

## H : DUCTILE IRON FERROUS SADDLES

### 1.0 GENERAL

#### 1.1 Scope

This Standard specifies the requirements for the design, materials, manufacturer and testing of standard ductile iron ferrous saddles for uPVC, Ductile iron and Asbestos cement pipes.

#### 1.2 Referenced Documents

The following referenced documents contain provisions, which, through reference in this text, constitute provisions of this Standard. For dated references, where there are subsequent amendments to, or revisions of, any of these publications, the Standard shall be amended or revised accordingly. For undated references, the latest edition of publication referred to applies.

The titles of publications referred to in this Standard are listed below:-

Spesifikasi JKR	JKR Standard Specification for Ferrous Saddles (revised edition 1999) 20200-0044-99
MS 628 :Part 1	Specification for unplasticised PVC (uPVC) pipes for water supply: Part 1: Pipes (First Revision)
MS 712	Specification for asbestos cement pressure pipes
N1S 740	Specification for hot-dip galvanized coatings on iron and steel articles
BS 21	Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (Metric dimensions)
BS 6681	Specification for malleable cast iron
BS 4190	Specification for ISO metric black hexagon bolts, screws and nuts
BS 970 : Part 1	Specification for general inspection and testing procedures and specific requirements for stainless steel
BS 3505	Specification for unplasticised PVC pipe for Cold water services
BS 4772	Specification for ductile iron pipes and fittings
BS 2789	Specification for spheroidal graphite or nodular graphite cast iron

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BS EN 1563	Specification for Founding - Spheriodal graphite cast iron
BS 1706	Method for specifying electroplated coatings of zinc and cadmium on iron and steel
BS 2779	Specification for pipe threads for tubes and fittings where pressure tight joints are not made on the threads (Metric dimensions)
MS 672 : 99	Specification for rubber sap-is in water supply, drainage & sewerage pipelines
BS 6920 : Part 1	Specification for suitability of non-metallic products for use in contact with water intended for human-consumption with regard to their effect on water quality of the water. Part 1: Specification
BS 3643 : Part 2	ISO metric screw threads . Specification for selected limits of size
BS 7079	Preparation of steel substrates before application of paints and related products
BS 3900	Methods of tests for paints.  Part F4 : Resistance to continuous salt spray  Part F11: Durability tests on paint films. Determination of resistance to cathodic disbanding of coatings for use on land-based buried structure
BS EN 512	Fibre-cement products. Pressure pipes and joints
BS EN 10083-1	Technical delivery conditions for special steels
AS 1646	Specification for elastomeric seals for waterworks purposes
AS 4020	Product for use in contact with water intended for human consumption with regard to their effect on the quality of water
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fitting for water industry purposes
ISO 2531	Specification for ductile iron pipes, fittings and accessories for pressure pipelines
ISO 8501: Part 1	Preparation of steel substrates before application of paints and related products - visual assesment of surface cleanliness

Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings

SS 05 5900	Pictorial surface preparation standard for painting steel surfaces
AWWA C210	Liquid epoxy coating systems for the interior and exterior of steel water pipelines
ASTM D570	Water absorption test
ASTM D 4066	Specification for nylon injection and extrusion materials (PA)

## 1.3 Definitions

For the purpose of this standard, the following definition applies.

### 1.3.1 *Ferrous Saddle*

Ferrous saddle is a device used in water works for making service connections and tapping. It is used as a services clamp, which is, attached directly 360° around the pipe or for pipe's wall which is too thin or too soft. The use of the ferrous saddle is to provide support for the pipe without deforming it and distributes stresses away from tapping hole as well as purchase for the threads of the ferrule.

### 1.3.2 *Polyamide Adaptor*

Polyamide (high strength plastic) adaptor provided with the tapping thread, is integral with the boss of the saddle. The design of polyamide adaptor is to have protection against corrosion. It replaces threading onto the ductile iron-boss/body of the saddle that will also prevent galvanic effect (that will cause severe corrosion) between ductile iron ferrous saddle and the brass ferrule.

## 1.4 Types of Ferrous Saddle

Ferrous saddles shall be one of the following types :

### 1.4.1 *Saddle Type A*

Type A ferrous saddle is suitable for tapping Asbestos Cement Pipe complying with MS 712 and BS EN 512 and Ductile Iron pipes complying with BS EN 545 : 2002 (previously known as BS4772 : 1933) and ISO 2531. (see Figure 1)

### 1.4.2 *Saddle Type B*

Type B ferrous saddle is suitable for tapping uPVC pipe complying with MS 628: Part 1 and BS 3505 (see Figure 2)

NOTE : Both are designed to withstand same torque loads and bending moments,

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## 1.5 Illustration

Ferrous saddle shall be of general form shown in Drawing.

## 1.6 Materials

The clamp ferrous saddle should be manufactured from compounded material meeting the followings specification as below.

**Table 1: Material for Ferrous Saddle**

Components	Material	Symbol	Reference	Grade or Designation
Ferrous saddle body	Ductile Iron	DI	BS 2789 BS EN 1563 : 97	420/10, 500/7 400/15, 500/7
Bolts, Nuts, Washer	Stainless Steel* Carbon Steel (Polymeric Coated)	SS	BS 970 Part 1 BS EN 10083-1	304 S31, 16S13, 321 S13 2C22
Sealing Gasket (TOP)	Synthetic Rubber	EPDM	MS 672: 99/ AS 1646/BS EN 681	66-75 IRHD
Sealing Gasket (Bottom)	Synthetic Rubber	EPDM	MS 672: 99/ AS 1646/BS EN 681	66-75 IRHD
Polyamide Adaptor	Polyamide -11	PA	ASTM D 4066	PA321

*NOTE : All casting shall have smooth, homogeneous and free from flaws, cracks blow outs or other harmful defects. Grey cast iron, of BS 1457 Grade 220 and Malleable cast iron BS 6681 Grade B30-06/W35-04 are not allowed to be used for this product.*

*\* For coating refer Section Two - Protection against corrosion*

All materials likely to contact with potable water should be incapable of permitting bacterial growth. Non-metallic materials should comply with the requirement of the effect of non-metallic materials on water quality as mentioned in specification.

## **1.6.1 Body**

Body material shall be manufactured from the materials given as appropriate in Table : Material For Ferrous Saddle.

*NOTE : Body materials may be specified by the purchaser in his enquiry or order*

## **1.6.2 Bolt, Nut and Washer**

Bolt, nut and washer materials should be selected from Table : Material For Ferrous Saddle. The length of the bolts shall be as shown in the drawing.

## **1.6.3 Sealing Gasket**

Gaskets shall be vulcanised, moulded or extruded elastomer and shall be free from porous areas, foreign materials and visible defects. Reclaimed rubber shall not be used

Sealing Gasket shall be made of EPDM complying with MS672 : 99, AS 1646:92 or BS EN 681 for potable water applications, sealing gasket made of natural rubber is not allowed. Materials complying with this standard shall meet the requirements of BS 6920, which specifies the requirements for non-metallic materials in contact with portable water.

Gaskets shall be manufactured from elastomeric compound of hardness (measured in IRHD) such that the ferrous saddle shall perform satisfactorily in both short and long term tests as specified. To meet this requirement gaskets shall fall within the nominal hardness range of 66 -75 IRHD)

## **1.6.4 Polyamide Adaptor**

The adaptor shall be made of injection moulded Polyamide 11 and shall comply with ASTM D 4066 and shall follow the dimension and illustration in drawing.

## **1.7 Effect of Non-Metallic Products on Water Quality**

When used under the conditions for which they are designed, non-metallic products in contact with or likely to come into contact with potable water shall comply with BS 6920 : Part 1.

## **1.8 Workmanship**

### **1.8.1 Casting**

All casting shall be homogeneous, smooth and shall be free from flaws, cracks, blowholes, cuts or other harmful defects. All surfaces in close proximity to the pipe and gaskets shall be smooth and free from sharp edges.

## **1.9 Nominal Sizes**

Ferrous saddle shall be one of the following nominal sizes (DN) DN 80, DN 100, DN 150, DN 200, DN 250, DN 300, DN 350 and shall be designated by the nominal diameter of the pipes.

## **1.10 Dimension and Tolerances**

The ranges of nominal sizes from DN 80 to DN 350 applicable to each materials, tapping sizes dimensions of each tape materials shall be as shown in drawing.

The tolerances for these dimensions shall be as shown in drawing.

NOTE. The details of ferrous saddle shown in drawing may differ from one manufacturer to another provided the dimensions identified are maintained.

### **1.10.1 Boss Dimensions**

The boss dimensions shall comply with table as appropriate. The boss shall permit tapping within the size range ½" to 1" BSP.

### **1.10.2 Tapping Dimensions**

The tapping hole shall be threaded in accordance with BS 21 with positive tolerance deviation accordance with the requirements of BS 2779.

### **1.10.3 Bolts, Nuts and Washer Dimensions**

Bolt, nut and washer dimensions shall comply with BS 4190. Bolts shall be provided with a track-head, or similar neck which locates in a similarly shaped hole in the ferrous saddle body, thus preventing rotation of the bolt and permitting tightening of the bolts using only one spanner. The threads on bolts, studs and nuts shall comply

with ISO metric series of BS 3643 : Part 2. Thread lengths shall in every case be of sufficient length to permit proper tightening of the ferrous saddle to create the designed pressure seal without the nut reaching the end of the threaded section.

All bolts holes shall be drilled or accurately moulded and shall be equally spaced on the pitch circle diameter and shall be located off-centre.

### **1.10.4 Sealing Gasket Dimensions**

Gaskets shall be such size and shape as to provide a pressure tight seal for the life expectancy of the pipeline under the specified working, transient and test pressure conditions.

## **Saddle Type A**

Sealing Gasket shall be contained within the recess between the boss and the pip. The thickness of the rubber sealing gasket shall be not less than 4 mm while the outside diameter shall be not less than 75mm.

## **Saddle Type B**

The thickness of sealing gasket contained within the recess between the boss and the pipes shall be not less than 4 mm while the rubber gasket contained under the ferrous saddle body shall be not less than 1.5 mm.

## **2.0 PROTECTION AGAINST CORROSION**

### **2.1 Surface Preparation**

This section specifies methods of protecting ferrous saddles against corrosion. It covers internal and external protection by Fusion Bonded Epoxy powder (FBE) and by Polyamide 11.

The surface to be protected shall be clean and free from porosity, cracks, scale, loose rust, oil, grease or other foreign matter. Surface preparations shall be effected by abrasive blast cleaning cold applied surface tolerant high solid epoxy with AWWA C210 can be used as an alternative polymeric coating system. The surface preparation, coating requirements and test methods for this coating system are separately dealt with in Appendix : Surface Preparation, Coating Requirements and Test Methods for Cold Applied Surface Tolerant High Solid Liquid Epoxy.

### **2.2 Degreasing**

All items intended for coating shall be decreased to remove all oil, grease and residual surface solids.

### **2.3 Abrasive Cleaning**

Iron and steel surfaces of ferrous saddles shall be prepared by abrasive blast cleaning to SA 2½ quality of BS 7079.

*NOTE : If a SA 3 surface quality is required, the purchaser shall specify this at time of placing an order.*

### **2.4 Pre-Treatment**

After blast cleaning the resultant surface shall be free of loose dust, oil, grease, soluble salts and other materials that may be deleterious to the final performance of the coating. Water washing, degreasing and oil-free air blast shall be used as necessary to ensure these contaminants are removed prior to proceeding with the coating process.

If recommended by the coating materials manufacturer, chemical pre-treatments such as phosphate conversion coatings may be applied. The final coating process shall be carried out within 24 h of such pre-treatment, and within 3 h if no chemical pre-treatment coating is applied.

All metal surfaces that are to receive a coating of Polyamide 11 shall be coated with a primer, supplied by the coating material manufacturer for use with the nylon powder and allowed to dry before the final coating process proceeds. This operation of priming shall take place within 8 hours after blast cleaning, onto clean, de-dusted surfaces. Threaded fasteners that are to be coated with a self-adhesive grade of Polyamide 11 do not require priming. The final coating shall take place within 8 hours after blast cleaning.

## **2.5. Coating**

### **2.5.1 General**

Coating shall be carried out using either fusion bonded epoxy powder or nylon 11 materials. The coating shall be applied using either the fluidised bed dipping process or the electrostatic spray process and shall produce a finished coating which fully complies with the thickness recommendations of the coating materials manufacturer, though subject to the thickness limitation specified.

### **2.5.2 Body**

The coatings on ferrous saddle body shall be not less than 250  $\mu\text{m}$  for Polyamide 11 or not less than 350  $\mu\text{m}$  thick for Fusion Bonded Epoxy as specified in AS/NZ 4158. Particular attention shall be paid to either thinning or excessive build-up of coatings at sharp edges especially at bolt - holes. Clearance between the pipe outside diameter and the internal diameter of coated ferrous saddles shall be sufficient to ensure satisfactory assembly of the ferrous saddle onto the pipe, without damage to the coating.

### **2.5.3 Fasteners**

Bolt, studs and nuts which are to be coated with epoxy or materials shall first be zinc plated on all surfaces to BS 1706 Grade Fe/Zn 12 Threaded fasteners which are to be Polyamide 11 coated shall use a self-adhesive grade of Polyamide 11.

The finished thickness of coating on threaded fasteners shall be between 75  $\mu\text{m}$  and 125  $\mu\text{m}$ . All surfaces of bolts, studs and nuts shall be coated, except that it is permissible to leave uncoated the internal surface of coated nuts and the extreme tips of coated bolts, provided that the resultant uncoated sections of bolts do not form part of the tensile section of the bolt after tightening.

Fasteners shall be provided with washers under each nut. Washers shall be spun galvanised to MS 740 and may in addition be further coated with either epoxy or Polyamide 11.



## 2.6 Coating Application

The method of coating application shall comply fully with the recommendations of the coating materials manufacturer and if required by the purchaser, the coupling manufacturer shall submit full detail of the method of application for approval by the purchaser. In case of epoxy coatings, which have limited shelf life, particular attention shall be taken on products tracing.

The resultant coating shall be uniform in colour and texture and shall not exhibit blisters, bubbles, crazed areas or contaminant inclusions. The coating shall be completely fused to a smooth continuous film. No bare metal shall be visible except for areas left deliberately uncoated. No pinholes, tears, runs, sags or excessive coating build-up shall be evident. All support points shall be touched up with a compatible coating material recommended by the coating supplier.

## 2.7 Tests on Applied Protections

### 2.7.1 *Holiday Test*

Ferrous saddle shall be tested for continuity of the applied coating protection using a high voltage holiday detector set at a minimum 1,500 V or 5  $\mu\text{m}$ . Discontinuities and pinholes indicated by the test shall be made good with an approved repair material and the component re-tested satisfactorily.

### 2.7.2 *Cure Test*

Fusion bonded epoxy coatings shall be tested for proper cure of the coating by rubbing the coating with MEK (methyl ethyl ketone). If the coating becomes soft or tacky, insufficient cure is indicated. In such case, post curing of the coating shall be carried out by further heating in an oven until the necessary degree of cure is achieved. Polyamide 11 coatings which are thermoplastic do not require this test.

NOTE. When working with MEK appropriate safety precautions must be taken. MEK is flammable and must be kept away from open flames or other sources of ignition.

## 2.8 Repair

Any defective coatings shall be made good using methods approved by the coating materials manufacturer.

## 2.9 Sampling

Two percent of each particular size and type of the ferrous saddles to be supplied shall be tested. Any test piece, which fails to comply with dimensions, tests, or showing signs of defect will render the whole batch to be rejected.

## **2.10 Protection Against Damage in Storage; Transport and Handling**

Coated ferrous saddle shall be protected against damage in storage, transport and handling by means of plastic sheeting, corrugated paper, rubber pads, wood wool pads, etc.

## **3.0 TESTING**

### **3.1 Testing**

#### **3.1.1 Test Requirement**

The manufacturer shall conduct a type test on each type and size of ferrous saddle before dispatch to the site.

Type testing shall consist of the following tests in the sequence specified:

- Strength Testing
- Functional Testing
- Corrosion Testing
- Water Testing Test
- Cathodic Disbondment Test
- Adhesion Test
- Chemical resistance test

Test results shall be recorded and retained by the manufacturer and shall include the results of a visual examination of the ferrous saddle components after type testing.

#### **3.1.2 Strength Testing**

The ferrous saddle should be attached directly 360° around the test apparatus with corresponding pipe OD in normal manner and gradually tightened the bolts with a torque as specified in Table 2, in order to test the strength of the ferrous saddle body. There shall be no visible evidence of structural damage to the ferrous saddle body.

#### **3.1.3 Functional Testing**

The same ferrous saddle be attached directly 360° around the corresponding type size of pipe with the insertion of sealing gasket under the boss (with tapping hole c/w stop plug) and around a hole drilled in the pipe with a torque which shall not at any point exceed the maximum functional test torque specified in Table 2 as applicable. There shall be no visible evidence of structural damage to the boss and ferrous saddle body and of leakage when subjected to an internal pressure of 16 bar during the test duration as shown below.

**Table 2: Test Torque**

Nominal Size (DN)	Minimum Strength Test Torque (Nm)	Maximum Functional Test Torque (Nm)	Test Duration (minimum) (Min)
80 up to & including 350	220	120	1

**3.1.4 Corrosion Testing**

The ferrous saddle should be coated in accordance with Clause 2.5 and shall conduct a salt spray test complying requirement specified in BS 3900 : F4.

**3.1.5 Water Absorption Test**

Samples shall be tested according to ASTM D570 for water absorption. The test consists of an immersion in water at 20 °C during 90 days. Samples shall display water absorption of not more than 3 % by weight of coating.

**3.1.6 Cathodic Disbondment test**

Coated pieces shall be tested according to Sections 5, 6, 7, 8 and 9 of BS 3900 : F11. The coating, when subjected to an impressed current at a negative voltage of 1.5 V, shall not disbond more than 5 mm radially from the end of the damaged coating after 28 days.

**3.1.7 Adhesion Test**

Adhesion testing shall be carried out to determine the adhesive strength of the coating to the substrate. It does not prove cohesive strength of the coating. Testing

shall be by means of a 'V'-cut test. Toughness of the film and visual evidence of coating in the anchor pattern valleys will give good indication of satisfactory adhesion.

The test shall be carried out using a sharp knife. Two cuts are made in the coating at an included angle of approximately 30°. Using the sharp point of a craft knife or similar, the knife shall be used to attempt to lift the point of the 'V' in a single action by levering against a fulcrum. No more than 2 mm of the 'V' shall be removed by this method by adhesive failure to the substrate or the adhesion shall be considered to be unsatisfactory.

The purchaser shall state his requirement for an adhesion test at time of order and shall agree with the coupling manufacturer the frequency of testing to be carried out and any variation on the acceptance criteria.

**3.1.8 Chemical Resistance Test**

The ferrous saddle shall be immersed in a saturated solution of zinc chloride under room temperature for 10 hours. There shall be no visible evidence of damage and of leakage when subjected to an internal pressure of 16 bar.

### **3.1.9 Visual Inspection**

Ferrous saddles shall be clean and free from such defects as can be established by visual inspection in accordance with this standard.

Ferrous saddles shall not deviate from roundness by more than +1mm. Ferrous saddle body shall be smoothed and free from excessive burrs that might cause damage to the gasket or might impair the pressure tightness of the joint.

Gaskets shall be moulded as specified in Sealing Gasket Dimensions.

### **3.1.10 Short Term Pressure Testing**

The ferrous saddle body shall be subjected to a hydrostatic pressure test of 1.5 times the maximum permissible installed working pressure for a period of at least 1 hour without leakage.

## **3.2. Production Testing**

Steel saddles which are flash welded and expanded beyond the yield point of the steel, need not be further mechanically or hydrostatically tested.

Steel saddles that are manufactured from previously pressure tested pipe or tubing need not be further hydrostatically tested.

Ferrous saddles made from malleable or ductile iron shall be 100 % air tested under water, either at the foundry or by the coupling manufacturer, to a pressure of at least 6 bar for a period of at least 5 seconds after static conditions have been obtained after immersion in the water, without visible leakage. Castings which fail this test shall be rejected.

## **4.0 MARKING**

### **4.1 Marking**

Each ferrous saddle shall be legibly marked (not on top of the boss of the saddle) in accordance with the following requirements.

- Manufacturer's name or trade mark;
- The designation of size
- Body material designation
- Year of manufacture (last two digits)
- Standard of manufacture
- Ferrous saddle type

*NOTE. Additional markings may be used at the option of the manufacturer and purchaser provided that they do not conflict with any of the markings specified.*