidant filter reduces response to VOCs. The filter effectiveness is reduced over the life of the sensor by an amount that depends on the VOC exposure level.

Carbon Monoxide (CO) – Low Hydrogen Interference

AICOAX

Parameter	Specification	Cross-Sensitivity*	Test Conc.	Response
Sensor Type	Electrochemical	H ₂ (@10°C)	900 ppm	18 ppm
Range	0-2000 ppm	H ₂ (@20°C)	900 ppm	36 ppm
Maximum Overload	4000 ppm	H ₂ (@30°C)	900 ppm	54 ppm
Resolution	1 ppm	Cl ₂	10 ppm	0 ppm
t ₉₀ Response Time	≤30 s	NO*	500 ppm	≤10 ppm
Bias	0 mV	NO ₂ *	10 ppm	≤0.1 ppm
Temp. Range	-30 to 50°C	NH ₃	20 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	+4 to -6 ppm	SO ₂ *	20 ppm	0 ppm
T Effect on Signal (-20 to 50°C)	±35%	C ₂ H ₄ (ethylene)	400 ppm	≤20 ppm
Warranty	1 year			
Default Alarms TWA/STEL	35 / 100 ppm			
Calibration Gas/Bal. Gas	60 ppm CO/Air (0-500 ppm range) 100 ppm CO/Air (0-1000 or 1999 ppm range)			

* Internal filter capacities: H₂S: 250,000 ppm-hours, SO₂: 250,000 ppm-hours, NO: 20,000 ppm-hours, NO₂: 500,000 ppm-hours. Filter effectiveness is reduced over the life of the sensor by an amount that depends on the exposure level.

Carbon Monoxide/ Hydrogen Sulfide (CO/H₂S) Dual Sensor

DDGS+4DT

Parameter	CO Specification	H ₂ S Specification	
Sensor Type	Electrochemical	Electrochemical	
Range	0-1000 ppm	0-200 ppm	
Extended Linear Range	NA	NA	
Resolution	1 ppm	0.5 ppm	
t ₉₀ Response Time	≤30 s	≤30 s	
Bias	0 mV	0 mV	
Temp. Range	-30 to 50°C	-30 to 50°C	
T Effect on Signal (-20 to 50°C)	±60%	±15%	
Warranty	1 year	1 year	
Default Alarms TWA/STEL	35 / 100 ppm	10 / 15 ppm	
Calibration Gas/Bal. Gas	100 ppm CO/Air	25 ppm H ₂ S/Air	
Cross-Sensitivity	Test Conc.	CO Response	H ₂ S Response
CO	300 ppm	300 ppm	<5 ppm
H ₂ S	25 ppm	<5 ppm	25 ppm
SO ₂	5 ppm	0 ppm	<1 ppm
NO	35 ppm	<0.1 ppm	<1 ppm
NO ₂	5 ppm	<0.1 ppm	0 ppm
Cl ₂	15 ppm	0 ppm	0 ppm
VOC*		*	

* An internal carbon/oxidant filter reduces CO sensor response to VOCs, with a filter lifetime of >20,000 ppm-hours

Chlorine (Cl₂)

SuDS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	ClO ₂	5.0 ppm	3.9 ppm
Range	0-10 ppm	O ₃	0.5 ppm	0.4 ppm
Extended Linear Range	50 ppm	CO	100 ppm	0 ppm
Resolution	0.1 ppm	H ₂	1000 ppm	0 ppm
Deadband (UNI/POLI)	0.4 / 0.2 ppm	NO	50 ppm	0 ppm
t ₉₀ Response Time	≤60 s	NO ₂	10 ppm	10 ppm
Bias	0 mV	SO ₂	20 ppm	0 ppm
Temp. Range	-40 to 50°C	H ₂ S	25 ppm	-3 ppm
T Effect on Zero (-20 to 50°C)	0.2 to -0.4 ppm			
T Effect on Signal (-20 to 50°C)	±20%			
Warranty	1 year			
Default Alarms TWA/STEL	0.5 / 1.0 ppm			
Calibration Gas/Bal. Gas	10 ppm Cl ₂ /N ₂			

Chlorine Dioxide (ClO₂)

Se3E10

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	Cl ₂	1 ppm	0.6 ppm
Range	0-1 ppm	O ₃	0.25 ppm	0.7 ppm
Extended Linear Range	0-1 ppm	CO	100	0 ppm
Resolution	0.03 ppm	H ₂	3000 ppm	0 ppm
Deadband (UNI/POLI)	0.03 ppm	Alcohols	1000 ppm	0 ppm
t ₉₀ Response Time	≤120 s	H ₂ S	20 ppm	-5 ppm
Bias	0 mV			
Temp. Range	-20 to 40°C			
T Effect on Zero (-20 to 50°C)	0 to 0.06 ppm			
T Effect on Signal (-20 to 50°C)	±20%			
Warranty	1 year			
Default Alarms TWA/STEL	0.1 / 0.3 ppm			
Calibration Gas/Bal. Gas	0.5 ppm ClO ₂ /N ₂ (Requires generator) or 1 ppm Cl ₂ / N ₂ (Available in gas cylinder). See TA Note 6 for generator options and procedures.			

Combustibles (LEL – Lower Explosive Limit)

SULEL

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Catalytic Oxidation	Responds to most combustible gases including H ₂ and VOCs up to C ₈ *		
Range	0-100% LEL			
Extended Linear Range	100% LEL			
Resolution	1% LEL			
Deadband (POLI)	6% LEL			
t ₉₀ Response Time	≤15 s			
Temp. Range	-20 to 55°C			
T Effect on Zero (-20 to 60°C)	±3% LEL			
T Effect on Signal (-20 to 60°C)	±10%			
Warranty	2 years			
Default Alarms LOW/HIGH	10 / 20 %LEL			
Calibration Gas/Bal. Gas	50% LEL CH ₄ /Air, 50% LEL Propane/Air or 20% LEL Pentane/Air			

* **CAUTION:** Poison-removing carbon fiber filters (PN M082-0903-010) placed on the sensor inlet should only be used for measuring methane or hydrogen because they greatly slow the response of propane and absorb heavier hydrocarbons like pentane or gasoline.

Ethylene Oxide & Acetaldehyde (ETO, C₂H₄O)

SUAS

Parameter	Specification	Cross-Sensitivity [†]	CF*
Sensor Type	Electrochemical	CO	2.3
Range (ETO / C ₂ H ₄ O)	0-100, 0-20 ppm	NO ₂	6.1
Extended Linear Range	200 ppm	HCN	2.8
Resolution	0.1 ppm	Formaldehyde	0.4
Deadband (ETO UNI/POLI)	0.5 / 4.5 ppm	Formic Acid	1.4
Deadband (C ₂ H ₄ O UNI/POLI)	- / 2.5 ppm	Methanol	0.9
t ₉₀ Response Time	≤120 s	Ethanol	1.5
Bias	300 mV	Ethylene Oxide	1.0
Temp. Range	-40 to 50°C	1,3-Butadiene	0.8
T Effect on Zero (-20 to 50°C)	-1 to 10 ppm	Isobutylene	1.7
T Effect on Signal (-20 to 50°C)	±25%	Vinyl Chloride	1.4
RH Effect on Signal (@45%RH)	≤10%	Acetone	NR
Warranty	1 year	Ethyl Acetate	NR
Default Alarms TWA/STEL	1 / 2 ppm	Benzene	NR
Calibration Gas/Bal. Gas	10 ppm ETO/Air	n-Hexane	NR

[†] For more cross-sensitivity data, see TA-Note 9.

* CF = Correction Factor = Response(ETO) / Response(Test Gas). After calibration to ETO, the true concentration of these gases is calculated as Reading x CF.

Hydrogen (H₂)

SUNT

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	50 ppm	150 ppm
Range	0-1000 ppm	Cl ₂	10 ppm	0.5 ppm
Extended Linear Range	2000 ppm	NO	50 ppm	10 ppm
Resolution	10 ppm	NO ₂	30 ppm	1 ppm
Deadband (UNI/POLI)	12 ppm	SO ₂	20 ppm	0 ppm
t ₉₀ Response Time	≤70 s	H ₂ S	100 ppm	0 ppm
Bias	0 mV			
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	-1 to 10 ppm			
T Effect on Signal (-20 to 50°C)	±300%			
Warranty	1 year			
Default Alarms LOW/HIGH	100 / 400 ppm			
Calibration Gas/Bal. Gas	700 ppm H ₂ /Air			

Hydrogen Chloride (HCl)

SULS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	HF	~12 ppm	~1 ppm
Range	0-50 ppm	HF	20 ppm	0.2 ppm
Extended Linear Range	100 ppm	CO	100 ppm	0 ppm
Resolution	0.1 ppm	CO ₂	500 ppm	0 ppm
Deadband (UNI/POLI)	0.8 ppm	NO	20 ppm	50 ppm
t ₉₀ Response Time	≤70 s	NO ₂	5 ppm	~15 ppm
Bias	200 mV	H ₂ S	25 ppm	110 ppm
Temp. Range	-40 to 50°C	SO ₂	20 ppm	30 ppm
T Effect on Zero (-20 to 50°C)	-1 to 15 ppm			
T Effect on Signal (-20 to 50°C)	±20%			
Warranty	1 year			
Default Alarms TWA/STEL	1 / 5 ppm			
Calibration Gas/Bal. Gas	10 ppm HCl/Air*			

* N₂ balance gas can be used if exposed <5 min. Use stainless steel regulator and allow ≥3 min. gas flow prior to start of calibration. See TA Note 6 for detailed procedures.

Hydrogen Cyanide (HCN)

SULS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	100 ppm	0 ppm
Range	0-50 ppm	Cl ₂	16 ppm	0 ppm
Extended Linear Range	100 ppm	NO	18 ppm	0 ppm
Resolution	0.2 ppm	NO ₂	23 ppm	-1 ppm
Deadband (UNI/POLI)	0.9 ppm	H ₂ S	26 ppm	52 ppm
t ₉₀ Response Time	≤120 s	SO ₂	23 ppm	8 ppm
Bias	0 mV	SiH ₄	20 ppm	0 ppm
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	-1 to 1 ppm			
T Effect on Signal (-20 to 50°C)	±25%			
Warranty	2 years			
Default Alarms TWA/STEL	4.7 / 4.7 ppm			
Calibration Gas/Bal. Gas	10 ppm HCN/Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes

Hydrogen Fluoride (HF)

SULS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	HCl	29 ppm	47 ppm
Range	0-20 ppm	Cl ₂	5 ppm	>20 ppm
Extended Linear Range	50 ppm	CO ₂	5000 ppm	~1 ppm
Resolution	0.1 ppm	CO	500 ppm	0 ppm
Deadband (UNI/POLI)	0.5 ppm	HCN	10 ppm	0 ppm
t ₉₀ Response Time	≤120 s	NO	5 ppm	>20 ppm
Bias	0 mV	NO ₂	20 ppm	180 ppm
Temp. Range	-40 to 50°C	NH ₃	50 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	0.4 to -1 ppm	H ₂ S	25 ppm	0 ppm
T Effect on Signal (-20 to 50°C)	±20%	SO ₂	5 ppm	0 ppm
Warranty	1 year	Isobutylene	100 ppm	0 ppm
Default Alarms TWA/STEL	3 / 6 ppm	Burnt paper fumes		++
Calibration Gas/Bal. Gas	10 ppm HF/Air* 10 ppm HCl/Air**†			

* Use stainless steel regulator and allow ≥2 min. of gas flow prior to start calibration. N₂ balance gas can be used if exposed <5 min.

† Set HF span value to 16 ppm when calibrating with 10 ppm HCl. See TA Note 6 for detailed procedures.

++ Unquantified moderate positive response.

Hydrogen Sulfide (H₂S) 0-50 ppm, 0-100 ppm & 0-200 ppm Ranges

SUAS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	Methyl Mercaptan	20 ppm	7 ppm
Range	0-100 ppm	CO	300 ppm	0 ppm
Extended Linear Range	500 ppm	H ₂	1000 ppm	0 ppm
Resolution	0.1 ppm	HCN	10 ppm	0 ppm
Deadband (UNI/POLI)	2.5 / 1.5 ppm	NH ₃	50 ppm	0 ppm
t ₉₀ Response Time	≤15 s	NO	18 ppm	1 ppm
Bias	0 mV	NO ₂	23 ppm	0 ppm
Temp. Range	-40 to 50°C	PH ₃	5 ppm	2 ppm
T Effect on Zero (-20 to 50°C)	-0.2 to 1 ppm	SO ₂	5 ppm	1 ppm
T Effect on Signal (-20 to 50°C)	±20%	SiH ₄	20 ppm	3 ppm
Warranty	2 years	Isobutylene	100 ppm	0 ppm
Default Alarms TWA/STEL	10 / 15 ppm			
Calibration Gas/Bal. Gas	25 ppm H ₂ S/Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes. 15 ppm H₂S is used in 4-gas mixtures used to calibrate MUNI & POLI when pellistor LEL sensors are present to limit LEL inhibition by H₂S.

Hydrogen Sulfide (H₂S) 0-1000 ppm Range

SUNS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	300 ppm	0 ppm
Range	0-1000 ppm	H ₂	1000 ppm	0 ppm
Extended Linear Range	2000 ppm	HCN	10 ppm	0 ppm
Resolution	0.1 ppm	NH ₃	50 ppm	0 ppm
Deadband (UNI/POLI)	5.5 / 1.5 ppm	NO	18 ppm	1 ppm
t ₉₀ Response Time	≤45 s	NO ₂	23 ppm	0 ppm
Bias	0 mV	SO ₂	5 ppm	1 ppm
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	0 to 10 ppm			
T Effect on Signal (-20 to 50°C)	±20%			
Warranty	2 years			
Default Alarms TWA/STEL	10 / 15 ppm			
Calibration Gas/Bal. Gas	≥25 ppm H ₂ S/Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes

Methyl Mercaptan (CH₃SH)

SUDS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	t-Butyl Mercaptan	7.3 ppm	7.6 ppm
Range	0-10 ppm	H ₂ S	2.5 ppm	5.5 ppm
Extended Linear Range	20 ppm	SO ₂	5 ppm	3 ppm
Resolution	0.1 ppm	CO	300 ppm	0 ppm
Deadband (UNI/POLI)	0.5 ppm	H ₂	10,000 ppm	25 ppm
t ₉₀ Response Time	≤20 s	NO	35 ppm	1 ppm
Bias	0 mV	NO ₂	5 ppm	-1 ppm
Temp. Range	-40 to 50°C	HCN	10 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	-0.1 to 0.6 ppm	NH ₃	50 ppm	0 ppm
T Effect on Signal (-20 to 50°C)	±20%	Isobutylene	1000 ppm	1.1 ppm
Warranty	1 year	Isobutylene [†]	10000 ppm	5.6 ppm
Default Alarms TWA/STEL	0.5 / 2.0 ppm	Methane**	2.5 Vol%	0.0 ppm
Calibration Gas/Bal. Gas	4 ppm CH ₃ SH/Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes.

** 2% Vol Methane does not affect methyl mercaptan readings significantly

[†] Could cause interference when measuring mercaptans in liquified petroleum gas (LPG)

Nitric Oxide (NO)

SuHS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	100 ppm	0 ppm
Range	0-250 ppm	H ₂ S	26 ppm	35 ppm
Extended Linear Range	1000 ppm	SO ₂	23 ppm	2 ppm
Resolution	0.5 ppm	NO ₂	20 ppm	10 ppm
Deadband (UNI/POLI)	5 ppm	NH ₃	50 ppm	0 ppm
t ₉₀ Response Time	≤30 s	Cl ₂	18 ppm	1.5 ppm
Bias	+300 mV	HF	10 ppm	≤1 ppm
Temp. Range	-40 to 50°C	Isobutylene	100 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	-2 to 10 ppm	Benzene	50 ppm	0 ppm
T Effect on Signal (-20 to 50°C)	±20%	Methanol	~1000 ppm	0 ppm
Warranty	2 years	Isopropanol	200 ppm	0 ppm
Default Alarms TWA/STEL	25 / 25 ppm	Acetone	200 ppm	0 ppm
Calibration Gas/Bal. Gas	25 ppm NO/Air			

Nitrogen Dioxide (NO₂)

SuCT

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	400 ppm	0 ppm
Range	0-20 ppm	NO	30 ppm	0 ppm
Extended Linear Range	200 ppm	NH ₃	50 ppm	0 ppm
Resolution	0.1 ppm	Cl ₂	11 ppm	-2 ppm
Deadband (UNI/POLI)	0.5 ppm	HF	11 ppm	0 ppm
t ₉₀ Response Time	≤30 s	H ₂	1000 ppm	0 ppm
Bias	0 mV	H ₂ S	25 ppm	<1 ppm
Temp. Range	-40 to 50°C	SO ₂	5 ppm	<3 ppm
T Effect on Zero (-20 to 50°C)	0.3 to -1 ppm	SiH ₄	20 ppm	Neg
T Effect on Signal (-20 to 50°C)	±20%	Isobutylene	100 ppm	0 ppm
Warranty	2 years	Benzene	50 ppm	0 ppm
Default Alarms TWA/STEL	1 / 1 ppm	Methanol*	~1000 ppm	~10 ppm
Calibration Gas/Bal. Gas	5 ppm NO ₂ /Air	Isopropanol*	200 ppm	≤6 ppm
		Acetone	200 ppm	0 ppm

* 200 Methanol reads 0.0 ppm after 2 minutes but slowly drifts upwards to several ppm and after gas removal drifts slowly back to 0.0. Isopropanol exhibits similar drifting behavior. These solvents are not expected to interfere significantly below 100 ppm.

Nitrous Oxide (N₂O)

DyMSHia-PN2OP

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	NDIR	CO ₂	1000 ppm	<100 ppm
Range	0-1000 ppm			
Extended Linear Range				
Resolution	10 ppm			
Deadband (UNI/POLI)	100 ppm			
t ₉₀ Response Time	≤30 s			
Bias	0 mV			
Temp. Range	-20 to 50°C			
Warm-up Time	45 s			
T Effect on Signal (-20 to 50°C)	±15%			
Warranty	2 years			
Default Alarms TWA/STEL	35 / 100 ppm			
Calibration Gas/Bal. Gas	400 ppm N ₂ O/Air*			

* Nitrogen balance gas can also be used.

Oxygen (O₂)

DDOx3

Parameter	Specification	Cross-Sensitivity	Response
Sensor Type	Galvanic Electrochemical	ppm levels of toxics including CO, Cl ₂ , O ₃ , NO ₂ , H ₂ S, SO ₂ , VOCs, etc.	No Effect
Range	0-25% Vol		
Extended Linear Range	0-30% Vol		
Resolution	0.1 % Vol		
Deadband (UNI/POLI)	0.45 / 0.55% Vol	Vol% levels of inert gases, N ₂ , Ar, He, etc.	No Effect*
t ₉₀ Response Time	≤10 s		
Bias	0 mV	Vol% levels of oxidizing gases, e.g. Cl ₂ & O ₃	Respond equal to their oxygen equivalence
Temp. Range	-30 to 50°C		
T Effect on Zero (-20 to 50°C)			
T Effect on Signal (-20 to 50°C)	±12%	Acid gases, e.g. CO ₂ & SO ₂	0.3% of signal per 1% Vol CO ₂ **
Warranty	2 years		
Default Alarms LOW/HIGH	19.5 / 23.5 %		
Calibration Gas	18% Vol O ₂ for span, pure N ₂ for zeroing		

* Above ~1% Vol, non-nitrogen inert gases change the diffusion rate, causing high or low readings if calibrated in air. See TA-Note 14.

** Cannot be used to measure continuously in >25% Vol CO₂ due to reaction with electrolyte.

Oxygen (O₂) Lead-Free

DDOxLF

Parameter	Specification	Cross-Sensitivity	Response
Sensor Type	Electrochemical	Vol% levels of inert gases, N ₂ , Ar, He, etc.	No Effect*
Range	0-25% Vol		
Extended Linear Range	0-30% Vol		
Resolution	0.1 % Vol		
Deadband (UNI/POLI)	0.65% Vol	Vol% levels of acid gases, CO ₂ & SO ₂ etc.	No Effect*
t ₉₀ Response Time	≤10 s		
Bias	-600 mV		
Temp. Range	-40 to 60°C		
T Effect on Zero (-20 to 50°C)			
T Effect on Signal (-20 to 50°C)	±11%		
Warranty	2 years		
Default Alarms LOW/HIGH	19.5 / 23.5 %		
Calibration Gas	10% Vol O ₂ for span, pure N ₂ for zeroing		

* Above ~1% Vol, non-nitrogen gases change the diffusion rate, causing high or low readings if calibrated in air. See TA-Note 14.

Ozone (O₃)

SUCS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	Cl ₂	5 ppm	~5 ppm
Range	0-5 ppm	ClO ₂	0.5 ppm	1.0 ppm
Extended Linear Range	50 ppm	NO ₂	1 ppm	1.1 ppm
Resolution	0.02 ppm	NO	25 ppm	3.1 ppm
Deadband (UNI)	0.08 ppm	NO	5 ppm	0.54 ppm
t ₉₀ Response Time	≤60 s	H ₂ S	25 ppm	-6.4 ppm
Bias	0 mV	SO ₂	20 ppm	0 ppm
Temp. Range	-40 to 50°C	CO	400 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	0 to -0.5 ppm	H ₂	1000 ppm	0 ppm
T Effect on Signal (-20 to 50°C)	±20%	CH ₄	25000 ppm	0 ppm
Warranty	1 year			
Default Alarms TWA/STEL	0.1 / 0.1 ppm			
Calibration Gas/Bal. Gas	0.5 ppm O ₃ /Air (O ₃ generator required)* 2.5 ppm Cl ₂ (available in gas cylinder) 2 ppm NO ₂ or 5 ppm NO (in gas cylinder)			

* See TA Note 6 for generator options and procedures. An O₃ generator is preferred because response to surrogate gases can vary.

Phosgene (COCl₂)

SuVS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	Cl ₂	1 ppm	0.5 ppm
Range	0-1 ppm	ClO ₂	1 ppm	negative
Extended Linear Range	0-1 ppm	SO ₂	5 ppm	1 ppm
Resolution	0.02 ppm	H ₂ S	5 ppm	15 ppm
Deadband (UNI/POLI)	0.03 / 0.1 ppm	CO	100	0 ppm
t ₉₀ Response Time	≤120 s	NO	18 ppm	0 ppm
Bias	0 mV	NO ₂	23 ppm	-1 ppm
Temp. Range	-40 to 50°C	O ₃	1 ppm	0 ppm
T Effect on Zero (-20 to 50°C)	±0.5 ppm			
T Effect on Signal (-20 to 50°C)	±20%			
Warranty	1 year			
Default Alarms TWA/STEL	0.1 / 0.3 ppm			
Calibration Gas/Bal. Gas	2.0 ppm Cl ₂ /N ₂ (Available in gas cylinder)* or 1.0 ppm Cl ₂ /air (from gas generator)			

* This is 1 ppm phosgene equivalent. Set span value to 0.95 ppm to avoid over-range alarm at 1.00 ppm. See TA Note 6 for details.

Phosphine (PH₃)

SuCS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	H ₂ S	25 ppm	20 ppm
Range	0-20 ppm	AsH ₃	10 ppm	10 ppm
Extended Linear Range	100 ppm	SiH ₄	20.5 ppm	6 ppm
Resolution	0.05 ppm	CO	300 ppm	0 ppm
Deadband (UNI/POLI)	0.2 / 0.5 ppm	H ₂	1000 ppm	0 ppm
t ₉₀ Response Time	≤60 s	HCN	10 ppm	0 ppm
Bias	0 mV	NH ₃	50 ppm	0 ppm
Temp. Range	-40 to 50°C	NO	18 ppm	1 ppm
T Effect on Zero (-20 to 50°C)	0 to 1 ppm	NO ₂	23 ppm	0 ppm
T Effect on Signal (-20 to 50°C)	±20%	SO ₂	5 ppm	1 ppm
Warranty	2 years	Isobutylene	100 ppm	0 ppm
Default Alarms TWA/STEL	0.3 / 1 ppm	Methyl Mercaptan	20 ppm	1 ppm
Calibration Gas/Bal. Gas	5 ppm PH ₃ /Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes

Phosphine (PH₃)

SuNS

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	500 ppm	0 ppm
Range	0-1000 ppm	H ₂	1000 ppm	<1 ppm
Extended Linear Range	2000 ppm	NH ₃	40 ppm	0 ppm
Resolution	1 ppm	SO ₂	5 ppm	<1 ppm
Deadband (POLI)	4.5 ppm	H ₂ S	25 ppm	20 ppm
t ₉₀ Response Time	≤60 s	Ethylene	50 ppm	<1 ppm
Bias	0 mV			
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	0 to 10 ppm			
T Effect on Signal (-20 to 50°C)	±20%			
Warranty	1 years			
Default Alarms TWA/STEL	0.3 / 1 ppm			
Calibration Gas/Bal. Gas	100 ppm PH ₃ /Air* 500 ppm H ₂ S/Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes

Sulfur Dioxide (SO₂) 0-20 and 0-100 ppm Ranges

SUCT

Parameter	Specification	Cross-Sensitivity	Test Conc.	Response
Sensor Type	Electrochemical	CO	400 ppm	<3 ppm
Range	0-20 & 0-100 ppm	H ₂	2000 ppm	<8 ppm
Extended Linear Range	150 ppm	NO	20 ppm	0 ppm
Resolution	0.1 ppm	NO ₂	20 ppm	<-24 ppm
Deadband (UNI/POLI)	0.5 ppm	H ₂ S	25 ppm	2.5 ppm**
t ₉₀ Response Time	≤45 s	SiH ₄	20 ppm	4 ppm
Bias	0 mV			
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	-0.1 to 1 ppm			
T Effect on Signal (-20 to 50°C)	±15%			
Warranty	2 years			
Default Alarms TWA/STEL	2 / 5 ppm			
Calibration Gas/Bal. Gas	5 ppm SO ₂ /Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes

** On-board filter material removes most H₂S response, typically for years, but after long or high exposures, the filter may be used up.

Tetrahydrothiophene (THT)

SULS

Parameter	Specification	Cross-Sens.	Test Conc.	Response [‡]
Sensor Type	Electrochemical	H ₂ S	25 ppm	2 ppm (8 mg/m ³)
Range	0-40 ppm (0-147 mg/m ³)	t-Butyl Mercaptan	5 ppm	~1.5 ppm
Extended Linear Range	None	CO	500 ppm	-1 ppm (-3 mg/m ³)
Resolution	0.1 ppm	NO ₂	23 ppm	10 ppm (35 mg/m ³)
Deadband (UNI/POLI)	1.2 / 0.2 ppm	CO ₂	1000 ppm	0
t ₉₀ Response Time	≤60 s [†]	H ₂	1000 ppm	0
Bias	300 mV	N ₂	100%	0
Temp. Range	-40 to 50°C			
T Effect on Zero (-20 to 50°C)	0 to 1.5 ppm			
T Effect on Signal (-20 to 50°C)	±15%			
Warranty	1 year			
Default Alarms TWA/STEL	5 / 5 ppm			
Calibration Gas/Bal. Gas	10 ppm THT/Air* 20 mg/m ³ THT/Air*			

* Nitrogen balance gas can also be used if exposure is <5 minutes. [‡] 1 ppm THT = 3.66 mg/m³ @ 20°C

[†] 2-3 min calibration time is recommended because response rises sharply and then tails. t₉₀ is about 30 s for H₂S.

Volatile Hydrocarbons (HCs) by NDIR

DynMSHia

Parameter	Specification	Specification	Cross-Sensitivity	CF**
Sensor Type	Infrared Absorption	Infrared Absorption	Methane	3.3
Range	0-5% Vol CH ₄ (0-100% LEL CH ₄ or 0-100% LEL VOC)	0-100% Vol CH ₄ (CH ₄ only, no other VOCs for this range)	Ethane	1.0
Resolution	0.025% Vol CH ₄ (0.5% LEL CH ₄)	0.5% Vol CH ₄	Propane	1.0
Deadband (POLI)	5% LEL CH ₄	3% Vol	Butane	1.0
Accuracy	±2% of full scale @ 20°C		Pentane	0.9
t ₉₀ Response Time	≤30 s @ 20°C		Hexane	0.8
Warm-up Time	1 min to ±2% of full scale		Ethylene	3.4
Long Term Zero Drift	±1% of full scale per month @ 20°C (max ±3% of full scale per year)		Propylene	1.7
Temp. Range	-20 to 50°C		Cyclopentane	1.6
T Effect on Signal (-20 to 50°C)	±2% of full scale @ 0-20% full scale ±10% of reading @ 20-50% full scale ±15% of reading @ 50-100% full scale		Methanol	2.2
Sensor Life	Warranty 2 years; typical life >5 years		Ethanol	1.7
Calibration Gas/Bal. Gas	50% LEL CH ₄ or Propane/Air or N ₂ *	50% LEL CH ₄ or 3-pt cal with 50% LEL and 100% Vol CH ₄ balance Air or N ₂ *	Isopropanol	1.4
Compound Sensitivity	Responds to VOCs with C-H bonds		Ethylene Oxide	0.85
			Acetone	3.3
			Methyl ethyl ketone	1.9
			Ethyl acetate	1.7
			Toluene	1.2
			Xylene	1.5
			Chloromethane	5.0
			Dichloroethane	8.6
			Hydrogen	NR#

* Cal gas type and concentration is preferably selected to be near the range of HCs to be measured. Single range 100%Vol CH₄ sensor should be calibrated with 20% to 100%Vol CH₄, while the Dual-Range LEL/VOL sensor is calibrated either with 2.5% Vol (50% LEL) CH₄ for standard 2-pt calibration or for 3-pt calibration using 2.5% Vol (50% LEL) CH₄ and 20-100%Vol CH₄.

** CF = Vol% Correction Factor using propane calibration gas, tested up to 2.1% Vol (100% LEL) propane equivalent.
True Vol Concentration = Reading x CF.

No response to H₂.

Volatile Organic Compounds (VOCs) by PID (4-Series, 1/4" Lamp)

SuPID

Parameter	Specification	Specification
Sensor Type	Photo-ionization	Photo-ionization
Range	0-300 ppm	0-1000 ppm
Resolution	0.1 ppm	1 ppm
t ₉₀ Response Time	≤3 s	≤5 s
Temp. Range	-40 to 50°C	-40 to 50°C
T Effect on Zero (-20 to 50°C)		
T Effect on Signal (-20 to 50°C)	+40% to -25%	+40% to -25%
Lamp Operating Life	10000 hrs (5 yrs @ 40-hr work week)	
Sensor Warranty	1 year	
Default Alarms TWA/STEL	50 / 100 ppm	
Calibration Gas/Bal. Gas	10 ppm IBE*/Air	100 ppm IBE*/Air
Compound Sensitivity	Responds to thousands of VOCs. See TA-1 and TA-2 for more information	

* IBE = isobutylene. Cal gas concentration is preferably selected to be near the concentration range of VOCs measured

Sensor Specifications and Default Configuration Summary

Sensor	Range (ppm)	Resolution (ppm)	LDL [†] (ppm)	Span* (ppm)	Low (ppm)	High (ppm)	STEL (ppm)	TWA (ppm)	UNI Ring Color	Response Time t ₉₀ (s)
CO	0-500	1	5.5 / 3	100	35	200	100	35	Red	15
	0-1000	1	5.5 / 3	100	35	200	100	35		15
	0-1999	1	5.5 / 3	100	35	200	100	35		15
H ₂ S	0-50	0.1	2.5 / -	25	10	20	15	10	Light Blue	15
	0-100	0.1	2.5 / 1.5	25	10	20	15	10		15
	0-200	0.1	2.5 / 1.5	25	10	20	15	10		15
	0-1000	1	5.5 / 1.5	25	10	20	15	10		45
NH ₃	0-100	1	4	50	25	50	35	25	Orange	90
	0-500	1	5 / 4	50	25	50	35	25		90
Cl ₂	0-50	0.1	0.4 / 0.2	10	0.5	5	1	0.5	Orange	60
ClO ₂	0-1	0.01	0.03	0.5**	0.2	0.5	0.3	0.1	Orange	120
COCl ₂	0-1	0.01	0.03 / 0.1	0.5**	0.2	0.5	0.3	0.1	Orange	120
H ₂	0-1000	1	12	100	100	400	400	100	Orange	70
	0-2000	1	12 / -	100	100	400	400	100		70
HCN	0-100	0.1	0.9 / 3.5	10	4.7	5	4.7	4.7	Orange	120
NO	0-250	1	5	25	25	50	25	25	Orange	90
NO ₂	0-20	0.1	0.5	5	1	10	1	1	Orange	30
N ₂ O	0-1000	10	10	400	35	200	100	35	N/A	30
PH ₃	0-20	0.01	0.2 / 0.5	5	1	2	1	0.3	Orange	60
PH ₃	0-1000	1	- / 4.5	20/50	1	2	1	0.3	Orange	60
SO ₂	0-20	0.1	0.5	5	2	10	5	2	Orange	15
SO ₂	0-100	0.1	0.5	5	2	10	5	2	Orange	15
ETO	0-100	0.1	0.5 / 4.5	10	2	5	2	1	Orange	120
	0-200	0.1	0.5 / -	10	2	5	2	1		120
O ₃	0-5	0.01	0.08 / -	1**	0.2	0.3	0.1	0.1	Orange	60
HF	0-20	0.1	0.5	6**	2	6	6	3	Orange	120
HCl	0-15	0.1	0.8	10**	2	5	5	1	Orange	70
CH ₃ SH	0-10	0.1	0.5	5	2	5	2	0.5	Orange	20
AsH ₃	0-1	0.01	0.05 / 0.03	5 (SO ₂)	0.2	0.5	0.3	0.1	Orange	30
Acetaldehyde	0-20	0.1	2.5	5	2	5	2	1	Orange	120
THT	0-40	0.1	1.2 / 0.2	10	5	10	5	5	Orange	60

[†] Lower Detection Limit (deadband) for UNI/POLI (applies to both if only one value is given, and "-" if sensor unavailable).

* The default span setting equals the recommended span gas concentration.

** Calibration of these sensors requires a gas generator or other special precautions. See TA Note 6 for recommended procedures and gas sources. COCl₂ uses 1.0 ppm Cl₂ from a generator because this low level is unstable in cylinders.

Sensor	Range (%)	Resolution (%)	LDL [†] (%)	Span* (%)	Low (%)	High (%)	STEL (%)	TWA (%)	UNI Ring Color	Response Time t ₉₀ (s)
O ₂	0 - 25	0.1	0.45 / 0.55	0.0	19.5	23.5	-	-	Dark Blue	15
	0 - 30	0.1	0.45 / 0.55	0.0	19.5	23.5	-	-		15
O ₂ Lead-free	0 - 30	0.1	0.65	0.0	19.5	23.5	-	-	Dark Blue	15

* Oxygen sensors in MP100 use pure nitrogen or other inert gas for both Span and Bump Test. [†] Lower Detection Limit

Cross-Sensitivities and Non-Recommended Sensor Combinations

Most sensors respond to some extent to gases other than just the target gas. In most cases cross-sensitive gases result in high readings and therefore err in the safe direction, even if they result in a false positive alarm. A positive cross-sensitivity is sometimes useful, such as when using a Cl₂ gas cylinder to calibrate an O₃ sensor. Of more concern are gases that have a negative interference and thus give a false low response and prevent an alarm when there should be one. A common example is that of reducing gases like NH₃, H₂S and SO₂ depressing the response of sensors for oxidizing gases like Cl₂, ClO₂ and O₃, and vice versa.

CAUTION 1: We strongly urge users to contact mPower Technical Support before purchasing a unit with negatively interfering sensors.

CAUTION 2: It is always most accurate to calibrate a sensor directly with the gas for which it is designed. Cross-sensitivities are not tested specifications when sensors are manufactured and thus may vary between individual sensors, sometimes by as much as a factor of 2.

Commonly-requested sensor combinations that require particular attention include:

- H₂S and Cl₂ or ClO₂ sensors
- NH₃ and Cl₂ sensors
- NO₂ and SO₂ sensors

In addition, the following sensors have strong interferences and it is difficult to measure:

- HCN when H₂S is present
- HF when HCl or NO₂ is present
- HCl when H₂S, NO, or SO₂ is present
- O₃, Cl₂ ClO₂ and/or NO₂ in the presence of each other
- CO when H₂ is present (use the Low-H₂ version CO sensor to reduce interference to ~2%)

The table below provides typical percent response of non-target gases when the sensor is calibrated to its named gas.

		SENSOR															
		NH ₃	CO	Cl ₂	ClO ₂	H ₂	HCl	HCN	HF	H ₂ S	CH ₃ SH	NO	NO ₂	O ₃	PH ₃	SO ₂	CO ₂
CHALLENGE GAS	NH₃	+100								0	0						
	CO	0	+100	0	0	+300	0	0	0	0	0	0	0	0	0	<1	
	Cl₂	neg*	+5	+100	+60	+5		0	pos*			+8	-20	+100			
	ClO₂			+80	+100									+200			
	H₂	0	+16	0	0	+100				0	<1		0	0	0	<0.5	
	HCl						+100		160								
	HCN	0						+100	0	0	0				0		
	HF								+100			+10					
	H₂S	+250	0	-15	-25	0	+450	+200	+40	+100	+220	+140	<-4	-25	+80	+10	
	CH₃SH	+50								+35	+100				+5		
	NO	0	+20	0		+20	+250	0	pos*	+5	<+2	+100	0	+10	+5	0	
	NO₂		+3	+100		+3		-4	+900	0	<-60	+50	+100	+100	0	-120	
	O₃				+300									+100			
	PH₃	0								+40					+100		
	SO₂	+120	0	0		0	+150	+25	0	+20	<+50	+10	<+60	0	+20	+100	
	CO₂	0					0										
VOC	0	pos*		0					0	0.1			0	0			

* pos, neg = positive or negative response expected but not yet quantified

Calibration of Cross-Sensitive Sensor Combinations

If two cross-sensitive sensors are used in the same instrument, zero both sensors before starting any span calibration. After spanning the first sensor, be sure to allow at least a few minutes time in fresh air for the second sensor to stabilize before calibrating the latter. Then wait a few more minutes for all sensors to reach zero and then recheck the first sensor in a bump test to verify that it is still within acceptable calibration.