Reference Material

NEMA Definitions

Type 1	General Purpose	indoor	accidential contact (cage or skeleton) will not rust
Type 2	Drip-proof	indoor	limited amounts of falling water and dirt (not dust-tight) will not rust
Type 3	Dust-tight, rain-tight	outdoor	windblown dust, rain, sleet, and undamaged by external ice formation
Type 3R	Dust-tight, rain-tight	outdoor	same as type 3 above, plus diverts water from live parts, provision for drainage, will not rust
Type 3S	Dust-tight, rain-tight	outdoor	same as type 3 above, operation of external mechanism when ice laden, will not rust
Type 4	Water-tight/dust-tight	indoor/ outdoor	windblown dust and rain, splashing water, and hose directed water, undamanged by ice formation, will not rust
Type 5	Dust-tight	indoor	dust and falling direct, will not rust
Type 6	Water-tight, dust-tight	indoor/ outdoor	temporary entry of water during limited submersion (6 ft. for 30 min), undamaged by formation of ice, will not rust
Type 6P	Water-tight/dust-tight	indoor/ outdoor	same as type 6 above plus prolonged submersion at 6 psig, will not rust
Type 7	Explosion proof Cl I, Gps A, B, C, D	indoor	Hazardous locations: protection against corrosive effects of liquids and gases
Type 8	Explosion proof Cl I, Gps A, B, C, D	indoor/ outdoor	Hazardous locations: protection against corrosive effects of liquids and gases; contacts or connections immersed in oil
Type 9	Explosion proof Cl II, Gps E or G	indoor	Hazardous locations: dust-tight, hazardous dust
Type 10	Hazardous Locations	indoor	(MSHA) Mine Safety and Health Adm. per 30 C.F.R., Part 18
Type 11	Oil-tight/Corrosion	indoor	protection from corrosive effects of gases and liquid dripping, seepage and external condensation of corrosives, oil immersion
Type 12	Oil-tight/Dust-tight	indoor	fibers, lint, dust and light splashing, seeage, and dripping condensation of non-corrosive liquids
Type 12K	Oil-tight/Dust-tight	indoor	same as type 12 above, enclosure has knockouts
Type 13	Oil-tight/Dust-tight	indoor	dust, spraying of water, oil and corrosive coolant, oil resistant gaskets

Enclosure Rating Descriptions

NEMA, UL & CSA type rating	Approximate IEC/IP classification	Abbreviated protection description
1	IP23	Indoor protection from contact with contents
2	IP30	Indoor with limited protection from dirt & water
3	IP64	Outdoor with some protection from rain, sleet, windblown dust & ice damage
3R	IP32	Outdoor with some protection from rain, sleet & ice damage
4	IP66	Indoor and outdoor with some protection from windblown dust, rain, splashing water, hose-directed water & ice damage
4X	IP66	Indoor and outdoor with some protection from corrosion, windblown dust, rain, splashing water, hose-directed water & ice damage
6	IP67	Indoor and outdoor with some protection from hose-directed water, entry of water during submersion at limited depth & ice damage
12	IP55	Indoor with protection from dust, falling dirt & dripping non-corrosive liquids
13	IP65	Indoor protection against dust, spraying water, oil & non-corrosive liquids

Source: Control Engineering, March 1999

Approval Agencies

These groups define the options or approvals that may be required for a particular application. Safety requirements, the demands of the machinery on which the product will be used, or the type of environment will all play a role in determining the type of approval needed.

UL D	**Underwriters Laboratories (UL)** **DEMCO** (Subsidiary of UL)	Our file number is E79070 for hazardous location switches and E81878 for general purpose switches. Our file number for Switchpak and Lumitech products is E125326. Our file number for the LPS is E79070.
MSHA	**Mine Safety and Health Administration (MSHA)**	Our file number is X/P-1504-1 November 20, 1984.
FM APPROVED	**Factory Mutual (FM)**	Factory Mutual approved switches are listed in the Factory Mutual Approved Guide. Our file number for the DVC-FF is 3010217.
CSA	**Canadian Standard Association (CSA)**	Our file number is LR-24226, (CSA) which includes most GO® Switches except special models.
	Standards Association of Australia (SAA)	Our file number is EL/29:78062/M90 Ex109.
Ex BASEEFA	**British Approvals Service for Electrical Equipment in Flammable Atmospheres (BASEEFA) (Cenelec)**	Our file number is Ex 89C1233X for use in Zone 1 Hazardous areas.

UL Hazardous Locations

Class I
Flammable Gases, Vapors or Liquids
Class I Area Classification

Division 1:
Where ignitable concentrations of flammable gases, vapors, or liquids can exist all of the time or some of the time under normal operating conditions.

Zone 0:
Where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or long periods of time under normal operating conditions.

Zone 1:
Where ignitable concentrations of flammable gases, vapors or liquids can exist some of the time under normal operating conditions.

Division 2:
Where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions.

Zone 2:
Where ignitable concentrations of flammable gases, vapors, or liquids are not likely to exist under normal operating conditions.

Class II
Combustible Dusts
Class II Area Classification

Division 1:
Where ignitable concentrations of combustible dusts can exist all of the time or some of the time under normal operating conditions.

Division 2:
Where ignitable concentrations of combustible dusts are not likely to exist under normal operating conditions.

Class III
Ignitable Fibers & Flyings
Class III Area Classification

Division 1:
Where easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used.

Division 2:
Where easily ignitable fibers are stored or handled.

Class I Groups

Division 1 & 2
A (acetylene)

B (hydrogen)
C (ethylene)
D (propane)

Zone 0, 1 & 2
IIC (acetylene & hydrogen)

IIB (ethylene)
IIA (propane)

Class II Groups

Division 1 & 2
E (metals - Div. 1 only)
F (coal)
G (grain)

Class III Groups

Division 1 & 2
None.

Class I Temperature Codes

Division 1 & 2

T1 (≤ 450°C)
T2 (≤ 300°C)
T2A, T2B, T2C, T2D (≤ 280°C, ≤ 260°C, ≤ 230°C, ≤ 215°C)
T3 (≤ 200°C)
T3A, T3B, T3C (≤ 180°C, ≤ 165°C, ≤ 160°C)
T4 (≤ 135°C)
T4A (≤ 120°C)
T5 (≤ 100°C)
T6 (≤ 85°C)

Zone 0, 1 & 2

T1 (≤ 450°C)
T2 (≤ 300°C)

T3 (≤ 200°C)

T4 (≤ 135°C)

T5 (≤ 100°C)
T6 (≤ 85°C)

Class II Temperature Codes

Division 1 & 2

T1 (≤ 450°C)
T2 (≤ 300°C)
T2A, T2B, T2C, T2D (≤ 280°C, ≤ 260°C, ≤ 230°C, ≤ 215°C)

T3 (≤ 200°C)
T3A, T3B, T3C (≤ 180°C, ≤ 165°C, ≤ 160°C)
T4 (≤ 135°C)
T4A (≤ 120°C)
T5 (≤ 100°C)
T6 (≤ 85°C)

Class III Temperature Codes

Division 1 & 2

T3B, T3C (≤ 165°C, ≤ 160°C)
T4 (≤ 135°C)
T4A (≤ 120°C)
T5 (≤ 100°C)
T6 (≤ 85°C)

Note: Article 503 of the NEC limits the maximum temperature codes for Class III equipment to 165°C for equipment not subject to overloading and to 120°C for equipment that may be overloaded.

UL Hazardous Locations

Class I, Division 1 & 2 Protection Methods

		Applicable Certification Documents	
Area	**Protection**	**U.S.**	**Canada**
Division 1	Explosion proof	UL 1203	CSA-30
	Intrinsically safe (2 fault)	UL 913	CSA-157
	Purged/pressurized (Type X or Y)	NFPA 496	NFPA 496
Division 2	Non-incendive	UL 1604	CSA-213
	Non-sparking device	UL 1604	CSA-213
	Purged/pressurized (Type Z)	NFPA 496	NFPA 496
	Hermetically sealed	UL 1604	CSA 213
	Any Class I, Div. 1 method	---	---
	Any Class I, Zone 1 or 2 method	---	---

Class I, Zone 0, 1 & 2 Protection Methods

		Applicable Certification Documents			
Area	**Protection**	**U.S.**	**Canada**	**IEC**	**Europe**
Zone 0	Intrinsically safe, 'ia' (2 fault)	UL 2279, Pt. 11	CSA-E79-11	IEC 60079-11	EN50020
	Class I, Div. 2 Intrinsically safe, (2 fault) method	UL 913	CSA-157	---	---
Zone 1	Encapsulation, 'm'	UL 2279, Pt. 18	CSA-E79-18	IEC 60079-18	EN 50028
	Flameproof, 'd'	UL 2279, Pt. 1	CSA-E79-1	IEC 60079-1	EN 50018
	Increased safety, 'e'	UL 2279, Pt. 7	CSA-E79-7	IEC 60079-7	EN 50019
	Intrinsically safe, 'ib' (1 fault)	UL 2279, Pt. 11	CSA-E79-11	IEC 60079-11	EN 50020
	Oil immersion, 'o'	UL 2279, Pt. 6	CSA-E79-6	IEC 60079-6	EN 50015
	Powder filling, 'q'	UL 2279, Pt. 5	CSA-E79-5	IEC 60079-5	EN 50017
	Purged/pressurized, 'p'	---	CSA-E79-2	IEC 60079-2	EN 50016
	Any Class I, Zone 0 method	---	---	---	---
	Any Class I, Div. 1 method	---	---	---	---
Zone 2	Non-incendive, 'nC'	UL 2279, Pt. 15	CSA-E79-15	IEC 60079-15	pr EN 50021
	Non-sparking device, 'nA'	2279, Pt. 15	CSA-E79-15	IEC 60079-15	pr EN 50021
	Restricted breathing, 'nR'	UL 2279, Pt. 15	CSA-E79-15	IEC 60079-15	pr EN 50021
	Hermetically Sealed, 'nC'	UL 2279, Pt. 15	CSA-E79-15	IEC 60079-15	pr EN 50021
	Any Class I, Zone 0 or 1 method	---	---	---	---
	Any Class I, Div. 1 or 2method	---	---	---	---

UL Hazardous Locations

Class II, Division 1 & 2 Protection Methods

		Applicable Certification Documents	
Area	**Protection**	**U.S.**	**Canada**
Division 1	Dust-ignition proof	UL 1203	CSA-25 or CSA-E-1241-1-1
	Intrinsically safe	UL 913	CSA-157
	Pressurized	NFPA 496	NFPA 496
Division 2	Dust-tight	UL 1604	CSA-157 or CSA-E-1241-1-1
	Non-incendive	UL 1604	---
	Non-sparking	UL 1604	---
	Pressurized	NFPA 496	NFPA 496
	Any Class II, Div. 1 method	---	---

Hazardous Locations Markings

Class I, II & III, Division 1 & 2 (U.S. & Canada)

This marking would include:
Class(es), Division(s), Gas/Dust Group(s), Temperature Code.
Example: Class I, Division 1, Groups C & D, T4A.

Class I, Zone 0, 1 & 2 (U.S. & Canada)

This marking would include:
Method A: For Zone Listings based on UL 2279 or the CSA-E79 Series Class, Zone(s), Ex, Protection Method(s), Gas Group, Temporary Code.
Example: Class I, Zone 1, Ex de IIB T4.

Method B: For Zone Listings based on UL or CSA Division Certification Documents Class, Zone(s), Gas Group, Temperature Code.
Example: Class I, Zone 1, Group IIB T4.

Note: For U.S. Zone Listings based on UL 2279, Article 505 of the 1999 NEC requires that the "Ex" element of the marking string shall read "AEx."

Note: For Canadian Zone Listings based on the CSA-E79 Series, the "Class" and "Zone" elements of the marking string are optional.

Zone 0, 1 & 2 (IEC only)

This marking would include: Ex, Protection Method(s), Gas Group, Temperature Code.
Example: Ex de IIB T4.

Zone 0, 1 & 2 (Europe only)

This marking would include: EEX, Protection Method(s), Gas Group, Temperature Code.
Example: EEX de IIB T4.

UL Hazardous Locations

Class III, Division 1 & 2 Protection Methods

		Applicable Certification Documents	
Area	**Protection**	**U.S.**	**Canada**
Division 1	Dust-tight	UL 1604	CSA-157
	Intrinsically safe	UL 913	CSA-157
Division 2	Dust-tight	UL 1604 Q	CSA-157
	Intrinsically safe	UL 913	CSA-157

UL's Hazardous Locations Standards

ANSI/UL 674	Electric motors and generators for use in Division 1 hazardous (classified) locations.
ANSI/UL 698	Industrial control equipment for use in hazardous (classified) locations.
ANSI/UL 781	Portable electric lighting units for use in hazardous (classified) locations.
ANSI/UL 783	Electric flashlights and lanterns for use in hazardous (classified) locations.
ANSI/UL 823	Electric heaters for use in hazardous (classified) locations.
ANSI/UL 844	Electric lighting fixtures for use in hazardous (classified) locations.
ANSI/UL 877	Circuit breakers and circuit-breaker enclosures for use in hazardous (classified) locations.
ANSI/UL 886	Outlet boxes and fittings for use in hazardous (classified) locations.
ANSI/UL 894	Switches for use in hazardous (classified) locations.
ANSI/UL 913	Intrinsically safe apparatus and associated apparatus for use in Class I, II and III, Division I, hazardous (classified) locations.
ANSI/UL 1002	Electrically operated valves for use in hazardous (classified) locations.
ANSI/UL 1010	Receptacle-plug combinations for use in hazardous (classified) locations.
ANSI/UL 1067	Electrically conductive equipment and materials for use in flammable anesthetizing locations.
ANSI/UL 1203	Explosion-proof and dust-ignition-proof electrical equipment for use in hazardous (classified) locations.
ANSI/UL 1207	Sewage pumps for use in hazardous (classified) locations.
UL 1604	Electrical equipment for use in Class I and II, Division 2, and Class III hazardous (classified) locations.
UL 2208	Solvent distillation units.
UL 2225	Metal-clad cables and cable-sealing fittings for use in hazardous (classified) locations.
ANSI/UL 2279	Electrical equipment for use in Class I, Zone 0, 1 and 2 hazardous (classified) locations.

NAMUR

The manufacturers involved in the ISO5211 committees began working on this standard in 1975, and it is only now nearing completion. Another popular standard for valve and actuator interfacing is called NAMUR (pronounced na-moor). This standard was developed at the end-user level.

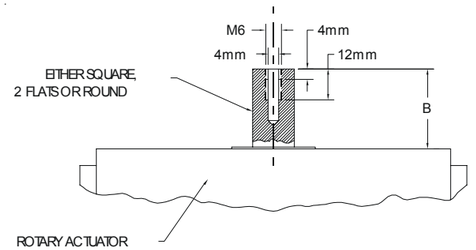
The chemical manufacturers in what was West Germany at the time, became impatient waiting for ISO and/or DIN (German Institute for Standardization) to adopt standards, so they formed their own work group called NAMUR. This is a German acronym that stands for "Normen Arbeitsgen Mess Und Regeltechnik" which loosely translates to "Standards Work Group for Instrumentation and Controls." NAMUR is not a standards organization; it is a group of chemical engineers from some of Germany's largest end users. NAMUR developed recommendations for interfaces between valves, actuators, and auxiliary equipment and published them in 1985. With a foothold in Germany, the NAMUR recommendations quickly spread to other countries. By 1990 most actuator manufacturers had a NAMUR version of their product available.

VDI/VDE3845

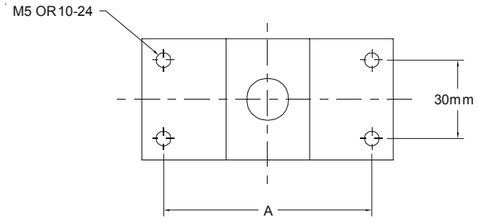
The NAMUR recommendations gained such acceptance that they were used as the main part of VDI/VDE, a German standard published in 1991 by the Society of German Engineers (VDI) and The Association of German Electrotechnicians (VDE).

VDI/DE3845 (loosely referred to as NAMUR) incorporates standards already defined in ISO5211/1&2 and DIN3337 (the DIN variation of ISO5211/3). However, it also breaks new ground by standardizing on mounting dimensions between rotary actuators and accessories such as positioners, signal transmitters (such as limit switches), and solenoid valves. This standard specifies a minimum bracket height of 45 mm (approx 2") and a maximum height of 75 mm (approx 3"). If the standard were any smaller it would make finger access to the bolts difficult, and a taller standard could present a problem when installation space is limited.

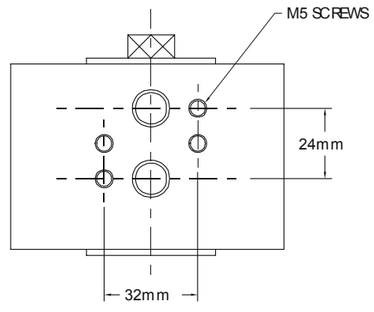
DIMENSIONS IN mm				
A	80	80	130	130
B	20	30	30	50



NAMUR Shaft



NAMUR Topworks Mounting



NAMUR Pilot Valve Ports

Acyclic Communication
A type of communication used between field devices and a host system. It is used for information that is not involved in loop execution.

Ambient Temperature
The temperature for a medium, such as gas or liquid, surrounding an object.

Analog Output
An electrical output from a sensor that changes proportionately with any change in input pressure.

Analog Signal
A signal in which the data is represented or transmitted in continuously varying quantities, as opposed to a digital signal.

ANSI
Abbreviation for American National Standards Institute.

AWG
Abbreviation for American Wire Gauge; based on circular mil system.

AWM
Appliance Wiring Material.

Axial Motion
A motion of the target along the reference axis.

BASEEFA
Abbreviation for British Approvals Service for Electrical Equipment in Flammable Atmospheres.

Baud
The number of bits that can be sent or received per second. Technically, baud is the number of times per second that the carrier signal shifts value. For example, a 1200 bit-per-second modem actually runs at 300 baud, but it moves 4 bits per baud (4 x 300 = 1200 bits per second).

bps
Bits-Per-Second. A measurement of how fast data is moved from one place to another. A 56K modem can move about 57,000 bits per second.

CEE
Abbreviation for the International Commission on Rules for the Approval of Electrical Equipment.

CE Mark
A trademark that allows a manufacturer trade privileges with the European Union. The CE Mark, by responsibility of the manufacturer, insures that certain directives have been met through testing and documentation.

CENELEC
European Committee for Electrotechnical Standardization.

C-UL
Products bearing this mark are a UL listed device and are tested to CSA standards.

Communications Protocol
Hardware and software standards that govern transmission between two computers or communications devices. There are several layers, or levels, of functionality in a protocol. Each layer may be available as a separate software component or several layers may be combined into one. Learning the seven-layer protocol hierarchy, known as the "OSI model," is essential for understanding protocols.

Communications Stack
The communications stack consists of a number of different functional layers. These layers are grouped by functionality and differ among specific protocols. The layers generally refer to the OSI seven-layer model. For example, FOUNDATION Fieldbus contains the following groups: the Physical layer, the Link and Application Layer, and the User Layer.

Contact Bounce
A condition that can occur with switching circuits in which the movable contacts close against the stationary contacts with enough energy to "bounce" and reopen the contacts. This may occur several times, very rapidly, during a contact closure.

Contact Pressure
The amount of force holding the movable and stationary contacts together.

CSA
Abbreviation for Canadian Standards Association.

Cyclic Communication
A type of communication used to communicate function blocks data between different function blocks in different devices.

DEMCO
A subsidiary of Underwriter's Laboratories.

Device Description (DD)
Provides an automatic way for host systems to see and use field devices. The device description is a representation of the device's functionality. Each device has a specific device description, which describes its resource and transducer blocks capability. The device description is available either from the vendor or from the Fieldbus FOUNDATION. This device description is loaded into a host in much the same way a printer driver is loaded into a personal computer. The host now has all of the capabilities necessary to fully use all of the functionality of the field device.

Device Description Language
A programming language specifically designed to develop field device descriptions. Device description language is a technology that is available only to FOUNDATION™ Fieldbus or to HART. It is a programming language similar to C language.

Differential
The distance which the actuator must move from the sensing point in order to allow the switch to reset. Also known as Hysteresis or Reset.

Differential Travel
A distance between the operating and release points.

Digital Output
Output that exists in only two stable states, appearing in the manner of a switch; that is, it is either "On" or "Off" or "High" or "Low" (i.e., high voltage or low voltage).

Digital Signal
A signal in which the data is transmitted or represented by a series of discrete pulses or steps of constant amplitude.

Dry Circuit
A circuit in which the open circuit voltage is 0.03V or less and the current is 200mA or less. At such low levels, the current is not able to break through the film of oxides, sulfides or other films which may build up on the contact surfaces.

Environmental Seal
A seal created by gaskets, seals, potting or other means, designed to keep out contamination which might reduce performance. An environmental seal is sometimes referred to as a "factory seal."

Explosion Proof
The property of being able to contain an explosion within the sensor or housing.

Fieldbus
An industrial control network for interconnecting sensors, actuators, and controllers. The fieldbus protocol stack includes a physical layer, data link layer, and application layer.

Fieldbus Foundation
A not-for-profit corporation that consists of many of the world's leading suppliers and end users of process control and manufacturing automation products.

Frequency
The number of cycles completed by an alternating current in one second. The newest term Hertz, abbreviated "Hz," is equivalent to "cycles per second."

Function Block
A process control or I/O function block that is used to implement the process control strategy. The function block interfaces with the transducer block to access process control information. The function block communicates with the FOUNDATION Fieldbus highway to make this information available to other devices. Examples: Analog Input (AI), Analog Output (AO), Proportional/Integral/Derivative (PID) control.

Gateway
A hardware or software setup that translates between two dissimilar protocols.

H1 Field Device
A fieldbus device connected directly to an H1 fieldbus. Typical H1 Field Devices are valves and transmitters.

Hermetic Seal
A permanent seal created by fusion, soldering, welding, brazing or other means, to prevent the transmission of gases. A hermetic seal is also referred to as "helium tight," "leak tight," or "vacuum tight." For most applications, a hermetic seal is one where the leakage rate is less than 1×10^{-8} cubic centimeters per second of helium, at a differential of one atmosphere.

Hi-Pot
A device used to place a high voltage across an insulator, to test its insulating properties. The typical Hi-Potential Breakdown Test specified by CSA and UL requires that the voltage be twice the rated voltage, plus 1000V, plus 20% of that total. For example, a 600V switch would be tested at [(600 x 2) + 1000] x 1.2=2640V. This voltage is placed across the insulator for 1 second. If the insulator doesn't break down, it is considered acceptable.

High Speed Ethernet (HSE)
High Speed Ethernet (HSE) is the Fieldbus FOUNDATION's backbone network that runs at 100 Mbit/second.

HSE Field Device
A fieldbus device connected directly to a High Speed Ethernet (HSE) fieldbus. Typical HSE Field Devices are HSE Linking Devices, HSE Field Devices running Function Blocks (FBs), and Host Computers.

HSE Linking Device
A device used to interconnect H1 fieldbus Segments to High Speed Ethernet (HSE) to create a larger network.

HSE Switch
Standard Ethernet equipment used to interconnect multiple High Speed Ethernet (HSE) devices such as HSE Linking Devices and HSE Field Devices to form a larger HSE network.

Hub
Generally, a term used to describe a device that serves as the center of a star-topology network. Hardware or software device that contains multiple independent but connected modules of network and internetwork equipment. Hubs can be active (where they repeat signals sent through them) or passive (where they do not repeat, but merely split, signals sent through them).

Hysteresis
The distance which the actuator must move from the sensing point in order to allow the switch to reset. Also known as Differential or Reset.

IEC
Abbreviation for the International Electrical and Electronics Engineers.

Interchangeability
The capability to substitute a device from one manufacturer with that of another manufacturer on a fieldbus network without loss of functionality or degree of integration.

Interoperability
The capability for a device from one manufacturer to interact with that of another manufacturer on a fieldbus network without loss of functionality.

Intranet
Any network that provides similar services within an organization to those provided by the Internet outside it but that is not necessarily connected to the Internet. The commonest example is the use by a company of one or more World-Wide Web servers on an internal TCP/IP network for distribution of information within the company.

Intrinsically Safe (IS)
Intrinsic safety may be attained through integral circuitry or an appropriately sized barrier, both of which are current limiting devices. The on-board circuitry, or barrier, is designed for the area classification which the monitoring device is to be used. The basis of intrinsic safety is to limit the amount of current through a device, so that if there is exposure to the surrounding atmosphere, there is not sufficient heat generated to ignite that atmosphere.

ISO
Abbreviation for the International Standards Organization.

kbps
Kilobits per second. A bit rate expressed in thousands of bits per second.

LAN
Local Area Network. A computer network limited to the immediate area, usually the same building or floor of a building.

Latching Condition
A condition where the switch will not reset to its unoperated mode. It must be operated, then reset, in two separate operations.

Lateral Motion
A motion of the target perpendicular to the reference axis.

Leakage Current
Minute amounts of current which flow through a switch even in the unoperated state. Leakage current occurs with electronic switches since they require an external power supply. GO® Switches do not require a power supply and, therefore have no leakage current.

Link Active Scheduler (LAS)
Maintains time critical device-to-device control communications on a segment. A LAS is a deterministic, centralized bus scheduler that maintains a list of transmission times for all data buffers in all devices that need to be cyclically transmitted. Only one Link Master (LM) device on an H1 fieldbus Link can be functioning as that link's LAS.

Macro Cycle
The coordination of function block execution and segment communications in a Foundation Fieldbus link. This coordination ensures that the control action is repeatable and deterministic.

Master Devices
Devices that determine the data communication on the bus. A master can send messages without an external request when it holds the bus access rights (the token).

Master-Slave Communications
Communications in which one side, called the "master," initiates and controls the session. The "slave" is the other side and responds to the master's commands.

MBps
Megabits per second. A bit rate expressed in millions of binary bytes per second.

MSHA
Abbreviation for Mine Safety Heath Administration.

NEC
National Electric Code.

NEMA
Abbreviation for the National Electrical Manufacturers Association.

Node
An addressable device attached to a network. More often called a "host."

Non-Incendive
Non-incendive equipment contain components that do not allow arcs or sparks to ignite concentrations of flammable gases. One method of producing a non-incendive switch is by sealing off the contact chamber with a hermetic seal so that a flammable gas cannot enter into the arcing/sparking area of the switch.

Normally Closed Circuit
Circuit which passes current when the GO Switch is not actuated. Symbolized by N/C.

Normally Open Circuit
Circuit which passes current when the GO Switch is actuated. Symbolized by N/O.

Operating Distance
A distance at which the target under its axial or lateral approaching causes the switch to operate. An axial operating distance is a distance between an operating point and the sensing face; a lateral operating distance is a distance between an operating point and the reference axis.

OSI
Open System Interconnection. An ISO standard for worldwide communications that defines a framework for implementing protocols in seven layers. Control is passed from one layer to the next, starting at the application layer in one station, proceeding to the bottom layer, over the channel to the next station, and back up the hierarchy.

OSI Reference Model
Network architectural model developed by ISO and ITU-T. The model consists of seven layers, each of which specifies particular network functions, such as addressing, flow control, error control, encapsulation, and reliable message transfer. The lowest layer (the physical layer) is closest to the media technology. The lower two layers are implemented in hardware and software whereas the upper five layers are implemented only in software. The highest layer (the application layer) is closest to the user. The OSI reference model is used universally as a method for teaching and understanding network functionality.

Physical Layer
The first functional layer in the communications stack. The physical layer is concerned with the physical characteristics of the signal of the wire.

Protocol
A set of formal rules describing how to transmit data, especially across a network. Low level protocols define the electrical and physical standards to be observed, bit- and byte-ordering, and the transmission and error detection and correction of the bit stream. High level protocols deal with the data formatting, including the syntax of messages, the terminal to computer dialogue, character sets, and the sequencing of messages.

Proximity Switch
A position switch which is operated without mechanical contact with a moving target.

PSI
Pounds per square inch. A unit of measure for pressure on a given surface.

Pulses Per Minute (PPM)
Refers to applications, particularly in motion control circuits on rotary applications, where several operations of a switch take place with each revolution of the actuator device. If the actuator turns at "X" revolutions per minute and there are "Y" operations per revolution, the pulses per minute rate would be "X" x "Y" PPM.

PVC
Polyvinyl chloride.

Rated Temperature
Maximum temperature at which an electric component can operate for extended periods without breaking down due to heat.

Rated Voltage
Maximum voltage at which an electric component can operate for extended periods without undue degradation or safety hazard.

Reference Axis
An axis perpendicular to the sensing face and passing through its center.

Release Point
A position of the target at its axial or lateral moving away from the switch when it returns to nonoperating state.

Repeatability
Ability to perform the same task operating parameters, consistently, time after time.

Repeater
An active, bus-powered or non-bus-powered device used to extend the range over which signals can be correctly transmitted and received for a given medium. The maximum number of Repeaters allowed varies based on the network protocol in use.

Reset
The distance which the actuator must move from the sensing point in order to allow the switch to reset. Also known as Differential or Hysteresis.

Resource Block
The resource block fully defines the device to the outside world. With the resource block, a host knows the attributes and functionality of the device. The resource block contains information which is common to the whole resource, including device identification, hardware, device features, memory and CPU availability, write protection, management of fail-safe, and alarms.

Response Time
The amount of time required for the switch to move from N/C position to N/O position, or vice versa.

Router
Network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information. Occasionally called a gateway (although this definition of gateway is becoming increasingly outdated).

RTV
Abbreviation for Room Temperature Vulcanizing.

SAA
Abbreviation for Standards Association of Australia.

SAE
Abbreviation for Society of Automotive Engineers.

Same Polarity Only
On DMDB switches the like terminals must be wired with the same voltage polarity.

Segment
A section of an H1 fieldbus that is terminated in its characteristic impedance. Segments can be linked by Repeaters to form a longer H1 fieldbus. Each segment can include up to 32 H1 devices.

Sensing Area
That location marked on a GO Switch that is most sensitive to a ferrous or magnetic target.

Sensing Distance Range
Maximum gap between switch and actuator when the switch first operates; the trip point.

Sensing Face
A surface of the switch through which the magnetic field interact with a moving target and causes the switch operate.

Slave Devices
Peripherals such as I/O devices, valves, drives and measuring transducers, that do not have bus access rights and can only acknowledge received messages or send messages to the master when requested to do so. Slaves are called passive stations. Since they only require a small portion of the bus protocol, their implementation is particularly economical.

SO Cable
Designed for use with industrial equipment.

Standard Target
A specified object used for making comparative measurements of the operating and differential distances.

Switch
A network device that filters, forwards, and floods frames based on the destination address of each frame. The switch operates at the data link layer of the OSI model.

Temperature Rating
Maximum and minimum temperature at which an insulating material can be used in continuous operation without loss of basic properties.

Terminator
An impedance-matching module used at or near each end of a transmission line.

TEW
Thermoplastic Equipment Wire.

Transducer
A fully packaged, signal conditioned, compensated, and calibrated sensor.

Transducer Block
Fully defines the information about the device sensor or actuator. It is the link between the physical world and the information world. The transducer block communicates with the analog input (AI) or analog output (AO) function block. The AI and AO blocks communicate with the outside world. This block is responsible for information and functionality specific to for example the measurement of a particular physical property, such as pressure or temperature, or a specific measurement technology, such as ultrasonic or Coriolis.

Transmitter
A transducer with a current loop or digital output enabling transmission of a signal over a longer distance.

Trunk
The main communication highway between devices on an H1 fieldbus network. The Trunk acts as a source of main supply to Spurs on the network.

UL
Abbreviation for Underwriter's Laboratories.

User Link & Application Layer
Term to describe some of the layers in a FOUNDATION Fieldbus communication stack.

User Layer
The upper layer in a FOUNDATION Fieldbus communications stack. The user layer has three major components: function blocks, transducer blocks, and resource blocks. The User Layer provides Function Blocks, as well as Device Descriptions, which allow the host system to communicate with the devices without the need of custom programming.

VCR
Virtual Communication Relationship. Configured application layer channels that provide for the transfer of data between applications. FOUNDATION Fieldbus describes three types of VCRs: Publisher/Subscriber, Client/Server, and Source/Sink.

Virtual Field Device (VFD)
Used to remotely view local device data described in the object dictionary. A typical device will have at least two VFDs.

Voltage Drop
The amount of voltage across a pair of closed contacts. In GO Switches, this voltage drop is extremely low, compared to solid state switches.

Voltage Rating
The highest voltage that may be continuously applied to an electrical device in conformance with standards or specifications.

WAN
Wide Area Network. Any internet or network that covers an area larger than a single building or campus.

Conversion Factors

PSI x 27.71 = in. H_2O
PSI x 2.036 = in. Hg
PSI x 703.1 = mm H_2O
PSI x 51.75 = mm Hg
PSI x .0703 = kg/cm^2
PSI x .0689 = bar
PSI x 68.95 = mbar
PSI x 6895 = Pa
PSI x 6.895 = kPa

Note: Conversion factors are rounded.

Pressure*			
BAR	ATM.	Kg cm2	PSI
1	1	1	15
2	2	2	30
3	3	3	45
5	5	5	75
10	10	10	150
20	20	20	300
30	30	30	450
50	50	50	750
100	100	100	1500
200	200	200	3000
300	300	300	4500
500	500	500	7500
1000	1000	1000	15000

*** Pressure**
Standard Atmosphere Pressure is 15 PSI (14.7)
15 PSI = 1 Atmosphere

Bar is a unit of pressure equal to 1 Atmosphere or approx. 15 PSI

*Conversions are approximate for the convenience of users.

Fraction/Decimal/Millimeter Conversion Chart					
Inches	Decimals	Millimeters	inches	Decimals	Millimeters
1/64	0.0157	0.40	33/64	0.5156	13.10
1/32	0.0313	0.80	17/32	0.5312	13.49
3/64	0.0469	1.19	35/64	0.5469	13.89
1/16	0.0625	1.59	9/16	0.5625	14.29
5/64	0.0781	1.98	37/64	0.5781	14.68
3/32	0.0938	2.38	19/32	0.5938	15.08
7/64	0.1094	2.78	39/64	0.6094	15.48
1/8	0.125	3.18	5/8	0.6250	15.88
9/64	0.1406	3.57	41/64	0.6406	16.27
5/32	0.1563	3.97	21/32	0.6563	16.67
11/64	0.1719	4.37	43/64	0.6719	17.07
3/16	0.1875	4.76	11/16	0.6875	17.46
13/64	0.2031	5.52	45/64	0.7031	17.86
7/32	0.2188	5.56	23/32	0.7188	18.26
15/64	0.2344	5.95	47/64	0.7344	18.65
1/4	0.2500	6.35	3/4	0.7500	19.05
17/64	0.2656	6.75	49/64	0.7656	19.45
9/32	0.2813	7.14	25/32	0.7813	19.84
19/64	0.2969	7.54	51/64	0.7969	20.24
5/16	0.3125	7.94	13/16	0.8125	20.64
21/64	0.3281	8.33	53/64	0.8281	21.03
11/32	0.3438	8.73	27/32	0.8348	21.43
23/64	0.3594	9.13	55/64	0.8594	21.83
3/8	0.3750	9.53	7/8	0.8750	22.23
25/64	0.3906	9.92	57/64	0.8906	22.62
13/32	0.4063	10.32	29/32	0.9063	23.02
27/64	0.4219	10.72	59/64	0.9219	23.42
7/16	0.4375	11.11	15/16	0.9375	23.81
29/64	0.4531	11.51	61/64	0.9531	24.21
15/32	0.4688	11.91	31/32	0.9688	24.61
31/64	0.4844	12.30	63/64	0.9844	25.00
1/2	0.5000	12.70	1	1	25.40

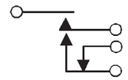
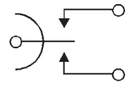
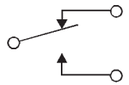
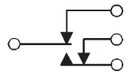
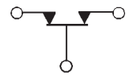
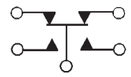
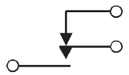
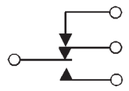
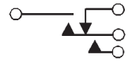
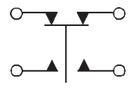
1 mm = .040" .001" = .0254 mm

Temperature Conversion	
Fahrenheit (F)	Centigrade (C)
-40	-40.00
-30	-34.44
-20	-28.89
-10	-23.33
0	-17.78
10	-12.22
20	-6.67
30	-1.11
40	4.44
50	10.00
60	15.56
70	21.11
80	26.67
90	32.22
100	37.78
110	43.33
120	48.89
130	54.44
140	60.00
150	65.56
160	71.11
170	76.67
180	82.22
190	87.78
200	93.33
250	121.11
275	135.00
300	148.89
325	162.78
350	176.67
375	190.55
400	204.44
425	218.33
450	232.22
475	246.11
500	260.00

Temperature conversion formulas

$C = \frac{5}{9}(F - 32)$ $F = \frac{9}{5}(C + 32)$

Basic Contact Forms

A **Make SPST-NO** 	**J** Make, Make, Break 
B Break SPST-NC 	**K** Center off SPDT 
C **Break, Make Transfer SPDT** 	**L** Break, Make, Make 
D Make, Break (Continuity Transfer) 	**U** Double make Contact on arm 
E Break, Make, Break 	**V** Double break Contact on arm 
F Make, Make 	**W** Double break, Double make, Contact on arm 
G Break, Make 	**X** Double make 
H Break, Break, Make 	**Y** Double break 
I Make, Break, Make 	**Z** **Double make Double break SPDT-DB** 

Notes