## OUTLINE OF DESIGN PROCEDURE

The data underlying the design procedure are given in detail in a circular[2] issued by the University of Illinois. In this procedure the design of the warm-air duct system is considered as an entire unit, so that for a given heat loss the sizes of leaders, stacks, boots, stackheads, and registers are all correlated. Similarly in the case of return ducts, the selection specifies a complete unit consisting of return grille, return duct, and shoe connection.

### Recommended Standard Sizes

For the purpose of simplification and standardization, selected combinations of commercial sizes of warm air pipes, return air pipes, ducts, grilles, fittings, and registers are designated as Combination Numbers. The numbers assigned and the combinations selected as standard are listed in the following Tables 1 to 4 inclusive.[3]

TABLE 1. FIRST STORY WARM-AIR DUCTS[a]

| Combination No. | Leader Pipe Diameter, In. | Register Size, In. | | |
|---|---|---|---|---|
| | | Floor | Baseboard | |
| | | | Size | Extension |
| 1 | 8 | 8 x 10 | 10 x 8 | 2¼ |
| 2 | 9 | 9 x 12 | 12 x 8 | 2¼ |
| 3 | 10 | 10 x 12 | 12 x 9 | 3¼ |
| 4 | 12 | 12 x 14 | 13 x 11 | 5¼ |
| 5 | 14 | 14 x 16 | ..... | ..... |

[a] When the calculations indicate a requirement for a given room greater than Combination No. 4, two or more smaller units totalling the required capacity are recommended.

TABLE 2. SECOND STORY WARM-AIR DUCTS—SINGLE WALL STACKS AND FITTINGS

| Combination No. | Leader Pipe Diameter, In. | Stack[b] Size In. | Register Size, In. | | | |
|---|---|---|---|---|---|---|
| | | | Floor | Baseboard | | Sidewall |
| | | | | Size | Extension | |
| 11 | 8 | 10 x 3¼ | 8 x 10 | 10 x 8 | 2¼ | 10 x 8 |
| 12 | 9 | 12 x 3¼ | 9 x 12 | 12 x 8 | 2¼ | 12 x 8 |
| 14 | 10 | 14 x 3¼ | 10 x 12 | 12 x 8 | 2¼ | 12 x 8 |
| 15 | 12 | 12 x 5¼ | ..... | 12 x 9 | 3¼ | ..... |
| 16 | 12 | 14 x 5¼ | ..... | 13 x 11 | 5¼ | ..... |

[b] Recommended stack sizes. Tables may also be applied to 3 in. and 3½ in. stack depths.

TABLE 3. SECOND STORY WARM-AIR DUCTS—DOUBLE WALL STACKS AND FITTINGS

| Combination No. | Leader Pipe Diameter, In. | Stack Size, In. | | Register Size, In. | | | |
|---|---|---|---|---|---|---|---|
| | | Internal | External | Floor | Baseboard | | Sidewall |
| | | | | | Size | Extension | |
| 21 | 8 | 2½[c] x 10 | 3⅛[c] x 10⅝ | 8 x 10 | 10 x 8 | 2¼ | 10 x 8 |
| 22 | 8 | 3 x 10 | 3⅝ x 10⅝ | 8 x 10 | 10 x 8 | 2¼ | 10 x 8 |
| 23 | 9 | 2½[c] x 12 | 3⅛[c] x 12⅝ | 9 x 12 | 12 x 8 | 2¼ | 12 x 8 |
| 24 | 9 | 3 x 12 | 3⅝ x 12⅝ | 9 x 12 | 12 x 8 | 2¼ | 12 x 8 |

[c] Commercial sizes vary ⅛ in. from values shown.



TABLE 4. RETURN AIR DUCTS

| Combination No. | Duct Dia. In. | Area at Shoe Connection, Sq In. | Metal Grille Sizes | | | When Joist Lining is Used[d] | | When Duct is Used | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Choose One | | | No. of Joists Lined | Minimum[e] Depth, In. | Choose One | |
| | | | A | B | C | | | | |
| 31 | 10 | | | 8 x 14 | 10 x 12 | 1 | 7 | 14 x 6 | 12 x 8 |
| 32 | 12 | | 6 x 30 | 8 x 24 | 12 x 14 | 1 | 9 | 22 x 6 | 16 x 8 |
| 33 | 14 | 170 | 8 x 30 | 10 x 24 | 14 x 16 | 1 | 12 | 28 x 6 | 22 x 8 |
| 34 | 16 | 220 | 10 x 30 | 12 x 24 | | 2 | 8 | 28 x 8 | 22 x 10 |
| 35 | 18 | 280 | 12 x 30 | 14 x 24 | | 2 | 10 | 36 x 8 | 28 x 10 |
| 36 | 20 | 340 | 14 x 30 | 18 x 24 | | 2 | 12.5 | 36 x 10 | 30 x 12 |
| 37 | 22 | 420 | 18 x 30 | | | 2 | 15.0 | 42 x 10 | 36 x 12 |
| 38 | 24 | 500 | 20 x 30 | | | 2 | 18.0 | 42 x 12 | 36 x 14 |

[d] Based on 14 in. space between joists.

[e] Use full depth of joist except when joist depth is less than minimum depth required, *when pan must be used*.

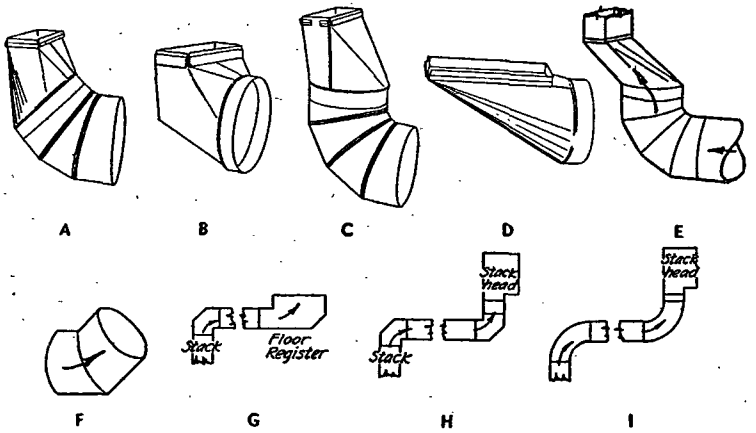



FIG. 2. TYPICAL WARM AIR BOOTS

TABLE 5. RESISTANCES OF WARM AIR BOOT COMBINATIONS EXPRESSED IN ELBOW EQUIVALENTS

| Warm Air Boot | Name of Combination | Equivalent No. of 90-Deg Elbows |
|---|---|---|
| A | 45-Deg Angle Boot and 45-Deg Elbow | 1 |
| B | 90-Deg Angle Boot | 1 |
| C | Universal Boot and 90-Deg Elbow | 1 |
| D | End Boot | 2 |
| E | Offset Boot | 2½ |
| F | 45-Deg Angle | ½ |
| G | Floor Register—Second Story | 3 |
| H | Offset | 3 |
| I | Offset | 2 |