## 5.3 Finish (4.3.2)

### 5.3.1 Surface evenness

When tested in accordance with C.1 the internal surface of a unit shall contain no irregularities that cause the central portion of the gauge to touch the unit.

*NOTE For units of the smaller nominal sizes, it may prove impracticable to test the central portion of the unit.*

### 5.3.2 Surface voids

When tested in accordance with C.2 surfaces of units shall be free from voids that permit diametrically opposite points of the rim of the gauge to touch the surface of the unit simultaneously and are greater than 12 mm deep.

Units exhibiting any surface void greater than 12 mm deep shall be deemed not to conform to this part of BS 5911.

*NOTE Voids up to and including 12 mm deep can be made good by the manufacturer — see BS EN 1916:2002, **4.3.2.***

**Table 2** — *Nominal sizes and tolerances of units with a circular bore, for use in a trench*

| **Nominal size** DN | **Tolerance on actual diameter from nominal size** mm |
|---|---|
| 225 | ±5 |
| 300 | ±5 |
| 375* | ±5 |
| 400 | ±5 |
| 450* | ±5 |
| 500 | ±6 |
| 525* | ±6 |
| 600 | ±6 |
| 675* | ±6 |
| 700 | ±7 |
| 750* | ±7 |
| 800 | ±7 |
| 825* | ±7 |
| 900* | ±8 |
| 1 000 | ±8 |
| 1 050* | ±8 |
| 1 200 | ±9 |
| 1 350* | ±10 |
| 1 400 | ±10 |
| 1 500* | ±11 |
| 1 600 | ±11 |
| 1 800 | ±12 |
| 2 000 | ±13 |
| 2 100* | ±14 |
| 2 200 | ±14 |
| 2 400* | ±15 |
| 2 500 | ±15 |
| 2 800 | ±15 |
| 3 000 | ±15 |

**Table 4** — *Nominal sizes, internal manufacturing diameter and tolerances of jacking pipes*

| Nominal size | Limits of internal manufacturing diameter | | Tolerance on actual diameter from manufacturing diameter[A)] | |
|---|---|---|---|---|
| DN | mm | | mm | |
| | Minimum | Maximum | Internal | External |
| 450 | 440 | 460 | ±5 | ±4 |
| 500 | 490 | 525 | ±6 | ±4 |
| 600 | 580 | 610 | ±6 | ±4 |
| 700 | 675 | 720 | ±7 | ±4 |
| 800 | 770 | 825 | ±7 | ±4 |
| 900 | 875 | 950 | ±8 | ±4 |
| 1 000 | 980 | 1 070 | ±8 | ±5 |
| 1 200 | 1 180 | 1 220 | ±9 | ±5 |
| 1 400 | 1 350 | 1 420 | ±10 | ±5 |
| 1 500 | 1 470 | 1 530 | ±11 | ±5 |
| 1 600 | 1 580 | 1 675 | ±11 | ±6 |
| 1 800 | 1 780 | 1 830 | ±12 | ±6 |
| 2 000 | 1 950 | 2 135 | ±13 | ±6 |
| 2 200 | 2 170 | 2 250 | ±14 | ±7 |
| 2 500 | 2 375 | 2 550 | ±15 | ±7 |
| 2 800 | 2 680 | 2 850 | ±15 | ±7 |
| 3 000 | 2 965 | 3 050 | ±15 | ±7 |

*NOTE The values of certain limits of internal manufacturing diameter have been chosen to allow for utilization of existing manufacturing equipment during transition to a rationalized metric range of nominal sizes and also to suit the installation equipment, which controls the external diameter of jacking pipes.*

[A)] See 3.6.

#### 5.4.5.1 Tolerances on the internal diameter of units with a circular bore, for use in a trench

The tolerances on the internal manufactured diameter of units with a circular bore, for use in a trench, shall be ±5 mm for nominal sizes up to and including DN 300 and ±(3 + 0.005DN) mm for larger nominal sizes (rounded to the nearest millimetre), limited to ±15 mm (see Table 2). All individual measurements, measured in accordance with D.2, shall be inside the specified limits.

#### 5.4.5.3 Tolerances on the internal diameter of jacking pipes

The tolerances on the internal manufactured diameter of jacking pipes shall be ±(3 + 0.005 DN) mm (rounded to the nearest millimetre), limited to ±15 mm (see Table 4). No individual measurement, measured in accordance with D.2, shall be outside the specified limits.

#### 5.4.5.4 Tolerances on the external diameter of jacking pipes

The tolerances on the external manufactured diameter of the barrel of a jacking pipe shall be as given in Table 4. All individual measurements, measured in accordance with D.3, shall be inside the specified limits.

#### 5.4.5.5 Tolerance on the wall thickness

When measured in accordance with D.4, the wall thickness shall be not less than the value stated in the factory documents.

#### 5.4.5.6 Deviation from straightness

When measured in accordance with D.5, for the internal straightness of a straight unit (and for jacking pipes, the external straightness) both ends of the gauge shall not make contact with the surface of the unit when using Edge X and the two studs shall be in contact simultaneously when using Edge Y.

*NOTE* *See Figure D.1.*

#### 5.4.5.7 Tolerance on the internal barrel length of jacking pipes

When evaluated in accordance with D.5.1 the tolerance on the mean internal barrel length of jacking pipes up to a nominal size of DN 800 shall be ±10 mm. For pipes with a larger nominal size the tolerances on the internal barrel length shall be between +25 and −10 mm. Where pipes are designed for use with a method of installation that requires tighter manufacturing tolerances, these shall be stated in the factory documents and inspection procedures shall provide for the selection and marking of groups of pipes for delivery to a specific contract.

#### 5.4.5.8 Squareness of ends

Units shall be capable of being jointed with their axes coincident within the deflection limit specified in BS EN 1916:2002, **F.5.2**; for circular units this requirement shall apply in any orientation.

*NOTE* *Squareness of ends of trench units is significant only to the extent that it relates to the performance of the joint assembly.*

When evaluated in accordance with D.5.1 and D.5.2 the ends of a jacking pipe shall conform to the requirements of Table 5 for squareness across a diameter and wall thickness.

**ıble 5** — *Tolerances on the squareness of ends of jacking pipes*

| Nominal size | Maximum deviation across a diameter | Maximum deviation across wall thickness |
|---|---|---|
| DN | mm | mm |
| DN k 900 | 3 | 2 |
| 900 < DN k 1 500 | 3.5 | 3 |

**Table 5** — *Tolerances on the squareness of ends of jacking pipes (continued)*

| Nominal size | Maximum deviation across a diameter | Maximum deviation across wall thickness |
|---|---|---|
| DN | mm | mm |
| 1500 < DN k 2 100 | 5 | 4 |
| 2100 < DN k 3 000 | 6 | 5 |

# Annex C (normative)
# Surface finish tests

## C.1 Surface evenness test

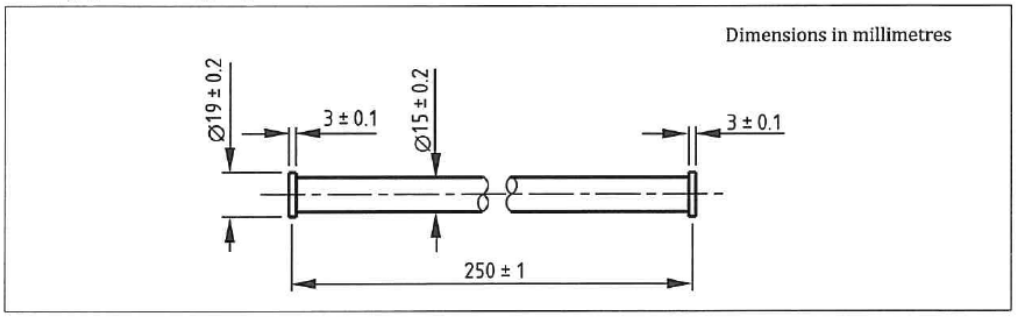
### C.1.1 Principle

This test evaluates whether the internal surface of a unit conforms to the limiting requirement in 5.3.1 for evenness.

### C.1.2 Apparatus

**C.1.2.1** *Gauge*, as described in **Figure C.1**.

**Figure C.1** — *Gauge for assessing surface evenness*




### C.1.3 Procedure

**C.1.3.1** Place the gauge in the unit so that its axis is in the same plane as the unit's longitudinal axis.

**C.1.3.2** Roll the gauge around the inside of the unit, maintaining its axis in the same plane as the unit's longitudinal axis at all times.

### C.1.4 Expression of result

Record whether the gauge rolled over any part of the internal surface without the central portion of the gauge contacting the unit.

## C.2 Surface void test

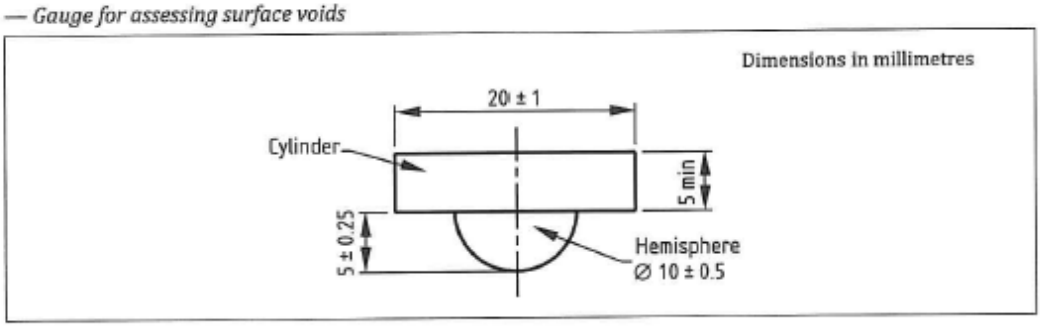
### C.2.1 Principle

The purpose of this test is to evaluate whether any void in the surface of a unit conforms to the limiting requirements in 5.3.2.

### C.2.2 Apparatus

**C.2.2.1** *Gauge*, as described in Figure C.2.

**Figure C.2** — *Gauge for assessing surface voids*




### C.2.3 Procedure

Apply the ball of the gauge to the void.

### C.2.4 Expression of result

Record whether diametrically opposite points in the rim of the gauge simultaneously touched the surface of the unit.

# Annex D (normative) Dimensional tests

*COMMENTARY ON ANNEX D*

*At the manufacturer's discretion it is permissible to use purpose-made "go/no-go" gauges for dimensional measurements instead of the apparatus specified for the tests in this annex.*

## D.1 Internal dimensions test

### D.1.1 Principle

The purpose of this test is to evaluate whether the internal diameter of circular units and circular units with base for trench use, the width/height of egg-shaped units and the internal diameter of jacking pipes conform to 5.4.5.1, 5.4.5.2 and 5.4.5.3 respectively.

### D.1.2 Apparatus

**D.1.2.1** *Steel measuring tape or retractable pocket rule*, with metric graduation and figuring conforming to BS 4484-1.

### D.1.3 Procedure

For units with a circular bore, take three measurements of the internal diameter at each end at approximately 60° to each other. For egg-shaped units, make a measurement of the horizontal and vertical axes at each end. For all units take the measurements approximately 50 mm from the ends of the internal barrel and record the measurement.

### D.1.4 Expression of results

Record whether each measured value of the internal diameter or width/height conforms to **5.4.5.1**, 5.4.5.2 and 5.4.5.3 as appropriate.

---

## D.2 External diameter test for jacking pipes

### D.2.1 Principle

The purpose of this test is to evaluate whether the external barrel of a jacking pipe conforms to 5.4.5.4.

### D.2.2 Apparatus

**D.2.2.1** *Steel measuring tape*, steel band or retractable pocket rule, with metric graduation and figuring conforming to BS 4484-1.

### D.2.3 Procedure

Measure the external circumference of the pipe at approximately 50 mm from the ends of the barrel and record this measurement.

Calculate the external diameter of the barrel from the measured circumference.

### D.2.4 Expression of results

Record whether each measured value of the external diameter conforms to 5.4.5.4.

---

## D.3 Wall thickness test

### D.3.1 Principle

The purpose of this test is to evaluate whether the wall thickness of a unit conforms to 5.4.5.5.

### D.3.2 Apparatus

**D.3.2.1** *Outside spring caliper*, conforming to BS 3123.

**D.3.2.2** *Steel measuring tape or retractable pocket rule*, with metric graduation and figuring conforming to BS 4484-1.

### D.3.3 Procedure

For circular units, measure the wall thickness approximately 50 mm from the end of the external barrel at the spigot end, at three positions equidistant around the circumference of the unit. For circular units with base and egg-shaped units, measure the wall thickness at approximately 50 mm from the end of the external barrel at the crown, springing points and invert.

### D.3.4 Expression of results

Record whether each measured value of the wall thickness conforms to 5.4.5.5.

## D.4 Straightness test

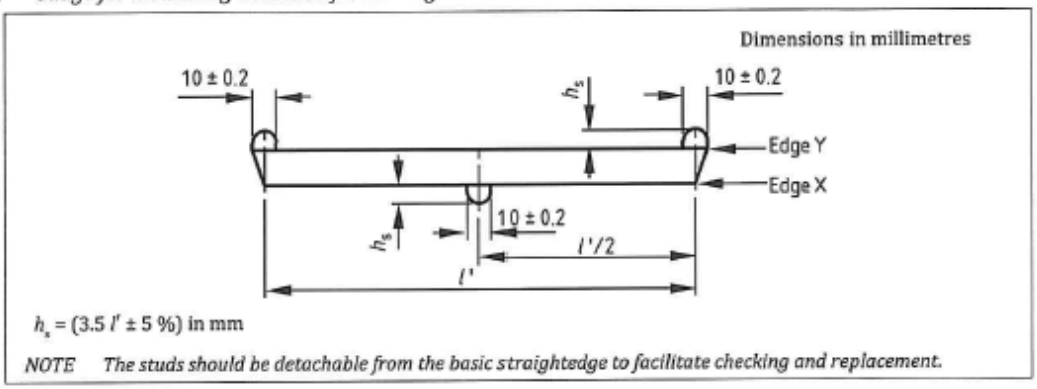
### D.4.1 Principle

The purpose of this test is to evaluate whether the internal straightness, and for jacking pipes the external straightness, of a unit conforms to 5.4.5.5.

### D.4.2 Apparatus

**D.4.2.1** *Rigid straightedge*, made into a gauge of the form and dimensions shown in Figure D.1.

**Figure D.1** — *Gauge for measuring deviation from straightness*




$h_s$ = (3.5 $l'$ ± 5 %) in mm

*NOTE The studs should be detachable from the basic straightedge to facilitate checking and replacement.*

### D.4.3 Procedure

**D.4.3.1** Place the straightedge in the bore of the unit with Edge X (see Figure D.1) in contact with the unit and on a line parallel to its longitudinal axis. Hold the plane of the gauge in a radial plane and record whether both ends of the gauge, wherever so placed, are in contact with the internal surface of the unit.

**D.4.3.2** If both ends of the gauge are not in contact with the internal surface of the unit at both ends, reverse the gauge so that Edge Y, placed as above (see Figure D.1), is adjacent to the internal surface of the unit.

**D.4.3.3** For jacking pipes, repeat the procedure with the straightedge placed along the external surface of the pipe and on a line parallel to its longitudinal axis.

#### D.4.3.4 Expression of result

Record whether both ends of the gauge are in contact with the surface of the unit when using Edge X, and whether the two studs (see Figure D.1) touch the surface simultaneously when using Edge Y.

## D.5 Internal barrel length and squareness of ends tests for jacking pipes

### D.5.1 Internal barrel length and squareness across a diameter test

#### D.5.1.1 Principle

The purpose of this test is to evaluate whether the internal barrel length and squareness of ends across a diameter of a jacking pipe conform to 5.4.5.7 and 5.4.5.8 respectively.

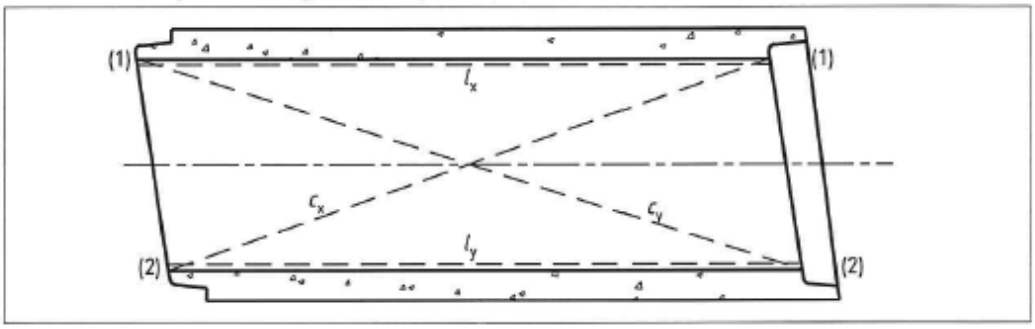
### D.5.1.2 Apparatus

**D.5.1.2.1** *Steel measuring tape or retractable pocket rule*, with metric graduation and figuring conforming to BS 4484-1.

### D.5.1.3 Procedure

Mark the opposite ends of an internal diameter at one end of the bore and measure the internal barrel length ($l_x$ and $l_y$) by "swinging" the tape or rule from each mark. Measure the minimum internal diagonals ($c_x$ and $c_y$), as shown in Figure D.2.

**Figure D.2** — *Measurement of internal lengths and diagonals of a jacking pipe*




Using the following formulae, calculate the respective deviations from squareness of the spigot end ($p_{sp}$) and socket end ($p_{so}$) of the pipe (see Figure D.3):

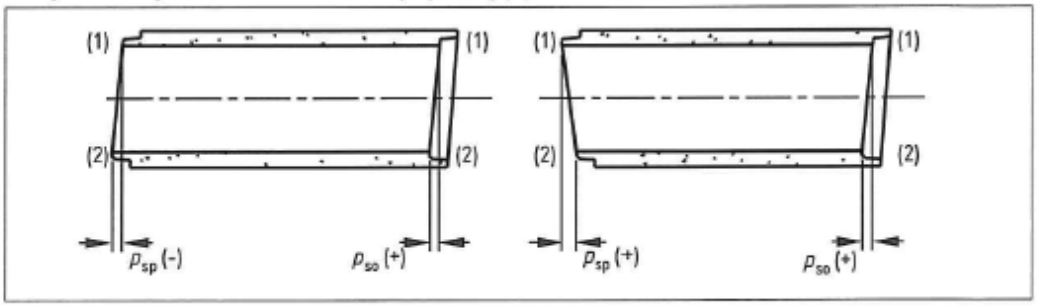
$$p_{sp} = (l_x^2 + c_x^2 - l_y^2 - c_y^2) / 2\,(l_x + l_y)$$

$$p_{so} = (l_x^2\, p\, c_x^2 - l_y^2 + c_y^2) / 2\,(l_x + l_y)$$

The orientation in relation to the points of measurements x and y is indicated by the algebraic sign of $p_{sp}$ and $p_{so}$ (see Figure D.2 and Figure D.3).

Repeat the procedure using marks made at approximately 90° to the original ones and calculate the mean of the four measurements of internal barrel lengths.

**Figure D.3** — *Squareness of ends across a diameter of a jacking pipe*




### D.5.1.4 Expression of result

Record whether the mean value of the four measurements of internal barrel length and each of the deviations from squareness across the diameter of the jacking pipe conformed to 5.4.5.7.

## D.5.2 Squareness across the wall thickness test

### D.5.2.1 Principle

The purpose of this test is to evaluate whether the squareness across the wall thickness at the end of a jacking pipe conforms to 5.4.5.8.

### D.5.2.2 Apparatus

**D.5.2.2.1** *Cast iron or steel straightedge*, conforming to BS 5204-1 or BS 5204-2.

**D.5.2.2.2** *Steel measuring tape or retractable pocket rule*, conforming to BS 4484-1, with metric graduation and figuring.

### D.5.2.3 Procedure

Place the straightedge diametrically across the end of the jacking pipe in three positions, approximately equidistant around its circumference. Measure and record any out-of-squareness across the wall thickness at each end of the three diameters.

### D.5.2.4 Expression of result

Record whether the squareness across the wall thickness of the jacking pipe conforms to 5.4.5.8.