

**ENGINEERING GUIDELINE****HSG-GDL-16021000****Revision: 2****Effective Date: 09-JUN-2017****TITLE: GROUNDING MATERIALS AND DETAILS**

Revision	Date	By	Description of Change
	29-DEC-2020	A. Wardin	Updated to SSG template revision 2
2.0	09-JUN-2017	ELEC Team	Replaces global document
1.0	3-JUL-2013	ELECTRICAL EET	New document replacing obsolete document 0000-std-16021000 per Electrical EET/R.Savard. Materials list and part numbers updated

**1. SCOPE**

- 1.1. This document contains descriptions and details of grounding materials including material specifications for the most commonly used grounding items and typical details used in grounding installations, including the following:
- A. Ground rod and ground rod connector
  - B. Ground wire and connectors
  - C. Ground tab and bartap connector
  - D. Ground wire to pipe connectors
  - E. Ground plate connector
  - F. Temporary grounding clamps

**2. DISCUSSION**

- 2.1. This document is intended as a guide to promote the standardization of types of grounding materials selected for new installations. Each type of grounding material is given a number designation (1 to 11). To denote a particular specification (application) within each material type, the number is followed by a letter suffix. For example, grounding wire has the number designation "3", 2/0 bare stranded wire (used as a buried ground bus) has a designation of "3A".
- 2.2. Complete material specifications will not be included in other grounding documents unless the grounding item is unique to the particular application shown. Likewise, detailed material specifications should not be included on grounding drawings. Whenever possible the item designation, a brief description, and the appropriate document number should be the method utilized to describe an item of grounding material on other documents and on electrical drawings.
- 2.3. 2/0 stranded cable is the most commonly used. For exceptions see the NEC.
- 2.4. See tables 2.5-1, 2.5-2 & 2.5-3 for grounding material details

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TABLE 2.5-1 Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
1A	Ground Rod - Copper-clad	Earth Ground	3/4" dia. X 10' long	Harger	3410	N/A
	Ground Rod - Copper-clad	Earth Ground	3/4" dia. X 10' long	Eritech	613400	N/A
1B	Ground Rod - Copper-clad	Lightning Protection	3/4" dia. X 8' long	Harger / Eritech	348 / #613480	N/A
2A	Connector - Rod	Ground Rod to 2/0 stranded wire	3/4" dia Copper-clad Ground rod	Harger "Uni-shots"	G11-342/0	KIT
	Connector - Rod	Ground Rod to 2/0 stranded wire	3/4" dia Copper-clad Ground rod	Cadweld "One-Shot"	GR1-182G	KIT
2B	Connector - Rebar	Rebar to stranded wire	2/0 to 3/4" dia	Harger	RP6L2/0B	UWM90
	Connector - Rebar	# 6 Rebar to 2/0 stranded wire	2/0 to 3/4" dia	Cadweld	RRH-542G	#90
	Connector - Rebar	# 5 Rebar to 2/0 stranded wire	2/0 to 5/8" dia	Harger	RP52/0B	UWM90
	Connector - Rebar	# 5 Rebar to 2/0 stranded wire	2/0 to 5/8" dia	Cadweld	RRC-532G	#90
	Connector - Rebar	# 4 Rebar to 2/0 stranded wire	2/0 to 1/2" dia	Harger	RP42/0B	UWM90
	Connector - Rebar	# 4 Rebar to 2/0 stranded wire	2/0 to 1/2" dia	Cadweld	RRC-522G	#90
2C	Connector - Rod	Copper-clad Ground Rod to 2/0 "T"	2/0 to 3/4" dia	Harger	GO342/0B	UWM115
	Connector - Rod	Copper-clad Ground Rod to 2/0 "T"	2/0 to 3/4" dia	Cadweld "One-Shot"	GT1-182G	KIT
2D	Connector - Rod	Copper-clad Ground Rod to 4/0 stranded wire	4/0 to 3/4" dia	Harger	GD344/0B	UWM90
	Connector - Rod	Copper-clad Ground Rod to 4/0 stranded wire	4/0 to 3/4" dia	Cadweld "One-Shot"	GR1-182Q	KIT
2E	Connector	# 6 Rebar to 4/0 stranded wire	4/0 to 3/4" dia	Harger	RP6L4/0B	UWM115
	Connector	# 6 Rebar to 4/0 stranded wire	4/0 to 3/4" dia	Cadweld	RRH-542Q	#115
	Connector	# 6 Rebar to 4/0 stranded wire	4/0 to 5/8" dia	Harger	RP54/0B	UWM115
	Connector	# 5 Rebar to 4/0 stranded wire	4/0 to 5/8" dia Rebar	Cadweld	RRC-532Q	#115
	Connector	# 4 Rebar to 4/0 stranded wire	4/0 to 1/2" dia Rebar	Harger	RP44/0B	UWM115
	Connector	# 4 Rebar to 4/0 stranded wire	4/0 to 1/2" dia Rebar	Cadweld	RRC-522Q	#115

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TABLE 2.5-1 Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
2F	Connector - Rod	Ground rod to # 6 or 8 Solid wire	3/4" dia Copper-clad Ground rod	Harger "Uni-shots"	G11-348	N/A
	Connector - Rod	Ground rod to # 6 or 8 Solid wire	3/4" dia Copper-clad Ground rod	Cadweld "One-Shot"	GR1-181G	N/A
2G	Connector - Rod	Ground rod to 4/0 tee	4/0 to 3/4" Copper-clad Ground rod	Harger	GO344/0B	UWM115
	Connector - Rod	Ground rod to 4/0 tee	4/0 to 3/4" Copper-clad Ground rod	Cadweld	GTC-182Q	#115
3A	Bare Ground Wire	Buried Ground Conductor	2/0 Bare Stranded	Copper Wire	N/A	N/A
3B	Insulated Ground Wire	Exposed Ground Conductor	2/0 Insulated Stranded	XHHW or THW Copper Green	N/A	N/A
3C	Ground Wire	Bonding Jumper	Sized per NEC	XHHW or THW Copper Green	N/A	N/A
3D	Ground Wire	Bonding Jumper	#4 Welding Cable	Carol or equal	Weld 4 600v	N/A
3E	Ground Wire	Bonding Jumper for Scales	3/16"dia. Bare 7x19 stranded	Monel McMaster Carr	3453T54	N/A
3F	Ground Coil Cable and Clamp	Bonding Jumper	10' long with REB Clamp	S.R.Browne	RAC10	N/A
	Ground Coil Cable and Clamp	Bonding Jumper	20' long with GAT-P Clamp	S.R.Browne	RAC20	N/A
3G	4/0 Bare Ground Wire	Buried Ground Conductor	4/0 Bare Stranded	Copper wire	N/A	N/A
3H	4/0 Covered Ground Wire	Exposed Ground Conductor	4/0 Insulated Stranded	XHHW or THW	N/A	N/A
3J	500kcmil Bare Wire	Buried Ground Conductor	500 Bare Stranded	Copper Wire	N/A	N/A
3K	500kcmil Covered Wire	Exposed Ground Conductor	500 Insulated Stranded	XHHW or THW	N/A	N/A
4A	Ground Tab	Structural Steel	1/4"x2"x3" flat steel bar with 7/16" dia hole	N/A	N/A	N/A
5A	Bar Tap Connector	1/4" flat bar to 2/0	With 3/8" bolt	Burndy	QGFL26B1	N/A

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Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
5B	Bar Tap Connector	1/4" flat bar to 4/0	With 3/8" bolt	Burndy	QGFL29B1	N/A
5C	Bar Tap to Cable Connector	2/0 Cable to 1/4"bus bar	1/4"thick x 2" wide	Harger	BE141.52/0B	UWM90
	Bar Tap to Cable Connector	2/0 Cable to 1/4"bus bar	1/4"thick x 2" wide	Cadweld	LJC-EG2G	#90
6A	Ground Wire Connector	Splice	2/0 to 2/0	Harger	BS2/0B	UWM65
	Ground Wire Connector	Splice	2/0 to 2/0	Cadweld	SSC-2G	#65
	Ground Wire Connector	Heavy Duty Splice	2/0 to 2/0 splice	T&B Comp Lug	53510	N/A
6B	Ground Wire Connector	Tee	2/0 to 2/0	Harger	RT2/02/0B	UWM90
	Ground Wire Connector	Tee	2/0 to 2/0	Cadweld	TAC-2G2G	#90
	Ground Wire Connector	Heavy Duty Tee	2/0 to 2/0	Blackburn Comp Lug	53055	N/A
6C	Cable to Rail Connector	Cable to Rail	2/0	Harger	RMVR2/0-WEB-K	UWM90
	Cable to Rail Connector	Cable to Rail	2/0	Cadweld	STR-2G	#90F80
6D	Ground Wire Connector	Splice	4/0 to 4/0	Harger	BS4/0B	UWM90
	Ground Wire Connector	Splice	4/0 to 4/0	Cadweld	SSC-2Q	#90
6E	Ground Wire Connector	Parallel Through Connector	4/0 to 2/0	Harger	PT4/02/0B	UWM150
	Ground Wire Connector	Parallel Through Connector	4/0 to 2/0	Cadweld	PTC-2Q2G	#150
6F	Ground Wire Connector	Lapped	2/0 to 2/0	Harger	XO2/02/0Q	UWM200
	Ground Wire Connector	Lapped	2/0 to 2/0	Cadweld	XBM-2G2G	#200
6G	Ground Wire Connector	Splice	4/0 to 2/0	Harger	BS4/0B + ADPSLV4/0 sleeves	UWM90
	Ground Wire Connector	Splice	4/0 to 2/0	Cadweld	SSC-2Q + B-133-2Q sleeves	#90
6H	Ground Wire Connector	Tee	4/0 to 2/0	Harger	RT4/02/0B	UWM90
	Ground Wire Connector	Tee	4/0 to 2/0	Cadweld	TAC-2Q2G	#90
6I	Ground Wire Connector	Cross	4/0 to 2/0	Harger	XX4/02/0B	UWM150

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Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
	Ground Wire Connector	Cross	4/0 to 2/0	Cadweld	XAC-2Q2G	#150
6J	Ground Wire Connector	Lapped	4/0 to 2/0	Harger	XO4/02/0Q	UWM200
	Ground Wire Connector	Lapped	4/0 to 2/0	Cadweld	XBM-2Q2G	#200
6K	Ground Wire Connector	Cross	2/0 to 2/0	Harger	XX2/02/0B	UWM115
	Ground Wire Connector	Cross	2/0 to 2/0	Cadweld	XAC-2G2G	#115
6L	Ground Wire Connector	Tee	4/0 to 4/0	Harger	RT4/04/0B	UWM150
	Ground Wire Connector	Tee	4/0 to 4/0	Cadweld	TAC-2Q2Q	#150
6M	Cable to Rail Connector	Cable to Rail	4/0	Harger	RMVR4/0-WEB-K	UWM115R
	Cable to Rail Connector	Cable to Rail	4/0	Cadweld	STR-2Q	#115F80
6N	Ground Wire Connector	Cross	4/0 to 4/0	Harger	XX4/04/0B	UWM200
	Ground Wire Connector	Cross	4/0 to 4/0	Cadweld	XAC-2Q2Q	#200
6P	Ground Wire Connector	Lapped	4/0 to 4/0	Harger	XO4/04/0Q	UWM250
	Ground Wire Connector	Lapped	4/0 to 4/0	Cadweld	XBM-2Q2Q	#250
6Q	Ground Wire Connector	Horizontal Steel	2/0	Harger	HB2/0B	UWM90
	Ground Wire Connector	Horizontal Steel	2/0	Cadweld	HSC-2G	#90
6R	Ground Wire Connector	Heavy duty Comp Lug Splice. Used only with approval from the Owner	2/0 to 2/0	T&B	53510	N/A
6S	Ground Wire Connector	Heavy Duty Comp Lug "Tee". Used only with approval from the Owner	2/0 to 2/0	T&B	53055	N/A
7A	Ground Wire to One-Hole Lug	One-Hole Lug Used only with approval from the Owner	2/0 to 3/8" Bolt	Harger	LBJ2/0181B	UWM45
	Ground Wire to One-Hole Lug	One-Hole Lug Used only with approval from the Owner	2/0 to 3/8" Bolt	T&B	54110	N/A
	Ground Wire to One-Hole Lug	One-Hole Lug Used only with approval from the Owner	2/0 to 3/8" Bolt	Burndy	QA26-B	N/A

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TABLE 2.5-1 Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
	Ground Wire to One-Hole Lug	One-Hole Lug. Used only with approval from the Owner	2/0 to 1/2" Bolt	Cadweld# B-121-CE	GLC-CE2G	#45
7B	Ground Wire to One-Hole Lug	One-Hole Lug. Used only with approval from the Owner	#6 to 1/4" Bolt	T&B	54105	N/A
7C	Ground Wire to Two-Hole Lug	Two Hole Lug	4/0 to 1/4"x1"	Harger	LBJ4/03161B	UWM65
	Ground Wire to Two-Hole Lug	Two Hole Lug	4/0 to 1/4"x1"	Cadweld # B-122-DE	GLC-DE2Q	#65
7D	Ground Wire to 2-Hole Lug	Two Hole Lug Crimp connector	#6	Panduit	LCD6-10A-L	N/A
7E	Ground Wire to 2-Hole Lug	Two Hole Lug Crimp connector	#2/0	Panduit	LCD2/0-14B-X	N/A
7F	#2/0 Ground Wire to 2-Hole Lug	Two Hole Lug	4/0 to 3/8" bolt	Burndy	QA-28B	N/A
8A	Ground Plate Connector	Flush Concrete embedment		Harger	BS4/0B	UWM90
	Ground Plate Connector	Flush Concrete embedment Use TBM-15 tool with Code 66 Die	4-hole, 2/0 wire 3/8" stud 1"x1" centers	T&B	52090	N/A
	Ground Plate Connector	Flush Concrete embedment Use Die index 997	4-hole, 2/0 wire 1/2" stud on 1-3/4"x1-3/4" centers	Burndy	YGF29-2N or YGF29-4N	N/A
	Ground Plate Connector	Flush Concrete embedment	4-hole, 4/0 welding stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers	Cadweld B1642Q	SSC-2Q	#90
8B	Ground Plate Connector	Flush Concrete embedment	4-hole, 4/0 welding stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers with 2' #2/0 pigtail	Harger XGP3.25/3.254/0	XGPGDD2/0X24	N/A
	Ground Plate Connector	Flush Concrete embedment	4-hole, 4/0 welding stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers with 2' #2/0 pigtail	Cadweld B1642Q	B530D2G24	N/A

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TABLE 2.5-1 Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
8C	Ground Plate Connector	Flush Concrete embedment	4-hole, 4/0 welding stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers with 2' #4/0 pigtail	Harger XGP3.25/3.254/0	XGPGDD4/0X24	N/A
	Ground Plate Connector	Flush Concrete embedment	4-hole, 4/0 welding stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers with 2' #4/0 pigtail	Cadweld B1642Q	B530D2Q24	N/A
8D	Ground Plate Connector	Flush Concrete embedment	4-hole, 500kcmil weld stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers with 2' 500kcmil pigtail	Harger XGP3.25/3.255CM	XGPDE5CMX24	N/A
	Ground Plate Connector	Flush Concrete embedment	4-hole, 500kcmil weld stud 1/2"-13, 1/2" deep holes on 1-3/4"x1-3/4" centers with 2' 500kcmil pigtail	Cadweld B1643Q	B530E3Q24	N/A
9A	Temporary Grounding Clamp	Drum, Tank Truck, RR Sta		S.R.Browne	REB2960	N/A
9B	Temporary Grounding Clamp	Drum, Tank Truck, RR Sta		S.R.Browne	G-40-PM	N/A

TABLE 2.5-2 - Ground wire to Pipe Connector Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
10A	Copper cable to rod/pipe	Heavy duty cast bronze 1/2" to 1"	#4 to #4/0	Harger	CPC.5/.75	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 1/2" to 1"	#4 to #4/0	Burndy	GAR3902-BU	

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TABLE 2.5-2 - Ground wire to Pipe Connector Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 1/2" to 1"	#4 to #4/0	T&B	3902BU	
10B	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 1-1/4" to 2"	#4 to #4/0	Harger	CPC1.5/2	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 1-1/4" to 2"	#4 to #4/0	Burndy	GAR3903-BU	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 1-1/4" to 2"	#4 to #4/0	T&B	3903BU	
10C	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 2-1/2" to 3-1/2"	#4 to #4/0	Harger	CPC2.5/3	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 2-1/2" to 3-1/2"	#4 to #4/0	Burndy	GAR3904-BU	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 2-1/2" to 3-1/2"	#4 to #4/0	T&B	3904BU	
10D	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 4" to 5" IPS	#4 to #4/0	Harger	CPC3.5/4 or CPC5/6	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 4" to 5" IPS	#4 to #4/0	Burndy	GAR3905-BU	
10E	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 6" IPS	#4 to #4/0	Harger	CPC5/6	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 6" IPS	#4 to #4/0	Burndy	GAR3906-BU	
10F	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 8" IPS	#4 to #4/0	Harger	UPC8C	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 8" IPS	#4 to #4/0	Burndy	GAR3907-BU	
10G	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 10" IPS	#4 to #4/0	Harger	UPC10C	
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 10" IPS	#4 to #4/0	Burndy	GAR3908-BU	
10H	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 12" IPS	#4 to #4/0	Harger	UPC12C	



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TABLE 2.5-2 - Ground wire to Pipe Connector Grounding Materials

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
	Heavy duty cast bronze Copper cable to rod/pipe	Heavy duty cast bronze 12" IPS	#4 to #4/0	Burndy	GAR3909-BU	
11A	"U-bolt" Type Copper cable to rod/pipe	Heavy duty 2-1/2"	#8Sol to #4Str	Harger	CPC2.5/3	
	Heavy duty "U-bolt" Type Copper cable to rod/pipe	Heavy duty 2-1/2"	#8Sol to #4Str	Burndy	GAR194C	
11B	Heavy duty "U-bolt" Type Copper cable to rod/pipe	Heavy duty 3"	#8Sol to #4Str	Harger	CPC2.5/3	
	Heavy duty "U-bolt" Type Copper cable to rod/pipe	Heavy duty 3"	#8Sol to #4Str	Burndy	GAR204C	

TABLE 2.5-3 - Grounding Busbars

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
12A	Copper Busbar (pre-drilled holes)	PBB: Tin plated Ground Bar	1/4"thick x 4"W x 24"L: BISCI Hole Pattern: 28 – 1/4" @ 5/8" Spacing 10 – 3/8" @ 1" Spacing	Harger	TGBI14424TMGB	
	Copper Busbar (pre-drilled holes)	PBB: Tin plated Ground Bar	1/4"thick x 4"W x 24"L: BISCI Hole Pattern: 28 – 1/4" @ 5/8" Spacing 10 – 3/8" @ 1" Spacing	Panduit	GB4B0632TPI-1	

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12B	Copper Busbar (pre-drilled holes)	SBB: Tin plated Ground Bar	1/4"thick x 2"W x 20"L: BISCI Hole Pattern: 12 – 1/4" @ 5/8" Spacing 3 – 3/8" @ 1" Spacing	Harger	TGBI14420TMGB	
	Copper Busbar (pre-drilled holes)	SBB: Tin plated Ground Bar	1/4"thick x 2"W x 20"L: BISCI Hole Pattern: 12 – 1/4" @ 5/8" Spacing 3 – 3/8" @ 1" Spacing	Panduit	GB2B0312TPI-1	
12C	Copper Busbar (pre-drilled holes)	EGB: Tin plated Ground Bar	1/4"thick x 4"W x 24"L: NEMA Hole Pattern: 16 – 1/2" @ 1-3/4" Spacing 16 – 5/16" @ 5/8" Spacing	Harger	TGBI14424HSC	
	Copper Busbar (pre-drilled holes)	EGB: Tin plated Ground Bar	1/4"thick x 4"W x 24"L: NEMA Hole Pattern 16 – 1/2" @ 1-3/4" Spacing 16 – 5/16" @ 5/8" Spacing	Panduit	GB4N0016TPI-1	

TABLE 2.5-4 – ESD Floor

Item	Description	Application	Size	Mfg or Type	Cat #	Weld Metal
13A	ESD Flooring Ground Strap	Ground Snap to Building Steel	3' L	Z-MAR	30202	
13B	ESD Flooring Ground Snap (Button)	Imbedded in Conductive Coated Floor		Z-MAR	30215	
14A	Inspection well	Grounding electrode system test point	13 3/4" wide X 23 1/4" long X 18" deep	Eritech	T416A	N/A
	Inspection well	Grounding electrode system test point	13" wide X 24" long X 18" deep	Harger	GAW132418HD	N/A

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<b>Term</b>	<b>Definition</b>
TMGB	Telecommunications Main Ground Bus
TGB	Telecommunications Grounding Busbar
EGB	Electrical Ground Bus

**4.     RELATED SSG DOCUMENTS**

<b>SSG Document No.</b>	<b>SSG Title</b>
None	

**5.     REFERENCES**

<b>Document No.</b>	<b>Title</b>
None	

**6.     APPENDICES / ATTACHMENTS****6.1.     Appendices**

<b>Document No.</b>	<b>Title</b>
None	

**6.2.     Attachments**

<b>Document No.</b>	<b>Title</b>
16.021.000.001	Grounding Materials and Details
16.021.000.002	Grounding Materials and Details
16.021.000.003	Grounding Materials and Details

\* \* \* END OF SECTION \* \* \*