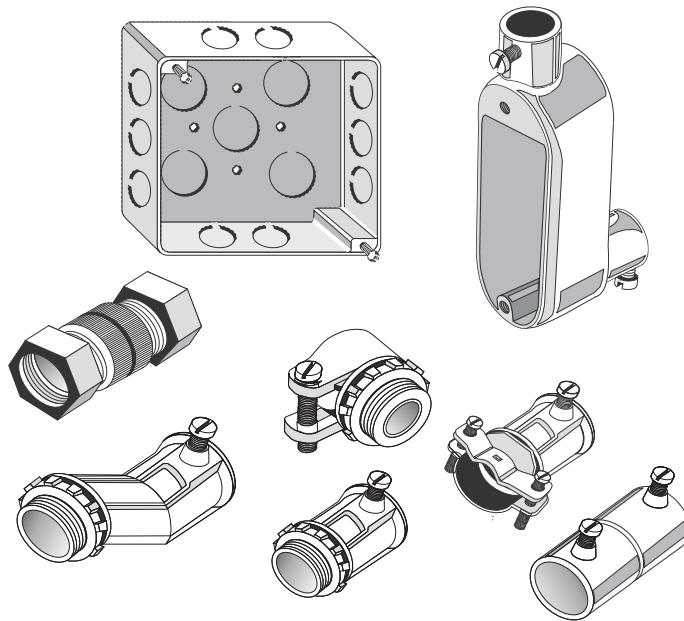


CHS Controls

Installation Products - Commercial Grade



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Commercial grade installation according to North American standard is different in several ways compared to techniques used in Europe. Installation rules for USA can be found in National Electrical Code (NEC) article 358 and for Canada in Canadian Electrical Code (CEC) article 12-1400.

Galvanized steel conduit is most commonly used, often in combination with flexible steel conduit. Boxes are also made of galvanized steel. Conduit and boxes made of PVC are available but not common. It is mostly a more expensive solution compared to steel products.

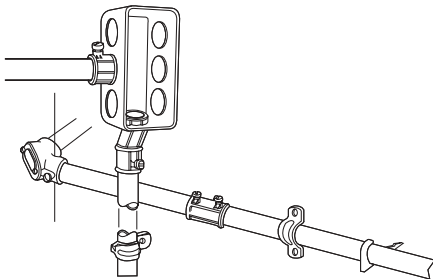


Fig 1. Installation with EMT conduit.

EMT Conduit

The most common type is EMT (Electrical Metallic Tubing), a light-weight type, supplied un-threaded in lengths of 3,05 m (10 feet). Couplings and connectors are equipped with set-screws or made as compression type. EMT conduit shall only be used in dry areas, use IMC or Rigid conduit if the installation also shall protect against moisture, contact CHS Controls for more information

EMT conduit can be used both exposed and concealed for example inside walls and in concrete. The conduit shall be securely fixed each 3rd m and max 900 mm from a box or similar, see figure 2. The distance to the box can be extended to 1,5 m as exception if a full length conduit is used and the surface does not admit a fixture point within 900 mm.

EMT conduit is not approved as lighting fixture hanger, the fixture must be secured separately.

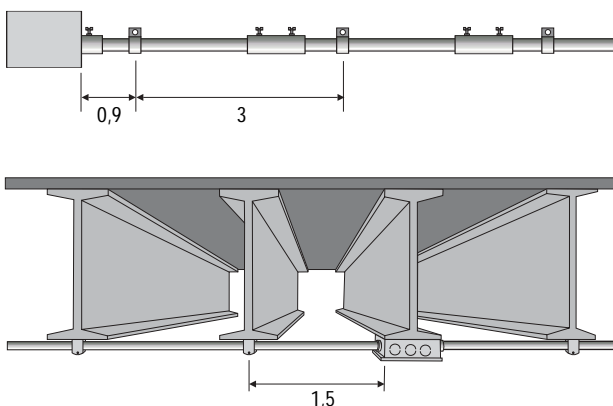


Fig 2. Secure fixing of EMT conduit. Max 3 m between fixing points and max 0,9 m from box, top picture. Bottom picture shows an example of an allowed exception, where the conduit can not be fixed 0,9 m from box. In this case 1,5 m is allowed if a full length conduit is used.

The conduit may be bended if needed. The bend shall be made in a manner that the inside diameter should not be reduced. Manually bending tools are available up to 1 1/4", larger require electrical machines. Max total bend between box/condulet is 360°.

Flexible Metal Conduit

Flexible metal conduit is commonly used in combination with EMT conduit. Flexible metal conduit can be used

- In dry area
- Concealed inside walls or behind roof
- To be accessible
- In lengths up to 1,8 m

Outlet Boxes, Device Boxes and Condulets

There are a wide selections of boxes available to cover most requirements. The boxes have knockouts in bottom and walls. There are also a selection of condulets available.

Maximum number of conductors in a box is depending on the box volume. The volume in cubic inch is normally stamped within the box. Figure 3 shows how the number of conductors shall be calculated.

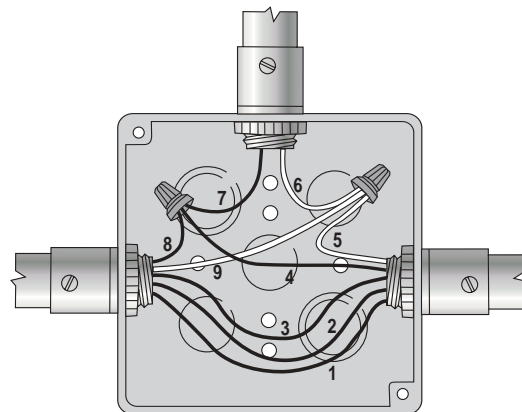


Fig 3. Calculation of number of conductors in a box. The picture shows a box with 9 conductors, AWG 14. Minimum volume is $9 \times 2 = 18$ cubic inch. Box IUTP434 with 30,5 cubic inch capacity can be used.

Wire and Cable

Single conductors are used in conduit and flexible conduit. The most common type is TFFN/THHN, a PVC insulated wire with a nylon cover which simplifies the installation. Max number of conductors in conduit is stated in NEC table C1. Dimensioning of conductors can be found in table 310-16. Smallest size for power circuits is AWG 14.

For some applications armoured cable or Tray Cable are used. See catalogue "Wire and Cable" for more information.

Power Distribution

European distribution boards, MCB:s and MCCB:s do normally not meet the North American requirements. North American load centers and panelboards are designed in a different way. Contact CHS Controls for more information regarding Cutler-Hammer load centers and panelboards.

Max Number of Conductors, TFFN/THHN, in EMT Conduit, NEC table C1

Size AWG/kcmil	mm ²	Conduit size, inch					
		1/2	3/4	1	1 1/4	1 1/2	2
18 (AWG)	0,81	22	38	63	108	148	244
16	1,3	17	29	48	83	113	186
14	2,1	12	22	35	61	84	135
12	3,3	9	16	26	45	61	101
10	5,3	5	10	16	28	38	63
8	8,4	3	6	9	16	22	36
6	13	2	4	7	12	16	26
4	21	1	2	4	7	10	16
2	34	1	1	3	5	7	11
1	42	1	1	1	4	5	8
1/0	53	1	1	1	3	4	7
2/0	67		1	1	2	3	6
3/0	85		1	1	1	3	5
4/0	107		1	1	1	2	4
250 (kcmil)	136			1	1	1	3
350	193			1	1	1	2
500	257				1	1	1

Dimension of TFFN/THHN Wire NEC table 310-16 see note 1

Size AWG/kcmil	mm ²	Max current at 30°C, A
18 (AWG)	0,81	14
16	1,3	18
14	2,1	25 see note 2
12	3,3	30 see note 2
10	5,3	40 see note 2
8	8,4	55
6	13	75
4	21	95
2	34	130
1	42	150
1/0	53	170
2/0	67	195
3/0	85	225
4/0	107	260
250 (kcmil)	136	290
350	193	350
500	257	430

Max Number of Conductors, TFFN/THHN in Flexible Metal Conduit, NEC table C3

Size AWG/kcmil	mm ²	Flexible metal conduit size, inch					
		1/2	3/4	1	1 1/4	1 1/2	2
18 (AWG)	0,81	23	38	59	93	135	237
16	1,3	17	29	45	71	103	181
14	2,1	13	22	33	52	76	134
12	3,3	9	16	24	38	56	95
10	5,3	6	10	15	24	35	62
8	8,4	3	6	9	14	20	35
6	13	2	4	6	10	14	25
4	21	1	2	4	6	9	16
2	34	1	1	3	4	6	11
1	42	1	1	1	3	4	8
1/0	53	1	1	1	2	4	7
2/0	67		1	1	1	3	6
3/0	85		1	1	1	2	5
4/0	107		1	1	1	1	4
250 (kcmil)	136			1	1	1	3
350	193			1	1	1	3
500	257				1	1	1

Min Volume per Conductor in a Box NEC table 314.16(B)

Size AWG	mm ²	Minimum volume in box for each conductor, inch ³
18	0,81	1,5
16	1,3	1,75
14	2,1	2
12	3,3	2,25
10	5,3	2,5
8	8,4	3
6	13	5

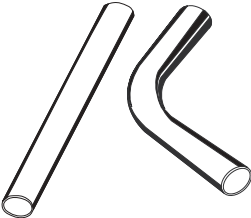
Colour Codes for Conductors, Two or More Systems in the Same Conduit/Box, NEC article 200.6D

	208/120 VAC	480/277 VAC
Phase L1	Black	Brown
Phase L2	Red	Orange
Phase L3	Blue	Yellow
Neutral	White	White with marking, not green
Prot. earth	Green	Green

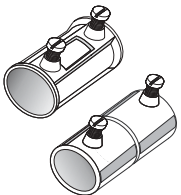
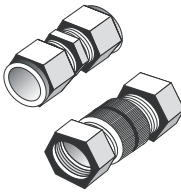
Note

- De-rating factors for more than 3 conductors in conduit:
 4-6 cond.=0,8 7-9 cond.=0,7 10-20 cond.=0,5
 21-30 cond.=0,45 31-40 cond.=0,4 41 or more cond.=0,35
- Unless otherwise specially permitted in NEC, the overcurrent protection shall not exceed 15 A for AWG 14, 20 A for AWG 12 and 25 A for AWG 10. See article 240.4(D)

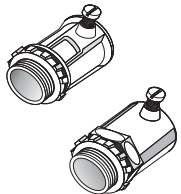

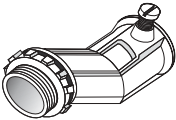
EMT Conduit and Elbows

	Size inch	Conduit, length 3,05 m (10 feet)			90° Elbow		
		outside dia. mm	Catalogue number	Weight/ea kg	Radius mm	Catalogue number	Weight/ea kg
	1/2	18	IMC50EMT	1,36	102	IME950EMT	0,118
	3/4	23	IMC75EMT	2,09	114	IME975EMT	0,209
	1	30	IMC100EMT	3,04	146	IME9100EMT	0,417
	1 1/4	38	IMC125EMT	4,58	184	IME9125EMT	0,62
	1 1/2	44	IMC150EMT	5,26	210	IME9150EMT	0,91
	2	56	IMC200EMT	6,71	235	IME9200EMT	1,27


EMT Couplings

	Size inch	Die cast Catalogue number	Weight/ea kg	Steel Catalogue number	Weight/ea kg
2 set screws 	1/2	IMCCPD50EMT	0,032	IMCCP50EMT	0,041
	3/4	IMCCPD75EMT	0,05	IMCCP75EMT	0,073
	1	IMCCPD100EMT	0,064	IMCCP100EMT	0,104
	1 1/4	IMCCPD125EMT	0,127	IMCCP125EMT	0,191
	1 1/2	IMCCPD150EMT	0,172	IMCCP150EMT	0,227
	2	IMCCPD200EMT	0,25	IMCCP200EMT	0,35
Compression type 	1/2	IMCCPCD50EMT	0,05	IMCCPC50EMT	0,055
	3/4	IMCCPCD75EMT	0,073	IMCCPC75EMT	0,082
	1	IMCCPCD100EMT	0,122	IMCCPC100EMT	0,122
	1 1/4	IMCCPCD125EMT	0,2	IMCCPC125EMT	0,201
	1 1/2	IMCCPCD150EMT	0,3	IMCCPC150EMT	0,286
	2	IMCCPCD200EMT	0,431	IMCCPC200EMT	0,418

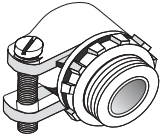
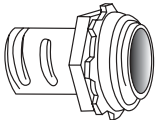
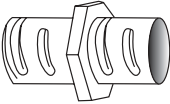
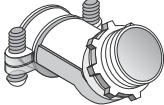
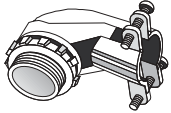
EMT Conduit Connectors including Locknut

Straight, 1 set screw 	1/2	IMFHD50EMT	0,027	IMFH50EMT	0,041
	3/4	IMFHD75EMT	0,045	IMFH75EMT	0,063
	1	IMFHD100EMT	0,068	IMFH100EMT	0,104
	1 1/4	IMFHD125EMT	0,127	IMFH125EMT	0,209
	1 1/2	IMFHD150EMT	0,163	IMFH150EMT	0,227
	2	IMFHD200EMT	0,25	IMFH200EMT	0,354
Straight, compression type 	1/2	IMFHCD50EMT	0,041	IMFHC50EMT	0,05
	3/4	IMFHCD75EMT	0,06	IMFHC75EMT	0,073
	1	IMFHCD100EMT	0,086	IMFHC100EMT	0,114
	1 1/4	IMFHCD125EMT	0,132	IMFHC125EMT	0,195
	1 1/2	IMFHCD150EMT	0,245	IMFHC150EMT	0,245
	2	IMFHCD200EMT	0,372	IMFHC200EMT	0,345
Offset 	1/2	IMFHO50EMT	0,05		
	3/4	IMFHO75EMT	0,082		
	1	IMFHO100EMT	0,114		

Flexible Metal Conduit

	Size inch	Diameter, mm		Bending rad. inside, mm	Packing size, m	Catalogue number	Weight/m kg
		Inside	Outside				
	1/2	16	22	152	30	AF50050	0,408
	3/4	21	27	203	30	AF50075	0,522
	1	25	33	254	15	AF50100	0,862
	1 1/4	32	39	318	15	AF50125	1,03
	1 1/2	38	47	381	7,5	AF50150	1,18
	2	51	60	508	7,5	AF50200	2

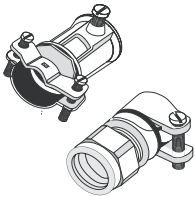
Flexible Metal Conduit Connector including Locknut se not 3

	Size inch	Die cast Catalogue number	Weight/ea kg	Steel Catalogue number	Weight/ea kg
Straight, clamp type 	1/2	IMFFD50EMT	0,041	IMFF50EMT	0,063
	3/4	IMFFD75EMT	0,05	IMFF75EMT	0,1
	1	IMFFD100EMT	0,068	IMFF100EMT	0,14
	1 1/4	IMFFD125EMT	0,136	IMFF125EMT	0,208
	1 1/2	IMFFD150EMT	0,172	IMFF150EMT	0,359
	2	IMFFD200EMT	0,227	IMFF200EMT	0,458
Straight, screw-in type 	1/2	IMFFQ50EMT	0,027		
	3/4	IMFFQ75EMT	0,045		
	1	IMFFQ100EMT	0,073		
	1 1/4	IMFFQ125EMT	0,127		
	1 1/2	IMFFQ150EMT	0,173		
	2	IMFFQ200EMT	0,286		
Straight, splice type 	1/2	IMFFS50EMT	0,027		
	3/4	IMFFS75EMT	0,048		
	1	IMFFS100EMT	0,082		
	1 1/4	IMFFS125EMT	0,127		
	1 1/2	IMFFS150EMT	0,166		
	2	IMFFS200EMT	0,257		
45° , clamp type 	1/2	IMFFD450EMT	0,077		
	3/4	IMFFD475EMT	0,109		
90° clamp type 	1/2	IMFFD950EMT	0,059		
	3/4	IMFFD975EMT	0,091		
	1	IMFFD9100EMT	0,163		
	1 1/4	IMFFD9125EMT	0,231		
	1 1/2	IMFFD9150EMT	0,513		
	2	IMFFD9200EMT	0,558		


Note

3 Flexible metal conduit connectors can also be used for armoured cable

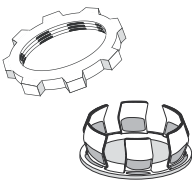
Combination Coupling, Flexible Metal Conduit to EMT Conduit

	Size inch	Clamp type/set screw		Clamp type/compression type	
		Catalogue number	Weight/ea kg	Catalogue number	Weight/ea kg
	1/2	IMFFFS50EMT	0,091	IMFFF50EMT	0,059
	3/4	IMFFFS75EMT	0,132	IMFFF75EMT	0,063
	1	IMFFFS100EMT	0,2	IMFFF100EMT	0,113
	1 1/4	IMFFFS125EMT	0,327	IMFFF125EMT	0,268
	1 1/2	IMFFFS150EMT	0,508	IMFFF150EMT	0,309
	2	IMFFFS200EMT	0,726	IMFFF200EMT	0,495

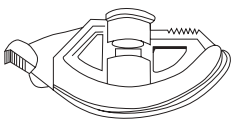
Conduit Clamp and Hanger

	Size inch	Conduit clamp		Conduit hanger	
		Catalogue number	Weight/ea kg	Catalogue number	Weight/ea kg
	1/2	IMCL50EMT	0,023	IMCLH50EMT	0,027
	3/4	IMCL75EMT	0,027	IMCLH75EMT	0,027
	1	IMCL100EMT	0,027	IMCLH100EMT	0,036
	1 1/4	IMCL125EMT	0,059	IMCLH125EMT	0,045
	1 1/2	IMCL150EMT	0,077	IMCLH150EMT	0,05
	2	IMCL200EMT	0,091	IMCLH200EMT	0,104

Locknut, plug

	Size inch	Locknut		Plug	
		Catalogue number	Weight/ea kg	Catalogue number	Weight/ea kg
	1/2	IML50	0,005	IMP50EMT	0,009
	3/4	IML75	0,008	IMP75EMT	0,009
	1	IML100	0,015	IMP100EMT	0,009
	1 1/4	IML125	0,024	IMP125EMT	0,013
	1 1/2	IML150	0,026	IMP150EMT	0,023
	2	IML200	0,041	IMP200EMT	0,032

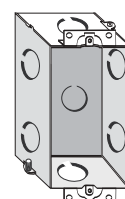
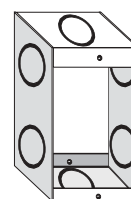
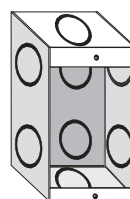
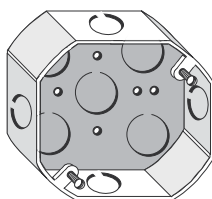
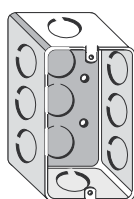
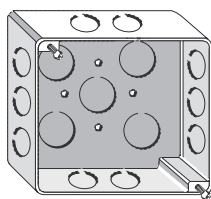
EMT Conduit Bender see note 4

	Size inch	Bending radius		Catalogue number	Weight/ea kg
		90° bend			
	1/2	127		IMTU495	0,8
	3/4	152		IMTU496	1,5
	1	203		IMTU497	2,9
	1 1/4	-		IMTU498	4,8

Notes

- 4 Shaft not included
- 5 See catalogue "Cooper Wiring Devices, Wiring Devices according to NEMA/CSA" for cover plates for receptacles and switches in combination with device boxes
- 6 The device box is used for one receptacle/switch. Contact CHS Controls for device boxes with space for more units
- 7 The device box is designed for two receptacles/switches when the box is mounted "through-the-wall". If the box is used only for one receptacle/switch, cover plate IUTP608 can be used
- 8 Both sides of the device box are removable to simplify fixing

Square Outlet Boxes, Octagon Roof Outlet Box, Device Boxes see note 5, 6, 8



IUTP434

IUTP594

IUTP274

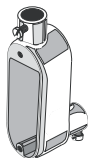
IUTP682
IUTP690IUCBTW-6
IUCBTW-8IUTP218
IUTP252

Type	Dimensions, mm			Volume inch ³	Knockouts, size		Catalogue number	Weight/ea kg
	Height	Width	Depth		Side	Bottom		
Square outlet box	102	102	54	30,3	1/2 & 3/4	1/2 & 3/4	IUTP434	0,381
Square outlet box	102	54	48	13	1/2	1/2	IUTP594	0,227
Octagon roof outlet box	102	102	38	15,5	1/2	1/2	IUTP274	0,227
Device box	95	45	64	15,5	1/2 & 3/4	1/2 & 3/4	IUTP682	0,317
Device box	95	49	89	22	1/2 & 3/4	1/2 & 3/4	IUTP690	0,381
Device box <small>see note 7</small>	94	57	140	42	1/2 & 3/4	1/2 & 3/4	IUCBTW-6	0,468
Device box <small>see note 7</small>	94	57	191	56,5	1/2 & 3/4	1/2 & 3/4	IUCBTW-8	0,55
Device box, sides removable	76	51	64	12,5	1/2	1/2	IUTP218	0,8
Device box, sides removable	76	51	89	18	1/2	1/2	IUTP252	0,345

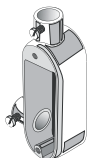
Cover Plates and Accessories for Boxes

Description	Catalogue number	Weight kg
Cover plate IUTP434, steel	IUTP472	0,140
Cover plate for IUTP594, steel	IUTP608	0,045
Cover plate for IUTP274, steel	IUTP372	0,099
Box support, to be used when the box can not be fixed against a wall support	IUTP708	0,022
Earth clamp, fixes the earth conductor securely onto the side of the box	IUTP706	0,002
Earth screw with 152 mm insulated green wire type THHN, AWG 14	IUTP707	0,004

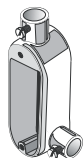
Condulets



Type LB



Type LL



Type LR



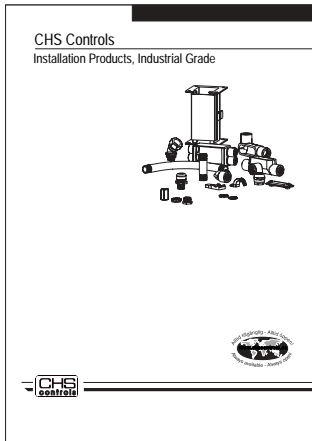
Type T



Cover

Size inch	Catalogue number					Weight/ea kg
	Type LB	Type LL	Type LR	Type T	Cover	
1/2	IMCOLB50EMT	IMCOLL50EMT	IMCOLR50EMT	IMCOT50EMT	IMCC50EMT	0,123
3/4	IMCOLB75EMT	IMCOLL75EMT	IMCOLR75EMT	IMCOT75EMT	IMCC75EMT	0,181
1	IMCOLB100EMT	IMCOLL100EMT	IMCOLR100EMT	IMCOT100EMT	IMCC100EMT	0,291
1 1/4	IMCOLB125EMT	IMCOLL125EMT	IMCOLR125EMT	IMCOT125EMT	IMCC125EMT	0,745
1 1/2	IMCOLB150EMT	IMCOLL150EMT	IMCOLR150EMT	IMCOT150EMT	IMCC150EMT	0,681
2	IMCOLB200EMT	IMCOLL200EMT	IMCOLR200EMT	IMCOT200EMT	IMCC200EMT	1,225

Other Catalogues Covering Installation Products



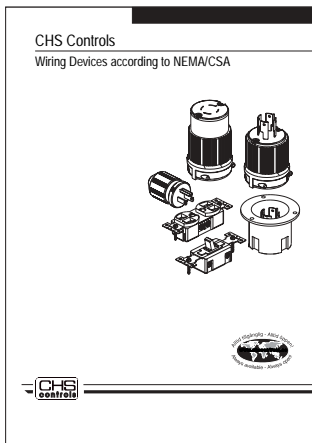
CHS Controls Installation Products - Industrial Grade

- Conduit
- Liquid-tight flexible conduit
- Flexible conduit connectors
- Cable connectors
- Wireways
- Condulets
- Device boxes



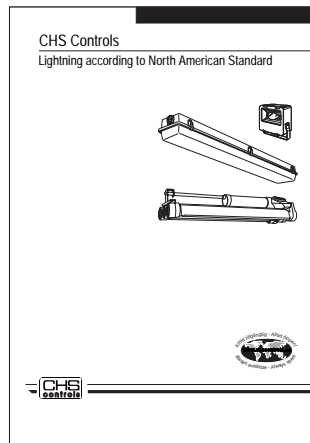
CHS Controls Wire and Cable

- Wire for industrial panels
- Wire for installation
- Tray cable
- Portable cords



Cooper Wiring Devices Wiring Devices according to NEMA/CSA

- Receptacles
- Plugs
- Inlets
- Connectors
- Modular jacks
- Device boxes



CHS Controls Lighting according to North American Standard

- Fluorescent fixtures
- Vapor Light Fixtures
- Fixtures for hazardous locations
- Floodlight
- Emergency lighting

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