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Specification for

# Nylon tubing —

**Part 2: Plasticized and unplasticized  
nylon tubing types 11 and 12 for use  
primarily in the automobile industry**

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Pitch Fibre Pipe Association of Great Britain

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This British Standard, having been prepared under the direction of the Plastics Standards Committee in consultation with the Automobile Standards Committee, was published under the authority of the Executive Board on 30 September 1978

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# Foreword

This Part of this British Standard has been prepared, under the direction of the Plastics Standards Committee in consultation with the Automobile Standards Committee, to specify the requirements for plasticized and unplasticized nylon tubing for use primarily in the automobile industry.

It is being considered along with national drafts from other member countries by Technical Committee TC 22/SC 2/WG 1, Pneumatic braking of vehicle combinations — Compatibility between tractor and trailer, of the International Organization for Standardization (ISO) in the preparation of an International Standard on this subject.

Part 1 of this standard specifies requirements for fully plasticized nylon tubing types 11 and 12 for use primarily in pneumatic installations.

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## Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 20, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.



## 1 Scope

This Part of BS 5409 specifies requirements for plasticized and unplasticized nylon (polyamide) tubing manufactured from nylon of either type 11 or type 12, of nominal outside diameter from 3 mm to 28 mm and of three grades differentiated by the limits specified for inside diameter.

The tubing is intended primarily for use in the automobile industry as fuel pipes, oil pressure pipes, control pipes, hydraulic clutch pipes and for air and vacuum braking operations.

Although this British Standard covers the material properties of coiled air brake tubing, specific component tests are not included. These will be the subject of a separate British Standard in the automobile series.<sup>1)</sup>

## 2 References

The titles of the publications referred to in this standard are listed on the inside back cover.

## 3 Material

**3.1** Material used for the manufacture of the tubing shall be 100 % virgin nylon (incorporating no reground material) of either type 11 or type 12, which may be either plasticized or unplasticized as required, and shall be compounded with carbon black in the ratio of 0.1 to 0.5 parts of carbon black per 100 parts of polymer.

**3.2** The only other additives permitted are those which are necessary to facilitate the manufacture, from the compound, of sound durable tubing with such qualities of flexibility, stability towards heat and light, and uniformity of colour, as are required. None of these additives either alone or in combination shall be used in quantities that are sufficient to impair the chemical and physical properties of the tubing as defined in this standard.

**3.3** When moulded sheets of the material are tested for tensile strength, elongation at break and hardness, they shall comply with the appropriate values specified in Table 1. The material shall be conditioned, as described in Appendix A, prior to test.

The tensile strength test shall be made on test pieces in accordance with the requirements of Figure 3 of BS 2782-3:Methods 320A to 320F:1976 and the rate of grip separation shall be 50 mm/min.

The hardness shall be determined in accordance with the method described in BS 2719.

**3.4** When tested by method 509A of BS 2782:1970, the density shall comply with the appropriate values specified in Table 1.

**3.5** When tested by the method described in Appendix B, the melting point shall comply with the appropriate values specified in Table 1.

## 4 Designation of tubing

**4.1 Grade.** Tubing shall be designated light duty grade if its dimensions comply with the requirements of Table 2, medium duty grade if its dimensions comply with Table 3, and heavy duty grade if its dimensions comply with Table 4.

**4.2 Material type.** Tubing shall be designated either plasticized or unplasticized according to whether or not the nylon contains plasticizer.

## 5 Dimensions

**5.1 Outside diameter.** The outside diameter shall comply with the appropriate values given in Table 2 or Table 3 or Table 4.

<sup>1)</sup> In course of preparation.

Table 1 — Physical requirements for material

| Property                      | Type 11     |               | Type 12     |               |
|-------------------------------|-------------|---------------|-------------|---------------|
|                               | Plasticized | Unplasticized | Plasticized | Unplasticized |
| Tensile strength, min. (MPa)  | 24          | 30            | 24          | 30            |
| Elongation at break, min. (%) | 250         | 200           | 250         | 200           |
| Hardness (Shore D units)      | 63 ± 1      | 70 ± 1        | 64 ± 1      | 71 ± 1        |
| Density (kg/m <sup>3</sup> )  | 1 060 ± 10  | 1 040 ± 10    | 1 040 ± 10  | 1 020 ± 10    |
| Melting point (°C)            | 185 ± 5     | 185 ± 5       | 175 ± 5     | 175 ± 5       |

**5.2 Internal diameter.** The internal diameter shall comply with the appropriate values given in Table 2 or Table 3 or Table 4.

**5.3 Concentricity.** The concentricity, defined as the maximum difference between any two values of wall thicknesses measured at the same cross section, shall not exceed the appropriate values given in Table 2 or Table 3 or Table 4.

Table 2 — Tubing dimensions: light duty grade

| Outside diameter |        |        | Inside diameter |        | Minimum wall thickness | Concentricity |
|------------------|--------|--------|-----------------|--------|------------------------|---------------|
| Nominal          | min.   | max.   | min.            | max.   |                        |               |
| mm               | mm     | mm     | mm              | mm     | mm                     | mm            |
| 3                | 2.875  | 3.000  | 2.375           | 2.500  | 0.19                   | 0.10          |
| 4                | 3.875  | 4.000  | 2.875           | 3.000  | 0.44                   | 0.10          |
| 5                | 4.875  | 5.000  | 3.875           | 4.000  | 0.44                   | 0.10          |
| 6                | 5.875  | 6.000  | 3.875           | 4.000  | 0.94                   | 0.10          |
| 8                | 7.875  | 8.000  | 5.875           | 6.000  | 0.94                   | 0.10          |
| 10               | 9.875  | 10.000 | 7.875           | 8.000  | 0.94                   | 0.10          |
| 12               | 11.825 | 12.000 | 8.825           | 9.000  | 1.41                   | 0.10          |
| 14               | 13.825 | 14.000 | 10.825          | 11.000 | 1.41                   | 0.10          |
| 16               | 15.825 | 16.000 | 12.825          | 13.000 | 1.41                   | 0.10          |

Table 3 — Tubing dimensions: medium duty grade

| Outside diameter |        |        | Inside diameter |        | Minimum wall thickness | Concentricity |
|------------------|--------|--------|-----------------|--------|------------------------|---------------|
| Nominal          | min.   | max.   | min.            | max.   |                        |               |
| mm               | mm     | mm     | mm              | mm     | mm                     | mm            |
| 3                | 2.875  | 3.000  | 1.875           | 2.000  | 0.44                   | 0.10          |
| 4                | 3.875  | 4.000  | 2.375           | 2.500  | 0.69                   | 0.10          |
| 5                | 4.875  | 5.000  | 2.875           | 3.000  | 0.94                   | 0.10          |
| 6                | 5.875  | 6.000  | 2.875           | 3.000  | 1.44                   | 0.10          |
| 8                | 7.875  | 8.000  | 4.875           | 5.000  | 1.44                   | 0.10          |
| 9                | 8.875  | 9.000  | 5.875           | 6.000  | 1.44                   | 0.10          |
| 10               | 9.875  | 10.000 | 5.875           | 6.000  | 1.94                   | 0.10          |
| 12               | 11.825 | 12.000 | 7.825           | 8.000  | 1.91                   | 0.10          |
| 13               | 12.825 | 13.000 | 8.825           | 9.000  | 1.91                   | 0.10          |
| 16               | 15.825 | 16.000 | 11.825          | 12.000 | 1.91                   | 0.10          |
| 18               | 17.750 | 18.000 | 13.750          | 14.000 | 1.88                   | 0.10          |
| 20               | 19.750 | 20.000 | 15.750          | 16.000 | 1.88                   | 0.10          |
| 22               | 21.750 | 22.000 | 17.750          | 18.000 | 1.88                   | 0.10          |
| 25               | 24.750 | 25.000 | 19.750          | 20.000 | 2.38                   | 0.10          |
| 28               | 27.750 | 28.000 | 21.750          | 22.000 | 2.88                   | 0.10          |

Table 4 — Tubing dimensions: heavy duty grade

| Outside diameter |        |        | Inside diameter |        | Minimum wall thickness | Concentricity |
|------------------|--------|--------|-----------------|--------|------------------------|---------------|
| Nominal          | min.   | max.   | min.            | max.   |                        |               |
| mm               | mm     | mm     | mm              | mm     | mm                     | mm            |
| 3                | 2.875  | 3.000  | 0.875           | 1.000  | 0.94                   | 0.10          |
| 4                | 3.875  | 4.000  | 1.875           | 2.000  | 0.94                   | 0.10          |
| 5                | 4.875  | 5.000  | 2.375           | 2.500  | 1.19                   | 0.10          |
| 6                | 5.875  | 6.000  | 1.875           | 2.000  | 1.94                   | 0.10          |
| 8                | 7.875  | 8.000  | 3.875           | 4.000  | 1.94                   | 0.10          |
| 10               | 9.875  | 10.000 | 4.875           | 5.000  | 2.44                   | 0.10          |
| 16               | 15.825 | 16.000 | 9.825           | 10.000 | 2.91                   | 0.10          |
| 20               | 19.750 | 20.000 | 13.750          | 14.000 | 2.88                   | 0.10          |
| 22               | 21.750 | 22.000 | 15.750          | 16.000 | 2.88                   | 0.10          |
| 25               | 24.750 | 25.000 | 17.750          | 18.000 | 3.38                   | 0.10          |
| 28               | 27.750 | 28.000 | 19.750          | 20.000 | 3.88                   | 0.10          |

## 6 Design criteria for safe maximum working pressure, minimum installation radii and short-time burst pressure

**6.1 Safe maximum working pressures and minimum installation radii.** Safe maximum working pressures over a range of temperatures are given in Table 5 to Table 10 together with information on the minimum installation radii. These pressures are calculated on the basis of a design safe induced stress of 6.67 MPa at 23 °C for plasticized nylon tubing and 11.33 MPa at 23 °C for unplasticized nylon tubing. Table 11 gives the factors for calculating the safe maximum working pressures at temperatures other than 23 °C.

NOTE The safe maximum working pressure of the tubing is calculated from the short-time burst pressure at 23 °C divided by a factor of 3. This allows an estimated tubing life of 100 000 h at 23 °C and also allows for ageing in service.

**6.2 Short-time burst pressure.** The short-time burst pressure specified in 7.5, on the basis of the test method described in Appendix C, is calculated on a design induced stress ( $\delta$ ) at burst, using the following formula:

$$\delta = \frac{P (d_{\max} - e_{\min})}{2e_{\min}}$$

where

$P$  is the burst pressure

$d_{\max}$  is the maximum outside diameter of the tubing

$e_{\min}$  is the minimum wall thickness

$\delta$  = 20 MPa for plasticized nylon tubing

$\delta$  = 34 MPa for unplasticized nylon tubing