Section 18

Surface Protection

18.1 Painting

There are numerous types of paint and application techniques. Correct preparation, choice of paint system, and application are necessary if the coating is to have the necessary protective effect.

18.1.1 Preparation

Commonly used surface preparation grades are taken from Swedish standard SIS O5 5900.

Table 18.1

Designation	*Preparation grade*
Sa 3	Blast cleaning to pure metal. No surface staining remaining
Sa $2^1/_2$	Thorough blast cleaning but some surface staining may remain
Sa 2	Blast cleaning to remove most of the millscale and rust
Sa 1	Light blast cleaning to remove the worst millscale and rust

18.1.2 Paint types

These are divided broadly into air-drying, two-pack, and primers.

- Air-drying types: alkyd resins, esters, and chlorinated rubbers.
- Two pack types: epoxy, polyurethanes.
- Primers: zinc phosphate or zinc chromate.

18.1.3 Typical paint system

Most paint systems for outdoor use have a minimum of three coats with a final dry film thickness (dft) of 150–200 μm.

Engineers' Data Book, Fourth Edition. Clifford Matthews.

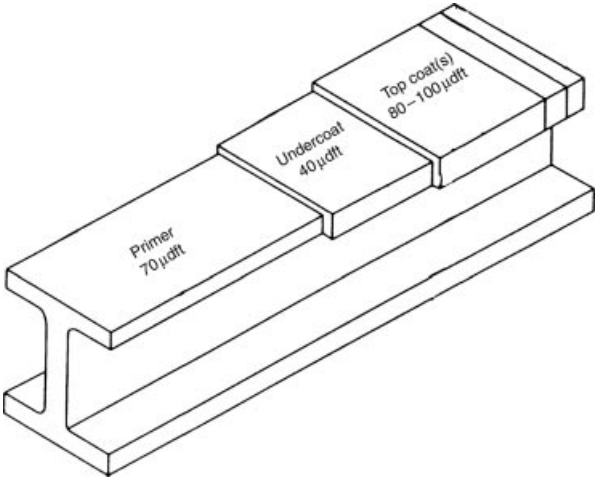

Figure 18.1

Useful Standards

1. BS 7079: Preparation of steel substrates before application of paints and related products. This document is in 16 separate parts.
2. SIS 05 5900: Pictorial standards for blast-cleaned steel (and for other methods of cleaning). (Standardiseringskommissionen, I Sverige, Stockholm).
3. BS 5493: 1977: Code of practice for protective coating of iron and steel structures against corrosion.
4. BS 381: 1988: Specification for colours for identification, coding and special purposes.
5. BS 3900: Methods for tests for paints. There are more than 100 parts to this standard.
6. ASTM D1186: 1993: Test methods for non-destructive measurement of dry film thickness of non-magnetic coatings applied to a ferrous base.

18.2 Galvanizing

Galvanizing is the generic term for the coating of iron and steel components with zinc. It can be used instead of painting to protect the base material from corrosion. The coating is usually applied by weight, in accordance with a standard such as BS 729. Guidelines are shown in Table 18.2.

Table 18.2

Parent material	*Min. galvanized coating weight (g/m^2)*
Steel 1–2 mm thick	335
Steel 2–5 mm thick	460
Steel >5 mm thick	610
Castings	610

An approximate conversion from coating weight to coating thickness is:

$$1\ g/m^2 \cong 0.14\ \mu m$$

Coating uniformity is tested by a 'Preece test' which involves exposing a coated specimen to a salt solution.

18.3 Chrome plating

Chrome plating provides a fine finish for hydraulic components and provides protection against some environmental conditions. The process is well covered by technical standards such as BS 1224. A typical specification for a plated component is:

Fe/Cu 20 Ni (p) Cr (mc)

- Fe denotes iron or steel parent material.
- Cu 20 denotes a minimum 20 μm of copper plated on to the steel.
- Ni 25 (p) denotes a minimum of 25 μm nickel plated on to the copper:
  (p) means 'semi-bright';
  (b) means 'fully bright'.
- Cr (mc) denotes the condition of the top chromium layer.

The classes are:
Cr (r): a 'regular finish' – minimum thickness 0.3 μm;
Cr (f): 'free' from cracks – minimum thickness 0.8 μm;
Cr (mc): 'micro-cracked' – minimum thickness 0.8 μm;
Cr (mp): 'microporous' – minimum thickness 0.3 μm.

Useful Standards

1. BS 729: 1994: Specification for hot dip galvanized coatings on iron and steel articles. Similar to ISO 1459/ISO 1460/ISO 1461.
2. BS 1224: 1970: Specification for electroplated coatings of nickel and chromium. Similar to ISO 1456/ISO 1458.

18.4 Rubber linings

Rubber lining is commonly used to protect materials in sea-water and chemical process systems against corrosive and erosive attack. It is applied in sheets up to about 6 mm thick. There are two main types:

- *Natural rubbers* for low temperatures in oil-free water or slurry applications.
- *Synthetic rubbers* (nitryl, butyl, neoprene) - for temperatures up to 120 °C or when oil is present.

18.4.1 Properties

Both natural and synthetic rubbers can be divided into hard and soft types. Two hardness scales are in use; IRHD (international rubber hardness degrees) and the 'Shore' scale.

- *Hard* rubber (sometimes called ebonite) is 80–100 degrees IRHD or 60–80 'Shore D' scale (see BS 903: Part A57).
- *Soft* rubber is 40–80 degrees IRHD or 40–80 'Shore A'.

18.4.2 Design features

Rubber-lined components need to have specific design features to help the lining adhere properly (see Fig. 18.2 and BS 6374: Part 5).

18.4.3 Application

The basic application procedure is:

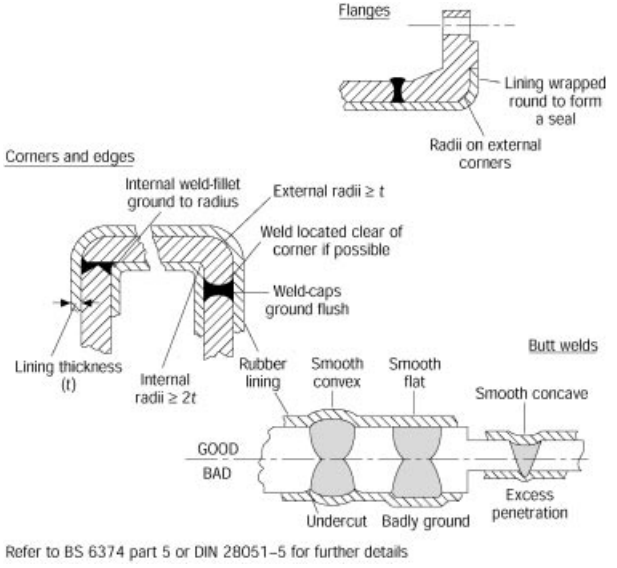

Figure 18.2 Rubber lined components – design features

1. Shotblast the metal surface to SIS 05 5900 grade Sa $2^1/_2$;
2. Apply adhesive to the surface;
3. Lay the sheets of rubber manually in scarf-jointed overlapping courses;
4. Vulcanize the rubber by heating to approximately 120 °C using steam or hot water.

18.4.4 Testing

Common tests on the applied rubber lining are:

- *Spark testing* ($\cong$ 20 kV) to check the continuity of the lining.
- *Rapping test* using a special hammer to test the adhesion of the lining to the metal.
- *Hardness test* using a hand-held gauge to measure the Shore or IRHD hardness. This shows whether vulcanization is complete.

Useful Standards

1. BS 6374: Parts 1–5: Lining of equipment with polymeric materials for the process industries.
2. DIN 28 051: 1990: Chemical apparatus – designs of metal components to be protected by organic coatings or linings.
3. BS 903 (various parts): *Physical testing of rubber*.
4. DIN 53 505: Rubber hardness testing.