DAMPER
Sizing & Selection

POWERS

Application Eng. Form
AE-24
June, 1972

INTRODUCTION

A damper can rightfully be referred to as an "Air Valve". Its function is to shut off, mix, divert or modify the flow of air in an air handling system just as a water valve produces these same functions in a water system. The technique of sizing dampers to match system characteristics provides a realistic means of improving the overall performance of a system. It will provide better results and greater stability of the final temperature, process or pressure. Damper sizing techniques are therefore another "tool" for the designer to insure proper performance of the total system. The ability to control the air flow with a damper is dependent upon the damper's ability to change the resistance of the system as its position is changed.

Just as with valve selection, damper selection is no longer done on the basis of "line size" or "duct size". Dampers are selected to control the flow of air in a specific manner to yield an air flow change which is proportional to the controller input signal change.

Correctly sized dampers can help in overcoming many of the inherent deficiencies in the typical system. For example, a built-up system must be sized to accommodate the coil supports, piping headers, filter drives, etc. This works against obtaining good linear control of air flow. Proper damper sizing can contain the air flow modulation within limits likely to provide the best results for the total system.

Dampers which are correctly sized and selected sometimes require a slight increase in fan size, but this increase is offset by the higher quality of control the system produces.

PURPOSE

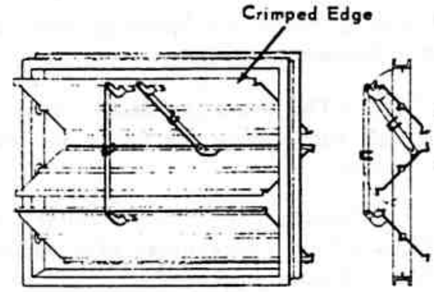
This article describes how the various types of dampers behave under various conditions. Also, how to utilize the damper characteristics to select the proper damper to yield the desired results in an air handling system.

The sizing procedures within this form have been simplified and are satisfactory for most applications. Critical applications should be referred to Application Engineering, Skokie.

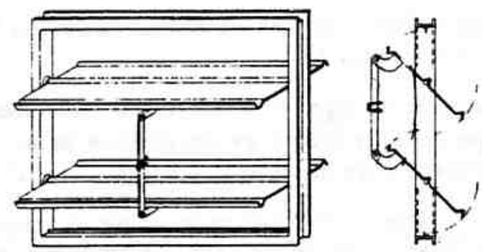
TERMINOLOGY

Parallel-Blade Damper – All blades rotate in the same direction (Fig. 1).

Opposed-Blade Damper – Adjacent blades rotate in opposite directions (Fig. 1).



Opposed Blade



Parallel Blade

Figure 1

TERMINOLOGY (Cont'd.)

Frame Dimensions – Dimension parallel to the blade axis is given as the first dimension. The second dimension given is measured perpendicular to the blade axis. (Dimensions are normally equal to or slightly less than actual duct size to facilitate installation.)

Horizontal or Vertical Axis – Orientation of the blade axis depending on whether the damper is to be mounted in the duct with the blade axis horizontal or vertical.

Damper Position – Position of the damper blades with respect to the plane of the frame. 0 deg. (closed), 90 deg. (open).

Blade Height – Height of a single blade measured perpendicular to the blade axis.

Crimped Edge – Edge of the blade parallel to the axis is provided with a crimp to allow the blades to overlap when closed. It also serves to strengthen the blade. (Fig. 1)

Seals – Soft cushion-like material attached to damper edges, end stops and edge stops to reduce leakage.

TERMINOLOGY (Cont'd.)

Edge Stops – Strips of metal placed on the frame of the damper to provide a fixed mechanical stop. The edge of the damper blades rest against these strips when the blades are in their closed position.

Shaft – A rod to which the blade is attached, rotates in frame mounted bearings.

Extended Shaft – The operating damper shaft which extends through and beyond the frame and duct for external actuation.

Leakage – The amount of air flowing through a closed damper, expressed as a percentage of maximum flow at a specified pressure drop.

Characteristics

Quick Opening – High percentage of maximum flow obtained with minimum blade opening. (Fig. 2)

Linear – Equal air volume change for equal blade movement. (Fig. 2)

Equal Percentage – Each equal increment of damper opening increases the air flow by an equal percentage over the previous value. (Fig. 2)

Damper Torque – The maximum value of torque required to operate the damper through its full rotation. Torque is measured at the driving blade.

Driving Blade – The blade that is positioned by an operator, and the remaining blades through linkage positions.

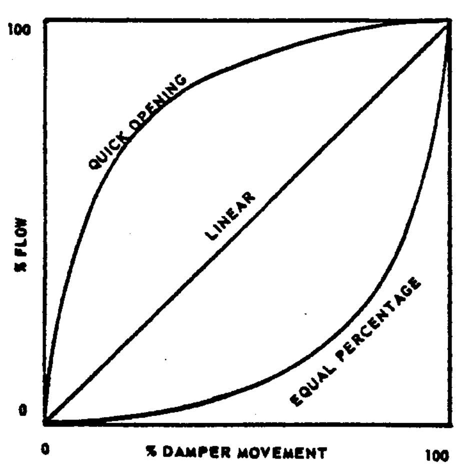


Figure 2

SIZING FACTOR

The sizing of a damper is very important if it is to render good service. If it is undersized, it will not have sufficient capacity. If it is oversized, the controlled variable will cycle. Important factors which must be considered in sizing dampers are:

1. What is the application? Mixing (or diverting) control; volume (or pressure reducing) control; face-bypass control. (see Fig. 3)

SIZING FACTOR (Cont'd.)

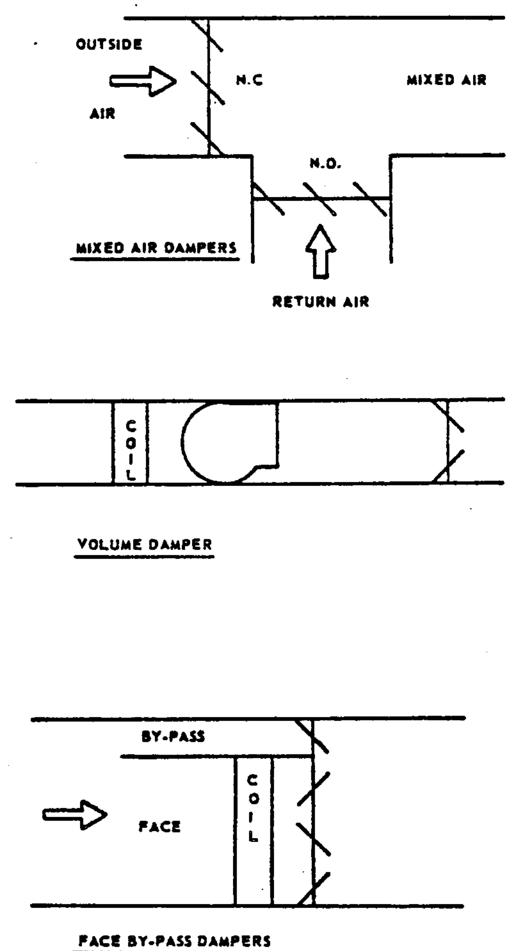


Figure 3

2. What is the maximum volume of air to be allowed by the damper in the fully opened position?
3. What is the maximum pressure drop allowed across the open damper?
4. What is the pressure drop across the closed damper?
5. What leakage (%) is acceptable?

PRESSURE DROP FOR AIR FLOW
(Damper Characteristics)

A pressure drop must exist across a damper if flow is to occur. The greater the drop, the greater the flow at any fixed opening. The pressure drop across a damper also varies with the blade position; from minimum when fully open, to as much as 100% of the system drop for volume dampers when fully closed. The pressure loss through open dampers is usually expressed in inches of water as a function of the approach velocity. This pressure loss should not be neglected in calculating the resistance of the total duct system.

The pressure loss of an opposed blade damper is greater than that of an equal size parallel blade damper in a throttled position. Because of this, the reduction of air flow for each degree of blade movement is greater with opposed blade dampers than with the parallel blade type.

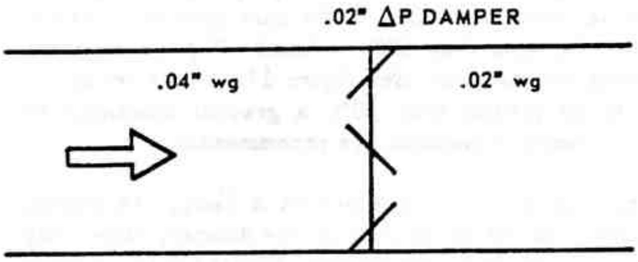


Figure 4 – Damper Pressure Drop

The relationship between air flow rate and damper blade position is called the flow characteristic. Figure 5 shows the flow characteristic of the parallel and opposed blade dampers with constant pressure drop.

A definite relationship exists between damper performance and how it is applied to a system. Figure 6 shows the characteristic of a typical fan system. The intersection of the fan characteristic and system characteristic curves is the design point. The static pressure at this point is the static pressure generated by the fan and equals the pressure drop across the open volume damper, ducts, grills, etc.

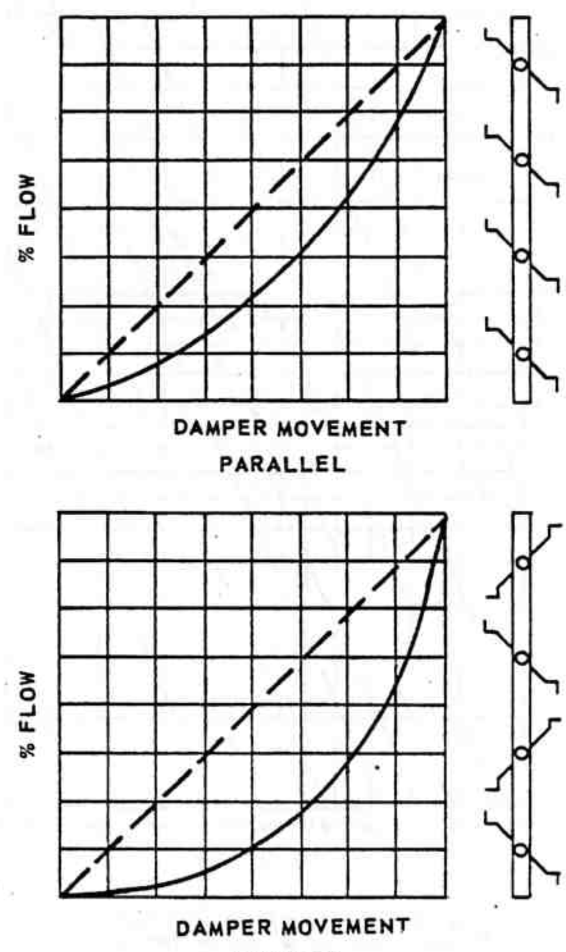


Fig. 5 – Flow Characteristics with Constant Pressure Drop

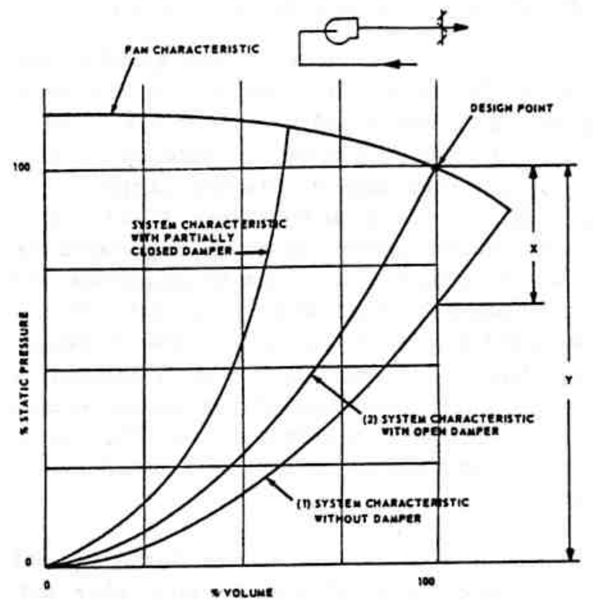
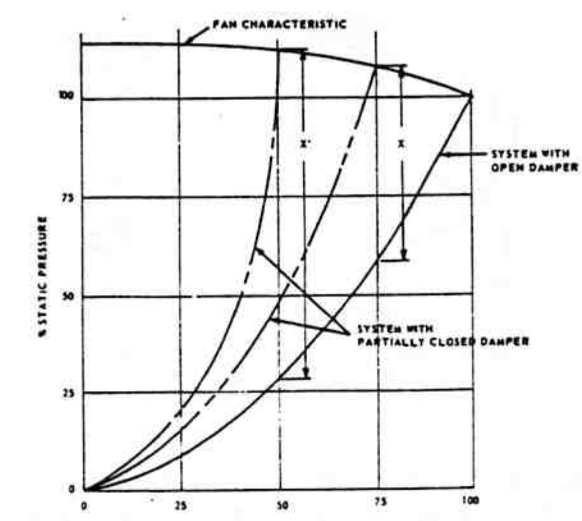


Figure 6

Curve 1 illustrates the system characteristic if the damper is omitted and curve 2 illustrates system characteristics with the damper added. The ratio X/Y represents the damper's resistance when wide open to the system in which it is installed. The ratio is an index of the damper's ability to control air flow.

If the damper resistance is a large percentage of the system resistance, any change in damper position will alter the system resistance significantly by varying the air flow. If the damper resistance is too small a percentage of the total system resistance, a substantial change in damper position is required to vary the air flow. *Note that as the damper closes to reduce air volume, pressure drop shifts from ducts, diffusers, etc. to the damper.* See figure 7.



NOTE X and X' represent the additional pressure drop shifted to the control damper as it closes

Figure 7

PRESSURE DROP FOR AIR FLOW (Cont'd.)

Varying flow characteristics for the parallel and opposed blade dampers in terms of the X/Y ratio are shown in figures 8 and 9. Note that all curves above the constant Δ P curve illustrate the effect of a varying pressure drop across the damper as it closes. The larger the ratio between X and Y (the smaller the curve number), the more exaggerated the flow curves become. This leads to inaccurate and unstable control because dampers normally do not provide good control in the initial 10% of damper rotation (Control Threshold). Control Threshold is the point at which regulation of flow begins to take effect. It is difficult to control below 10%, due to leakage and accumulated tolerances in damper linkage, etc.

The damper flow characteristics are shifted upward toward a "quick opening" characteristic when the damper pressure drop is too small a percentage of the total system pressure drop. To shift the flow characteristic to a nearly linear one, the damper must be sized so that its wide open pressure drop is a certain percent of the total system static pressure. Curve 5 of figure 8 and curve 9 of figure 9 provide the closest linear flow characteristic.

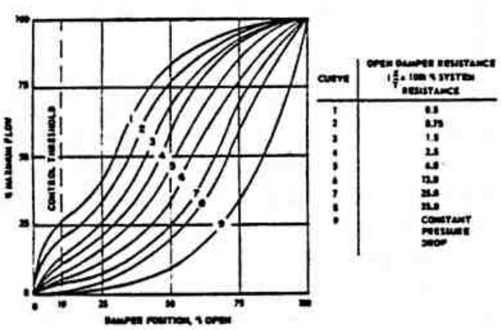


Fig. 8 – Opposed Blade Damper Flow Characteristics

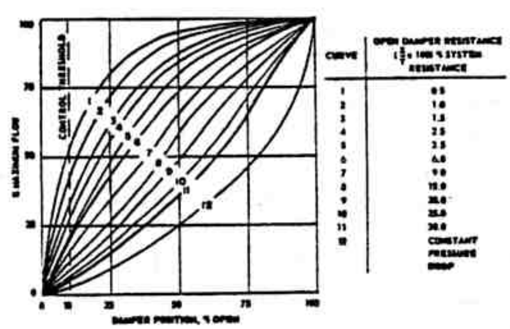


Fig. 9 – Parallel Blade Damper Flow Characteristics

The approach velocities that produce the wide open pressure drops at various system resistances are shown in figures 10 and 11. Use the approach velocity vs. system resistance to size damper for throttling applications. If the CFM is known, the approach velocity can be directly related to the duct area.

Generally, when a damper is properly sized, it is smaller than duct size. If the duct area is to be reduced by less than 30%, a blank-off plate or metal safing may be used. See figure 15b. If the reduction is to be greater than 30%, a gradual transition to meet damper dimensions is recommended.

Since the pressure drop across a damper is related to the velocity of air through the damper, either may be used for sizing the damper. Figures 8 and 9 show various damper characteristic curves when the wide open damper resistance is a percentage of the total system resistance. From these curves it may be seen that opposed blade dampers should be sized so their wide-open resistance is approximately 6% or a range of 4-8% of the system resistance; for parallel blade dampers, approximately 20% or a range of 15-25% of the system resistance. Figures 10 and 11 give the range velocities which yield these percentages of resistances. The selected dampers should fall in these ranges.

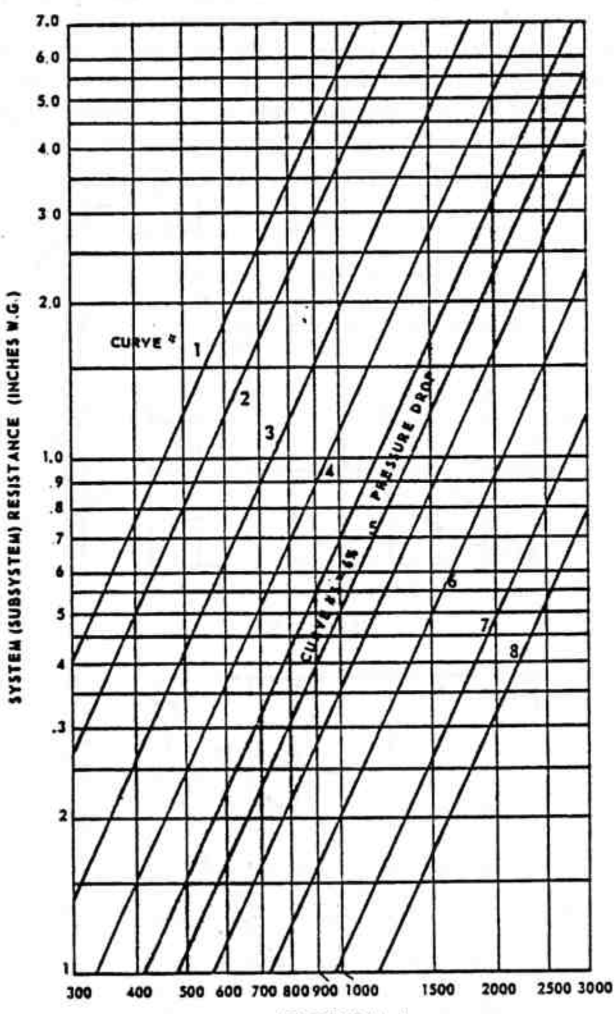


Fig. 10 – Pressure Drop Thru Open Damper (Opposed Blade) at Varying System Resistance %

Curve numbers cross referenced with Fig. 8
Recommended pressure drop is in shaded area

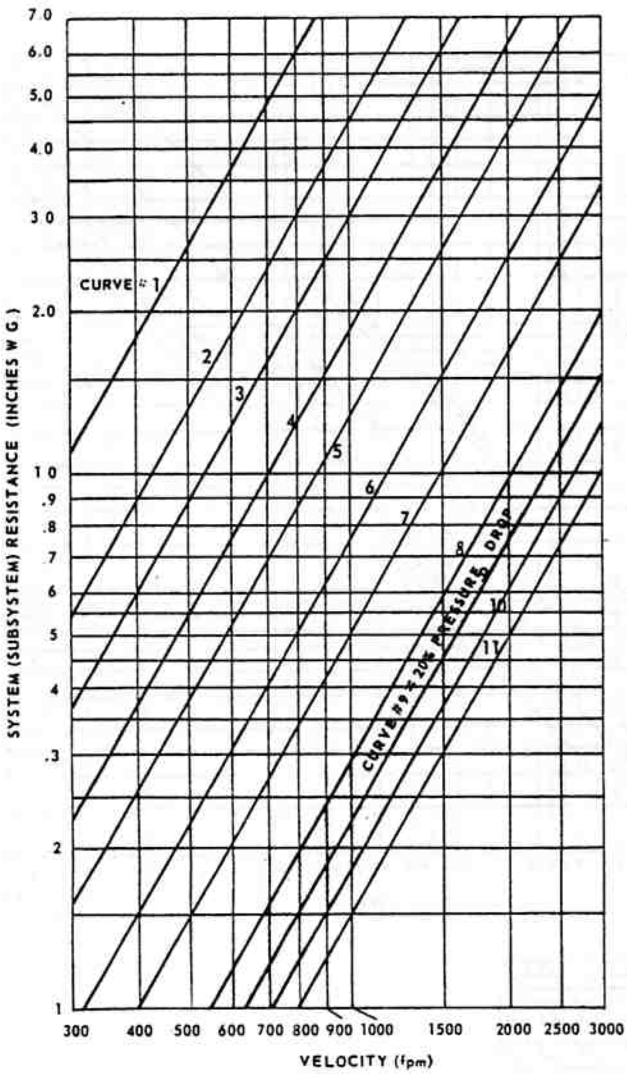


Fig. 11 – Pressure Drop Thru Open Damper (Parallel Blade) at Varying System Resistance %

Curve numbers cross referenced with Fig. 9
Recommended pressure drop is in shaded area

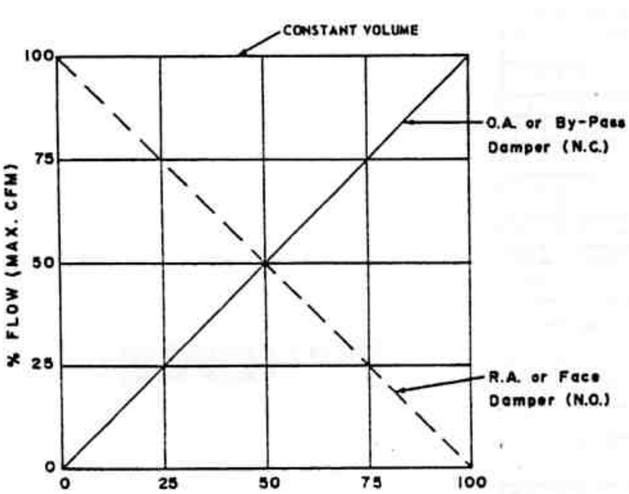


Fig. 12 – Ideal Flow Characteristics of Dampers with Linear Flow Characteristics

SELECTION

The selection of either a parallel or opposed blade damper depends on the damper application. Figures 8 and 9 show how the flow characteristic curve depends upon the pressure drop across the open damper.

When the damper is used for volume (pressure reducing) control, a damper sized for a linear characteristic should be used.

Dampers used for mixed air and face by-pass damper applications must be sized individually to achieve both linear and constant flow characteristics. See figure 12.

VOLUME DAMPER SIZING

Use Work Sheet AE-24, Supplement 1

1. Use opposed blade dampers (to minimize total system resistance).

2. List cfm, system or subsystem pressure drop, and the open damper pressure drop that provides 4 to 8% of system or subsystem resistance. NOTE: System or subsystem resistance is that static pressure measured across the damper when it is closed. This would normally be equal to the difference of fan outlet static pressure and room or space static pressure.

3. From system resistance, find the ideal damper velocity from figure 10. Locate ideal velocity band on system resistance coordinate.

4. To find damper size, refer to figure 13. Locate cfm, follow cfm coordinate to ideal damper air velocity found in step 3. Where these intersect, gives the damper in free area needed for ideal control. Nominal total area is also shown to facilitate estimating and ordering.

5. Damper is then chosen based on average total area that best fits duct size dimensions. Dampers should be supported by 3 sides of the duct. (Figure 15).

6. When damper is smaller than duct size, the sheet metal contractor may furnish blank-off plates providing they do not exceed 30% of the total duct area. If the blank-off plate exceeds 30%, excessive turbulance and pressure drops occur. A gradual transition should be used when the blank-off plate exceeds 30%.

7. Multi-section dampers are used when the size required is larger than a single section of damper.

8. Dampers are ordered via standard procedures.

VOLUME DAMPER SIZING (Cont'd.)

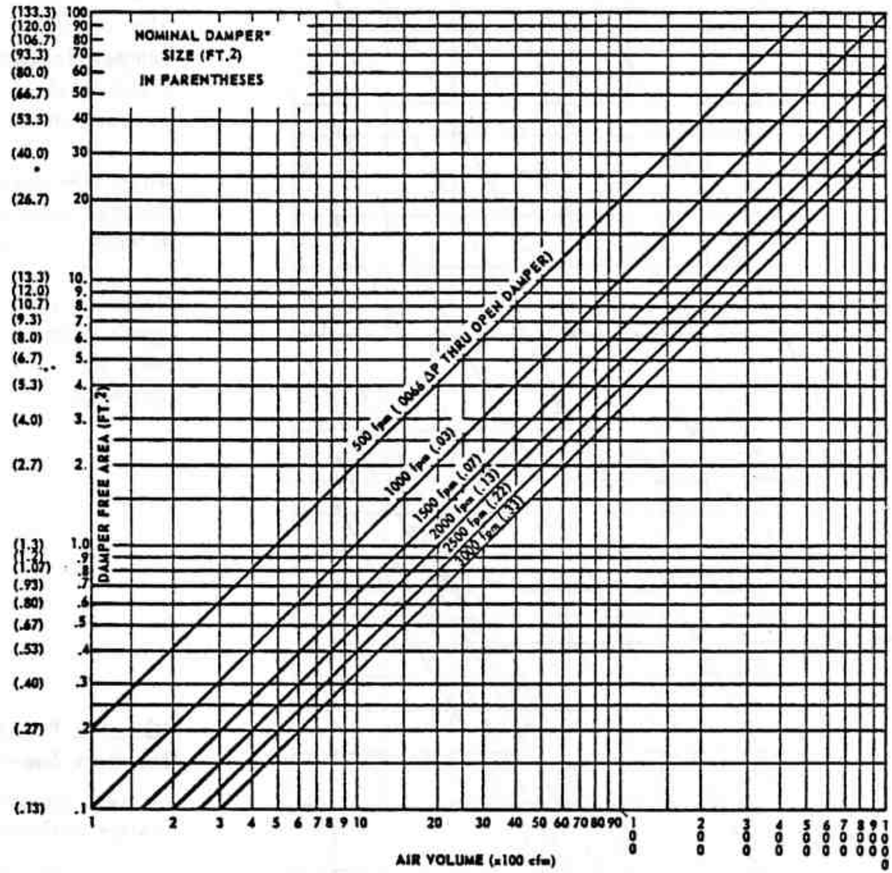


Fig. 13 – Opposed Blade Damper Sizing

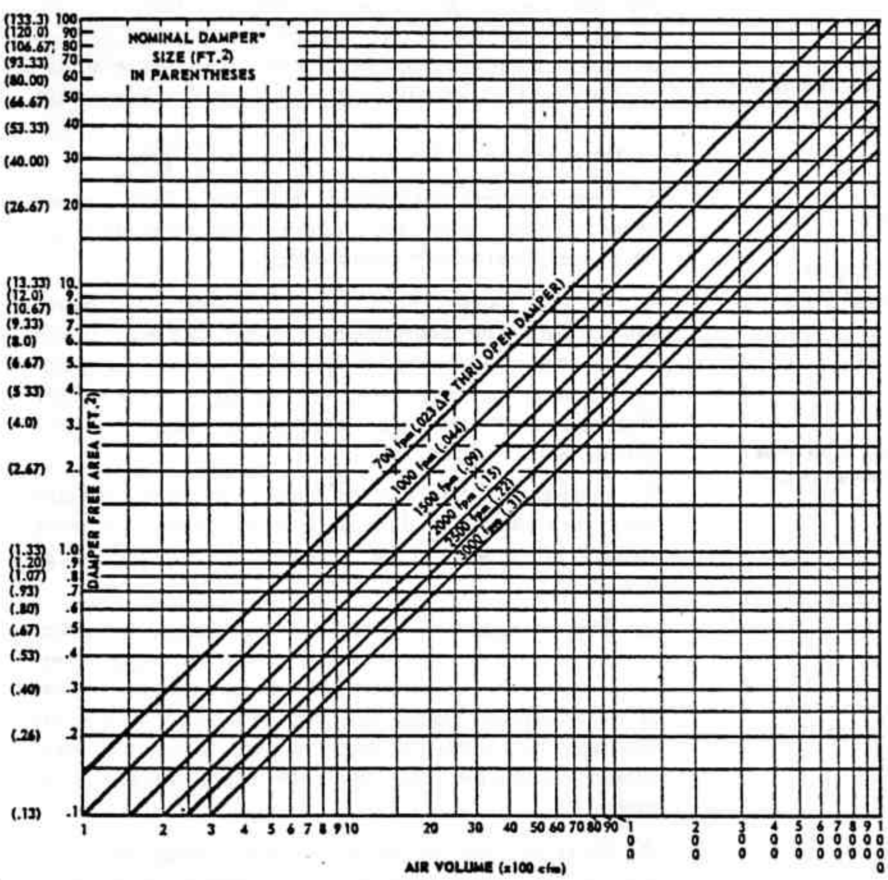


Fig. 14 – Parallel Blade Damper Sizing

* Nominal Damper size was figured for damper with free area equal to 75% of nominal size.

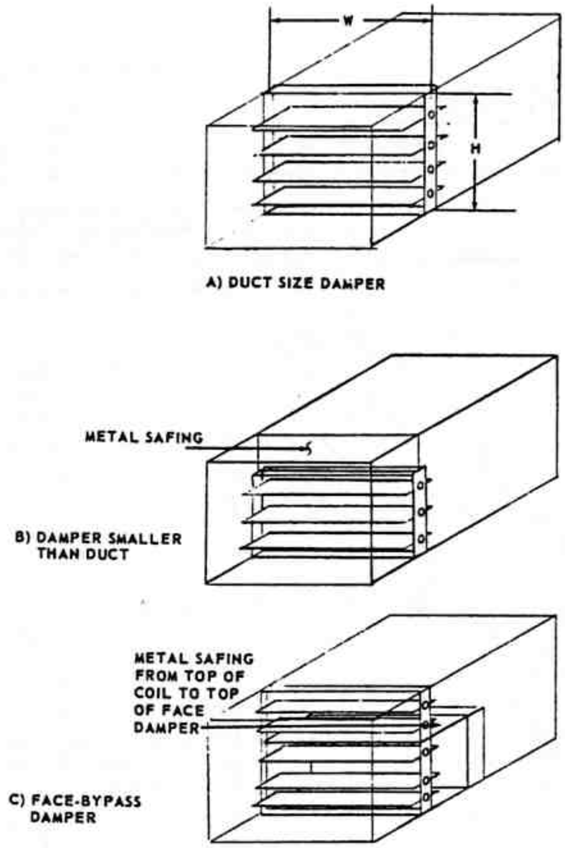


Fig. 15 – Dampers Mounted in Ducts

VOLUME CONTROL – EXAMPLE: (See Figure 16)

Given: Duct system for office having variable volume control.
Total air quantity - 30,000 cfm
20 air terminals - 1,500 cfm each
System operating pressure - .27 in. wg
Subsystem "A" - .258" wg, 13,500 cfm
Subsystem "B" - .234" wg, 9,000 cfm
Subsystem "C" - .21" wg, 7,500 cfm

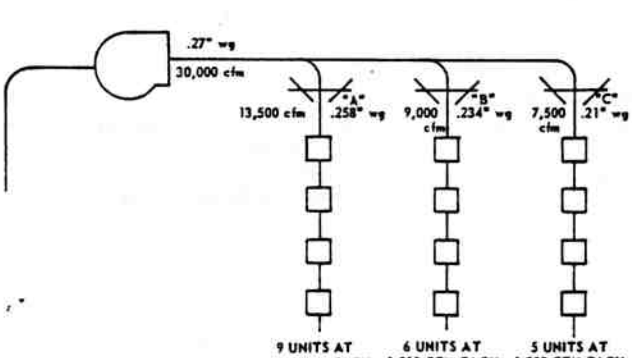


Fig. 16 – Volume Control Damper Sizing Example

Size: Dampers for volume control at "A", "B" & "C"

SOLUTION:

Use opposed blade dampers. Refer to Volume Damper Sizing, in step 3, Subsystem "A" resistance .258" wg shows that a damper in the ideal velocity band of 630 fpm to 880 fpm. Choosing a velocity of 700 fpm, proceeding to step 4, we go to figure 13. Along the cfm coordinate 13,500, the intersection with the velocity line of 700 fpm gives a damper with free area of 19 sq. ft. (Nominal area 25 sq. ft.). Figures 17 and 18 show how it is done.

Subsystem "B" is shown in figures 19 and 20. Free damper area is 13 sq. ft. (Nominal area 17.3 sq. ft.). Subsystem "C" is shown in figures 21 and 22. Free damper area is 10.8 sq. ft. (Nominal area 14.4 sq. ft.).

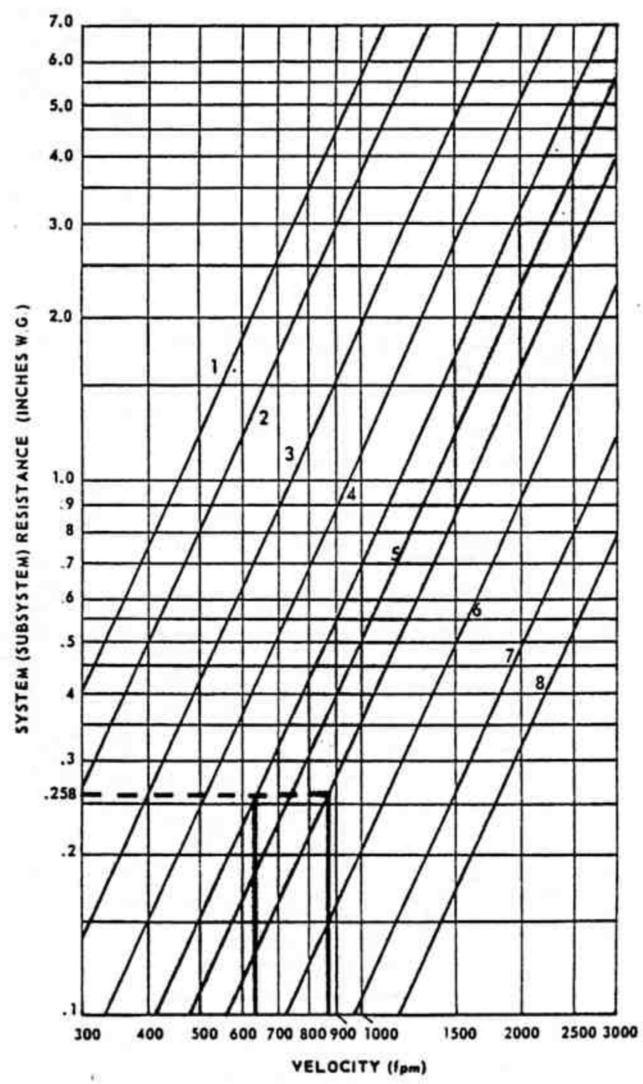


Fig. 17 – Volume Control Sizing Example Subsystem "A" – Locating Ideal Velocity

VOLUME CONTROL (Cont'd.)

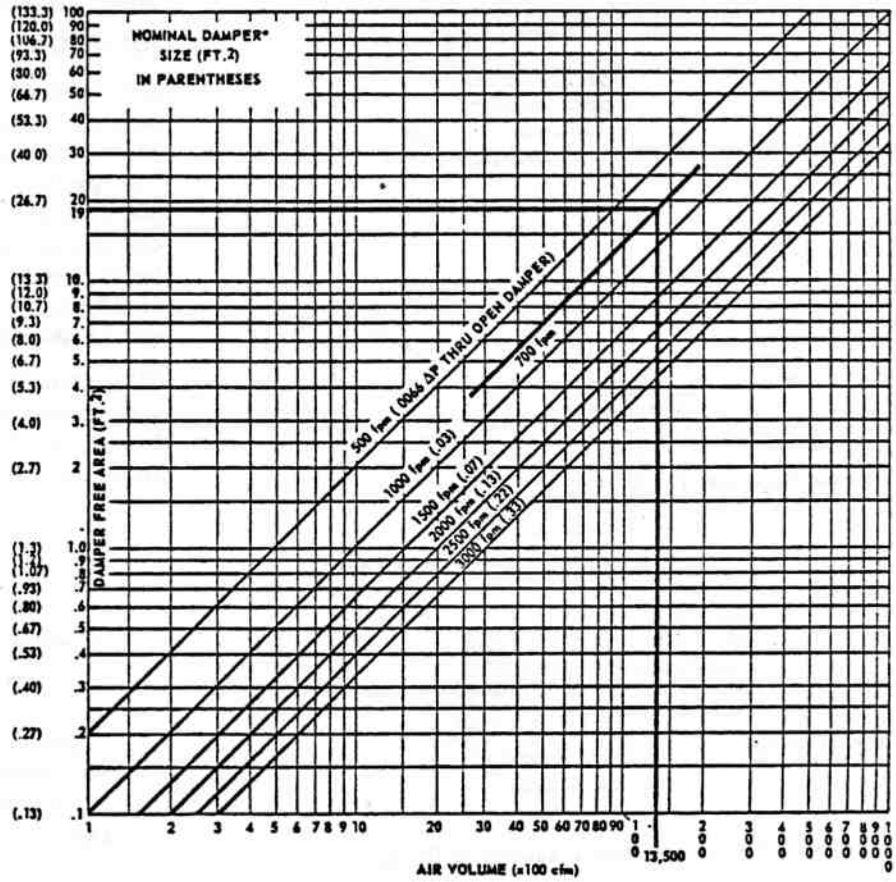


Fig. 18 – Volume Control Sizing Example Subsystem "A" Choosing Damper Size

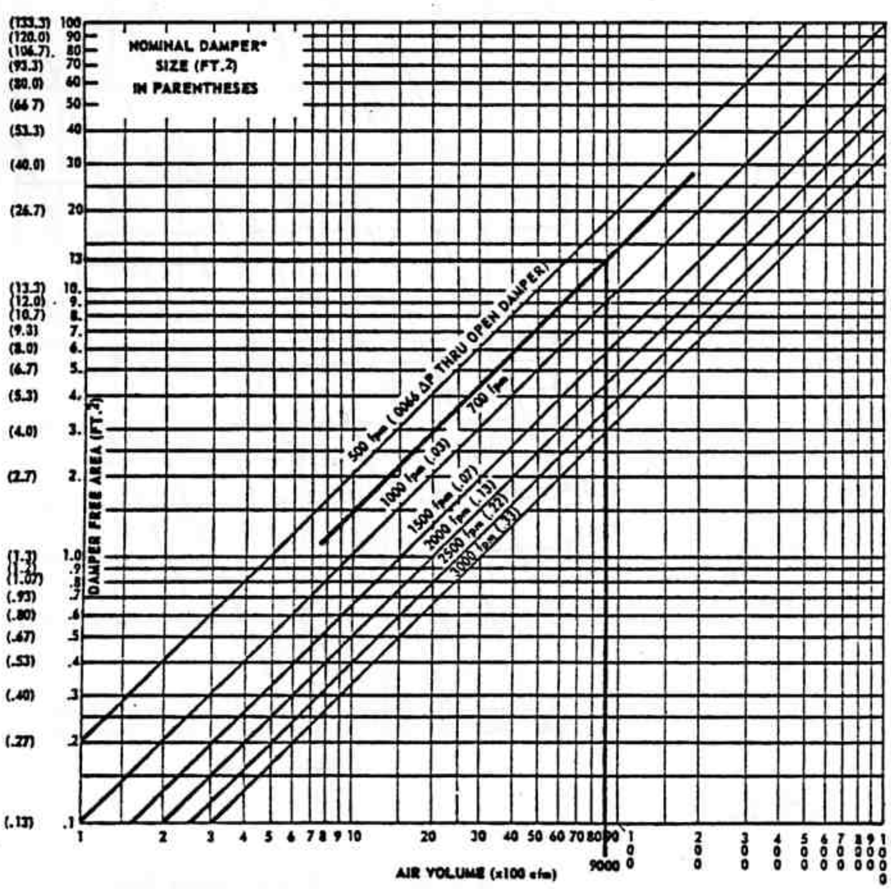


Fig. 19 – Volume Control Sizing Exumple Subsystem "B" Choosing Damper Size

*Nominal damper size was figured for damper with free area equal to 75% of nominal size.

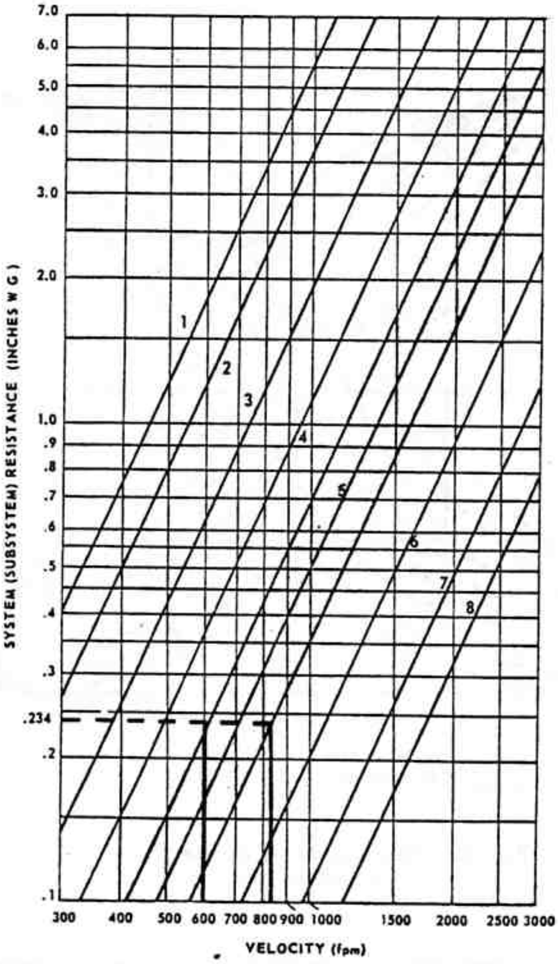


Fig. 20 – Volume Control Sizing Example
Subsystem "B" – Locating Ideal Velocity

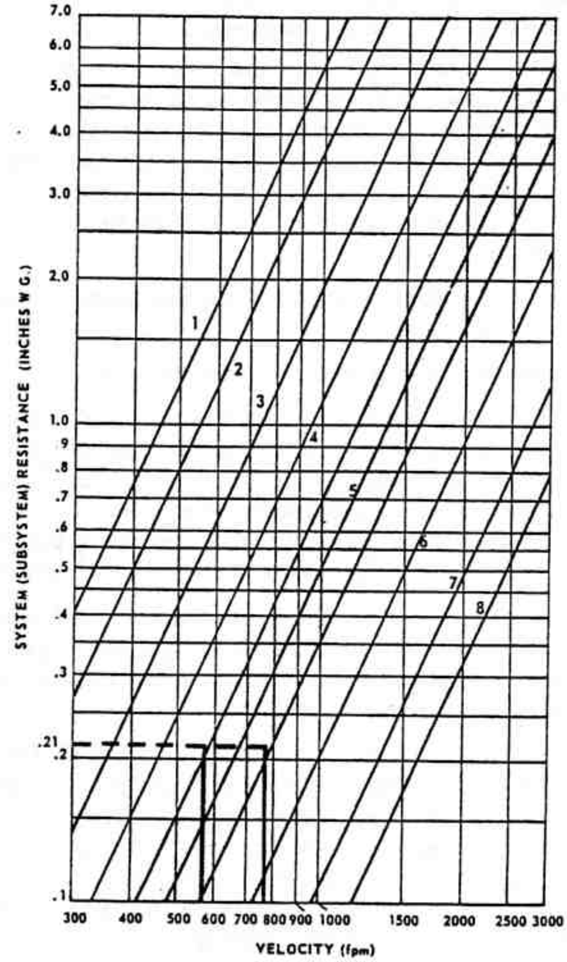


Fig. 21 – Volume Control Sizing Example
Subsystem "C" – Locating Ideal Velocity

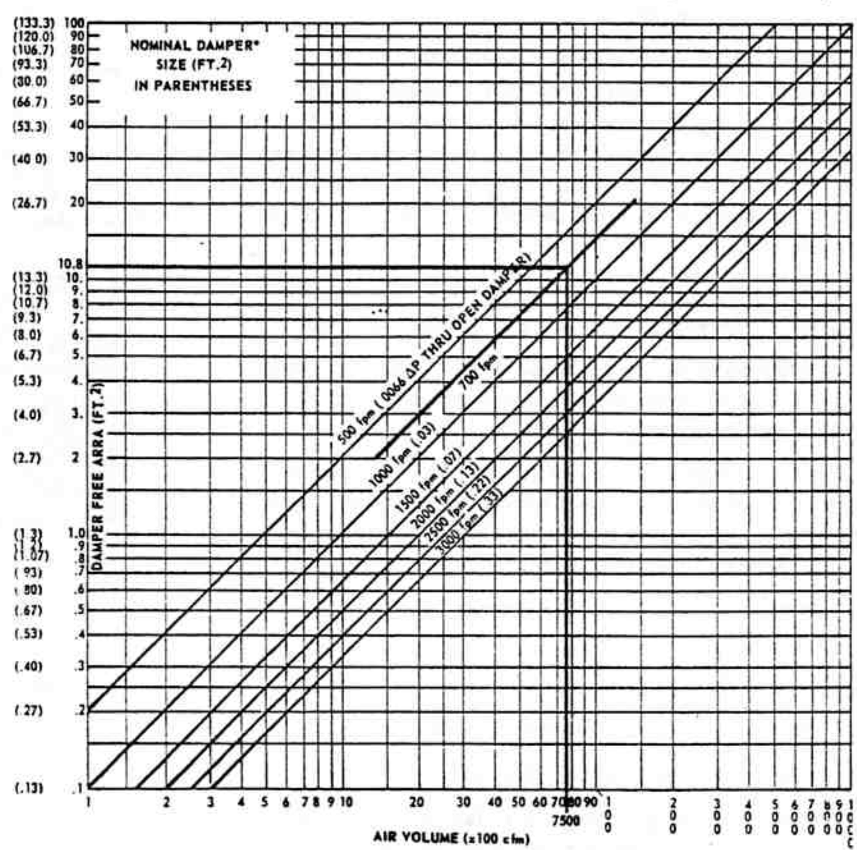


Fig. 22 – Volume Control Sizing Example
Subsystem "C"
Choosing Damper Size

*Nominal damper size was figured for damper with free area equal to 75% of nominal size.

FACE-BYPASS DAMPER SIZING
Use Work Sheet AE-24, Supplement 1

Where possible, size face and by-pass dampers separately to achieve both linear and constant system flow characteristics. See figure 12. At times it is not practical to reduce the size of the face damper less than coil area. Then select a face damper equal to the coil area that has a damper flow characteristic closest to linear.

Method A – (Where face and by-pass dampers can be individually sized.)

1. Use opposed or parallel blade dampers.

2. List cfm, subsystem pressure drop and the open damper pressure drop that provides 4 to 8% (for opposed blade dampers) or 15 to 25% (for parallel blade dampers) of subsystem resistance.
NOTE: Subsystem resistance is that static pressure measured across the damper when it is closed.

3. From subsystem resistance, find the ideal damper velocity from figures 10 or 11 for opposed or parallel blade dampers. Locate ideal velocity band on system resistance coordinate.

4. To find damper size, refer to figure 13 for opposed blade damper or figure 14 for parallel blade damper. Locate cfm, follow cfm coordinate to ideal damper air velocity found in step 3. Where these intersect, gives the damper in free area needed for ideal control. Nominal total area is also shown to facilitate estimating and ordering.

5. Damper is then chosen that best fits duct size dimensions. Dampers should be supported by 3 sides of the duct (figure 15).

6. When damper free area is smaller than duct size, the sheet metal contractor may furnish blank-off plates providing they do not exceed 30% of the total duct area. If the blank-off plate exceeds 30%, excessive turbulance and pressure drops occur. A gradual transition should be used when the blank-off plate exceeds 30%.

7. Multi-section dampers are used when the size required is larger than a single section of damper.

8. The by-pass damper should have a pressure drop in the open position equal to the pressure drops of the coil and open face damper.

9. Refer to figure 13 or 14, follow the desired cfm coordinate to the intersection of the velocity curve that has a ΔP equal to the total ΔP found in step 8. This gives the damper size needed.

10. Dampers are ordered via normal channels.

Method B – (Where face damper equals coil area.)

1. List cfm and pressure drop through the coil.

2. Face damper is equal to the coil area.

3. To find velocity through the damper, refer to figure 13 or 14. Follow the nominal damper area co-

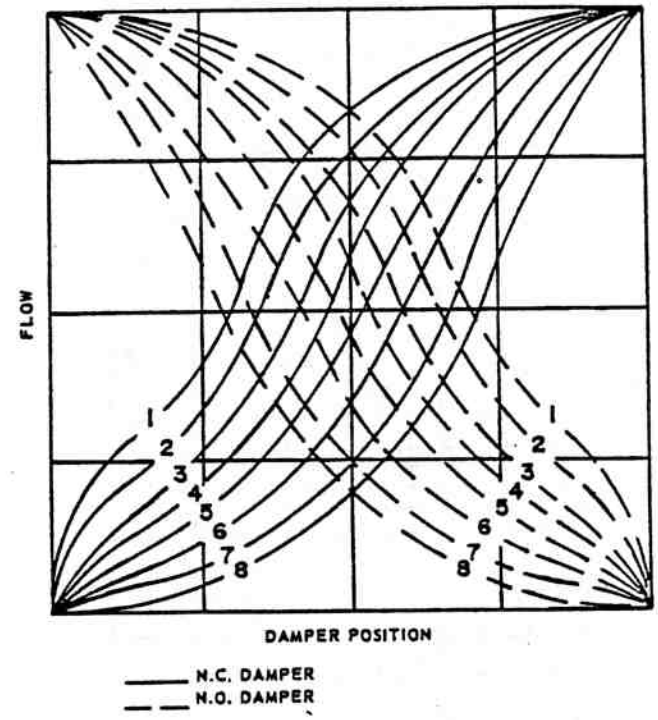


Fig. 23 – Opposed Blade Damper Flow Characteristics

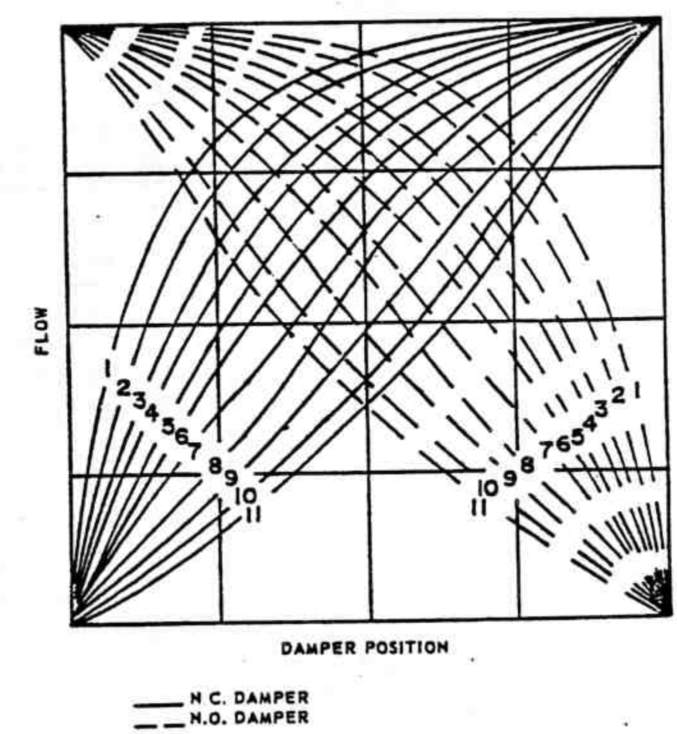


Fig. 24 – Parallel Blade Damper Flow Characteristics

ordinate to the cfm coordinate. The point of intersection gives the velocity.

4. With the velocity found above, look at both figures 10 and 11. Follow the subsystem (coil) pressure drop to the intersection of the velocity line. This point gives the damper flow characteristic curve. Choose the damper (opposed or parallel) that has the most linear flow characteristic.

5. Outline appropriate curve in figure 23 or 24.

6. The by-pass damper flow curve is chosen that allows as close as possible to 100% flow.

7. The by-pass damper should have a pressure drop in the open position equal to the pressure drops of the coil and open face damper.

8. Refer to figure 13 (opposed blade) or 14 (parallel blade). Follow the desired cfm coordinate to the intersection of the velocity curve that has a ΔP equal to the total ΔP found in step 7. This gives the damper in free area and nominal area.

9. Damper is then chosen that best fits duct size dimensions. Dampers should be supported by 3 sides of the duct (figure 15).

10. When damper free area is smaller than duct size, the sheet metal contractor may furnish blank-off plates providing they do not exceed 30% of the total duct area. If the blank-off plate exceeds 30%, excessive turbulance and pressure drops occur. A gradual transition should be used when the blank-off plate exceeds 30%.

11. Multi-section dampers are used when the size required is larger than a single section of damper.

12. Dampers are ordered via normal channels.

EXAMPLE: (See Figure 25)

Given: Air quantity = 6,000 cfm
Coil dimensions = 72" w x 30" h
Pressure drop thru coil at velocity of 400 fpm = .2" wg

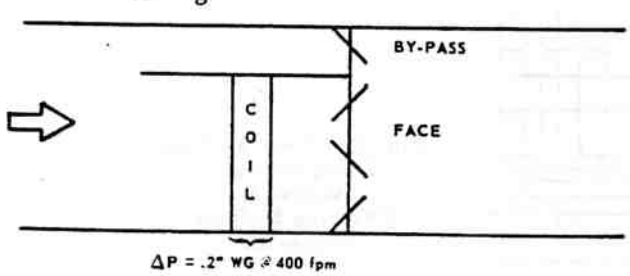


Fig. 25 – Face By-Pass Damper Sizing Example

Method A: (Size Face Damper and By-Pass Damper individually.)

1. Use opposed blade dampers.

2. 6,000 cfm, .2" wg ΔP and .2 x 6% = .012" wg ΔP through open face damper.

3. Velocity band 560 to 780 fpm, use 700 fpm (fig. 26).

4. 8.5 ft.^{2} damper free area or 11.3 ft.^{2} nominal area (fig. 27).

5. Nominal area 11.3 x 144 = 1627 in.^{2}, dividing by 72 in. the damper dimensions are: 72" w x 22" h.

6. A blank-off plate would be needed to make up the difference in duct dimensions.

7. The damper would be multi-section due to 72" w.

8. The by-pass damper has to take the total subsystem pressure drop of .212" wg in the open position.

9. From figure 28, the by-pass damper size is 3.3 ft.^{2} nominal.

10. 3.3 x 144 = 475 in.^{2}; dividing by 72 in. the damper size is 72" w x 6.5" h.

11. The damper would be multi-section due to 72" w.

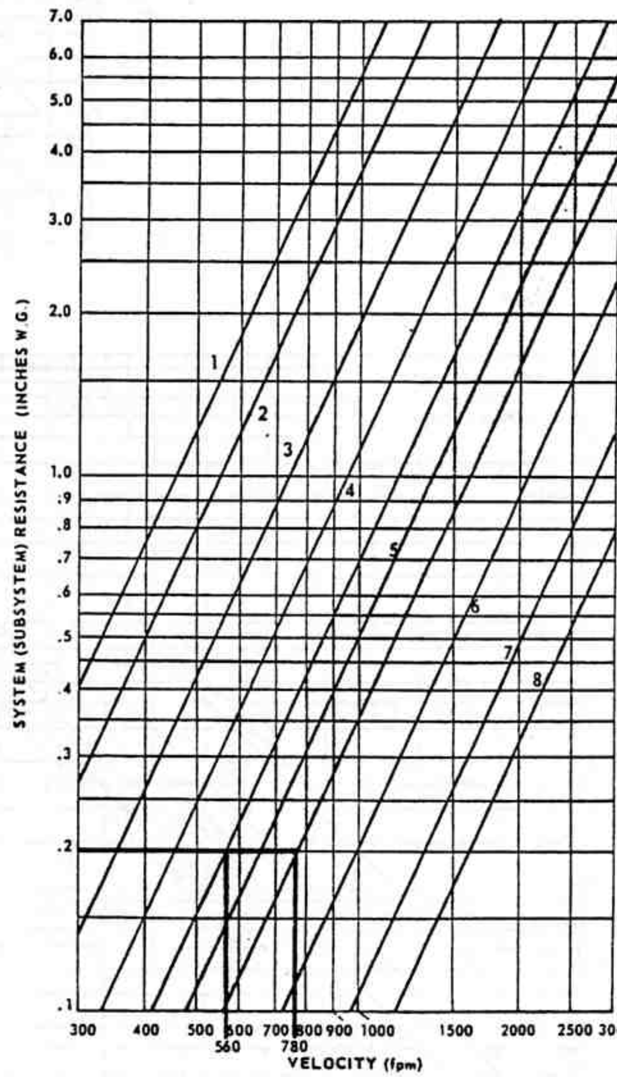


Fig. 26 – Face By-Pass Sizing Example
Method A – Locating Ideal Velocity

See page 12
for Figures 27 and 28

Method A (Cont'd.)

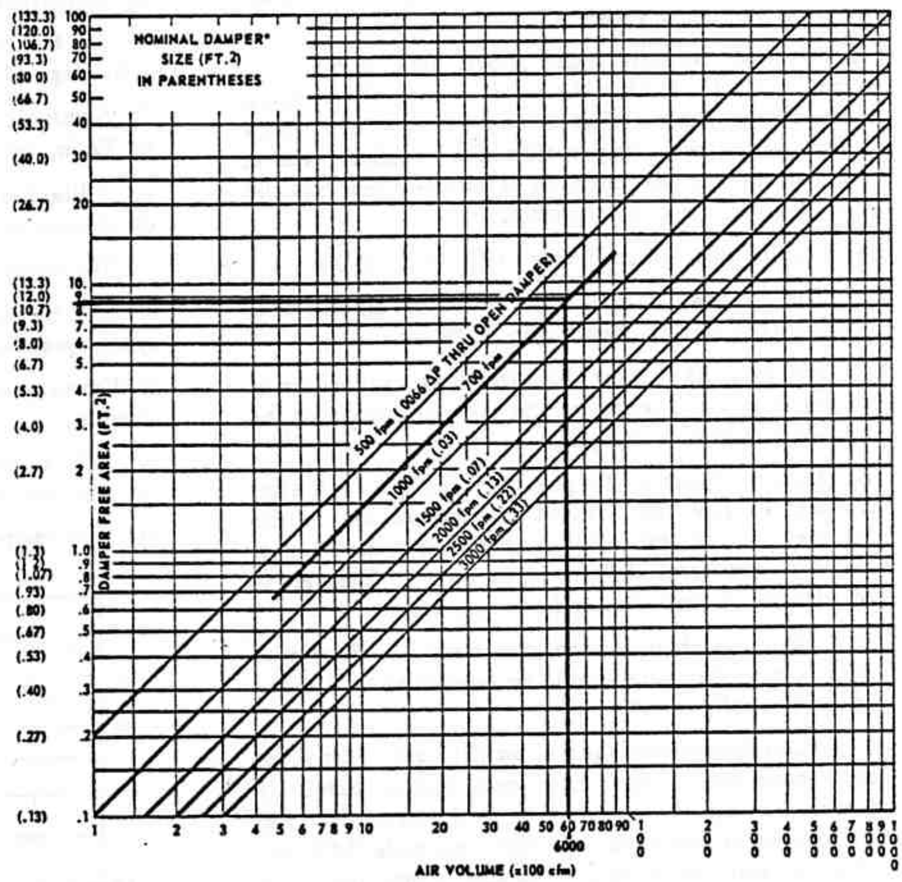


Fig. 27 – Face By-Pass Sizing Example Method A Choosing Face Damper Size

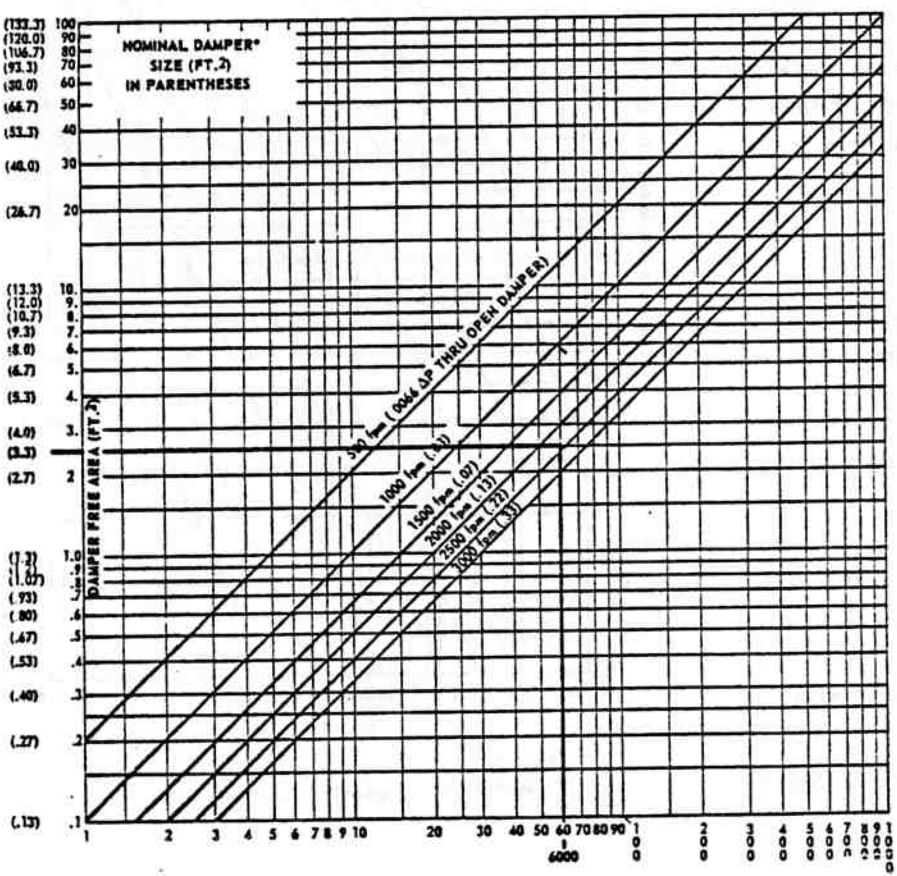


Fig. 28 – Face By-Pass Sizing Example Method A Choosing By-Pass Damper Size

***Nominal Damper size was figured for damper with free area equal to 75% of nominal size.**

Method B: (Use Face Damper equal to coil area.)

1. 6,000 cfm and .2" wg ΔP.

2. Face damper = 72" w x 30" h.

3. Velocity through damper ~500 fpm (figure 31).

4. See figures 29 and 30. It appears as though an opposed blade damper should be chosen.

5. See figures 33 and 34.

6. Choose a by-pass damper that allows flow closest to 100%. Opposed blade dampers would then be chosen. The face damper has flow characteristic No. 4 and the by-pass damper has No. 5.

7. The subsystem resistance is .2" wg + .2" x 2.5% = .2005" wg.

8. See figure 32. By-pass free area 2.6 ft.^{2}, nominal area 3.5 ft.^{2}.

9. Nominal area 3.5 x 144 = 504 in.^{2}, dividing by 72 in., the by-pass damper dimensions are: 72" w x 7" h.

10. Depending on duct size, determines blank-off plate size.

11. The damper would be multi-section because of 72" width.

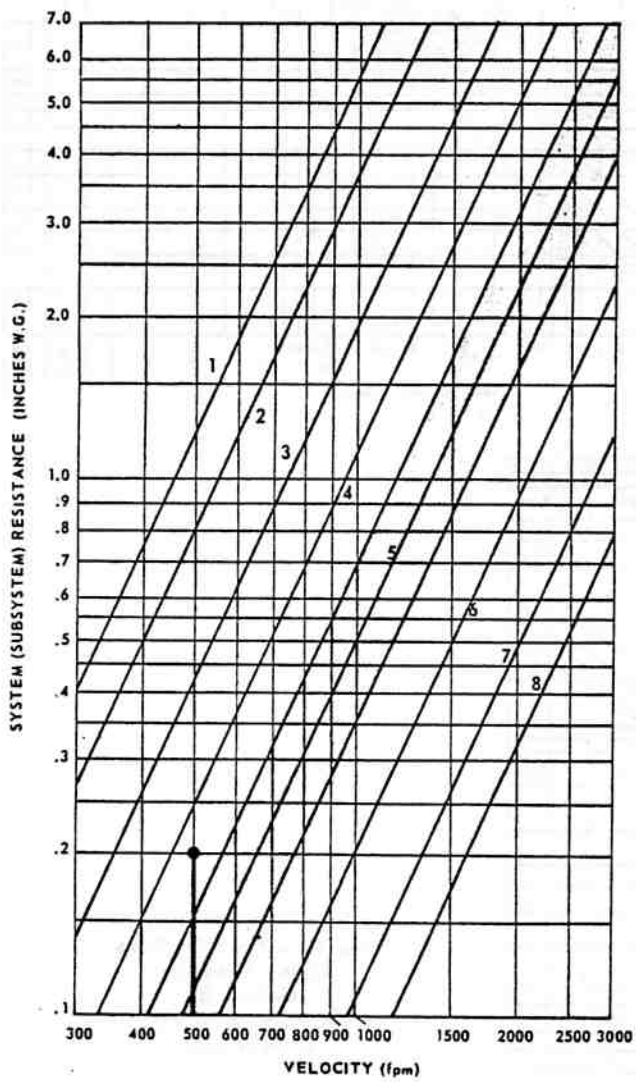


Fig. 29 – Face By-Pass Sizing Example Method B Choosing Damper Type

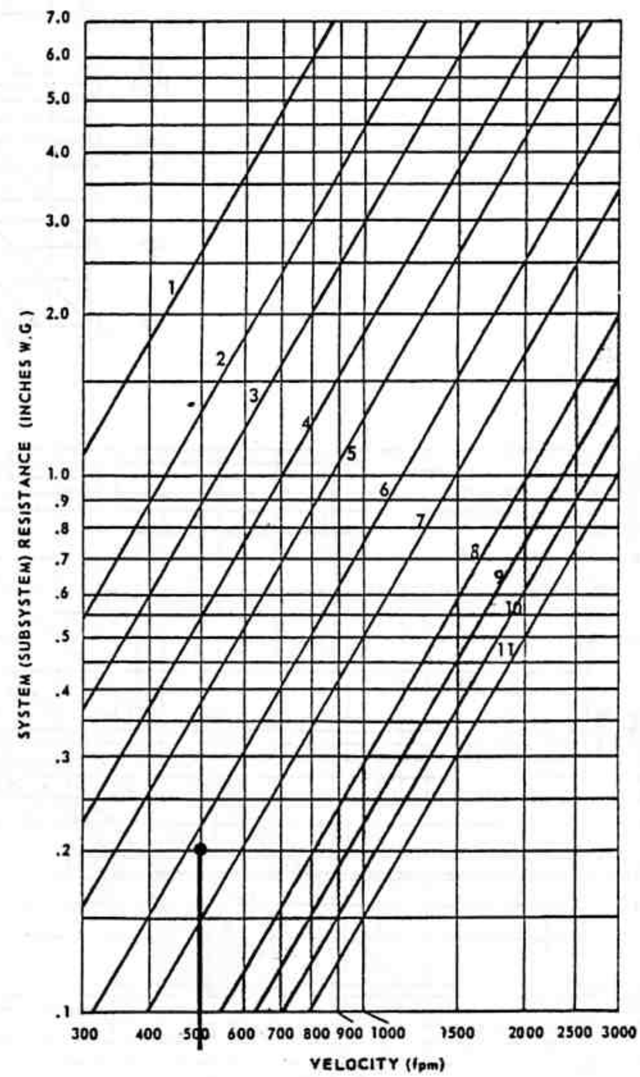
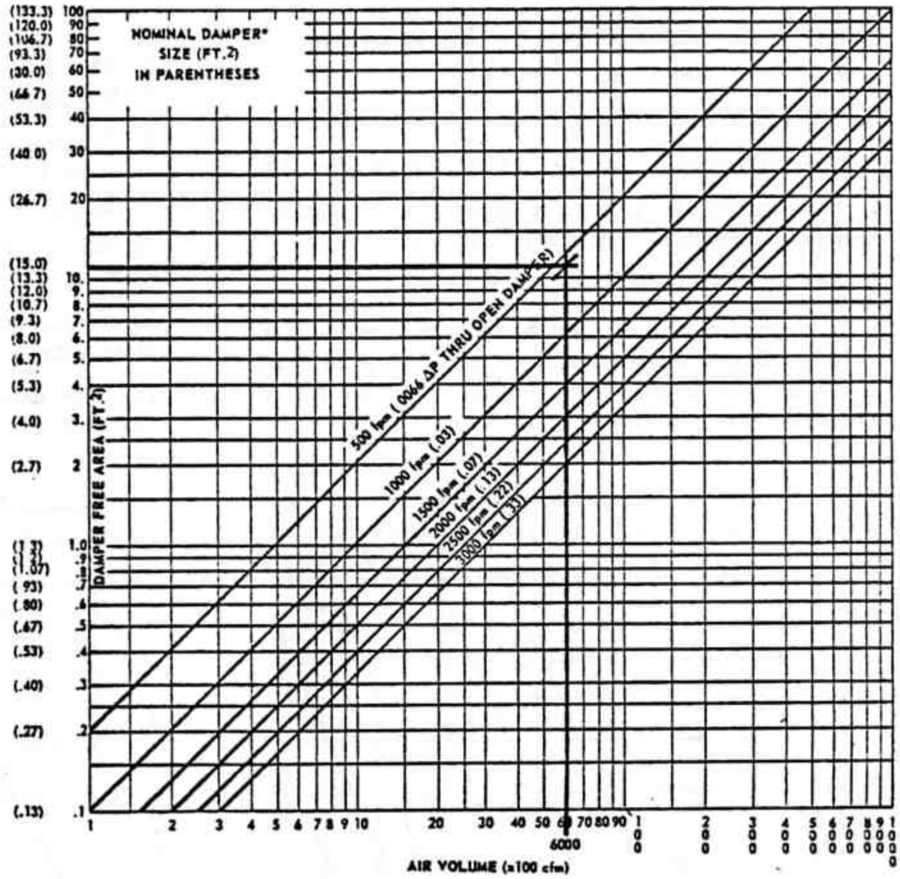


Fig. 30 – Face By-Pass Sizing Example Method B Choosing Damper Type

Fig. 31 – Face By-Pass Sizing Example Method B Finding Velocity through Face Damper



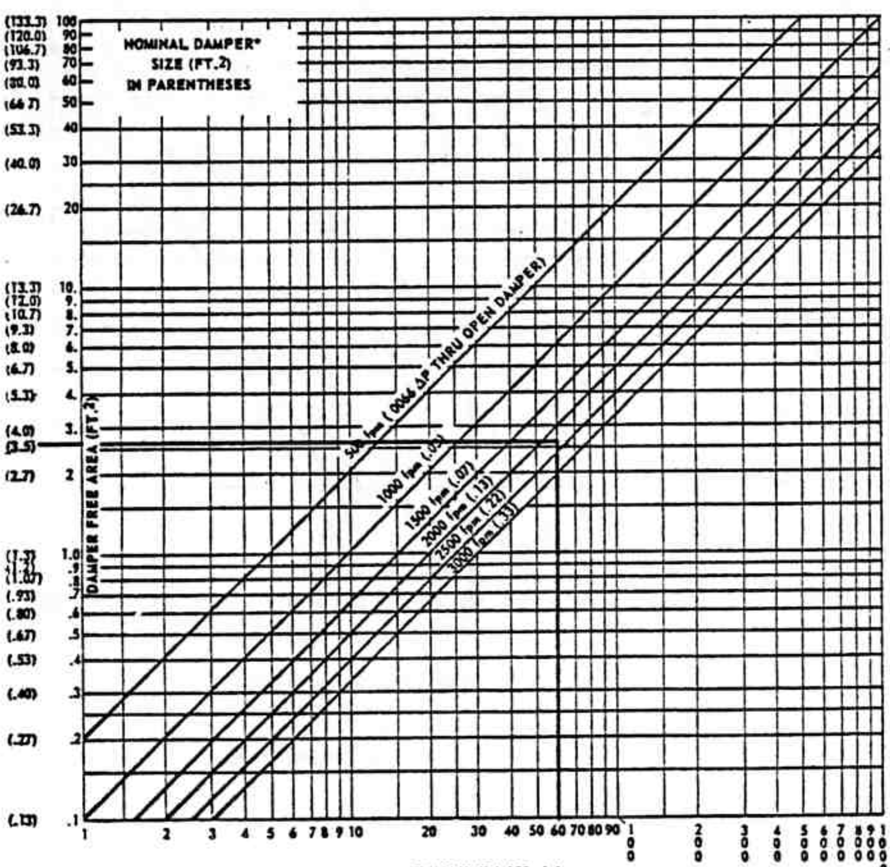


Fig. 32 – Face By-Pass Sizing Example Method B Choosing By-Pass Damper Size

*Nominal damper size was figured for damper with free area equal to 75% of nominal size.

Method B (Cont'd.)

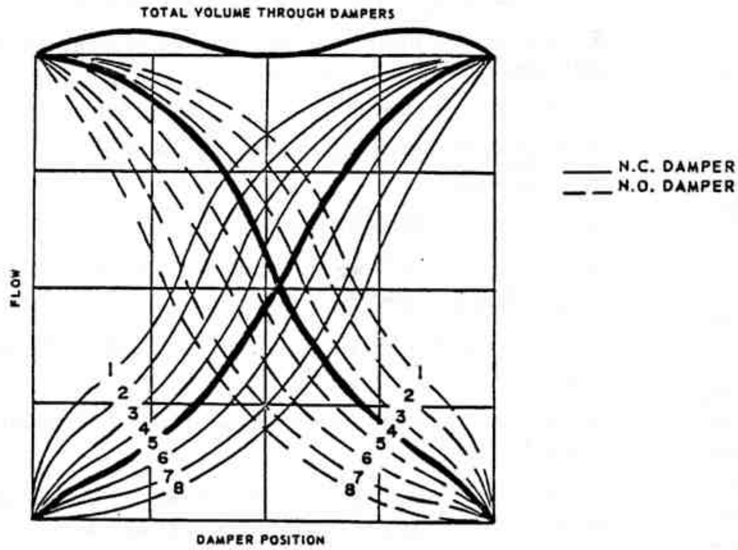


Fig. 33 – Face By-Pass Sizing Example
Method B – Matching Damper Characteristics
for 100% Flow – (Opposed Blade Dampers)

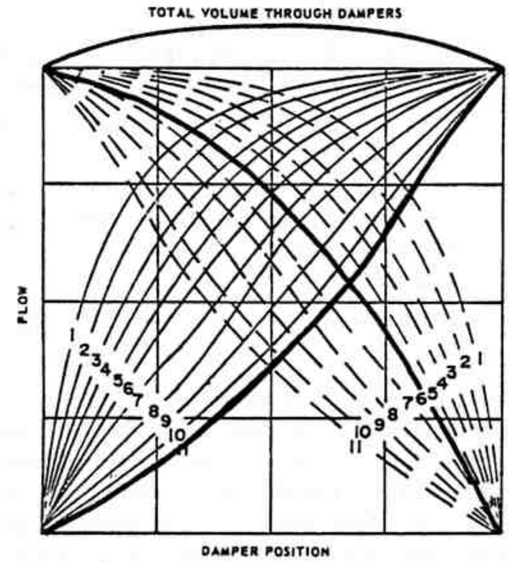


Fig. 34 – Face By-Pass Sizing Example
Method B – Matching Damper Characteristics
for 100% Flow – (Parallel Blade Dampers)

MIXED AIR DAMPER SIZING

Use Work Sheet AE-24, Supplement 1

Where possible, size outside air, exhaust air and return air dampers separately to achieve both linear and constant system flow characteristics. See figure 12 (Method A). At times, it is not practical to reduce the size of the outside air and exhaust air dampers to less than louver area because of space. Then select a damper equal to the louver area that has a damper flow characteristic closest to linear (Method B).

Although the total allowable system or subsystem pressure drop is a function of fan selection and duct design, it should be noted that mixing apparatus (i.e. one damper opens as other damper closes) tends to maintain a constant sub-system pressure drop for all damper positions.

Method A – (Where O.A., E.A. and R.A. dampers can be individually sized.)

Each damper is sized by the following 7 steps:

1. Use opposed or parallel blade dampers.

2. List cfm, subsystem pressure drop and the open damper pressure drop that provides 4 to 8% (for opposed blade dampers) or 15 to 25% (for parallel blade dampers) of subsystem resistance. NOTE: Subsystem resistance is that static pressure measured across the damper when it is closed.

3. From subsystem resistance, find the ideal damper velocity from figures 10 or 11 for opposed or parallel blade dampers. Locate ideal velocity band on system resistance coordinate.

4. To find damper size, refer to figure 13 for opposed blade damper or figure 14 for parallel blade damper. Locate cfm, and follow cfm coordinate to ideal damper air velocity found in step 3. Where these intersect, gives the damper in free area needed for ideal control. Nominal total area is also shown to facilitate estimating and ordering.

5. Damper is then chosen that best fits duct size dimensions. Dampers should be supported by 3 sides of the duct (figure 15).

6. When damper free area is smaller than duct size, the sheet metal contractor may furnish blank-off plates providing they do not exceed 30% of the total duct area. If the blank-off plate exceeds 30%, excessive turbulance and pressure drops occur. A gradual transition should be used when the blank-off plate exceeds 30%.

7. Multi-section dampers are used when the size required is larger than a single section of damper.

8. Dampers are ordered via normal channels.

Method B – (Where O.A. and E.A. dampers equal louver area.)

1. List cfm and subsystem pressure drop.

2. O.A. and E.A. dampers are equal to the louver area.

3. To find velocity through the damper, refer to figure 13 or 14. Follow the nominal damper area coordinate to the cfm coordinate. The point of intersection gives the velocity.

4. With the velocity found above, look at both figures 10 and 11. Follow the subsystem pressure drop to the intersection of the velocity line, this point gives the damper flow characteristic curve. Choose the damper (opposed or parallel) that has the most linear flow characteristic.

5. Outline appropriate curve in figure 23 or 24.

Method B (Cont'd.)

6. The R.A. damper flow curve is chosen that allows as close to 100% flow as possible.

7. Refer to figure 10 (opposed blade) or 11 (parallel blade), the point at which the R.A. damper flow characteristic and subsystem resistance meet gives the velocity through the open R.A. damper.

8. Refer to figure 13 (opposed blade) or 14 (parallel blade), use the velocity found in step 7 and the point of intersection with cfm gives the damper in free area and nominal area.

9. Damper is then chosen that best fits duct size dimensions.

10. When damper free area is smaller than duct size, the sheet metal contractor may furnish blank-off plates providing they do not exceed 30% of the total duct area. If the blank-off plate exceeds 30%, excessive turbulance and pressure drops occur. A gradual transition should be used when the blank-off plate exceeds 30%.

11. Multi-section dampers are used when the size required is larger than a single section of damper.

12. Dampers are ordered via normal channels.

EXAMPLE: (See Figure 35)

Given: Air quantity = 8,000 cfm
Pressures as shown
Dimensions: O.A. opening 60" w x 48" h
E.A. opening 60" w x 48" h

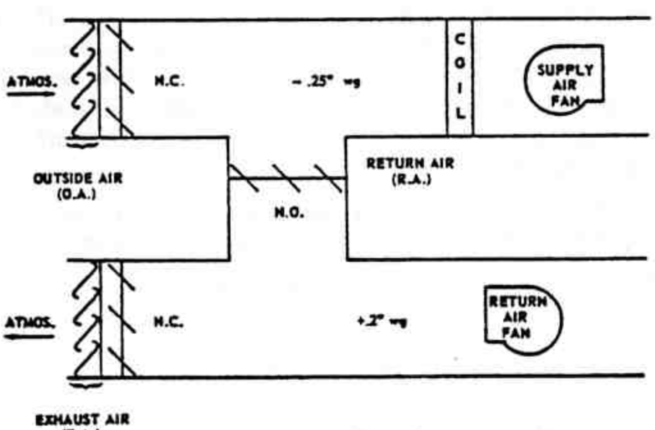


Fig. 35 – Mixed Air Damper Sizing Example

Method A: (Size O.A., E.A. and R.A. dampers individually.)

O.A. Damper and E.A. Damper

1. Use opposed blade damper.

2. 8,000 cfm, .25" wg ΔP and .25 x 6% = .015" wg ΔP through open O.A. damper.

3. Velocity band 620 to 850 fpm, use 700 fpm (figure 36).

4. 11.5 ft.^{2} damper free area or ~15 ft.^{2} nominal area (figure 37).

5. Nominal area 15 x 144 = 2160 in.^{2}, dividing by 60 in. the damper dimensions are: 60" w x 36" h.

6. A blank-off plate would be needed to make up the difference in duct dimensions.

7. The damper would be multi-section due to 60" w.

E.A. Damper: sized similarly is 60" w x 38" h.

R.A. Damper

1. Use opposed blade damper.

2. 8,000 cfm, .45" wg ΔP and .45" x 6% = .027" wg ΔP through open R.A. damper.

3. Velocity band 840 to 1200 fpm, use 1000 fpm (figure 39).

4. 8.0 ft.^{2} damper free area ~10.67 ft.^{2} nominal area (figure 38).

5. Nominal area 10.67 x 144 = 1536 in.^{2}, dividing by 48 in., the damper dimensions are: 48" w x 32" h. Since R.A. duct dimensions were not given, any width-height combination that gives the area could be used.

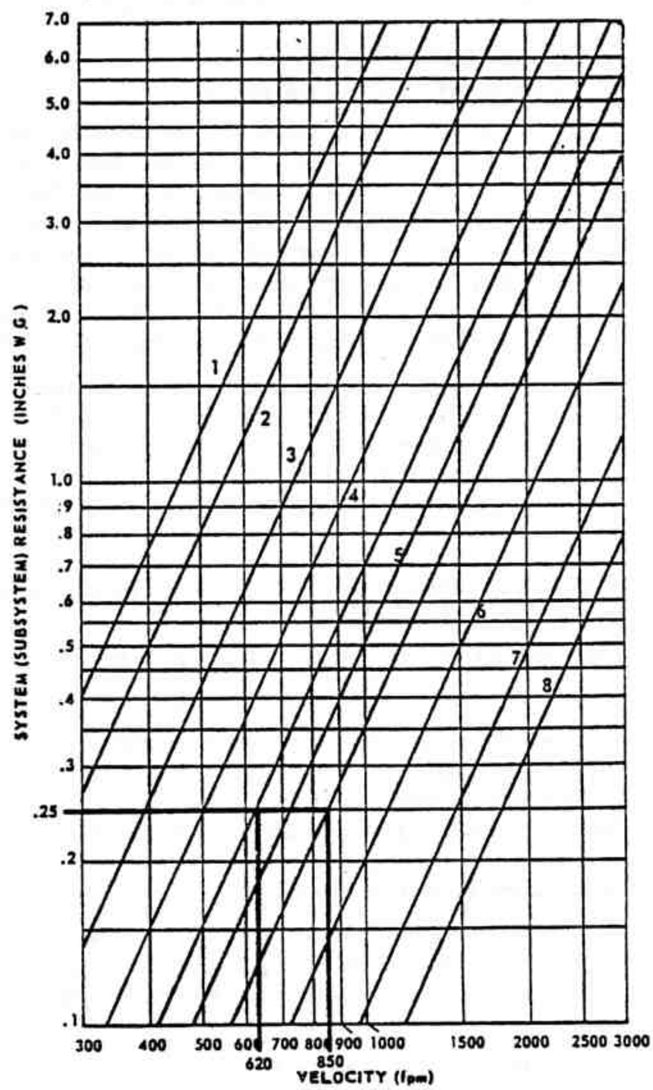


Fig. 36 – Mixed Air Sizing Example Method A – Locating Ideal Velocity (O.A. & E.A. Dampers)

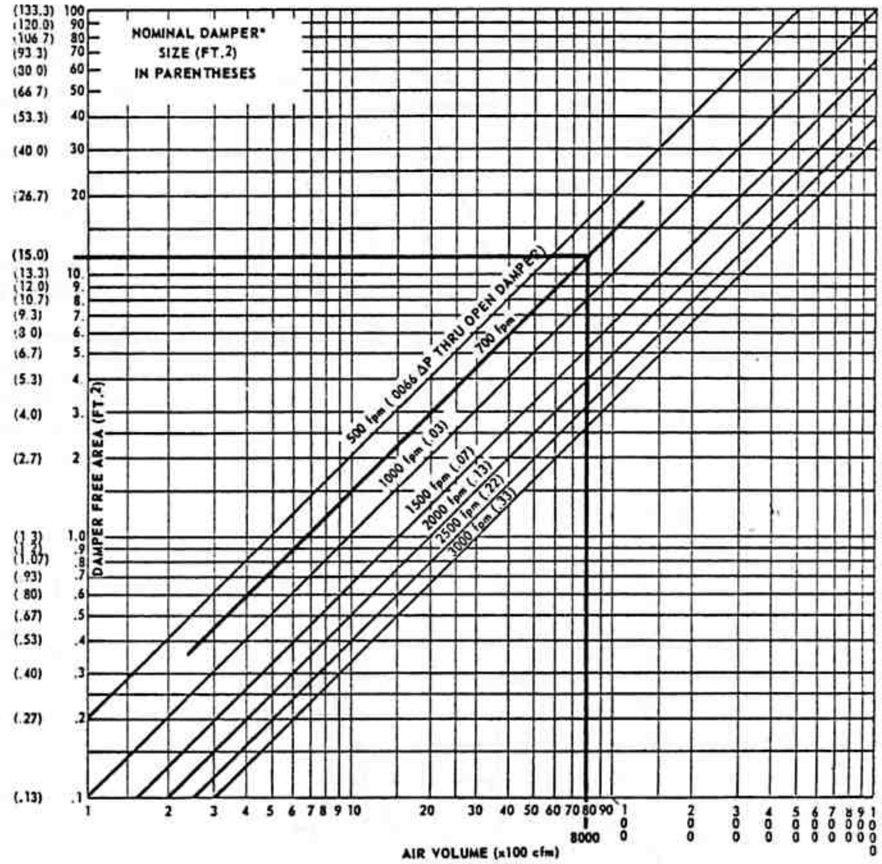


Fig. 37 – Mixed Air Sizing Example
Method A
Choosing O.A. & E.A. Damper Size

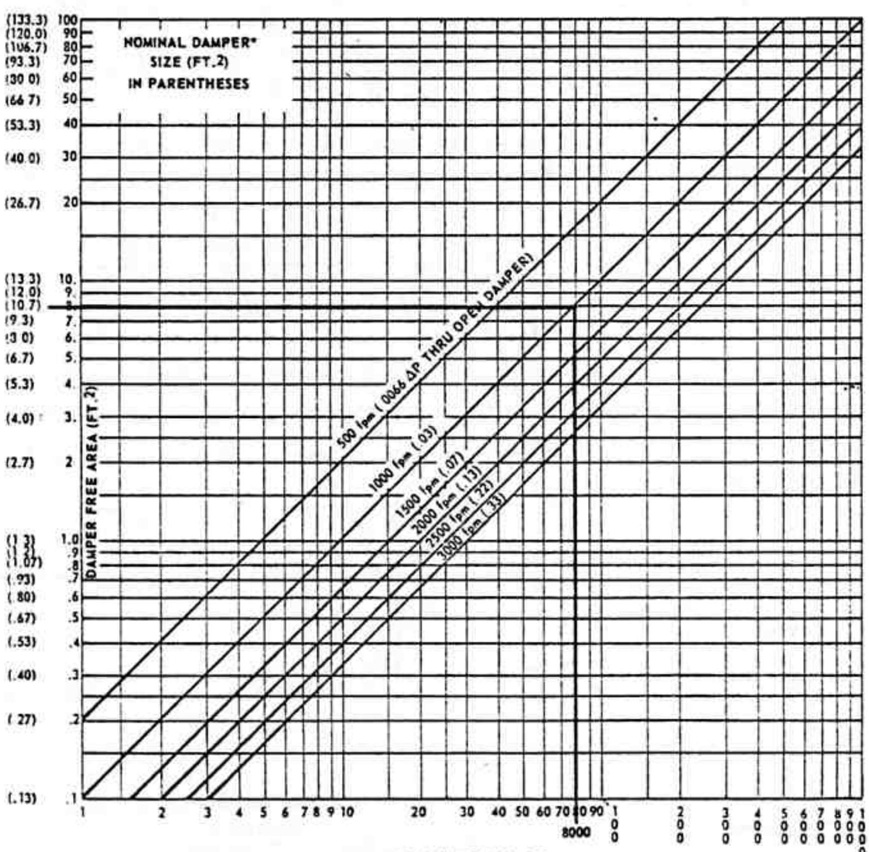


Fig. 38 – Mixed Air Sizing Example
Method A – Choosing R.A. Damper Size

*Nominal damper size was figured for damper with free area equal to 75% of nominal size.

Method A (Cont'd.)

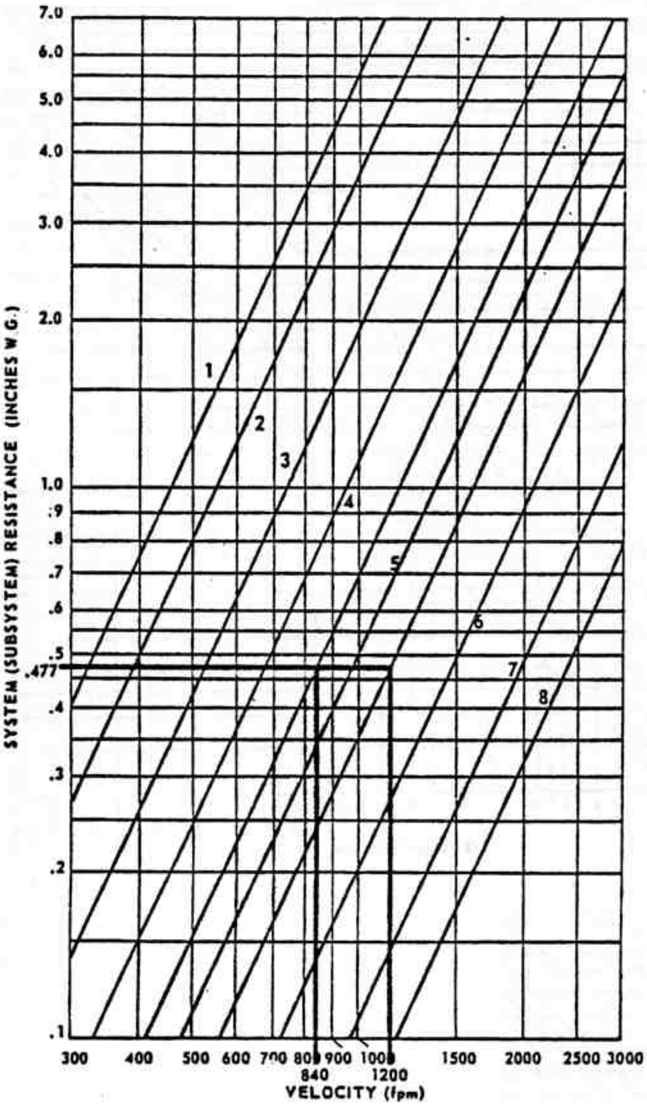


Fig. 39 – Mixed Air Sizing Example
Method A – Locating Ideal Velocity (R.A. Damper)

Method B: (Use O.A. and E.A. damper equal to louver area.)

1. 8,000 cfm, .25" wg Δ P for O.A., .20" wg Δ P for E.A.

2. O.A. damper = 60" w x 48" h
   E.A. damper = 60" w x 48" h

3. Velocity through dampers ~540 fpm (figure 41).

4. See figures 40 and 42. It appears as though an opposed blade damper should be chosen.

5. See figures 43 and 44.

6. Choose a R.A. damper that allows flow closest to 100%. Opposed blade dampers combine the flow curves No. 4 (O.A.) and No. 6 (R.A.) to give the total flow in figure 43. Parallel blade dampers combine the flow curves No. 6 (O.A.) and No. 11 (R.A.) to give the total flow in figure 44.

7. The subsystem resistance using opposed blade dampers is .45" wg + .45" x 2.5% = .46" wg. See figure 45. Velocity ~1,500 fpm. The subsystem resistance using parallel blade dampers is .45" wg + .45" x 30% = .58" wg. See figure 46. Velocity ~ 2,200 fpm. This is too high. Use opposed blade dampers.

8. See figure 47. R.A. damper free area 5.4 ft.^{2}, nominal area 7.2 ft.^{2}.

9. Nominal area 7.2 x 144 = 1036 in.^{2}, dividing by 48 in., the damper dimensions are 48" w x 22" h. Since R.A. duct dimensions were not given, any width-height combination that gives the area could be used.

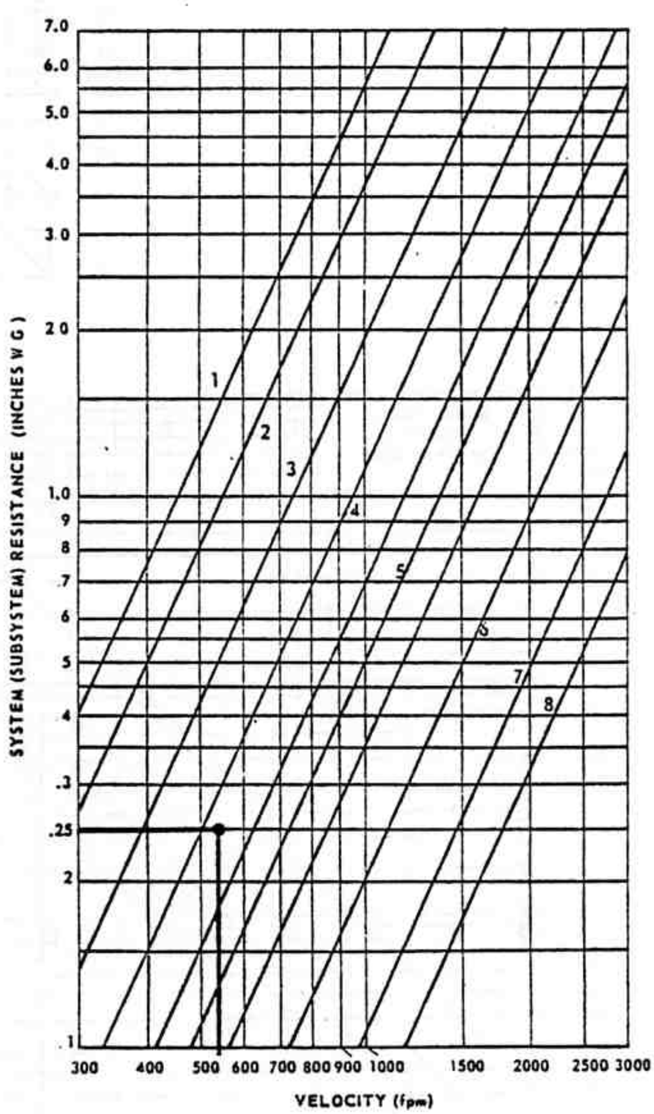


Fig. 40 – Mixed Air Sizing Example
Method B
Choosing Damper Type (Opposed Blade)

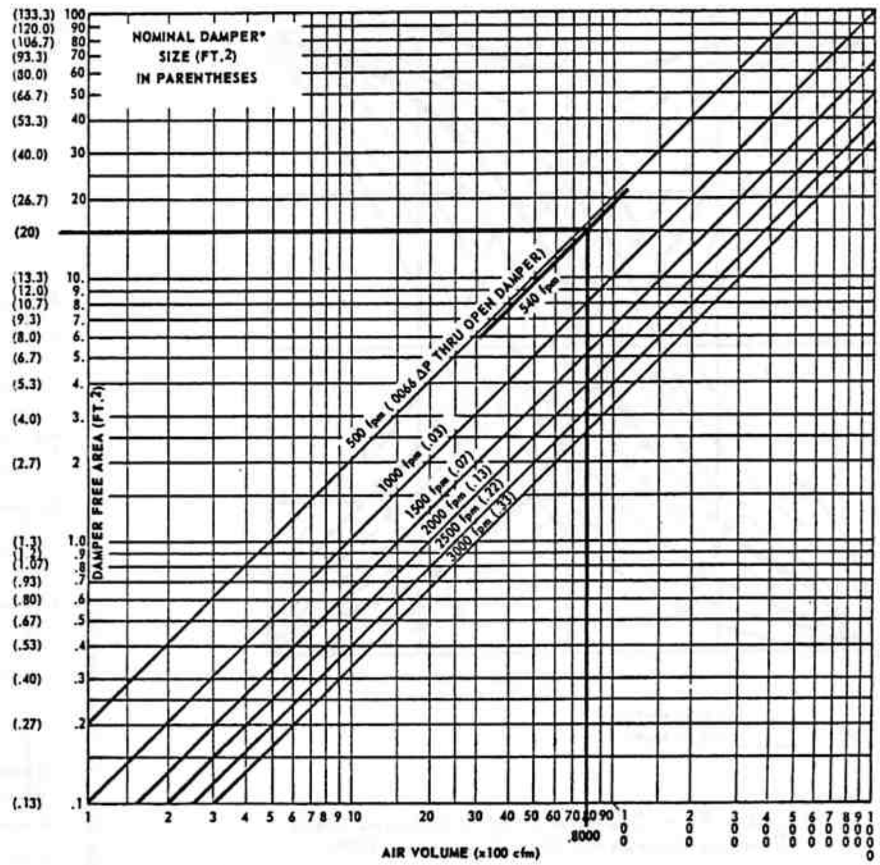


Fig. 41 – Mixed Air Sizing Example
Method B
Finding Velocity through
O.A. & E.A. Damper

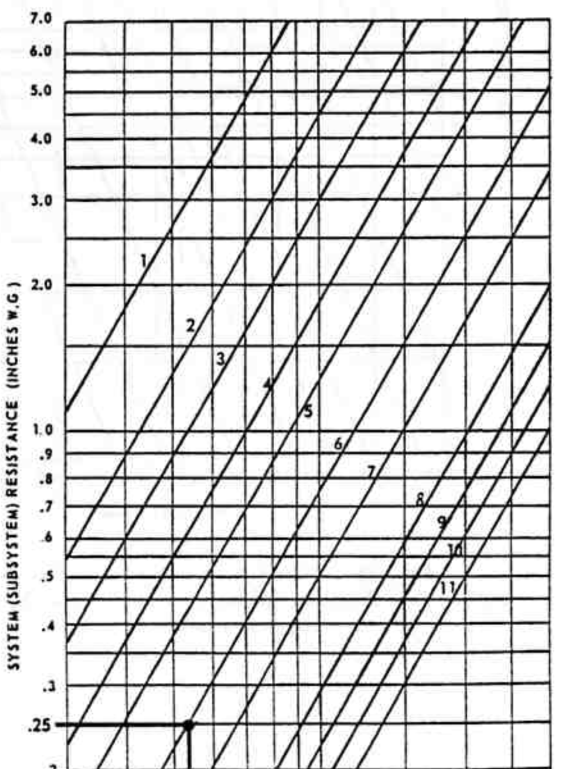


Fig. 42 – Mixed Air Sizing Example
Method B
Choosing Damper Type
(Parallel Blade)

*Nominal damper size was figured for damper with free area equal to 75% of nominal size.

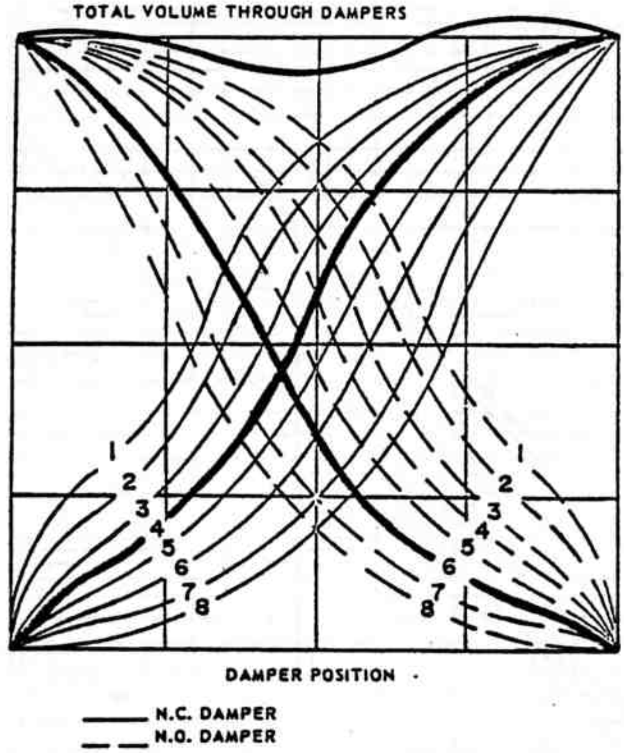


Fig. 43 – Flow Characteristics of Opposed Blade Dampers Chosen for Flow Closest to 100%

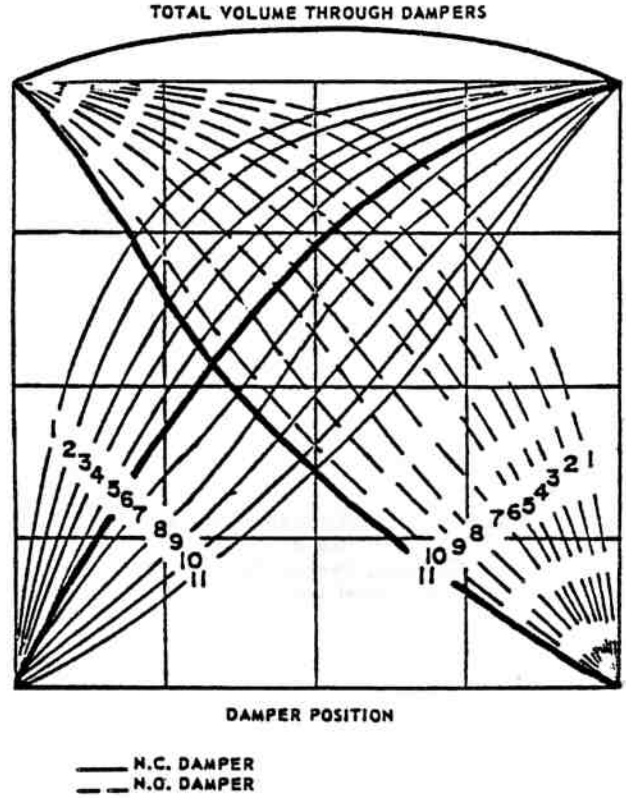


Fig. 44 – Flow Characteristics of Parallel Blade Dampers Chosen for Flow Closest to 100%

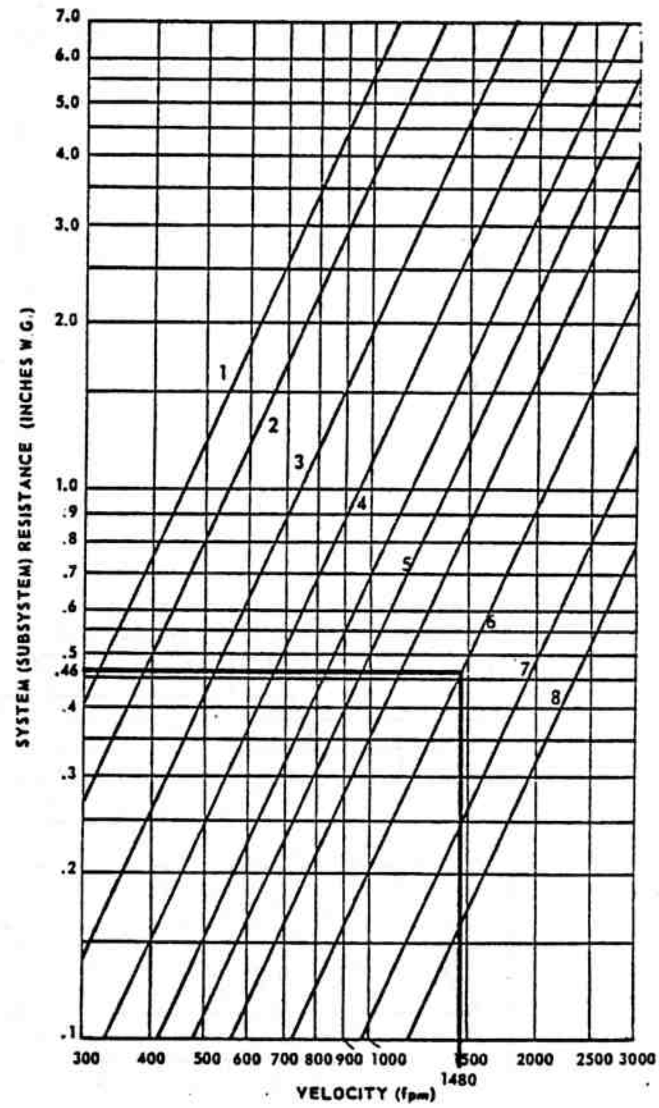


Fig. 45 – Mixed Air Sizing Example
Method B – Finding Velocity through R.A. Damper (Opposed Blade)

Method B (Cont'd.)

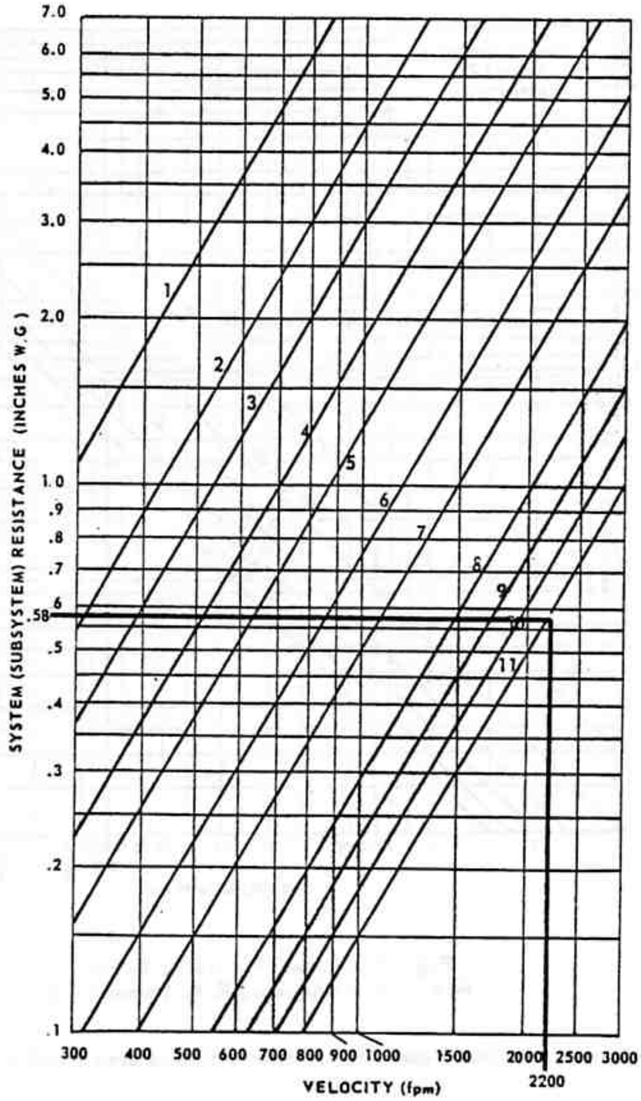


Fig. 46 – Mixed Air Sizing Example
Method B – Finding Velocity through R.A. Damper
(Parallel Blade)

Method B (Cont'd.)

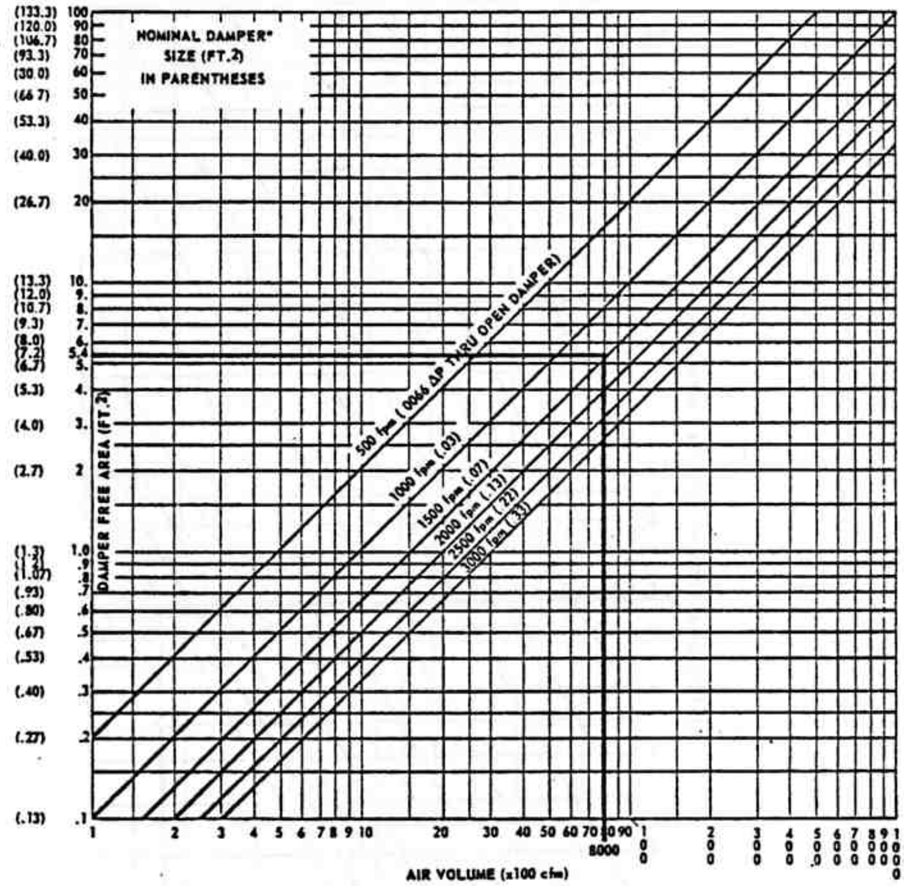


Fig. 47 – Mixed Air Sizing Example
Method B – Choosing R.A. Damper Size

*Nominal damper size was figured for damper with free area equal to 75% of nominal size.

DAMPER LIMITATIONS

High air velocities and static pressures require dampers of good quality. The blade width and length, shaft bearings and linkage need to be considered. Well constructed dampers allow better control.

Installation of a damper too close to a fan may shorten its working life because of excessive turbulance or oscillations set up by the fan. Dampers should be installed to aid mixing of air to minimize stratification. For example: mixed air system – have warmer air approach cooler air from the bottom; face by-pass system – have the face damper below the by-pass damper if coil is heating coil.

LEAKAGE

With a damper in the fully closed position, the air flow is theoretically zero. In actuality, it is something greater than zero because of leakage through the ends and edges of the damper blades. The volume of air leaking through the closed damper is usually expressed as a percentage of the maximum flow through the damper in the wide open position at a specific pressure drop. Flexible edge and end seals reduce leakage considerably and should be used when leakage is undesirable.

Control devices are combined to make a system. Each control device is mechanical in nature and all mechanical components must be regularly serviced to optimize their operation. All Powers branch offices offer service contracts that will insure you continuous, trouble-free system performance.

For Further Information Contact Your Nearest Powers Representative