CABLE PRESSURE SYSTEMS
CONTINUOUS FEED - MAINTENANCE
CABLE PRESSURIZATION COMPUTER

CONTENTS PAGE

1. GENERAL

1.01 This section is issued to provide instructions for the use of the Form E-4829, Cable Pressurization Computer, in flow analysis procedures.

1.02 For convenience, reference is made throughout this section to the Cable Pressurization Computer or, the computer, rather than to the complete name "Form E-4829, Cable Pressurization Computer."

2. DESCRIPTION OF THE COMPUTER

2.01 The Cable Pressurization Computer is an instrument for use in performing the mathematical computations required for cable pressure analysis procedures which are based on the computation of flow and pressure drop.

2.02 The computer is composed of three parts, ***the body, the slide,*** and the ***indicator*** (see Fig. 1). The body of the computer has two sections; the ***top section*** of the body and the ***bottom section*** of the body. The two sections of the body are separated by the slide which moves between them. The indicator is composed of a clear plastic rectangle with a fine line etched on it. This line is referred to as the ***hairline.***

2.03 The following computations can be made with the computer:

(1) Compute flow (scfh).

(2) Compute pressure drop (psi).

(3) Compute the reciprocal of a pneumatic resistance.

(4) Compute problems of proportion involving pneumatic resistance, distance, flow and pressure drop.

(5) Determine total pneumatic resistance for a cable of known length, size and gauge.

3. THE SCALES OF THE COMPUTER

3.01 The scales of the computer are printed on the top and bottom section of the body of the computer and the slide. The scales included on the computer are as follows:

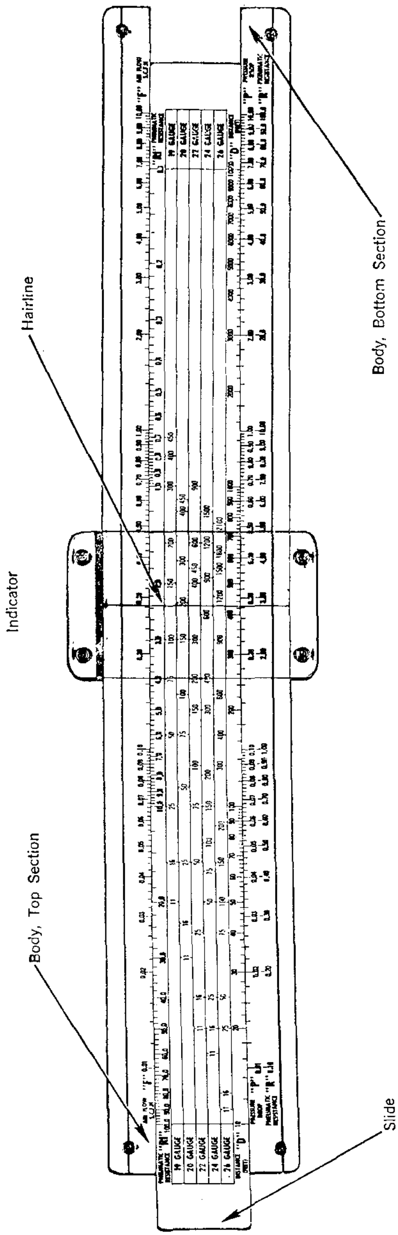

Hairline
Indicator
Body, Top Section
Body, Bottom Section
Slide

FIG. 1

(1) "F" scale, located on top section of the body.

(2) "RI" scale, located on the top of the slide.

(3) "D" scale, located on the bottom of the slide.

(4) "P" scale, located on the bottom section of the body.

(5) "R" scale, located on the bottom section of the body, below the "P" scale.

3.02 All scales are logarithmic and each scale is composed of three complete sections, each of which is also a complete logarithmic scale. All scales are matching scales except the "RI" scale. The "RI" scale is identical to the other scales except that it is ***inverted,*** i.e., it reads from ***right to left*** instead of from ***left to right*** as do the other scales.

3.03 The "F" scale represents the flow of air in standard cubic feet per hour (scfh) and covers a flow from 0.01 scfh to 10.0 scfh. The three sections of the scale read from ***left to right*** as follows:

(1) Left section: 0.01 scfh to 0.1 scfh

(2) Middle section: 0.1 scfh to 1.0 scfh

(3) Right section: 1.0 scfh to 10.0 scfh

3.04 The "RI" and "D" scales are located on the slide of the computer. In addition to these scales, the pneumatic resistance per 1000 ft. for each size and gauge of paper or pulp insulated cable is printed in red on the center portion of the slide between the "RI" scale and the "D" scale. The pneumatic resistance per 1000 ft. for each cable is represented by a vertical line called a ***"tic line."*** Each tic line is designated as to the size of cable and is located in the horizontal space designated for gauge of the cable. The tic lines are considered as part of the "RI" scale.

3.05 The "RI" scale represents the total pneumatic resistance of the cable expressed in total units of pneumatic resistance per 1000 ft. (Section 637-020-020, Table 1, "R" column). This is an ***inverted*** scale and covers total pneumatic resistance per 1000 ft. from 0.1 to 100.0. ***The graduations of this scale read from right to left*** and this fact must be kept in mind when reading this scale. In order to emphasize this, the numbers for this scale are printed in red. The three sections of the scale read from ***right to left*** as follows:

(1) Right section: 0.1 to 1.0

(2) Middle section: 1.0 to 10.0

(3) Left section: 10.0 to 100.0

3.06 The "D" scale represents distance expressed in feet and covers a distance from 10 feet to 10,000 feet. The three sections of this scale read from ***left to right*** as follows:

(1) Left section: 10 feet to 100 feet

(2) Middle section: 100 feet to 1000 feet

(3) Right section: 1000 feet to 10,000 feet

3.07 The "P" scale represents pressure drop in pounds per square inch (psi) and covers a pressure drop from 0.01 psi to 10.0 psi. The three sections of this scale read from ***left to right*** as follows:

(1) Left section: 0.01 psi to 0.1 psi

(2) Middle section: 0.1 psi to 1.0 psi

(3) Right section: 1.0 psi to 10.0 psi

3.08 The "R" scale represents total pneumatic resistance expressed in units of pneumatic resistance and covers a total pneumatic resistance from 0.1 to 100.0. The three sections of the scale read from ***left to right*** as follows:

(1) Left section: 0.1 to 1.0

(2) Middle section: 1.0 to 10.0

(3) Right section: 10.0 to 100.0

3.09 Each section of each scale is divided into ten main parts or ***main divisions.*** Since the divisions are not equal, but are larger near the low numbers and smaller near the high numbers, it is not practical to divide the main division into ten ***subdivisions.*** Instead, each main division is divided into ***five*** subdivisions. Each subdivision, therefore, is equal to two tenths (0.2) of the main division. When the hairline falls between subdivisions of the scale or when a setting is to be made between the subdivisions, the value must be interpolated (determine the value of the subdivision space and estimate the value of the appropriate part of the subdivision). The following table may be helpful in reading and interpolating the scale of the computer.

IF THE SECTION OF THE SCALE IS DESIGNATED:	THE VALUE OF EACH SUBDIVISION IS:
0.01 to 0.1	0.002
0.1 to 1.0	0.02
1.0 to 10.0	0.2
10.0 to 100.0	2.0
100.0 to 1000.0	20.0
1000.0 to 10,000.0	200.0

4. COMPUTING FLOW

4.01 To compute flow, the pressure drop, cable length plus size and gauge, or the pneumatic resistance per 1000 ft., must be known. Flow is computed as follows:

Step 1: Move indicator until the hairline is over the pressure drop on scale "P".

Step 2: Without disturbing the setting of the indicator, move the slide until the distance on scale "D" appears under the hairline.

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over the tic line for the size and gauge cable or until the hairline is over the pneumatic resistance per 1000 ft. on the "RI" scale.

Step 4: Read the flow on scale "F" under the hairline.

4.02 The steps for computing flow as covered in Par. 4.01 follow a definite sequence of settings on each scale. This sequence is as follows:

"P" Scale —to→ "D" Scale —to→ "RI" Scale —to→ "F" Scale

These steps are diagrammed on the back of the computer as shown below.

TO COMPUTE FLOW

Step 4	Read Flow	F Scale
Step 3	Set TIC Line for S&G Cable or Set R per 1000 Ft.	RI Scale

Move Indicator

Step 2	Set Distance Between Points of Pressure Drop	D Scale
Step 1	Set Pressure Drop	P Scale

Notes: (These notes apply to diagrams for all computations.)

1. Scales on diagram are in same position as they appear on the computer.

2. The term ***"set"*** means that the hairline is ***set over*** a number on a designated scale or that a number on a designated scale is ***set under*** the hairline.

3. The term ***"read"*** means that the answer is found or read under the hairline on a designated scale.

4.03 An example of a typical flow computation is shown in the following:

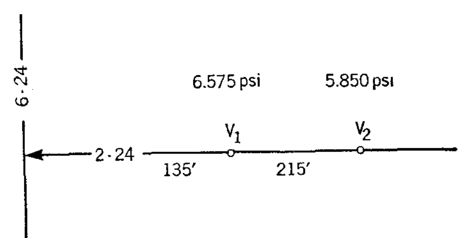


FIG. 2

Pressure Drop = 6.575 − 5.850 = 0.725 psi

Step 1: Move indicator until hairline is over 0.725 on the "P" scale (see Fig. 3).

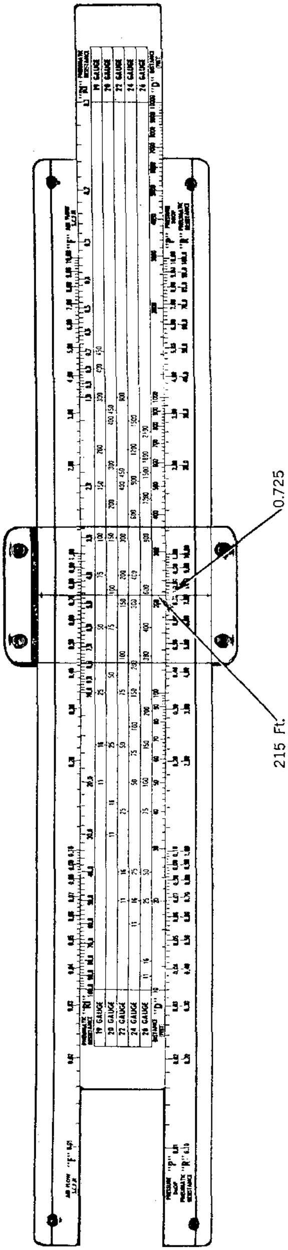


FIG. 3

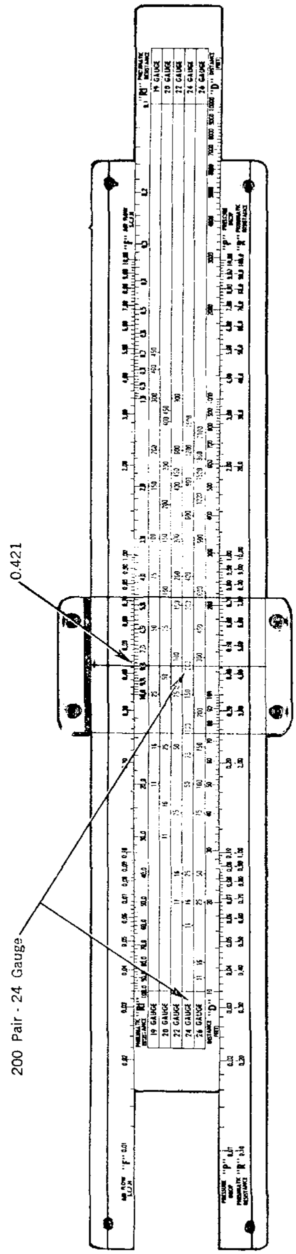


FIG. 4

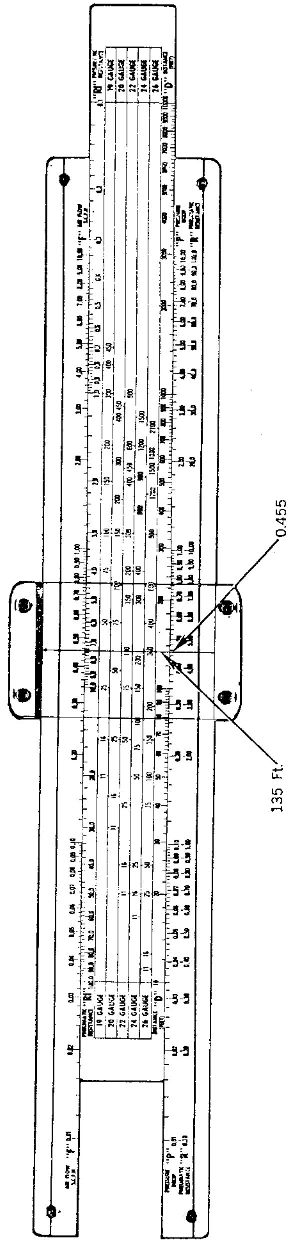


FIG. 5

Step 2: Without disturbing the setting of the indicator, move the slide until 215 feet on the "D" scale appears under the hairline (see Fig. 3).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over the tic line for 200 pair 24 gauge cable (see Fig. 4).

Step 4: Read the flow on scale "F" under the hairline (0.421 scfh) (see Fig. 4).

Note: Since the branch cable has the same size and gauge from the main cable to V_2 the pressure drop to the main cable can be found with the same setting. The pressure drop to the main cable is found by using the same setting as was made in Step 1 and Step 2 and then moving the indicator until the hairline is over 135 ft. on the "D" scale. The pressure drop is then read on the "P" scale under the hairline; in this example 0.455 psi (see Fig. 5). If the cable is not the same size and gauge, the pressure drop can be computed as covered in Part 5.

5. COMPUTING PRESSURE DROP WHEN ONE SIZE AND GAUGE OF CABLE IS INVOLVED

5.01 To compute pressure drop, the flow, cable length plus size and gauge or pneumatic resistance per 1000 ft., must be known. Pressure drop is computed as follows:

Step 1: Move indicator until the hairline is over the flow on the "F" scale.

Step 2: Without disturbing the setting of the indicator, move the slide until the tic line for the size and gauge of cable is under the hairline or until the pneumatic resistance per 1000 ft. on the "RI" scale is under the hairline.

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over the distance on scale "D".

Step 4: Read the pressure drop under the hairline on scale "P".

5.02 The steps for computing pressure drop as covered in Par. 5.01 follow a definite sequence of settings on each scale. This sequence is as follows:

"F" Scale → to → "RI" Scale → to → "D" Scale → to → "P" Scale

These steps are diagrammed on the back of the computer as shown in the following:

TO COMPUTE PRESSURE DROP WHEN ONE SIZE AND GAUGE OF CABLE IS INVOLVED

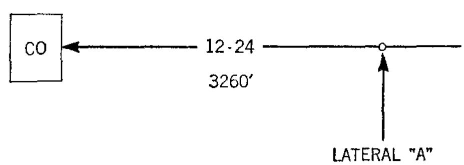
Step 1	Set Flow	F Scale
Step 2	Set TIC Line for S&G Cable or Set R per 1000 Ft.	RI Scale

Move Indicator

Step 3	Set Distance for Which Pressure Drop is to be Determined	D Scale
Step 4	Read Pressure Drop	P Scale

Notes for diagram in Par. 4.02 apply to this diagram also.

5.03 An example of a typical pressure drop computation is shown in the following:



FLOW IN LATERAL "A" IS 0.275 SCFH
DETERMINE THE PRESSURE DROP IN THE MAIN CABLE FROM C.O. TO LATERAL RESULTING FROM FLOW IN LATERAL

FIG. 6

Step 1: Move indicator until the hairline is over 0.275 on the "F" scale (see Fig. 7).

Step 2: Without disturbing the setting of the indicator, move the slide until the tic line for 1200 pair 24 gauge cable appears under the hairline (see Fig. 7).

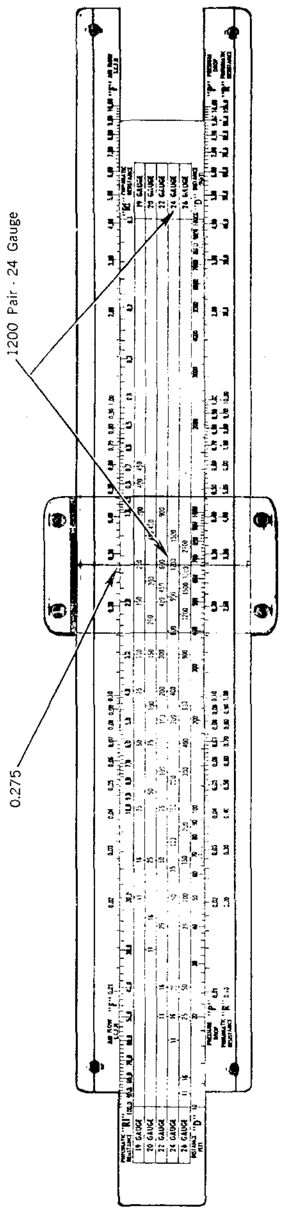


FIG. 7

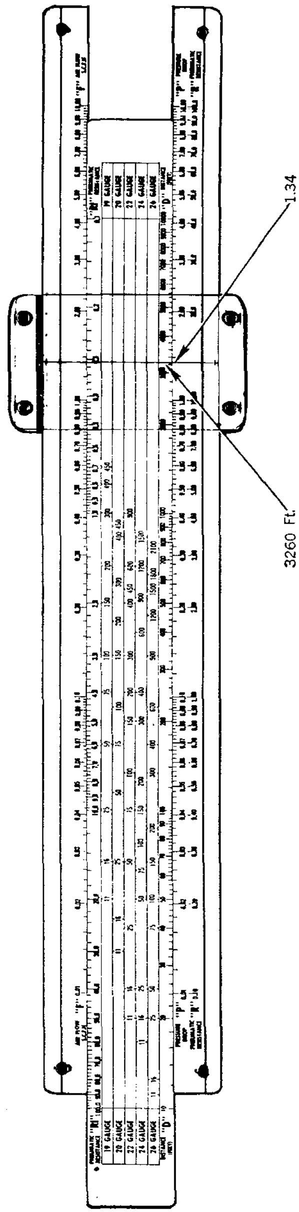


FIG. 8

Step 3: Without disturbing the setting of the slide, move the indicator until 3260 feet on the "D" scale appears under the hairline (see Fig. 8).

Step 4: Read the pressure drop (1.34 psi) on scale "P" under the hairline as shown in Fig. 8.

5.04 Where the flow and the pressure at an analysis valve are known the distance to a zero leak beyond the analysis valve can be obtained as follows:

Step 1: Move indicator until the hairline is over the flow on the "F" scale.

Step 2: Without disturbing the setting of the indicator, move the slide until the tic line for the size and gauge of cable is under the hairline or until the pneumatic resistance per 1000 ft. is under the hairline on "RI" scale.

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is set over a pressure drop on scale "P" equal to the pressure reading of the analysis valve from which the distance to the zero leak is to be computed.

Step 4: Read the distance on scale "D".

Note: If more than one size and gauge cable is involved and the distance so computed is greater than the distance to the junction point of the two sizes and gauges of cable, the pressure drop to the junction will be computed. This pressure drop shall be subtracted from the valve reading from which the distance to the zero leak is to be computed and the remaining distance computed as outlined above using the second size and gauge cable in Step 2.

5.05 Where significant pressure is found at or near the projected zero leak location, it indicates a "less than zero" leak ***back toward the pressure source.*** With such a condition the distance from the second analysis valve to the "less than zero" leak can be approximated as follows:

Step 1: Move indicator along scale "P" until the hairline is over the pressure drop between the two analysis valves.

Step 2: Without disturbing the setting of the indicator, move the slide until the distance between the analysis valves appear under the hairline on scale "D".

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline on scale "P" is over the pressure drop between the second analysis valve and the valve at the original projected zero leak location.

Step 4: Under the hairline of the indicator, read on the "D" scale the distance from the second analysis valve to the "less than zero" leak. The actual leak will almost invariably be on the upstream or pressure source side of the indicated "distance".

5.06 An example of the computation for the "less than zero" leak is described in the following:

At a 50-pair 22-gauge branch cable the analysis valves are 160 feet apart. Measured pressure at the first analysis valve is 2.1 psi and at the second valve it is 1.7 psi. The zero leak projection, as obtained with the computer, is 680 feet beyond the second valve. However, a reading close to this indicated zero projection shows a pressure of 1.0 psi. A "less than zero" leak is indicated and recalculation is recommended.

Step 1: Move indicator along scale "P" until the hairline is over 0.4 psi (pressure drop between the two analysis valves).

Step 2: Without disturbing the setting of the indicator, move the slide until 160 feet on the "D" scale appears under the hairline.

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 0.7 psi on scale "P" (pressure drop between the second analysis valve and the pressure measured at the indicated zero projection).

Step 4: Under the hairline of the indicator, read 280 feet on scale "D". This is the indicated distance from the second analysis valve to the "less than zero" leak. It is probable that the actual leak will be found somewhat closer than 280 feet to the second analysis valve.

6. COMPUTING PRESSURE DROP WHEN TWO OR MORE SIZES AND GAUGES OF CABLE AND/OR PARALLEL CABLES ARE INVOLVED

6.01 To compute pressure drop when two or more sizes and gauges and/or parallel cables are involved proceed as follows:

Step 1: Move indicator until hairline is over the flow on the "F" scale.

Step 2: Without disturbing the setting of the indicator, move the slide until the total pneumatic resistance of the cables for which pressure drop is to be computed appears under the hairline on the "RI" scale (red).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 1000 ft. on the "D" scale.

Step 4: Read the pressure drop under the hairline on scale "P".

6.02 The steps for computing pressure drop follow a definite sequence of settings on each scale. This sequence is as follows:

"F" Scale → to "RI" Scale → to "D" Scale 1000′ → to "P" Scale

These steps are diagrammed on the back of the computer as shown in the following:

TO COMPUTE PRESSURE DROP WHEN TWO OR MORE SIZES AND GAUGES OF CABLE AND/OR PARALLEL CABLES ARE INVOLVED

Step 1	Set Flow	F Scale
Step 2	Set Total Pneumatic Resistance	RI Scale

Move Indicator

Step 3	Set 1000 ft.	D Scale
Step 4	Read Pressure Drop	P Scale

6.03 An example of a typical pressure drop computation is shown in the following:

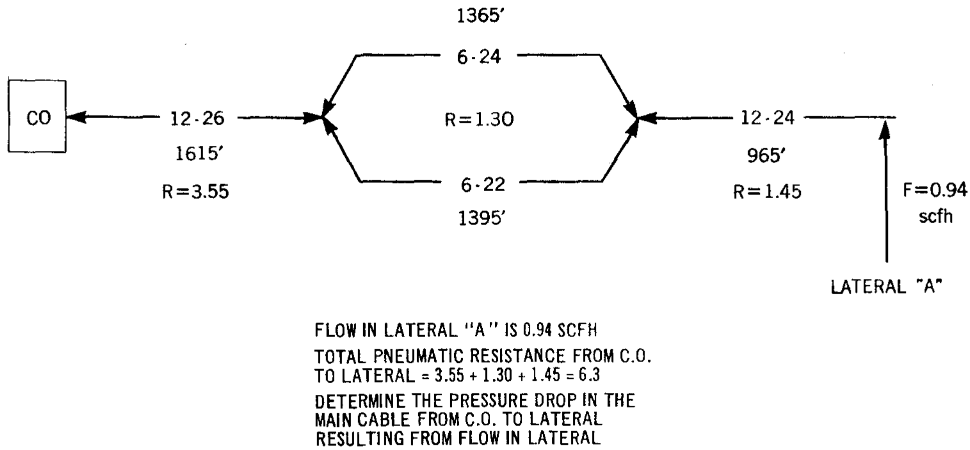


FIG. 9

Step 1: Move indicator until the hairline is over 0.94 on the "F" scale (see Fig. 10).

Step 2: Without disturbing the setting of the indicator, move the slide until 6.3 (total pneumatic resistance) on the "RI" scale appears under the hairline (see Fig. 10).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 1000 ft. on the "D" scale (see Fig. 11).

Step 4: Read the pressure drop (5.92 psi) on scale "P" under the hairline as shown in Fig. 11.

7. CONVERTING DISTANCE TO PNEUMATIC RESISTANCE OR CONVERTING PNEUMATIC RESISTANCE TO DISTANCE

7.01 To convert distance to pneumatic resistance or to convert pneumatic resistance to distance, the pneumatic resistance for a specified distance must be known. This may be the pneumatic resistance per 1000 ft. as taken from the computer or as shown in Section 637-020-020, or it may be the combined pneumatic resistance effect of a parallel cable which has been computed for a specified distance other than 1000 ft. Regardless of which distance is used the pneumatic resistance for that distance must be used.

7.02 Distance is converted to pneumatic resistance as follows:

Step 1: Move indicator until the hairline is over the known pneumatic resistance on the "R" scale.

Step 2: Without disturbing the setting of the indicator, move the slide until the distance corresponding to the known pneumatic resistance appears under the hairline on scale "D".

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline appears over the distance on scale "D" for which the pneumatic resistance is to be determined.

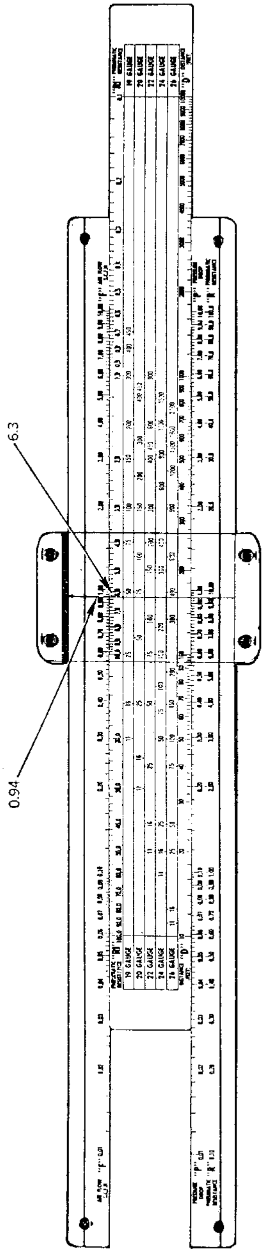


FIG. 10

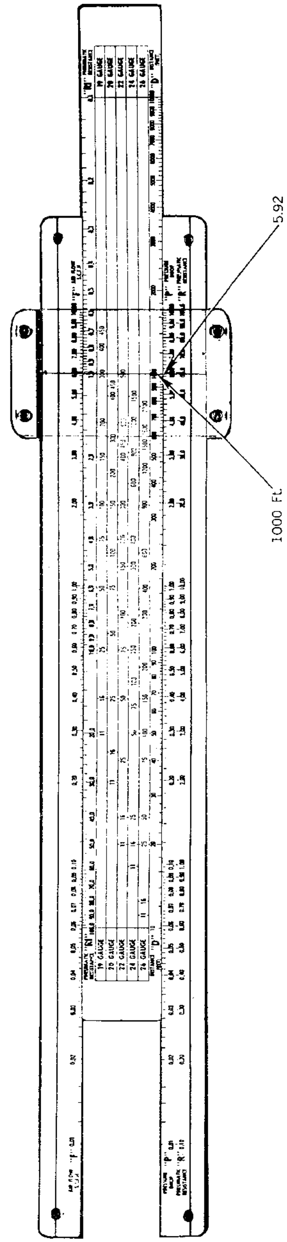


FIG. 11

Step 4: Without disturbing the setting of the indicator, read the pneumatic resistance under the hairline on scale "R".

Note: Steps 1 and 2 establish a direct relationship of pneumatic resistance to distance for that particular cable. With this setting established, distance can be converted to pneumatic resistance or pneumatic resistance can be converted to distance by setting the hairline over a distance on scale "D" and reading pneumatic resistance under the hairline on scale "R". The converse of this is also true; i.e., by setting the hairline over a pneumatic resistance on the "R" scale, the distance corresponding to the pneumatic resistance can be read under the hairline on scale "D".

7.03 The steps for converting distance to pneumatic resistance follow a definite sequence as follows:

"R" Scale to → "D" Scale to → "D" Scale to → "R" Scale

These steps are diagrammed on the back of the computer as shown below.

TO CONVERT DISTANCE TO PNEUMATIC RESISTANCE

Step 2	Set Known Distance	D Scale
Step 1	Set Pneumatic Resistance for Known Distance	R Scale

Move Indicator

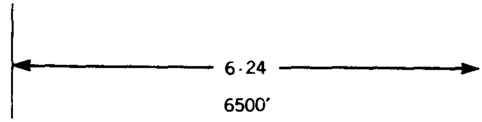
Step 3	Set Distance for which Pneumatic Resistance is to be Determined	D Scale
Step 4	Read Pneumatic Resistance	R Scale

See Notes for diagram in Par. 4.02.

7.04 The steps for converting pneumatic resistance to distance follow a very similar sequence as shown in the following:

"R" Scale to → "D" Scale to → "R" Scale to → "D" Scale

7.05 An example of a typical pneumatic resistance computation is shown in the following:



TOTAL PNEUMATIC RESISTANCE PER 1000 FT. OF 600 PAIR 24 GAUGE CABLE IS 2.5 (FROM TIC LINE ON SLIDE OR FROM 637-020-020 TABLE 1) DETERMINE THE TOTAL PNEUMATIC RESISTANCE OF THE 6500 FT. LENGTH

FIG. 12

Step 1: Move indicator until the hairline is over 2.5 on "R" scale (see Fig. 13).

Step 2: Without disturbing the setting of the indicator, move slide until 1000 ft. on "D" scale is under the hairline (see Fig. 13).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 6500 ft. on the "D" scale (see Fig. 14).

Step 4: Read the total pneumatic resistance (16.25) under the hairline on scale "R", as shown in Fig. 14.

Note: If the length of cable is greater than 10,000 ft., divide the length by 10 or 100 as required to reduce the length to a figure less than 10,000, then multiply the answer by 10 or 100 as appropriate. For example, for a length of cable 15,750 ft., divide 15,750 by 10 to obtain 1575 ft. Find the total pneumatic resistance for a length of 1575 ft. and then multiply this pneumatic resistance by 10.

7.06 When distance is to be converted to pneumatic resistance and the pneumatic resistance per 1000 ft. is known, the following procedure will simplify the conversion:

Step 1: Move the indicator until the hairline is over 0.1 on the "F" scale.

Step 2: Without disturbing the setting of the indicator, move the slide until the tic line for the size and gauge cable is under the hairline.

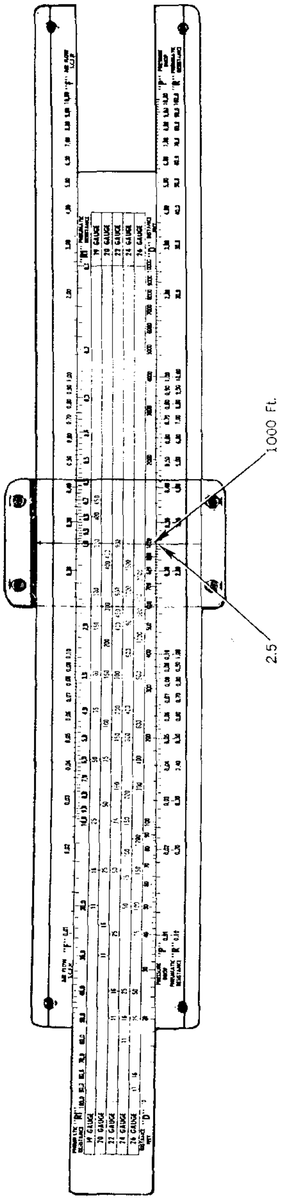


FIG. 13

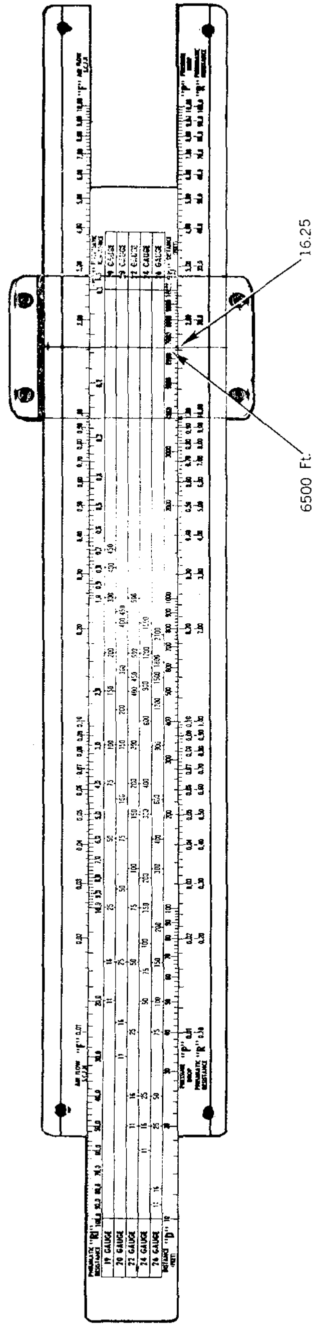


FIG. 14

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over the distance on the "D" scale, for which the pneumatic resistance is to be determined.

Step 4: Read the pneumatic resistance under the hairline on scale "R".

7.07 The steps for converting distance follow a definite sequence of scales as follows:

"F" ⟶ "RI" ⟶ "D" ⟶ "R"
(0.1) Tic Line

These steps may be diagrammed as follows:

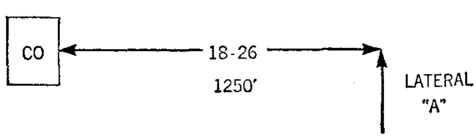
TO CONVERT
DISTANCE TO PNEUMATIC RESISTANCE

Step 1	Set 0.1	F Scale
Step 2	Set TIC Line for S&G Cable	RI Scale

Move Indicator

Step 3	Set Distance	D Scale
Step 4	Read Total Pneumatic Resistance	R Scale

7.08 Example:



DETERMINE THE TOTAL PNEUMATIC RESISTANCE OF THE 1250 FT. OF 1800 PAIR 26 GAUGE CABLE BETWEEN THE C.O. AND LATERAL "A"

FIG. 15

Step 1: Move indicator until hairline is over 0.1 on the "F" scale (see Fig. 16).

Step 2: Without disturbing the setting of the indicator, move slide until the tic line for 1800-26 on the "RI" scale appears under the hairline (see Fig. 16).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 1250 ft. on the "D" scale (see Fig. 17).

Step 4: Read the total pneumatic resistance (2.00) on the "R" scale (see Fig. 17).

8. COMPUTING THE RECIPROCAL OF A PNEUMATIC RESISTANCE

8.01 This computation is used to find the combined pneumatic resistance of two or more cables in parallel. The computation is based on the following mathematical formula:

$$R_T = \cfrac{1}{\cfrac{1}{R_1} + \cfrac{1}{R_2} + \cfrac{1}{R_3} \cdots\cdots}$$

R_T in this formula is the combined pneumatic resistance.

8.02 Combined pneumatic resistance for parallel cables is determined as follows:

Step 1: Determine the reciprocal* of each pneumatic resistance in parallel (see Par. 8.03).

Step 2: Add the reciprocals * so determined.

Step 3: Find the reciprocal * of the sum of the reciprocals * (Step 2). The reciprocal determined in this step is the combined pneumatic resistance of the cables involved.

*The reciprocal of a number is obtained by dividing the number into unity; as the reciprocal of 10 is $\frac{1}{10}$, and the reciprocal of R, is $\frac{1}{R}$.

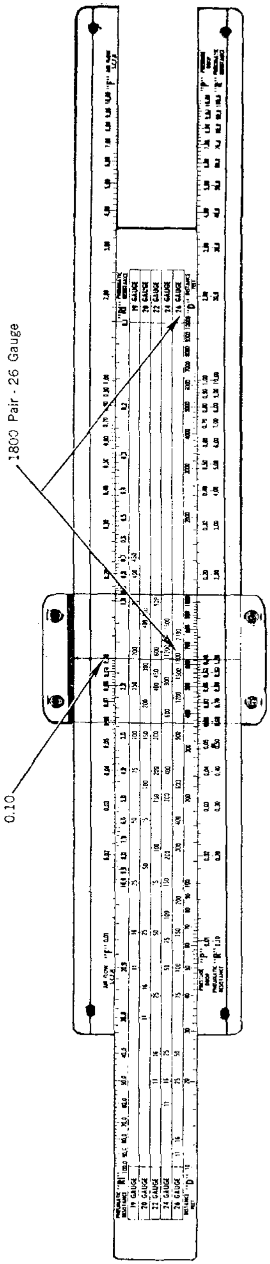


FIG. 16

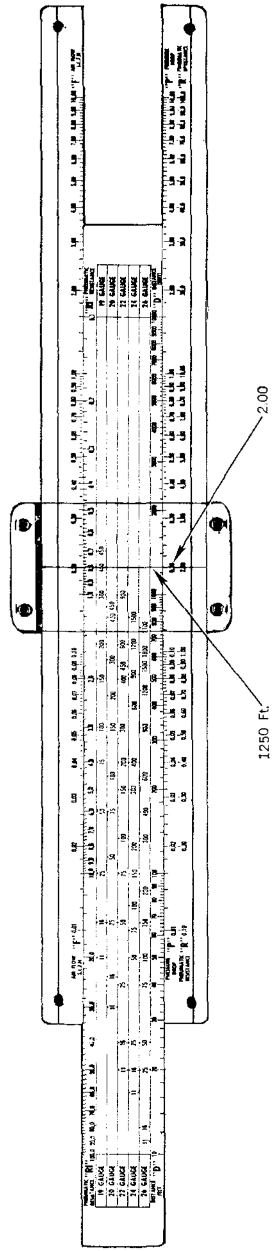


FIG. 17

8.03 The reciprocal of a pneumatic resistance is computed as follows:

Step 1: Close the rule, i.e., match the "RI" and "F" scales (0.01 on "F" scale over 100 on "RI" scale).

Step 2: With the scales matched, move the indicator until the hairline is over the pneumatic resistance on "RI" scale for which the reciprocal is to be determined.

Step 3: Read the reciprocal under the hairline on scale "F".

8.04 The steps outlined in Par. 8.03 are diagrammed on the back of the computer as shown below:

TO FIND RECIPROCAL OF PNEUMATIC RESISTANCE

CLOSE RULE		
Step 2	Read Reciprocal	F Scale
Step 1	Set Resistance for which the Reciprocal is to be Determined	RI Scale

See Notes for diagram in Par. 4.02

8.05 An example of how reciprocals are used in determining the combined resistance of two parallel cables is shown in the following:

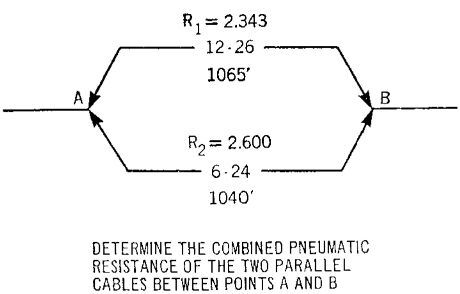


FIG. 18

Step 1: Close rule.

Step 2: Move indicator until hairline is over 2.343 on "RI" scale (see Fig. 19).

Step 3: Read reciprocal (0.427) under hairline on Scale "F" (see Fig. 19).

Step 4: Move indicator until hairline is over 2.6 on "RI" scale (see Fig. 20).

Step 5: Read reciprocal (0.385) under hairline on Scale "F" (see Fig. 20).

Step 6: Add reciprocals found in Steps 3 and 5 ($0.427 + 0.385 = 0.812$).

Step 7: Move indicator until hairline is over 0.812 on "RI" scale (see Fig. 21).

Step 8: Read reciprocal of 0.812 on "F" scale (1.232). This reciprocal is the combined pneumatic resistance of the two cables (see Fig. 21).

9. MISCELLANEOUS SETTINGS

9.01 Many of the computations used in analyzing pressure conditions in a cable or cable network involve mathematical ratios and proportions. The computer offers a simple method for setting up ratios and solving problems of proportion.

9.02 A ***ratio*** is the fixed relationship of one thing to another. A ratio is usually expressed as a fraction, i.e., A/B. A ***proportion*** is a method for expressing equality between two or more ratios, i.e.,

$$\frac{A}{B} = \frac{A_1}{B_1} = \frac{A_2}{B_2} - - - -$$

This equation means that the relationship of A to B is the same as that for A_1 to B_1 and for A_2 to B_2. A ***direct proportion*** is one in which two quantities are so related that an increase in one causes a corresponding increase in the other or that a decrease in one causes a corresponding decrease in the other. Proportions used in the analysis of pressure conditions are ***direct proportions.***

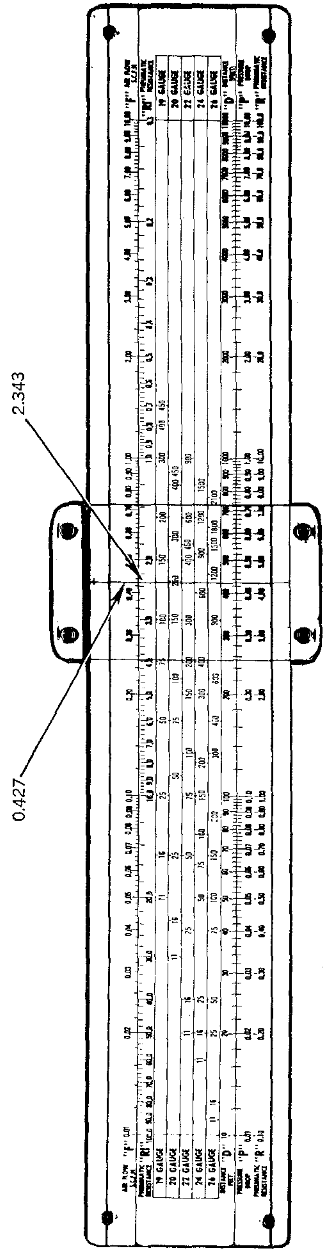


FIG. 19

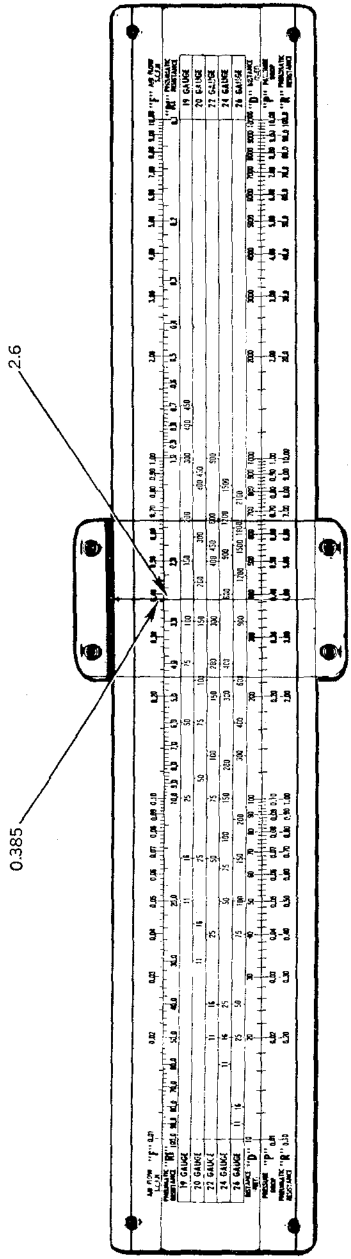


FIG. 20

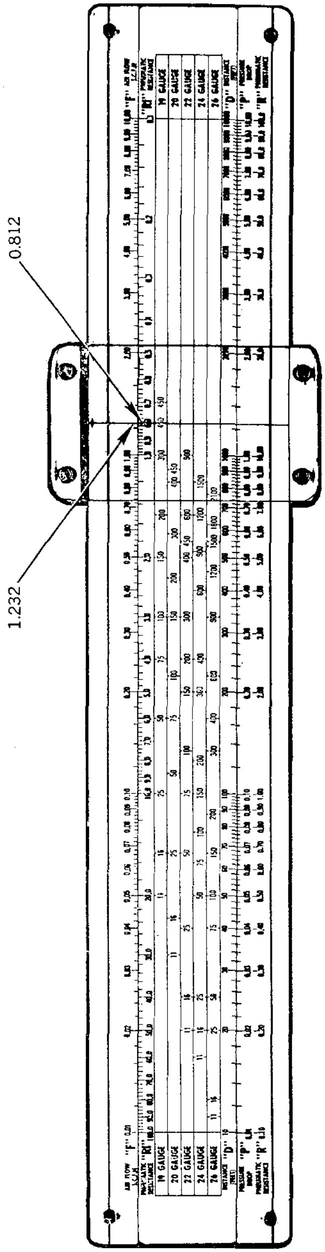


FIG. 21

9.03 There are three proportions that are used frequently in the analysis of pressure conditions in a cable or cable network. These proportions are as follows:

(1) For the same size and gauge of cable or for different sizes and gauges of cable having the same pneumatic resistance per thousand feet, distance is proportional to pneumatic resistance. This proportion is expressed as follows:

$$\frac{D}{R}=\frac{D_1}{R_1}=\frac{D_2}{R_2} - - - -$$

(2) For the same size and gauge of cable and for the same flow, pressure drop is proportional to distance. This proportion is expressed as follows:

$$\frac{P}{D}=\frac{P_1}{D_1}=\frac{P_2}{D_2} - - - -$$

(3) For the same flow, pressure drop is proportional to pneumatic resistance. This proportion is expressed as follows:

$$\frac{P}{R}=\frac{P_1}{R_1}=\frac{P_2}{R_2} - - - -$$

9.04 The computer settings for the proportion of distance to pneumatic resistance (Par. 9.03 [1]) are covered in Part 7.

9.05 To establish the proportion of pressure drop to distance (Par. 9.03 [2]) on the computer, the values of the basic ratio must be known. For this proportion the pressure drop for a specific distance must be known. With these two values known, the sequence of operations is as follows:

Step 1: Move the indicator until the hairline is over the pressure drop on the "P" scale.

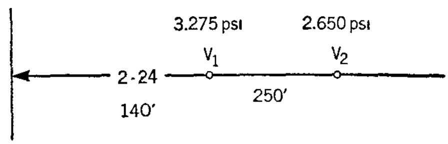
Step 2: Without disturbing the setting of the indicator, move the slide until the known distance appears under the hairline on the "D" scale. This setting determines the basic ratio of pressure to distance for a ***specific size and gauge of cable and for a specific flow.***

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over any desired pressure drop on scale "P".

Step 4: Under the hairline read the distance on scale "D" for the pressure drop selected in Step 3.

Note: Steps 3 and 4 can be reversed to determine the pressure drop for any desired distance.

9.06 A typical example of how, for the same size and gauge of cable, distance can be computed for any pressure drop or how pressure drop can be computed for any distance is shown in the following. Note that in this simplified computation it is unnecessary to consider cable size, gauge or flow rate.



THE PRESSURE DROP BETWEEN V_1 AND V_2 = 3.275 - 2.650 = 0.625 PSI
DETERMINE:

(A) DISTANCE FROM V_1 (RISER POLE) AT WHICH THE PRESSURE WILL DROP 3.275 PSI

(B) PRESSURE DROP AT A POINT ON THE CABLE 750 FT FROM V_1

FIG. 22

Step 1: Move indicator until hairline is over 0.625 on scale "P" (see Fig. 23).

Step 2: Without disturbing the setting of the indicator, move the slide until 250 on scale "D" appears under the hairline (see Fig. 23).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 3.275 on scale "P" (see Fig. 24).

Step 4: Read the distance on the "D" scale under the hairline (1310 ft. is distance from V_1 at which the pressure drop will be 3.275 psi) (see Fig. 24).

Step 5: Wtihout disturbing the setting of the slide, move the indicator until the hairline is over 750 on the "D" scale (see Fig. 25).

Step 6: Read the pressure drop on scale "P" under the hairline (1.875 psi drop at a point 750 ft. from V_1) (see Fig. 25).

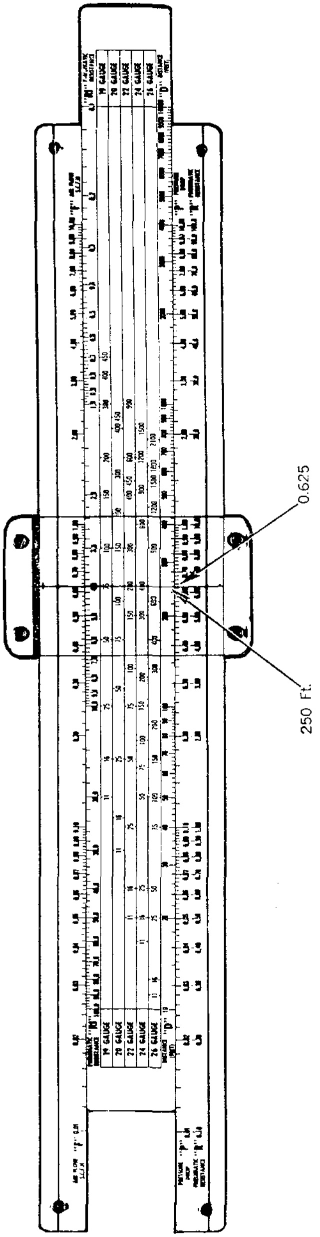


FIG. 23

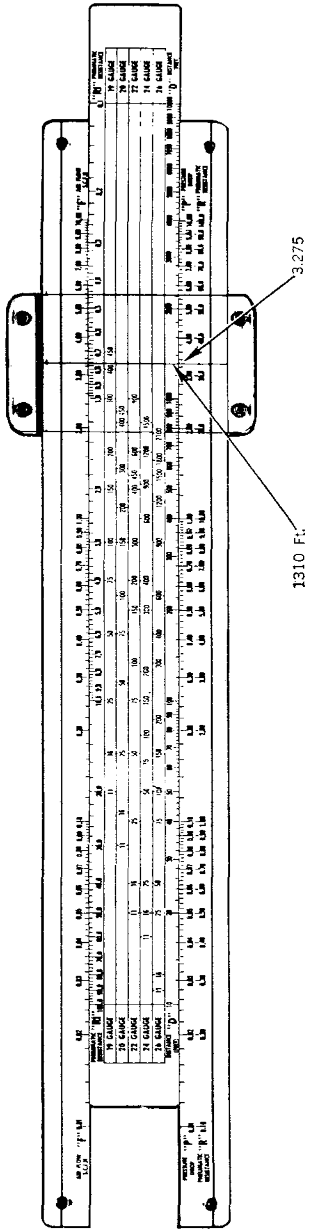


FIG. 24

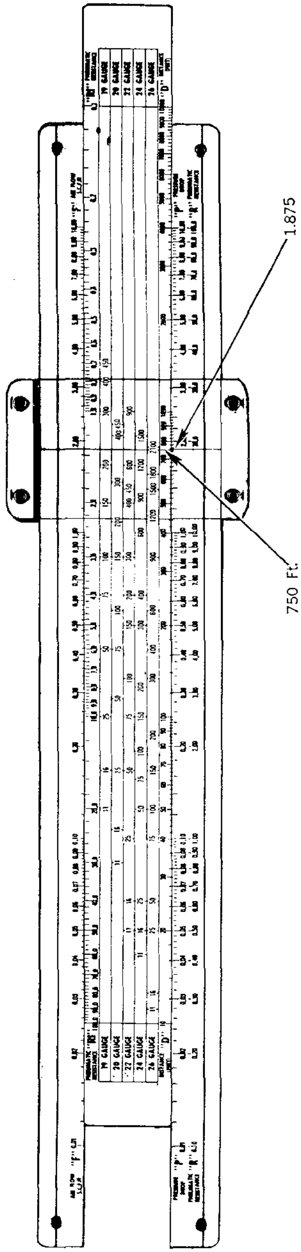


FIG. 25

9.07 To establish the proportion of pressure drop to pneumatic resistance (Par. 9.03[3]) on the computer, the values of the basic ratio must be known. For this proportion the pressure drop for a specific pneumatic resistance must be known. With these two values known, the sequence of operations is as follows:

Step 1: Move the indicator until the hairline is over the pressure drop on the "P" scale.

Step 2: Without disturbing the setting of the indicator, move the slide until the known pneumatic resistance appears under the hairline on the ***"D" scale.*** This setting determines the basic ratio of pressure drop to pneumatic resistance for a ***specific flow.***

Note: For setting up this proportion the "D" scale, which is normally distance, is used as an "R" scale.

The ratio of pressure drop to pneumatic resistance or vice versa is established for a ***specific flow.*** With this computer setting established, the hairline of the indicator may be set over any pressure drop on the "P" scale and the corresponding pneumatic resistance can be read under the hairline on the "D" scale. The converse of this is also true; i.e., the hairline of the indicator may be set over any pneumatic resistance on the "D" scale and the corresponding pressure drop can be read under the hairline on the "P" scale.

9.08 The following are typical examples involving the ratio of pressure drop to pneumatic resistance.

Example 1: At a point that is 32 units of pneumatic resistance from a 10 psi pressure source the cable pressure is 4.85 psi. Compute the pressure at a point 54 units from the pressure source, assuming that there are only negligible leaks between the source and that point.

Pressure at source	10.00 psi
Pressure at 32 units from source	4.85 psi
Pressure drop	5.15 psi

Step 1: Move indicator until hairline is over 5.15 on scale "P".

Step 2: Without disturbing the setting of the indicator, move the slide until 32 (units of pneumatic resistance) appears under the hairline on scale "D".

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 54 on scale "D".

Step 4: Read pressure drop (8.7 psi) under the hairline on scale "P".

Step 5: Since the pressure at the source is 10 psi and the pressure drop to a point 54 units distant is 8.7 psi, the pressure at that point is 10-8.7 or 1.3 psi.

Example 2: A contactor has been set to operate at 6 psi at a point that is 30 units of pneumatic resistance from a 10 psi pressure source. It has been verified by one or more pressure readings at intermediate points that there is no significant leak or restriction between the pressure source and the contactor.

Estimate the monitoring range beyond the contactor to a zero leak.

Pressure at source	10.00 psi
Contactor operating pressure	6.00 psi
Presure drop to operate contactor	4.00 psi

Step 1: Move indicator until hairline is over 4.00 on scale "P" (see Fig. 26).

Step 2: Without disturbing the setting of the indicator, move the slide until 30 (units of pneumatic resistance) appears under the hairline on scale "D" (see Fig. 26).

Step 3: Without disturbing the setting of the slide, move the indicator until the hairline is over 10.00 on scale "P" (10 psi pressure drop from source to the zero leak) (see Fig. 27).

Step 4: Read pneumatic resistance (75 units) under the hairline on scale "D" (see Fig. 27).

Step 5: Since the contactor is located 30 units of pneumatic resistance from the source, the contactor could monitor a zero leak at 45 units (75-30) beyond the contactor location.

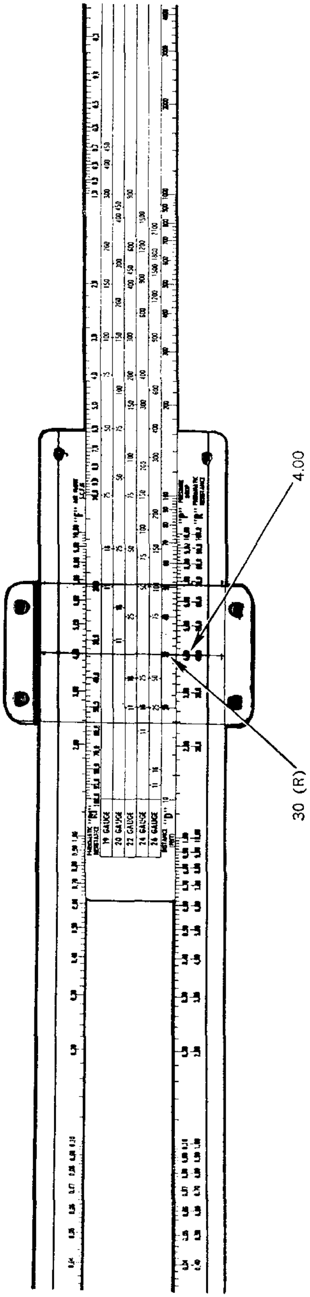


FIG. 26

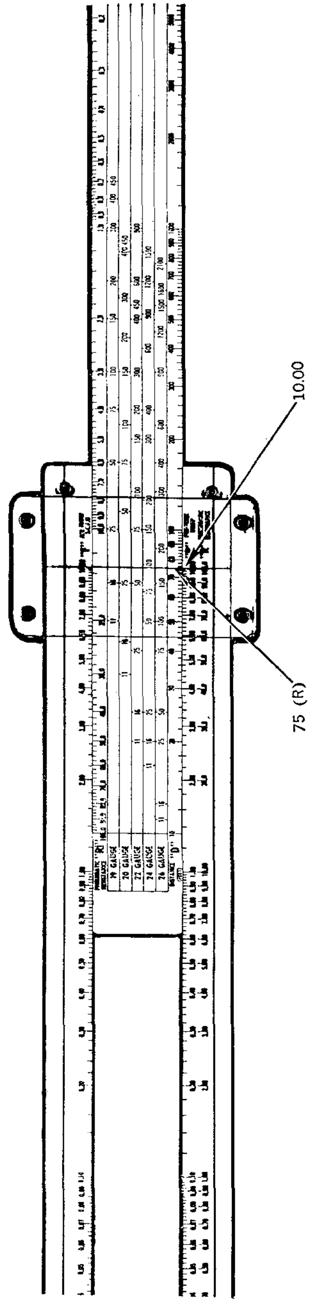


FIG. 27