

Variation of friction factor with Reynolds number and roughness is now reliably known for the whole range of numbers generally encountered in industry. Surprisingly, at higher Reynolds numbers the friction factor becomes a constant, independent of the Reynolds number and a function of the relative roughness only:

$$f = \frac{1}{(1.74 + 2 \log r/k)^2} \quad (6)$$

Limits of applicability for this formula when applied to air at atmospheric pressure and temperature are given in Table I. Instead of using the relative roughness k/r , its reciprocal, the relative smoothness r/k , is used for convenience. Relationship of equation (6) and pipe diameters is shown in Fig. 3.

Finding Design Constants. Gas velocities in exhaust systems usually range from 25 to 80 fps. Higher velocities often cause pressure drops to become so large that single-stage fans cannot maintain desired deliveries. Lower velocities are not desirable either, because they increase duct size unneces-

sarily and dust particles settle out, adhering to the duct walls. As shown in Table I the friction factors computed from equation (6) can be used for all velocities generally encountered in fan-powered systems.

Greatest possible error that may occur at lower velocities is small in view of other uncertainties, especially the fact that the relative roughness of the pipe is usually not known accurately.

Pipe relative roughness, k/r , on which the friction factor depends, cannot very well be determined by measuring the surface projections k and dividing their mean value by radius r . It is most reliably obtained by finding first the friction factor from test data on high velocity flow, that is, for Reynolds numbers greater than R_c in Table I. Unfortunately, very few such tests are known and usually pertinent facts, such as the kind and number of pipe joints used and information regarding other conditions which influence the pressure drop, are lacking.

The calculating chart, Fig. 4, based

on equations (4) and (6) helps to find quickly the pressure drop in a pipe length of one diameter when temperature, velocity and relative smoothness of pipe are known. It shows readily the great variation in pressure drop with the pipe-surface condition and the utter uselessness of any pressure-drop calculation if pipe roughness is unknown.

Available information indicates that absolute roughness rather than relative roughness is about the same for various pipe diameters. For round sheet-metal ducts, such as fan systems use, an absolute roughness of 0.015 appears to be a fair mean value.

A concerted effort by all those concerned with designing and installing air-duct and piping systems is needed to make available more reliable flow data than are obtainable today. With easily made pressure-drop readings on existing systems and the use of Fig. 3 and 4, roughness factors can be found for ducts of given diameters, materials, and kinds and numbers of joints.

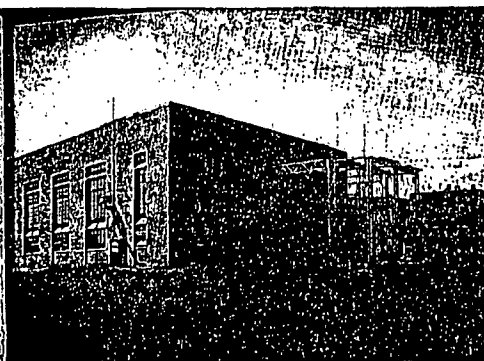
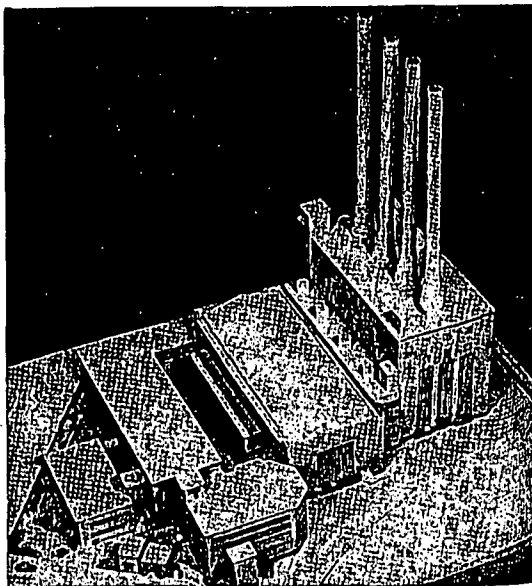


Australian Plant Of Advanced Design

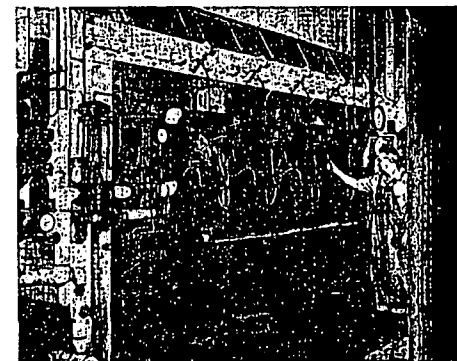
► SYDNEY COUNTY COUNCIL's new Pyrmont B power station will use the highest steam pressure and temperature in Australia, 1200 psig and 925 F. Now under construction, the plant will ultimately house four generators arranged on the unit system, with steam and feedwater mains interconnected.

Boiler plant will have 430,000-lb-per-hr radiant-type waterwall units with dry-ash bottoms. Economizers and air preheaters are being provided. The steam generators will lead 3-cylinder impulse-type 50,000-kw 3000-rpm turbines driving 3-phase 33,000-v 50-cycle alternators.

The plant will be pulverized-coal fired, with fuel delivered by rail. English firms are supplying most of the principal plant equipment.



ELECTRICITY comes into the plant at 34,500 v; is stepped down to 4160 v in the two 5000-kva transformers comprising the main substation alongside the powerhouse building, above



STEAM is supplied by two 45,000-lb-per-hr oil-fired integral-furnace boilers. Approximately 60% of steam generated is used for process operations

Power for Plastics Production

► Power services play a major role in the complex and closely controlled processes of laminated-plastics manufacture at General Electric's new plant at Coshocton, Ohio, where everything is made, from gears and bearings to insulators and refrigerator door panels.

The single-story plant and the 2-story and basement office building enclose more than 300,000 sq ft of floor space. Here, engineers of the Austin Co., which handled design and construction, have combined many new types of building material and equipment to insure production efficiency.

Electrical Equipment. Purchased electricity enters through two 5000-kva 34,500/4160-v transformers supplying four 1000-kva unit substations inside the manufacturing plant, and two 750-kva substations in boilerhouse and varnish building. These deliver 480-v 3-phase current to an overhead-bus distribution system embracing nearly half a mile of plug-in and feeder lines. All smaller transformers are mounted on mezzanines suspended from roof trusses. Varnish house has explosionproof equipment.

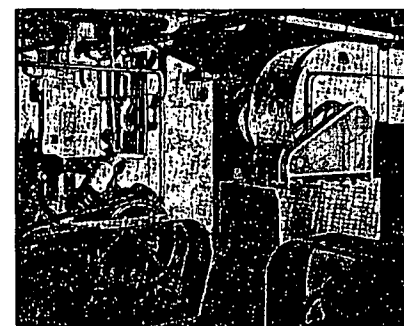
Boilers. Boilerhouse at northeast corner of site contains two oil-fired

integral-furnace boilers rated at 45,000 lb per hr. These supply steam for the many process uses and to unit heaters for winter heating.

Air Conditioning. Certain process areas, where controlled conditions are important, employ air conditioning and special wall construction. These walls consist of 4 in. of outside common brick, backed by 2 in. of foam-glass insulation, 4 in. hollow tile, and 4 in. glazed tile. Air-conditioning equipment, to maintain 70-F dry bulb and 35% relative humidity, is located on suspended mezzanine platforms.



HYDRAULIC pumps and the accumulator in the background maintain 3000-psi pressure for molding presses. Smaller pumps in background serve the 500-psi system



AIR-CONDITIONING equipment serves several controlled-conditions areas where laminating stock is stored and built up for pressing. Total refrigeration load is 188 tons