



CSA S250:20
National Standard of Canada



Mapping of underground utility infrastructure



Legal Notice for Standards

Canadian Standards Association (operating as "CSA Group") develops standards through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA Group administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document's fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party's intellectual property rights. CSA Group does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA Group makes no representations or warranties regarding this document's compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA GROUP, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA GROUP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA Group is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA Group accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA Group is a private not-for-profit company that publishes voluntary standards and related documents. CSA Group has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

Intellectual property rights and ownership

As between CSA Group and the users of this document (whether it be in printed or electronic form), CSA Group is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA Group's and/or others' intellectual property and may give rise to a right in CSA Group and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by licence or by law, CSA Group reserves all intellectual property rights in this document.

Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA Group shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

Authorized use of this document

This document is being provided by CSA Group for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF format.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA Group to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA Group; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



Standards Update Service

CSA S250:20

June 2020

Title: *Mapping of underground utility infrastructure*

To register for e-mail notification about any updates to this publication

- go to store.csagroup.org
- click on **Product Updates**

The **List ID** that you will need to register for updates to this publication is **2427902**.

If you require assistance, please e-mail techsupport@csagroup.org or call 416-747-2233.

Visit CSA Group's policy on privacy at www.csagroup.org/legal to find out how we protect your personal information.

Canadian Standards Association (operating as "CSA Group"), under whose auspices this National Standard has been produced, was chartered in 1919 and accredited by the Standards Council of Canada to the National Standards system in 1973. It is a not-for-profit, nonstatutory, voluntary membership association engaged in standards development and certification activities.

CSA Group standards reflect a national consensus of producers and users — including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

Individuals, companies, and associations across Canada indicate their support for CSA Group's standards development by volunteering their time and skills to Committee work and supporting CSA Group's objectives through sustaining memberships. The more than 7000 committee volunteers and the 2000 sustaining memberships together form CSA Group's total membership from which its Directors are chosen. Sustaining memberships represent a major source of income for CSA Group's standards development activities.

CSA Group offers certification and testing services in support of and as an extension to its standards development activities. To ensure the integrity of its certification process, CSA Group regularly and continually audits and inspects products that bear the CSA Group Mark.

In addition to its head office and laboratory complex in Toronto, CSA Group has regional branch offices in major centres across Canada and inspection and testing agencies in eight countries. Since 1919, CSA Group has developed the necessary expertise to meet its corporate mission: CSA Group is an independent service organization whose mission is to provide an open and effective forum for activities facilitating the exchange of goods and services through the use of standards, certification and related services to meet national and international needs.

For further information on CSA Group services, write to
CSA Group
178 Rexdale Boulevard
Toronto, Ontario, M9W 1R3
Canada



A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at www.scc.ca.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada's economic competitiveness and social well-being, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at www.scc.ca.

Standards Council of Canada
600-55 Metcalfe Street
Ottawa, Ontario, K1P 6L5
Canada



Standards Council of Canada
Conseil canadien des normes

Cette Norme Nationale du Canada n'est disponible qu'en anglais.

Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users to judge its suitability for their particular purpose.

**A trademark of the Canadian Standards Association, operating as "CSA Group"*

National Standard of Canada

CSA S250:20

Mapping of underground utility infrastructure



*®A trademark of the Canadian Standards Association,
operating as "CSA Group"*



*Published in June 2020 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3*

*To purchase standards and related publications, visit our Online Store at store.csagroup.org
or call toll-free 1-800-463-6727 or 416-747-4044.*

*ICS 01.080.30
ISBN 978-1-4883-2774-2*

*© 2020 Canadian Standards Association
All rights reserved. No part of this publication may be reproduced in any form whatsoever
without the prior permission of the publisher.*

Contents

Technical Committee on Mapping of Underground Utility Infrastructure 4

Preface 7

0 Introduction 9

1 Scope 10

1.1 General 10

1.2 Application 10

1.3 Terminology 10

2 Reference publications 11

3 Definitions 11

4 Mapping records 15

4.1 General 15

4.2 Mapping records management 15

4.2.1 General 15

4.2.2 Accuracy 15

4.2.3 Content 15

4.2.4 Record systems 15

4.2.5 Source records 16

4.2.5.2 Record retention 16

4.2.6 Monitoring and auditing 16

4.2.7 Continual improvement 16

4.2.8 Disaster recovery 16

4.2.9 Training 16

4.3 Accountabilities and responsibilities 16

4.3.1 Owner 16

4.3.2 Locator 17

4.3.3 Excavator 17

4.4 Mapping record characteristics 17

4.4.1 General 17

4.4.2 Validity 17

4.4.3 Map data interoperability 17

4.5 Records lifecycle 17

4.5.1 General 17

4.5.2 Planning and design 17

4.5.3 Construction 18

4.5.4 Operation and maintenance 18

4.6 Types of mapping records 19

4.6.1 General 19

4.6.2 Field records 19

4.6.3 As-built drawing 19

4.6.4 Base mapping 19

4.6.5	Photographs and video recordings	20
4.6.6	Red-line drawings and records	20
4.6.7	Sketches	20
4.7	Map data sharing	20
4.7.1	General	20
4.7.2	Owner responsibilities	20
4.7.3	Sign-off/transmittal (process of sharing the data)	20
4.7.4	Data sharing	21
4.7.5	Mapping data compatibility	21
5	Reliability and accuracy of mapping records	21
5.1	General	21
5.2	Measuring and recording the location of underground utility infrastructures	21
5.2.1	Owner's responsibility	21
5.2.2	Competency	22
5.2.3	Trenchless technology	22
5.2.4	Intervals for measurements	22
5.3	Absolute spatial positioning	22
5.3.1	Horizontal and vertical datum	22
5.3.2	Projection or coordinate system	22
5.4	Relative spatial positioning	22
5.4.1	Use of permanent structures	22
5.4.2	Absolute positioning of relative locations	23
5.5	Accuracy of as-built records	23
5.6	Application of spatial accuracy	23
5.6.1	General	23
5.6.2	Measurements of spatial accuracy	23
5.7	Accuracy of supplementary utility records	24
5.8	Quality levels for underground utility infrastructure mapping	24
5.9	Measurements	25
5.9.1	General	25
5.9.2	Recording measurements	25
5.9.3	Project control points	25
5.9.4	Non-conforming information	25
5.9.5	GNSS/GPS coordinates	26
5.9.6	Vertical structures	26
6	Feature description	26
6.1	General	26
6.2	Data structure	26
6.3	Symbols	26
6.4	Clarity of information	26
6.5	Line style	27
6.5.1	General	27
6.5.2	Line style attributes	27
6.5.3	Line style appearance	27
6.5.4	Colour	27
6.5.5	Line weight	27
6.5.6	Layers or levels	27

6.5.7	Dimensions	27
6.5.8	Text	27
7	Underground utility infrastructure specific requirements for mapping records	29
7.1	General	29
7.1.1	Introduction	29
7.1.2	Material abbreviations	29
7.2	Water systems	30
7.2.1	Inclusions	30
7.2.2	Exclusions	30
7.2.3	Graphical representation	30
7.3	Wastewater systems	30
7.3.1	General	30
7.3.2	Inclusions	30
7.3.3	Graphical representation	31
7.4	Electrical systems	31
7.4.1	Inclusions	31
7.4.2	Graphical representation	31
7.5	Liquid petroleum and gas systems	32
7.5.1	Inclusions	32
7.5.2	Exclusions	32
7.5.3	Graphical representation	32
7.6	Telecom systems	32
7.6.1	Inclusions	32
7.6.2	Graphical representation	33

Annex A (informative)	— Commentary	49
Annex B (informative)	— Distinction between records and as-built drawings	66
Annex C (informative)	— Underground utility infrastructure corridors	67
Annex D (informative)	— Sample layout drawings/GIS output plots	71
Annex E (informative)	— Sample mapping error and omissions form and process	74

Technical Committee on Mapping of Underground Utility Infrastructure

L. Hanley	Union Gas Limited, Chatham, Ontario, Canada <i>Category: Carriers</i>	<i>Chair</i>
L. E. Arcand	T2 Utility Engineers Inc., Whitby, Ontario, Canada <i>Category: General Interest</i>	<i>Vice-Chair</i>
J. Hale	Department of National Defence, Ottawa, Ontario, Canada <i>Category: User Interest</i>	<i>Vice-Chair</i>
J. Arnott	Enbridge Gas Distribution, Toronto, Ontario, Canada <i>Category: Carriers</i>	
A. Cazavant	Ville de Longueuil, Longueuil, Québec, Canada	<i>Non-voting</i>
P. Churcher	Department of National Defence, Ottawa, Ontario, Canada	<i>Non-voting</i>
J. P. Cook	R&B Construction Services Inc., Acton, Ontario, Canada <i>Category: General Interest</i>	
B. Dale	Toronto Hydro, Toronto, Ontario, Canada	<i>Non-voting</i>
I. Danis	ACRGTO, Anjou, Québec, Canada <i>Category: Regulatory Authority</i>	
T. P. Harkness	Pat Harkness and Associates, Chilliwack, British Columbia, Canada <i>Category: General Interest</i>	
G. Jurca	Teck Resources Limited, Sparwood, British Columbia, Canada	<i>Non-voting</i>

T. N. Kee	Federation of Alberta Gas Co-ops Ltd, Sherwood Park, Alberta, Canada <i>Category: Regulatory Authority</i>	
P. Lamb	Ministry of Transportation — Ontario (MTO), St. Catharines, Ontario, Canada <i>Category: Regulatory Authority</i>	
C. Lessard	Énergir, Montréal, Québec, Canada	<i>Non-voting</i>
H. Louie	City of Burnaby, Burnaby, British Columbia, Canada <i>Category: Regulatory Authority</i>	
J. Marshall	Hydro One Networks, Oro Station, Ontario, Canada <i>Category: Carriers</i>	
S. Murphy	Region of York, Newmarket, Ontario, Canada <i>Category: Regulatory Authority</i>	
D. Niles	Cansel, Toronto, Ontario, Canada <i>Category: User Interest</i>	
R. Phillips	ATCO Pipelines, Edmonton, Alberta, Canada <i>Category: Carriers</i>	
M. E. Pollock	Utilicor Technologies Inc., Toronto, Ontario, Canada <i>Category: User Interest</i>	
J. Scaife	Urban X, Mississauga, Ontario, Canada <i>Category: User Interest</i>	
S. Slusarenko	ProStar Geocorp Inc., Surrey, British Columbia, Canada <i>Category: General Interest</i>	
T. Turk	Toronto Hydro-Electric System Ltd, Toronto, Ontario, Canada <i>Category: Carriers</i>	

S. S. Viridi	Technical Standards & Safety Authority (TSSA), Toronto, Ontario, Canada <i>Category: Regulatory Authority</i>	
T. Walker	TELUS, Calgary, Alberta, Canada	<i>Non-voting</i>
M. Braiter	CSA Group, Toronto, Ontario, Canada	<i>Project Manager</i>

Preface

This is the second edition of CSA S250, *Mapping of underground utility infrastructure*. It supersedes the previous edition published in 2011.

The following are the major changes to this edition:

- recognized field data collection technologies have been expanded to include LiDAR, total station survey (TSS), and video recordings (for supplemental records);
- the requirement for mapping records has been expanded to include all stages of operational status, which include abandoned in-place, in-service, out-of-service, and proposed;
- minor changes have been made to the requirements for record retention;
- accountabilities and responsibilities of the locator and excavator have been revised to better align with CAN/CSA-Z247;
- the records lifecycle obligation has been upgraded to be mandatory during all phases of the lifecycle of underground utility infrastructure;
- directions on the limitations of digital base mapping has been provided, as well as obligations towards its use;
- clarification has been provided in Clause [5](#) on how information is collected and used to depict the location and attributes of utility infrastructure so users can be confident of its level of reliability and accuracy;
- the owner's responsibility for measuring and recording the location of underground utility infrastructures has been revised;
- the requirements for absolute spatial positioning (i.e., horizontal and vertical datums) have been revised;
- the accuracy requirements for as-builts have been streamlined in Table [1](#) (see Clauses [5.5](#) and [5.6.2](#) and Figures [2](#) to [6](#)) and Table [2](#) (see Clause [5.7](#) and Figures [2](#) to [6](#));
- the measurement requirement has been revised to include the lowest point below grade for vertical structures (i.e., the bottom of the utility pole);
- the obligation to identify third-party data sources has been expanded within the title block of shared maps and drawings;
- the material abbreviations have been revised to better align with other industry standards;
- the specific utility infrastructure requirements and graphical representations for mapping records have been revised;
- Clause [A.4.5.4.2.2](#) has been expanded to provide guidance on leveraging the resolution of mapping discrepancies to drive the improvement of mapping records; and
- Clause [A.4.7.5](#) has been revised to recognize the importance of open data standards that enable data sharing between industry partners and their respective software environments.

This Standard was prepared by the Technical Committee on Mapping of Underground Utility Infrastructure, under the jurisdiction of the Strategic Steering Committee on Construction and Civil Infrastructure, and has been formally approved by the Technical Committee.

This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Notes:

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- 3) *This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as "substantial agreement. Consensus implies much more than a simple*

majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.

- 4) To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include "Request for interpretation" in the subject line:
 - a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
 - b) provide an explanation of circumstances surrounding the actual field condition; and
 - c) where possible, phrase the request in such a way that a specific "yes" or "no" answer will address the issue.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at standardsactivities.csa.ca.

- 5) This Standard is subject to review within five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line:
 - a) Standard designation (number);
 - b) relevant clause, table, and/or figure number;
 - c) wording of the proposed change; and
 - d) rationale for the change.

CSA S250:20

Mapping of underground utility infrastructure

0 Introduction

The purpose of this Standard is to specify the mapping records requirements used to identify and locate underground utility infrastructure. This Standard is intended to promote the use and drive the advancement of mapping records during the planning, design, construction, and operation of underground utility infrastructure.

Underlying the development of this Standard is the two-fold recognition that it is a privilege, not a right, to bury anything underground in the public right-of-way, and that it is in consideration or exchange for that privilege that the owner is obliged to provide an accurate and retrievable as-built location of that underground utility infrastructure.

The underground is a maze of pipes and cables. Currently, thousands of kilometres of underground pipes and cables have never been accurately mapped or recorded. Infrastructure in Canada's older cities was installed more than 100 years ago when as-built drawings, if any existed, referred to surface features that have long since disappeared. Up until recently, recording the presence and location of such utilities was not formally required or was not carried out in an accurate or methodical way. Today, many of the records that do exist are in formats that are incompatible between utilities, making it difficult to position one company's pipes relative to another's cables.

With so many communications lines, fibre-optic cables, and petroleum, natural gas, electricity, water, and sewer lines, public safety issues arise as to how quickly the underground utility infrastructure can be located and accurately identified in order to avoid an excavation mishap that could result in significant damage, an interruption of service, possible serious injury to workers or the public, or negative impact to the environment.

Municipal authorities and the construction industry are now making a concerted effort to prevent accidental damage to underground utility infrastructure. For example, in the late 1980s, the Common Ground Alliance (CGA) launched the "One Call — Call Before You Dig" program designed to serve as a national resource for professional excavators. Since then, this program processes approximately 28 million underground utility locate requests a year in the United States and Canada, making it the first step in the damage prevention process.

In 2004, to measure the success of this program and to establish a benchmark to measure progress, the CGA introduced a new Damage Information Reporting Tool (D.I.R.T.) to catalogue and identify the causes of approximately 350 000 underground utility infrastructure strikes that occur each year in Canada and the United States. A "root cause" analysis of that data shows that more than half of the reported damages (52%) were the result of poor excavation practices, but approximately 17% were due to poor mapping or locating issues. A more accurate approach of mapping and identifying underground buried utility infrastructure will have a positive impact on reducing the number of those infrastructure strikes and damage near misses.

But both Call Before You Dig and the D.I.R.T. Report are reactive measures. There is much that can be done proactively to establish recording, mapping, and reporting standards that will improve the

usefulness of the underground mapping record going forward. The work of the Technical Committee is dedicated to that effort.

The as-built drawings, records, and mapping systems are the final component of the design and construction activity. They are the combination of many records created during the planning, design, construction, and operation lifecycle of an underground utility infrastructure. At the planning and design stages, it is decided and recorded that the plant should be locatable and identifiable during construction. At the construction stage, records are generated on how the plant is laid, how the tracer wire is applied, and how the tracer is tested. At the construction stage, records are generated to illustrate changes to the design, actual clearances from other utilities, and depth of cover. At the operation and maintenance stage, records are generated to illustrate modifications to the underground utility infrastructure and the repairs made to them at each phase of its lifecycle.

Application of this Standard on a go-forward basis does not necessarily mean that utilities need to dispose of their current mapping policies and practices. However, at a minimum, among the benefits associated with adopting this Standard is the opportunity to establish accuracy and quality levels that are consistent across all Canadian jurisdictions. Adoption of a single standard makes it easier for all end users to respond to calls for proposals, eliminates the need for familiarity with the details of multiple standards, and encourages consistency of approach.

This Standard is complemented by Annexes [A](#) to [E](#), which provide rationale statements and explanatory material for many of the clauses.

1 Scope

1.1 General

This Standard specifies mapping requirements for the recording and depiction of underground utility infrastructure and related appurtenances at or below grade. This Standard does not apply to utility infrastructure that is normally above grade (e.g., overhead wires, pole-mounted transformers, antennas, and dishes).

1.2 Application

This Standard applies to proposed, existing, abandoned in-place, retired, or reserved for future use underground utility infrastructure.

This Standard applies to the generation, storage, distribution, and use of mapping records to ensure that underground utilities are readily identifiable and locatable. Application of this Standard will help capture accurate information about the location and nature of the underground utility infrastructure and make this information available for future projects.

1.3 Terminology

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the Standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.