Introduction to Boiler Operation

Objectives and other details of modules

Duration – 90 minutes

Training aids

Power point Presentations

Reading Material

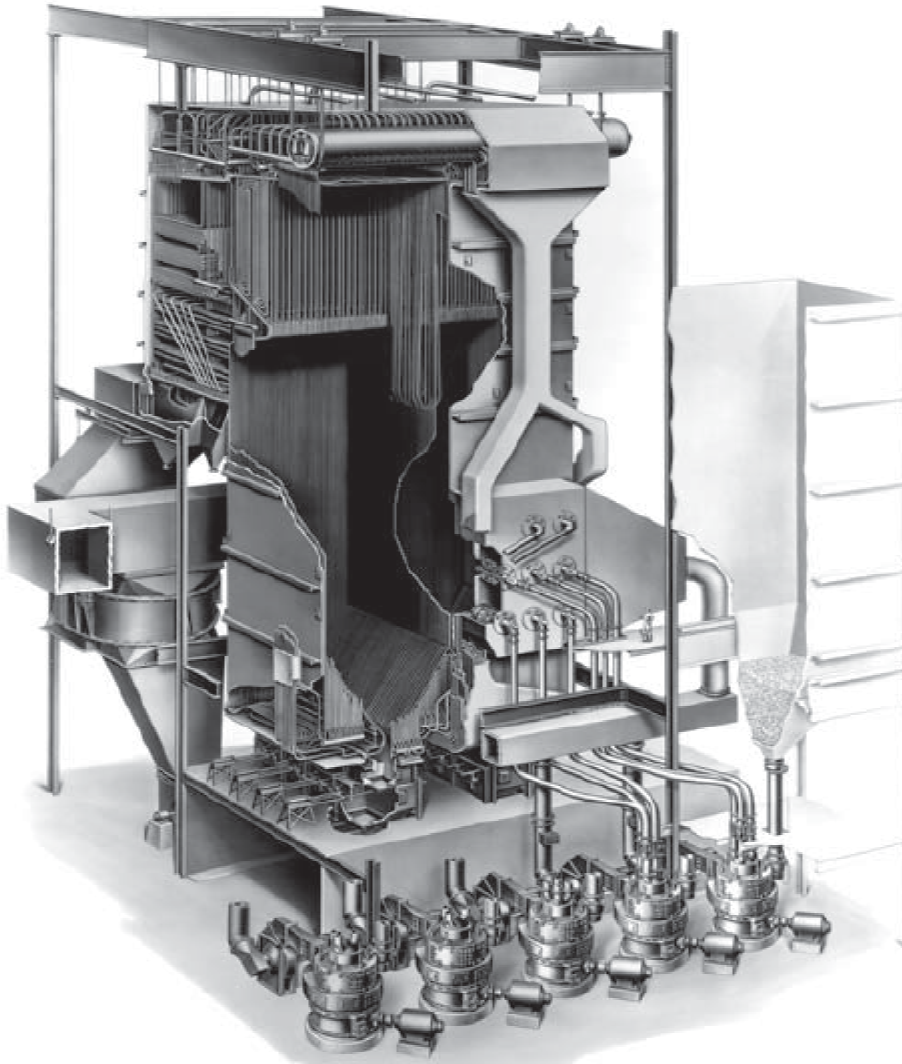
Objective

At the end of the session participants will be able to:

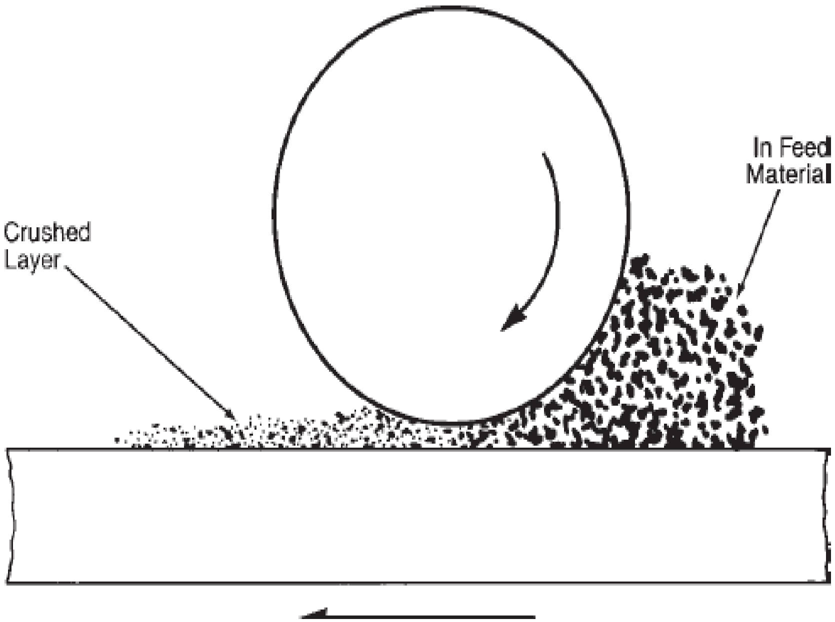
- ***Detail out the fundamental of boiler operation with respect to –***
  - ***Mill Firing,***
  - ***Oil Firing,***
  - ***Fans Operations***
- ***Describe critical aspect of boiler operation and its implication for operators***

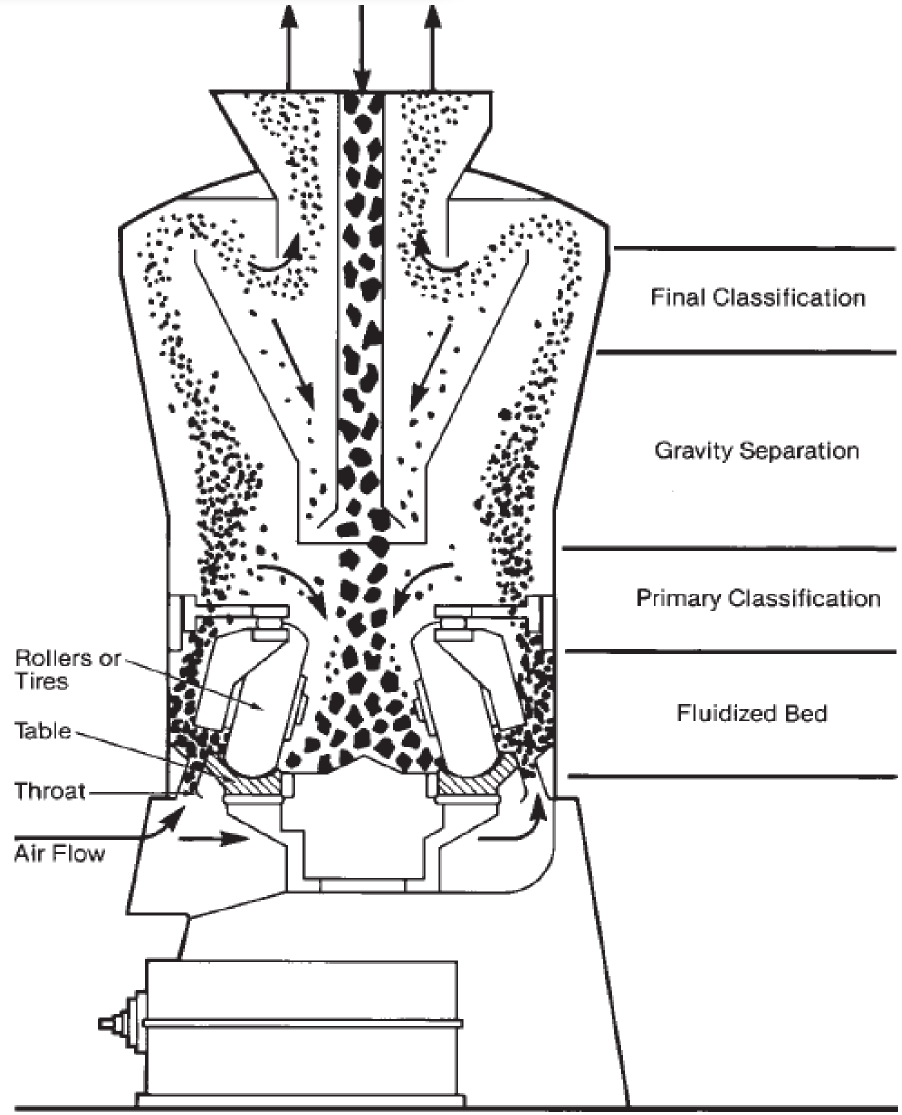
Coal Pulveriser system

Coal Pulverizer system layout

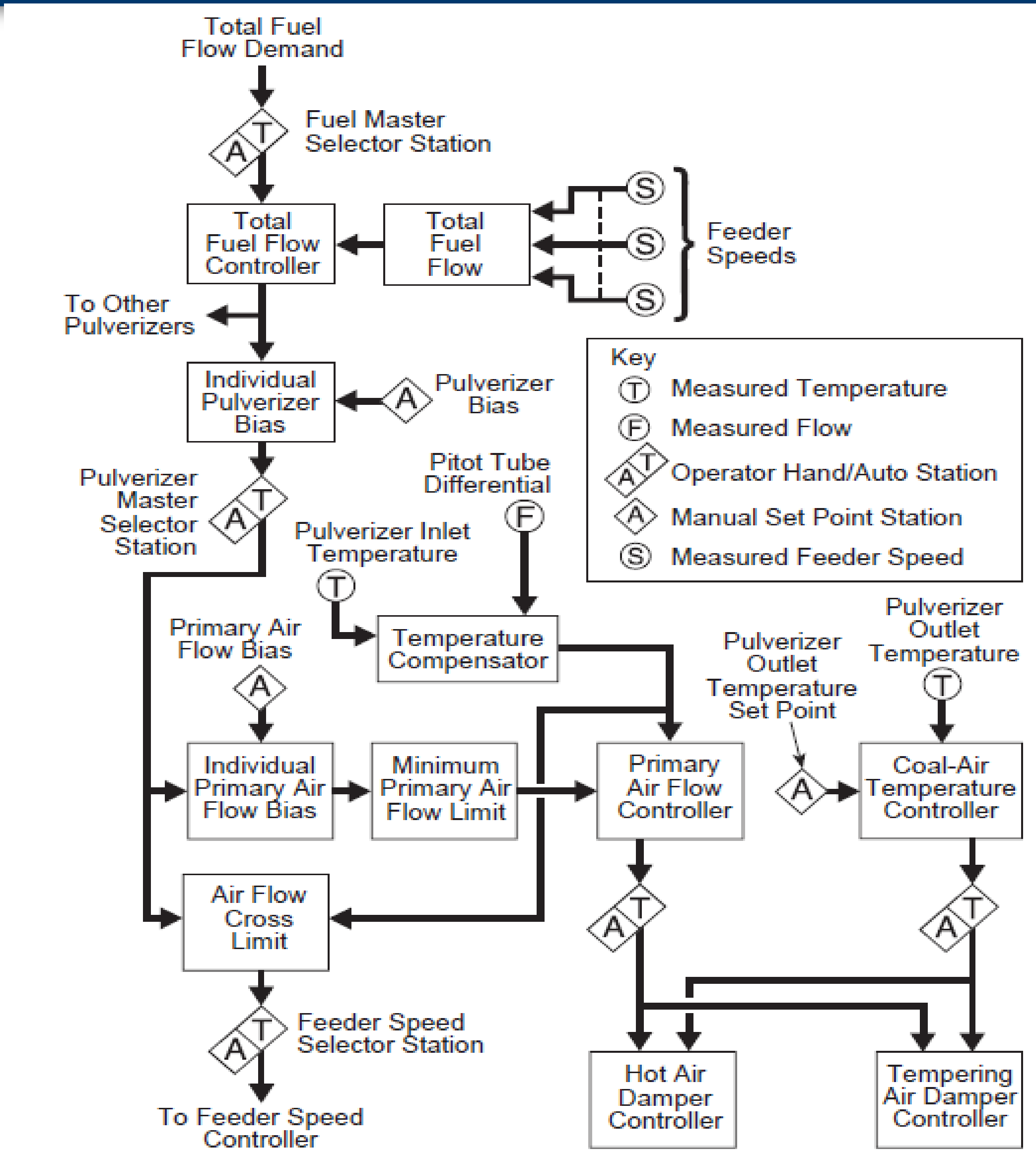


Roller mill Grinding principle





Pulverizer control system



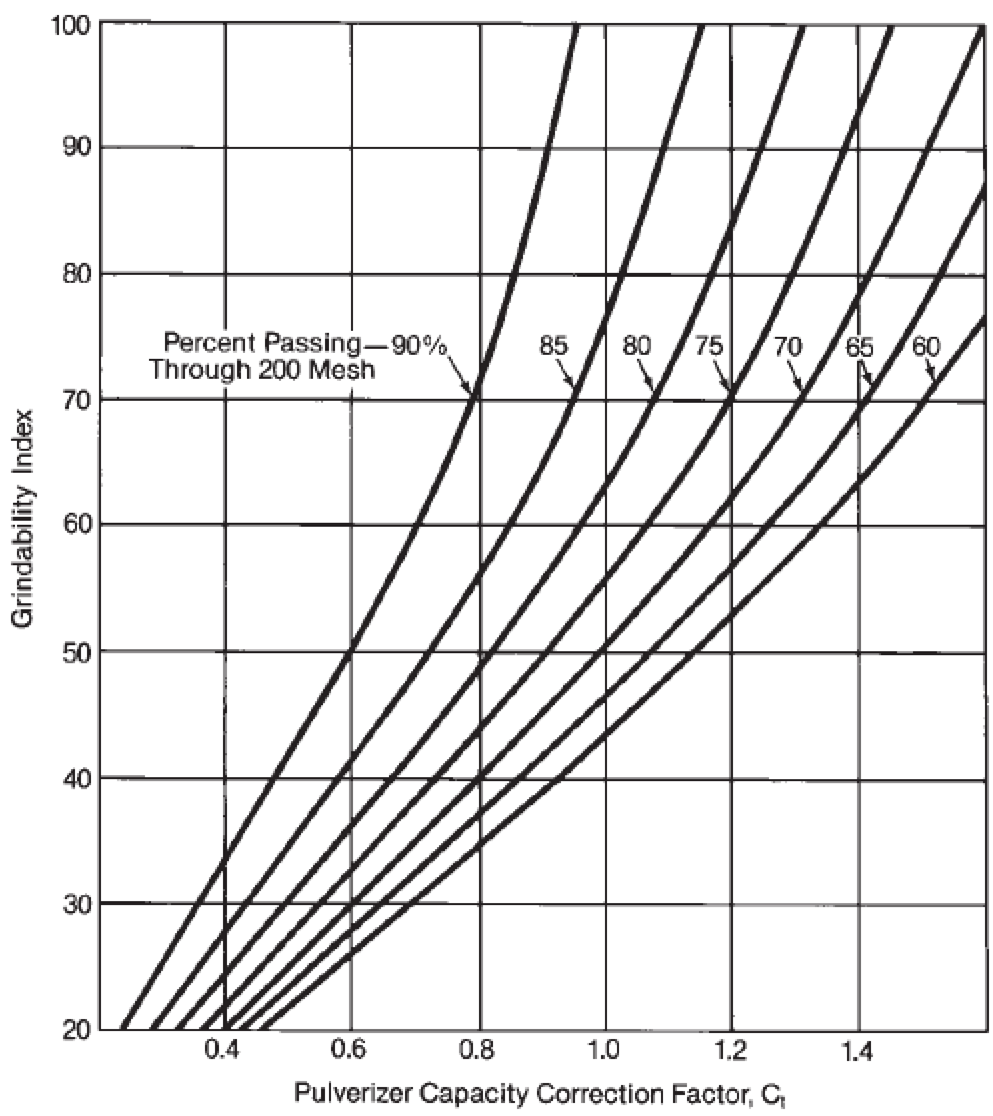
Pulverizer outlet temperatures

Fuel Type	Volatile Content, %*	Exit Temperature F (C)**
Lignite	All values	120 to 140 (49 to 60)
Subbituminous	All values	130 to 150 (54 to 66)
High volatile bituminous	Above 31	140 to 175 (60 to 79)
Medium and low volatile bituminous	14 to 31	160 to 200 (71 to 93)
Anthracite and coal waste	0 to 14	200 to 210 (93 to 99)
Petroleum coke	0 to 8	200 to 250 (93 to 121)

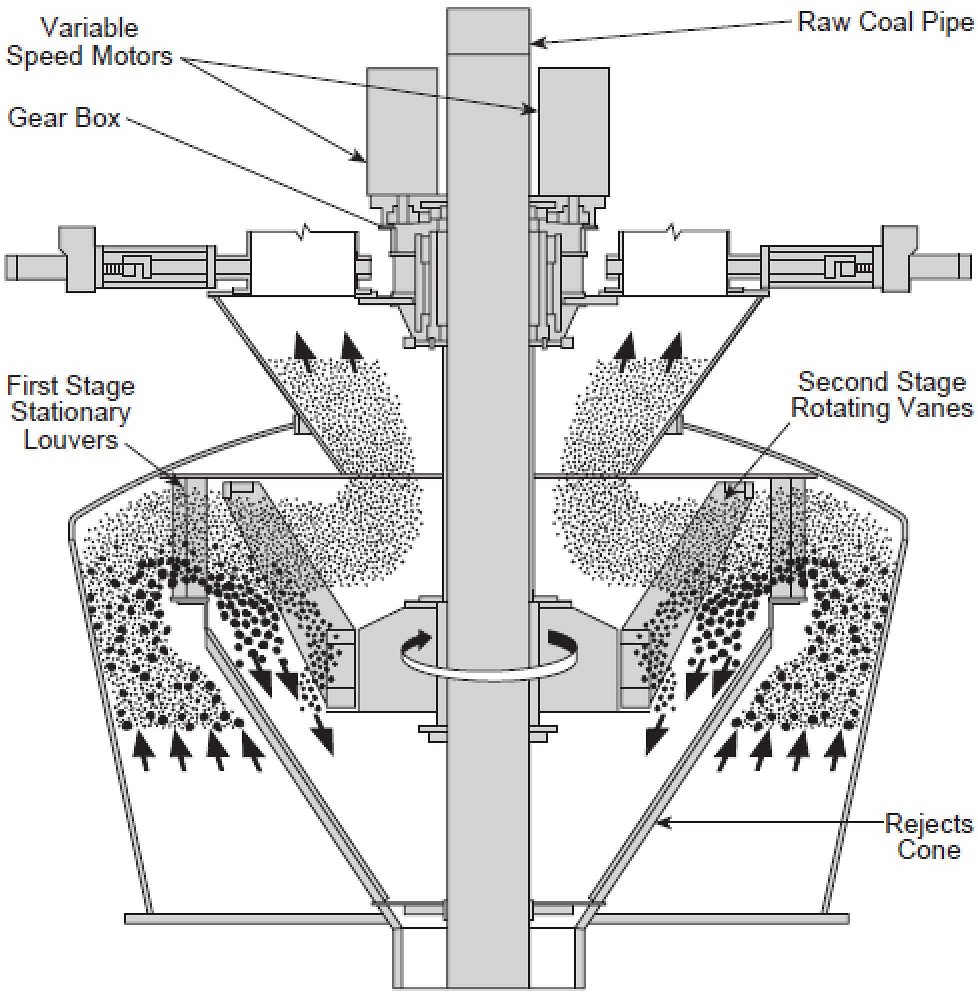
* Volatile content is on a dry, mineral-matter-free basis.

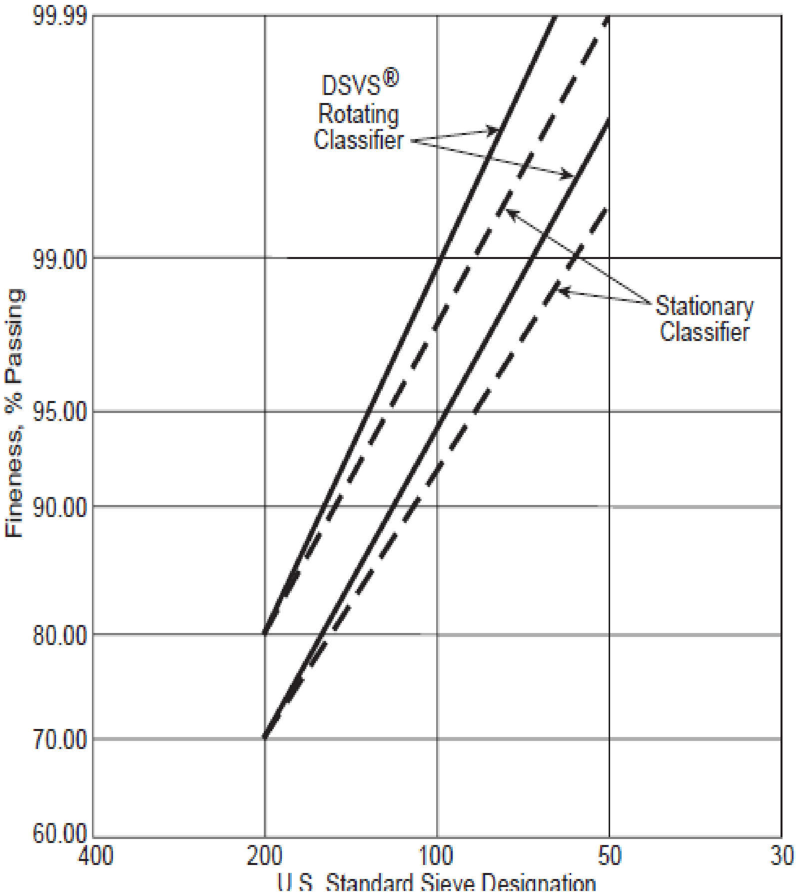
** The capacity of pulverizer is adversely affected for exit temperatures below 125F (52C) when grinding high moisture lignites.

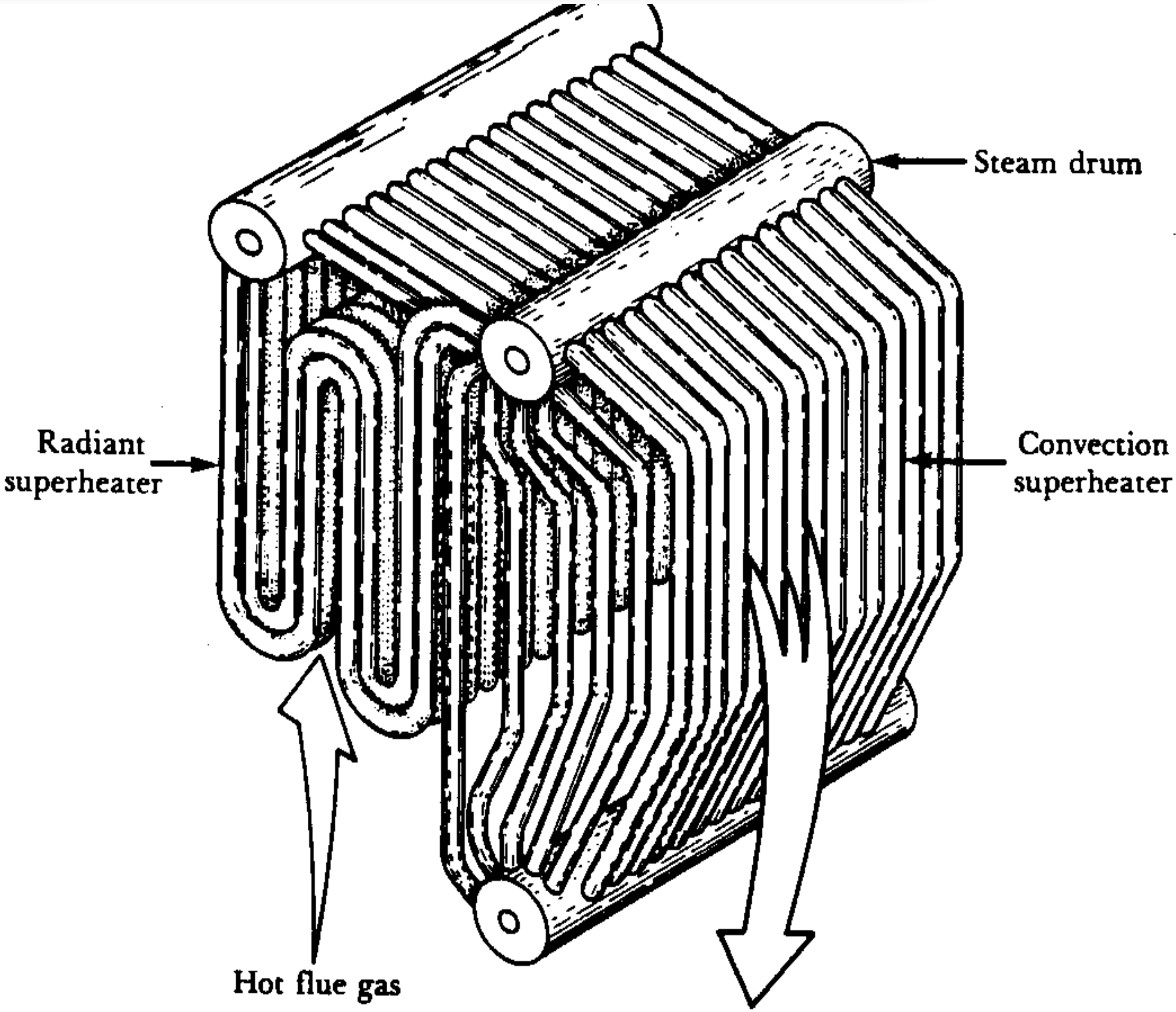
Fuel Fineness-capacity restrictions



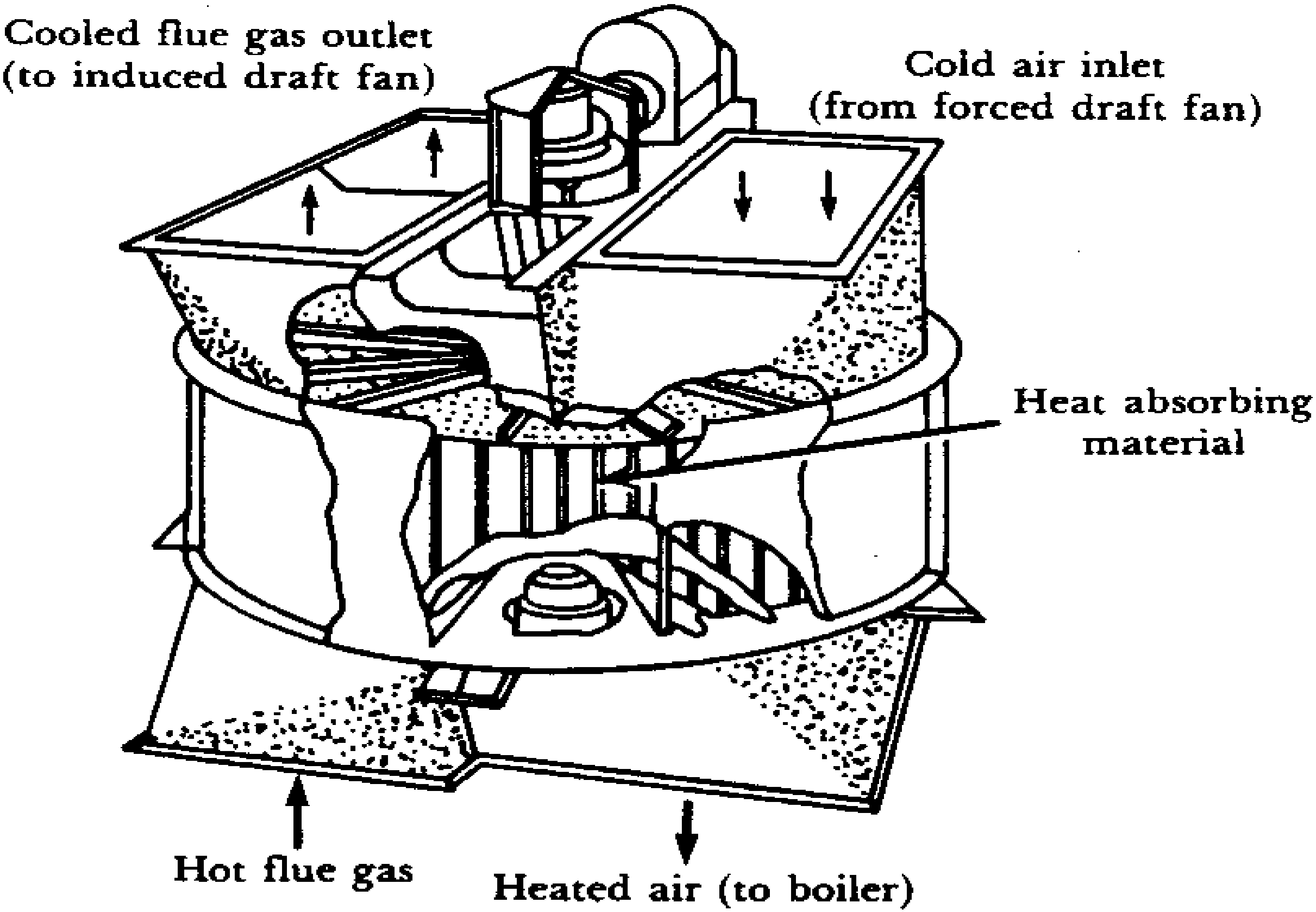
Dynamic classifier



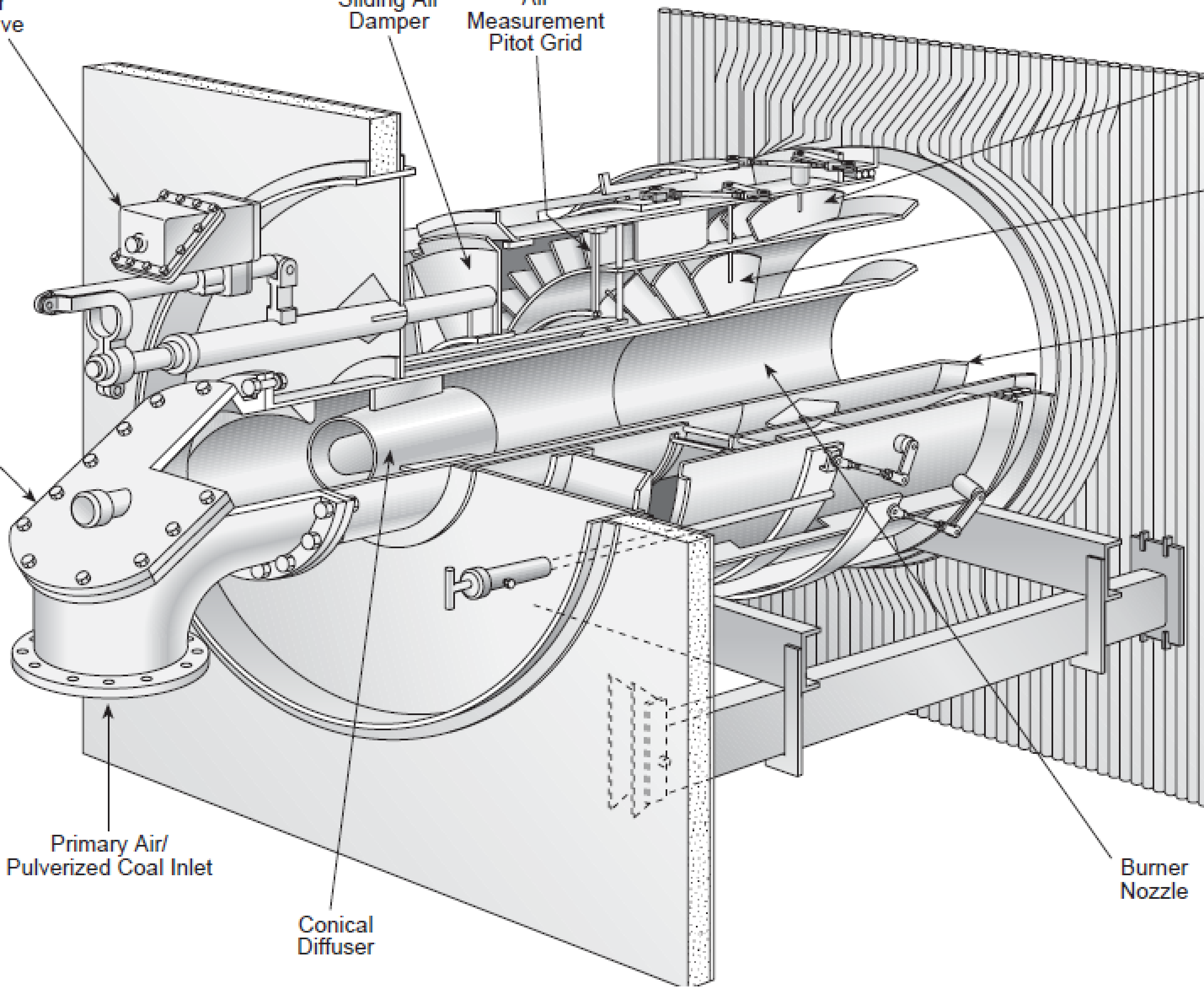



Steam drum
Radiant superheater
Convection superheater
Hot flue gas

Air preheater



Coal Burner


Sliding Air
Damper Drive
Sliding Air
Damper
Air
Measurement
Pitot Grid
Adjustable
Outer Vanes
Adjustable
Inner Vanes
Flame
Stabilizing
Ring
Burner
Elbow
Primary Air/
Pulverized Coal Inlet
Conical
Diffuser
Burner
Nozzle

Milling System operation

•**Coal Firing**

•Ensure that the clean air flow test of the mill is completed satisfactorily

•Boiler shall be lighted up with oil firing as per the regular operating procedure given in O & M manual

•Charge HP/LP bypass system following the manual start up procedure.

•Ensure that ignition energy permit is available as given in FSSS logic for the elevation in which mill is to be put into operation.

•Start PA fan and load the fan to maintain hot PA header pressure of 750-800 mmwc.

•Start seal air fan and maintain seal air fan discharge pressure at 150-200 mmwc more that the PA header pressure.

•Ensure that mill discharge valves are opened.

•Start mill. Ensure that the mill seal air damper will open automatically.

•Establish hot air flow through the mill by opening the respective hot air gate and hot air damper.

•Raise the mill outlet temperature to a value of around 750C to 850C.

•Open the bunker outlet gate and feeder inlet gate and charge the coal upto feeder.

•Open the feeder outlet gate.

•Start the feeder on local mode and run till coal on belt. Switch is actuated by the incoming coal bed.

•Simultaneously start the clean out conveyor of the feeder.

Milling System operation

•Continue the feeder at minimum speed and establish coal feeding into the pulveriser. Coal fed into mill gets pulverized and carried into furnace thus establishing coal firing.
•Check for any coal power leakage from coal pipes, mills feeder area and attend the same immediately.
•Monitor mill outlet temperature and adjust the opening of hot and cold air damper such a way that the mill outlet temperature is around 75 – 770 C.
•Operate mill reject dampers and check the coal reject. Only stones, pyrites and foreign materials shall come out through reject dampers along with very small quantity of coal.
•Put the PA header pressure control, mill outlet temperature control on auto mode at a suitable point of mill load.
•Observe the furnace and ensure that combustion chamber is stable with complete combustion of coal admitted inside the furnace.
•Take coal powder sampling and analyses for fineness. If the fineness is less than 70% passing through 200 mesh, the classifier vane assembly may be adjusted to higher set value. To start, with the classifier may be set at 3 or 4 position. (Coal sampling preferably taken at higher loads of the mill after allowing the mill to operate for some period)
•The same procedure may be adopted for other mills for taking them into service and the load on the Unit may be raised gradually according to the coal feeding rate

Oil Firing

•Start ID/FD/APH Systems as per normal start up procedure.

•(Respective Testing Schedules or O&M manual to be referred) and establish required furnace draft (Around –5 to –10 mmwc)

•Charge SCAPH and raise the air temperature to around 600C.

•Adjust the boiler airflow and windbox DP to the required level Charge

•a. Atomising Steam System and

•b. Steam Tracing System

•Start any one of the HFO Pump and after charging HFO Heater,charge HFO line up to boiler and put under short recirculation first and then long recirculation for raising HFO temperature.

•After attaining HFO firing temperature (around 1150C -- 1200C),give command for HFO burner “start”. Watch the flame establishment.

•Once the flame is established, ensure a. Oil combustion is proper and b. Flame scanner picks up the flame.

•After few minutes of operation, trip the burner and observe and ensure that shutdown sequence take place as envisaged.

•Repeat the above procedure for other HFO Oil Gun, in that elevation

Fans and draft system

Fans-ID,FD,PA

Draft fans are classified as either centrifugal or axial, according to the direction of air or gas flow through the fans. Centrifugal fans move air or gas perpendicular to the impeller shaft.

Axial fans move air or gas parallel to the impeller shaft.
The performance characteristics of centrifugal fans are highly dependent on the type of blade used.
Basically, three types of blades are used on centrifugal fans in power plant applications: backward curved, straight, and radial tip.

Fans

backward curved

Highest efficiency, over 90%,

- Very stable operation,
- Low noise level,
- Ideal capabilities for high-speed service

straight : Good abrasion resistance; • Simplified maintenance, particularly blade replacement; and • Wide range of capacities.

The disadvantage of straight blades is the relatively low operating efficiency and an overloading horsepower characteristic.

radial tip *Blades.*

Radial tip blades are normally used for moderately erosive gas applications. Radial tip blades have several advantageous operating characteristics: • Non overloading horsepower, • High capacity for size, • Excellent abrasion resistance, • Very stable operation, and • Essentially self cleaning capabilities.

The disadvantage of using radial tip blades is that efficiency is not as high as that of backward curved blades

SYSTEM RESISTANCE

When a gas is forced through a duct system, a loss in pressure occurs. This loss in pressure is called system resistance.
System resistance is composed of two components: friction losses and dynamic losses.
Friction losses occur at the walls of the duct system and can be quantified by the following equation:

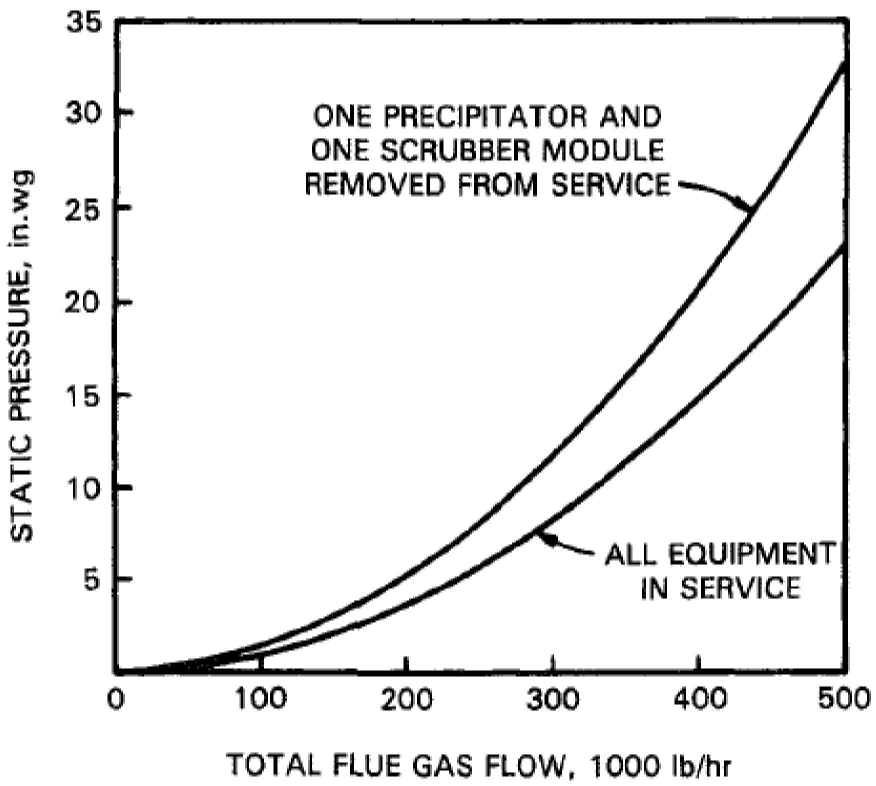
ДP (friction) $= \frac{f \rho v^2 L}{D g_c}$

Dynamic losses occur at changes of direction in gas flow and at sudden duct enlargements and contractions. Dynamic losses can also be called velocity pressure losses.

$$\Delta P \text{ (dynamic)} = \tfrac{1}{2} \frac{\rho K V^2}{g_c}$$

By adding the friction losses to the dynamic losses, the total system resistance can be determined.
Once the system resistance is determined for one set of flow conditions, gas density, and average duct velocity (or volumetric flow rate), the system resistance can be predicted for any other flow rate or gas density. As shown in the friction and dynamic loss equations, when the system geometry is not modified, that is, when*/, L, D, gc, and K are held* constant, only changes in gas density and flow rate cause the system resistance to change.

Fan Performance characteristics



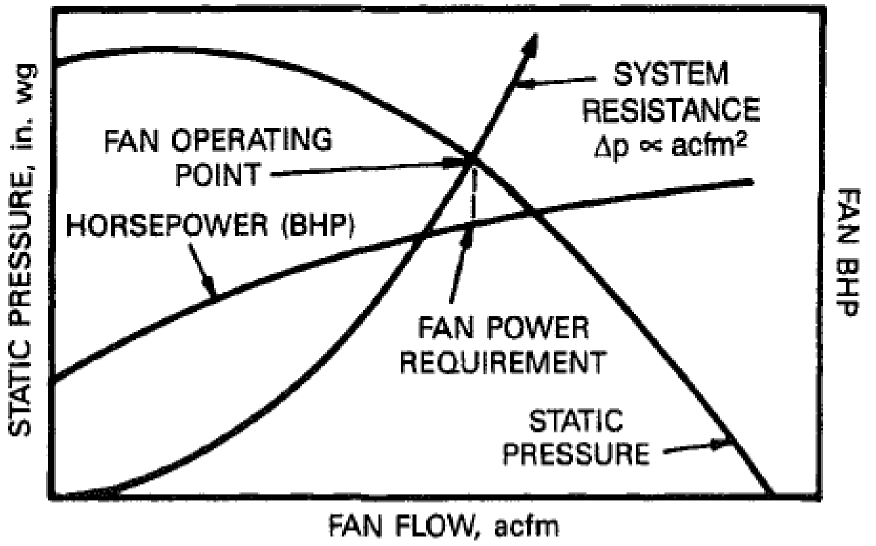


Fig. 10-11. Typical installed centrifugal fan performance curve.