

## SECTION IV — Product Types

### 1. As-Welded Hot Rolled or Cold Rolled Flash-In

The ID flash is not removed in this type of tubing. This type is used where the height of the ID weld flash is not important.

### 2. As-Welded Hot Rolled or Cold Rolled Flash-Controlled or Removed

For this product type, the ID weld flash is removed by scarfing or controlled by rolling to one of two different specifications.

- a. Flash Controlled or Removed — ID flash is removed by scarfing or controlled by rolling to a maximum of .010".
- b. Flash Controlled or Removed — ID flash is removed by scarfing or controlled by rolling to a maximum of .005".

### 3. Sink Drawn

Sink drawn tubing is produced by drawing the welded tube through a die with only the OD being controlled. This operation is performed when closer tolerances or a better surface might be required on the OD only and for enhanced mechanical properties. Sink drawn tubing can be produced from either hot rolled or cold rolled steel, and ID flash can be any of the conditions described above.

### 4. Drawn over Mandrel (DOM)

This product type is produced by drawing the welded tubing through a die and over a mandrel, improving surface finish and controlling the OD and ID, OD and wall, or ID and wall to closer tolerances, and/or for enhanced mechanical properties. DOM's superior concentricity is important when OD or ID machining is involved.

### 5. Special Smooth ID

Special Smooth ID (SSID) is a cold drawn welded tube that must meet special standards of surface in the ID. The finish must be within the microinch limits established by the governing specification, ASTM A 513. Table 1 shows these requirements. SSID tubing attains its high quality ID finish through careful selection of starting material, special processing, and extremely critical inspection at all stages of production. By taking these steps, guaranteed microinch finishes can be obtained. SSID tubing is usually furnished in the as-drawn condition, as any annealing may harm the smoothness and cleanliness of the surface.

### 6. Coated Tubing

This special product is produced from pre-coated, flat rolled steel, or the coating may be applied to the tube in-line immediately after welding. The weld zone of pre-coated material may be remetalized immediately after welding. Either galvanized or aluminum coatings are available and provide extra corrosion protection. The coating is an excellent base for a long lasting painted surface where desired.

## SECTION V — Special Applications

### 1. Hydraulic Line Tubing

Hydraulic line tubing is one of the highest quality products made by the ERW industry. It is normally produced to ANSI Standard B93.4-latest revision but also meets all the requirements of NFPA, SAE, and JIC Standards. Normalizing after welding, cold drawing, and full annealing as a final heat treatment assure ductility for severe flaring and bending. A pressure or electric test and extensive expansion, flattening, and reverse flattening tests demonstrate the tube's soundness. Typical applications would be in the hydraulic harnesses of earthmovers, machine tools, trucks, buses, cranes, etc.

Table 31

### Welded Steel Hydraulic Fluid Line Tubing — Chemical Composition, Mechanical Properties, and Dimensional Tolerances

#### Chemical Composition (Percentage by Weight)

Carbon	0.18 max.
Manganese	0.30-0.60
Phosphorus	0.04 max.
Sulfur	0.05 max.

#### Mechanical Properties

Tensile Strength	45,000 psi. min.
Yield Strength	25,000 psi. min.
Elongation in 2"	35% min. <sup>A</sup>
Rockwell Hardness	B65 max. <sup>B</sup>

<sup>A</sup> For tubes with O.D. of  $\frac{3}{8}$ " or less or wall thickness of .035" or less a minimum elongation of 25% is permitted.

<sup>B</sup> The hardness requirement does not apply to tubes with less than .065 in. wall thickness. Such tubes shall meet all other mechanical properties and all mechanical tests of this recommended standard.

#### Dimensional Tolerances

When tubing is specified by outside diameter and inside diameter, the tolerances shown in the table below apply.

Nominal Outside Diameter	O.D. Inches	I.D. inches
Up to $\frac{3}{8}$ ", inclusive	± 0.002	± 0.005
Over $\frac{3}{8}$ " to $\frac{5}{8}$ ", inclusive	± 0.0025	± 0.0025
Over $\frac{5}{8}$ " to 2", inclusive	± 0.003	± 0.003
Over 2" to 2½", inclusive	± 0.004	± 0.004
Over 2½" to 3", inclusive	± 0.005	± 0.005
Over 3" to 4", inclusive	± 0.006	± 0.006

When tubing is specified by the outside diameter (or the inside diameter) and the nominal wall thickness, the above tolerances apply for the specified diameter, and the allowable wall thickness variation is ± 10% for tubes  $\frac{3}{8}$ " diameter and over, and ± 15% for tubes under  $\frac{3}{8}$ " O.D.

Ref.: NFPA STD T3.15.67.1, approved as ANSI Standard B93.4-1981

Extracted from American National Standard Electric Resistance Welded Mandrel Drawn Hydraulic Line Tubing (ANSI B93.4-1981) with the permission of the publisher, The National Fluid Power Association, Inc.

## 2. Hydraulic Cylinder Tubing

Hydraulic cylinder tubing is, as the name implies, used to produce hydraulic cylinders. It is available in two grades, regular DOM and Special Smooth ID (SSID). DOM is not furnished with an ID of cylinder quality. The ID is sometimes surface finished by the buyer but can also be furnished in that condition by the mill or steel service center. SSID tubing is an excellent choice for certain types of hydraulic cylinders where no further finishing of the ID is desired or required.

Honing is used to modify the inside surface of tubing used for hydraulic cylinders to meet the cylinder manufacturers' requirements for surface finish (microinch) and ovality. The process uses honing stones, held on a rotating shaft. The honing head is passed through the tube ID in a helical pattern. Honing pressure, stone grit and number of passes control the final ID dimensions of the tubing.

## 3. Propeller Shaft Tubing

Wall thickness uniformity inherent in welded tubing in either the as-welded or cold drawn condition provides a well balanced tube especially suited for propeller or drive shafts in automotive vehicles.

This application of welded tubing demands rigid requirements. Well balanced tubing for propeller and drive shaft applications differs from regular mechanical tubing in tolerances and often in mechanical properties.

The following evaluations, affecting the dimensions and processing of the tubing supplied for this application, will need to be considered by the design engineer:

- (1) Torque rating of engine.
- (2) Low or reverse gear ratio, whichever is greater.
- (3) Distance between bearing points.
- (4) Maximum speed of shaft in r.p.m.
- (5) Method used to attach splines to tube.

**Table 32**  
**Minimum Inside Diameter Stock Allowance on Diameter<sup>4</sup> for Removal of Inside-Surface Imperfections by Honing Operation (Mandrel-Drawn Tubing)**

Outside Diameter, in. <sup>a</sup>	Wall Thickness, in. <sup>b</sup>							
	0.065 and under	Over 0.065 to 0.125, incl	Over 0.125 to 0.180, incl	Over 0.180 to 0.230, incl	Over 0.230 to 0.360, incl	Over 0.360 to 0.460, incl	Over 0.460 to 0.563, incl	Over 0.563
Up to and incl 1½	0.010	0.011	0.013	0.015	0.018	...	...	...
Over 1½ to 3 incl	0.010	0.012	0.014	0.016	0.018	0.021	0.023	...
Over 3 to 4 incl	0.011	0.013	0.015	0.017	0.019	0.021	0.023	0.025
Over 4 to 4¾ incl	...	0.014	0.016	0.018	0.020	0.022	0.024	0.026
Over 4¾ to 6 incl	...	0.015	0.017	0.019	0.021	0.023	0.025	0.027
Over 6 to 8 incl	...	0.016	0.018	0.020	0.022	0.024	0.026	0.028
Over 8 to 10½ incl	...	...	...	0.021	0.023	0.025	0.027	0.029
Over 10½ to 12½ incl	...	...	...	0.022	0.024	0.026	0.028	0.030
Over 12½ to 14 incl	...	...	...	0.024	0.025	0.027	0.029	0.031
Over 14 to 15 incl	...	...	...	0.025	0.026	0.028	0.030	0.032

<sup>4</sup>If a specific size is desired, these allowances plus normal size tolerances must be considered in calculating size to be ordered.

<sup>b</sup>1 in. = 25.4 mm.

Ref.: ASTM A 513-85

