

FREENESS OF PULP

The freeness test is an arbitrary measure of the drainage properties of pulp stock when tested under specific conditions of temperature and stock concentration, using a specified testing instrument. The property is commonly called Canadian Standard Freeness and is based on the test developed by the Canadian Pulp and Paper Research Institute. The design of the instrument is such that the result is strongly influenced by the drainage rate in the initial stages of drainage. Freeness is therefore different from Drainage Time and Drainage Factor. The result depends mainly on the quantity of fines and debris present (Reference 6.1) and on the degree of fibrillation of fibres, their flexibility and their fineness.

The test was originally designed to yield information for the control of the manufacture of groundwood pulp, but it is also used in studies of the behaviour of various pulps during beating and in the control of beaters and refiners. Freeness measurements do not necessarily correlate with drainage behaviour on the wire of a paper machine.

In this method stainless steel is listed as a preferred material of construction for some components. Certain stocks will corrode bronze, and corrosion effects on screen plates, orifice pieces and side tubes change the performance of the instrument. In addition, some stocks readily give rise to deposits at these places, and it is convenient to be able to clean the parts by drastic chemical methods such as are permissible with a corrosion resistant material.

1. APPARATUS

1.1 Freeness tester (see Figure 1), consisting of a drainage chamber and a rate measuring funnel mounted on a vibration free support so that their axes of symmetry are vertical and coincide, and the top of the funnel is 180 ± 15 mm below the bottom of the screen plate (Note 5.1). Except where stated otherwise the components of the tester may be fabricated from stainless steel or phosphor bronze or from metal wholly plated with nickel or hard chrome. The drainage chamber consists of a cylinder closed at the top with a rigid lid capable of providing an air-tight closure. The inside surface of the lid is fitted with a thick rubber gasket ring. An air-cock is provided in the centre of the lid as a means of admitting air to the cylinder. The bottom of the cylinder is fitted with a perforated plate (screen plate) fabricated preferably from stainless steel (Note 5.2) but brass may be used. The screen plate is held in place by the flange of a ring which is screwed on to the bottom of the cylinder. The bottom of the cylinder is closed with a rigid bottom lid, which is covered with a thick soft rubber gasket which fits against the flange holding the screen plate in position.

The internal dimensions of the cylinder are 101.5 ± 0.3 mm in diameter by 128 ± 1 mm from the upper surface of the screen plate to the rim. The specified height gives the cylinder a capacity in excess of 1000 mL above the screen plate. The air-cock bore should be at least 4.5 mm. Both stainless steel and brass screen plates are typically 111.0 ± 0.5 mm in diameter, 0.4 ± 0.15 mm thick with 0.5 ± 0.01 mm diameter holes spaced at 1.07 mm centres, 97 ± 5 per 100 mm^2 . Stainless steel plates must be soaked in nitric acid (1 part concentrated HNO_3 to 4 parts water by volume) then thoroughly

washed in water before initial use. All plates must be fitted to the cylinder with the burrs (if any) of the perforations downwards (Note 5.3).

Screen plates must be calibrated against a standardized screen plate by the method described in Appendix A.

The rate measuring funnel (Note 5.4) has an open cylindrical top 203.5 ± 0.5 mm in diameter and 270 ± 15 mm total depth. The bottom of the conical part is machined on the inside to a slope of $30.0 \pm 1.0^\circ$ and flares out to the top cylindrical portion. A detachable spreader cone is supported inside the funnel to prevent splash from directly entering the side orifice tube (see Figures 1 and 2).

The spreader cone is supported by three legs which locate in nicks in the side of the funnel. Alternatively the legs may be extended and machined to the same angle as the funnel so that the cone fits securely and symmetrically without the need for nicks in the funnel.

The side orifice consists of a tube which penetrates the funnel (sliding fit) at an angle at 45° to the vertical. The end of the tube which goes inside the funnel must be cut square to the axis of the tube and the other end may be square cut or angle cut as shown in Figure 3. The head of water (i.e. the vertical distance of the point of overflow above the bottom of the bottom orifice) is critical to the flow rate through the bottom orifice. The use of washers in securing the side tube in position allows the head of water to be varied. The bottom of the funnel is fitted with a detachable orifice piece (bottom orifice piece). The diameter, length and shape of the lower section of this are also critical to the flow rate. These