IEEE Southern Alberta Section, Industrial Applications and Power & Energy Chapter – Technical Program

Conductors and Raceway Design

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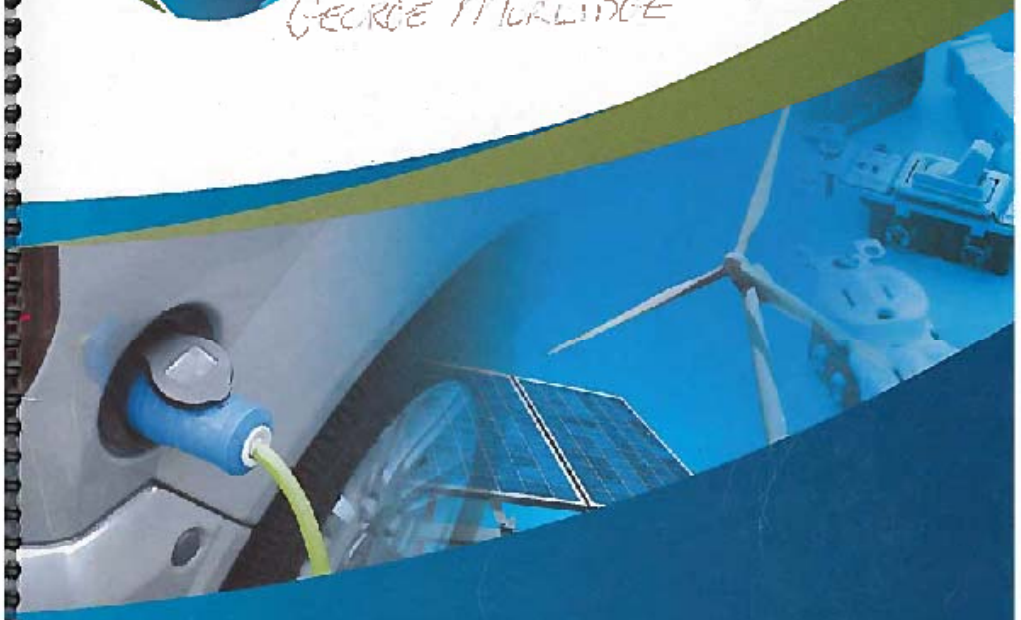
C22.1-12

CSA Standards

GEORGE MURLIDGE



Canadian Electrical Code, Part I

Safety Standard for Electrical Installations

22ND EDITION

2012

Conductors, Cables, and Raceways

- Appendix A
  - Safety standards for electrical equipment, *Canadian Electrical Code*, Part II

CANADIAN STANDARDS ASSOCIATION

C22.2 No. 0.3-09

Test methods for electrical wires and cables

C22.2 No. 0.3-09

- Test methods for electrical wires and cables
  - Scope
    - This standard describes the apparatus, test methods, and formulas to be used in carrying out the tests and calculations required by CSA electrical wire and cable Standards.

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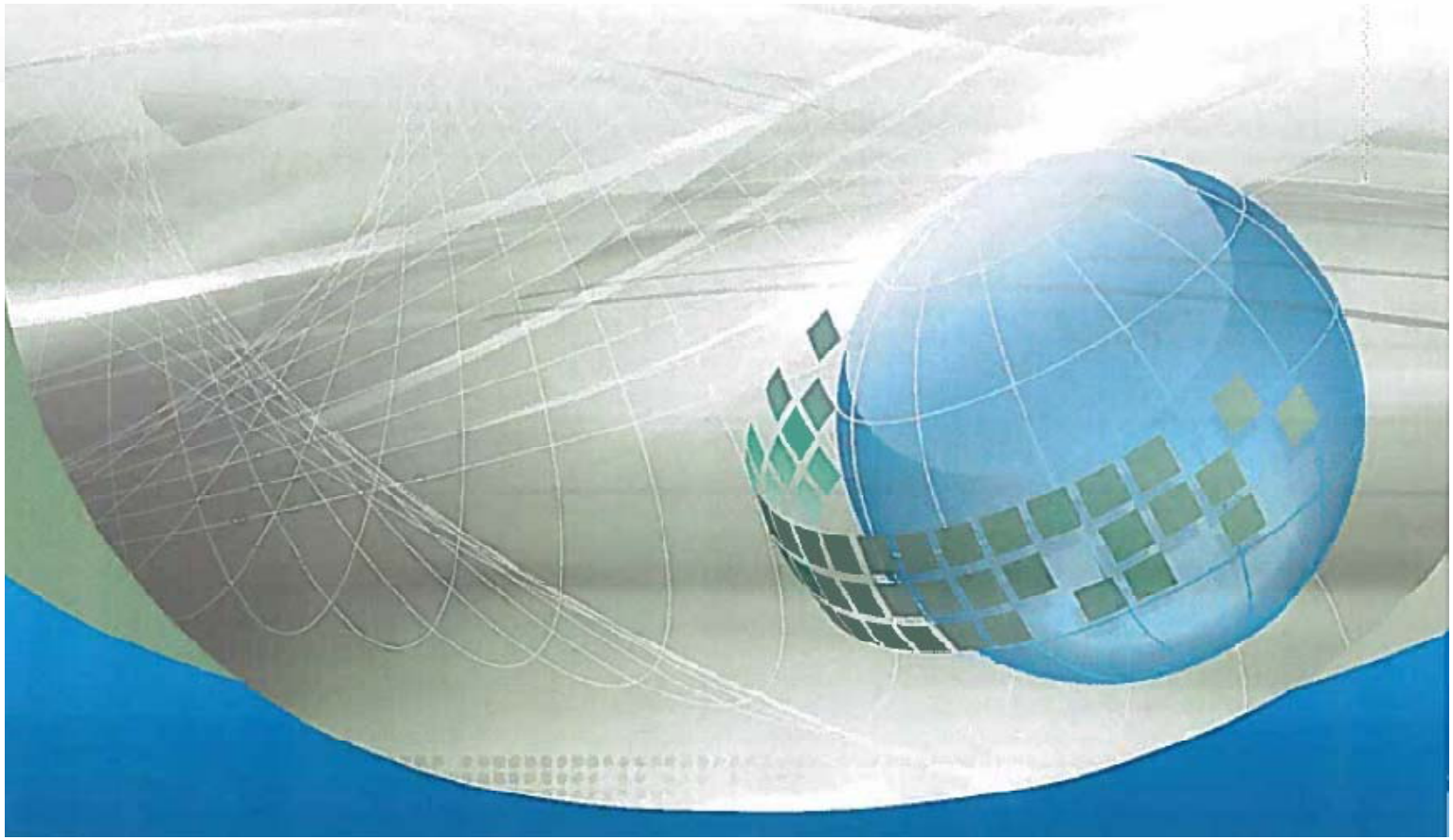
CSA Group

C22.2 No. 38-14

Thermoset-insulated wires and cables

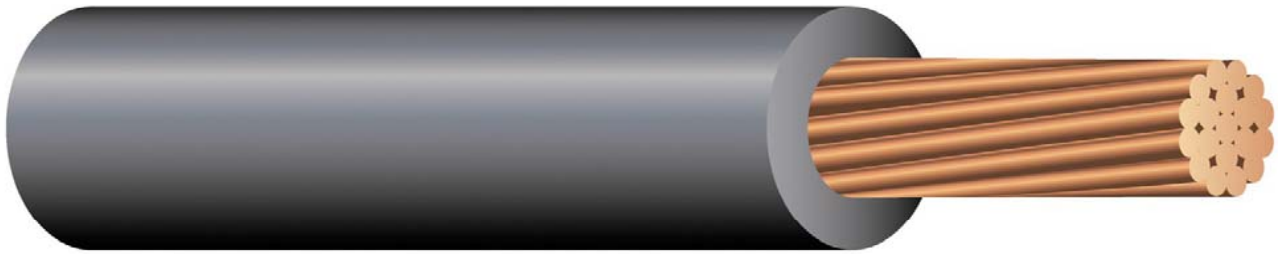


C22.2 No. 38-14

- Thermoset-insulated wires and cables
  - Scope
    - This Standard specifies the requirements for single-conductor and multiple-conductor thermoset-insulatd wires and cables rated 600V, 1000V, 2000V, and 5000V ….(tri-national standard)

C22.2 No. 38-14

- Thermoset-insulated wires and cables
  - Definition
    - An insulating or jacketing polymeric material which, when cross-linked, will not flow on subsequent heating. Cross-linking is accomplished by either chemically or by radiation.
    - Example - RW90 XLPE



RW90

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CANADIAN STANDARDS ASSOCIATION

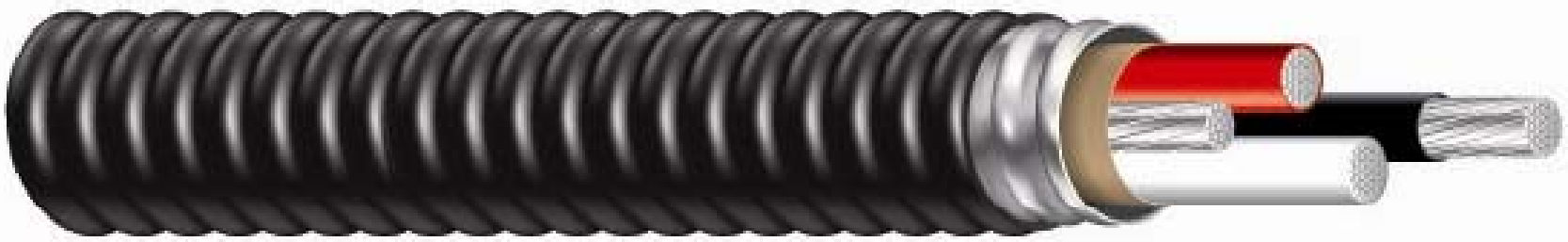
C22.2 No. 51-09

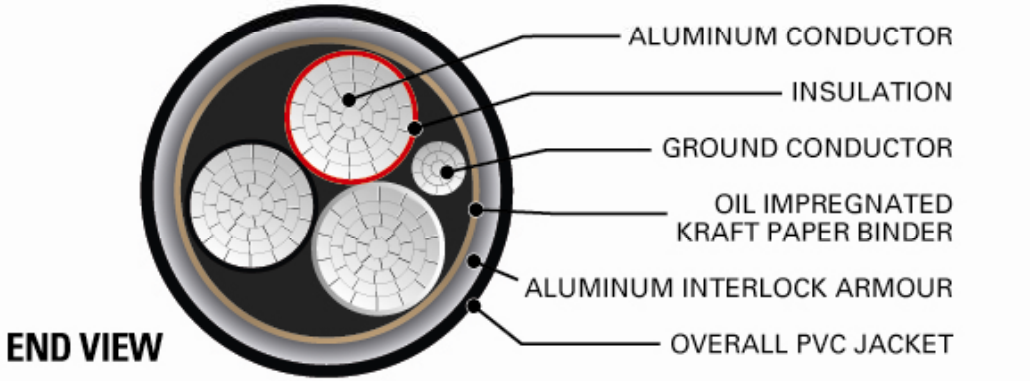
Armoured cables

C22.2 No. 51-09

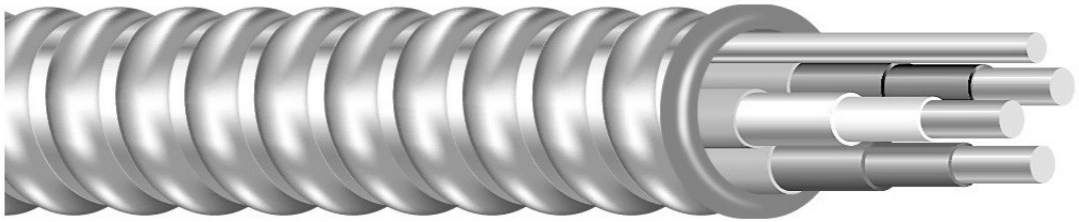
- Armoured Cables
  - Scope
    - This standard specifies requirements for single- and multi-conductor insulated cable having metalic interlocking armour without an overall jacket (Type AC90 or ACG90) or with an overall jacket (Type ACWU90 or ACGWU90) that are intrended for installation in accordance with the CEC Part 1 on systems having a nominal voltage of 600v or less. ACG90 and ACGWU90 apply to multi-conductor insulated cables only.

ACWU90 Construction





AC 90



ACG 90

C22.2 No. 51-09

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C22.2 No. 51-09

Annex A (informative) – Conductor types covered by this Standard
(See Clause 1.1)

Wire type designation	Voltage rating, V	Electrical code recognition		
		Canadian	Mexican	U.S.
XHHW-2	600	No	Yes	Yes
XHHW	600	No	Yes	Yes
XHH	600	No	No	Yes
RHH	600 or 2000	No	Yes	Yes
RHW-2	600 or 2000	No	Yes	Yes
RHW	600 or 2000	No	Yes	Yes
SA	600	No	No	Yes
SF	600	No	Yes	No
SIS	600	Yes	Yes	Yes
R90	600, 1000, 2000, or 5000	Yes	No	No
RW75	600, 1000, 2000, or 5000	Yes	No	No
RW90	600, 1000, 2000, or 5000	Yes	No	No
RWU75	1000	Yes	No	No
RWU90	1000	Yes	No	No

Note: *See Annex B for a summary of construction and test requirements and the grouping of different wire types with identical requirements.*

C22.2 No. 51-09

Table 9
Diameter of Class B, C, and D round concentric-lay-stranded conductors
(See Clause 4.1.6.1 and Annex B)

Conductor size		Nominal diameter	
mm^2	AWG or kcmil	mm	Inches
2.08	14 AWG	1.85	0.0727
3.31	12	2.32	0.0915
5.26	10	2.95	0.116
8.37	8	3.71	0.146
13.3	6	4.67	0.184
21.2	4	5.89	0.232
26.7	3	6.60	0.260
33.6	2	7.42	0.292
42.4	1	8.43	0.332
53.5	1/0	9.45	0.372
67.4	2/0	10.62	0.418
85.0	3/0	11.94	0.470
107	4/0	13.41	0.528
127	250 kcmil	14.6	0.575
152	300	16.00	0.630
177	350	17.30	0.681
203	400	18.49	0.728
228	450	19.61	0.772
253	500	20.65	0.813

C22.2 No. 51-09

Table 12 – Thickness of insulation on 600 V Types XHHW-2, XHHW, XHH, and Types RW75[a], R90[a], and RW90[a]

(See Clause 4.2.3, Tables 35, 36, and 45, and Annex B)

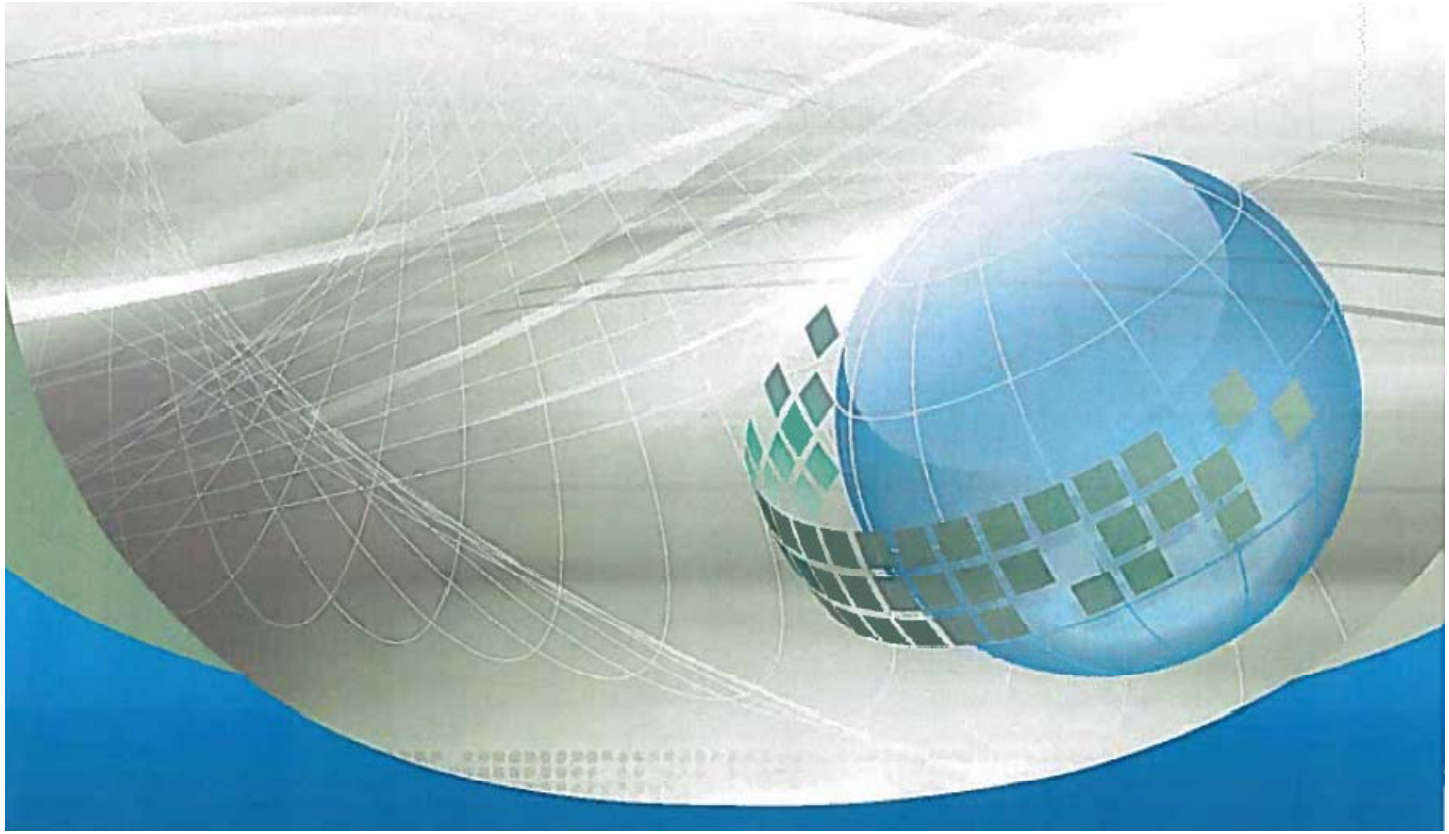
Size of conductor		mm		mils	
mm²	AWG or kcmil	Minimum average thickness	Minimum thickness at any point	Minimum average thickness	Minimum thickness at any point
2.08 – 5.26	14 – 10 AWG	0.76	0.69	30	27
9.37 – 33.6	8 – 2	1.14	1.02	45	40
42.4 – 107	1 – 4/0	1.40	1.27	55	50
Larger than 107 – 253	Larger than 4/0 – 500 kcmil	1.65	1.47	65	58
Larger than 253 – 507	Larger than 500 – 1000	2.03	1.83	80	72
Larger than 507 – 1010	Larger than 1000 – 2000	2.41	2.18	95	86

[a] For types employing silicone insulation, see Table 15.

CSA Group

C68.10-08
(reaffirmed 2013)

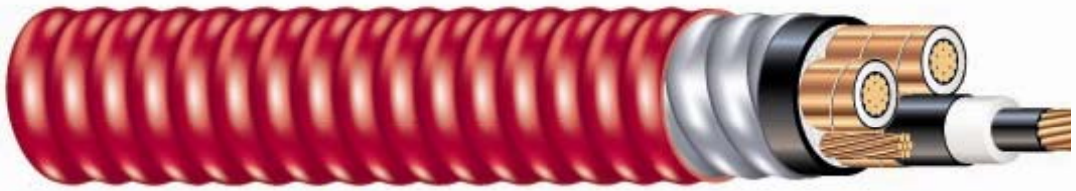
Shielded power cable for commercial and industrial applications, 5–46 kV

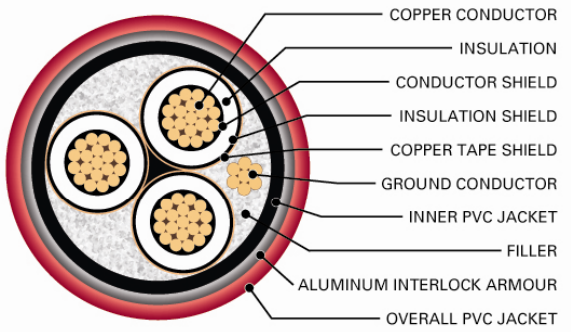


C68.10-08

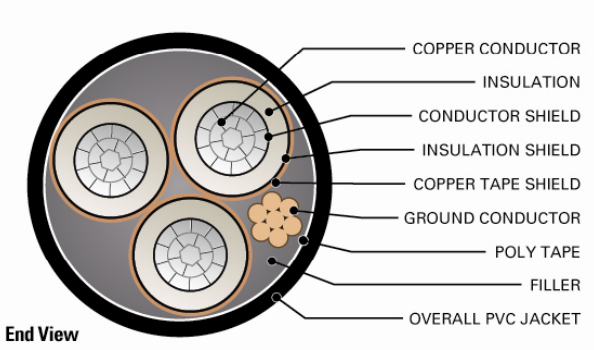
- Shielded power cable for commercial and industrial applications, 5 – 46 kV
  - Scope
    - This Standard applies to the materials, construction, and testing of one- to four-conductor cross-linked polyethylene or ethylene propylene rubber-insulated shielded power cables, rated 5 to 46 kV, that are used for the distribution of electrical energy under normal conditions of installation and service in indoor, outdoor, aerial, underground, or underwater locations.

HVTECK




COPPER CONDUCTOR
INSULATION
CONDUCTOR SHIELD
INSULATION SHIELD
COPPER TAPE SHIELD
GROUND CONDUCTOR
INNER PVC JACKET
FILLER
ALUMINUM INTERLOCK ARMOUR
OVERALL PVC JACKET

HVTC


COPPER CONDUCTOR
INSULATION
CONDUCTOR SHIELD
INSULATION SHIELD
COPPER TAPE SHIELD
GROUND CONDUCTOR
POLY TAPE
FILLER
OVERALL PVC JACKET
End View

C68.10-08

- Shielded power cable for commercial and industrial applications, 5 – 46 kV
  - Definitions
    - See a long list of definitions pertinent to medium voltage power cables such as insulation level etc

C68.10-08

- A Standard specifying the construction of Shielded Power Cable
  - TOC
    - 4.0 Conductors
    - 5.0 Conductor shield (stress control layer)
    - 6.0 Insulation
    - 7.0 Extruded insulation shields and coverings
    - 8.0 Metallic shielding
    - 9.0 Jackets and metalic and associated covering
    - 10.0 Constructon of specific types of cable
    - 11.0 Cable assembly and fillers
    - 12.0 Cable identification
    - 13.0 Production tests
    - etc

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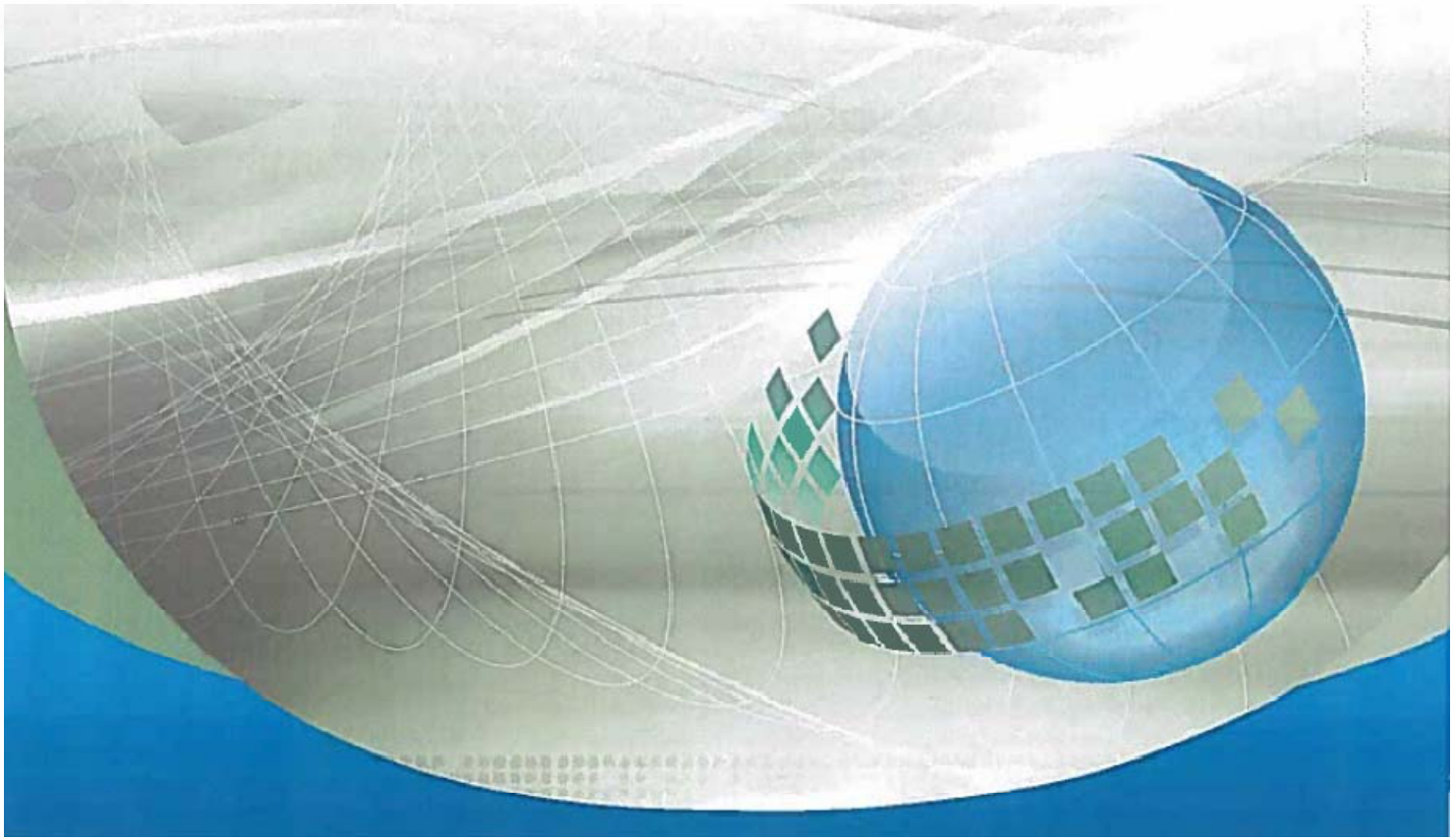
C22.2 No. 75-08
(reaffirmed 2013)

Thermoplastic-insulated wires and cables



C22.2 No. 75-08

- Thermoplastic-insulated wires and cables
  - Scope
    - This Standard specifies the requirements for 600V, single-conductor, thermoplastic-insulated wires and cables, ….(tri-national standard)….
    - In Canada and the United States, requirements for multi-conductor thermoplastic-insulated and –jacketed cables rated 600V are covered in other Standards. ….

C22.2 No. 75-08

- Thermoplastic-insulated wires and cables
  - Definitions
    - PVC – a thermoplastic compound whose characteristics constituent is polyvinyl chloride or a copolymer of vinyl chloride and vinyl acetate. (Type TW)

C22.2 No. 75-08

- Referenced CSA Standards
  - CEC Part 1
  - C22.2 No. 0.3-96 Test methods for electrical wires and cables
  - C22.2 No. 131M89 Type TECK 90 cable
  - C22.2 No. 230 M1988 Tray cables
  - C22.2 No. 239 -97 Control and instrument cables
  - C22.2 No. 2556 -05 Wire and cable test methods
  - Plus many U.S. and European standards

C22.2 No. 75-08

Table A1
Wire Type/Electrical Code Cross-Reference Chart
(See Clause 1.1.)

Wire type designation	Electrical code		
	Canada *Canadian Electrical Code (CEC)*	**Mexico** *Standard for Electrical Installations* (NOM-001-SEDE)	**United States** *National Electrical Code (NEC)*
TW	YES	YES	YES
TWU	YES	NO	NO
TWU75	YES	NO	NO
THW	NO	YES	YES
TW75	YES	NO	NO
THW-2	NO	YES	YES
THW-LS	NO	YES	NO
THHW	NO	YES	YES
THHW-LS	NO	YES	NO
THHN	NO	YES	YES
T90 NYLON	YES	NO	NO
THWN-2	NO	YES	YES
THWN	NO	YES	YES
TWN75	YES	NO	NO

Note:

(1) *This table is accurate at the date of publication. Subsequent changes in any national code will supersede this table. See Clause 6.1.3.2 for multiple type designation markings.*

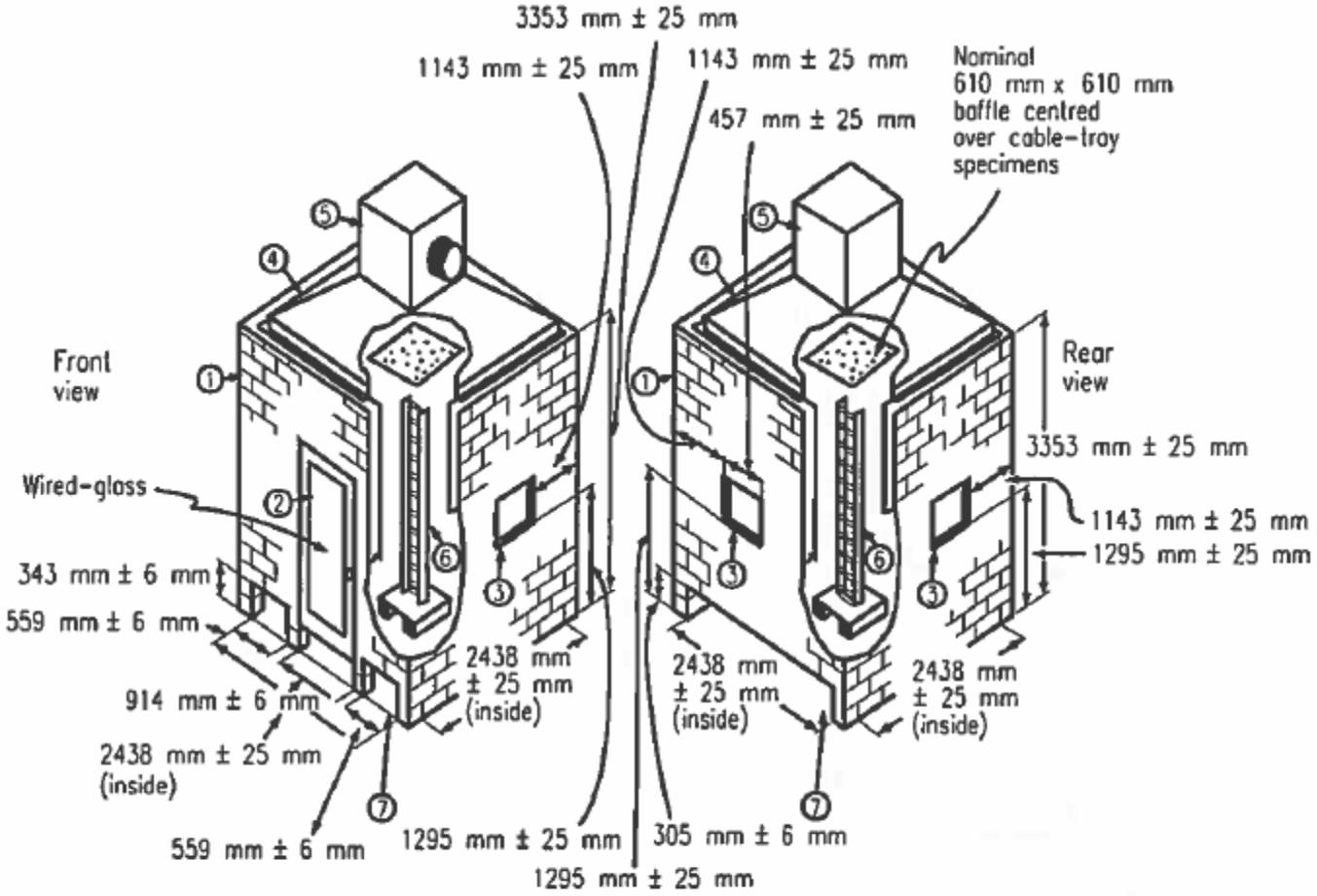
C22.2 No. 75-08

Table B2
Minimum Size of Equipment-Grounding Conductor
(See Clause B3.)

Size of circuit conductor (phase)		Minimum size of grounding conductor	
Cross-sectional area mm^2	AWG or kcmil	Cross-sectional area mm^2	AWG
2.08 – 5.26	14 – 10	The same size as circuit conductor	
8.37	8	5.26	10
13.3 – 21.2	6 – 4	8.37	8
33.6 – 67.4	2 – 2/0	13.3	6
85.0 – 203	3/0 – 400	33.6	2
253 – 507	500 – 1000	42.4	1

C22.2 No. 75-08

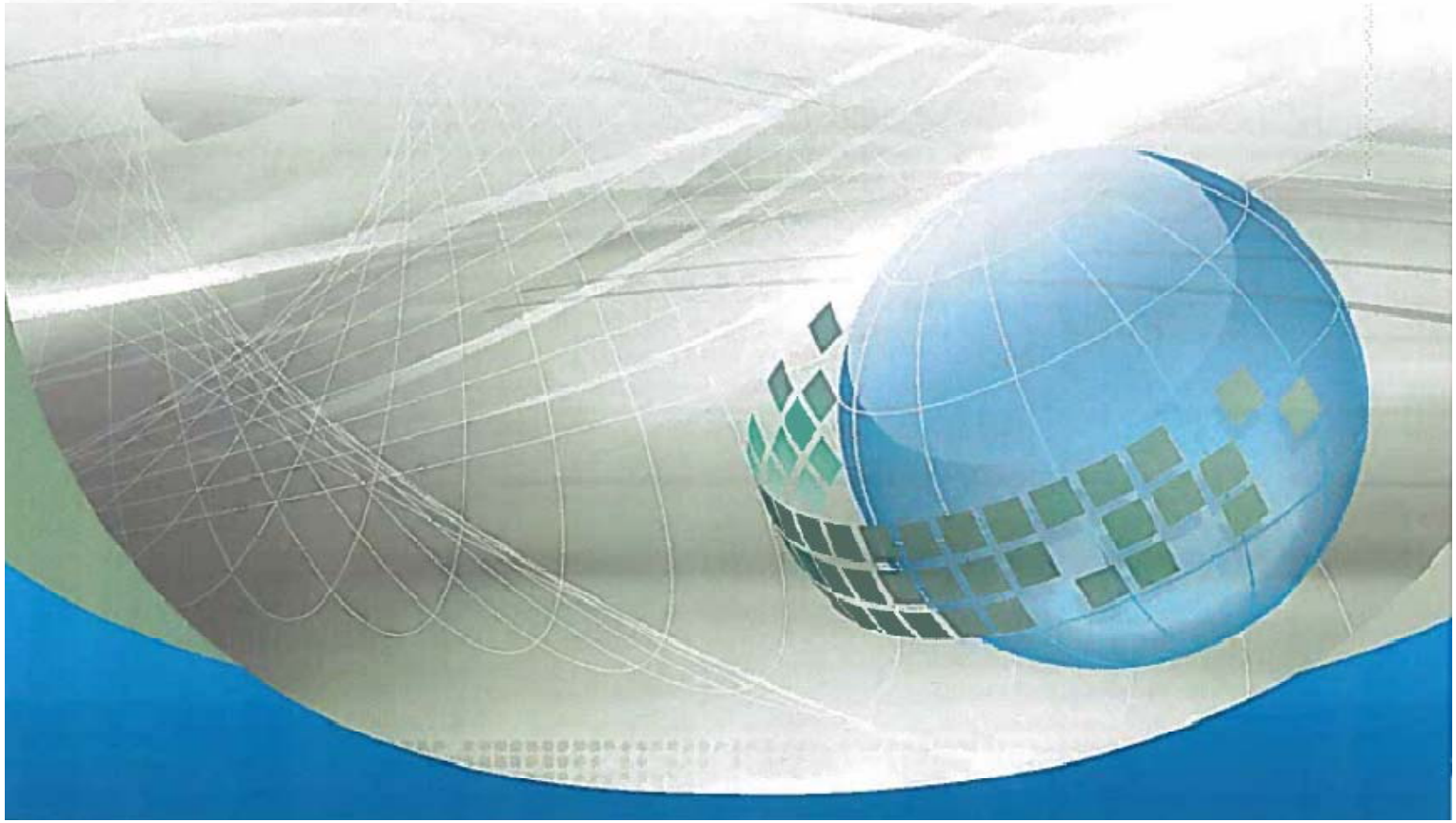
Figure 1
Cable Test Enclosure and Exhaust Duct
(See Clauses 8.2.6.1.2 and 8.2.6.2.2.)



CSA Group

C22.2 No. 96-13

Portable power cables



C22.2 No. 96-13

- Portable power cables
  - Scope
    - This standard specifies construction and testing requirements for portable power cables normally used in applications where the cables are subject to frequent flexing and where installation is in accordance with CSA M421 and/or the CEC Part 1.

SHD-GC

C22.2 No. 96-13

- Portable power cables
  - Definitions
    - See a long list of definitions pertinent to portable power cables such as mine trailing cables etc

C22.2 No. 96-13

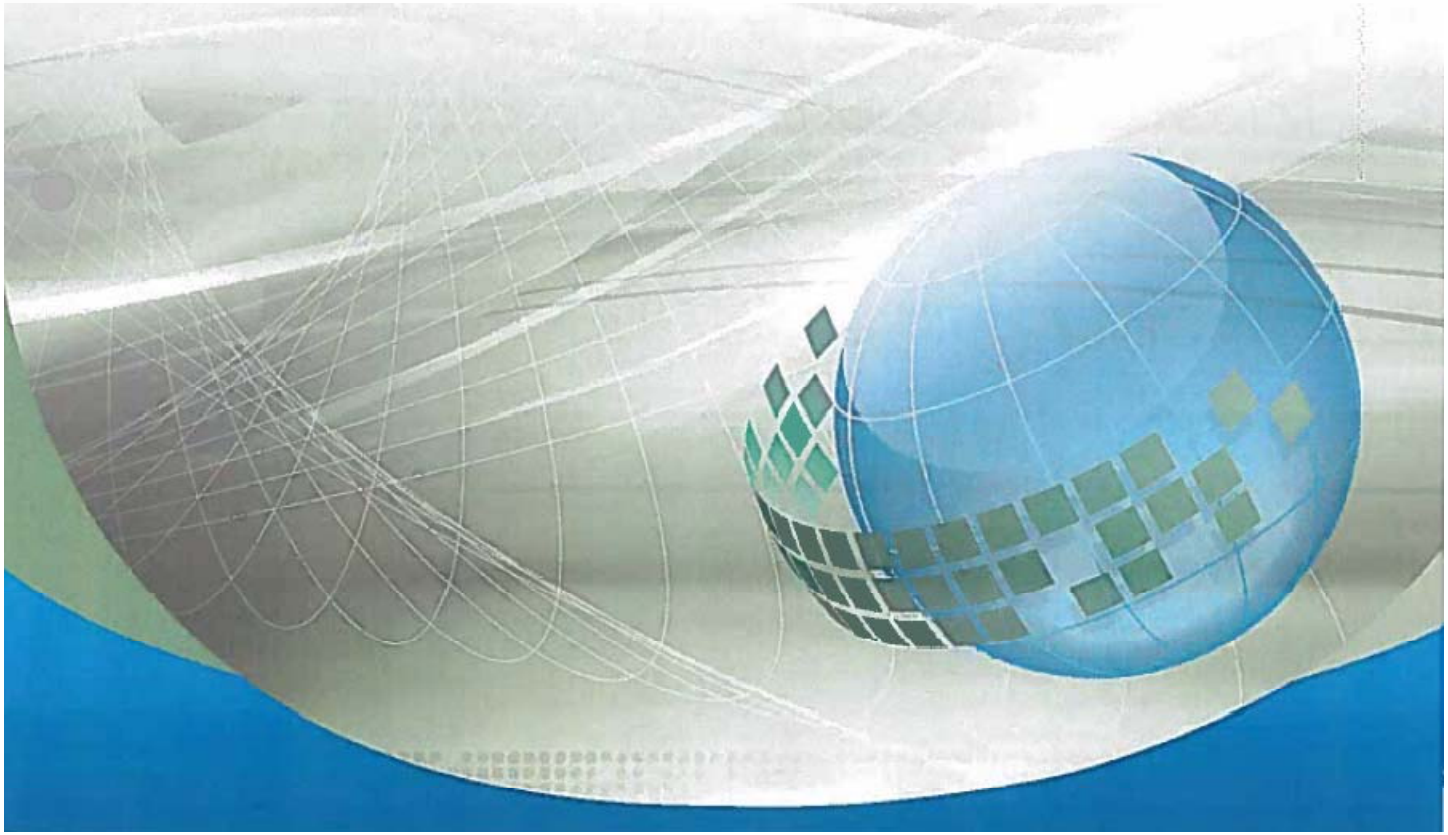
- Contents
  - This is an extensive standard that includes much detail on construction and testing of different types of Portable Power Cable.

Type GGc

CSA Group

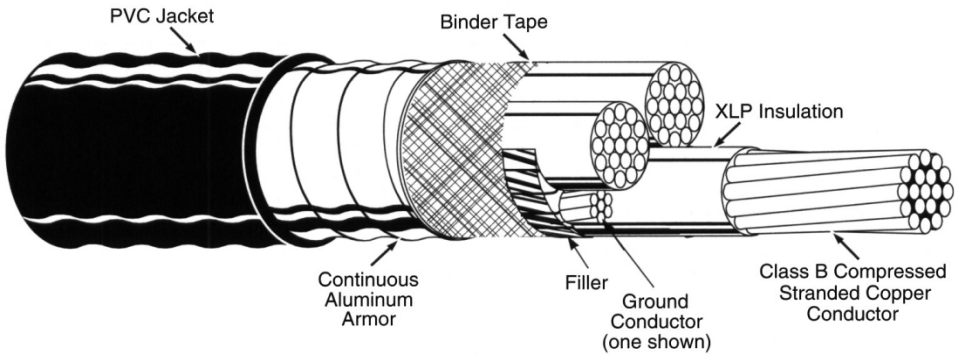
C22.2 No. 123-08
(reaffirmed 2012)

Metal sheathed cables



C22.2 No. 123-08

- Metal Sheathed Cables
  - Scope
    - This Standard applies to single-conductor and multi-conductor Type RA90 and RC90 cables having a maximum temperature rating of 90 degrees C in both dry and wet locations and intended for installation in accordance with the Rules of the CEC Part 1.



C22.2 No. 123-08

- Metal Sheathed Cables
  - Definition
    - RA90 – an aluminum sheathed cable incorporating a thermoset insulated conductor(s) having 90 degree C temperature rating
    - RC90 – a copper sheathed cable incorporating a thermoset insulated conductor(s) having 90 degree C temperature rating

C22.2 No. 123-08

- Contents
  - This is an extensive standard that includes much detail on construction and testing of different types of Metal Sheathed Cable.

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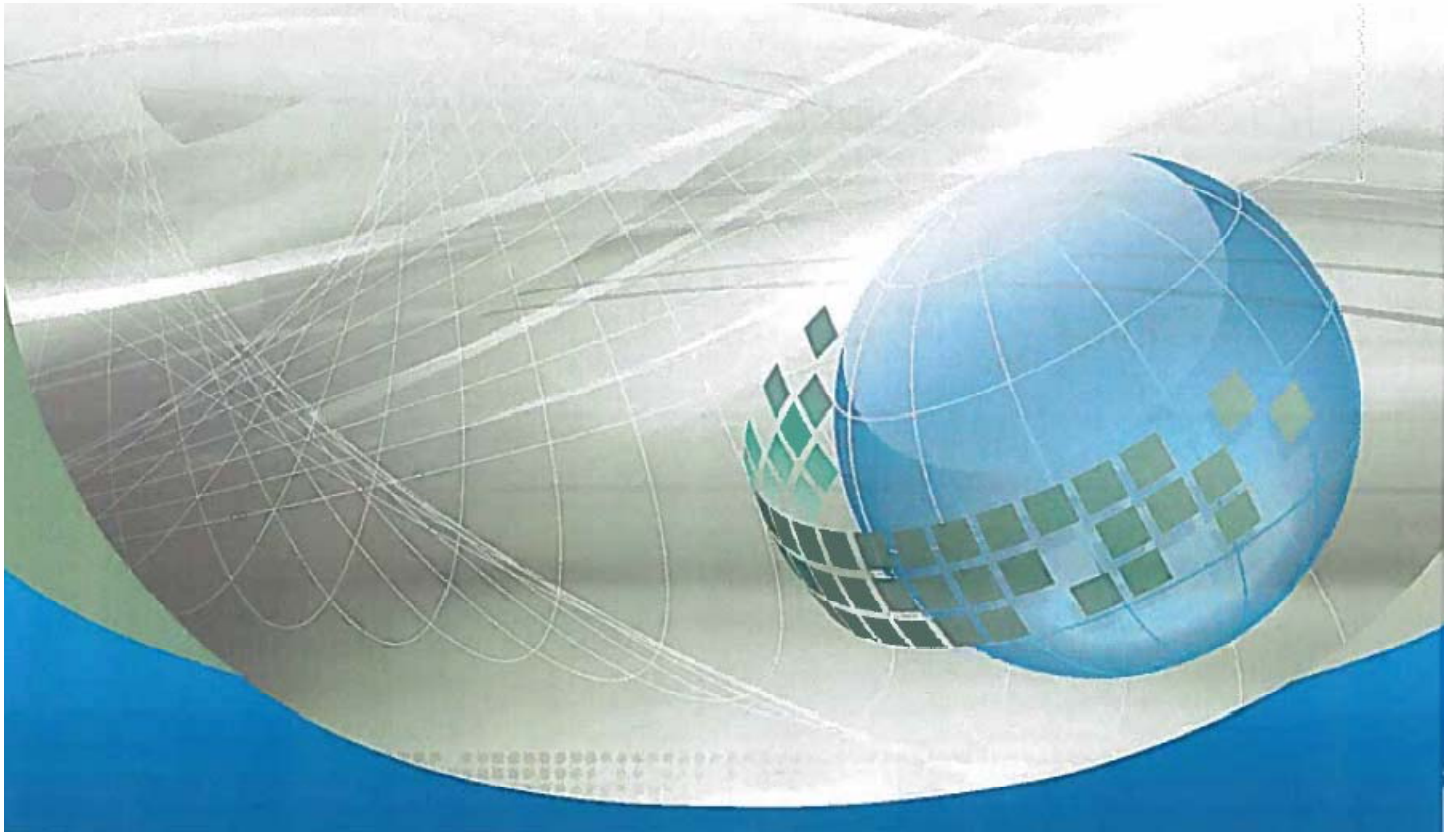
C22.2 No. 131-07
(reaffirmed 2012)

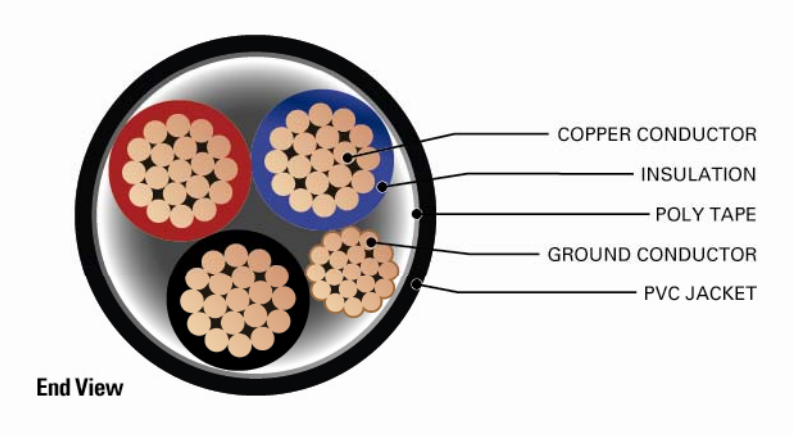
Type TECK 90 cable



C22.2 No. 131-07

- Type TECK 90 cable
  - Scope
    - This standard applies to single- and multi-conductor Type TECK 90 armoured cable intended for installation in accordance with the rules of the CEC Part 1 on systems having nominal voltages of 5000V and less and having a maximum temperature rating of 90 degrees C in both dry and wet locations.

TECK90 Construction



C22.2 No. 131-07

5 Construction *2*

5.1 Circuit conductors *2*
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5.1.2 Joints *2*
5.1.3 Sizes *2*
5.1.4 Conductor shield *2*
5.2 Bonding conductors *3*
5.2.1 General *3*
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5.3 Insulation *4*
5.3.1 General *4*
5.3.2 Thickness *4*
5.4 Coverings and separators *4*
5.5 Insulation shielding *4*
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5.7 Fillers *5*
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C22.2 No. 131-07

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7.19 Spark test *13*

CANADIAN STANDARDS ASSOCIATION

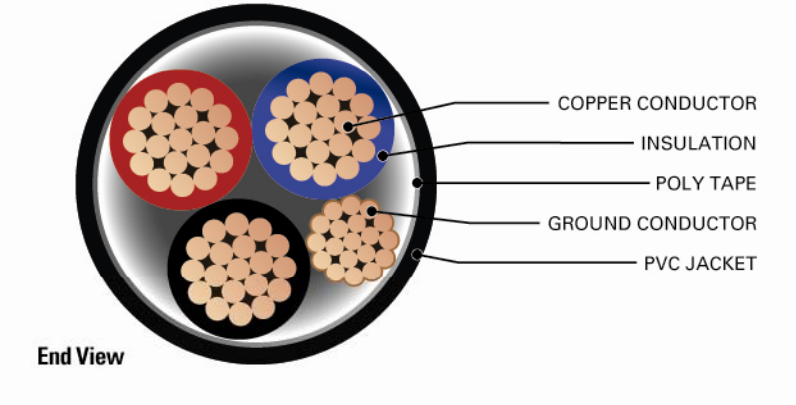
C22.2 No. 230-09

Tray cables

C22.2 No. 230-09

- Tray Cables
  - Scope
    - This standard applies to single conductor and multi-conductor constructions, without metal sheath or armour, suitable for use in cable trays and other applications when installed in accordance with the CEC Part 1.
    - (a very brief Standard – does not include construction details, only references other Standards and includes testing for same)

Tray Cable Construction



C22.2 No. 230-09

- Construction
  - Constructions include types specified in the following Standards:
    - (a) CAN/CSA 22.2 No. 38 Thermoset-insulated wires and cables
    - (b) CSA 22.2 No. 75Thermoplastic-insulated wires and cables
    - (c) CSA 22.2 No. 96 Portable power cables
    - (d) Can/CSA-22.2 No. 239 Control and instrumentation cables; and
    - (e) CSA C68.10 Shielded power cables for commercial and industrial applications 5-46kV

C22.2 No. 230-09

- Tests
  - 5.1 General
  - 5.2 Flame
  - 5.3 Abnormal low temperature – impact
  - 5.4 Mechanical damage – impact
  - 5.5 Mechanical damage – crushing
  - 5.6 Weather resistance
  - 5.7 Oil resistance (optional)
  - 5.8 Explosion on cables with bundled subassemblies

CANADIAN STANDARDS ASSOCIATION

C22.2 No. 239-09

Control and instrumentation cables

C22.2 No. 239-09

- Control and instrumentation cables
  - Scope
    - This Standard applies to multiple-conductor control and instrumentation cables (including thermocouple cables and thermocouple extension cables) having a voltage rating not exceeding 1000V and intended for installation in accordance with the CEC Part1.
    - *Note: The designations for such cables are CIC for unarmoured cables and ACIC for armoured cables.*

C22.2 No. 239-09

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5.1.2 Sizes *5*
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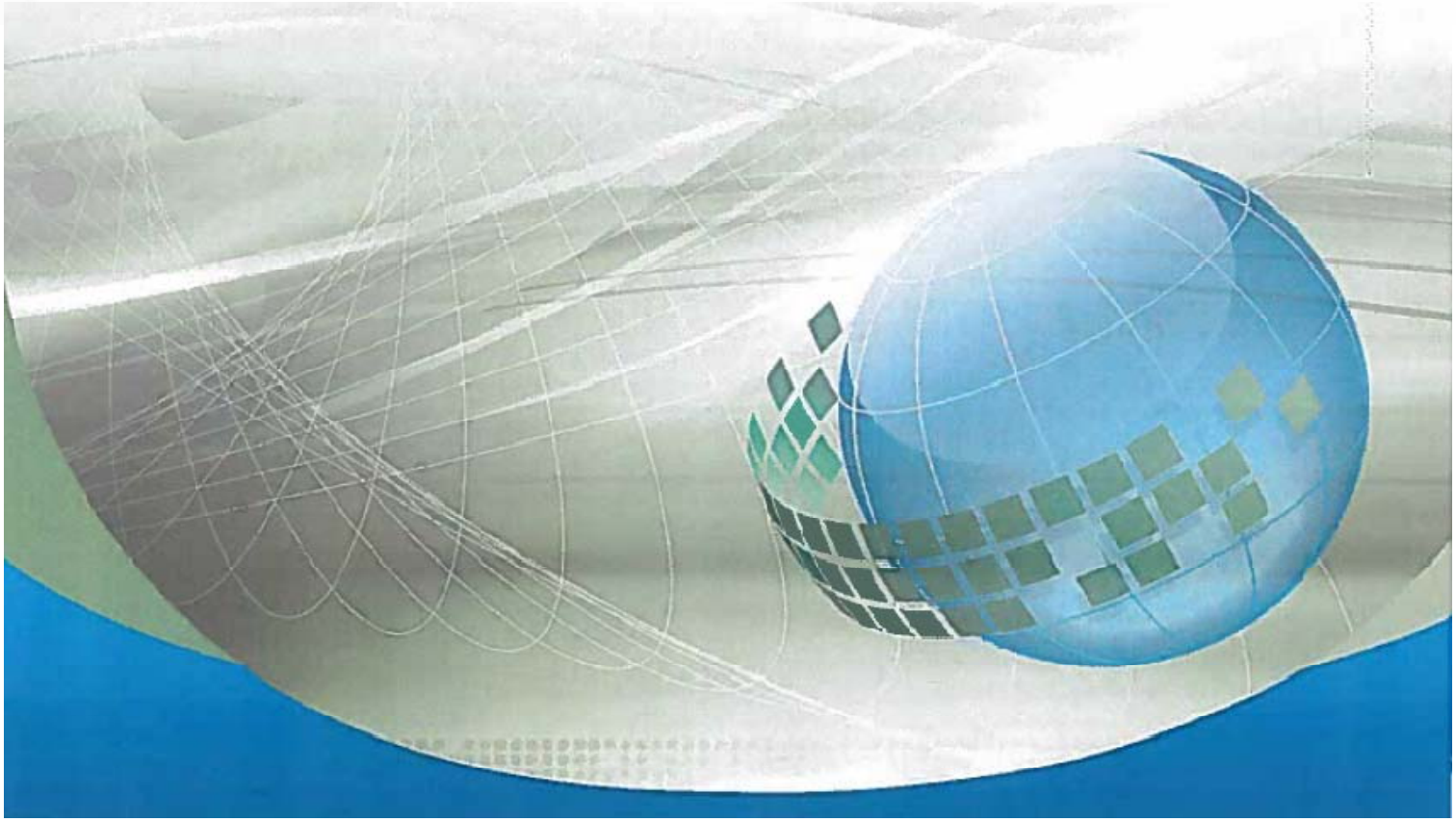
CSA Group

C22.2 No. 2556-13

Wire and cable test methods



C22.2 N0. 2556-13

- Wire and cable test methods
  - Scope
    - This standard describes the apparatus, test methods, and formulas to be used in carrying out the tests and calculations required by wire and cable Standards.

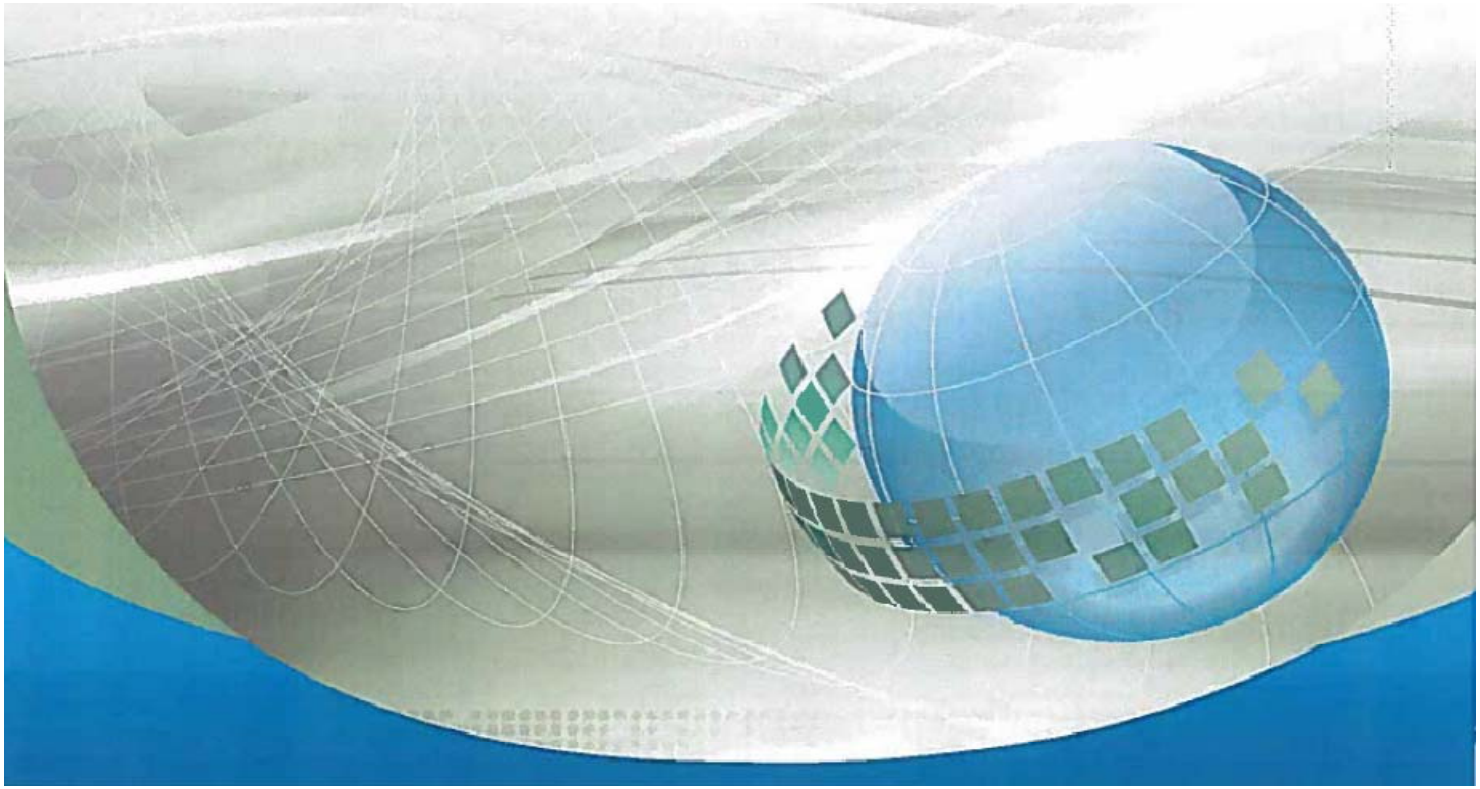
C22.2 N0. 2556-13

- *This Standard is very similar to C22.2 No. 0.3-09, Test methods for electrical wires and cables. It is the tri-national equivalent and is referenced in many new Standards instead of C22.2 No. 0.3-09.*

CSA Group

C22.2 No. 174-M1984
(reaffirmed 2012)

Cables and cable glands for use in hazardous locations



C22.2 No. 174-M1984

- Cables and cable glands for use in hazardous locations
  - Scope
    - This Standard allies to cables and cable glands intended for (a) fixed wiring in Class 1, Groups A, B, C, and D; Class II, Groups E, F, and g; and Class III hazardous locations in accordance with the Roles of the CEC Part 1; and (b) fixed wiring and portable cables in gaseous mines in accordance with the Rules of the CEC Part V; and is in addition to the basic electrical requirements applicable to such cables and cable glands for use in other hazardous locations.

C22.2 No. 174-M1984

- Cables and cable glands for use in hazardous locations
  - Scope cont'd
    - *Note: The requirements of this Standard for cables and cable glands for use in hazardous locations in accordance with the Rules of the CEC, Part 1, are based on the premise that the basic electrical requirements for such cables and cable glands exist in other published CSA documents.*

C22.2 No. 174-M1984

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C22.2 No. 174-M1984

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CANADIAN STANDARDS ASSOCIATION

C22.2 No. 126.1-09

Metal cable tray systems

C22.2 No. 126.1-09

Canadian Standards Association
CSA C22.2 No. 126.1-09
Third Edition

National Electrical Manufacturers Association
NEMA VE 1-2009
Fifth Edition

Metal cable tray systems

September 2009

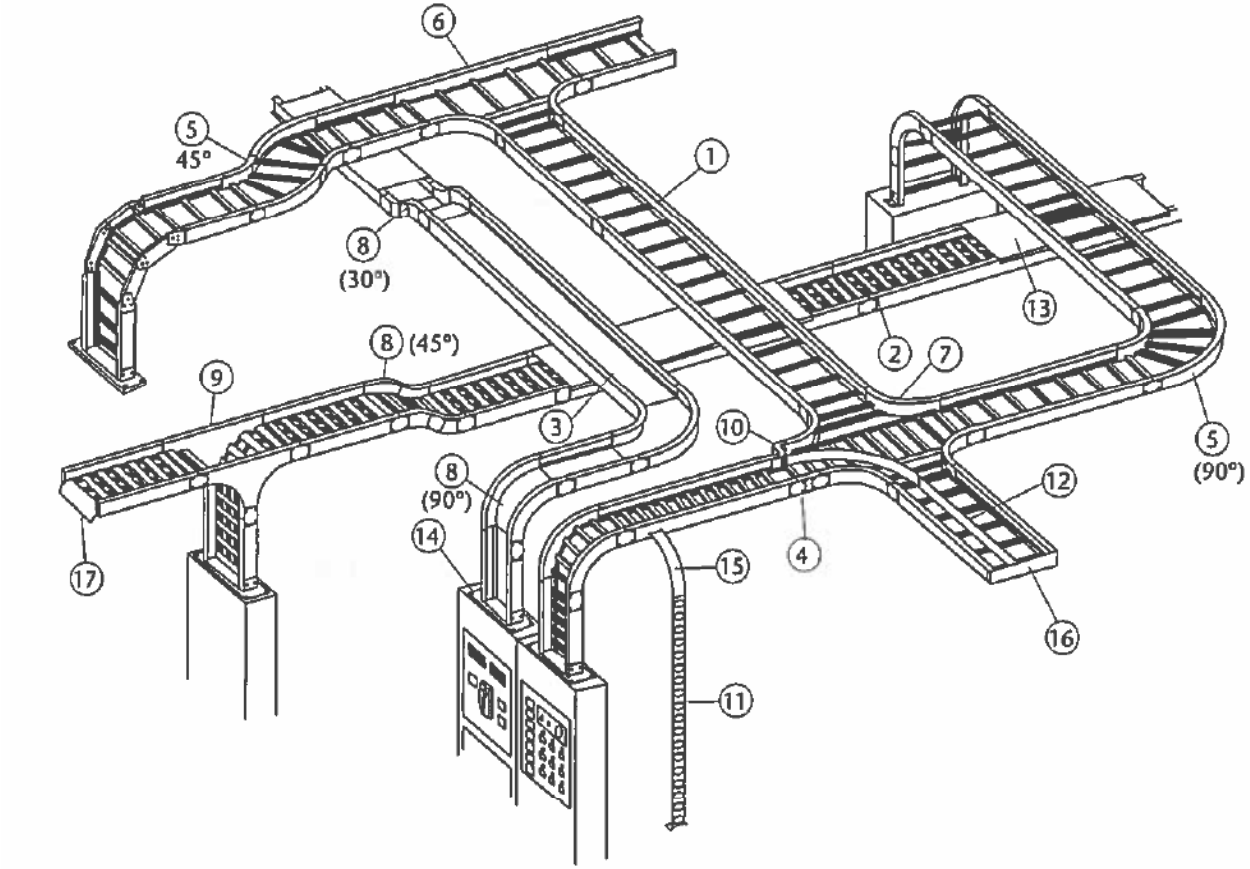
C22.2 No. 126.1-09

- Metal cable tray systems
  - Scope
  - This Standard specifies the requirements for metal cable trays and associated fittings designed for use in accordance with the rules of the CEC Part 1, and the National Electrical Code (NEC)

C22.2 No. 126.1-09

- Metal cable tray systems
  - Preface
    - This is the common CSA and NEMA Standard for metal cable tray systems. It is the third edition of CSA C22.2 No. 126.1, superseding the previous edition published in 2002 and 1998, and the fifth edition of NEMA VE 1, superseding the previous edition published in 2002.
    - *(CANENA Technical Harmonization committee)*

C22.2 No. 126.1-09



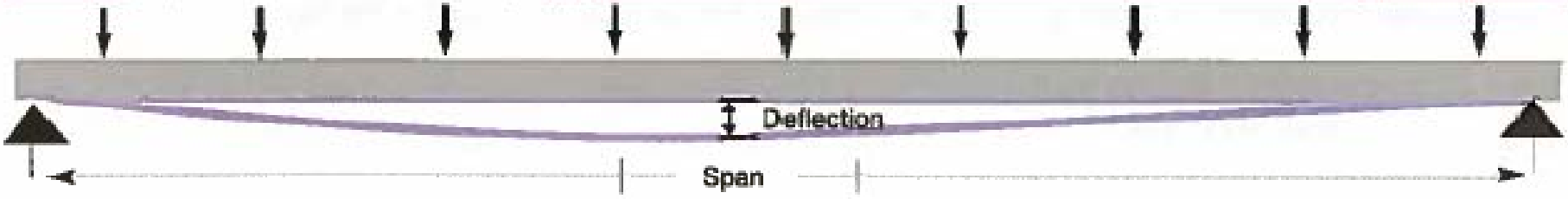
Legend:

1 = Ladder cable tray
2 = Ventilated cable tray
3 = Solid-bottom cable tray
4 = Rigid connector
5 = Horizontal elbow
6 = Horizontal tee
7 = Horizontal cross
8 = Vertical elbow
9 = Vertical tee
10 = Reducer
11 = Channel cable tray
12 = Divider
13 = Cover
14 = Tray-to-box connector
15 = Channel vertical elbow
16 = Blind end
17 = Dropout

Cable Tray Loading

TABLE 1 Load / Span Class Designation

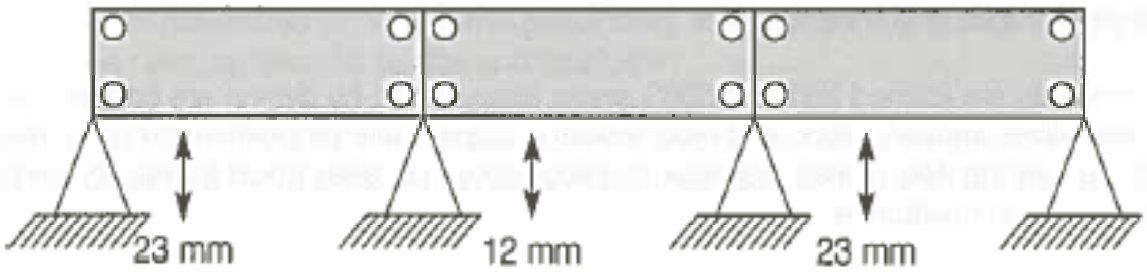
LOAD kg/m (lb/ft)		SPAN, m (ft)				
		2.4 (8)	3.0 (10)	3.7 (12)	4.9 (16)	6.0 (20)
37	(25)	–	A	–	–	–
67	(45)	–	–	–	–	D
74	(50)	8A	–	12A	16A	20A
97	(65)	–	C	–	–	–
112	(75)	8B	–	12B	16B	E or 20B
149	(100)	8C	–	12C	16C	20C
179	(120)	–	D	–	–	–
299	(200)	–	E	–	–	–



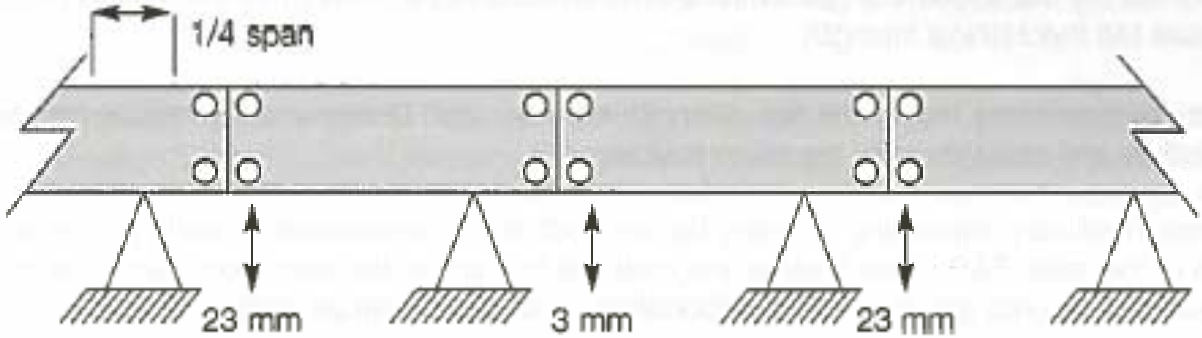
Note: 8A/B/C, 12A/B/C, 16A/B/C, and 20A/B/C are the traditional NEMA designations. A, C, D, and E are the conventional CSA designations.

Cable Tray Support

Couplers at Supports - Not Recommended



Couplers at 1/4 Span From Supports - Ideal Layout



Conductors

- CEC
  - Section 4 Conductors
  - Section 12 Wiring Methods

Conductors

4-004 Ampacity of wires and cables (see Appendices B and I)

(1) The maximum current that a copper conductor of a given size and insulation may carry shall be as follows:

(a) single-conductor and single-conductor metal-sheathed or armoured cable, in a free air run, with a cable spacing not less than 100% of the larger cable diameter, as specified in Table 1;

(b) one, two, or three conductors in a run of raceway, or 2- or 3-conductor cable, except as indicated in Subrule (1)(d), as specified in Table 2;

(c) four or more conductors in a run of raceway or cable, as specified in Table 2 with the correction factors applied as specified in Table 5C;

(d) single-conductor and 2-, 3-, and 4-conductor cables and single-conductor and 2-, 3-, and 4-conductor metal-armoured and metal-sheathed cables, in conductor sizes No. 1/0 AWG and larger, installed in accordance with configurations described in Diagrams B4-1 to B4-4 in an underground run, directly buried or in a raceway, as specified in Tables D8A through D15B.

(e) underground configurations not specified in Item (d), in conductor sizes No. 1/0 AWG and larger, as calculated by the IEEE 835 calculation method; and

(f) underground configurations in conductor sizes smaller than No. 1/0 AWG, as specified in Item (b) or as calculated by the IEEE 835 calculation method.

Conductors

Table 2
Allowable ampacities for not more than three copper conductors in raceway or cable (based on an ambient temperature of 30 °C*)
(See Rules 4-004, 8-104, 12-2210, 14-104, 26-142, 42-008, and 42-016 and Tables 5A, 5C, 19, and D3.)

Size, AWG or kcmil	Allowable ampacity†‡‡					
	60 °C‡	75 °C‡	90 °C‡**	110 °C‡ See Note	125 °C‡ See Note	200 °C‡ See Note
14§	20	20	25	25	30	35
12§	25	25	30	30	35	40
10§	30	35	40	45	45	65
8	40	50	55	65	65	105
6	55††	65	75	80	90	155
4	70	85	95	105	115	205
3	85	100	115	125	135	240
2	95	115	130	145	155	280
1	110	130	145	165	175	320
0	125	150	170	190	200	375
00	145	175	195††	220	235	435
000	165	200	225	255	270	510
0000	195	230	260	290	310	590
250	215	255	290	320	345	—
300	240	285	320	360	385	—
350	260	310	350	390	420	—
400	280	335	380	425	450	—
500	320	380	430	480	510	—
600	350	420	475	530	565	—
700	385	460	520	580	620	—
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7

Conductors

(2) The maximum current that an aluminum conductor of a given size and insulation may carry shall be as follows:

(a) single-conductor and single-conductor metal-sheathed or armoured cable, in a free air run, with a cable spacing not less than 100% of the larger cable diameter, as specified in Table 3;

(b) one, two, or three conductors in a run of raceway, or 2- or 3-conductor cable, except as indicated in Subrule (2)(d), as specified in Table 4;

(c) four or more conductors in a run of raceway or cable, as specified in Table 4 with the correction factors applied as specified in Table 5C;

(d) single-conductor and 2-, 3-, and 4-conductor cables and single-conductor and 2-, 3-, and 4-conductor metal-armoured and metal-sheathed cables, in conductor sizes No. 1/0 AWG and larger, installed in accordance with configurations described in Diagrams B4-1 to B4-4 in an underground run, directly buried or in a raceway, as specified in Tables D8A through D15B.

(e) underground configurations not specified in Item (d), in conductor sizes No. 1/0 AWG and larger, as calculated by the IEEE 835 calculation method; and

(f) underground configurations in conductor sizes smaller than No. 1/0 AWG, as specified in Item (b) or as calculated by the IEEE 835 calculation method.

Conductors

(8) The ampacity correction factors of Table 5A shall apply where conductors are installed in an ambient temperature exceeding or anticipated to exceed 30 °C.

(9) Where the free air spacing between adjacent single conductor cables is maintained at not less than 25% nor more than 100% of the diameter of the largest cable, the ampacity shall be obtained from Subrules (1)(a) and (2)(a) for copper and aluminum conductors respectively, multiplied by the correction factor obtained from Table 5D.

(10) Where up to and including four single conductor cables in free air are spaced at less than 25% of the diameter of the largest conductor or cable, the ampacity shall be the same as that obtained from Subrules (1)(b) and (2)(b) for copper and aluminum conductors respectively, multiplied by the correction factor obtained from Table 5B.

(11) Notwithstanding Subrule (10), where not more than four non-jacketed single-conductor mineral-insulated cables are grouped together in conformance with Rule 4-010(3) and are installed on a messenger or as open runs with a maintained free air space of not less than 2.15 times the diameter of the largest cable contained within the group and adjacent groups or cables, the ampacity of each conductor in the group shall be permitted to be determined in accordance with Subrule (1)(a) without applying the factors of Table 5B.

(12) More than four single conductor cables in free air, when spaced at less than 25% of the largest cable diameter, shall have an ampacity obtained from Tables 2 and 4 for copper and aluminum conductors respectively, multiplied by the correction factor obtained from Table 5C.

(13) Notwithstanding Subrule (12), when the length of a multiple conductor cable run is less than 600 mm, the correction factor from Table 5C shall not apply.

(14) The ampacity of conductors of different temperature ratings installed in the same raceway shall be

Conductors

4-006 Temperature limitations (see Appendix B)

(1) Where equipment is marked with a maximum conductor termination temperature, the maximum allowable ampacity of the conductor shall be based on the corresponding temperature column from Table 1, 2, 3, or 4.

(2) Where equipment is not marked with a maximum conductor termination temperature, 90 °C shall be used by default.

IEEE 835 Table

857

25 to 46 kV Shielded Single Conductor Extruded Dielectric Power Cable

in Underground Duct Bank - Triplexed - Three Circuits

25°C Earth Ambient

Condr Size	Neut. Size	60 Rho 75 LF	60 Rho 100 LF	90 Rho 75 LF	90 Rho 100 LF	120 Rho 75 LF	120 Rho 100 LF
90°C - Aluminum Conductor - Concentric Strand							
1	Full	140	127	128	114	119	104
1	1/2	140	127	128	114	119	104
1	1/3	140	127	129	114	119	104
1	1/6	140	127	129	114	119	104
1/0	Full	158	143	145	128	134	117
1/0	1/2	159	144	145	129	135	117
1/0	1/3	159	144	145	129	135	117
1/0	1/6	159	144	146	129	135	117
2/0	Full	179	162	164	145	151	131
2/0	1/2	180	163	165	145	152	132
2/0	1/3	180	163	165	145	152	132
2/0	1/6	180	163	165	146	152	132
3/0	Full	203	183	185	163	170	147
3/0	1/2	204	184	186	164	171	148
3/0	1/3	204	184	186	164	172	148
3/0	1/6	204	184	187	164	172	149
4/0	Full	228	205	208	183	191	165
4/0	1/2	230	207	210	184	193	166
4/0	1/3	231	208	210	185	193	167
4/0	1/6	232	208	211	185	194	167
250	1/3	252	226	229	201	210	181
250	1/6	253	227	230	202	211	182
250	1/12	253	228	231	202	212	182
250	1/18	253	228	231	202	212	183

Conductors

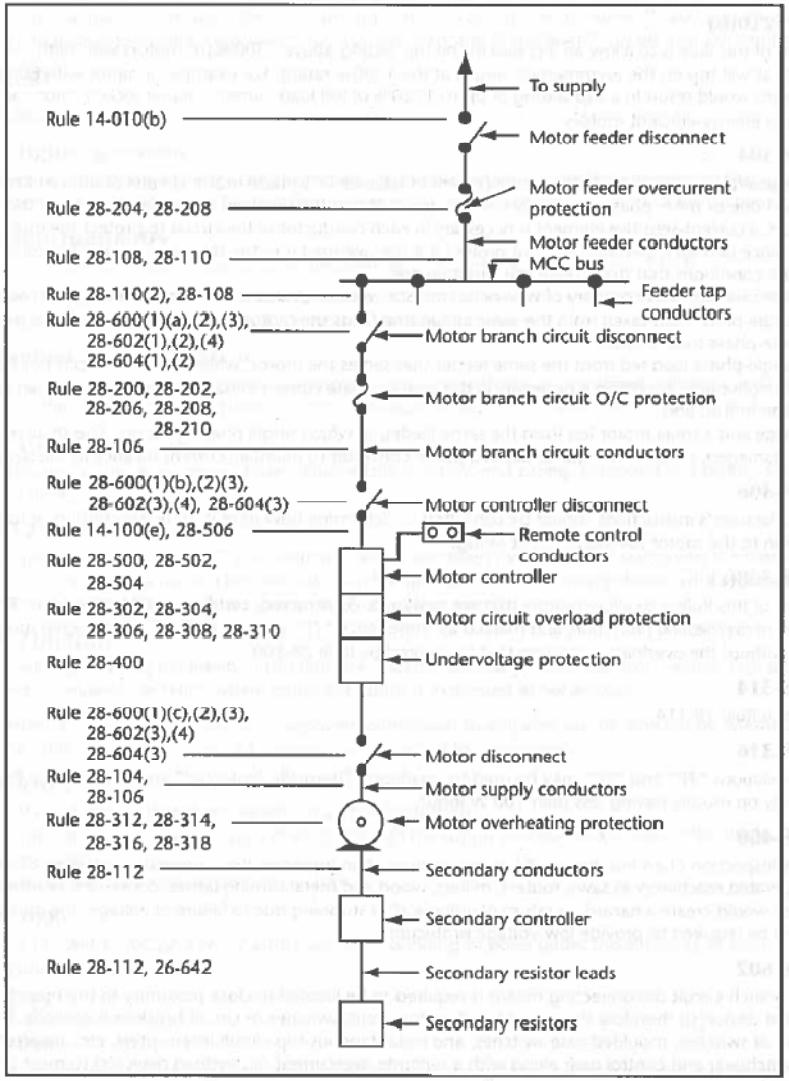
Table 19 (Continued)

Conditions of use	Trade designation	CSA type designation	Maximum allowable conductor temperature, °C	Reference Notes
For use in raceways, except cable trays, in wet locations	Rubber (thermoset) insulated cable	RW75, RWU75	75	5, 8, 9
		RW90, RWU90	90	5, 8, 9
	Thermoplastic-insulated cable	TW, TWU	60	4, 5
		TW75, TWN75, TWU75	75	—
	Solar photovoltaic cable	RPV90, RPVU90	90	5, 8, 9, 34
For use in ventilated, non-ventilated, and ladder-type cable trays in dry locations only	Armoured cable	AC90	90	8, 9
		ACG90	90	8, 9, 33
		TECK90	90	8, 9
For use in ventilated, non-ventilated, and ladder-type cable trays in wet locations	Armoured cable	TECK90	90	5, 8, 9
		ACWU90	90	5, 8, 9
		ACGWU90	90	5, 8, 9, 33
	Aluminum-sheathed cable	RA75	75	5
		RA90	90	5, 8, 9
	Copper-sheathed cable	RC90	90	5, 7, 8, 9
	Mineral-insulated cable	MI, LWMI	90	5
	Rubber (thermoset) insulated lead-sheathed cable	RL90	90	5, 8, 9
For use in ventilated and non-ventilated cable trays in vaults and switch rooms	Rubber (thermoset) insulated cable	RW75	75	8, 9, 10
		RW90	90	8, 9, 10
For direct earth burial (with protection as required by inspection authority)	Armoured cable	ACWU90	90	3, 8, 9
		ACGWU90	90	3, 8, 9, 33
		TECK90	90	3, 8, 9
	Non-metallic-sheathed cable	NMWU	60	3, 20
	Rubber (thermoset) insulated cable	RWU75	75	3, 8, 9
		RL90, RWU90	90	3, 8, 9
	Aluminum-sheathed cable	RA75	75	3
		RA90	90	3, 7, 8
	Copper-sheathed cable	RC90	90	3, 7, 8, 9

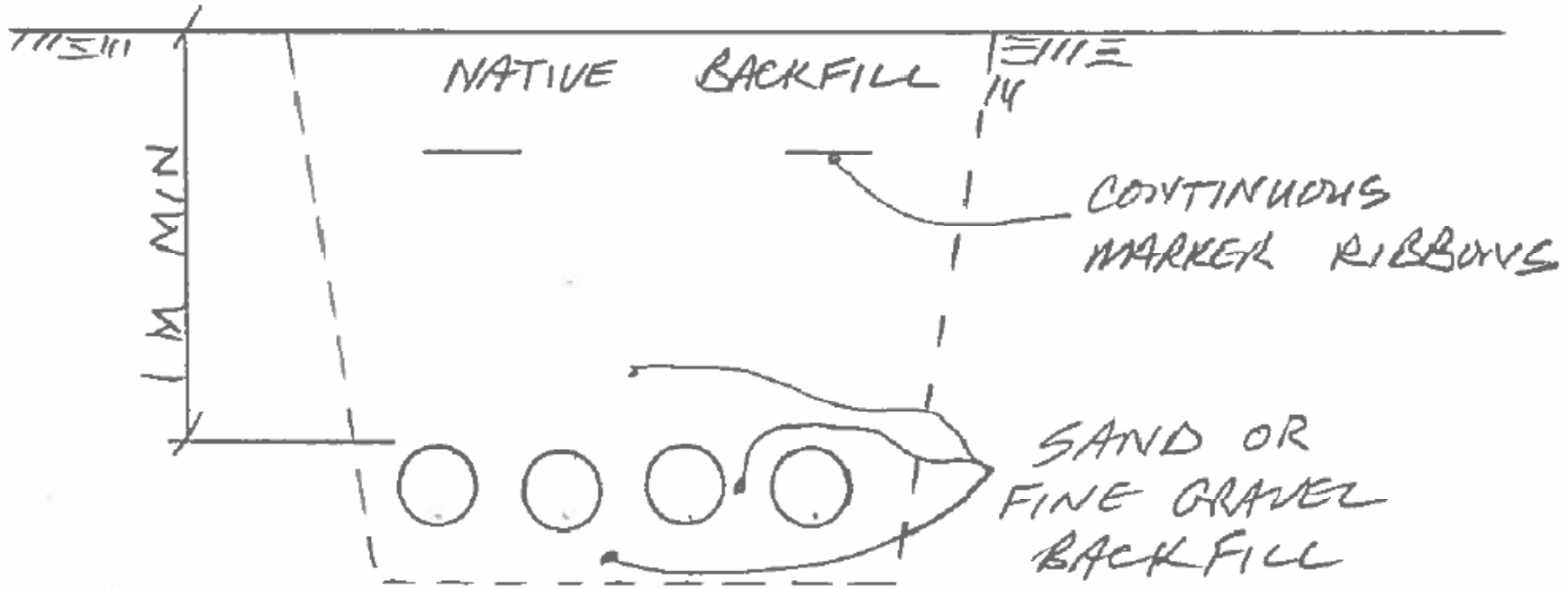
(Continued)

Conductors

Diagram of circuits, control, and protective devices for motors

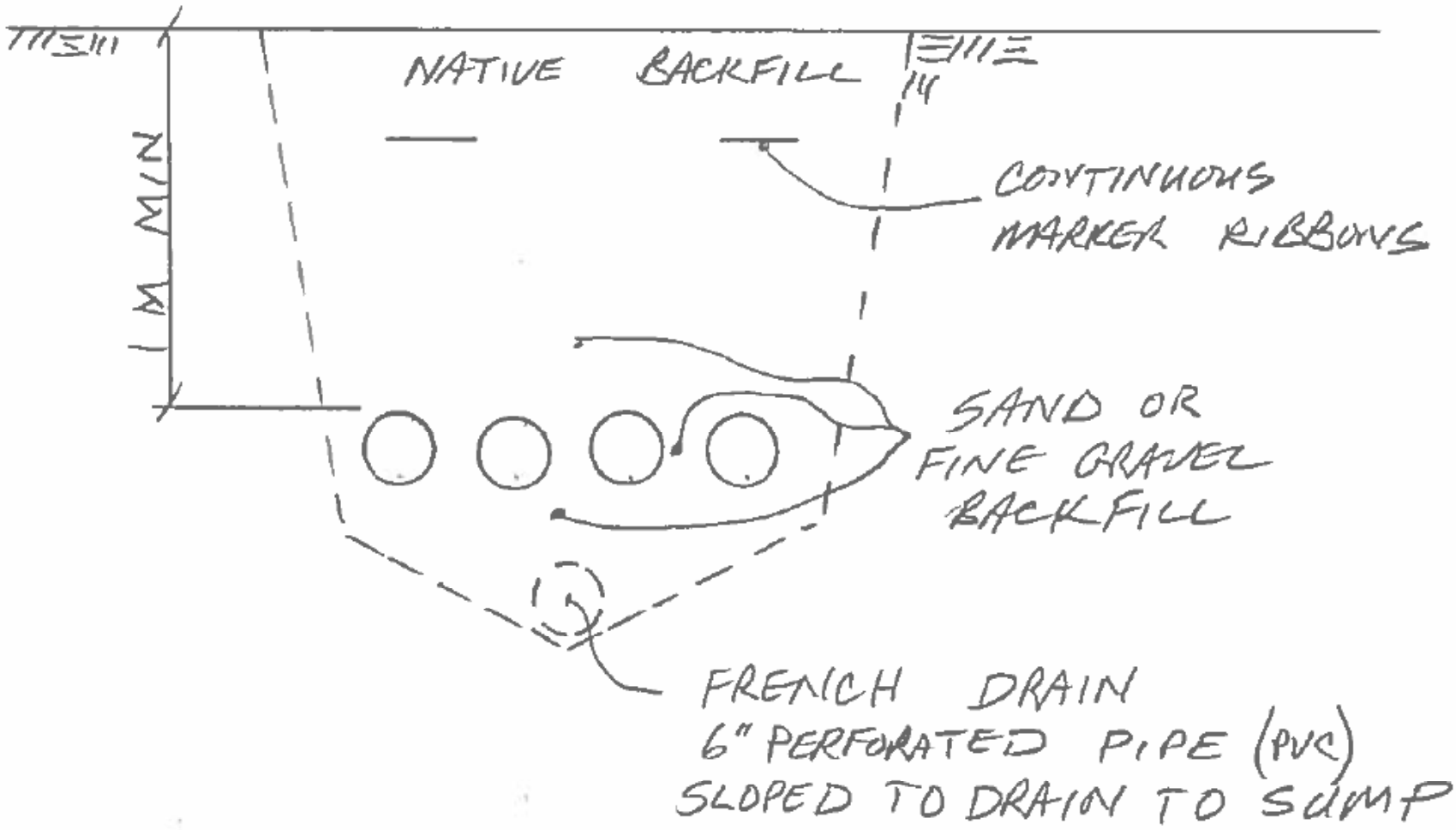


Underground Duct Banks

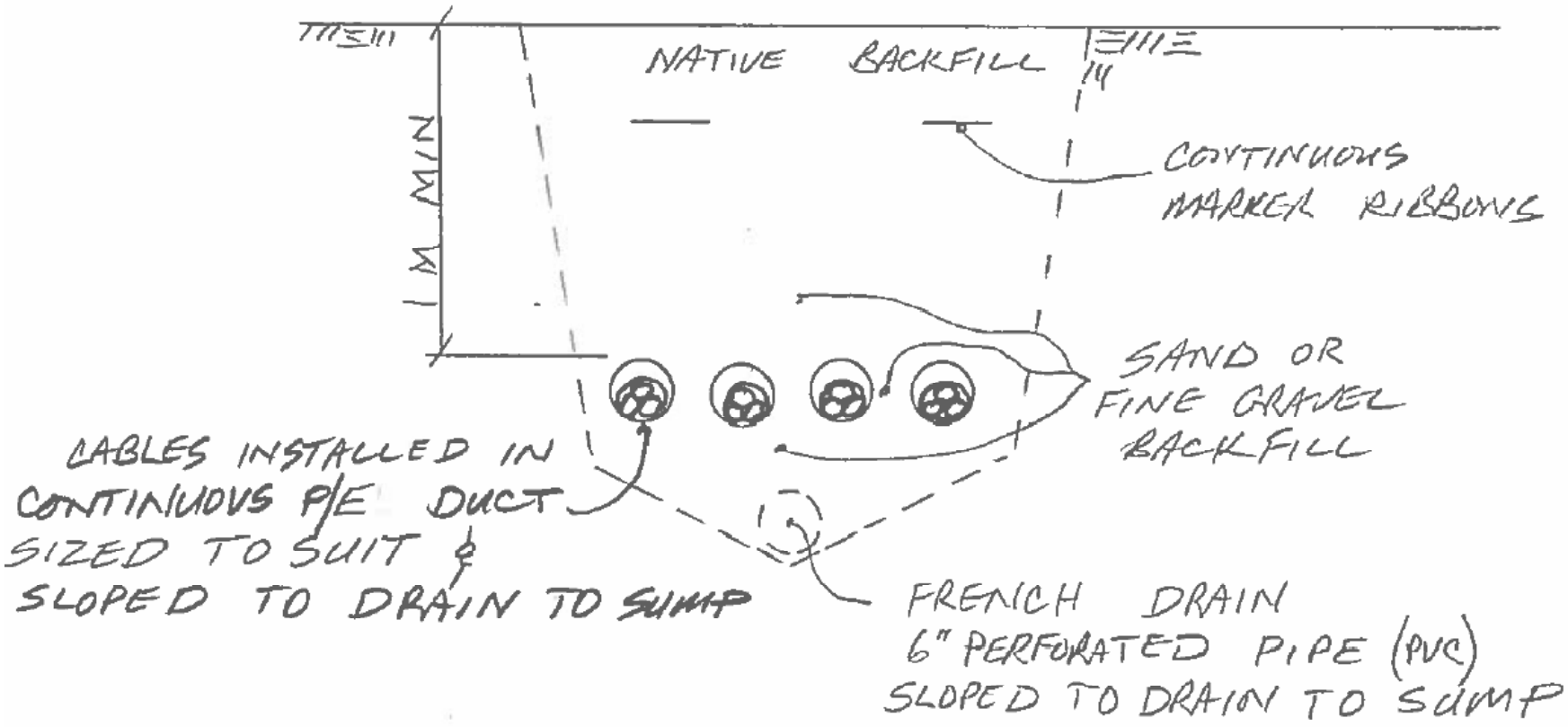


CABLES DIRECT BURIED IN SAND

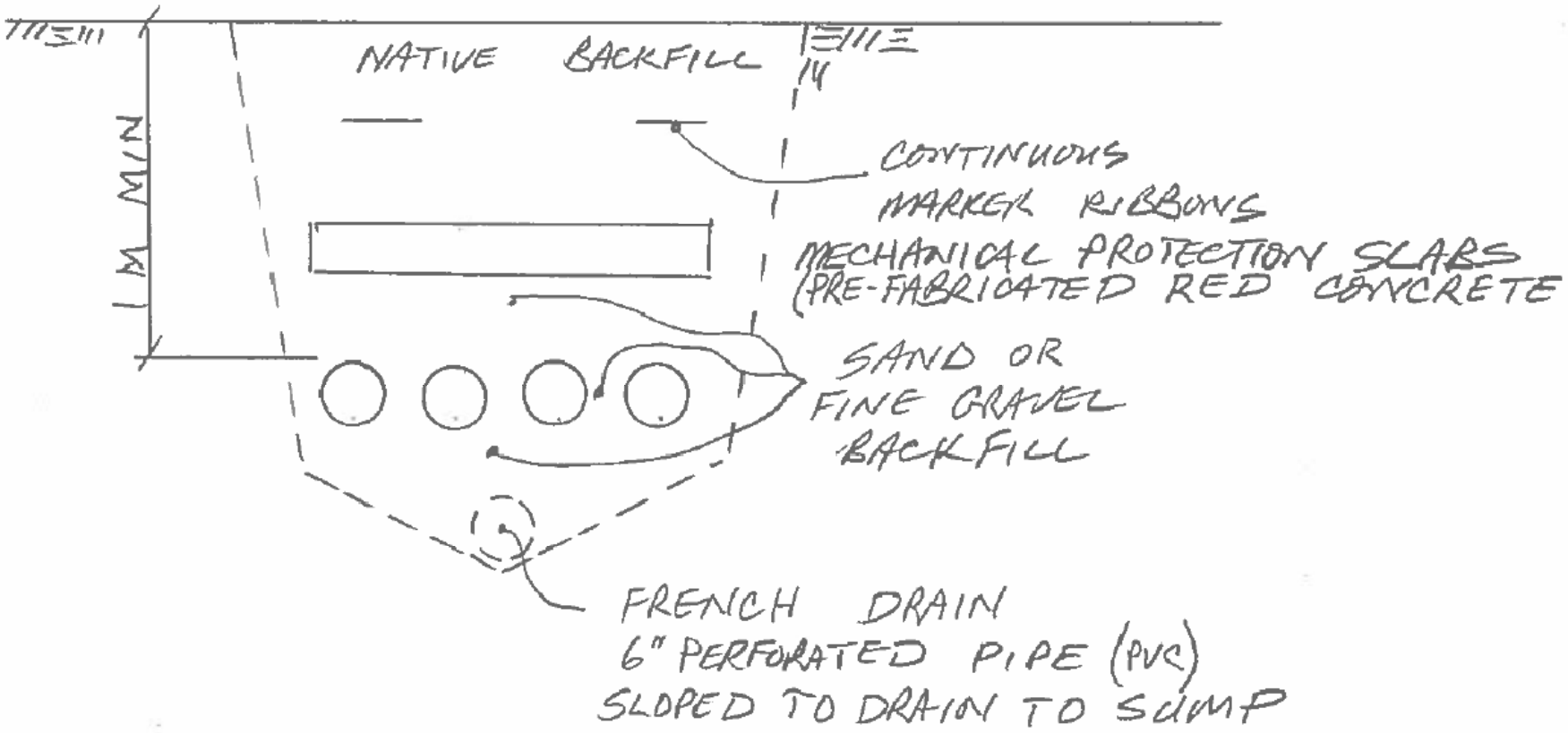
Underground Duct Banks



Underground Duct Banks



Underground Duct Banks



Underground Duct Banks