

GP 16-04-01	Grounding and Overvoltage Protection	January 2002
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Grounding and Overvoltage Protection

GP 16-04-01

Scope

- 1) [I] This Global Practice (GP) covers bonding, grounding, overvoltage protection, and lightning protection facilities for electrical power systems and equipment, structures and buildings, and product loading stations.
 - 2) [I] This GP does not cover process instrumentation or cathodic protection systems. However, overall grounding system design shall include requirements specified in other practices, e.g., instrumentation. Contractor shall submit overall grounding design to the Owner's Engineer for approval.
 - 3) [I] An asterisk (*) indicates that additional information is required. If a job is contracted, this additional information is furnished in the Job Specification.
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1. Required References

[I] This Section lists Standards that are generically referenced and assumed to be a part of this document. Unless otherwise specified herein, use the latest edition. Equivalent regional or national standards may be used when approved by the Owner's Engineer.

1.1. API–American Petroleum Institute

API RP 540	Electrical Installations in Petroleum Processing Plants
API RP 2003	Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents

1.2. IEEE–Institute of Electrical and Electronics Engineers

IEEE 80	Guide for Safety in AC Substation Grounding
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems IEEE Green Book (ANSI/IEEE)
IEEE 837	IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

1.3. NFPA–National Fire Protection Association

NFPA 70	National Electrical Code
NFPA 780	Standard for the Installation of Lightning Protection Systems

2. Definitions

Term	[I] Description
Acceptable and Preferred Practices	* Where this GP lists more than one type of equipment or method as acceptable, Contractor shall make the selection based on the installed cost. Where one particular type of equipment or method is listed as preferred, it shall be selected, provided: (1) it is lower or equivalent in installed cost than other acceptable types or methods, (2) it has reduced maintenance and operating costs that provide sufficient cost benefit to offset an initial added investment. Owner's Engineer shall approve alternative choices.

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Term	[I] Description
Bonding	Two or more objects are considered to be bonded if connected together through a conducting path. Objects that are not inherently in contact with each other through a conducting path may be bonded by connecting them together with a bonding conductor. The conductor shall be sized to safely conduct the current or dissipate the charge likely to be imposed.
Ground Return Path	A metallic connection between the metal enclosure of electrical equipment and the system neutral ground of the power supply to the equipment. If the systems neutral is grounded through impedance, the ground return path must connect on the ground side of the impedance. The path is a low-impedance path from the equipment enclosure to the neutral ground. It serves as the equipment grounding conductor in grounded neutral systems.
Grounding	An object is considered to be grounded when connected by a conducting connection either inherently or by a grounding conductor to the earth, or to some conducting body that serves in place of the earth, such as where rock or high resistivity soil is present.
Grounding Electrode System	Grounds are the Grounding Electrode System. The electrodes may be buried grounding conductors, underground metallic water piping, large underground metallic objects in intimate contact with earth such as metallic building frames, pile casings, or concrete encased electrodes consisting of reinforcing bars or copper conductors in underground foundations or footings, and driven rods.
Lightning Arrester (Surge Arrester)	A protective device for limiting surge voltages on equipment by discharging or bypassing surge current. It prevents continued flow of follow current to ground, and is capable of repeating these functions. Use of arcing horns and/or rod gaps is not an acceptable method of suppressing electrical surges
Liquids Classified as Static Electrical Charge Accumulators	Liquids are Classified as Static Electrical Charge Accumulators if their conductivity is 50 picomhos/meter (50 pS/m) or less. Distilled petroleum products, including petroleum solvents, are generally accumulators. Crude oil, residual fuel oil, asphalts (both penetration or cutback), Bunker C, residual products with Conradson carbon above 1 percent and water soluble products, such as alcohol have high conductivity and are classified as non-accumulators.
Switch Loading	Loading a high flash product into a tank truck, tank car, or container previously containing a low flash product, without cleaning or gas-freeing the tank or container. The high flash product must be treated as low flash during loading in such cases

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Term	[I] Description
Zone of Lightning Protection	Space adjacent to a lightning protection system that is substantially immune to direct lightning flashes. NFPA 780 Chapter 3, "Protection for Ordinary Structures," and Chapter 6, "Protection for Structures Containing Flammable Vapors, Flammable Gases or Liquids That Can Give Off Flammable Vapors," cover the cone and rolling sphere concepts for determining the zone extent. Specific regional or national standards, while using the same concepts, may have requirements that result in different extents of the zone of protection.

3. Bonding and Grounding Materials and Methods

- 1) [S] Bonding shall be provided where necessary to insure the electrical continuity of grounding circuits and where necessary to provide a path for the dissipation of static charges.
- 2) [S] Bonds provided for the dissipation of static charges shall have a resistance of one megohm or less.

3.1. Bonding and Grounding Conductors

- 1) * [R] Unless otherwise specified, bonding and grounding conductors shall be bare stranded medium-hard-drawn copper. Where the size is not specified elsewhere in this practice, minimum sizes shall be 2 AWG (35 mm²) for underground conductors and 6 AWG (16 mm²) for aboveground conductors. Conductor sizes shall be increased above the minimum sizes if required to:
 - a) Insure adequate mechanical strength.
 - b) Withstand the thermal stresses of ground fault currents.
 - c) Hydrocarbon, steam, or other process lines shall not be used for grounding purposes.
- 2) * [R] Ground return conductors located within cable assemblies, or run with or enclosing individual circuit conductors, are preferred. When specified, common ground return conductors run with underground conduits or buried cable are acceptable.
- 3) [I] Ground return conductors located within cable assemblies may be uninsulated and shall be of the same material and stranding as the cable line conductors. If insulated, color coding shall comply with requirements of the applicable regulations.
- 4) [R] Grounding conductor burial depths shall be at least 18 in. (450 mm). Burial depths in switch or transformer yards graded with stone shall be at least 12 in. (300 mm) below the stone.
- 5) [R] If the wiring method is buried cable, common grounding conductors run with the buried cable shall be laid in the cable trenches as far as routing permits.
- 6) [R] If the wiring method is underground conduit, common grounding conductors run with the conduits shall be laid along a formed side of the duct banks.
- 7) [I] Insulated copper conductors shall be provided in:
 - a) Corrosive environments (H₂S, acids, caustics, etc.)
 - b) Highly corrosive soil conditions

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