
WATER AUTHORITY OF JORDAN

STANDARD AND MATERIAL SPECIFICATIONS FOR DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES



Foreword

The Water Authority of the Hashemite Kingdom of Jordan established a technical committee to elaborate state-of-the-art standard specifications and minimum requirements for Ductile Iron Pipes, Fittings and Accessories to be manufactured, imported and used in the Hashemite Kingdom of Jordan for Water Supply Projects.

This Standard OF THE Water Authority of the Hashemite Kingdome of Jordan refers to the EN 545:2010 for Ductile iron pipes, fittings, accessories and their joints for water pipelines, requirements and test methods - English translation, superseding the EN 545:2006 and standardising the preferred classes

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1 SCOPE

This Water Authority of Jordan Standard specifies the requirements and associated test methods applicable to ductile iron pipes, fittings, accessories and their joints for the construction of pipelines outside buildings.

Reference is made to EN 545:2010, 1. Scope.

2 NORMATIVE REFERENCES

The indispensable referenced documents for the application of this Standard are referred to EN 545:2010, 2. Normative References.

3 TERMS AND DEFINITIONS

The terms and definitions in the EN 545:2010 also apply for this Standard.

4 TECHNICAL REQUIREMENTS

4.1 GENERAL

4.1.1 DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES

Nominal sizes, pressure classes, thicknesses, lengths and coatings are specified in the EN 545:2010, Su-Clauses 4.1.1, 4.2, 4.3.1, 4.3.3, 4.5 and 4.6.

4.1.2 SURFACE CONDITION AND REPAIR

Reference is made to Sub-Clause 4.1.2 of the EN 545:2010.

4.1.3 TYPES OF JOINTS AND INTERCONNECTIONS

4.1.3.1 GENERAL

Elastomeric gasket made of EPDM shall comply with the requirements of EN 681-1, type WA.

4.1.3.2 FLEXIBLE JOINTS

Reference is made to Sub-Clause 4.1.3.2 of the EN 545:2010.

4.1.3.3 FLANGED JOINTS

Reference is made to Sub-Clause 4.1.3.3 of the EN 545:2010.

The minimum requirement of drilling of flanges shall be PN16 according to EN 1092-2 (no PN10 drilling); other pressure classes for drillings according to EN 1092-2.

4.1.3.4 PIPE SADDLES

Reference is made to Sub-Clause 4.1.3.4 of the EN 545:2010.

4.1.4 MATERIALS IN CONTACT WITH WATER INTENDED FOR HUMAN CONSUMPTION

Reference is made to Sub-Clause 4.1.4 of the EN 545:2010.

All pipes, coating, and lining materials shall be certified for potable water use and shall contain no

ingredients that may migrate into water in amounts that are considered to be toxic or otherwise dangerous for health.

The Contractor is prohibited to import or to use any of the “Acryl amide and N-Methyl-poly acryl amide Grouts” or any other toxic or poisonous materials or sub materials.

The contractor is required to submit certificates from third party inspectors recognised by the governmental tender directorate, its latest issue, but limited to following internationally recognized and accredited companies:

- Bureau Veritas
- Lloyds
- SGS
- WRAS
- RSS

that all components of the supply must not be of any way toxic to the water being conveyed and can be fully used for the distribution of potable water to a temperature up to 50° C.

The Certificates must be submitted for the following materials:

- a. Cement mortar lining
- b. Bituminous paint
- c. Epoxy paint
- d. Epoxy powder coating
- e. EPDM Sealing Rings and Rubber Gaskets
- f. Lubricating paste

4.2 PRESSURE CLASS

Reference is made to Sub-Clause 4.2 of the EN 545:2010.

4.3 DIMENSIONAL REQUIREMENTS

4.3.1 PIPES AND FITTINGS THICKNESS

Reference is made to Sub-Clause 4.3.1 of the EN 545:2010.

4.3.2 DIAMETER

4.3.2.1 EXTERNAL DIAMETER

Reference is made to Sub-Clause 4.3.2.1 of the EN 545:2010.

4.3.2.2 INTERNAL DIAMETER

Reference is made to Sub-Clause 4.3.2.2 of the EN 545:2010.

4.3.3 LENGTH

4.3.3.1 STANDARDIZED LENGTHS OF SOCKET AND SPIGOT PIPES

Reference is made to Sub-Clause 4.3.3.1 of the EN 545:2010.

4.3.3.2 STANDARDIZED LENGTHS OF FLANGED PIPES

Reference is made to Sub-Clause 4.3.3.2 of the EN 545:2010

4.3.3.3 STANDARDIZED LENGTHS OF FITTINGS

Reference is made to Sub-Clause 4.3.3.3 of the EN 545:2010.

4.3.3.4 LIMIT DEVIATIONS ON LENGTHS

Reference is made to Sub-Clause 4.3.3.4 of the EN 545:2010.

4.3.4 STRAIGHTNESS OF PIPES

Reference is made to Sub-Clause 4.3.4 of the EN 545:2010.

4.4 MATERIAL CHARACTERISTICS

4.4.1 TENSILE PROPERTIES

Reference is made to Sub-Clause 4.4.1 of the EN 545:2010.

4.4.2 HARDNESS

Reference is made to Sub-Clause 4.4.2 of the EN 545:2010.

4.5 COATINGS AND LININGS FOR PIPES

4.5.1 GENERAL

This Water Authority of Jordan Standard specifies for the particular requirement of coating of ductile iron pipes to be adequate for the local soil conditions following:

- a. Zinc-aluminium alloy with or without other metals coating of minimum 400 g/m² with finishing layer of epoxy paint. The internal surface of the socket end shall be painted with a layer of zinc rich epoxy paint plus a layer of non toxic epoxy paint referring to EN 545:2010, Annex D, D.1.1, a), 2) and D.2.2.

Evidence of the long term performance of the above mentioned solution (e.g. tests and references) should be provided by the manufacturer.

- b. In difficult conditions (extremely aggressive soils, with very low resistivity under 500 Ω . Cm and/or low pH), the pipes will be protected externally with the different coatings as described in EN 545:2010, Cement mortar coating fibre reinforced, according to EN 15542, referring to EN 545:2010, Annex D, D.1.1, a) and D.2.3, Polyurethane coating according to EN 15189 or Polyethylene according to EN 14628

For all other general requirements, reference is made to Sub-Clause 4.5.1 of the EN 545:2010.

Option (a) is must unless otherwise mentioned clearly in the tender documents.

4.5.2 COATINGS CHARACTERISTICS

Reference is made to Annex D.2.2 in clause 4.1.1 of the EN 545:2010.

This Standard specifies this coating characteristics as minimum requirement for ductile iron pipes complying with Annex D.2.2 and ductile iron fittings and accessories complying with 4.6.2 may be buried in contact with a large number of soils, which can be identified by soil studies on site, except as specified in Annex D, D.2.1, Standard Coating or otherwise specified in the Tender Documents.

4.5.3 REPAIRS

Reference is made to Sub-Clause 4.5.2.3 of the EN 545:2010.

4.6 INTERNAL LINING OF CEMENT MORTAR

4.6.1 GENERAL

Reference is made to Sub-Clause 4.5.3 of the EN 545:2010. The cement mortar used should be one of those listed in Sub-Clause 4.5.3.1

4.6.2 STRENGTH OF THE LINING

Reference is made to Sub-Clause 4.5.3.2 of the EN 545:2010.

4.6.3 THICKNESS AND SURFACE CONDITION

Reference is made to Sub-Clause 4.5.3.3 of the EN 545:2010.

4.6.4 REPAIRS

Reference is made to Sub-Clause 4.5.3.4 of the EN 545:2010.

4.7 COATINGS FOR FITTINGS AND ACCESSORIES

4.7.1 GENERAL

Reference is made to Sub-Clause 4.6.1 of the EN 545:2010.

This Standard specifies following coating and lining for Fittings and Accessories:

a. Coating

1. Epoxy powder coating (or epoxy paint for ND > 1000mm)

2. Zinc rich paint coating with finishing layer
3. Enamel Lining
4. Epoxy powder lining (or epoxy paint for ND > 1000mm)
5. Cement mortar lining
6. Enamel
7. thick electro-deposited coating with a minimum thickness of 50 microns applied on a blast-cleaned and phosphorated surface

Depending on the external and internal conditions of use, alternative coatings, detailed in Annex D of the EN 545:2010 may be required and used as specified in the tender documents.

Epoxy powder or epoxy paint lining inside and coating outside shall be according to EN 14901

- coating thickness: minimum 200 µm
- **zero porosity:** **minimum 1500 V spark test**
- **adhesion:** **minimum 8 N/mm²**

4.7.2 PAINT COATING

4.7.2.1 GENERAL

Reference is made to Sub-Clause 4.6.2.1 of the EN 545:2010.

Relevant only for bitumen, synthetic resin, zinc rich paint with finishing layer and enamel

4.7.2.2 COATING CHARACTERISTICS

Reference is made to Sub-Clause 4.6.2.2 of the EN 545:2010.

Relevant only for bitumen, synthetic resin, zinc rich paint with finishing layer and enamel

4.8 MARKING OF PIPES, FITTINGS AND ACCESSORIES

4.8.1 PIPES AND FITTINGS

Reference is made to Sub-Clause 4.7.1 of the EN 545:2010.

According to Sub-Clause 4.6, the manufacture's name or mark will be cast-on or cold-stamped (not painted)

4.8.2 ACCESSORIES

Reference is made to Sub-Clause 4.7.2 of the EN 545:2010.

4.9 LEAK TIGHTNESS

Reference is made to Sub-Clause 4.8 of the EN 545:2010.

5 PERFORMANCE REQUIREMENTS FOR JOINTS AND PIPE SADDLES

5.1 GENERAL

To insure their fitness for purpose in the field of water supply, all the joints and pipe saddles shall fulfil the relevant performance requirements of clause 5 of the EN 545: 2010.

A. Quality Assurance System:

The manufacturer shall control the quality of his products during their manufacture by a system of process control according to EN DIN ISO 9001:2000, in order to comply with the technical requirements of the standards. The tests should confirm that the ductile iron pipes, fittings and accessories are manufactured according to EN 545:2010.

B. Traceability System:

The manufacturer shall clearly mention the method by which he can keep records and trace of the manufactured ductile iron pipes, fittings and accessories to ensure the capability of going back to the records for the manufactured item in case any problems accrues after the installation.

5.2 FLEXIBLE JOINTS

5.2.1 GENERAL

The minimum deflection in joints shall be as in Sub-Clause 5.2.1 of the EN 545:2010.

5.2.2 TEST CONDITION

Reference is made to Sub-Clause 5.2.2 of the EN 545:2010.

5.3 TEST PARAMETERS

5.3.1 ANNULUS

Reference is made to Sub-Clause 5.2.3.1 of the EN 545:2010.

5.3.2 PIPE THICKNESS

Reference is made to Sub-Clause 5.2.3.2 of the EN 545:2010.

5.3.3 SHEAR

Reference is made to Sub-Clause 5.2.3.3 of the EN 545:2010.

5.4 RESTRAINED FLEXIBLE JOINTS

Reference is made to Sub-Clause 5.3 of the EN 545:2010.

Types of used restrained flexible joints should be clarified by the manufacturer with an evidence of performance and a list of references.

5.5 FLANGED JOINTS AS CAST, SCREWED, WELDED AND ADJUSTABLE

Reference is made to Sub-Clause 5.4 of the EN 545:2010.

5.6 PIPE SADDLES

5.6.1 TEST CONDITIONS

Reference is made to Sub-Clause 5.5.1 of the EN 545:2010.

5.6.2 ANNULUS

Reference is made to Sub-Clause 5.5.2 of the EN 545:2010.

6 TEST METHODS

6.1 PIPE DIMENSIONS

6.1.1 WALL THICKNESS

Reference is made to Sub-Clause 6.1.1 of the EN 545:2010.

6.1.2 EXTERNAL DIAMETER

Reference is made to Sub-Clause 6.1.2 of the EN 545:2010.

6.1.3 INTERNAL DIAMETER

Reference is made to Sub-Clause 6.1.3 of the EN 545:2010.

6.1.4 LENGTH

Reference is made to Sub-Clause 6.1.4 of the EN 545:2010.

6.2 STRAIGHTNESS OF PIPES

Reference is made to Sub-Clause 6.2 of the EN 545:2010.

6.3 TENSILE TESTING OF DUCTILE IRON COMPONENTS

Reference is made to Sub-Clause 6.3 of the EN 545:2010.

6.3.1 SAMPLES

Reference is made to Sub-Clause 6.3.1 of the EN 545:2010.

6.3.1.1 CENTRIFUGALLY CAST PIPES

Reference is made to Sub-Clause 6.3.1.1 of the EN 545:2010.

6.3.1.2 PIPES NOT CENTRIFUGALLY CAST, FITTINGS AND ACCESSORIES

Reference is made to Sub-Clause 6.3.1.2 of the EN 545:2010.

6.3.2 PREPARATION OF TEST BAR

Reference is made to Sub-Clause 6.3.2 of the EN 545:2010.

6.3.3 APPARATUS AND TEST METHOD

Reference is made to Sub-Clause 6.3.3 of the EN 545:2010.

6.3.4 TEST RESULTS

Reference is made to Sub-Clause 6.3.4 of the EN 545:2010.

6.4 BRINELL HARDNESS OF DUCTILE IRON COMPONENTS

Reference is made to Sub-Clause 6.4 of the EN 545:2010.

6.5 WORKS LEAK TIGHTNESS TEST FOR PIPES AND FITTINGS

Reference is made to Sub-Clause 6.5 of the EN 545:2010.

6.5.1 GENERAL

Reference is made to Sub-Clause 6.5.1 of the EN 545:2010.

6.5.2 CENTRIFUGALLY CAST PIPES

Reference is made to Sub-Clause 6.5.2 of the EN 545:2010.

6.5.3 PIPES NOT CENTRIFUGALLY CAST, FITTINGS AND ACCESSORIES

Reference is made to Sub-Clause 6.5.3 of the EN 545:2010.

6.6 ZINC MASS

Reference is made to Sub-Clause 6.6 of the EN 545:2010.

6.7 THICKNESS OF PAINT COATINGS

Reference is made to Sub-Clause 6.7 of the EN 545:2010.

6.8 THICKNESS OF CEMENT MORTAR LINING

Reference is made to Sub-Clause 6.8 of the EN 545:2010.

7 PERFORMANCE TEST METHODS

7.1 COMPRESSIVE STRENGTH OF THE CEMENT MORTAR LINING

Reference is made to Sub-Clause 7.1 of the EN 545:2010.

7.2 LEAK TIGHTNESS OF FLEXIBLE JOINTS

7.2.1 GENERAL

Reference is made to Sub-Clause 7.2.1 of the EN 545:2010.

7.2.2 LEAK TIGHTNESS OF FLEXIBLE JOINTS TO POSITIVE INTERNAL PRESSURE

Reference is made to Sub-Clause 7.2.2 of the EN 545:2010.

7.2.3 LEAK TIGHTNESS OF FLEXIBLE JOINTS TO NEGATIVE INTERNAL PRESSURE

Reference is made to Sub-Clause 7.2.3 of the EN 545:2010.

7.2.4 LEAK TIGHTNESS OF FLEXIBLE PUSH-IN JOINTS TO POSITIVE EXTERNAL PRESSURE

Reference is made to Sub-Clause 7.2.4 of the EN 545:2010.

7.2.5 LEAK TIGHTNESS OF FLEXIBLE JOINTS TO DYNAMIC INTERNAL PRESSURE

Reference is made to Sub-Clause 7.2.5 of the EN 545:2010.

7.3 LEAK TIGHTNESS AND MECHANICAL RESISTANCE OF FLANGED JOINTS

Reference is made to Sub-Clause 7.3 of the EN 545:2010.

7.4 LEAK TIGHTNESS AND MECHANICAL RESISTANCE OF PIPE SADDLES

7.4.1 POSITIVE INTERNAL PRESSURE

Reference is made to Sub-Clause 7.4.1 of the EN 545:2010.

7.4.2 NEGATIVE INTERNAL PRESSURE

Reference is made to Sub-Clause 7.4.2 of the EN 545:2010.

8 TABLES OF DIMENSIONS

8.1 SOCKET AND SPIGOT PIPES

General Reference is made to Sub-Clause 8.2 of the EN 545:2010.

The Water Authority Standard specifies for each DN the following minimum wall thicknesses highlighted in colour (see the following page), according to the Preferred Classes as described in EN 545:2010.

DN	External diameter DE		Minimum wall thickness <i>e</i>						
	mm		mm						
	Nominal	Limit deviations	Class 20	Class 25	Class 30	Class 40	Class 50	Class 64	Class 100
40	56	+1/-1,2				3,0	3,5	4,0	4,7
50	66	+1/-1,2				3,0	3,5	4,0	4,7
60	77	+1/-1,2				3,0	3,5	4,0	4,7
65	82	+1/-1,2				3,0	3,5	4,0	4,7
80	98	+ 1/- 2,7				3,0	3,5	4,0	4,7
100	118	+1/-2,8				3,0	3,5	4,0	4,7
125	144	+1/-2,8				3,0	3,5	4,0	5,0
150	170	+1/-2,9				3,0	3,5	4,0	5,9
200	222	+1/-3,0				3,1	3,9	5,0	7,7
250	274	+ 1/- 3,1				3,9	4,8	6,1	9,5
300	326	+1/-3,3				4,6	5,7	7,3	11,2
350	378	+1/-3,4			4,7	5,3	6,6	8,5	13,0
400	429	+1/-3,5			4,8	6,0	7,5	9,6	14,8
450	480	+1/-3,6			5,1	6,8	8,4	10,7	16,6
500	532	+1/-3,8			5,6	7,5	9,3	11,9	18,3
600	635	+1/-4,0			6,7	8,9	11,1	14,2	21,9
700	738	+1/-4,3		6,8	7,8	10,4	13,0	16,5	
800	842	+1/-4,5		7,5	8,9	11,9	14,8	18,8	
900	945	+1/-4,8		8,4	10	13,3	16,6		
1 000	1 048	+1/-5,0		9,3	11,1	14,8	18,4		
1 100	1 152	+1/-6,0	8,2	10,2	12,2	16,2	20,2		
1 200	1 255	+1/-5,8	8,9	11,1	13,3	17,7	22,0		
1 400	1 462	+1/-6,6	10,4	12,9	15,5				
1 500	1 565	+1/-7,0	11,1	13,9	16,6				
1 600	1 668	+1/-7,4	11,9	14,8	17,7				
1 800	1 875	+1/-8,2	13,3	16,6	19,9				
2 000	2 082	+1/-9,0	14,8	18,4	22,1				

NOTE 1 The bold figures indicate the standard products which are suitable for most applications. Grey boxes represent products which are outside the scope of this standard.

NOTE 2 For smaller DN, the minimum pipe wall thickness is governed by a combination of manufacturing constraints, structural performance and installation and handling requirements.

NOTE 3 The minimum thickness is given for non-restrained joints (see 4.2).

NOTE 4 Pressure classes between 50 and 100 may be supplied by interpolation on request.

8.2 FLANGED PIPES

Reference is made to Sub-Clause 8.2 of the EN 545:2010.

8.3 FITTINGS FOR SOCKETED JOINTS

Reference is made to Sub-Clause 8.3 of the EN 545:2010.

8.4 FITTINGS FOR FLANGED JOINTS

Reference is made to Sub-Clause 8.4 of the EN 545:2010.

9 EVALUATION OF CONFORMITY

9.1 GENERAL

Reference is made to Sub-Clause 9.1 of the EN 545:2010.

9.2 INITIAL PERFORMANCE TESTING

Reference is made to Sub-Clause 9.2 of the EN 545:2010.

9.2.1 GENERAL

Reference is made to Sub-Clause 9.2.1 of the EN 545:2010.

9.2.2 CHARACTERISTICS

Reference is made to Sub-Clause 9.2.2 of the EN 545:2010.

9.2.3 TREATMENT OF CALCULATED VALUES AND DESIGN

Reference is made to Sub-Clause 9.2.3 of the EN 545:2010.

9.2.4 SAMPLING, TESTING AND CONFORMITY CRITERIA

Reference is made to Sub-Clause 9.2.4 of the EN 545:2010.

9.2.4.1 SAMPLING PROCEDURE

Reference is made to Sub-Clause 9.2.4.1 of the EN 545:2010.

9.2.4.2 TESTING AND COMPLIANCE CRITERIA

Reference is made to Sub-Clause 9.2.4.2 of the EN 545:2010.

9.3 FACTORY PRODUCTION CONTROL (FPC)

Reference is made to Sub-Clause 9.3 of the EN 545:2010.

A. Tests required according to the Water Authority Standard of the Hashemite Kingdom of Jordan

The manufacturer shall demonstrate the conformity of his products with the standards by submitting the performance tests specified in the standards:

B. Quality Assurance System:

The manufacturer shall control the quality of his products during their manufacture by a system of process control according to EN ISO 9001:2000, in order to comply with the technical requirements of the standards. The tests should confirm that the ductile iron pipes, fittings and accessories are manufactured according to EN 545:2010.

C. Traceability System:

The manufacturer shall clearly mention the method by which he can keep records and trace of the manufactured ductile iron pipes, fittings and accessories to ensure the capability of going back to the records for the manufactured item in case any problems accrues after the installation.

9.3.1 GENERAL

Reference is made to Sub-Clause 9.3.1 of the EN 545:2010.

9.3.2 FPC REQUIREMENTS FOR ALL MANUFACTURERS

Reference is made to Sub-Clause 9.3.2 of the EN 545:2010.

9.3.2.1 GENERAL

Reference is made to Sub-Clause 9.3.2.1 of the EN 545:2010.

9.3.2.2 FPC FOR TENSILE TESTING

Reference is made to Sub-Clause 9.3.2.2 of the EN 545:2010.

9.3.3 MANUFACTURER-SPECIFIC FPC SYSTEM REQUIREMENTS

Reference is made to Sub-Clause 9.3.3 of the EN 545:2010.

9.3.3.1 PERSONNEL

Reference is made to Sub-Clause 9.3.3.1 of the EN 545:2010.

9.3.3.2 EQUIPMENT

Reference is made to Sub-Clause 9.3.3.2 of the EN 545:2010.

9.3.3.3 DESIGN PROCESS

Reference is made to Sub-Clause 9.3.3.3 of the EN 545:2010.

9.3.3.4 RAW MATERIALS AND COMPONENTS

Reference is made to Sub-Clause 9.3.3.4 of the EN 545:2010.

9.3.3.5 IN-PROCESS CONTROL

Reference is made to Sub-Clause 9.3.3.5 of the EN 545:2010.

9.3.3.6 NON-CONFORMING PRODUCTS

Reference is made to Sub-Clause 9.3.3.6 of the EN 545:2010.

9.3.3.7 CORRECTIVE ACTION

Reference is made to Sub-Clause 9.3.3.7 of the EN 545:2010.

10 ANNEX A

(normative)

10.1 ALLOWABLE PRESSURES

10.1.1 A.1 GENERAL

Reference is made to Annex A.1 of the EN 545:2010.

10.1.2 A.2 SOCKET AND SPIGOT PIPES (SEE 8.1)

Reference is made to Annex A.2 of the EN 545:2010.

10.1.3 A.3 FITTINGS FOR SOCKETED JOINTS (SEE 8.3)

Reference is made to Annex A.3 of the EN 545:2010.

10.1.4 A.4 FLANGED PIPES (SEE 8.2) AND FITTINGS FOR FLANGED JOINTS (SEE 8.4)

Reference is made to Annex A.4 of the EN 545:2010.

10.1.5 A.5 ACCESSORIES

Reference is made to Annex A.5 of the EN 545:2010.

11 ANNEX B

(informative)

11.1 LONGITUDINAL BENDING RESISTANCE OF PIPES

Reference is made to Annex B of the EN 545:2010.

12 ANNEX C

(informative)

12.1 DIAMETRAL STIFFNESS OF PIPES

Reference is made to Annex C of the EN 545:2010.

13 ANNEX D

(informative)

13.1 SPECIFIC COATINGS, FIELD OF USE, CHARACTERISTICS OF SOILS

13.1.1 D.1 ALTERNATIVE COATINGS

13.1.1.1 D.1.1 PIPES

Reference is made to Annex D.1.1 of the EN 545:2010.

13.1.1.2 D.1 .2 FITTINGS AND ACCESSORIES

Reference is made to Annex D.1.2 of the EN 545:2010.

13.2 D.2 FIELD OF USE IN RELATION TO THE CHARACTERISTICS OF SOILS

13.2.1 D.2.1 STANDARD COATING

Reference is made to Annex D.2.1 of the EN 545:2010.

13.2.2 D.2.2 ALLOY OF ZINC AND ALUMINIUM WITH OR WITHOUT OTHER METALS

Reference is made to Annex D.2.2 of the EN 545:2010.

13.2.3 D.2.3 REINFORCED COATINGS

Reference is made to Annex D.2.3 of the EN 545:2010.

14 ANNEX E

(informative)

14.1 FIELD OF USE, WATER CHARACTERISTICS

Reference is made to Annex E of the EN 545:2010.

15 ANNEX F

(informative)

15.1 F.1 CALCULATION METHOD OF BURIED PIPELINE, HEIGHT OF COVER.

15.1.1 F.1.1 CALCULATION FORMULA

Reference is made to Annex F.1.1 of the EN 545:2010.

15.1.2 F.1.2 PRESSURE FROM EARTH LOADING

Reference is made to Annex F.1.2 of the EN 545:2010.

15.1.3 F.1.3 PRESSURE FROM TRAFFIC LOADING

Reference is made to Annex F.1.3 of the EN 545:2010.

15.1.4 F.1.4 BEDDING FACTOR, K

Reference is made to Annex F.1.4 of the EN 545:2010.

15.1.5 F.1.5 FACTOR OF LATERAL PRESSURE, F

Reference is made to Annex F.1.5 of the EN 545:2010.

15.1.6 F.1.6 MODULUS OF SOIL REACTION, E'

Reference is made to Annex F.1.6 of the EN 545:2010.

15.2 F.2 HEIGHTS OF COVER

Reference is made to Annex F.2 of the EN 545:2010.

16 BIBLIOGRAPHY

Reference is made to Bibliography of the EN 545:2010.