

Plant-applied external coatings for steel pipe



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 treaty 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 form.

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.



Revision History

Z245.20 Series-18, Plant-applied external coatings for steel pipe

Update No. 1 — December 2019	Revision symbol (in margin)
<p>Z245.20-18 Clauses 3, 4.3, 4.4, 6.2.1, 7.3.2.10, 12.9.3, 12.10.3, 12.11.2, 12.11.3, and 12.13.2 Tables 2, 3, 4, 6, 7, and 8</p> <p>Z245.21-18 Clauses 4.3, 6.2.1, 8.3.1, and 8.3.1A</p> <p>Z245.22-18 Clauses 4.3, 6.1.1, 7.5.4.3.2, 8.4.1, A.3.2.1, and B.4.2.1</p>	①

Standards Update Service

Z245.20 Series-18 September 2018

Title: *Plant-applied external coatings for steel pipe*

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 **24251-2**

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.

Z245.20 Series-18
***Plant-applied external coatings for
steel pipe***



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

*Published in September 2018 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.*

ISBN 978-1-4883-1405-6

*© 2018 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 Petroleum and Natural Gas Industry Pipeline Systems and Materials 8

Subcommittee on Coatings 13

Preface 16

Z245.20-18, Plant-applied external fusion bond epoxy coating for steel pipe

1 Scope 19

2 Reference publications 19

3 Definitions 20

4 General requirements 21

4.1 Product ordering requirements 21

4.1.1 Standard requirements 21

4.1.2 Optional requirements 21

4.2 Rounding procedure 22

4.3 Requirements for quality 22

4.4 Compliance 22

5 Materials 22

5.1 Pipe 22

5.2 Epoxy powders 22

5.2.1 General 22

5.2.2 Properties 23

5.2.3 Packaging 23

6 Coating application 23

6.1 Coating qualification 23

6.1.1 General 23

6.1.2 Preparation of laboratory-coated test specimens 23

6.1.3 Coating qualification test requirements 24

6.2 Production application practices and equipment 24

6.2.1 General 24

6.2.2 Surface preparation 24

6.2.3 Application and curing temperatures 26

6.2.4 Coating thickness 26

6.2.5 Final finish 26

7 Inspection and testing 27

7.1 Inspection notice 27

7.2 Plant access 27

7.3 Tests 27

7.3.1 Epoxy powder and coating 27

7.3.2 In-line inspection and measurement 28

7.3.3	Production test rings	31
8	Repair of coated pipe	32
8.1	General	32
8.2	Holiday repairs (see Table 9)	33
8.3	Stripping and recoating (see Table 9)	33
9	Markings	33
9.1	General	33
9.2	Required markings	33
10	Handling and storage	34
10.1	Handling	34
10.2	Storage	34
11	Test reports and certificates of compliance	34
12	Test procedures	35
12.1	Cure time of the epoxy powder	35
12.1.1	Equipment	35
12.1.2	Procedure	35
12.1.3	Report	36
12.2	Gel time of the epoxy powder	36
12.2.1	Equipment	36
12.2.2	Procedure	36
12.2.3	Report	36
12.3	Moisture content of the epoxy powder — Titration	37
12.3.1	Equipment	37
12.3.2	Reagents	37
12.3.3	Procedure	37
12.3.4	Report	37
12.4	Moisture content of the epoxy powder — Mass loss	37
12.4.1	Procedure A	38
12.4.2	Procedure B	38
12.4.3	Report	38
12.5	Particle size of the epoxy powder	39
12.5.1	Equipment	39
12.5.2	Procedure	39
12.5.3	Report	39
12.6	Density of the epoxy powder	39
12.6.1	Equipment	39
12.6.2	Procedure	39
12.6.3	Report	40
12.7	Thermal characteristics of the epoxy powder and coating	41
12.7.1	General	41
12.7.2	Equipment	41
12.7.3	Procedure	41
12.7.4	Report	43
12.8	Cathodic disbondment of the coating	43

12.8.1	Equipment	43
12.8.2	Test specimens	43
12.8.3	Procedure	43
12.8.4	Report	44
12.9	Interface contamination of the coating	44
12.9.1	Equipment	44
12.9.2	Test specimens	44
12.9.3	Procedure	44
12.9.4	Report	45
12.10	Porosity of the coating	45
12.10.1	Equipment	45
12.10.2	Test specimens	45
12.10.3	Procedure	45
12.10.4	Report	45
12.11	Flexibility of the coating	45
12.11.1	Equipment	45
12.11.2	Test specimens	46
12.11.3	Procedure	46
12.11.4	Report	47
12.12	Impact resistance of the coating	47
12.12.1	Equipment	47
12.12.2	Test specimens	47
12.12.3	Procedure	47
12.12.4	Report	48
12.13	Cathodic disbondment of strained coating	48
12.13.1	Equipment	48
12.13.2	Test specimens	48
12.13.3	Procedure	48
12.13.4	Report	48
12.14	Adhesion of the coating	48
12.14.1	Equipment	48
12.14.2	Test specimens	49
12.14.3	Procedure	49
12.14.4	Report	49
12.15	Gouge resistance of coating	49
12.15.1	General	49
12.15.2	Equipment	49
12.15.3	Test specimens	50
12.15.4	Procedure	50
12.15.5	Report	51
12.16	Surface roughness for anti-slip overcoat systems	51
12.16.1	Equipment	51
12.16.2	Procedure	51
12.16.3	Report	52

Z245.21-18, *Plant-applied external polyethylene coating for steel pipe*

1 Scope 66

2	Reference publications	66
3	Definitions	68
4	General requirements	69
4.1	Product ordering requirements	69
4.1.1	Standard requirements	69
4.1.2	Optional requirements	69
4.2	Rounding procedure	70
4.3	Requirements for quality	70
4.4	Compliance	70
5	Materials	70
5.1	Pipe	70
5.2	General	70
5.3	Primer	71
5.3.1	Liquid primer	71
5.3.2	Powdered primer	71
5.4	Adhesive	71
5.5	Polyethylene	71
5.6	Packaging	71
6	Coating application	71
6.1	Coating qualification	71
6.1.1	General	71
6.1.2	Testing requirements for Systems A, B1, and B2	71
6.1.3	Polyethylene evaluation for Systems A and B1	72
6.1.4	Polyethylene evaluation for System B2	72
6.2	Production application practices and equipment	72
6.2.1	General	72
6.2.2	Surface preparation	72
6.2.3	Application	73
6.2.4	End finish	73
7	Production, inspection, and testing	73
7.1	Inspection notices	73
7.2	Plant access	74
7.3	Incoming raw materials testing	74
7.4	Production tests	74
7.4.1	In-line inspection and measurement	74
7.4.2	Holiday inspection	76
7.4.3	Production test rings	77
7.4.4	Re-tests	78
8	Repair of coated pipe	78
8.1	General	78
8.2	Holiday repairs	78
8.3	Stripping and recoating	78
9	Markings	80

- 9.1 General 80
- 9.2 Required markings 80

10 Handling and storage 80

- 10.1 Handling 80
- 10.2 Storage 80

11 Test reports and certificates of compliance 81

12 Test procedures 81

- 12.1 Viscosity 81
 - 12.1.1 Equipment 81
 - 12.1.2 Procedure 81
 - 12.1.3 Report 81
- 12.2 Flow 82
 - 12.2.1 Equipment 82
 - 12.2.2 Procedure 82
 - 12.2.3 Report 82
- 12.3 Cathodic disbondment of the coating 82
 - 12.3.1 Equipment 82
 - 12.3.2 Test specimens 83
 - 12.3.3 Procedure 83
 - 12.3.4 Report 83
- 12.4 Peel adhesion (constant rate of peel) 84
 - 12.4.1 Equipment 84
 - 12.4.2 Test specimens 84
 - 12.4.3 Test parameters 84
 - 12.4.4 Procedure 84
 - 12.4.5 Report 85
- 12.5 Peel adhesion (hanging mass) 85
 - 12.5.1 Equipment 85
 - 12.5.2 Test specimens 85
 - 12.5.3 Test parameters 85
 - 12.5.4 Procedure 85
 - 12.5.5 Report 86
- 12.6 Heat aging 86
 - 12.6.1 Equipment 86
 - 12.6.2 Test specimens 86
 - 12.6.3 Procedure 86
 - 12.6.4 Report 87
- 12.7 Couge resistance 87

Z245.20-18, Plant-applied external polyurethane foam insulation coating for steel pipe

1 Scope 100

2 Reference publications 100

3	Definitions	103
4	General requirements	104
4.1	Product ordering requirements	104
4.1.1	Standard requirements	104
4.1.2	Optional requirements	104
4.2	Rounding procedure	104
4.3	Requirements for quality	104
4.4	Compliance	105
5	Materials	105
5.1	Pipe	105
5.2	General	105
5.3	Anti-corrosion coating systems	105
5.4	Polyurethane foam system	105
5.5	Wrap tape over foam insulation	105
5.6	Adhesive over foam insulation	106
5.7	External polyethylene jacket	106
5.8	Packaging	106
5.9	Leak detection and monitoring system (LDMS)	106
6	Coating application	106
6.1	Qualification	106
6.1.1	General	106
6.1.2	Qualification test requirements	106
6.1.3	Anti-corrosion coating with applied foam insulation qualification test requirement	107
6.2	Production application practices and equipment	107
6.2.1	General	107
6.2.2	Surface preparation	107
6.2.3	Foam insulation coating application	108
6.2.4	External polyethylene jacket application	108
6.2.5	End finish	109
7	Inspection and testing	109
7.1	Inspection notice	109
7.2	Plant access	109
7.3	Incoming raw materials testing	109
7.4	In-line inspection and measurement for production tests	110
7.4.1	General	110
7.4.2	Application temperature	110
7.4.3	Insulation coating thickness	110
7.4.4	External polyethylene jacket thickness	110
7.5	Finished product inspection and testing	111
7.5.1	Facilities	111
7.5.2	Test samples — Foam insulation and polyethylene jacket	111
7.5.3	Other tests	111
7.5.4	Testing requirements	111
8	Repair of coated pipe	112

8.1	Anti-corrosion coating	112
8.2	Foam insulation	112
8.3	External polyethylene jacket	113
8.4	Stripping and recoating	113
9	Markings	114
9.1	General	114
9.2	Required markings	114
10	Handling and storage	114
10.1	Handling	114
10.2	Storage	114
11	Test reports and certificates of compliance	115
12	Test procedures	115
12.1	Heat aging	115
12.1.1	Equipment	115
12.1.2	Test specimen	115
12.1.3	Procedure	115
12.2	Creep at maximum design temperature	115
12.2.1	Equipment	115
12.2.2	Test specimen	116
12.2.3	Procedure	116
12.2.4	Report	116
12.3	Insulation axial shear strength	116
12.3.1	Equipment	116
12.3.2	Specimen	116
12.3.3	Procedure	117
12.3.4	Report	117
12.4	External polyethylene jacket bend back	117
12.4.1	Equipment	117
12.4.2	Specimen	117
12.4.3	Specimen conditioning — Temperature	118
12.4.4	Procedure	118
12.4.5	Report	118
Annexes		
Annex A (normative)	— Polyolefin tape coatings	126
Annex B (normative)	— Liquid coating	135

Preface

This is the third edition of the CSA Z245.20 Series, *Plant-applied external coatings for steel pipe*, which consists of the eighth edition of CSA Z245.20, *Plant-applied external fusion bond epoxy coating for steel pipe*, the seventh edition of CSA Z245.21, *Plant-applied external polyethylene coating for steel pipe*, and the third edition of CSA Z245.22, *Plant-applied external polyurethane foam insulation coating for steel pipe*. This edition of CSA Z245.20 supersedes the previous editions published in 2014, 2010, 2006, 2002, 1998, 1992, and 1986; this edition of CSA Z245.21 supersedes the previous editions published in 2014, 2010, 2006, 2002, 1998, and 1992; and this edition of CSA Z245.22 supersedes the previous editions published in 2014 and 2010.

CSA Z245.20 deals with the requirements for plant-applied external fusion bond epoxy coating for steel pipe. The main differences from the previous edition are as follows:

- updated definitions (Clause [3](#)); and
- revised test procedures (Clause [12](#)).

CSA Z245.21 deals with the requirements for plant-applied external polyethylene coating for steel pipe. The main differences from the previous edition are as follows:

- revised product ordering requirements (Clause [4.1](#));
- revised requirements for the repair of coated pipe (Clause [8](#));
- revised test procedures (Clause [12](#)); and
- revised acceptance criteria for polyethylene (Tables [3](#) and [9](#)).

CSA Z245.22 deals with the requirements for plant-applied external polyurethane foam insulation coating for steel pipe. The main differences from the previous edition are as follows:

- revised test procedures (Clause [12](#));
- revised coating system qualification tests (Table [2](#)); and
- revised acceptance criteria for polyethylene (Table [5](#)).

In this 2018 edition, where a major change or addition to the previous edition of this Standard has been made, the clause, table, or figure affected is identified by the symbol ® in the margin. Users of this Standard are advised that the change markers in the text are not intended to be all-inclusive and are provided as a convenience only; such markers cannot constitute a comprehensive guide to the revisions made to this Standard. Care must therefore be taken not to rely on the change markers to determine the current requirements of this Standard. As always, users of this Standard must consider the entire Standard.

These Standards were prepared by the Subcommittee on Coatings, under the jurisdiction of the Technical Committee on Petroleum and Natural Gas Industry Pipeline Systems and Materials and the Strategic Steering Committee on Petroleum and Natural Gas Industry Systems, and have been formally approved by the Technical Committee.

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:
- define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
 - provide an explanation of circumstances surrounding the actual field condition; and
 - 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:
- Standard designation (number);
 - relevant clause, table, and/or figure number;
 - wording of the proposed change; and
 - rationale for the change.

Z245.20-18

***Plant-applied external fusion bond
epoxy coating for steel pipe***



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

*Published in September 2018 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.*

ISBN 978-1-4883-1405-6

*© 2018 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.*

Z245.20-18

Plant-applied external fusion bond epoxy coating for steel pipe

1 Scope

1.1

This Standard covers the qualification, application, inspection, testing, handling, and storage of materials required for plant-applied fusion bond epoxy (FBE) coating applied externally to bare steel pipe. The coated pipe is intended primarily for buried or submerged service for oil or gas pipeline systems.

1.2

This Standard covers the following coating systems:

- a) System 1A: single-layer FBE with a glass transition temperature of 115 °C or less;
- b) System 1B: single-layer FBE with a glass transition temperature greater than 115 °C;
- c) System 2A: two-layer FBE with an anti-corrosion coating and a protective overcoat;
- d) System 2B: two-layer FBE with an anti-corrosion coating and an abrasion-resistant overcoat;
- e) System 2C: two-layer FBE with an anti-corrosion coating and an anti-slip overcoat; and
- f) System 3: three-layer FBE with an anti-slip overcoat applied over an anti-corrosion coating and a protective overcoat.

1.3

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.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

② 2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the editions listed below, unless the user finds it more appropriate to use newer or amended editions of such publications.