220 CMR 126.00: UNDERGROUND ELECTRIC SUPPLY AND COMMUNICATION LINES 50,000 VOLTS AND BELOW

Section

126.01: Definitions

The following definitions are for use with the Massachusetts Department of Public Utilities Code for Underground Electric Supply and Communication Lines. For other use and for definitions not contained in 220 CMR 126.01; see Definitions of Electrical Terms (ANSIC-42. 100-1972).

Appliance. Current-conducting; energy-consuming equipment, fixed or portable; for example, heating, cooking, and small motor-operated equipment.

Automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence -- as, for example; a change in current strength; not manual, without personal intervention. Remote control that requires personal intervention is not automatic, but manual.

Backfill (When Used as a Noun). Materials such as sand, crushed stone, soil, etc., that are placed to fill an excavation.

Ballast Section (Railroads). The section of material, generally trap rock, which provides support under railroad tracks.

Bonding. The electrical interconnection of conductive parts, e.g., cable sheaths, armors or enclosures, designed to maintain a common electrical potential.

Cable. A conductor with insulation, a stranded conductor with or without insulation and other coverings (single-conductor cable) or a combination of conductors insulated from one another (multiple-conductor cable).

Cable Sheath. A conductive protective covering applied to cables.

Note: A cable sheath may consist of multiple layers of which one or more is conductive.

Cable Terminal (Termination). A device which provides insulated egress for the conductors.

Circuit. A conductor or system of conductors through which an electric current is intended to flow.

Communication Lines. The conductors and their supporting or containing structures which are used for public or private signal or communication service, and which Operate at potentials not exceeding 400 volts to ground or 750 volts between any two points of the circuit, and the transmitted power of which does not exceed 150 watts. When operating at less than 150 volts no limit is placed on the capacity of the system. Under specified conditions, communication cables include communications circuits not complying with the preceding limitations where such circuits are also used to supply power incidentally to communications equipment.

Note: Telephone, telegraph, railroad-signal, data, clock, fire, police-alarm, community television antenna and other systems conforming with the above are included. Lines used for signaling purposes, but not included under the above definition, are considered as supply lines of the same voltage and are to be so run.

126.01: continued

Conductor. A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current.

Conductor Shielding. An envelope which encloses the conductor of a cable and provides an equipotential surface in contact with the cable insulation.

Conduit. A structure containing one or more ducts.

Note: Conduit may be designated as iron pipe conduit, tile conduit, etc. If it contains one duct only, it is called "single-duct conduit"; if it contains more than one duct it is called "multiple-duct conduit", usually with the number of ducts as a prefix, viz., two-duct multiple conduit.

Conduit System. Any combination of duct, conduit, conduits, manholes, handholes and vaults joined to form an integrated whole.

Current-carrying Part. A conducting part intended to be connected in an electric circuit to a source of voltage. Non-current-carrying parts are those not intended to be so connected.

De-energized (Dead). Free from any electrical connection to a source of potential difference and from electrical charges: not having a potential different from that of the earth.

Note: The term is used only with reference to current-carrying parts which are sometimes energized (alive or live).

Department. The Department of Public Utilities.

Duct. A single enclosed raceway for conductors or cable.

Enclosed. Surrounded by a case, cage or fence, which will protect the contained equipment and prevent accidental contact of a person with live parts.

Energized (Alive or Live). Electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of the earth in the vicinity. The term "live" is sometimes used in place of the term "current-carrying", where the intent is clear, to avoid repetition of the longer term.

Equipment. A general term which includes fittings, devices, appliances, fixtures, apparatus, and the like used as part of, or in connection with, a supply or communications installation.

Electric Supply Equipment (Supply Equipment). Equipment which produces, modifies, regulates, controls, or safeguards a supply of electric energy.

Electric Supply Lines (Supply Lines). Those conductors used to transmit electric energy and their necessary supporting or containing structures. Signal lines of more than 400 volts wire to wire are always supply lines within the meaning of the rules, and those of less than 400 volts wire to wire may be considered as supply lines, if so run and operated throughout.

Exposed. Not isolated or guarded.

Fire-proofing (of Cables). The application of a fire-resistant covering.

Grounded. Connected to or in contact with earth or connected to some extended conducting body which serves instead of the earth.

Grounded Effectively (Effectively Grounded). Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the building up of voltages which may result in undue hazard to connected equipment or to persons.

126.01: continued

Grounded System. A system of conductors in which at least one conductor or point is intentionally grounded, either solidly or through a current-limiting device (not a current-interrupting device).

Grounding Conductor. A conductor which is used to connect the equipment or the wiring system with a grounding electrode or electrodes.

Guarded. Covered, fenced, enclosed, or otherwise protected by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed 'to prevent dangerous approach or contact by persons or objects. Note: Wires which are insulated but not otherwise protected are not considered as guarded.

Handhole. An opening in an underground system containing cable and/or equipment into which workmen reach but do not enter.

Insulated. Separated from other conducting surfaces by a dielectric substance (including air space) offering a high resistance to the passage of current.

> Note: When any object is said to be insulated, it is understood to be insulated in a suitable manner for the conditions to which it is subjected. Otherwise, it is, within the purpose of 220 CMR 126.00, uninsulated. Insulating covering of conductors is one means of making, the conductor insulated.

Insulation (as Applied to Cable). That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground.

Insulation Shielding. An envelope which encloses insulation of a cable and provides an equipotential surface in contact with the cable insulation.

Isolated (as Applied to Objects). Not readily accessible to persons unless special means of access are used.

Jacket. A protective covering over the insulation, core, or sheath of a cable.

Joint Use. Simultaneous use by two or more kinds of utilities.

Manhole. A subsurface enclosure which personnel may enter and which is used for the purpose of installing, operating, and maintaining submersible equipment and/or cable.

Manhole Cover. A removable lid which closes the opening to a manhole or similar subsurface enclosure.

Manhole Grating. A grid which provides ventilation and a protective cover for a manhole opening.

Manual. Capable of being operated by personal intervention.

Padmounted. A method of supporting equipment, generally at ground level.

126.01: continued

Pulling Iron. An anchor secured in the wall, ceiling or floor of a manhole or vault to attach rigging used to pull cable.

Pulling Tension. The longitudinal force exerted on a cable during installation.

Qualified. Being familiar with the installation, construction or operation of the apparatus and the hazards involved.

Random Separation. Installed with no deliberate separation.

Remotely Operable (as Applied to Equipment). Capable of being operated from a position external to the structure in which it is installed or from a protected position within the structure.

Roadway. The portion of a highway including shoulders for vehicular use. A divided highway has two or more roadways.

Shoulder. The portion of the roadway contiguous with the travelled way for accommodation of stopped vehicles for emergency use, and for lateral support of base and surface courses.

Side-wall Pressure. The crushing force exerted on a cable during installation.

Switch. A device for opening and closing or for changing the connection of a circuit. In 220 CMR 126.00, a switch is understood to be manually operable, unless otherwise stated.

Susceptiveness. The characteristics of a communications circuit, including its connected apparatus, which determine the extent to which it is adversely affected by inductive fields.

Vault. An enclosure above or below ground which personnel may enter and is used for the purpose of installing, operating, and/or maintaining equipment and/or cable which need not be of a submersible design.

Voltage. The effective (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values.

The nominal voltage of a system or circuit is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. The operating voltage of the system may vary above or below this value.

Voltage of a Circuit Not Effectively Grounded. The highest nominal voltage between any two conductors. If one circuit is directly connected to and supplied from another circuit of higher voltage (as in the case of an autotransformer), both are considered as of the higher voltage, unless the circuit of lower voltage is effectively grounded, in which case its voltage is not determined by the circuit of higher voltage. Direct connection implies electric connection as distinguished from connection merely through electromagnetic or electrostatic induction.

Voltage of a Constant Current Circuit. The highest normal full load voltage of the circuit.

Voltage of an Effectively Grounded Circuit. The highest nominal voltage between any conductor and ground unless otherwise indicated.

126.30: Purpose, Scope and Application of 220 CMR 126.00

(1) Purpose of 220 CMR 126.00. The purpose of 220 CMR 126.00 is the practical safeguarding of persons from hazards arising from the installation, operation and maintenance of underground or buried supply and communications lines, and associated equipment. It contains basic provisions considered necessary for safety. It is not intended as a design specification or an instruction manual. Construction should be made in accordance with accepted practice for the given local conditions in all particulars not specified in 220 CMR 126.00.

(2) Scope of 220 CMR 126.00. 220 CMR 126.00 covers underground supply and underground communications conductors, 50 KV and below -- phase to phase, owned and/or operated by systems under the jurisdiction of the Department. (This includes such systems owned and/or operated by electric companies and municipal electric departments, as defined in M.G.L. c. 164; telephone companies, telegraph companies and railroads. It does not include CATV systems, or systems owned and operated exclusively by municipal police or fire departments.)

(3) Application of 220 CMR 126.00.

(a) New Installations, Reconstructions and Extensions. 220 CMR 126.00 shall apply to all new installations, reconstructions and extension made following October 3, 2008, except that they may be waived or modified by the Department when shown to be impractical. In such cases, equivalent or greater safety shall be secured in other ways, including special working methods. Methods of construction and installation other than those specified in 220 CMR 126.00 may be used experimentally to obtain information if done where proper supervision is administered.
(b) Existing Installations. 220 CMR 126.00 do not apply to existing installations except as may be required for safety reasons by the Department.
(c) Waiver.

1. It will sometimes be necessary to modify or waive certain rules in cases of temporary installations or installations which are soon to be discarded or reconstructed.
2. In cases of emergency, the person responsible for the installation may decide as to modification or waiver of any rule, but shall promptly notify all parties directly concerned. This action shall be submitted to the Department for review.
3. Pending the decision of the Department; the person responsible for the installation may decide as to modification or waiver of any rule.
4. It is not intended that 220 CMR 126.00 shall supersede rules of others having jurisdiction in specific areas.

(4) Requirements. 220 CMR 126.00 state the safety requirements for the installation and maintenance of underground electric supply and communication lines. To meet service or operational criteria it may be necessary to exceed these requirements or to provide other design and construction features. Safety requirements shall not be neglected in so doing.

(5) Not Complete Specifications. 220 CMR 126.00 is not complete specifications, but is intended to embody the requirements which are most important from the standpoint of safety. Rules in 220 CMR 126.00 which are to be regarded as mandatory are characterized by the use of the word "shall". Where a rule is of an advisory nature, it is indicated by the use of the word "should".

(6) Interpretations. Interpretations are intended to clarify the intent of specific rules and are not intended to supply consulting information on the application of the code. Requests for interpretation may be addressed to the Department. After due consideration by the Department, the inquirer will be notified of its decision in writing.

126.31: General Requirements Applying to Underground Lines

(1) Design and Construction. All electric supply and communication lines and equipment shall be of suitable design and construction for the service and conditions under which they are to be operated.

126.31: continued

(2) Installation and Maintenance.

(a) All electric supply and communication lines and equipment shall be installed in a manner that will promote the purpose of 220 CMR 126.00 and shall be maintained in such a manner as to preserve the safety of the installation.
(b) Persons responsible for underground facilities shall be in a position to indicate the location of their facilities.
(c) Reasonable advance notice should be given to owners or operators of other proximate facilities which may be adversely affected by new construction or changes in existing facilities.

(3) Accessibility. All parts which must be examined or adjusted during operation shall be arranged so as to be readily accessible to authorized persons by the provision of adequate working spaces, working facilities, and clearances.

(4) Inspection and Tests of Lines and Equipment.

(a) When in Service.

1. Initial Compliance with 220 CMR 126.00. Lines and equipment shall comply with this safety code upon being placed in service.
2. Inspection. Accessible lines and equipment shall be inspected from time to time by the responsible party at such intervals as experience has shown to be necessary.
3. Tests. When considered necessary, lines and equipment shall be subjected to practical tests to determine required maintenance.
4. Record of Defects. Any defects affecting compliance with this code revealed by inspection, if not promptly corrected, shall be recorded; such record shall be maintained until the defects are corrected.
5. Remedying Defects. Lines and equipment found to be defective so as to endanger life or property shall be promptly repaired, permanently disconnected or isolated until repairs can be made.

(b) When Out of Service.

1. Lines Infrequently Used. Lines and equipment infrequently used shall be inspected or tested as necessary to see that they are in safe condition prior to being placed in service.
2. Lines Temporarily Out of Service. Lines temporarily out of service shall be maintained in a safe condition.
3. Line Abandoned. Lines abandoned shall be removed or abandoned in a manner which will not be hazardous to workmen or to the public.

(5) Grounding of Circuits and Equipment.

(a) Methods. The methods to be used for grounding of circuits and equipment are given in Section 9 of the 2007 National Electrical Safety Code.

(b) Conductive Parts to Be Grounded. Cable sheaths and shields, equipment frames and cases (including padmounted devices) and metal lamp posts shall be effectively grounded. Ducts and riser guards of conductive material which are exposed to possible contact with conductors of more than 300 volts to ground shall be effectively grounded.

Exception 1. 220 CMR 126.31(5) does not apply to parts which are eight feet or more above readily accessible surfaces or are otherwise isolated or guarded.
Exception 2. 220 CMR 126.31(5) does not apply to ducts and riser guards which contain cables having effectively grounded sheaths or shields in contact with the duct or guard.

(c) Use of Earth as Part of Circuit. Supply circuits shall not be designed to use the earth normally as the sole conductor for any part of the circuit.

(6) Communications Protective Requirements.

(a) Where Required. Where communications apparatus is handled by other than qualified persons, it shall be protected by one or more of the means listed in 220 CMR 126.31(5)(b) if such apparatus is permanently connected to lines subject to any of the following:

126.31: continued

1. Lightning.
2. Possible contact with supply conductors whose voltage exceeds 300 volts.
3. Transient rise in ground potential exceeding 300 volts.
4. Steady state induced voltage exceeding 50 volts to ground.

(b) Means of Protection. Where communications apparatus is required to be protected under 220 CMR 126.31, protective means adequate to withstand the voltage expected to be impressed shall be provided by insulation protected where necessary by arresters. Severe conditions may require the use of additional devices such as auxiliary arresters, drainage coils, neutralizing transformers or isolating devices.

(c) In Vicinity of Supply Stations. Before communications cables are placed in the vicinity of supply stations where large ground currents may flow, the effect of these currents on the communications circuits shall be evaluated.

(7) Induced Hazards. Rules covering electrical influence and susceptiveness have not been detailed in 220 CMR 126.00. Induced hazards from proximate facilities shall be eliminated. Cooperative procedures are recommended.

126.32: Underground Conduit Systems

Note: While it is often the practice to use "duct" and "conduit" interchangeably, "duct," as used in 220 CMR 126.32, is a single enclosed raceway for conductors or cable; "conduit" is a structure containing one or more ducts; and "conduit system" is the combination of conduit, conduits, manholes, handholes, and/or vaults joined to form an integrated whole.

(1) Location.

(a) Routing -- General.

1. Conduit systems should be located so as to be subject to the least disturbance 410 practical. Conduit systems extending parallel to other subsurface structures should not be located directly over or under other subsurface structures., If this is not practical, the rules on "Clearances" (see 220 CMR 126.32(1)(g)) should be followed.
2. Conduit alignment should be such that there are no protrusions which would be harmful to the cable.
3. When bends are required, the minimum radius shall be sufficiently large to prevent damage to cable being installed in the conduit.

(b) Routing -- Natural Hazards. Routes through unstable soils such as mud, shifting soil, etc., or through highly corrosive soils, should be avoided. If construction is required in these soils, the conduit should be constructed in such a manner as to minimize movement and/or corrosion.

(c) Routing -- Highways and Streets. When conduit must be installed longitudinally under the roadway, it should be installed in the shoulder or within the limits of one lane of traffic if practical.,

(d) Routing -- Bridges and Tunnels. The conduit system shall be located so as to minimize the possibility of damage by traffic. It should be located to provide safe access for inspection or maintenance of both the structure and the conduit system.

(e) Routing -- Crossing Railroad Tracks.

1. The top of a conduit system should be located not less than 36 inches below the top of the rails of a street railway or 60 inches below the top of the rails of a railroad. Where unusual conditions exist or where proposed construction would interfere with existing installations, a greater depth than specified above may be required.

Exception: Where this is impractical, or for further other reasons, this clearance may be reduced by agreement between the parties concerned and the Department. In no case, however, shall the top of the conduit or any conduit protection extend higher than the bottom of the ballast section which is subject to working or cleaning.

126.32: continued

2. All crossing under railroads, manholes, handholes, and vaults should not, where practical, be located in the road bed.

(f) Routing -- Submarine Crossings. Submarine crossings should be routed and/or installed so they will be protected from erosion by tidal action or currents. They should not be located where ships normally anchor.

(g) Clearances from Other Underground Installations.

1. General. The clearance between a conduit system and other underground structures paralleling it should be as large as necessary to permit maintenance of the system without damage to the paralleling structures. A conduit which crosses over another subsurface structure shall have a minimum clearance sufficient to prevent damage to either structure. These clearances should be determined by the parties involved.

Exceptions: When conduit crosses a manhole, vault or subway tunnel roof, it may be supported directly on the roof with the concurrence of all parties involved.

2. Separations Between Supply and Communication Conduit Systems. Conduit systems to be occupied by communication conductors shall be separated from conduit systems for supply conductors by: three inches of concrete, or four inches of masonry, or 12 inches of well-tamped earth.

Exception: Lesser separations may be used where the parties concerned concur.

3. Sewers. Sanitary and Storm. If conditions require a conduit to be installed parallel to and directly over a sanitary or storm sewer, it may be done provided both parties are in agreement as to the method. Where a conduit run crosses a sewer it shall be designed to have suitable support on each side of the sewer to prevent transferring any direct load onto the sewer.

4. Water Lines. Conduit should be installed as far as is practical from a water main in order to protect it from being undermined if the main breaks. Conduit which crosses over a water main shall be designed to have suitable support on each side as required to prevent transferring any direct loads onto the main.

5. Fuel Lines. Conduit shall have sufficient clearance from fuel lines to permit the use of pipe maintenance equipment. Conduit and fuel lines shall not enter the same manhole.

6. Steam Lines. Conduit should be so installed as to prevent detrimental heat transfer between the steam and conduit systems.

(2) Excavation and Backfill.

(a) Trench. The bottom of the trench should be undisturbed, tamped, or relatively smooth earth. Where the excavation is in rock, the conduit should be laid on a protective layer of clean tamped backfill.

(b) Quality of Backfill. All backfill should be free of materials that may damage the conduit system.

Recommendation: Backfill within six inches of the conduit should be free of solid material greater than four inches in maximum dimension or with sharp edges likely to damage it. The balance of backfill should be free of solid material greater than eight inches in maximum dimension. Backfill material should be adequately compacted.

(3) Ducts and Joints.

(a) General.

1. Duct material shall be corrosion-resistant and suitable for the intended environment.

2. Duct material and/or the construction of the conduit shall be designed so that a cable fault in one duct would not damage the conduit to such an extent that it would cause damage to cables in adjacent ducts.

3. The conduit system shall be designed to withstand external forces to which it may be subjected by the surface loadings set forth in 220 CMR 126.32(4) except that impact loading may be reduced 1/3 for each foot of cover, so no impact loading need be considered when cover is three feet or more.

4. The internal finish of the duct shall be free of sharp edges or burrs which could damage supply cable.

126.32: continued

(b) Installation.

1. Restraint. Conduit, including terminations and bends, should be suitably restrained by backfill, concrete envelope, anchors or other means to maintain its design position under stress of installation procedures, cable pulling operations and other conditions such as settling and hydraulic or frost uplift.

2. Joints. Ducts shall be joined in a manner sufficient to prevent solid matter from entering the conduit line. Joints shall form a sufficiently continuous smooth interior surface between joining duct sections so that supply cable will not be damaged when pulled past the joint.

3. Externally Coated Pipe. When conditions are such that externally coated pipe is required, the coating shall be corrosion-resistant and should be inspected and/or tested to see that it is continuous and intact prior to backfill. Precautions shall be taken to prevent damage to the coating when backfilling.

4. Building Walls. Conduit installed through a building wall shall have a seal (or seals) intended to prevent the entrance of gas or water into the building insofar as practical. The use of seals may be supplemented by gas venting devices in order to minimize building up of positive gas pressures in the conduit.

5. Bridges. Conduit installed in bridges shall include the capability to allow for expansion and contraction of the bridge.

Conduits passing through a bridge abutment should be installed so as to avoid or resist any shear due to soil settlement;

Conduit of Conductive material installed on bridges shall be effectively grounded.

6. In Vicinity of Manholes. Conduit shall be installed on compacted soil, or otherwise supported when entering a manhole to prevent shear stress on the conduit at the point of manhole entrance.

(4) Manholes, Handholes, Vaults.

(a) Strength. Manholes, handholes and vaults shall be designed to sustain all expected loads which may be imposed upon the structure. The horizontal and/or vertical design loads shall consist of dead load, live load, equipment load, impact, load due to water table, frost and any other load expected to be imposed upon and/or occur adjacent to the structure. The structure shall sustain the combination of vertical and lateral loading that produces the maximum shear and bending moments in the structure.

1. In roadway areas, the live load shall consist of the weight of a moving tractor -- semi trailer truck illustrated in 220 CMR 126.32 Figure 1. The vehicle wheel load shall be considered applied to an area as indicated in 220 CMR 126.32 Figure 2. In the case of multilane pavements, the structure shall sustain the combination of loadings which results in vertical and lateral structure loadings which produce the maximum shear and bending moments in the structure.

Note: Loads imposed by equipment used in road construction may exceed loads to which the completed road may be subjected.

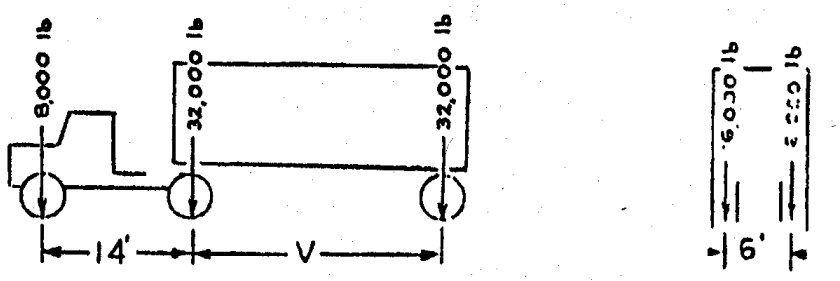
2. In designing structures not subject to vehicular loading, the minimum live load shall be 300 pounds per square foot.

3. Live loads shall be increased by 30% for impact.

4. When hydraulic, frost or other uplift will be encountered, the structure shall be of sufficient weight or so restrained as to withstand this force: The weight of equipment installed in the structure is not to be considered as part of the structure weight.

5. Where pulling iron facilities are furnished, they should be installed with a factor of safety of two based on the expected load to be applied to the pulling iron.

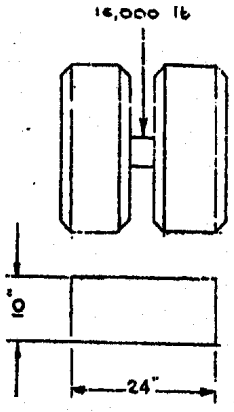
Figure 1



V = Variable spacing -- 14 feet to 30 feet. Spacing to be used is that which results in vertical and lateral structure loading which produces the maximum shears and bending moments in the structure.

Figure 2

Underground Conduit Systems



(b) Dimensions. Manholes shall meet the following requirements:

A clear working space sufficient for performing the necessary work shall be maintained. The horizontal dimensions of the clear working space shall be not less than three feet. The vertical dimensions shall be not less than six feet except in manholes where the opening is within one foot, horizontally, of the adjacent interior side wall of the manhole.

Exception 1: Where one boundary of the working space is an unoccupied wall and the opposite boundary consists of cables only, the horizontal working space between these boundaries may be reduced to 30 inches.

Exception 2: In manholes containing only communications cables and/or equipment, one of the horizontal dimensions of the working space may be reduced to not less than two feet, provided the other horizontal dimension is increased so that the sum of the two is at least six feet.

(c) Manhole Access Openings.

1. Round access openings in a manhole containing supply cables shall be not less than 26 inches in diameter. Round access openings in any manhole containing communication cables only or manholes containing supply cables having a fixed ladder which does not obstruct the opening, shall be not less than 24 inches in diameter. Rectangular access openings should have dimensions not less than 26 inches by 22 inches.

126.32: continued

2. Openings shall be free of protrusions which will injure personnel or prevent quick egress.

(d) Covers.

1. Manholes and handholes, when not being worked in, shall be securely closed by covers of sufficient weight or proper design so they cannot be easily removed without tools.
2. Covers should be suitably designed or restrained so that they cannot fall into manholes or protrude into manholes sufficiently far to contact cable or equipment.
3. Strength of covers and their supporting structure shall be at least sufficient to sustain the applicable loads of 220 CMR 126.32(4)(a).

(e) Access.

1. Vault or manhole openings shall be located so that safe access can be provided. When in the highway, they should be located outside of the paved roadway when practical. They should be located outside the area of street intersections and crosswalks whenever practical to reduce the traffic hazards to the men working at these locations.
2. Personnel access openings in vaults or manholes should be located so that they are not directly over the cable or equipment. Where these openings interfere with curbs, etc., they may be located over the cable if one of the following is provided:

A conspicuous warning sign,
A protective barrier over the cable,
A fixed ladder.

In vaults, other types of openings may be located over equipment to facilitate work on this equipment.

(f) Access Doors.

1. Where accessible to the public, access doors to utility tunnels and vaults shall be locked unless qualified persons are in attendance to prevent entry by others.
2. Such doors shall be designed so that a person on the inside may exit when the door is locked from the outside.

Exception: 220 CMR 126.00 does not apply where the only means of locking is by padlock and the latching system is so arranged that the padlock can be closed on the latching system to prevent unauthorized locking from the outside.

(g) Ladder Requirements. Fixed ladders shall be painted or otherwise treated to resist corrosion when location demands.

(h) Drainage. Where drainage is into sewers, suitable traps or other means should be provided to prevent entrance of sewer gas into manholes, vaults or tunnels.

(i) Ventilation. Adequate ventilation to open air shall be provided for manholes, vaults and tunnels, having an opening into enclosed areas used by the public. Where such enclosures house transformers, switches, regulators, etc., the ventilating system shall be cleaned at necessary intervals.

Exception: This does not apply to enclosed areas under water or in other locations where it is impractical to comply.

(j) Mechanical Protection. Supply cables and equipment should be installed or guarded in such a manner as to avoid damage by objects falling or being pushed through the grating.

(k) Identification. Manhole and handhole covers should have an identifying mark which will indicate ownership or type of utility.

126.33: Supply Cable

(1) General.

Recommendation. Cable should be capable of withstanding tests applied in accordance with an applicable standard issued by a recognized organization such as the Association of Edison Illuminating Companies, the Insulated Power Cable Engineers Association, the National Electrical Manufacturers Association or the American Society for Testing and Materials.

126.33: continued

(a) The design and construction of conductors, insulation, sheath, jacket and shielding shall include consideration of mechanical, thermal, environmental and electrical stresses which are expected during installation and operation.

(b) Cable shall be designed and manufactured to retain specified dimensions and structural integrity during manufacture, reeling, storage, handling, and installation.

(c) Cable shall be designed and constructed in such a manner that each component is protected from harmful effects of other components.

(d) The conductor, insulation, and shielding shall be designed to withstand the effects of the expected magnitude and duration of fault current, except in the immediate vicinity of the fault.

(2) Sheaths and Jackets. Sheaths and/or jackets shall be provided when necessary to protect the insulation or shielding from moisture or other adverse environmental conditions.

(3) Shielding.

(a) General.

1. Conductor shielding should be provided in accordance with an applicable standard issued by a recognized organization such as the Association of Edison Illuminating Companies, the Insulated Power Cable Engineers Association and the National Electrical Manufacturers Association.
2. Insulation shielding shall be provided for cable operating at more than 5 KV to ground and is recommended for cables operating above 2 KV to ground.
Exception: Shielding is not required for short jumpers which do not contact a ground surface within enclosures or vaults provided they are guarded or isolated.
3. Insulation shielding may be sectionalized provided that each section is effectively grounded.

(b) Material.

1. The shielding system may consist of semi-conducting materials, non-magnetic metal or both. The shielding adjacent to the insulation shall be designed to remain in intimate contact with the insulation under all operating conditions.
2. Shielding material either shall be designed to resist excessive corrosion under the expected operating conditions or shall be protected.

(4) Joints and Accessories.

(a) Cable joints, materials and accessories shall be designed to withstand the mechanical, thermal, environmental and electrical stresses expected during operation.

(b) Cable joints shall be designed and constructed in such a manner that each component of the cable and joint is protected from harmful effects of the other components of the cable or joint.

(c) Cable joints shall be designed and constructed to maintain the structural integrity of the cables to which they are applied and to withstand the magnitude and duration of the fault current expected during operation, except in the immediate vicinity of the fault.

(d) For insulating joints, see 220 CMR 126.33(3)(a)3.

126.34: Cable in Conduit Systems

(1) General. On systems operating above 2 KV to ground, the design of the conductors or cables installed in non-metallic conduit should consider the need for an effectively grounded shield and/or sheath.

(2) Installation.

(a) General.

1. Bending during handling, installation and operation shall be controlled to avoid damage to any of the components of the supply cable.

126.34: continued

2. Pulling tensions and side-wall pressures of cable should be limited to avoid damage to the supply cable. Manufacturer's recommendations may be used as a guide.
3. Ducts should be cleaned of foreign material which could damage the supply cable during pulling operations.
4. Cable lubricants shall not be detrimental to cable or conduit systems.
5. On slopes or vertical runs, consideration-should be given to restraining cables to prevent downhill movement.
6. Supply, control, and communication cables shall not be installed in the same duct unless the cables are maintained or operated by the same utility.

(b) Cable in Manholes and Vaults -- Supports.

1. Cable supports shall be designed to withstand both live and static loading and should be compatible with the environment.
2. Supports shall be provided to maintain specified separation between cables.
3. Horizontal runs of supply cables shall be supported at least three inches above the floor, or be suitably protected.
Exception: 220 CMR 126.34(2)(b) does not apply to grounding or bonding conductors.
4. The installation should allow cable movement without destructive concentration of stresses. The cable should remain on supports during operation.

(c) Cable in Manholes and Vaults -- Separation.

1. Adequate working space shall be provided in accordance with 220 CMR 126.32(4)(b).
2. Between supply and communication facilities (cable and/or equipment):

Where cable and/or equipment is to be installed in a joint use manhole or vault, it shall be done only with the concurrence of all parties concerned.

Supply and communication cables should be racked from separate walls. Crossings should be avoided.

Where supply and communication cables must be racked from the same wall, the supply cables should be racked below the communication cables.

Supply and communication facilities shall be installed to permit access to either without moving the other.

Clearances shall be maintained as specified in 220 CMR 126.34: Table 1.

Table 1

Minimum Separation Between Supply and Communications Facilities in Joint Use Manholes and Vaults

Phase-to-Phase Supply Voltage	Inches of Separation (Surface to Surface)
0, to 15,000	6
15,001 to 50,000	9

Exception 1: These separations do not apply to grounding conductors.
Exception 2: These separations may be reduced by mutual agreement between the parties concerned when suitable barriers or guards are installed.

(d) Identification of Cables in Manholes and Vaults.

1. Cables shall be permanently identified by tags or otherwise at each manhole or other access opening of the conduit system.

Exception: 220 CMR 126.34(2)(d) i. does not apply where the position of a cable, in conjunction with diagrams or maps supplied to workmen, or other means give sufficient identification.

2. All identification shall be of a corrosion-resistant material suitable for the environment.

126.34: continued

3. All identification shall be of such quality and located so as to be readable with auxiliary lighting.
4. Where cables in a manhole are maintained or operated by different utilities or are of supply and communication usage, they shall be permanently marked as to company and/or type of use.

(3) Grounding and Bonding.

(a) Insulation shielding of cable and joints shall be effectively grounded.
(b) Cable sheaths or shields which are connected to a ground at a manhole shall be bonded or connected to a common ground.
(c) Bonding and grounding leads shall be of a corrosion-resistant material suitable for the environment or suitably protected.

(4) Fire-proofing. Although fire-proofing is not a requirement, it may be provided in accordance with each utility's normal service reliability practice to provide protection from external fire.

(5) Communication Cables Containing Special Supply Circuits. Special circuits operating at voltages in excess of 400 volts to ground and used for supplying power solely to communications equipment may be included in communications cables under the following conditions:

(a) Such cables shall have a conductive sheath or shield which shall be effectively grounded and each such circuit shall be carried on conductors which are individually enclosed with an effectively grounded shield.
(b) All circuits in such cables shall be owned or operated by one party and shall be maintained only by qualified personnel.
(c) Supply circuits included in such cables shall be enclosed in an effectively grounded shield or shields and shall be terminated at points accessible only to qualified employees.
(d) Communications circuits brought out of such cables, if they do not terminate in a repeater station or terminal office, shall be protected or arranged so that, in the event of a failure within the cable, the voltage on the communications circuit will not exceed 400 volts to ground.
(e) Terminal apparatus for the power supply shall be so arranged that live parts are inaccessible when such supply circuits are energized.
(f) Such cables shall be identified and the identification shall meet the pertinent requirements of 220 CMR 126.34(2)(d).

Exception: The requirements of 220 CMR 126.34(5) do not apply to supply circuits of 550 volts or less which carry power not in excess of 3200 watts.

126.35: Direct Buried Cable

(1) General.

(a) Cables operating above 600 volts to ground shall have a continuous shield, sheath or concentric neutral which is effectively grounded.
(b) Cables of the same circuit operating below 600 volts to ground and without an effectively grounded shield or sheath shall be placed in close proximity (no intentional separation) to each other.
(c) Communications cables containing special circuits supplying power solely to communications equipment shall comply with the requirements of 220 CMR 126.34(5)(a) through 126.34(5)(e).

(2) Location and Routing.

(a) General.

1. Cables should be located so as to be subject to the least disturbance practical. Cables to be installed parallel to other subsurface structures should not be located directly over or under other subsurface structures, but if this is not practical, the rules on clearances in 220 CMR 126.35(3) should be followed.

126.35: continued

2. Cables should be installed in as straight and direct a line as practical. Where bends are required, the minimum radius shall be sufficiently large to prevent damage to the cable being installed.
3. Cable systems should be routed so as to allow safe access for construction, inspection and maintenance.
4. The location of structures in the path of the projected cable route shall, as far as practical, be determined prior to the trenching, plowing or boring operation.

(b) Natural Hazards. Routes through unstable soil such as mud, shifting soils, corrosive soils or other natural hazards, should be avoided. If burying is required through areas with natural hazards, the cables shall be constructed and installed in such a manner as to protect them from damage. Such protective measures should be compatible with other installations in the area.

(c) Other Conditions.

1. Swimming Pools. Supply cable shall not be installed within five feet of a swimming pool or its auxiliary equipment.
2. Buildings and Other Structures. Cable should not be installed directly under building or storage tank foundations. Where a cable must be installed under such a structure, the structure shall be suitably supported to prevent transfer of a harmful load onto the cable.
3. Railroad Tracks. The installation of cable longitudinally under the ballast section for railroad tracks should be avoided. Where cable must be installed longitudinally under the ballast section of a railroad, it should be located at a depth of not less than 60 inches below the top, of the rail.

Where a cable crosses under railroad tracks, the same clearances indicated in 220 CMR 126.32(1)(e) shall apply.

4. Highways and Streets. The installation of cable longitudinally under traveled surfaces of highways and streets should be avoided. When cable must be installed longitudinally under the roadway, it should be installed in the shoulder or within the limits of one lane of traffic if practical.
5. Submarine Crossings. Submarine crossings should be routed and/or installed so they will be protected from erosion by tidal action or currents. They should not be located where ships normally anchor.

(3) Clearance from Other Underground Structures (sewers, water lines, fuel lines, building foundations, steam lines, other supply or communication conductors not in random separation, etc.).

(a) Horizontal Clearance. The horizontal clearance between direct buried cable and other underground structures should be controlled at a minimum of 12 inches or larger as necessary to permit access to and maintenance of either facility without damage to the other. Installations with less than 12 inches horizontal separation shall conform with the requirements of 220 CMR 126.35(3)(c) and/or 126.35(5).

(b) Crossings.

1. Where a cable crosses under another underground structure, the structure shall be suitably supported to prevent transfer of a harmful load onto the cable system.
2. Where a cable crosses over another underground structure, the cable shall be suitably supported to prevent transfer of a harmful load onto the structure.
3. Adequate support may be provided by installing the facilities with sufficient vertical separation.
4. Adequate vertical clearance shall be maintained to permit access to and maintenance of either facility without damage to the other. A vertical clearance of 12 inches is, in general, considered adequate but the parties involved may agree to a lesser separation.

(c) Parallel Facilities. If conditions require a cable system to be installed with less than 12 inches horizontal separation or directly over and parallel to another underground structure (or another underground structure installed directly over and parallel to a cable), it may be done providing all parties are in agreement as to the method. Vertical clearance shall be at least 12 inches except where the parties mutually agree that lesser separation will be adequate.

126.35: continued

(d) Thermal Protection. Cable should be installed with sufficient clearance from other underground structures, such as steam or cryogenic lines, to avoid thermal damage to the cable. Where it is not practical to provide adequate clearance, a suitable thermal barrier shall be placed between the two facilities.

(4) Installation.

(a) Trenching. The bottom of the trench receiving direct buried cable should be relatively smooth, undisturbed earth, well-tamped earth or sand. When excavation is in rock or rocky soils, the cable shall be laid on a protective layer of well-tamped backfill. Backfill within four inches of the cable shall be free of materials that may damage the cable. Backfill should be adequately compacted. Machine compaction should not be used within four inches of the cable.

(b) Plowing.

1. Plowing in of cable in soil containing rock or other solid material should be done in such a manner that the solid material will not damage the cable, either during the plowing operation or afterward.
2. The design of cable plowing equipment and the plowing-in operation should be such that the cable will not be damaged by bending, side-wall pressure or excessive cable tension.

(c) Boring. Where a cable system is to be installed by boring and the soil and surface loading conditions are such that solid material in the region may damage the cable, the cable shall be adequately protected.

(d) Depth of Burial. The distance between the top of a cable and the surface under which it is installed (depth of burial) shall be sufficient to protect the cable from injury or damage imposed by expected surface usage.

1. Minimum burial depths shall be as indicated in 220 CMR 126.35(4)(d)1. Table 1:

Table 1
CONDUCTORS OR CABLES

Voltage Phase to Ground	Depth of Burial (Inches)
600 and below	24
601 to 22,000	30
22,001 to 40,000	36
40,001 and above	42

2. In areas where frost conditions could damage cables, greater burial depths than indicated above may be desirable.
3. When lesser depths than indicated above cannot be avoided, adequate supplemental protection shall be provided.
4. Where the surface under which a cable is to be installed is not to designated final grade, the cable shall be placed so as to meet or exceed the requirements indicated above, both at the time of installation and subsequent thereto.

(5) Random Separation -- Additional Requirements. The following rules apply to conductors or cables when the radial separation between them will be less than 12 inches.

(a) Supply Conductors or Cables. The conductors or cables of a supply circuit and those of another supply circuit may be buried together at the same depth with no deliberate separation between facilities, provided all parties involved are in agreement.

(b) Communication Conductors or Cables. The conductors or cables of a communication circuit and those of another communication circuit may be buried together and at the same depth with no deliberate separation between facilities, provided all parties involved are in agreement.

126.35: continued

(c) Supply and Communication Conductors or Cables. Supply cables or conductors and communication cables or conductors may be buried together at the same depth with no deliberate separation between facilities, provided all parties involved are in agreement and the following requirements are met:

1. Voltage. Grounded supply systems shall not be operated in excess of 22,000 volts to ground. Ungrounded supply systems shall not be operated in excess of 5300 volts phase to phase.

2. Bare Grounded Conductor. A supply facility operating above 300 volts to ground must include a bare grounded conductor in continuous contact with the earth. This conductor, adequate for the expected magnitude and duration of the fault current which may be imposed, shall be, one of the following: a sheath and/or shield; multiple concentric conductors closely spaced circumferentially; a separate bare conductor in contact with the earth and in close proximity to the cable where such cable or cables also have a grounded sheath or shield not necessarily in contact with the earth. The sheath and/or shield as well as the bare conductor shall be adequate for the expected magnitude and duration of the fault currents which may be imposed.

Note: This is applicable when cable in non-metallic duct is considered as a direct buried cable installation and random separation is desired.

Exception: Where a buried cable passes through a short section of conduit, such as under a roadway, the contact with earth of the grounded conductor can be omitted, provided the grounded conductor is continuous through the conduit.

The bare conductor(s) in contact with the earth shall be of suitable corrosion-resistant material.

3. Ungrounded Supply Systems. Cables of an ungrounded supply system operating above 300 volts shall be of effectively grounded concentric shield construction in continuous contact with the earth. Such cables shall be maintained in close proximity to each other.

(d) Multiple Cable Systems. More than one cable system buried in random separation may be treated as one system when considering clearance from other underground structures or facilities.

(e) Protection.

1. Supply circuits operating above 300 volts to ground or 600 volts between conductors shall be so constructed, operated and maintained that when faulted, they shall be promptly de-energized initially or following subsequent protective device operation. (Phase-to-ground faults for grounded circuits, phase-to-phase faults for ungrounded circuits.)

2. Ungrounded supply circuits operating above 300 volts shall be equipped with a ground fault indication system.

3. Communication protective devices shall be adequate for the voltage and currents expected to be impressed on them in the event of contact with the supply conductors.

4. Adequate bonding shall be provided between the effectively grounded supply conductor(s) and the communications cable shield or sheath. (Preferably at intervals not to exceed 1000 feet.)

126.36: Risers

(1) General.

(a) All supply conductors or cables from underground systems which connect to overhead systems shall be protected by a covering which gives suitable mechanical protection up to a point eight feet above the ground.

Exception: Armored cables or cables installed in a grounded metal conduit and risers in fenced-in areas not accessible to the public.

(b) Supply conductors or cable should rise vertically from the cable trench with only such deviation as necessary to permit a reasonable cable bending radius.

(c) Exposed conductive pipes or guards containing supply conductors or cables shall be grounded in accordance with 220 CMR 126.31(5).

126.36: continued

(2) Installation.

(a) The installation should be designed so that water does not stand in riser pipes above the frost line.

(b) Conductors or cables shall be supported in a manner designed to prevent damage to conductors, cables or terminals.

(c) Where conductors or cables enter the riser pipe or elbow, they shall be installed in such a manner that shall minimize the possibility of damage due to relative movement of the cable and pipe.

(3) Pole Risers -- Additional Requirements.

(a) Risers should be located on the pole in the safest available position with respect to climbing space and possible exposure to traffic damage.

(b) The number, size and location of riser ducts or guards shall be limited to allow adequate access for climbing.

(4) Padmounted Installations.

(a) Supply conductors or cables rising from the trench to transformers, switchgear, or other equipment mounted on pads shall be so placed and arranged that they will not bear on the edges of holes through the pad nor the edges of bends or other duct work below the pad.

(b) Cable entering padmounted equipment shall be maintained substantially at adequate depth for the voltage class until it becomes protected by being directly under the pad, unless other suitable mechanical protection is provided.

126.37: Supply Cable Terminations

(1) General.

(a) Cable terminations shall be designed and constructed to meet the requirements of 220 CMR 126.33(4).

(b) A cable termination shall be designed to prevent moisture access to the cable insulation where such penetration is detrimental to the cable.

(c) Where clearances between parts at different potential are reduced below those adequate for the voltage and Basic Impulse Level (BIL), suitable insulating barriers or fully insulated terminals shall be provided to meet the required equivalent clearances.

(2) Support at Terminations.

(a) Cable terminations shall be secured and supported in a manner designed to maintain their installed position.

(b) Cable shall, where necessary, be supported or secured in a manner designed to prevent the transfer of damaging mechanical stresses or bending to the termination, equipment or structure.

(3) Identification. Suitable circuit identification shall be provided for all terminations.

Exception: This requirement does not apply where the position of the termination, in conjunction with diagrams or maps supplied to workmen, gives sufficient identification.

(4) Separations and Clearances in Enclosures or Vaults.

(a) Adequate electrical clearances and separations of supply terminations shall be maintained, both between conductors and between conductors and ground, consistent with the type of terminator used.

(b) Where exposed live parts are in an enclosure, clearances and separations or insulating barriers adequate for the voltages and the design Basic Impulse Level (BIL) shall be provided.

(c) Where a termination is in a vault, uninsulated live parts are permissible provided they are guarded or isolated.

126.37: continued

(5) Grounding.

(a) All exposed conducting surfaces of the termination device, other than live parts, and equipment to which it is attached shall be effectively grounded and/or bonded.

(b) Conductive structures supporting cable terminations shall be effectively grounded.

Exception: Grounding and/or bonding is not required where the above parts are isolated or guarded.

126.38: Equipment

(1) General.

(a) Equipment includes:

1. Buses, transformers, switches, etc., installed for the operation of the electric supply system.

2. Repeaters, loading coils, etc., installed for the operation of the communication system.

3. Auxiliary equipment such as sump pumps, convenience outlets, etc., installed incidental to the presence of the supply or communication systems.

(b) Where equipment is to be installed in a joint-use manhole, it shall be done with the concurrence of all parties concerned.

(c) Supporting structures, including racks, hangers, or pads and their foundations shall be designed to sustain all loads and stresses expected to be imposed by the supported equipment including those stresses caused by its operation.

(2) Design.

(a) All equipment and mountings shall be designed for the thermal, chemical, mechanical and environmental conditions expected at the location.

(b) All equipment including auxiliary devices shall be designed to be adequate for the normal, emergency and fault conditions expected during operation.

(c) Switches shall be provided with clear indication of contact position, and the handles or activating devices clearly marked to indicate operating directions.

Recommendation: The handles or control mechanism of all switches throughout the system should operate in a like direction to open and in a uniformly different direction to close in order to minimize errors.

(d) Remotely controlled or automatic devices shall have provisions for local blocking to prevent operation if such operation may result in a hazard to the workman.

(e) Enclosures containing fuses and interrupter contacts shall be designed to withstand the effect of the normal, emergency and fault conditions expected on the system during operations.

(f) When tools are to be used to connect or disconnect energized devices, space or barriers shall be designed to provide adequate clearance from ground or between phases.

(g) Where padmounted equipment is not within a fenced or other protected area, it shall be locked to prevent access to unauthorized persons.

(3) Location in Underground Structures.

(a) Equipment shall not obstruct personnel access openings in manholes or vaults nor shall it prevent easy egress by men working in the structures containing the equipment.

(b) Equipment shall not be installed closer than eight inches to the back of fixed ladders and shall not interfere with the proper use of such ladders.

(c) Equipment should be arranged in a manhole or vault to permit installation, operation and maintenance of all items in such structures.

(d) Switching devices which have provision for manual or electrical operation shall be operable from a safe position. This may be accomplished by use of portable auxiliary devices, temporarily attached.

(e) Equipment should not interfere with drainage of the structure.

(f) Equipment shall not interfere with the ability to ventilate any structure or enclosure.

126.38: continued

(4) Installation.

(a) Provisions for lifting, rolling to final position, and mounting shall be adequate for the weight of the device.

(b) Live parts shall be guarded or isolated to prevent contact by persons in a normal position adjacent to the equipment.

(c) Operating levers, inspection and test facilities shall be visible and readily accessible when equipment is in final location without moving permanent connections.

(d) Live parts shall be isolated or protected from exposure to conducting liquids or other material expected to be present in the structure containing the equipment.

(e) Operating controls of supply equipment, readily accessible to unauthorized personnel, shall be secured by bolts, locks or seals.

(5) Grounding.

(a) Cases and enclosures made of conductive material shall be effectively grounded or guarded.

(b) Supply and communication cases and enclosures, if made of conductive material and installed above ground, shall be bonded together except where guarded or separated by more than five feet.

(c) Guards constructed of conductive material shall be effectively grounded.

(6) Identification. Where transformers, regulators or other similar equipment not located in the same manhole operate in multiple, special tags, diagrams, or other suitable means shall be used to indicate that fact.

Exception: This requirement does not apply where disconnecting devices are provided to permit cutting such equipment completely off the system.

REGULATORY AUTHORITY

220 CMR 126.00: M.G.L. c. 164, § 76C.