

---

# 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

**© 2010 CEN. All rights of exploitation of the EN 545:2010, in any form and by any means is reserved worldwide for CEN national Members, therefore the Water Authority Standard of the Hashemite Kingdom of Jordan for Ductile iron pipes, fittings, accessories and their joints for water pipelines, requirements and test methods refers to the EN standard in its chapters and clauses.**

Jan 2012

## CONTENTS

<b>1</b>	<b>SCOPE .....</b>	<b>5</b>
<b>2</b>	<b>NORMATIVE REFERENCES.....</b>	<b>5</b>
<b>3</b>	<b>TERMS AND DEFINITIONS.....</b>	<b>5</b>
<b>4</b>	<b>TECHNICAL REQUIREMENTS .....</b>	<b>5</b>
<b>4.1</b>	<b>GENERAL .....</b>	<b>5</b>
4.1.1	Ductile iron pipes, fittings and accessories.....	5
4.1.2	Surface Condition and Repair .....	5
4.1.3	Types of Joints and Interconnections .....	5
4.1.4	Materials in contact with water intended for human consumption .....	5
<b>4.2</b>	<b>PRESSURE CLASS.....</b>	<b>6</b>
<b>4.3</b>	<b>DIMENSIONAL REQUIREMENTS.....</b>	<b>6</b>
4.3.1	Pipes and Fittings Thickness.....	6
4.3.2	Diameters.....	6
4.3.3	Length .....	7
4.3.4	Straightness of pipes.....	7
<b>4.4</b>	<b>MATERIAL CHARACTERISTICS .....</b>	<b>7</b>
4.4.1	Tensile properties .....	7
4.4.2	Hardness .....	7
<b>4.5</b>	<b>COATINGS AND LININGS FOR PIPES .....</b>	<b>7</b>
4.5.1	General.....	7
4.5.2	Coatings characteristic.....	8
4.5.3	Repairs .....	8
<b>4.6</b>	<b>INTERNAL LINING OF CEMENT MORTAR .....</b>	<b>8</b>
4.6.1	General.....	8
4.6.2	Strength of the lining .....	8
4.6.3	Thickness and surface condition.....	8
4.6.4	Repairs .....	8
<b>4.7</b>	<b>COATINGS FOR FITTINGS AND ACCESSORIES.....</b>	<b>8</b>
4.7.1	General.....	8
4.7.2	Paint coating .....	9
<b>4.8</b>	<b>MARKING OF PIPES, FITTINGS AND ACCESSORIES .....</b>	<b>9</b>
4.8.1	Pipes and fittings.....	9
4.8.2	Accessories.....	9
<b>4.9</b>	<b>LEAK TIGHTNESS .....</b>	<b>9</b>
<b>5</b>	<b>PERFORMANCE REQUIREMENTS FOR JOINTS AND PIPE SADDLES .....</b>	<b>10</b>
<b>5.1</b>	<b>GENERAL .....</b>	<b>ERREUR ! SIGNET NON DEFINI.</b>
<b>5.2</b>	<b>FLEXIBLE JOINTS .....</b>	<b>10</b>
5.2.1	General.....	10

5.2.2	Test Condition .....	10
<b>5.3</b>	<b>TEST PARAMETERS .....</b>	<b>10</b>
5.3.1	Annulus .....	10
5.3.2	Pipe thickness .....	10
5.3.3	Shear .....	10
<b>5.4</b>	<b>RESTRAINED FLEXIBLE JOINTS .....</b>	<b>10</b>
<b>5.5</b>	<b>FLANGED JOINTS AS CAST, SCREWED, WELDED AND ADJUSTABLE.....</b>	<b>10</b>
<b>5.6</b>	<b>PIPE SADDLES .....</b>	<b>11</b>
5.6.1	Test conditions.....	11
5.6.2	Annulus .....	11
<b>6</b>	<b>TEST METHODS.....</b>	<b>11</b>
<b>6.1</b>	<b>PIPE DIMENSIONS.....</b>	<b>11</b>
6.1.1	Wall thickness .....	11
6.1.2	External Diameter .....	11
6.1.3	Internal Diameter.....	11
6.1.4	Length .....	11
<b>6.2</b>	<b>STRAIGHTNESS OF PIPES .....</b>	<b>11</b>
<b>6.3</b>	<b>TENSILE TESTING OF DUCTILE IRON COMPONENTS .....</b>	<b>11</b>
6.3.1	Samples.....	11
6.3.2	Preparation of test bar.....	11
6.3.3	Apparatus and test method .....	11
6.3.4	test result .....	12
<b>6.4</b>	<b>BRINELL HARDNESS OF DUCTILE IRON COMPONENTS .....</b>	<b>12</b>
<b>6.5</b>	<b>WORKS LEAK TIGHTNESS TEST FOR PIPES AND FITTINGS .....</b>	<b>12</b>
6.5.1	General.....	12
6.5.2	Centrifugally cast pipes.....	12
6.5.3	Pipes not centrifugally cast, fittings and accessories.....	12
<b>6.6</b>	<b>ZINC MASS .....</b>	<b>12</b>
<b>6.7</b>	<b>THICKNESS OF PAINT COATINGS.....</b>	<b>12</b>
<b>6.8</b>	<b>THICKNESS OF CEMENT MORTAR LINING.....</b>	<b>12</b>
<b>7</b>	<b>PERFORMANCE TEST METHODS.....</b>	<b>12</b>
<b>7.1</b>	<b>COMPRESSIVE STRENGTH OF THE CEMENT MORTAR LINING.....</b>	<b>12</b>
<b>7.2</b>	<b>LEAK TIGHTNESS OF FLEXIBLE JOINTS .....</b>	<b>12</b>
7.2.1	General.....	12
7.2.2	Leak tightness of flexible joints to positive internal pressure .....	12
7.2.3	Leak tightness of flexible joints to negative internal pressure .....	12
7.2.4	Leak tightness of flexible push-in joints to positive external pressure.....	12
7.2.5	Leak tightness of flexible joints to dynamic internal pressure .....	13
<b>7.3</b>	<b>LEAK TIGHTNESS AND MECHANICAL RESISTANCE OF FLANGED JOINTS.....</b>	<b>13</b>
<b>7.4</b>	<b>LEAK TIGHTNESS AND MECHANICAL RESISTANCE OF PIPE SADDLES .....</b>	<b>13</b>

7.4.1	Positive internal pressure .....	13
7.4.2	Negative internal pressure.....	13
<b>8</b>	<b>TABLES OF DIMENSIONS.....</b>	<b>13</b>
<b>8.1</b>	<b>SOCKET AND SPIGOT PIPES .....</b>	<b>13</b>
<b>8.2</b>	<b>FLANGED PIPES.....</b>	<b>15</b>
<b>8.3</b>	<b>FITTINGS FOR SOCKETED JOINTS .....</b>	<b>15</b>
<b>8.4</b>	<b>FITTINGS FOR FLANGED JOINTS.....</b>	<b>15</b>
<b>9</b>	<b>EVALUATION OF CONFORMITY .....</b>	<b>15</b>
<b>9.1</b>	<b>GENERAL .....</b>	<b>15</b>
<b>9.2</b>	<b>INITIAL PERFORMANCE TESTING .....</b>	<b>15</b>
9.2.1	General.....	15
9.2.2	Characteristics.....	15
9.2.3	Treatment of calculated values and design .....	15
9.2.4	Sampling, testing and conformity criteria .....	15
9.2.5	Sampling, testing and conformity criteria .....	15
<b>9.3</b>	<b>FACTORY PRODUCTION CONTROL (FPC) .....</b>	<b>15</b>
9.3.1	General.....	16
9.3.2	FPC requirements for all manufacturers.....	16
9.3.3	Manufacturer-specific FPC system requirements .....	16
<b>10</b>	<b>ANNEX A.....</b>	<b>17</b>
<b>10.1</b>	<b>ALLOWABLE PRESSURES .....</b>	<b>17</b>
10.1.1	A.1 General .....	17
10.1.2	A.2 Socket and spigot pipes (see 8.1) .....	17
10.1.3	A.3 Fittings for socketed joints (see 8.3).....	17
10.1.4	A.4 Flanged pipes (see 8.2) and fittings for flanged joints (see 8.4).....	17
10.1.5	A.5 Accessories .....	17
<b>11</b>	<b>ANNEX B.....</b>	<b>17</b>
<b>11.1</b>	<b>LONGITUDINAL BENDING RESISTANCE OF PIPES .....</b>	<b>17</b>
<b>12</b>	<b>ANNEX C.....</b>	<b>17</b>
<b>12.1</b>	<b>DIAMETRIC STIFFNESS OF PIPES .....</b>	<b>17</b>
<b>13</b>	<b>ANNEX D.....</b>	<b>17</b>
<b>13.1</b>	<b>SPECIFIC COATINGS, FIELD OF USE, CHARACTERISTICS OF SOILS .....</b>	<b>17</b>
13.1.1	D.1 Alternative coatings.....	17
<b>13.2</b>	<b>D.2 FIELD OF USE IN RELATION TO THE CHARACTERISTICS OF SOILS .....</b>	<b>18</b>
13.2.1	D.2.1 Standard coating.....	18
13.2.2	D.2.2 Alloy of zinc and aluminium with or without other metals.....	18
13.2.3	D.2.3 Reinforced coatings .....	18
<b>14</b>	<b>ANNEX E.....</b>	<b>18</b>
<b>14.1</b>	<b>FIELD OF USE, WATER CHARACTERISTICS.....</b>	<b>18</b>
<b>15</b>	<b>ANNEX F.....</b>	<b>18</b>

<b>15.1</b>	<b>F.1 CALCULATION METHOD.....</b>	<b>18</b>
15.1.1	F.1.1 Calculation formula .....	18
15.1.2	F.1.2 Pressure from earth loading .....	18
15.1.3	F.1.3 Pressure from traffic loading .....	18
15.1.4	F.1.4 Bedding factor, K .....	18
15.1.5	F.1.5 Factor of lateral pressure, F .....	18
15.1.6	F.1.6 Modulus of soil reaction, E' .....	18
<b>15.2</b>	<b>F.2 HEIGHTS OF COVER .....</b>	<b>19</b>
<b>16</b>	<b>BIBLIOGRAPHY .....</b>	<b>19</b>

## **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/m<sup>2</sup> 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  $\Omega$ . 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/mm<sup>2</sup>**

#### 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				<b>3,0</b>	3,5	4,0	4,7
50	66	+1/-1,2				<b>3,0</b>	3,5	4,0	4,7
60	77	+1/-1,2				<b>3,0</b>	3,5	4,0	4,7
65	82	+1/-1,2				<b>3,0</b>	3,5	4,0	4,7
80	98	+ 1/- 2,7				<b>3,0</b>	3,5	4,0	4,7
100	118	+1/-2,8				<b>3,0</b>	3,5	4,0	4,7
125	144	+1/-2,8				<b>3,0</b>	3,5	4,0	5,0
150	170	+1/-2,9				<b>3,0</b>	3,5	4,0	5,9
200	222	+1/-3,0				<b>3,1</b>	3,9	5,0	7,7
250	274	+ 1/- 3,1				<b>3,9</b>	4,8	6,1	9,5
300	326	+1/-3,3				<b>4,6</b>	5,7	7,3	11,2
350	378	+1/-3,4			<b>4,7</b>	5,3	6,6	8,5	13,0
400	429	+1/-3,5			<b>4,8</b>	6,0	7,5	9,6	14,8
450	480	+1/-3,6			<b>5,1</b>	6,8	8,4	10,7	16,6
500	532	+1/-3,8			<b>5,6</b>	7,5	9,3	11,9	18,3
600	635	+1/-4,0			<b>6,7</b>	8,9	11,1	14,2	21,9
700	738	+1/-4,3		<b>6,8</b>	7,8	10,4	13,0	16,5	
800	842	+1/-4,5		<b>7,5</b>	8,9	11,9	14,8	18,8	
900	945	+1/-4,8		<b>8,4</b>	10	13,3	16,6		
1 000	1 048	+1/-5,0		<b>9,3</b>	11,1	14,8	18,4		
1 100	1 152	+1/-6,0	8,2	<b>10,2</b>	12,2	16,2	20,2		
1 200	1 255	+1/-5,8	8,9	<b>11,1</b>	13,3	17,7	22,0		
1 400	1 462	+1/-6,6	10,4	<b>12,9</b>	15,5				
1 500	1 565	+1/-7,0	11,1	<b>13,9</b>	16,6				
1 600	1 668	+1/-7,4	11,9	<b>14,8</b>	17,7				
1 800	1 875	+1/-8,2	13,3	<b>16,6</b>	19,9				
2 000	2 082	+1/-9,0	14,8	<b>18,4</b>	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.