

Eversource Underground Transmission Line Standards

1. Scope

This standard establishes the minimum vertical, horizontal and diagonal design clearance requirements between underground transmission lines (69 kV through 345 kV), the top of grade, and other underground facilities. Underground facilities may include but are not limited to water, sewer and gas piping, and other buried conduit.

The clearances established by this standard shall be used both in the design of new underground transmission lines and the modification to existing underground transmission lines. The clearances in this standard may also be applied to underground transmission lines within substations. These clearances may also be used to evaluate the acceptability of other proposed underground facilities which may parallel or cross an existing transmission line.

Use of the clearances contained herein is not intended to negate the need for cathodic protection measures (either for ES infrastructure or neighboring facilities). A separate evaluation of the Electromagnetic interference ("EMI") is required to address the potential need for cathodic *protection or other remediation measures on adjacent facilities.*

Use of this standard is also not intended to negate the need for evaluations of the heat generation associated with new cables and existing nearby facilities. The clearances contained herein may be insufficient to accommodate heat generation and may therefore have to be increased.

2. Regulations and Related Codes and Standards

Conformance with this standard provides assurance that the design of new transmission lines and modification to existing transmission lines include provisions to achieve clearances with other underground facilities, services and structures which meet or exceed electrical safety code requirements.

- A. In Connecticut and New Hampshire, conformance to ANSI C2, otherwise known as the National Electric Safety Code (NESC) Part 3, "Safety Rules for the Installation and Maintenance of Underground Electric Supply and Communications Lines", is required.
- B. In Massachusetts, conformance to the Code of Massachusetts Regulations 220 CMR 125.00, "Installation and Maintenance of Electric Transmission Lines", is required.

3. Requirements:

New underground transmission lines, facilities or structures being installed in parallel, crossing or in proximity to other existing underground utilities shall be designed to meet or exceed the clearances specified below.

Unless otherwise noted, the clearances provided below are for all voltages between 69 kV and 345 kV. Conformance with these clearances satisfies all of the provisions of Massachusetts Department of Public Utilities Regulations 220 CMR 125.31(4) and Part 3 of the NESC.

- A. Pipe-Type Cable/Conduit of Any Type

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<u>Description of Encounter</u>	<u>CT/NH Requirements</u>			<u>MA Requirements</u>		
	<u>NESC Ref.</u>	<u>Distance</u> (Note 7)	<u>Notes</u>	<u>CMR Ref.</u>	<u>Distance</u> (Note 7,8)	<u>Notes</u>
Rails						
Top of Power Conduit to Top of Rails of Street Railway	320 A.5.a	48"	1	220 CMR 125.31(4)(b)	30"	9
Top of Power Conduit to Top of Rails of Railroad	320 A.5.a	62"	1	220 CMR 125.31(4)(b)	42"	9
Top of Power Conduit to Top of Rails for Secondary or Industrial Railway		60"		220 CMR 125.31(4)(b)	42"	9
Underground Structures						
Power Cable Horizontal Clearance to Underground Structure (concrete/masonry)	353.A.1	24"			6"	
Power Cable Vertical Clearance to Underground Structure (concrete/masonry)	353.A.1	24"			6"	
Communication Line						
Power Conduit to Communication Line Conduit Separated Using Concrete	320.B.2.	15"			18"/24"	10
Power Conduit to Communication Line Conduit Separated Using Masonry	320.B.2.	16"			18"/24"	10
Power Conduit to Communication Line Conduit Separated Using Well Tamped Earth	320.B.2.	24"			18"/24"	10
Water, Gas & Sewer Piping and Other Electrical Conduits & Ducts and Earth Surface						
Vertical, Horizontal or Diagonal Clearance between Power Conduit and Welded Gas or Water Piping		24"			12"/24"	10
Vertical, Horizontal or Diagonal Clearance between Power Conduit and Bell & Spigot Water & Sewer Pipes		30"			18"/24"	10
Vertical, Horizontal or Diagonal Clearance between Power Conduit and Other Electric Supply Conduits or Ducts		30"			18"/24"	10, 11
Vertical Clearance between Power Conduit and Earth Surface	322.A.3	48"	3	220 CMR 125.30(2)	24"	

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Description of Encounter	CT/NH Requirements			MA Requirements		
	NESC Ref.	Distance (Note 7)	Notes	CMR Ref.	Distance (Note 7,8)	Notes
Vertical Clearance between Power Conduit and Bottom of Stream Bed at Entrenched Water Crossings		72"	4		72"	4
Horizontal Clearance between Power Conduit and Parallel Flammable Liquid or 150 psi or greater Gas Piping	95.B.2	132"	5, 6	95.B.2	120"	5, 6
Metallic Conduit						
Vertical, Horizontal or Diagonal Clearance between any Water, Gas or Steam Metallic Pipe Systems in proximity of UG Cables in Metallic Pipes ONLY	353.A.1	24"	5	220 CMR 125.31(4)(c)	12"	5, 13

B. Direct Embedded Cables

Description of Encounter	CT/NH Requirements			MA Requirements		
	NESC Ref.	Distance (Note 7)	Notes	CMR Ref.	Distance (Note 7,8)	Notes
Rails						
Top of Power Cable to Top of Rails of Street Railway	351.C.3.b	48"	1	220 CMR 125.31(4)(b)	30"	9
Top of Power Cable to Top of Rails of Railroad	351.C.3.b	62"		220 CMR 125.31(4)(b)	42"	9
Longitudinal Installation Under Ballast Section of Railroad or Street Railway	351.C.3.a	62"		220 CMR 125.31(4)(b)	42"	9
Underground Structures						
Power Cable Horizontal Clearance to Underground Structure (concrete/masonry)	353.A.1	24"			12"	
Power Cable Vertical Clearance to Underground Structure (concrete/masonry)	353.A.1	24"			12"	

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Description of Encounter	CT/NH Requirements			MA Requirements		
	NESC Ref.	Distance (Note 7)	Notes	CMR Ref.	Distance (Note 7,8)	Notes
Miscellaneous						
Power Cable Buried	352.D.2	54"		352.D.2	42"	
Horizontal or Diagonal Clearance Between Power Cable and Swimming Pool or Its Auxiliary Equipment	351.C.1	72"		351.C.1	60"	
Water, Gas & Sewer Piping and Other Electrical Conduits & Ducts						12
Vertical, Horizontal or Diagonal Clearance between Power Conduit and Welded Gas or Water Piping		24"			12"/24"	10
Vertical, Horizontal or Diagonal Clearance between Power Conduit and Bell & Spigot Water & Sewer Pipes		30"			18"/24"	10
Vertical, Horizontal or Diagonal Clearance between Power Conduit and Other Electric Supply Conduits or Ducts		30"			18"/24"	10, 11
Vertical Clearance between Power Conduit and Bottom of Stream Bed at Entrenched Water Crossings		72"	4		72"	4
Horizontal Clearance between Power Conduit and Parallel Flammable Liquid or 150 psi or greater Gas Piping	95.B.2	132"	5, 6	95.B.2	120"	5, 6

Notes for A and B above:

- [1] May be reduced by more than 12", but only by mutual agreement between parties, and cannot result in a facility above the bottom of ballast that is subject to working or clearing.
- [2] Minimum design separation may be reduced to 24" for conduit carrying 69 kV power.
- [3] Cover less than 36" allowed by NESC Section 322.A.3, if designed for live and impact loads.
- [4] Subject to Special Permit
- [5] As noted above, EMI study may be required to determine need for cathodic protection or other remediation for adjacent facilities.
- [6] There are additional requirements for electrical installations in classified areas within power plants or substations [i.e., area where handling of flammable dusts, liquids and

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gasses (Coal Dust, Gasoline, Hydrogen, Liquid Petroleum Gas & Natural Gas/Methane) occur]. See the latest version of NESC127/NFPA 70. Article 500.

- [7] Unless otherwise defined, the “Distance” between the underground transmission line and other underground facility is the shortest measurable vertical, horizontal and diagonal edge to edge distance between the line and the facility.
- [8] MA code 220 CMR 125.31 (4)(a) states that all minimum cover and clearance offsets shall met and maintained, where practicable. These distances may be reduced by agreement between all parties when the noted values cannot be maintained.
- [9] Offsets to rail lines need to be per the MBTA directive – will most likely be more stringent than the values noted in MA code 220 CMR 125.31 (4)(b).
- [10] The first noted value is the minimum distance to the outside of the duct bank envelope to an adjacent pipe/facility that is 12” diameter or less. The second noted value is the same but for an adjacent pipe/facility that is greater than 12” diameter.
- [11] This value may need to be updated per project depending on ampacity calculations.
- [12] Clearances to Massachusetts Water Resources Authority (MWRA) and Boston Water and Sewer Commission (BWSC) Sewer, Water, and Drain infrastructure will require final approval by the agencies to obtain permits.
- [13] MA code 220 CMR 125.31 (c) states that if a buried metallic pipe is used as a conduit for underground cables, it shall not be laid in direct contact with any water, gas or steam metallic pipe systems. Where the clearance is less than 12” to any gas pipes and less than two inches for any other metallic structures, the metal conduit shall be adequately separated from other metallic pipe systems by a barrier of suitable material or electrically bonded together at the point of least separation. Where metallic electrical conduit is to be located within 4’ of other buried metallic structures, the owner of said structures should be notified relative to mutual protection.

C. Responsibilities

- 1) Transmission Line Engineering is responsible for implementing and administering the clearance requirements of this standard in new underground transmission line designs and to evaluate the clearances associated with any new or modified facilities which are in the proximity of existing transmission lines.
- 2) Transmission Department field personnel, including Conduit Inspectors and Construction Managers, are responsible for identifying to the Project Manager and UG Transmission Project Engineer, situations in which conformance with the clearances specified above cannot be reasonably maintained.

D. Reductions in Clearances – CT and NH Clearance Requirements Only

The minimum design clearances in the above tables were developed by adding 12 inches to the most limiting applicable code minimum clearance. During construction, conditions may be discovered which could result in maintenance of these clearances becoming impractical. The above clearances may be reduced by removing some of the margin between the design clearances and code minimums. The following individuals may reduce the design clearances on a case by case basis, where those clearances cannot be reasonably maintained:

- 1) The ES Owner’s Representative responsible for monitoring construction of ES facilities may reduce a specific design clearance shown above by up to six (6) inches.

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The Project Engineer or Manager of Transmission and Civil Engineering shall be informed of the reduction and of the actual "as-measured" clearance.

- 2) The ES Project Engineer, where construction of a new underground ES Transmission facility is involved, may approve a reduction of a specific design clearance shown above by up to a total maximum of nine (9) inches. This is a total reduction from the design clearance and includes any clearance waivers which the ES Owner's Representative may have previously authorized.
- 3) The Manager of Transmission and Civil Engineering may approve a reduction of a specific design clearance shown above by up to a total maximum of twelve (12) inches. This is a total reduction from the design clearance and includes any clearance waivers which the ES Owner's Representative and/or the Project Engineer may have previously authorized.

In order to reduce the clearances provided in the tables in 3A and 3B above, an actual field measurement of the minimum clearance between the line and the existing facility must be obtained and verified to be within the allowable reductions specified in D1 through D3 above.

4. Deviations

This standard sets forth the current ES 'best practices' for most applications of this subject matter. Therefore, deviation from this standard is generally not permitted. However, in unique instances a user may submit a written deviation request including justification to the listed Subject Matter Expert (SME). The SME must approve or deny the request in writing prior to the user commencing any non-standard activities. The SME may consult with his/her supervisor, co-SME if any and co-SME supervisor, and subsequently must copy any approval to them.

5. Cognizant Engineering Groups

1. Transmission Line and Civil Engineering – CT/WMA
2. Transmission Line Engineering – EMA
3. Transmission Engineering – NH

Revision History

Rev.0 – original issue 09/29/2008

Rev.1– removal of Northeast Utilities, addition of Eversource, addition of MA specific clearance requirements

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