Global Reference Guide for Use of Electrical Apparatus in Explosive Atmospheres and Hazardous Locations (EU / ATEX / IECEx)

Typical marking of electrical apparatus for gas-Ex-areas (EU / ATEX / IECEx):

Marking according to directive 2014/34/EU (previous 94/9/EG) (ATEX)	Marking according to IEC/CENELEC standard 60079-0
CE 0158 Ex II 2 G	Ex db eb IIC T4 Gb

CE 0158	CE-marking and number of the notified (monitoring) body (0158 = DEKRA EXAM GmbH) (not for equipment category 3)
Ex	Explosion-protection marking
II	Equipment group (equipment for use in hazardous areas, except of mines endangered by firedamp)
2	Equipment category (category 2)
G	Explosive atmosphere sustainability (gas, vapour or mist)

Ex	Explosion marking
db	Type of protection (flameproof enclosure „db“)
eb	Type of protection (Increased safety „eb“)
IIC	Equipment group (Electrical apparatus group II, subgroup IIC (typical gas: hydrogen), designed for use in areas, where an explosible gas atmosphere must be expected, except of mines endangered by firedamp)
T4	Temperature class (max. surface temperature 135 °C)
Gb	Equipment protection level (EPL Gb; apparatus with high protection level)

Typical marking of electrical apparatus for dust-Ex-areas (EU / ATEX / IECEx):

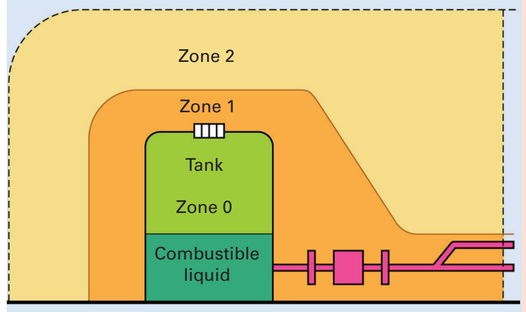
Marking according to directive 2014/34/EU (previous 94/9/EG) (ATEX)	Marking according to IEC/CENELEC standard 60079-0
CE 0158 Ex II 2 D	Ex tb IIIC T80 °C Db

CE 0158	CE-marking and number of the notified (monitoring) body (0158 = DEKRA EXAM GmbH) (not for equipment category 3)
Ex	Explosion-protection marking
II	Equipment group (equipment for use in hazardous areas, except of mines endangered by firedamp)
2	Equipment category (Category 2)
D	Explosive atmosphere sustainability (dust)

Ex	Explosion marking
tb	Type of protection (protection by enclosure „tb“)
IIIC	Equipment group (Electrical apparatus group II, subgroup IIC (conductive dust), designed for use in areas, where an explosible dust atmosphere must be expected, except of mines endangered by firedamp)
T80 °C	Surface temperature (max. 80 °C)
Db	Equipment protection level (EPL Gb; apparatus with high protection level)

Exemplary localisation of gas-Ex zones

Gas-Ex zones according to IEC/EN 60079-10-1



Explosion group

Explosive Atmosphere		Typical combustible material	Group
Gas, vapour or mist		Acetylene	IIC
		Hydrogen	IIC / IIB+H2
		Ethylene/Formaldehyde	IIB
		Methane/Octane	IIA
Dust	Conductive	Metal dust	IIIC
		Coal dust	
	Non-conductive	Grain dust	IIIB
	Fibres & Flyings	Wood, paper or cotton processing	IIIA

Temperature class

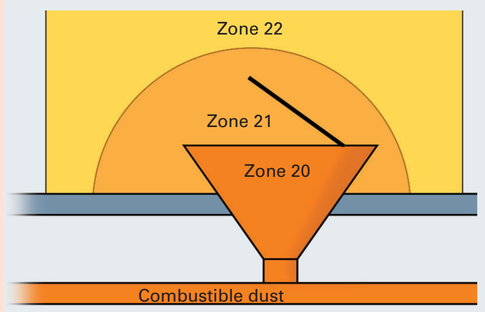
Maximum surface temperature	IEC/EN 60079-0
450 °C	T1
300 °C	T2
200 °C	T3
135 °C	T4
100 °C	T5
85 °C	T6

IP class according to IEC 60529

First digit		Second digit	
Protection against solid foreign objects		Protection against ingress of water with damaging effects	
0	No protection	0	No protection
1	≥ 50 mm diameter	1	Vertically dripping water
2	≥ 12,5 mm diameter	2	15° angled dripping water
3	≥ 2,5 mm diameter	3	Spraying water
4	≥ 1,0 mm diameter	4	Splashing water
5	Dust protected	5	Water jets
6	Dust tight	6	Strong water jets
		7	Temporary submersion
		8	Permanent submersion
		9	High pressure and high jet-water temperature

Exemplary localisation of dust-Ex zones

Dust-Ex zones according to IEC/EN 60079-10-2



Electrical type of protection for hazardous atmospheres made of combustible gas, mist and vapour

Type	Protection level	Type of protection	Group	Device-category	Equipment protection level (EPL)	CENELEC /IEC standard	Protection concept
d	da	Flameproof enclosure	II	1 G	Ga	EN 60079-1 / IEC 60079-1	Explosion containment, flame barrier
d	db	Flameproof enclosure	II	2 G	Gb	EN 60079-1 / IEC 60079-1	Explosion containment, flame barrier
d	dc	Flameproof enclosure	II	3 G	Gc	EN 60079-1 / IEC 60079-1	Explosion containment, flame barrier
p	pxb pyb	Pressurized enclosure	II	2 G	Gb	EN 60079-2 / IEC 60079-2	Exclusion of Ex-atmosphere
p	pzc	Pressurized enclosure	II	3 G	Gc	EN 60079-2 / IEC 60079-2	Exclusion of Ex-atmosphere
q		Sand encapsulation	II	2 G	Gb	EN 60079-5 / IEC 60079-5	Prevention of explosion diffusion
o	ob	Oil encapsulation	II	2 G	Gb	EN 60079-6 / IEC 60079-6	Exclusion of Ex-atmosphere
o	oc	Oil encapsulation	II	3 G	Gc	EN 60079-6 / IEC 60079-6	Exclusion of Ex-atmosphere
e	eb	Increased safety	II	2 G	Gb	EN 60079-7 / IEC 60079-7	No arcs, sparks or hot surfaces
e	ec	Increased safety	II	3 G	Gc	EN 60079-7 / IEC 60079-7	No arcs, sparks or hot surfaces
i	ia	Intrinsic safety	II	1 G	Ga	EN 60079-11 / IEC 60079-11	Limit of spark energy and surface temperature
i	ib	Intrinsic safety	II	2 G	Gb	EN 60079-11 / IEC 60079-11	Limit of spark energy and surface temperature
i	ic	Intrinsic safety	II	3 G	Gc	EN 60079-11 / IEC 60079-11	Limit of spark energy and surface temperature
p/v		Pressurized enclosure/ ventilation	II	2 G	Gb	EN 50381 IEC 60079-13	Exclusion of Ex-atmosphere / dilution
nA		Non-sparking equipment	II	3 G	Gc	EN 60079-15 / IEC 60079-15	No arcs, sparks or hot surfaces
nC		Enclosed equipment	II	3 G	Gc	EN 60079-15 / IEC 60079-15	Explosion containment, flame barrier
nR		Restricted breathing enclosure	II	3 G	Gc	EN 60079-15 / IEC 60079-15	Temporary exclusion of Ex-atmosphere
m	ma	Encapsulation	II	1 G	Ga	EN 60079-18 / IEC 60079-18	Exclusion of Ex-atmosphere
m	mb	Encapsulation	II	2 G	Gb	EN 60079-18 / IEC 60079-18	Exclusion of Ex-atmosphere
m	mc	Encapsulation	II	3 G	Gc	EN 60079-18 / IEC 60079-18	Exclusion of Ex-atmosphere
i		Intrinsic system	II	2 G	Gb	EN 60079-25 / IEC 60079-25	Limit of spark energy and surface temperature
		Equipment with protection level (EPL) Ga	II	1 G 1 G/2 G	Ga Ga/Gb	EN 60079-26 / IEC 60079-26	Double protection concept
op is		Inherent safe optical radiation	II	1 G	Ga	EN 60079-28 / IEC 60079-28	Limit of radiation energy
op is		Inherent safe optical radiation	II	2 G	Gb	EN 60079-28 / IEC 60079-28	Limit of radiation energy
op is		inherent safe optical radiation	II	3 G	Gc	EN 60079-28 / IEC 60079-28	Limit of radiation energy
op pr op sh		Safe/interlocked optical radiation	II	2 G	Gb	EN 60079-28 / IEC 60079-28	Limit or containment of radiation energy
op pr op sh		Safe/interlocked optical radiation	II	3 G	Gc	EN 60079-28 / IEC 60079-28	Limit or containment of radiation energy
s	sa	Special protection	n.a.	n.a.	Ga	IEC 60079-33	Special measures
s	sb	Special protection	n.a.	n.a.	Gb	IEC 60079-33	Special measures
s	sc	Special protection	n.a.	n.a.	Gc	IEC 60079-33	Special measures

Electrical type of protection for hazardous atmospheres made of combustible dust

Type	Protection level	Type of protection	Group		Device category	Equipment protection level (EPL)	CENELEC /IEC standard	Protection concept
			Directive	Standard				
p	pxb	Pressurized enclosure	II	III	2 D	Db	EN 60079-2 / IEC 60079-2	Exclusion of Ex-atmosphere
p	pzc	Pressurized enclosure	II	III	3 D	Dc	EN 60079-2 / IEC 60079-2	Exclusion of Ex-atmosphere
i	ia	Intrinsic safety	II	III	1 D	Da	EN 60079-11 / IEC 60079-11	Limit of spark energy and surface temperature
i	ib	Intrinsic safety	II	III	2 D	Db	EN 60079-11 / IEC 60079-11	Limit of spark energy and surface temperature
i	ic	Intrinsic safety	II	III	3 D	Dc	EN 60079-11 / IEC 60079-11	Limit of spark energy and surface temperature
m	ma	Encapsulation	II	III	1 D	Da	EN 60079-18 / IEC 60079-18	Exclusion of Ex-atmosphere
m	mb	Encapsulation	II	III	2 D	Db	EN 60079-18 / IEC 60079-18	Exclusion of Ex-atmosphere
m	mc	Encapsulation	II	III	3 D	Dc	EN 60079-18 / IEC 60079-18	Exclusion of Ex-atmosphere
op is		Inherent safe optical radiation	II	III	1 D	Da	EN 60079-28 / IEC 60079-28	Limit of radiation energy
op is		Inherent safe optical radiation	II	III	2 D	Db	EN 60079-28 / IEC 60079-28	Limit of radiation energy
op is		Inherent safe optical radiation	II	III	3 D	Dc	EN 60079-28 / IEC 60079-28	Limit of radiation energy
op pr op sh		Safe/interlocked optical radiation	II	III	2 D	Db	EN 60079-28 / IEC 60079-28	Limit or containment of radiation energy
op pr op sh		Safe/interlocked optical radiation	II	III	3 D	Dc	EN 60079-28 / IEC 60079-28	Limit or containment of radiation energy
t	ta	Protection by enclosure	II	III	1 D	Da	EN 60079-31 / IEC 60079-31	Exclusion of dust
t	tb	Protection by enclosure	II	III	2 D	Db	EN 60079-31 / IEC 60079-31	Exclusion of dust
t	tc	Protection by enclosure	II	III	3 D	Dc	EN 60079-31 / IEC 60079-31	Exclusion of dust
s	sa	Special protection		III	n.a.	Da	IEC 60079-33	Special measures
s	sb	Special protection		III	n.a.	Db	IEC 60079-33	Special measures
s	sc	Special protection		III	n.a.	Dc	IEC 60079-33	Special measures

Classification of explosion protected apparatus in equipment groups and categories according to directive 2014/34/EU

Equipment group I for mines endangered by firedamp.
The equipment group I is subdivided into the Categories M1 and M2:

M1	The apparatus of this category are for use in underground mines as well as in their facilities above ground who are endangered by firedamp or combustible dust. The equipment must continue to work even in the event of infrequent failures coinciding with an existing explosive atmosphere and must feature such protective measures against explosion so that, if one constructional protective measure fails, at least one other independent constructional measure will ensure the required safety, or, if two independent faults occur in combination, the required safety is still ensured.
M2	The apparatus of this category are for use in underground mines as well as in their facilities above ground who are endangered by firedamp or combustible dust. If an explosive atmosphere occurs, it must be possible to switch off the equipment. The constructional explosion-protection measures ensure the required degree of safety during normal operation, even under severe operating conditions and, in particular, in cases of rough handling and changing environmental influences.

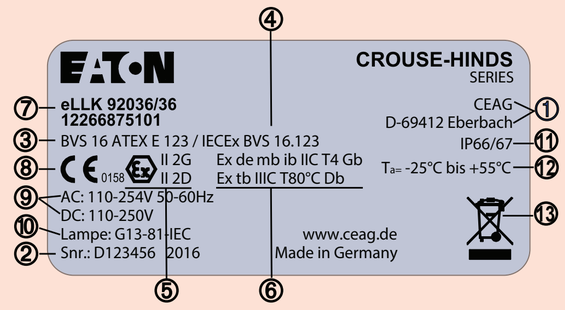
Equipment group II for all other hazardous areas
The equipment group II is subdivided into the Categories 1, 2 and 3:

1	The equipment is intended for use in areas in which an explosive atmosphere is present continuously or for long periods or frequently. Even if equipment failures only occur infrequently, the equipment must ensure the required degree of safety and feature such explosion-protection measures that — if one constructional protective measure fails, at least one other independent constructional protective measure ensures the required degree of safety, or — if two independent faults occur in combination, the required degree of safety is still ensured.
2	The equipment is intended for use in areas in which an explosive atmosphere occurs occasionally. Even in the case of frequent equipment failures or faulty conditions that are normally to be expected, the constructional explosion-protection measures ensure the required degree of safety.
3	The equipment is intended for use in areas in which no occurrence of an explosive atmosphere due to gases, vapours, mists or whirled-up dust is to be expected. If, however, it occurs, then in all probability only rarely or for a short period. During normal operation the equipment ensures the required degree of safety.

Zone classification / Equipment protection level

Substance	Period of presence of the combustible substances	Zone	Minimum requirements to the equipment				Protection level
			Directive 2014/34/EU		Standard IEC/EN 60079-0		
			Equipment group	Equipment category	Group	Equipment protection level EPL	
Gas, mist, vapour	Continuously for long periods or frequently	Zone 0	II	1 G	II	Ga	very high
	Occasional occurrence	Zone 1	II	2 G	II	Gb	high
	Not likely, but if it occurs only rarely and for a short period	Zone 2	II	3 G	II	Gc	increased
Dust	Continuously for long periods or frequently	Zone 20	II	1 D	III	Da	very high
	Occasional occurrence	Zone 21	II	2 D	III	Db	high
	Not likely, but if it occurs only rarely and for a short period	Zone 22	II	3 D	III	Dc	increased
Methane, coal dust		Mining	I	M1	I	Ma	very high
		Mining	I	M2	I	Mb	high

Type label - example: CEAG product



1. Name or registered trade mark (CEAG) and address of the manufacturer
2. Serial number including year of manufacture
3. Certificate number, may end with “X” or “U”
   - “X” means, that special conditions for a safe use have to be observed
   - “U” marks a component certification
4. Additional IECEx certification
5. Marking according to directive: Equipment group (II) and equipment category (2); type of explosive atmosphere G (Gas, vapour or mist) – D (dust)
6. Marking according to standard: IEC/EN
7. Equipment name/type
8. CE marking and number of the „Notified Body“, responsible for the monitoring the quality system (0158 = EXAM Germany)
9. Electrical parameter
10. Other essential information (depends on the standard, e.g. lamp)
11. Other optional information (e.g. degree of protection)
12. Permissible ambient temperature (-25 °C up to +55 °C); for -20 °C up +40 °C there is no marking required (standard for all equipment)
13. Marking according to EU-directive 2002/96/EC (WEEE-directive: Waste of Electrical and Electronic Equipment)

Colour legend

Information according to gas-Ex-areas

Information according to dust-Ex-areas

Information according to mines endangered by firedamp

Information all parts of explosion protection

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Global Reference Guide for Use of Electrical Apparatus in Explosive Atmospheres and Hazardous Locations: NEC/CEC Reference

Typical NEC/CEC marking of electrical apparatus in USA and Canada:

Marking according to NEC 500

Class I Division 1 Groups A, B, C & D T6

Class I .....Hazard category
Division I .....Area classification
Groups A, B, C & D.....Hazardous atmosphere category (gas or dust grouping)
T6 .....Temperature classification

Marking according to NEC 505 / CEC 18

Class I Zone 1 AEx e IIC T6

Class I .....Hazard category
Zone 1 .....Area classification
AEx.....Explosion-protection standard
e.....Method of explosion protection
IIC .....Hazardous atmosphere category (gas or dust grouping)
T6 .....Temperature classification

Method of explosion protection

Type of protection	Description of protection	Permitted for use in USA	Permitted for use in Canada			Protection concept
		NEC 500	NEC 505	CEC 18	CEC 18	
		Division	Zone	Division	Zone	
e	Increased safety	-	1, 2	-	1, 2	No arcs, sparks or hot surfaces
n	Non-incendive	2	2	2	2	
d	Flameproof	-	1, 2	-	1, 2	Contain the explosion pre-vent the flame propagation
-	Explosion-proof	1, 2	-	1, 2	-	
q	Powder filled	-	1, 2	-	1, 2	
ia	Intrinsic safety	1, 2	0, 1, 2	1, 2	0, 1, 2	Limit the energy of the spark and the surface temperature
ib	intrinsic safety	-	1, 2	-	1, 2	
p	Pressurized (purged)	1, 2	1, 2	1, 2	1, 2	Keep the flammable gas out
m	Encapsulation	-	1, 2	-	1, 2	
o	Oil immersion	2	1, 2	2	1, 2	

Area classification

	Continuous hazard	Intermittent hazard	Hazard under abnormal conditions
North America / NEC 500-503/CEC 18	Division 1	Division 1	Division 2
NEC 505-506/CEC 18	Zone 0 (Zone 20 dust)	Zone 1 (Zone 21 dust)	Zone 2 (Zone 22 dust)

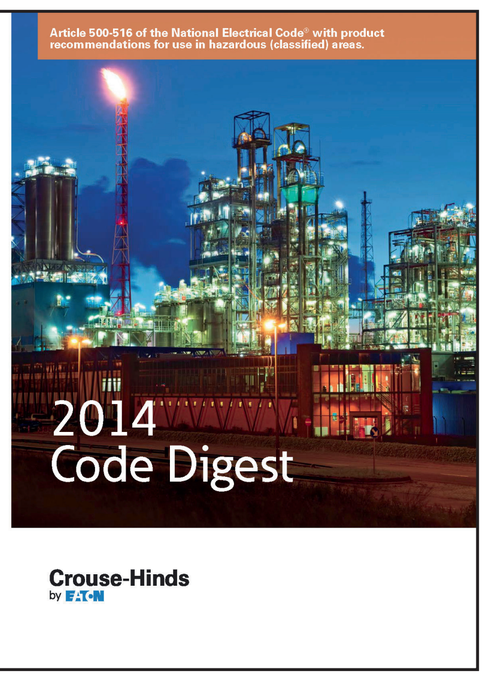
Temperature classification according to NEC/CEC

Maximun surface temperature	Zone concept	Division concept
450 °C (842 °F)	T1	T1
300 °C (572 °F)	T2	T2
280 °C (536 °F)		T2A
260 °C (500 °F)		T2B
230 °C (446 °F)		T2C
215 °C (419 °F)		T2D
200 °C (392 °F)	T3	T3
180 °C (356 °F)		T3A
165 °C (329 °F)		T3B
160 °C (320 °F)		T3C
135 °C (275 °F)	T4	T4
120 °C (248 °F)		T4A
100 °C (212 °F)	T5	T5
85 °C (185 °F)	T6	T6

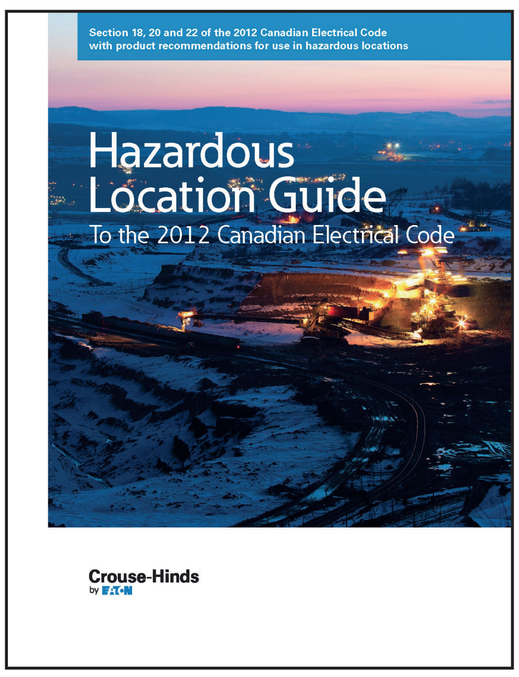
Committees and directives

NEMA	(National Electrical Manufacturers Association) NEMA 250 series standards for enclosure types covers both hazardous areas (potentially explosive atmospheres) and non-hazardous areas.
NEC	– National Electrical Code (USA)
CEC	– Canadian Electrical Code (Canada)

NEC Code Digest



CEC Code Digest



Hazardous atmosphere category (gas or dust grouping)

Explosive atmosphere	Typical hazard material	North America NEC 500-503 / CEC 18		NEC 505 / CEC 18
		Hazard category	Grouping	Gas-grouping
Gases and vapours*	Acetylene	Class I	Group A	IIC
	Hydrogen	Class I	Group B	IIC or IIB+H2
	Ethylene/Formaldehyde	Class I	Group C	IIB
	Methane/Octane	Class I	Group D	IIA
Dust**	Metal dust	Class II	Group E	IIIC
	Coal dust	Class II	Group F	IIIC
	Grain dust	Class II	Group G	IIIB
Fibres & Flyings	Wood, paper or cotton processing	Class III	-	IIIA

* Equipment listed and marked in accordance with 505.9(C)(2) for use in Zone 0, 1, or 2 locations are permitted in Class I, Division 2 locations for the same gas and with a suitable temperature class,see article 501.5 of the National Electrical Code.

** Equipment listed and marked in accordance with 506.9(C)(2) for Zone 20, 21, or 22 locations are permitted in Class II, Division 2 locations for the same dust atmosphere and with a suitable temperature class, see article 502.6 of the National Electrical Code

NEMA enclosure types

Enclosure type	Intended use	Equivalent IP rating*
1	Indoor use, limited amounts of falling dirt	20
3	Outdoor use, rain, sleet, windblown dust, external formation of ice	55
3R	Outdoor use, rain, sleet, external formation of ice	24
3S	Outdoor use, rain, sleet, windblown dust, external mechanisms operable when ice laden	55
4	Indoor or outdoor use, windblown dust and rain, splashing water, hose directed water, external formation of ice	66
4X	Indoor or outdoor use, windblown dust and rain, splashing water, hose directed water, corrosion resistant, external formation of ice laden	66
5	Indoor use, settling airborne dust, falling dirt, non-corrosive liquids	53
6	Indoor or outdoor use, hose directed water, temporary submersion, external formation of ice	67
6P	Indoor or outdoor use, hose directed water, prolonged submersion, external formation of ice	68
7**	Indoor use, Class I, Division 1, Groups A, B, C, and D hazardous locations, air-break equipment	
8**	Indoor or outdoor use, Class I, Division 1 Groups A, B, C, and D hazardous loca-tions, oil-immersed equipment	
9**	Indoor use, Class II, Division 1, Groups E, F, and G hazardous locations, air-break equipment	
10**	Mining applications	
12	Indoor use, circulating dust, falling dirt, dripping noncorrosive liquids	54
12K	Indoor use, circulating dust, falling dirt, dripping noncorrosive liquids, provided with knockouts	54
13	Indoor use, lint, dust, spraying of water, oil an noncorrosive coolant	54

* NEMA Enclosure Type can be converted to IP Code rating, but IP Codes cannot be converted to NEMA Enclosure Type (Ref. NEMA 250)

** Enclosure Types for U.S. only (Ref. NEMA 250)

More detailed information about the definition of hazardous areas according to NEC/CEC and the requirements of explosion protected apparatus for use in North America you will find in the 2014 Code Digest (NEC) and the Hazardous Location Guide (CEC).

You will find this comprehensive basic guides and further information on the net by:

http://www.cooperindustries.com/content/public/en/crouse-hinds/resources/Library/technical_documents.html

Using the following link you can download the PDF documents dirctly:

2014 Code Digest (NEC):

http://www.cooperindustries.com/content/dam/public/crousehinds/resources/pdfs/other-pdfs/crouse-hinds-codedigest2014.pdf

Hazardous Location Guide (CEC):

http://www.cooperindustries.com/content/dam/public/crousehinds/resources/pdfs/literature/canadian-code-2012.pdf

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