DET-TRONICS®
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Technical Bulletin

Catalytic Gas Sensor Conversion K-Factors

Catalytic combustible gas detection systems are best used for the detection of a specific gas or vapor type, although they will respond to a variety of flammable vapor species. The Instrument Society of America (ISA) recommends always calibrating your catalytic sensor with the specific vapor type that is expected to be detected at the job site whenever possible. This recommendation means that every project requires some investigation as to the gas hazard(s) expected to be detected before specifying the calibration gas.

While Det-Tronics catalytic gas detection systems are capable of accurately measuring literally hundreds of different flammable gases, only a handful of pre-mixed, compressed calibration gas types are offered. This means that whenever a gas or vapor must be detected for which there is not a matching calibration gas mixture offered, a conversion K-Factor must be used by the technician performing the calibration procedure to ensure proper sensitivity to the vapor is provided by the system. Det-Tronics' PIRECL, an infrared (IR) combustible gas detector, does not require the use of K-Factors. IR based point detectors are available for a variety of combustible gas applications.

In a typical calibration, a known concentration (typically one-half of the sensor's full scale detection range) of the **actual** gas or vapor that is expected to be detected should be used to calibrate the system. Det-Tronics' calibration gas should be used to ensure proper system calibration performance and accuracy. Calibration gas should not be used if the oxygen concentration within the gas is listed at less than 20% by volume.

A conversion K-Factor must be used in the calibration of the system whenever detection of gases/vapors other than the gas used in the actual calibration process will occur. See Table 1 for the current list of Det-Tronics K-Factors. The K-Factor represents the relative sensor response ratio of the calibration gas to the detected gas. The K-Factor is used within the K-Factor equation to determine the proper transmitter output level (span setpoint) when the sensor is exposed to the calibration gas.

The K-Factor equation is as follows:

$C \times K = S$

where,
- C = Concentration of the calibration gas, in % LFL
- K = Conversion K-Factor for the gas to be monitored with the given calibration gas
- S = Corrected combustible gas transmitter calibration span output level (span setpoint)

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Example:	Gas/vapor to be detected:	Gasoline vapors				
	Calibration gas:	50% LFL propane in air				
	K-Factor:	1.04				
	Equation:	C	x	K	=	S
		50	x	1.04	=	52

For proper system sensitivity to gasoline vapors, the transmitter span setpoint should be adjusted to read 52% LFL when the sensor is exposed to 50% LFL propane in air mixture calibration gas.

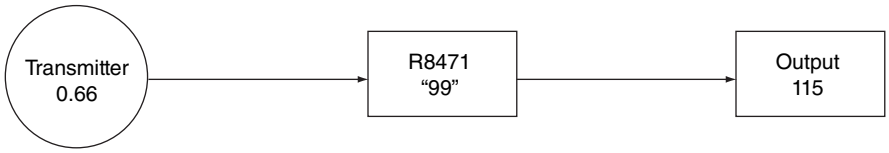
If more than one calibration gas type and K-Factor is listed for a gas to be detected, generally the best calibration gas to use is that which provides a K-Factor closest to value 1.0 (one). Note that the presence of methane gas as a potential detectable gas is an exception. Always use methane calibration gas if methane is expected to be present within the protected area.

If the determined K-Factor for the gas/vapor to be detected exceeds 2.0, the controller setpoint adjustment for the calibration gas should be utilized. See the following example:

Example:	Gas/vapor to be detected:	Diesel fuel oil #2				
	Calibration gas:	50% LFL propane in air				
	K-Factor:	2.30				
	Equation:	C	x	K	=	S
		50	x	2.30	=	115

A cumulative effect exists between the controller calibration gas setpoint adjustment (R8471 or U9500) and the transmitter (500/505/K-series) span potentiometer adjustment. To maximize catalytic sensor life, the controller calibration gas setpoint adjustment should be adjusted to compensate for as much of the span value as possible; a setting of “99” is recommended. Refer to the appropriate controller or transmitter instruction manual to make this adjustment.

Example: A customer utilizes a 505 transmitter and a R8471 controller to detect diesel fuel oil #2. The calibration gas is 50% LFL propane and the span adjustment is determined to be 115. Prior to calibrating the catalytic gas sensor, the R8471 controller calibration gas setpoint should be adjusted to “99”. During calibration of the 505 transmitter, with the calibration gas applied to the sensor, the span potentiometer should be adjusted to 0.66 Vdc. This will give the entire system the correct output when in the presence of the diesel fuel.



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If a specific gas/vapor and K-Factor is not listed within Table 1, then K-Factor testing by Det-Tronics Sensor Engineering department is required. Det-Tronics may not accept some items for testing, such as hazardous, toxic, carcinogenic, pyrophoric, or hypergolic materials. In this case, an estimated K-Factor may be provided based upon the Material Safety Data Sheet (M.S.D.S.), or reference of previous test data and engineering judgement.

Conversion K-Factors

Table 1 is applicable to all current Det-Tronics Combustible Gas Sensors including all CGS-series sensor part numbers, as well as all 225006-XXX, 226530-XXX, 226531-XXX, 225957-XXX, 226999-XXX, and 226931-XXX series sensor part numbers.

Table 1 is not applicable to Det-Tronics C7061C series sensors (part numbers 003699-XXX), used with R8460/8466 and U8700A - D gas detection systems.

Table 1– Current List of Det-Tronics K-Factors

Gas to be detected	Type of Calibration Gas		
	Methane	Hydrogen	Propane
Acetaldehyde	0.96	0.97	0.79
Acetic Anhydride	1.46	0.97	1.00
Acetone	1.44	1.65	1.04
Acetonitrile	–	–	1.10
Acetylene	1.12	1.56	0.95
Ammonia	1.06	1.40	0.83
Benzene	1.56	1.79	1.13
Butadiene	1.35	1.80	1.08
Butane	1.47	1.75	1.10
Calsol Thinner 325	–	–	1.70
Cyclohexane	1.49	1.70	1.07
Cumene	–	–	1.70
Dichloroethane	–	–	1.12
Dicyclopentadiene	2.06	1.63	1.51
Diethyl Ether	1.20	1.11	0.97
Diesel fuel oil #2	–	–	2.30
Dimethylformamide	1.68	1.20	1.24
Ethane	1.24	1.41	0.89
Ethanol	1.26	1.43	0.91
Ethyl Acetate	–	–	1.12
Ethylbenzene	1.80	–	1.40
Ethylene	1.03	1.17	0.74
Ethylene Dichloride	–	–	1.12
Formaldehyde	0.69	0.65	0.54
Freon 142B	2.77	2.47	2.03

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Gas to be detected	Type of Calibration Gas		
	Methane	Hydrogen	Propane
Gasoline	1.45	1.65	1.04
Heptane	–	–	1.42
Hexane	1.87	2.14	1.35
1-Hexene	1.27	1.36	1.04
Hydrogen	0.88	1.00	0.63
Isobutane	1.47	1.75	1.10
Isobutylene	1.11	1.46	0.89
Isopentane	1.50	1.71	1.08
Isoprene	0.97	0.86	0.82
Isopropyl Alcohol	1.31	1.22	1.09
Jet Fuel A	–	–	1.70
Jet Fuel JP-5	–	–	1.90
Methane	1.00	1.14	0.72
Methanol	0.96	1.09	0.69
Methyl Acrylate	1.62	1.47	1.40
Methyl Ethyl Ketone	1.66	1.90	1.20
MethylIsobutyl Ketone	–	–	1.25
Naptha (VM & P)	1.69	1.82	1.47
Pentane	1.50	1.72	1.08
Propane	1.39	1.59	1.00
Propylene	1.20	1.37	0.86
Stoddard Solvent	1.47	1.33	1.22
Styrene	–	–	1.90
Tetrahydrofuran	1.21	1.07	1.02
Toluene	1.69	1.94	1.22
Trimethyl amine	1.19	1.08	1.03
Xylene	1.75	2.20	1.33

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