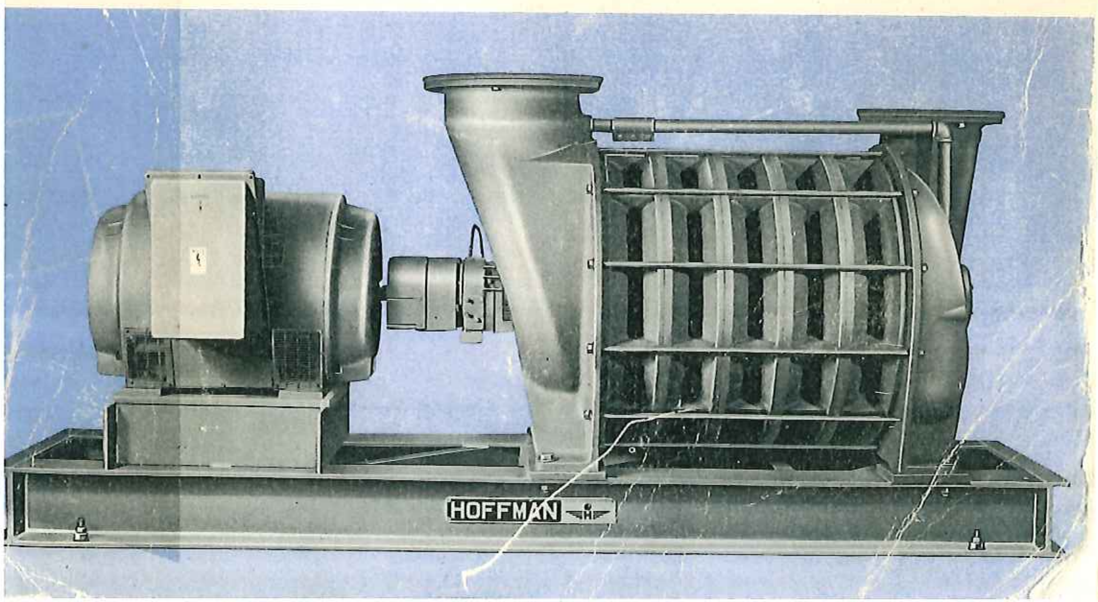
CENTRIFUGAL COMPRESSOR ENGINEERING



CHAPTER 14
DETAILED
AIR PIPING HEAD
LOSS CALCULATION PROCEDURES

Air Piping consists of the following components:

1. Discharge Check Valves
2. Discharge Control (Butterfly) Valves
3. Fittings (Bends, Wyes, Tees, etc.)
4. Meters (Orifices, etc.)
5. Inlet Filter Systems (Baghouses, etc.)
6. Inlet Control (Butterfly) Valves
7. Inlet Piping (Main)
8. Discharge Piping (Mains)
9. Pressure Relief Valves as required
10. Snubbers as required
11. Couplings, etc.

The two (2) types of air piping materials in current use which enjoy the most popularity are:

1. Ductile Iron or Cast Iron Pipe
2. Steel Pipe (hot dip galvanized after fabrication)

The piping is usually sized on a velocity basis. It should be sized such that the losses in the blower discharge mains, tank headers, and diffuser manifolds are small in comparison to the losses across the diffusers (orificing plus submergence).

Valves should be provided for flow regulation. They are typically of the quick opening-quick closing type, either butterfly valves or plug valves.

Typical air velocities (at standard conditions) are given in Table 14-1.

TABLE 14-1

TYPICAL AIR VELOCITIES IN BLOWER DISCHARGE PIPING

Pipe Diameter Inches / MM	Velocity M/S / FPM — Std. Air
25 / 1- 3 / 80	6 / 1200 - 1800 / 9
100 / 4-10 / 250	9 / 1800 - 3000 / 15
300 / 12-24 / 600	14 / 2700 - 4000 * / 20
750 / 30-60 / 1500	19 / 3800 - 6500 * / 33

* The vast majority of systems utilizing centrifugal blowers are designed at pipe velocities of less than 3500 FPM which minimizes line losses and noise, with an accompanying decrease in power consumption.

Because of the high temperature of the air discharged by blowers (120–300 degrees F), condensation in air piping does not pose a problem, except where air piping is submerged in sewage. For that reason, all underwater piping should be either stainless steel, hot dipped galvanized steel, or coated cast or ductile iron. Where coatings are used, they should be specified to withstand a temperature of at least 300 degrees F. Also any gasketing or jointing materials should be specified to withstand a temperature up to 300 degrees F., and to not deteriorate with age. Underground piping may condense moisture — a simple blow-off as shown in Figure 14-1 will provide for moisture removal.

It is essential that the designer make provisions in his layout for expansion and contraction in both vertical and horizontal piping runs. This is typically done with the use of pipe couplings or flanged coupling adapters. it is also necessary to completely isolate the blower from piping forces with sleeves or expansion joints.

Piping losses should be computed for maximum summer temperatures. In most instances in the South and Southwestern United States, this means that the system will start out with 110 degrees F. air at the blower intake filters. The temperature rise during compression is given by the formula:

$$\Delta T = \frac{T_1}{c}\left[(P_2/P_1)^n - 1\right]$$

Where:

ΔT	=	actual temperature rise
T_1	=	absolute inlet temperature, degrees Rankine
P_1	=	absolute inlet pressure, pound per square inch, absolute (psia)
P_2	=	absolute discharge pressure, (psia)
n	=	$(K-1)/(K) = 0.283$ for air
K	=	1.395 for air
c	=	blower efficiency (usually between .60 & .80)

Between the blowers and the biological reactor (aeration basins) the blower discharge air temperature will drop not more than 10–20 degrees F,and then will quickly approach the temperature of the wastewater under treatment in the submerged air piping.