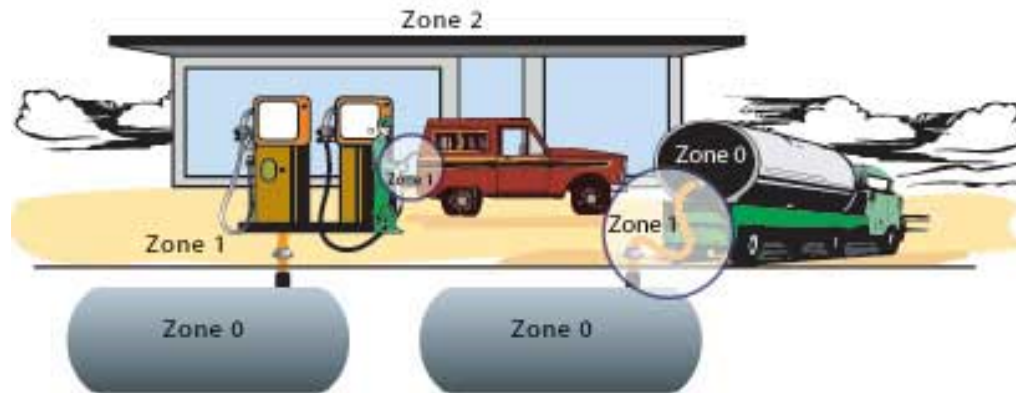


Session 3 – Zone Concept



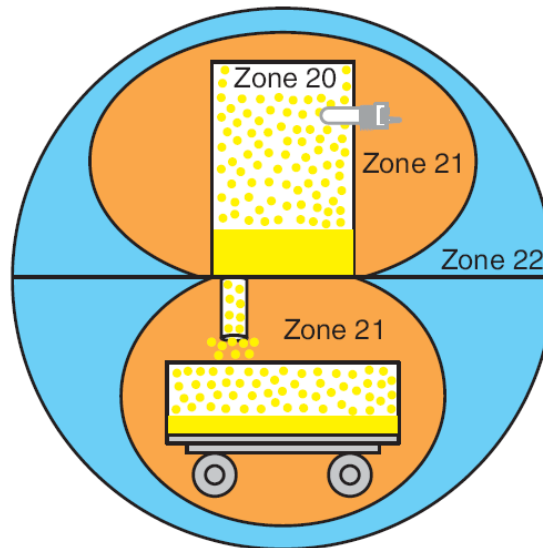
Area Classification to IEC - Gas



Gas

Zone 0	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously, for long periods, or frequently.
Zone 1	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist can form occasionally in normal operation.
Zone 2	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation, but if it does occur, will persist for a short period only (usually no longer than 2 hours).

Area Classification to IEC - Dust

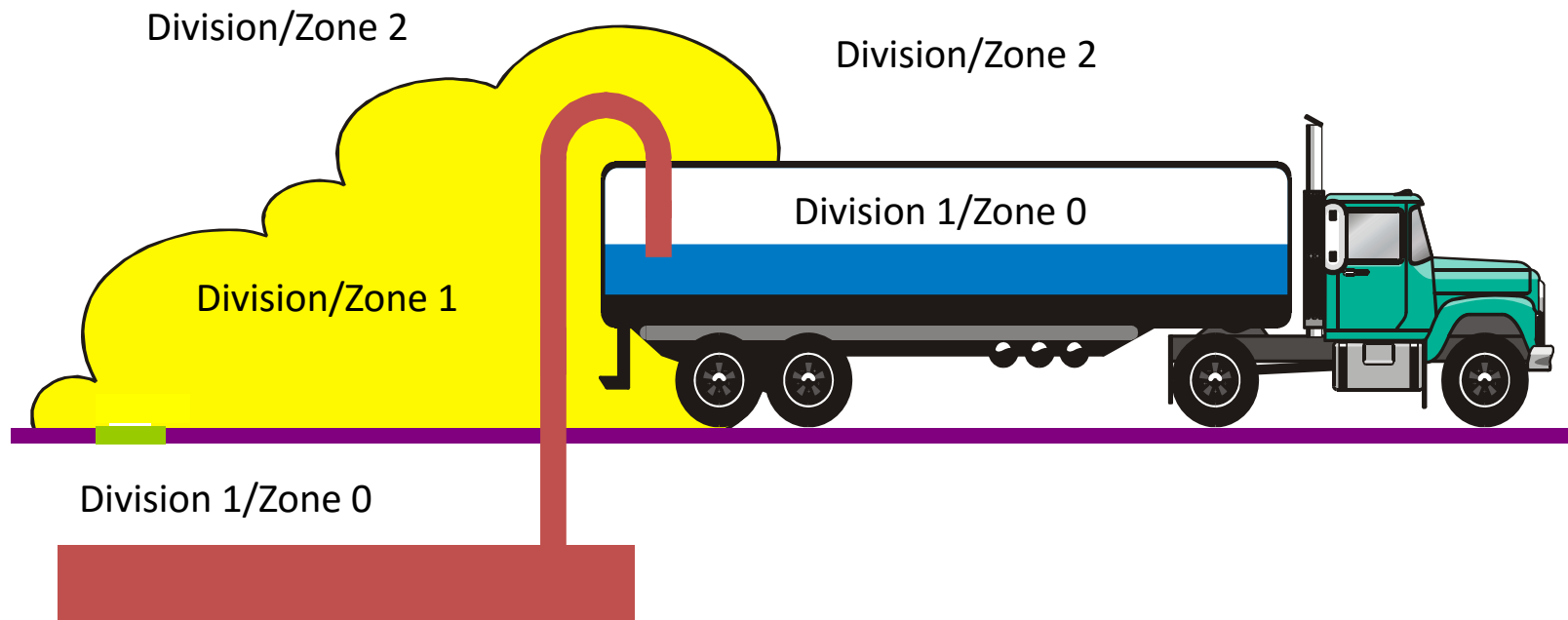


Dust

Zone 20	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, for long periods, or frequently.
Zone 21	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air can form occasionally in normal operation.
Zone 22	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation, but if it does occur, will persist for a short period only.

Area Classification to NEC

- Division 1 - hazard can exist under normal operating conditions or because of leakage [NEC 500-5,6,7],
- Division 2 – flammable concentrations are processed but normally confined within containers or systems [NEC 500-5,6,7]
- Zone Concept – Recognized under NEC 505



Comparison of IEC vs. NA Gas Groupings...

Gas groupings in the North American world do differ slightly from the IEC world as to gas groupings...

IIC = A, B	IEC	NFPA	CHANGE	Material
IIB = C	IIB	B	↓	Ethylene Oxide
IIB = C	IIC	C	↑	Carbon Disulfide
IIB = C	IIA	C	↓	Acetaldehyde
IIB = C	IIA	C	↓	Ethyl Mercaptan
IIB = C	IIB	D	↓	Isoprene
IIB = C	IIB	D	↑	Cyclopropane
			↑	

Comparison of IEC vs. NA Zone vs. Division Concept

Frequency of Occurrence	CEC / NEC Division System	IEC/CENELEC/CEC /NEC Zone System
Continuous Intermittent Periodically	Class I, Division 1	Zone 0
		Zone 1
Abnormal Condition	Class 1, Division 2	Zone 2

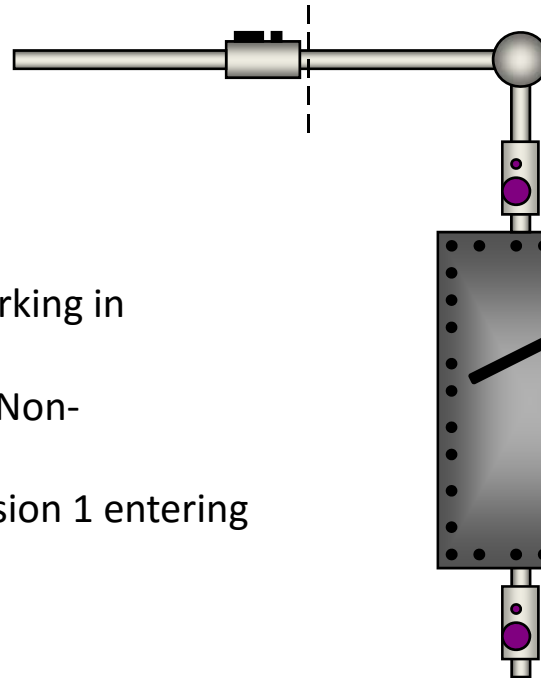
Class 1, Division 1 & 2 Wiring Examples

Division 1

- Conduit or Approved MC/MI Cables
- Seals Used in Division 1 on Cables

Division 2

- Tray Cable (Unarmored)
- Standard Location Cable Glands permitted
- Non Explosion-proof Conduit Bodies



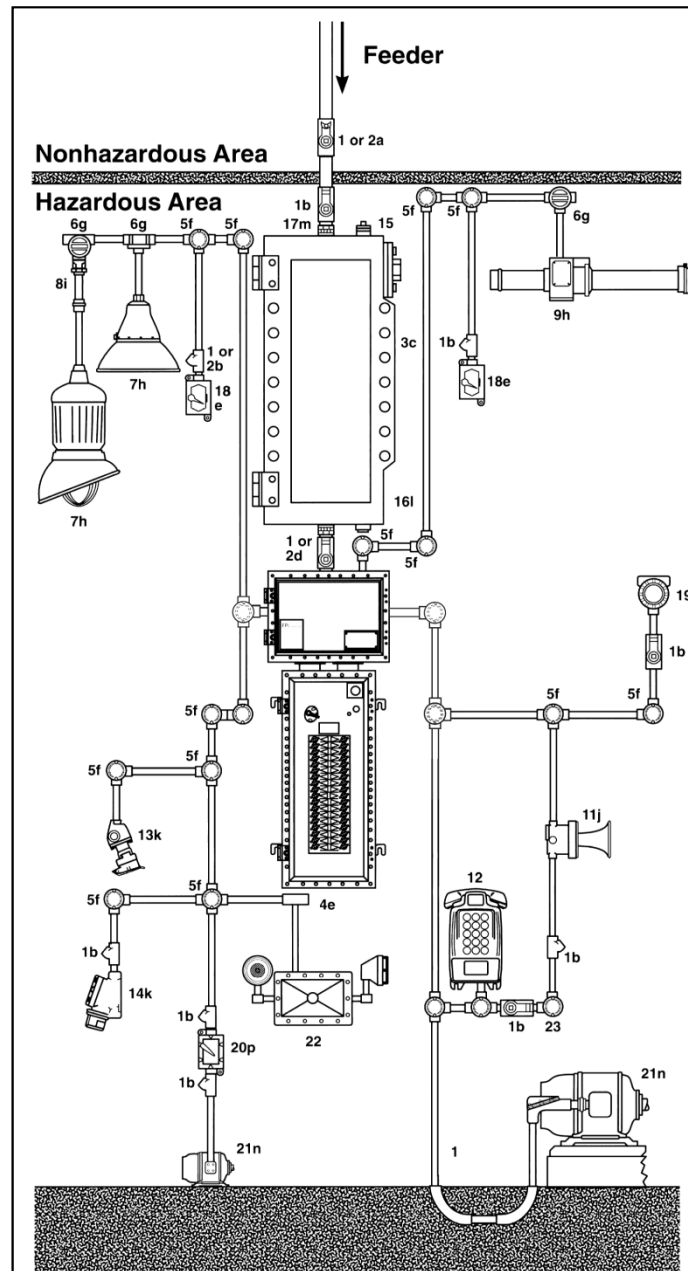
Conduit Seals used:

- Within 18" of arcing/sparking in Division 1
- Boundary of Hazardous/Non-Hazardous
- Conduit 2" or larger Division 1 entering non-arcing enclosures

Gas Grouping per NPFA for US Installations

Class I* Group	Substance	Auto-* Ignition Temp.		Flash** Point		Flammable Limits** Percent by Volume		Vapor** Density (Air Equals 1.0)
		°F	°C	°F	°C	Lower	Upper	
C	Acetaldehyde	347	175	-38	-39	4.0	60	1.5
D	Acetic Acid	867	464	103	39	4.0	19.9 @ 200°F	2.1
D	Acetic Anhydride	600	316	120	49	2.7	10.3	3.5
D	Acetone	869	465	-4	-20	2.5	13	2.0
D	Acetone Cyanohydrin	1270	688	165	74	2.2	12.0	2.9
D	Acetonitrile	975	524	42	6	3.0	16.0	1.4
A	Acetylene	581	305	gas	gas	2.5	100	0.9
B(C)	Acrolein (inhibited) ¹	455	235	-15	-26	2.8	31.0	1.9
D	Acrylic Acid	820	438	122	50	2.4	8.0	2.5
D	Acrylonitrile	898	481	32	0	3.0	17	1.8
D	Adiponitrile			200	93			
C	Allyl Alcohol	713	378	70	21	2.5	18.0	2.0
D	Allyl Chloride	905	485	-25	-32	2.9	11.1	2.6
B(C)	Allyl Glycidyl Ether ¹							
D	Ammonia ²	928	498	gas	gas	15	28	0.6
D	n-Amyl Acetate	680	360	60	16	1.1	7.5	4.5
D	sec-Amyl Acetate			89	32			4.5
D	Aniline	1139	615	158	70	1.3	11	3.2
D	Benzene	928	498	12	-11	1.3	7.9	2.8
D	Benzyl Chloride	1085	585	153	67	1.1		4.4
B(D)	1,3-Butadiene ¹	788	420	gas	gas	2.0	12.0	1.9
D	Butane	550	288	-76	-60	1.6	8.4	2.0
D	1-Butanol	650	343	98	37	1.4	11.2	2.6
D	2-Butanol	761	405	75	24	1.7 @ 212°F	9.8 @ 212°F	2.6
D	n-Butyl Acetate	790	421	72	22	1.7	7.6	4.0
D	iso-Butyl Acetate	790	421					
D	sec-Butyl Acetate			88	31	1.7	9.8	4.0
D	t-Butyl Acetate							
D	n-Butyl Acrylate (inhibited)	559	293	118	48	1.5	9.9	4.4
C	n-Butyl Formal							
B(C)	n-Butyl Glycidyl Ether ¹							
C	Butyl Mercaptan			35	2			3.1
D	t-Butyl Toluene							
D	Butylamine	594	312	10	-12	1.7	9.8	2.5
D	Butylene	725	385	gas	gas	1.6	10.0	1.9
C	n-Butyraldehyde	425	218	-8	-22	1.9	12.5	2.5
D	n-Butyric Acid	830	443	161	72	2.0	10.0	3.0
- ³	Carbon Disulfide	194	90	-22	-30	1.3	50.0	2.6
C	Carbon Monoxide	1128	609	gas	gas	12.5	74.0	1.0
C	Chloroacetaldehyde							
D	Chlorobenzene	1099	593	82	28	1.3	9.6	3.9
C	1-Chloro-1-Nitropropane			144	62			4.3
D	Chloroprene			-4	-20	4.0	20.0	3.0
D	Cresol	1038-1110	559-599	178-187	81-86	1.1-1.4		
C	Crotonaldehyde	450	232	55	13	2.1	15.5	2.4
D	Cumene	795	424	96	36	0.9	6.5	4.1
D	Cyclohexane	473	245	-4	-20	1.3	8.0	2.9
D	Cyclohexanol	572	300	154	68			3.5
D	Cyclohexanone	473	245	111	44	1.1 @ 212°F	9.4	3.4
D	Cyclohexene	471	244	<20	<-7			2.8

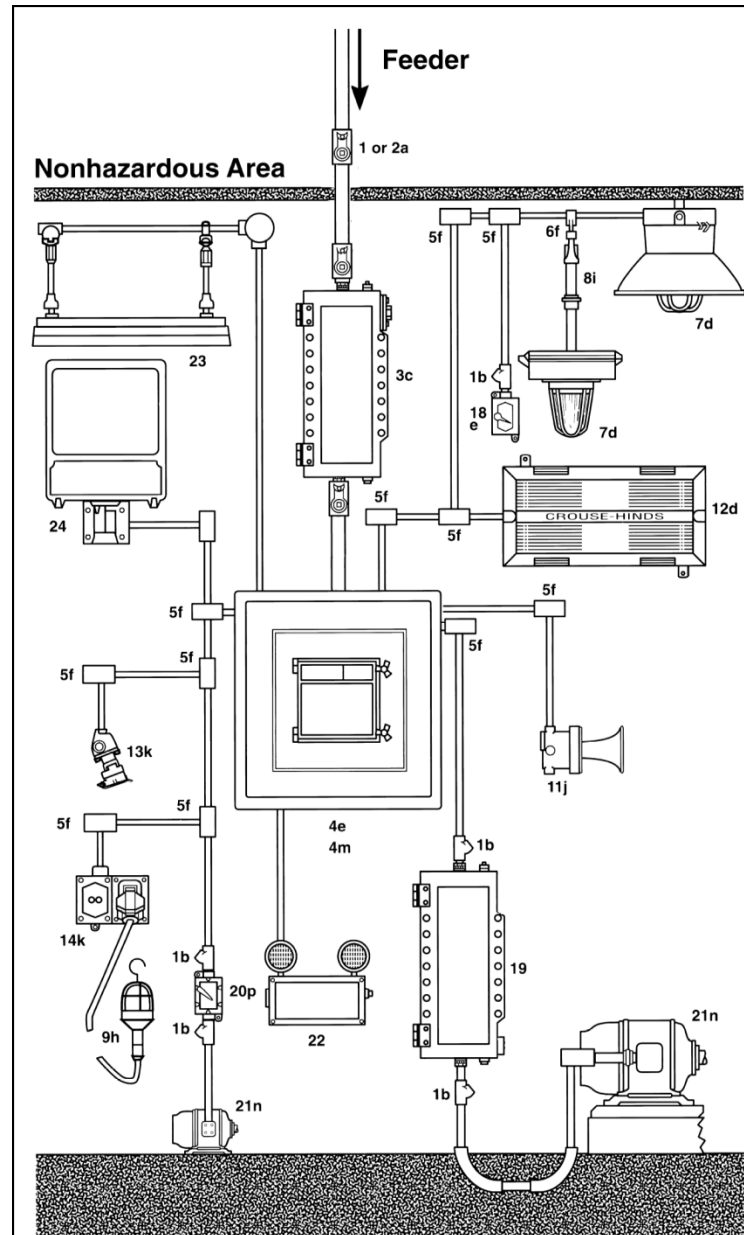
Class 1, Division 1 Wiring Examples



Note the following:

- Explosion Proof conduit Fittings even when not directly exposed to explosion potential from enclosures/lighting...
- Seal fittings or factory sealing on all arcing devices
- Typical Cast construction of equipment

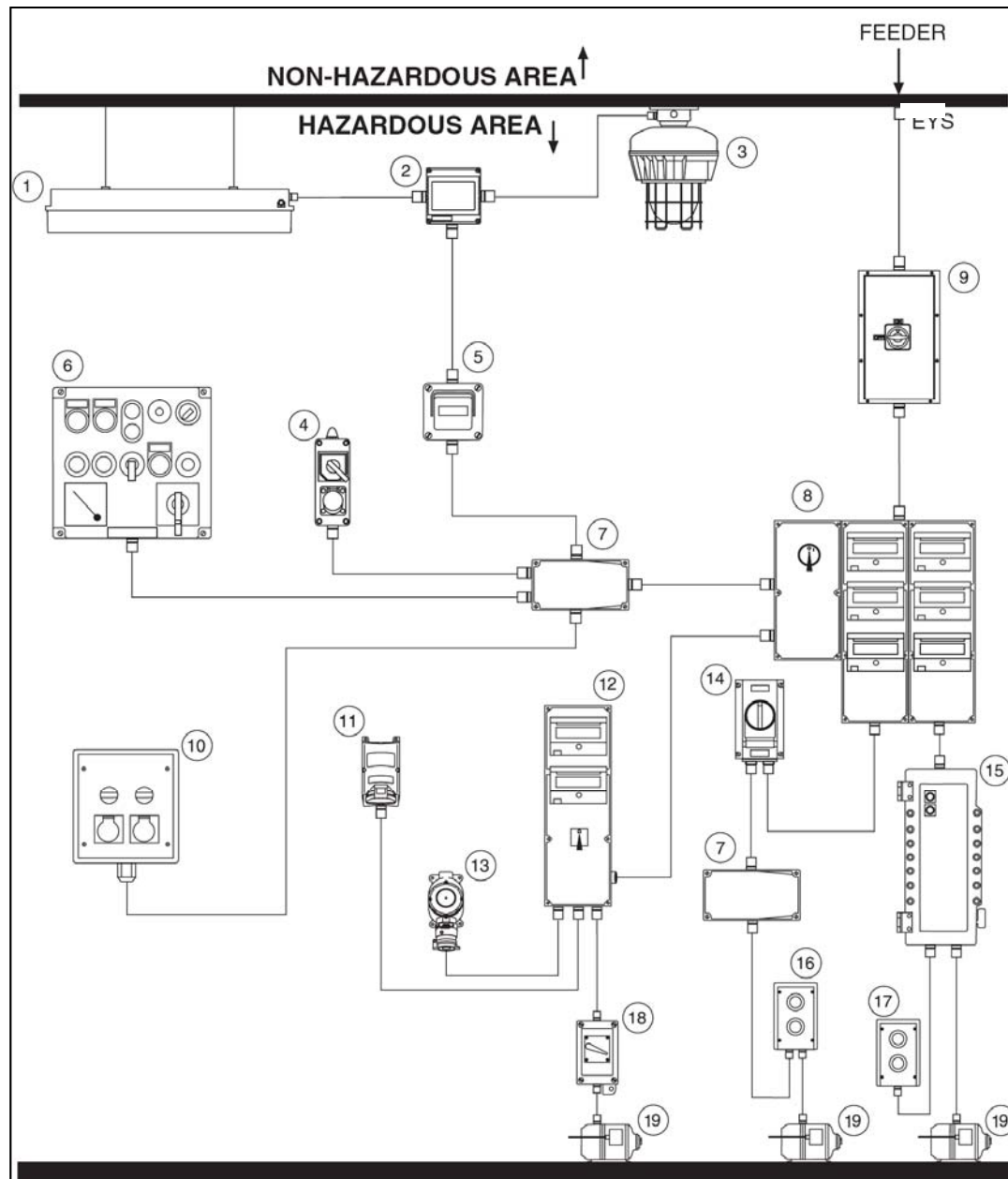
Class 1, Division 2 Wiring Examples



Note the following:

- Non Explosion proof conduit fittings such as LB's, T's, etc.
- Seal fittings or factory sealing on all arcing devices
- Die cast /FRP construction of some devices
- Not limited to conduit but is commonly used...

North American Zone 1 & 2 Installation



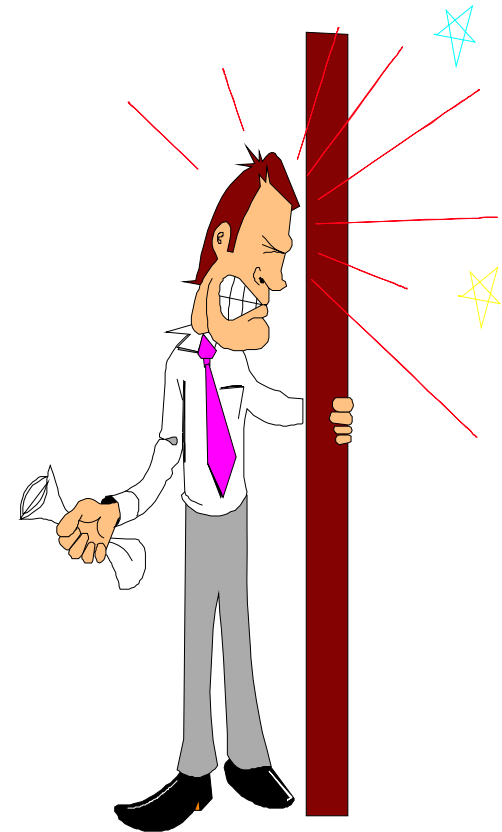
Similar to IEC EX construction with different cable construction and different marking and testing requirements for the products. In some cases, products have dual EX and AEX certification per Cenelec and ANSI/NEMA standards....

Who is The Authority Having Jurisdiction ?

- Countries Determine Who Is Responsible For Product “Standards” and “Testing”
 - North America
 - US - America National Standards Institute - ANSI
 - Canada - Standards Council of Canada
 - Internationally
 - Depends On Your Country
 - e.g. Standards Australia, BOMBA, South Africa Bureau Of Standards, Türk Standardlari Enstitüsü, Saudi Arabian Standards Organization, Directorate of Standardization and Metrology, Ministry of Finance and IndustrySingapore Productivity and Standards Board (PSB), Dirección General de Normas

Who is The Authority Having Jurisdiction ?

- Regulations May Vary By
 - County
 - Province
 - State
 - City
 - Accredited Testing Agency



Authority Having Jurisdiction - Europe

Explosion protection is legally regulated worldwide by the governments of the individual states. Country-specific differences in the technical requirements and requested approvals for explosion-proof devices are a significant hindrance to the trade of globally operating manufacturers, and necessitate high development and approval overheads. Within the European Community, the harmonization process in the explosion protection sector has been largely completed in the meantime. At the international level, the IEC is attempting to reach the goal "One test and one certificate worldwide" by introducing the so-called IECEx scheme.

