

**The Uni-Bell PVC Pipe Association**

# **Handbook of PVC Pipe Design and Construction**

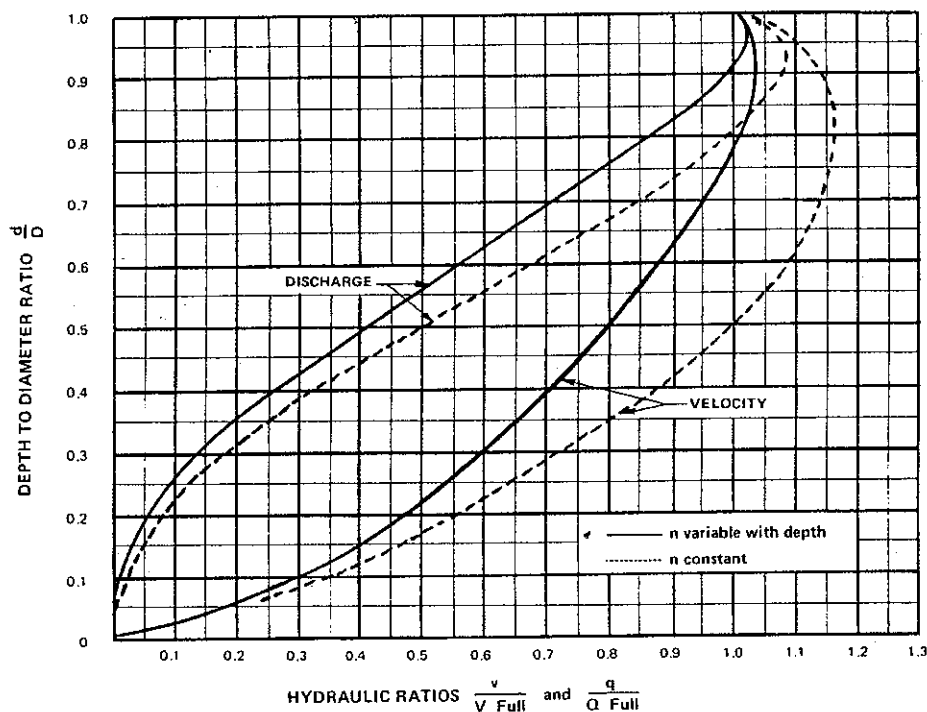


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assumed to be constant. Experiments have shown that  $n$  actually varies with the flow depth and is slightly larger in non-full flow pipes. The solid lines in Figure 9.4 incorporate this variability of  $n$ .

**FIGURE 9.4**  
**HYDRAULICS IN PVC SEWER PIPE AT VARYING DEPTHS**



It is recommended that flow velocity in sanitary sewer lines be not less than 2 ft/s (0.6 m/s) for self-cleansing action in the lines. Some authorities may require 2.5 ft/s (0.8 m/s) minimum velocities, particularly for storm sewers. At velocities above 10 ft/s (3 m/s) special consideration should be given to energy dissipation and erosion prevention. When slopes exceed 20 percent (approximately 11.5°), pipe anchorage should be considered. To allow for future growth or unanticipated flows, it is customary to size sanitary collection sewers to flow one-half full at maximum design inflow.

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# PIPING HANDBOOK

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**Hydraulically Smooth.** The interior surface of fiberglass pipe is extremely smooth and tends to resist buildup so the inner surface usually remains in this condition throughout the service life of the pipe. A Hazen-Williams flow coefficient of 150, an absolute roughness of 0.0002 in, is common for most fiberglass pipe, and flow tests run on pipe after many years in service show that buildup or increased friction losses are the exception rather than the rule for this type of pipe.

**Inherent Flexibility.** Most filament wound pipe is rather flexible, having a modulus of elasticity in the axial direction of 1 to 3 million psi. As mentioned previously, this flexibility is a definite advantage during installation. Because of the relatively low axial modulus of this type of pipe, the axial forces generated during temperature changes are only about one-twentieth of those developed by Schedule 40 steel. This allows the designer to use relatively lightweight anchors to restrain the pipe and in most instances eliminates the need for expansion loops or expansion joints.

**Abrasion Resistance.** Fiberglass pipe is not the solution to abrasion problems encountered in pneumatic conveying of materials, but the addition of a liquid medium has a tremendous effect on the performance of fiberglass pipe conveying abrasive materials. Calcium carbonate slurries and fly ash slurries in coal fired power plants are often handled by fiberglass pipe with a standard wall construction. If increased abrasion resistance is required in slurry applications, abrasion-resistant materials such as alumina can be added to the pipe liner. Pipes with a ceramic alumina bead liner have been used successfully for several years to handle severe bottom ash slurry abrasion problems in coal fired power plants.<sup>5,18</sup>

Because it does not depend upon a protective oxide film for corrosion resistance, fiberglass pipe is not subject to the combination of corrosion and abrasion which occurs with metals when handling high-velocity water. Tests with water conveyed at 100 ft/s have failed to show any wear in a 355-h study.<sup>3</sup> And fiberglass pipes have been operated in liquid services at velocities as high as 25 ft/s. Liquid handling piping systems are normally designed to operate in the range of 5 to 10 ft/s. This usually makes most efficient use of a given size of pipe and helps to eliminate the possibility of severe water hammer in the system.

**Low Maintenance.** The exterior corrosion resistance of fiberglass pipe is usually enough to protect the pipe from any plant atmosphere to which it will be exposed. When fiberglass pipe is painted, the paint usually has a longer life because tiny nicks and scratches do not cause corrosion products to develop and lift the coating as on a metal pipe. If fiberglass pipe is to be installed outdoors in strong sunlight, the pipe should be painted to protect it from ultraviolet surface degradation. Such degradation, while giving the appearance of severe attack, is actually a very mild surface phenomenon. Several studies have shown that the physical properties of pipe with severe surface attack from exposure to ultraviolet radiation show no measurable difference from the physical properties of similar unexposed pipe.<sup>7</sup> But the appearance of such pipe can become unacceptable in a year or less in extreme southern climates where ultraviolet exposure is intense. As with indoor piping, paint life on fiberglass pipe installed outdoors is excellent.

**Low Thermal and Electrical Conductivity.** The low electrical conductivity of most fiberglass pipe (some pipe is made to be electrically conductive for special applications) is often used to isolate stray currents from metallic equipment for cor-