VARITRANE™
DUCT DESIGNER

Getting Started Guide

Getting Started

VariTrane™ Duct Designer

Version 4.1

TRANE®

LIMITATIONS OF LIABILITY AND DISCLAIMERS

VariTrane Duct Designer, whether used by itself or in combination with other software, is intended as a tool to model HVAC supply-duct systems. Program accuracy is highly dependent on user-supplied data. It is the user's responsibility to understand how the data entered affects program output, and to understand that any predefined libraries are to be used only as guidelines for entering that data. The calculation results and reports from this program are meant to aid the building designer and are not a substitute for design services, judgment, or experience.

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Contents

1 Overview

VariTrane™ Duct Designer is a supply duct system design and analysis software that will help you efficiently and quickly model new or existing round, rectangular, or flat oval supply duct systems. You can also create reports that document projected performance and a bill of materials.

VariTrane Duct Designer consists of three applications:

- Duct Configurator to model and size duct supply systems,
- Ductulator™ to size system components and determine nominal duct size for equal friction applications, and
- Fitting Loss Calculator to identify optimal fittings and sizes for each duct section by comparing efficiency and cost.

As you enter design information, the program quickly helps determine the best shapes, sizes, and fittings for your project in order to minimize pressure losses and fan horsepower. You select equal-friction or static-regain methodology to size ductwork for desired airflow. VariTrane Duct Designer will help you choose the duct sizes, shapes, and fittings to optimize your layout.

Design Tools software download

The VariTrane Duct Designer program is part of the Design Tools suite. This suite is available for download from the Download Center on www.tranecds.com. The software download includes these components:

- Executable files for each Design Tools program
- *Getting Started* manuals
- Installation instructions

Installing (and uninstalling) VariTrane Duct Designer

The VariTrane Duct Designer program must be installed on your hard disk; it cannot run off a network. Step-by-step installation instructions are included with the download.

Note: A license is required to activate the software.

Installing TOPSS

The TOPSS program is also available for download from the Download Center on www.tranecds.com. TOPSS must be installed on your hard disk.

After installing the VAV products for the TOPSS program, you will be able to make Trane VAV selections while working in VariTrane Duct Designer.

Note: If VariTrane Duct Designer has already been installed, a prompt enabling you to quickly install the VAV products only will appear during the TOPSS installation process.

Uninstalling the program

If you ever need to remove the program from your computer, use the Uninstall Programs function in the Windows® Control Panel. This utility will delete all VariTrane Duct Designer/TOPSS files—except for those shared by other applications.

Starting VariTrane Duct Designer

Start VariTrane Duct Designer just as you would any other Windows program, by doing *one* of the following:

- Double-click the **VariTrane Duct Designer** icon on the desktop, or
- On the **Start** menu, point to **Programs** and **C.D.S. Applications**; then click **VariTrane Duct Designer**.

Learning to use VariTrane Duct Designer

The following resources are available to you:

This manual

The *Getting Started* manual will acquaint you with:

- How the program works (Chapter 2)
- Work area basics (Chapter 3)
- Duct Configurator (Chapter 4)
- Ductulator (Chapter 5)
- Fitting Loss Calculator (Chapter 6)
- Reports (Chapter 7)

Read the manual from cover to cover, or skip directly to Chapter 4 to begin using the program by completing a tutorial.

Online Help

VariTrane Duct Designer's online Help describes how to perform basic tasks. It also provides detailed information about each program entry. To open online Help, do one of the following:

- On the **Help** menu, click **Contents and Index**, or
- Press F1 for the Help topics related to the currently displayed screen, or
- Click the **Help** button on the toolbar.

Web resources

Additional sources of information and help are available on the Trane Web site. Visit www.tranecds.com for access to our online knowledge base, download center, and training opportunities, and to subscribe for notifications about program updates.

Technical support

Your license agreement (renewed annually) entitles you to continued use of the program, free program upgrades, and the latest documentation. As a Trane C.D.S. customer, you're also eligible for free technical assistance from the experienced HVAC engineers and software specialists in our support center.

Support center hours are 8:00 a.m. to 5:30 p.m. (central time), Monday through Thursday; and 8:00 a.m. to 5:00 p.m., Friday.

phone	• 608-787-3926
fax	• 608-787-3005
Web site	• www.tranecds.com
e-mail	• cdshelp@trane.com
mailing address	• TRANE Attn.: C.D.S. Group 12-2 3600 Pammel Creek Rd La Crosse, WI 54601-7599

Comments?

We are committed to continually improving our HVAC design and analysis tools. As you use VariTrane Duct Designer and discover opportunities to improve its usability, or if you encounter difficulties, please take a moment to let us know by e-mail, fax, or phone.

2 How VariTrane Duct Designer Works

The VariTrane Duct Designer program contains three different applications to accommodate your project needs. Take a look at the next few pages to familiarize yourself with each application.

Choosing which application to use

The three different VariTrane Duct Designer applications, as described briefly in this section, allow you to experiment to find the most efficient solution for your project using either English (I-P) or metric (SI) units.

Duct Configurator

Use Duct Configurator when you want to model, size, and adjust an entire supply-duct system and find the required fan static pressure. If you choose, this application can automatically balance the system, making your design time instantly more productive. Duct Configurator creates files with a *.PRJ extension.

Duct Configurator can …

- Determine the optimum dimensions for each section
- Determine design static pressure for an existing or newly modeled duct system
- Add dampers and orifices where needed
- Balance a system based on either equal-friction or static-regain methodology
- Provide a complete bill of materials
- Correct airflows for duct-heat pickup and leakage

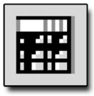
… and more!

Ductulator

We converted the popular Ductulator wheel into a user-friendly program that helps you to easily and accurately find airflow, friction rate, velocity, and diameter for your equal-friction systems. You fine-tune the layout based on space requirements and installation costs. Ductulator creates files with a *.DCL extension.

Note: Analyze and compare sections with Duct Configurator; size duct-system components with Ductulator.

Fitting Loss Calculator

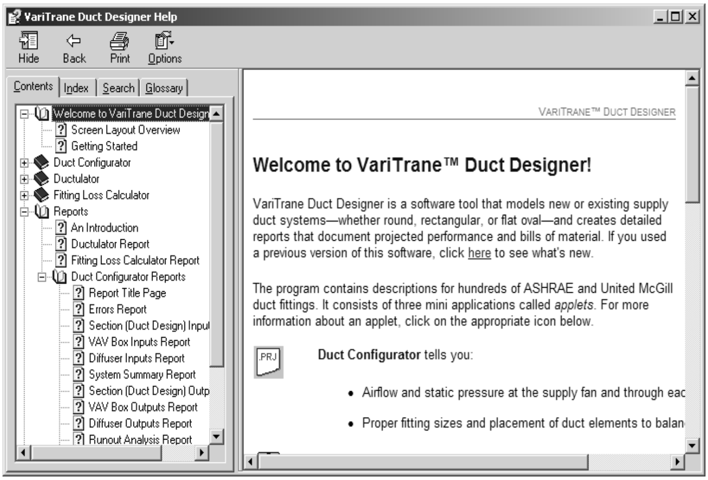


Fitting Loss Calculator contains a database of ASHRAE and United McGill fittings (also used by Duct Configurator). With this application, you can quickly find the best fittings and sizes for your duct sections. Choose a fitting type and enter dimensions, airflows, and other required parameters, and the application instantly calculates static-pressure drops through the duct fitting. Use Fitting Loss Calculator to compare fittings for performance and to find the optimum sections and fittings that balance cost and efficiency. Fitting Loss Calculator creates files with an *.FLC extension.

Note: You can size equal-friction-based return and exhaust systems by using Ductulator in conjunction with Fitting Loss Calculator.

To learn more ...

To familiarize yourself with each application, try the tutorials in Chapters 4 through 6. If you have a question about a particular screen, “worksheet,” or entry, check out the online Help. Press **F1** to display online Help for the current screen; a typical example is shown on the next page.



Duct design methodologies

Equal friction vs. static regain

In any duct system, static pressure and velocity pressure offset friction loss. Duct systems sized with equal-friction methodology keep the pressure drop per unit length of duct relatively constant throughout the duct system.

By varying sizes, you can create a duct system that delivers the required airflow at a velocity that does not increase friction loss. In theory, you assume a constant duct friction rate (as determined by root section parameters, typically 0.1 in. H_2O per 100 feet), and calculate duct dimensions as necessary to maintain friction loss below the assumed factor.

Equal-friction methodology is widely used for sizing relatively low-velocity, constant-volume systems, but with VariTrane Duct Designer you can apply equal-friction methodology to any system.

The theory of static-regain design is a little more complex. The goal of static regain is to keep static pressure relatively constant throughout the duct system. At diverging junctions and transitions, velocity pressure decreases to offset friction losses while static pressure remains unchanged. The static pressure recovered at each section is known as static regain.

As distance from the fan increases, this method decreases velocity and converts velocity pressure to static pressure at approximately the same rate that static pressure is lost to friction. Static regain attempts to maintain balanced static pressure at any given point in the system, thereby preventing inlet pressures at the terminals from varying significantly. Static-regain methodology is commonly used with high-velocity, variable-air-volume systems.

VariTrane Duct Designer terminology

Some terminology used in this program may differ from that in previous programs. In addition to reviewing the items below, remember that you can find in-depth definitions of many terms by accessing the program's Help function. Press F1 or utilize the Help drop-down menu.

A **section** is all ductwork from the inlet of a junction or transition fitting to the inlet of the next downstream junction or transition fitting. A root section is connected directly to the supply-fan outlet.

Junction and **transition fittings** connect the sections of ductwork. In-line fittings join, adjust, or adapt other duct-system components within duct sections. VariTrane Duct Designer's database contains hundreds of ASHRAE and United McGill fittings.

Variable-air-volume systems use **VAV boxes** to modulate flow for a zone. **Diffusers** are the final link in constant-volume duct systems that connect the duct system directly to the space.

A **variable-air-volume (VAV) system** consists of a fan, duct sections, and modulating terminal devices (VAV boxes). Ductwork and diffusers are downstream from these terminals.

Constant-volume (CV) systems consist of a fan, sections, and a diffuser for each terminal device. The diffusers do not modulate airflow.

A **path** consists of the connected sections and fittings between a fan and a terminal device. Each section and fitting may belong to several paths, but each path is unique.

The **critical path** has the largest pressure drop of all the paths associated with a fan. Therefore, all **noncritical paths** are over-pressurized and require either resizing or the addition of dampers and/or orifices to balance the system.

Auto-balance is the capability of VariTrane Duct Designer to automatically add dampers or orifices at points of diverging flow, as necessary, and to adjust these dampers and orifices to equalize the static pressure of noncritical paths with that of the critical path.

3 Work Area Basics

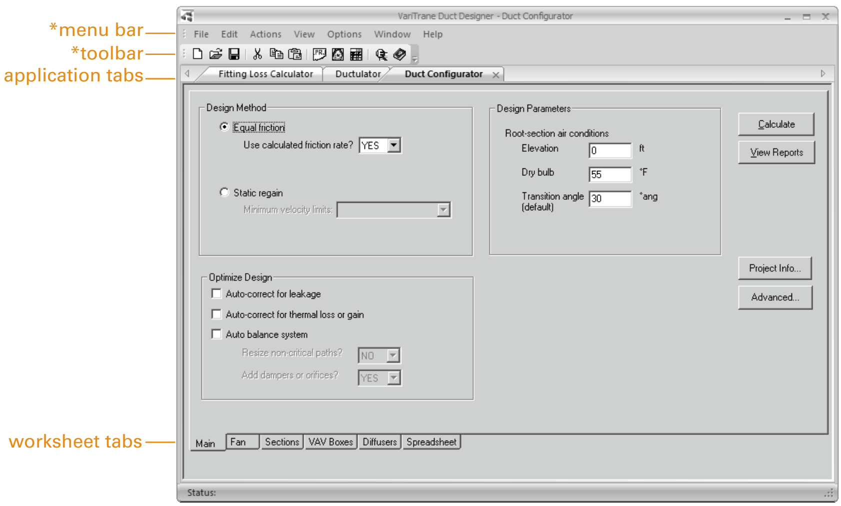
This section discusses:

- "Layout," p. 3–1
- "Menus and toolbar," p. 3–2
- "Setting preferences," p. 3–2

Layout

VariTrane Duct Designer's main screen is shown below. From this screen you can access Duct Configurator, Ductulator, or Fitting Loss Calculator.

Figure 3-1 VariTrane Duct Designer work area



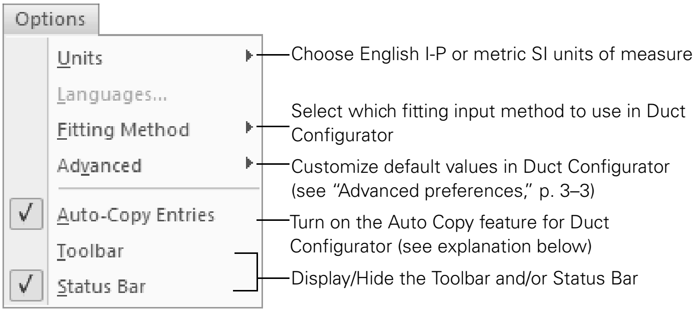
*See online Help to learn more about specific menu commands, toolbar buttons, or other elements in the work area

Menus and toolbar

Menus across the top of the main window organize the commands that help you manage and work with your analysis projects. A **toolbar** directly below the menus provides one-click access to the most commonly used commands, as well as shortcut buttons for the three applications. For more information about specific commands, refer to online Help.

Setting preferences

Preferences are options that let you "tell" the program how you want it to work. Your choices remain in effect until you change them. In VariTrane Duct Designer, the preferences are set under the **Options** menu:



Auto-Copy Entries

This function affects Duct Configurator Only. If a check mark precedes Auto-Copy Entries, the program automatically fills in most of the entries for each new element with the values of the one just completed. When "on" (default), this command only affects three of the Duct Configurator worksheets: Sections, VAV Boxes, and Diffusers.

*Note: The **Copy** button on each of these worksheets performs the same function as Auto-Copy Entries, but only for the entries on that worksheet.*

Advanced preferences

To review and/or change your preferences, open the **Options** menu, highlight **Advanced** and click **Change Preferences**.

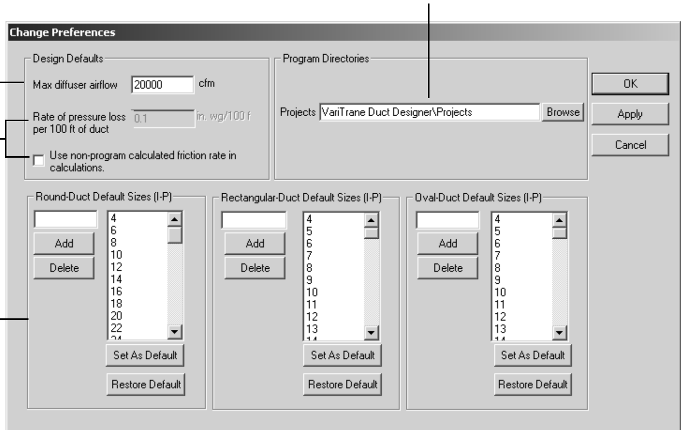
This screen allows you to change the program defaults for airflow, rate of pressure loss, duct sizes, and project location.

Change the default location for project files by typing the new path or browsing to the desired location.

Change the default value of the max diffuser airflow by typing a new value in this field.

Change the default value of the rate of pressure loss by checking the box and typing a new value in the field.

Customize the list of available duct sizes by adding and deleting duct sizes as needed. Click **Set As Default** to make the new list the program default. To return to the original settings, click **Restore Default**.



4 Duct Configurator

Duct Configurator is the application you will use to size and analyze supply duct sections. You can model the conditions for the duct system and specifications for each section, terminal, and diffuser. This section-by-section approach incorporates existing ductwork and fittings.

You will need the following information before you can use Duct Configurator to detail and refine the design of your supply duct system:

- Airflow and static pressure required at each terminal device (typically determined with the help of load-design software)
- Maximum velocity for each duct section
- Length of each duct section
- Block fan airflow, or the system diversity factor, for VAV systems
- Any limitations and constraints on your system design due to building layout and available space

As you build the project file for your supply duct system, you can review and compare design details by switching to the spreadsheet view. If necessary, switch back to the other appropriate worksheets in order to add, remove, or modify sections, VAV boxes, diffusers, or other components of your system.

Need to balance the system? Let Duct Configurator do it for you. Duct Configurator can automatically resize noncritical paths to optimize your system.

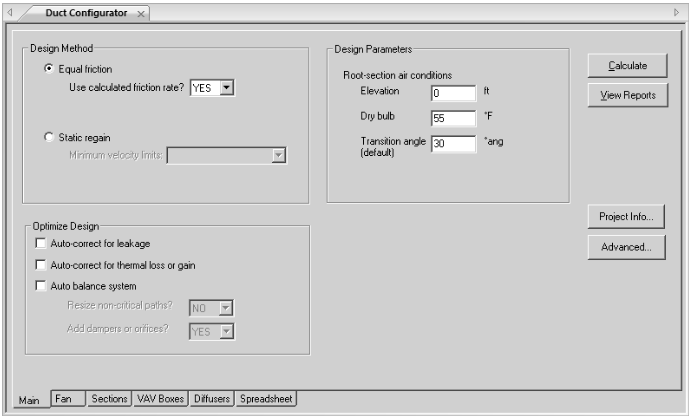
Basic duct design procedure

If designing duct systems is new for you, take a moment to review this basic procedure. Complete Steps 1 through 4 on your own; then Duct Configurator can help you complete your design. Still have questions? Refer to the 1993 *ASHRAE Handbook—Fundamentals,* Chapter 32, "Duct Design," or call your local Trane sales representative for current literature on duct design.

1. Study the building plans and arrange the supply and return outlets to provide proper distribution of air within each space.
2. Select fan outlet sizes that meet the airflow requirements of the system.
3. Sketch the duct system, connecting supply outlets and return intakes with the air-handling units and/or air conditioners. Space that is allocated for supply and return ducts often dictates system layout and ductwork shape. Use round ducts wherever feasible.
4. Determine the system sections and number each section. A duct system should be divided at all points where flow, size, or shape changes.
5. Using design airflows and section descriptions, size supply ducts (using either equal-friction or static-regain methodology), calculate system total pressure loss, and then select the fan.
6. Adjust diffuser and/or terminal air quantities for design airflow, and resize duct sections to account for heat gains or losses and leakage.
7. Resize duct sections to approximately balance pressures in noncritical sections.
8. Lay out the system in detail. If duct routing and fittings vary significantly from the original design, recalculate the pressure losses and reselect the fan if necessary.

A brief overview...

The Duct Configurator window contains six worksheets. Complete the **Main** worksheet to create your project file and continue entering information on each tab (working left to right). To switch worksheets, click a tab at the bottom of the screen. You can switch between worksheets at any time, although you may have to enter required data first. Error messages explain what information is required.



Select a design method and specify the conditions of your system at the root section to begin your project. Note that when you begin defining the sections for your system, the program will automatically enter the upstream connection and shape, in accordance with the information entered on the **Fan** worksheet.

Duct Configurator can make sizing adjustments to automatically balance noncritical paths, account for leakage, and account for thermal loss. Select the check box next to these items to take advantage of these optional features. You can select these at any time.

Entering project information for your own purposes is optional, and it can be done at any time.

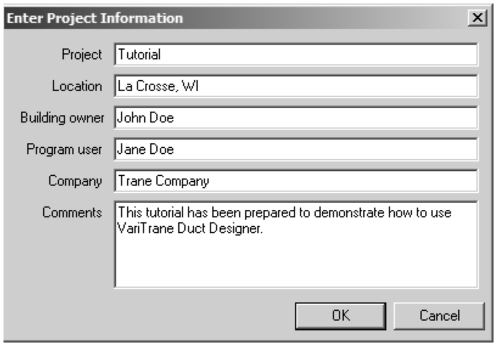
To open the Project Information dialog box

- On the **Main** worksheet for your project, click **Project Info**.

  –or–

- On the **Actions** menu, click **Enter Project Information**.

If you enter project information, the data will print on the Title Page report.



After you have entered all your system design data, your file is ready to be calculated.

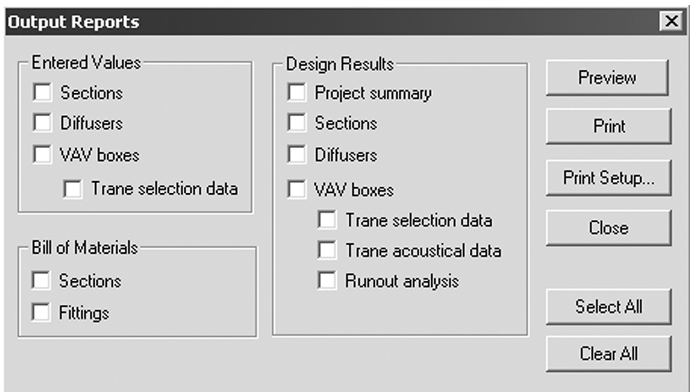
To calculate your file

- On the **Main** worksheet for your project, click **Calculate**.

  –or–

- On the **Actions** menu, click **Calculate**.

When calculations are complete, you will see the **Output Reports** dialog box, which presents numerous options.



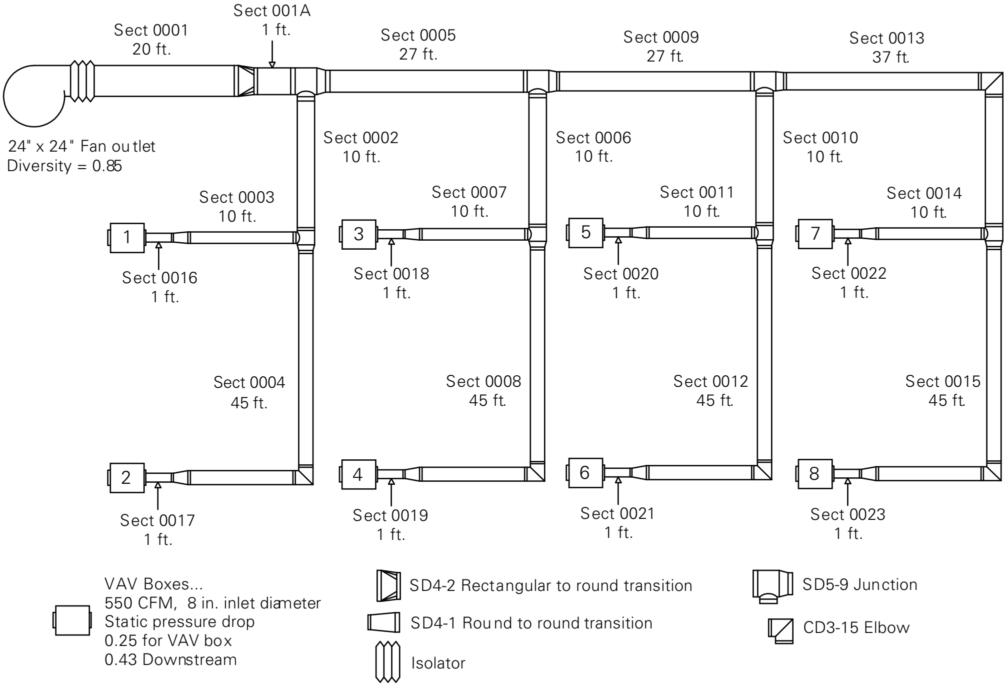
Note: It is best to view or print reports after the file has been calculated. This ensures that any design modifications you have made will be reflected in the results. Failure to calculate the file before viewing or printing a report can yield results based on previous calculations or a different file.

Tutorial

Although Duct Configurator performs a number of functions, this exercise focuses on just one: determining duct size and static pressure required at the supply fan.

Scenario

The schematic below illustrates a simple supply duct system. The steps that follow describe how to determine the duct size and static pressure required at the supply fan, given its size and the duct fittings identified below.



Solution

For this tutorial, we will define the fan characteristics first, then each supply air path, beginning with the root section and working outward through the terminal section to the VAV box. We will start with Section 0001—the section closest to the supply fan.

Note: These steps describe one of several sequences that can be used to model this system. You could describe the system and supply fan characteristics last rather than first, or describe all of the sections before defining any of the VAV boxes. Just remember that the ***Upstream section connection*** *is a required entry. The program will not allow you to complete the description of a new section, VAV box, or diffuser if you have not defined the section that immediately precedes it.*

Complete the tutorial by following the steps below.

Open a new file

- Click the **Duct Configurator** tab on the main window.

  –or–

- Click the **Duct Configurator** icon  on the toolbar.

  –or–

- On the **File** menu, click **New** and select **Duct Configurator Project.**

Set up the file

- Check the **Options** menu to make sure that the units are **English I-P** and **Auto-Copy Entries** is checked. Under **Fitting Method**, click **ASHRAE Selection**.
- For this basic tutorial, you will leave all the default selections and values on the **Main** worksheet as they are. Also, leave the three available options in the **Optimize Design** section unchecked.

Define fan characteristics

1. Click the **Fan** tab at the bottom of the **Main** worksheet.
2. In the **Diversity factor** box, enter **0.85**. (*Note: The program allows the entry of either a diversity factor or a specification for block fan airflow. The unused option becomes unavailable.*)
3. Leave the default of 2 in. wg in the **Static pressure loss...** box.
4. In the **Fan outlet shape** box, select **Rectangular**.

5 In both the **Fan outlet width** and **Fan outlet height** boxes, enter **24** in.

6 On the **File** menu, click **Save As**. Name your file and specify a location for its storage on your hard disk. Click **Save**.

Define Section 0001

1 Click the **Sections** tab, then click **New Section**.

2 Leave the **Section ID** as 0001. In the **Description** box, type **Root**. *(Note: Although section descriptions are optional, you may find that routinely entering them in a consistent and logical fashion is helpful in the later stages of the project.)*

3 In the **Upstream fitting connection** box, click **Select Fitting**.

4 In the **Fitting type** box, select **Fan connection**.

5 In the **Fitting** box, select **Isolator**. Click **OK**.

6 In the **Length** box, type **20** ft, as indicated in our sample schematic illustration.

Define Section 001A

Next, you will define a section with the ID "001A." Notice that the program automatically applies several values from the previously defined section.

1 Click **New Section**.

2 In the **Section ID** box, delete "0002" and type **001A**.

3 In the **Description** box, type **transition to round**.

4 In the **Upstream section connection box,** select **0001**.

5 In the **Shape** box, select **Round**.

6 In the **Upstream fitting connection** box, click **Select Fitting**.

7 In the **Fitting Type** box, select **Transition**. Note that the program automatically provides the available rectangular-to-round fitting. Click OK.

8 In the **Length** box, type **1** ft.

Define Section 0002

1 Click **New Section**. The section ID value automatically increments to 0002.

2 In the **Description** box, type **Takeoff 1**.

3 In the **Upstream section connection** box, select **001A**.

4 By definition, a section extends from the inlet of its upstream junction or transition to the inlet of the next downstream junction or transition. In the **Upstream fitting connection** box, click **Select Fitting**.

5 In the **Fitting Type** box, select **Junction**.

6 In the **Fitting** box, select **SD5-9 div., tee with straight branch**. Click OK.

7 The junction has two discharge openings, so the Section 0002 connection must also be identified. In the **Junction Outlet** box, select **Branch 1**.

8 In the **Length** box, type **10** ft and save your entries.

Define Section 0003

1 Click **New Section**. The section ID value automatically increments to 0003.

2 In the **Description** box, type **Takeoff 1A**.

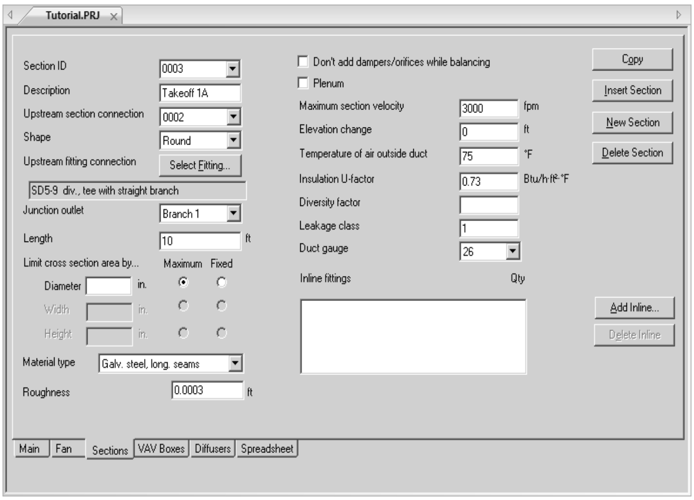
3 In the **Upstream fitting connection** box, click **Select Fitting**.

4 In the **Fitting Type** box, select **Junction**.

5 In the **Fitting** box, select **SD5-9 div., tee with straight branch**. Click OK.

6 In the **Junction Outlet** box, select **Branch 1**.

7 Check that the **Length** is **10** ft and save your entries.



Define Section 0016

1. Click **New Section**.
2. Change the **Section ID** to **0016.**
3. In the **Description** box, type **Takeoff 1A Termination**.
4. In the **Upstream section connection** box, select **0003**.
5. In the **Upstream fitting connection** box, click **Select Fitting**.
6. In the **Fitting Type** box, select **Transition**. Note that the program automatically provides the available round-to-round fitting. Click OK.
7. In the **Length** box, type **1** ft.
8. In the **Material type** box, select **Flexible, fabric and wire**. The **Roughness** box defaults to 0.01 ft. Save your entries.

Define VAV Box 1

At this point, you could define Section 0004 (or even Section 0005), but we will describe VAV Box 1 instead.

1. Click the **VAV Boxes** tab and then click **New VAV Box**. Duct Configurator fills in the default values for several fields.
2. In the **Description** box, type **Takeoff 1A terminal unit**.
3. In the **Upstream section connection** box, select **0016**.
4. Change the value in the **Cooling design airflow** box to **550** cfm.
5. Change the value in the **Inlet diameter** box to **8** in.
6. Change the value in the **VAV box SP drop at design airflow** box to **0.25** in. wg.
7. Change the value in the **Downstream SP at design airflow** box to **0.43** in. wg. The defaults for the other entries are fine for this example.

Note: You cannot define VAV Box 2 until you complete Sections 0004 and 0017.

Define Section 0004

To define Section 0004, take advantage of the fact that many of its characteristics are the same as Section 0003.

1. Click the **Sections** tab.
2. In the **Section ID** box, select section **0003**, then click **New Section**.
3. Change the **Section ID** to **0004.**
4. In the **Description** box, type **Takeoff 1B**.
5. In the **Upstream section connection** box, select **0002**. When you do, the program automatically identifies the appropriate upstream fitting connection, SD5-9 div., tee with straight branch, and narrows your choice of Junction outlet to Outlet.
6. In the **Length** box, type **45** ft.
7. Unlike the other sections defined so far, this one has an elbow. To include it in the description of Section 0004, click the **Add Inline** button.
8. In the **Fitting Type** box, select **Elbow**.
9. In the **Fitting** box, select **CD3-15, 90 deg., mitered**. Click **OK**. Notice that the elbow now appears under **Inline fittings** at the bottom right of the **Sections** worksheet. Save your work.

Define Section 0017

Section 0017 is virtually identical to Section 0016.

1. In the **Section ID** box, select **0016**.
2. Click **New Section**. The **Section ID** changes to **0017.**
3. In the **Description** box, type **Takeoff 1B Termination**.
4. In the **Upstream section connection** box, select **0004**.
5. In the **Upstream fitting connection** box, click **Select Fitting**.
6. In the **Fitting Type** box, select **Transition**. Note that the program automatically provides the available round-to-round fitting. Click OK.
7. Verify that the **Length** is **1** ft; **Material type** is **Flexible, fabric and wire;** and **Roughness** is 0.01 ft.
8. Save your entries.

Define VAV Box 2

1. Click the **VAV Boxes** tab and click **New VAV Box**.
2. In the **Description** box, type **Takeoff 1B VAV box**.
3. In the **Upstream section connection** box, select **0017**.
4. The remaining fields are fine as is. Save your entries.

Define the remaining sections

Repeat the process to define the rest of the supply duct system paths.

Use the spreadsheet to make changes

Now suppose that, for acoustic reasons, you have determined that you must change the **Maximum Section Velocity** for your system from 3000 fpm to 2500 fpm. You can make this change from the **Spreadsheet** view by using the **Copy** and **Paste** commands, as follows:

1. Click the **Spreadsheet** tab near the bottom of the **Main** worksheet.
2. Scroll to the right until you reach the **Sections** column. Double-click the cell directly below the column heading to display all of your Section worksheet entries so far.
3. Scroll to the right until you reach the **Maximum Section Velocity** column, then click the first data field (box) in that column. This box turns yellow.
4. Type **2500** in the yellow box and press **Enter**.
5. From the **Edit** menu on the toolbar, select **Copy**.
6. With the cursor still positioned on this box, click the left mouse button and hold it down. Drag downward through this column to highlight all values on it.
7. From the **Edit** menu, select **Paste**. This changes all values in the **Maximum Section Velocity** column to 2500.
8. When you are finished, save your work and then click **Previous** to return to the **Main** spreadsheet.

Note: Alternatively, you could make this change by clicking ***Advanced*** *on the right side of the* ***Main*** *worksheet, and entering the new value in the* ***Maximum Section Velocity*** *override box.*

Calculate and view reports

- On the **Main** worksheet, click **Calculate**.

  –or–

- On the **Actions** menu, click **Calculate**.

Duct Configurator performs the equal-friction duct-sizing calculations. It also creates and stores reports that record the design results, the bill of materials for ducts and fittings, and your worksheet entries. When finished performing these calculations, the application displays an **Output Reports** dialog box. Check **Project Summary** and click **Preview**.

*Note: You can view or print all the other available reports and bills of material for your system by checking the desired options in the **Output Reports** dialogue box and selecting **Preview** or **Print**.*

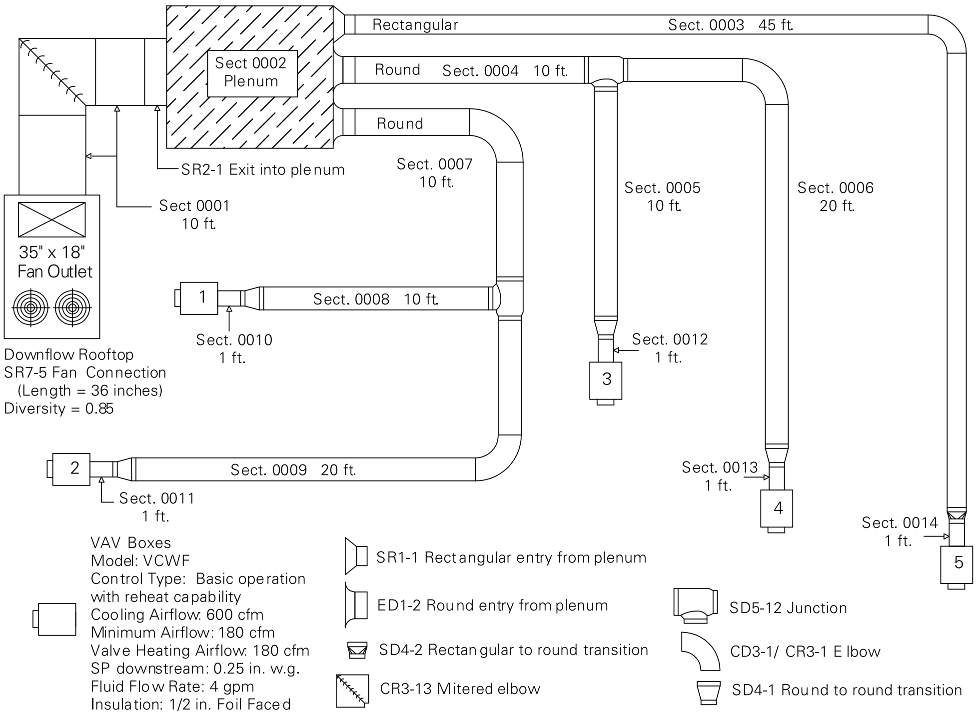
The Fan Information section of the report reveals that the system supply fan must provide a block airflow of 3740 cfm and generate 2.91 in. wg. of static pressure.

Refer to Chapter 7 for examples of each report.

Advanced tutorial

This exercise provides the opportunity for you to explore and practice using some of the more advanced features of the program.

Note: For this advanced tutorial, leave all default values as they are unless instructed otherwise.



Complete the tutorial by following the steps below.

Open a new file

- Click the **Duct Configurator** tab on the main window.

  –or–

- Click the **Duct Configurator** icon  on the toolbar.

  –or–

- On the **File** menu, click **New** and select **Duct Configurator Project.**

Set up the file

- Check the **Options** menu to make sure that the units are **English I-P** and **Auto-Copy Entries** is checked. Under **Fitting Method**, click **ASHRAE Selection**.

Define the friction rate and enable auto-balancing

For the design of this system, which has a large supply opening, you will enter a specific value for the friction rate, instead of allowing the program to calculate this value automatically.

1. On the **Main** worksheet, change **Use calculated friction rate?** to **No.**
2. In the **Friction rate per 100 ft** box, enter **0.13**.
3. Under **Optimize Design**, select the **Auto balance system** check box. This will automatically apply dampers or orifices where they are necessary to balance pressure drop for noncritical paths with that of the critical path.

Define fan characteristics

1. Click the **Fan** tab at the bottom of the **Main** worksheet.
2. In the **Diversity factor** box, enter **0.85**.
3. In the **Fan outlet shape** box, select **Rectangular**.
4. In the **Fan outlet width** box, enter **35** in.
5. In the **Fan outlet height** box, enter **18** in.
6. On the **File** menu, select **Save As**. Name your file and specify a location for it on your hard disk. Click **Save**.

Define Section 0001

1. Click the **Sections** tab, then click **New Section**. (Leave the **Section ID** as 0001.)
2. In the **Description** box, type **root through curb**.
3. In the **Upstream fitting connection** box, click **Select Fitting**.
4. In the **Fitting** box, select **SR7-5 SWSI with elbow down**.
5. In the Variables section of this same dialog box, enter **36** in. for length (defining the distance between the fan and the down elbow). Leave **Blast/Inlet** set to the default value of **0.8**. Click OK to return to your current Sections worksheet.
6. In the **Length** box, enter **10** ft.
7. Click **Add Inline**.

8 In the **Fitting type** box, select **Elbow**.

9 In the Fitting box, select **CR3-13 mitered, single thickness vanes**. Click **OK**.

Define the plenum section

1 Click **New Section**. (Leave the **Section ID** as **0002**.)

2 In the **Description** box, type **plenum**.

3 On the **Options** menu, point to **Fitting Method** and click **Lowest Friction**. In order to increase input speed, you have just enabled the program to automatically select the fitting with the lowest loss—within the fitting category you specify—for each section.
*(Note: You can change fitting input methodology at any time during your input process. To select a fitting other than the one the current program methodology selects, simply return to the **Options** menu, change the **Fitting Method**, and assign the fitting you require.)*

4 In the **Upstream section connection** box, select section **0001**.

5 Check the **Plenum** box (in the right column).

6 In the **Upstream fitting connection box,** select **Exit**. The program automatically enters **SR2-1 abrupt exit**.

Define Section 0003

1 Click **New Section.** (Leave the **Section ID** as **0003**.)

2 In the **Description** box, type **rectangular entry from plenum**.

3 In the **Upstream section connection** box, select section **0002**.

4 In the **Upstream fitting connection** box, select **Entry** (because this connection re-enters the ductwork from the plenum). Because you have enabled the Lowest Friction fitting input methodology, the program automatically provides the fitting **SR1-1 conical bellmouth from plenum**.

5 In the **Length** box, enter **45** ft.

6 Click **Add Inline**.

7 In **Fitting type** box, select **Elbow**.

8 In the **Fitting** box, select **CR3-1 smooth radius without vanes**.

9 Click **OK** to return to the **Sections** worksheet.

Define Section 0004

1 Click **New Section**. (Leave the **Section ID** as **0004**.)

2 In the **Description** box, type **round entry from plenum**.

3 In the **Upstream section connection** box, select section **0002**.

4 In the **Shape** box, select **Round**.

5 In the **Upstream fitting connection** box, select **Entry** (because this connection also re-enters the ductwork from the plenum). The program automatically provides the fitting **ED1-2 bellmouth**.

6 In the **Length** box, enter **10** ft.

Define Section 0005

1 Click **New Section**. (Leave the **Section ID** as **0005**.)

2 In the **Description** box, enter an appropriate description.

3 In the **Upstream section connection** box, select section **0004**.

4 In the **Upstream fitting connection** box, select **90 degree tee**. The program automatically provides the fitting **SD5-12 div., tee w/45 deg. entry branch**.

5 In the **Junction outlet** box, select **Branch 1**.

6 Leave other default values as they are, and leave the **Length** at 10 ft.

Define sections 0006 through 0009

Use the skills you have acquired to define sections 0006 through 0009.

Define section 0010

1 Click **New Section**. (Leave the **Section ID** as **0010**.)

2 In the **Description** box, type **Takeoff termination**.

3 In the **Upstream section connection** box, select section **0008**.

4 In the **Upstream fitting connection** box, select **Transition**. The program automatically provides the fitting **SD4-1 round to round**.

5 In the **Length** box, enter **1** ft.

Define sections 0011 through 0014

Remember to save your work frequently.

Define the first VAV box for this system

1 Click the **VAV Boxes** tab at the bottom of the current worksheet.

2 Click **New VAV Box**.

3 In the **Description** box, type **takeoff section 0010**.

4 In the **Upstream section connection** box, select section **0010**.

5 Click **Trane**. A new set of options appears.

6 In the **Model** box, select **Single duct with VCWF**. You will see that several input fields become red, and others become white. All red fields are required. *(Note: You can access extensive information on Trane VAV box selections at any time, including terminology used, limits for the various fields, dynamic links between the input fields, and explanations of error messages. Simply press the F1 key or use the Help drop-down menu.)*

7 In the **Control type** box, select **UC400DDC-Basic (water heat - Modulating)**.

8 In the **Cooling design** box, type **600** cfm.

9 In the **Cooling minimum** box, type **180** cfm. Notice that, when you move to the next entry, the program automatically sets **Valve heating** to **180** cfm also.

10 In the **Flow rate** box (in the **Fluid** section), type **4** gpm.

11 In the **Insulation** box (bottom of the right column), select **½” foil faced**.

Define the remaining VAV boxes

Because all information other than the upstream connection is the same for VAV boxes 002 through 0005, you can quickly define the remaining VAV boxes. For each, click **Copy** and then assign the proper **Upstream section connection**. The program automatically completes the other required fields.

Calculate and view reports

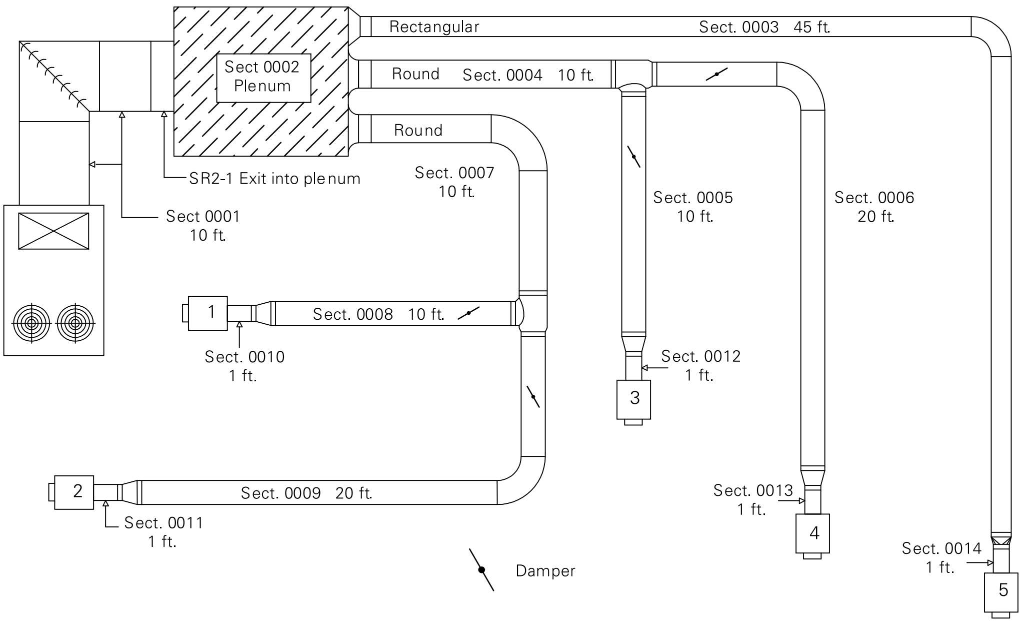
Click **Calculate**, and then **Yes** when asked whether you wish to save your file before the program performs calculations. The program quickly performs duct-sizing calculations for all sections, records all your worksheet entries, and creates several reports. These reports include useful summaries of your system design, as well as bills of material for both ducts and fittings.

To view the Project Summary report:

1 When calculations are complete, click **OK** in the dialog box identifying the number of fittings that have been added.

2 In the Output Reports dialog box, check **Project Summary** and select **Preview** (to view the report on your screen), or **Print**.

The Project Summary Report for this system indicates that the fan must supply a block fan airflow of 2550 cfm and static pressure of 2.89 in. wg.



Note: Because the Auto balance feature was enabled, the duct system has been completely balanced with dampers as shown above.

5 Ductulator

Ductulator™ simplifies the manual process of sizing ductwork based on equal-friction methodology. It computes the friction rate or pressure drop in a particular duct so that you can specify an appropriate nominal size**.** Or given a nominal size, it can compute pressure loss in a duct.

A brief overview...

To get started, describe the physical characteristics of the duct and specify two performance parameters (typically airflow and maximum velocity), and the program will calculate the friction rate and dimensions. With that information, you can enter a nominal duct size that approximates the calculated value(s) and let the program determine the new friction rate and maximum velocity. Ductulator lets you analyze friction losses through supply, exhaust, or return duct fittings.

Required entries

Ductulator requires the following information:

Required entries	**Plus any two of these variables …**
Duct Shape	Airflow
Material Type	Friction Rate
Roughness	Velocity
Duct ID	Dimension(s)
Length	

Note: To use a different variable, delete one of your entries and enter a new value. The program will calculate the other two.

For a round duct, enter the **Diameter** *plus* **Airflow** or **Friction Rate** or **Velocity.**

For a rectangular or oval duct, either:

- Enter the **Height** and **Width** *plus* **Airflow** or **Friction Rate** or **Velocity**. These entries can be made in any order.

  –or–

- Enter one dimension (either **Height** or **Width**) *plus* two other variables from among **Airflow**, **Friction Rate**, and **Velocity**. This method fixes the duct height or width *if* you enter that value before completing the other entries.

Equation methodology

Equivalent-by-flow equation

The following "equivalent diameter" equations are based on equal airflow, resistance, and length.

Rectangular ducts …

$$D_e = \frac{1.3(h \text{ ¥ } w)^{0.625}}{(h + w)^{0.25}}$$

Flat oval ducts …

$$D_e = \frac{1.55\left[\frac{\pi b^2}{4} + b(a - b)\right]^{0.625}}{(\pi b + 2(a - b))^{0.25}}$$

where …

- D_e=diameter equivalent by flow, in inches (in.) or millimeters (mm)
- h=height of rectangular duct, in inches (in.) or millimeters (mm)
- w=width of rectangular duct, in inches (in.) or millimeters (mm)
- a=major axis of flat oval duct, in inches (in.) or millimeters (mm)
- b=minor axis of flat oval duct, in inches (in.) or millimeters (mm)

Equivalent-by-friction equation

The following "equivalent diameter" equations are based on an equal pressure loss per unit of length:

Rectangular ducts …

$$D_h = \frac{2(h \times w)}{h + w}$$

Flat oval ducts …

$$D_h = \frac{4\left[\frac{\pi b^2}{4} + b(a - b)\right]}{\pi b + 2(a - b)}$$

where …

- D_h=diameter equivalent by friction, in inches (in.) or millimeters (mm)

Equivalent-by-velocity equation

The following "equivalent diameter" equations are based on an equal cross-sectional area:

Rectangular ducts …

$$D_v = 2\left(\frac{h \times w}{\pi}\right)^{0.5}$$

Flat oval ducts …

$$D_v = 2\left(\frac{\frac{\pi b^2}{4} + b(a - b)}{\pi}\right)^{0.5}$$

where …

- D_v=diameter equivalent by velocity, in inches (in.) or millimeters (mm)

Air density equation

The program solves these equations to determine air density:

I-P …

$$BP = 407.19 \text{¥} (1 - (6.875 \text{¥} 10^{-6}) \text{¥} z)^{5.26}$$

$$\rho = \frac{BP}{10.266(DB + 460)}$$

SI …

$$BP = 101.325 \text{¥} (1 - (2.2557 \text{¥} 10^{-5}) \text{¥} z)$$

$$\rho = \frac{BP}{0.287(DB + 273)}$$

where …

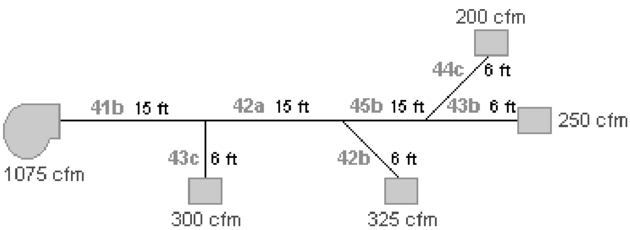
- *BP*=barometric pressure, in inches water gauge (in. H_2O) or kilo Pascals (kPa)
- *z*=elevation, in feet (ft) or meters (m)
- *DB*=dry bulb temperature, in degrees Fahrenheit (°F) or degrees Centigrade (°C)
- ρ=density, in pounds mass per cubic foot (lbm/ft^3) or kilograms per cubic meter (kg/m^3)

Tutorial

The following tutorial demonstrates a common application for Ductulator: identifying appropriate nominal duct sizes based on the equal-friction duct-sizing methodology.

Scenario

The schematic below illustrates a simple duct system that must be sized to handle 1075 cfm. Determine the friction rate of the root section based on a maximum velocity of 1200 fpm. Then determine the proper nominal size for the remaining duct sections, using the root-section friction rate as the target.



Solution

Start VariTrane Duct Designer and initiate your new project by doing one of the following:

Open a new file

- Click the **Ductulator** tab on the main window.

  –or–

- Click the **Ductulator** icon  on the toolbar.

  –or–

- On the **File** menu, click **New** and select **Ductulator File.**

To find the target friction rate for the system, begin with the root section.

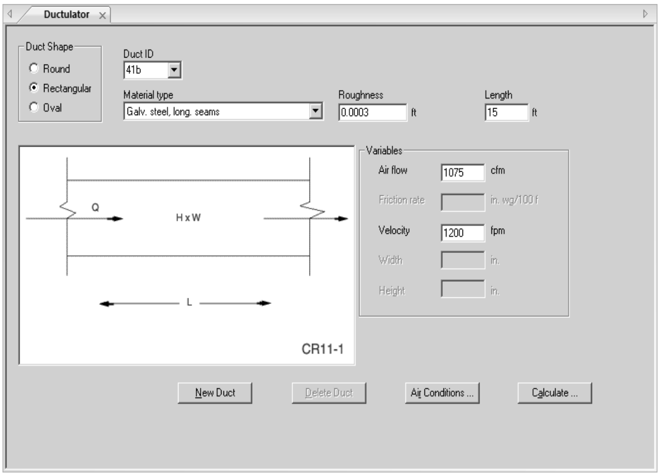
1 Select **Rectangular** for the **Duct Shape**.

2 In the **Duct ID** box, enter **41b**.

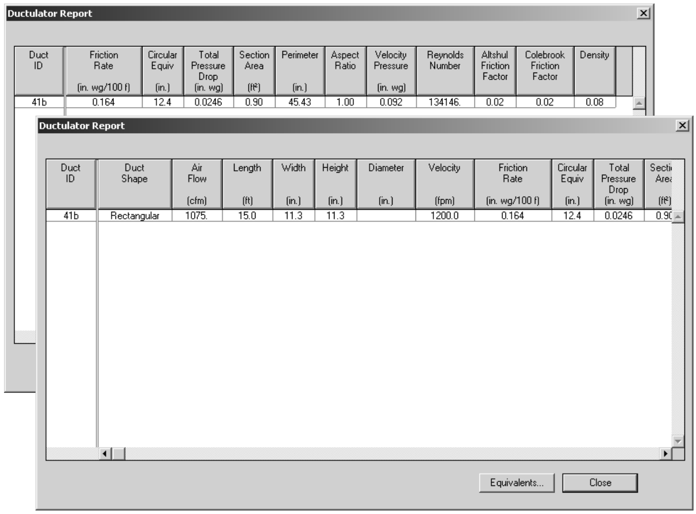
3 Complete these required entries:

Required entries	**Select or type:**
Material Type	Galv. steel, long. seams
Roughness	0.0003
Length	15 ft
Airflow	1075 cfm
Velocity	1200 ft/min

When finished, your screen should look like this:



4 Click **Calculate**. When you do, Ductulator automatically calculates the performance characteristics of the root section and displays the results in a spreadsheet format. The report contains more columns than the screen can display at one time, so use the horizontal scroll bar to bring the other performance information into view. Click **Close** to return to the main Ductulator window.



5 With 41b still displayed as the **Duct ID**, delete the **Velocity** value. Then change the **Height** and **Width** entries to nominal sizes that approximate the values calculated by the program. In this case, use **12** for both dimensions.

6 Click **Calculate** and locate the resulting friction rate in the Ductulator report. The displayed value, 0.125 in. H_2O/100 ft, is the target friction rate for sizing the other duct sections. Click **Close** to exit the report.

Size Section 43c

1 Click **New Duct** at the bottom of the screen. Notice that the characteristics of the previous section become the default values for this one.

2 In the **Duct ID** box, enter **43c.**

3 In the **Length** box, enter **6** ft.

4 In the **Airflow** box, enter **300** cfm.

5 In the **Friction rate** box, enter **0.125**.

Size the remaining sections

1 Click **New Duct.**

2 Refer to the schematic to complete the entries for each duct section.

*Note: If the **Auto Copy Duct** option is on, the application automatically copies the friction rate from the previous section. You need only enter values for **Duct ID**, **Length**, and **Airflow**.*

Calculate

1. Click **Calculate** to display the performance and dimensions computed for each duct section. Notice that none of the section dimensions (except for those of the root section) are a nominal duct size. Click **Close**.
2. Beginning with section 43c, delete the value in the **Friction rate** box, and change the **Height** and **Width** values calculated by the program to nominal sizes.
3. Do the same for the remaining sections.
4. Click **Calculate** at any time to display the effects of your changes.
5. Click **Save** to name and store your project.

Each section of this simple duct system is now properly sized based on the equal-friction method.

Refer to Chapter 7 for an example of the Ductulator report.

6 Fitting Loss Calculator

Fitting Loss Calculator computes the total pressure drop of a fitting based on its configuration, dimensions, and the airflow passing through it. The application bases its calculations on an extensive library of fittings originating from United McGill and ASHRAE's 1993 duct fitting database.

Fitting Loss Calculator computes total pressure performance for supply, exhaust, or return duct fittings. VariTrane Duct Designer gives you two ways to use Fitting Loss Calculator:

- Within Duct Configurator, to add and size inline fittings using the Sections worksheet.
- By itself, to compare fitting efficiencies.

The only difference between these operating modes is the number of entries needed: Duct Configurator automatically passes relevant information about the duct section to Fitting Loss Calculator.

A brief overview...

Describe the fitting(s) and applicable air conditions, and the application calculates:

- Velocity at the inlet(s) and/or outlet(s)
- Velocity pressure at the inlet(s) and/or outlet(s)
- Total pressure drop at the inlet(s) and/or outlet(s)
- Loss coefficient at the inlet(s) and/or outlet(s)

Tutorial

The following exercise demonstrates how you can compare the total pressure performance of various duct fittings to optimally balance the efficiency and cost of your duct system designs.

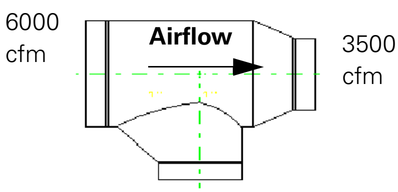
Scenario

One section of a noncritical supply duct path presently calls for an SD5-12 junction. At this point in the design process, 6000 cfm of air enters the junction, 2500 cfm of air leaves the junction through the branch, and 3500 cfm of air leaves through the outlet. The relevant diameters are:

- **18** inches for the common inlet,
- **16** inches for the system outlet, and
- **12** inches for the branch.

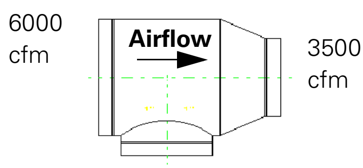
Compare the performance of junction SD5-12 with that of the less expensive SD5-9.

SD5-12



Branch
2500 cfm

SD5-9



Branch
2500 cfm

Solution

To compare the performance of junction SD5-12 to SD5-9, complete the following steps.

Open a new file

- Click the **Fitting Loss Calculator** tab on the main window.

  –or–

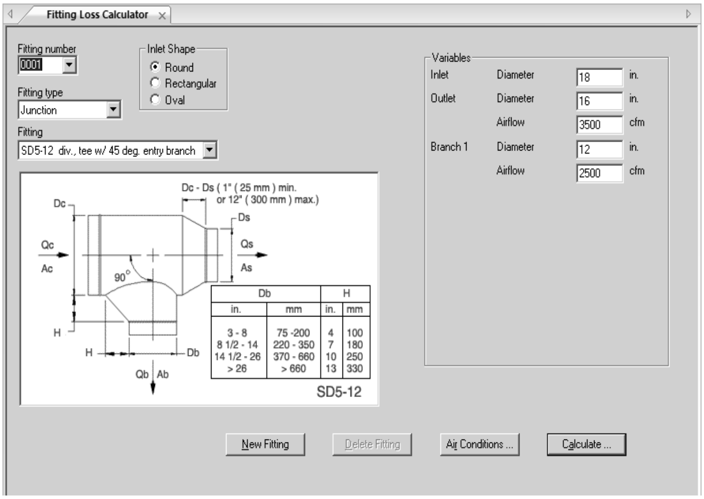
- Click the **Fitting Loss Calculator** icon  on the toolbar.

  –or–

- On the **File** menu, click **New** and select **Fitting Loss Calculator File.**

Define SD5-12

1. In the **Inlet Shape** section, click **Round**.
2. In the **Fitting type** box, select **Junction**.
3. In the **Fitting** box, select **SD5-12**.
4. Refer to the scenario and enter the appropriate diameter and airflow values. When finished, your screen should look like this:



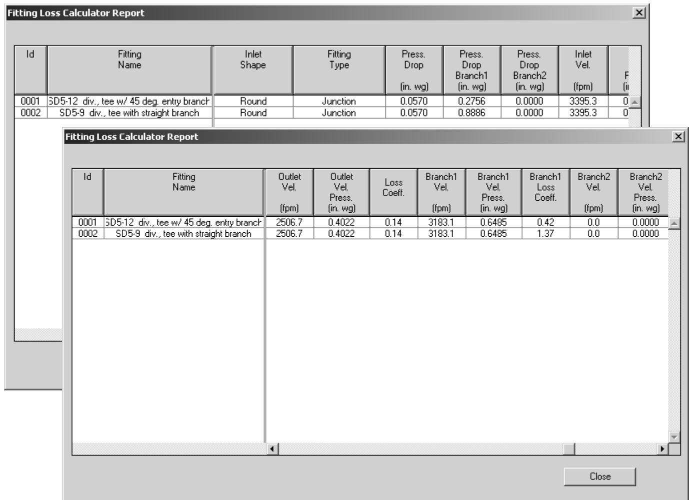
Define SD5-9

1. Click **New Fitting** at the bottom of the screen.
2. In the **Fitting** box, select **SD5-9**.

3 Refer to the scenario and enter the appropriate diameter and airflow values.

Calculate and compare

1 Click **Calculate**. When you do, the Fitting Loss Calculator automatically calculates the total pressure performance of each fitting and displays the results in a spreadsheet format, as shown below. The report contains more columns than the screen can display at one time, so use the horizontal scroll bar to bring the other performance information into view.



2 Click **Close** to return to the main Fitting Loss Calculator window. To name and store your project, click **Save**.

Because the velocity pressure drop is the same for both fittings, notice that the SD5-9 fitting imposes an additional static pressure loss of 0.61 in. wg. through the branch, which reflects the same additional loss in total pressure.

Which junction is the “right” choice? That depends. If pressure loss in this path is to be minimized, the more efficient (but more expensive) SD5-12 fitting may be preferable. Otherwise, the less expensive (but less efficient) SD5-9 fitting may be adequate.

Refer to Chapter 7 for an example of the Fitting Loss Calculator report.

7 Reports

Each VariTrane Duct Designer application generates one or more reports that can be previewed on screen or printed.

Duct Configurator Reports:

Entered Values	**Design Results**
Sections	Project Summary
Diffusers	Sections
VAV Boxes	Diffusers
Trane Selection Data	VAV Boxes
Bill of Materials	Trane Selection Data
Sections	Trane Accoustical Data
Fittings	Runout Analysis

Ductulator Report

Fitting Loss Calculator Report

Examples of each type can be found on the following pages.

Project Summary

Advanced Tutorial

Project Information:

Location	Anytown, USA
Building Owner	John Q. Customer
Program User	Trane
Company	Distributor, Inc.
Comments	This tutorial allows you to explore and use some of the advanced features of the Duct Configurator application

System Information:

Calculation Method	Equal Friction
Friction Rate	0.13
Correct For Leakage?	NO
Correct For Thermal Losses/Gains?	NO
Auto-Balance?	YES
Resize Non-Critical Paths?	NO

Air Conditions:

Elevation	0.00 ft
Dry-Bulb Temperature	55.00 °F
Air Density	0.077 lb/cu ft

Fan Information:

Total VAV Box/Diffuser Airflow (As Entered)	3,000 cfm
Peak Fan Airflow (Including Leakage and Thermal Changes)	3,000 cfm
Block Fan Airflow (Including Leakage and Thermal Changes)	2,550 cfm
Diversity Factor	0.85
Fan Outlet Shape	Rectangular
Fan Outlet Dimensions	
Width	35.00 in.
Height	18.00 in.
Discharge Velocity	582.86 fpm
Fan Static Pressure (At Sea Level)	2.89 in. wg
Fan Static Pressure (At Altitude)	2.89 in. wg
Static Pressure Through Equipment and Return (At Sea Level)	2.00 in. wg
Static Pressure Through Equipment and Return (At Altitude)	2.00 in. wg
Leakage Airflow	0.00 cfm
Thermal Losses/Gains Airflow	0.00 cfm

File: C:\Users\cds\Documents\VariTrane Duct Designer Projects\Advanced Tutorial.prj

VariTrane™ Duct Designer 4.1 calculated at 9:55:11AM on 03/21/2012
Project Summary Report Page 1 of 1

Entered Values: Sections

Section ID	Description	Upstream Section ID	Number Of Inline Fittings	Junction Outlet	Shape	Length ft	Max Velocity fpm	Air Temp. Outside Duct °F	Insulation Btu/h·ft²·°F	Diversity	Elevation Change ft	Material	Roughness ft	Gauge	Leakage Class
0001		Fan	1	Outlet	Rectangular	10.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0002	plenum	0001			Plenum										
0003	rectangular	0002	1	Outlet	Rectangular	45.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0004	round	0002		Inlet	Round	10.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0005		0004		Branch 1	Round	10.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0006		0004	1	Outlet	Round	20.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0007	round II	0002	1	Inlet	Round	10.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0008		0007		Branch 1	Round	10.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0009		0007	1	Outlet	Round	20.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0010	takeoff1	0008		Outlet	Round	1.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0011	takeoff2	0009		Outlet	Round	1.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0012	takeoff3	0005		Outlet	Round	1.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0013	takeoff4	0006		Outlet	Round	1.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1
0014	takeoff5	0003		Outlet	Round	1.0	3,000	75.00	0.73			Galv. steel, long. seams	0.0003	26	1

Number Of Sections Specified For This System: 14

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:42:00AM on 1/9/2012
Entered Values: Sections Report Page 1 of 1

Entered Values: Diffusers

Diffuser ID	Description	Upstream Section	Inlet Size in.			Diffuser Airflow cfm	Required Inlet SP in. wg	Design Supply Air Temp. °F	Thermostat Cooling Setpoint °F
			H	W	D				
0001	Takeoff 1 Diffuser	0016			6	550	0.1000	55.0	75.0
0002	Takeoff 2 Diffuser	0017			6	550	0.1000	55.0	75.0

Number Of Diffuser Units Specified For This System: 2

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\diffuser.PRJ

VariTrane™ Duct Designer 4.1 calculated at 10:11:24AM on 1/9/2012
Entered Values: Diffusers Report Page 1 of 1

Entered Values: VAV Boxes

VAV Box ID	Description	Upstream Section ID	VAV Box Type	Inlet Size in. H	Inlet Size in. W	Inlet Size in. D	Airflow cfm	Box SP Loss in. wg	Downstream SP in. wg	Design Supply Air Temp. °F	Thermostat Cooling Setpoint °F
0001	Takeoff0010	0010	Trane			8	600	0.3415	0.2500	55.0	75.0
0002	takeoff0011	0011	Trane			8	600	0.3415	0.2500	55.0	75.0
0003	takeoff0012	0012	Trane			8	600	0.3415	0.2500	55.0	75.0
0004	takeoff0013	0013	Trane			8	600	0.3415	0.2500	55.0	75.0
0005	takeoff0014	0014	Trane			8	600	0.3415	0.2500	55.0	75.0

Number Of VAV Boxes Specified For This System: 5

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:43:06AM on 1/9/2012
Entered Values: VAV Boxes Report Page 1 of 1

Entered Values: Trane® Selection Data

Units Of Measure:

Airflows: cfm	Velocity: fpm
Inlet Dimensions: in.	Heating Capacity: hp
Temperatures: °F	Fluid Flow: gpm

Box ID:	0001	0002	0003	0004	0005
Description:					
Upstrm Section ID:	0010	0011	0012	0013	0014
Unit Model:	Single duct v	Single duct v	Single duct v	Single duct v	Single duct v
Control Type:	UC400 DDC-Basic (Water heat-	UC400 DDC-Basic (Water heat-	UC400 DDC-Basic (Water heat-	UC400 DDC-Basic (Water heat-	UC400 DDC-Basic (Water heat-
Primary Inlet Size:					
Design Clg Airflow:	600.00	600.00	600.00	600.00	600.00
Min Clg Airflow:	180.00	180.00	180.00	180.00	180.00
Max Inlet Velocity:					
Room Clg Setpoint:	75.00	75.00	75.00	75.00	75.00
Room Htg Setpoint:	68.00	68.00	68.00	68.00	68.00
Fan Airflow:					
Fan Size:					
Motor Voltage:					
Max NC:					
Insulation:					
Coil Htg Capacity:					
Fluid Flow Rate:	4.00	4.00	4.00	4.00	4.00
Coil DeltaT:					
Unit EWT:	180.00	180.00	180.00	180.00	180.00
Unit LAT:					
Electric Htr Voltage:					
Electric Htr kW:					
Electric Htr Stages:					
Valve Htg Airflow:	180.00	180.00	180.00	180.00	180.00
Downstream SP:	0.25	0.25	0.25	0.25	0.25

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:43:38AM on 1/9/2012
Entered Values: Trane Selection Data Report Page 1 of 1

Design Results: Sections

Section ID	Critical Path	Upstream Section ID	Length ft	Shape	Dimensions: in. W	H	D	Optimized[1] Equiv. Diameter	Airflow cfm	Leakage Airflow cfm	Temp. Change In Section °F	Velocity fpm	Section Outlet SP in. wg	Static ** Pressure Drop in. wg	Total ** Pressure Drop in. wg	Inline Fittings Qty Elbows	Dampers/ Orifices	Others
0001	*	Fan	10	Rectangular	35	18		Fixed	2,550			583	0.8689	0.0171	0.0171	1		
0002	*	0001	0	Plenum				Fixed					0.8470	0.0219				
0003		0002	45	Rectangular	10	10		10.73	600			864	0.7615	0.0854	0.0594	1		
0004		0002	10	Round			14	13.90	1,128			1,055	0.7841	0.0628	0.0133			
0005		0004	10	Round			12	10.73	600			764	0.7814	0.0027	0.0366			
0006		0004	20	Round			12	10.73	600			764	0.7861	-0.0020	0.0319	1		
0007	*	0002	10	Round			14	13.90	1,128			1,055	0.7763	0.0707	0.0212	1		
0008	*	0007	10	Round			12	10.73	600			764	0.7735	0.0027	0.0366			
0009		0007	20	Round			12	10.73	600			764	0.7783	-0.0020	0.0319	1		
0010	*	0008	1	Round			8	Fixed	600			1,719	0.5915	0.1821	0.0303			
0011		0009	1	Round			8	Fixed	600			1,719	0.5962	0.1821	0.0303			
0012		0005	1	Round			8	Fixed	600			1,719	0.5993	0.1821	0.0303			
0013		0006	1	Round			8	Fixed	600			1,719	0.6040	0.1821	0.0303			
0014		0003	1	Round			8	Fixed	600			1,719	0.6028	0.1587	0.0174			

*** Denotes Critical Path** **Number Of Sections Specified For This System: 14**

**** Upstream Fitting included In The Pressure Drop**

1 Optimized Equivalent Round Size Caculated Based On User Selected Sizing Method With No Sizing Restrictions Applied

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:45:56AM on 1/9/2012

Design Results: Sections Report Page 1 of 1

Design Results: Diffusers

Diffuser ID	Description	Upstream Section ID	Inlet Size in. H	W	D	Airflow cfm	SP Available At Inlet in. wg	Supply Air Temp. °F
0001	Takeoff 1 Diffuser	0016			6			55.0
0002	Takeoff 2 Diffuser	0017			6			55.0

*** Denotes Critical Path**

Number of Diffusers Specified For This System: 2

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\diffuser.PRJ

VariTrane™ Duct Designer 4.1 calculated at 10:12:49AM on 1/9/2012

Design Results: Diffusers Report Page 1 of 1

Design Results: VAV Boxes

VAV Box ID	Description	Upstream Section ID	Box Type	Inlet Size in. H	W	D	Airflow cfm	Box SP Loss in. wg	Downstream SP in. wg	Supply Air Temp. °F
0001 *	Takeoff0010	0010	Trane			8	600	0.3415	0.2500	55.00
0002	takeoff0011	0011	Trane			8	600	0.3415	0.2500	55.00
0003	takeoff0012	0012	Trane			8	600	0.3415	0.2500	55.00
0004	takeoff0013	0013	Trane			8	600	0.3415	0.2500	55.00
0005	takeoff0014	0014	Trane			8	600	0.3415	0.2500	55.00

*** Denotes Critical Path**

Number Of VAV Boxes Specified For The System: 5

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:46:41AM on 1/9/2012

Design Results: VAV Boxes Report Page 1 of 1

Design Results: Trane® Selection Data

General Information								Fan Information					Heating Information									
VAV Box ID	Uptream Section ID	Unit Model	Primary Inlet Size in.	Design Cooling Airflow cfm	Min Cooling Airflow cfm	Box SP Loss At Cooling Airflow cfm	Downstrm SP in. wg	Fan Size	Fan Airflow cfm	Fan Total SP in. wg	Motor Voltage	Fan Power MBh	Valve Heating Airflow cfm	Unit LAT °F	Coil Heating Capacity MBh	Fluid Flow Rate gpm	Main Coil Type	Coil Fluid PD ft wg	Electric Heater Voltage	Electric Heater KW	Electric Heater Stages
0001	0010	t with hot	8.00	600	180	0.3415	0.25						180	138.9	16.37	4.0	2 row	1.1	None	0.0	None
0002	0011	t with hot	8.00	600	180	0.3415	0.25						180	138.9	16.37	4.0	2 row	1.1	None	0.0	None
0003	0012	t with hot	8.00	600	180	0.3415	0.25						180	138.9	16.37	4.0	2 row	1.1	None	0.0	None
0004	0013	t with hot	8.00	600	180	0.3415	0.25						180	138.9	16.37	4.0	2 row	1.1	None	0.0	None
0005	0014	t with hot	8.00	600	180	0.3415	0.25						180	138.9	16.37	4.0	2 row	1.1	None	0.0	None

Number of Trane VAV Boxes Specified For This System: 5

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:47:09AM on 1/9/2012
Design Results: Trane Selection Data Report Page 1 of 1

Design Results: Trane® Acoustical Data

VAV Box ID	Upstream Section ID	Unit Model	Primary Inlet Size in.	Fan Size	Airflow cfm	Max Inlet SP in. wg	Discharge Fan Sound Per Octave Band 63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	NC	Radiated Fan Or Fan/Valve Sound Per Octave Band 63 Hz	125 Hz	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz	8K Hz	NC
0001	0010	with hot	8.00		600	0.75	0	65	64	57	54	53	57	0	**22.**	0	56	52	50	47	53	51	0	**25.**
0002	0011	with hot	8.00		600	0.75	0	65	64	57	54	53	57	0	**22.**	0	56	52	50	47	53	51	0	**25.**
0003	0012	with hot	8.00		600	0.75	0	65	64	57	54	53	57	0	**22.**	0	56	52	50	47	53	51	0	**25.**
0004	0013	with hot	8.00		600	0.75	0	65	64	57	54	53	57	0	**22.**	0	56	52	50	47	53	51	0	**25.**
0005	0014	with hot	8.00		600	0.75	0	65	64	57	54	53	57	0	**22.**	0	56	52	50	47	53	51	0	**25.**

Number Of Trane VAV Boxes Specified For This System: 5

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:47:32AM on 1/9/2012
Design Results: Trane Acoustical Data Report Page 1 of 1

Bill Of Materials: Sections

	Material Type	Quantity	Diameter in.	Width in.	Height in.	Length ft	Surface Area ft²	Weight lb	Gauge
Others									
SUBTOTAL		1							
GRAND TOTALS:				**0.0**	**0.0**	**0.00**	**0.00**	**0.00**	
ROUND DUCTS:									
	Galv. steel, long. seams		8						26
SUBTOTAL		5				5.00	10.47	9.49	
	Galv. steel, long. seams		12						26
SUBTOTAL		4				60.00	188.50	170.78	
	Galv. steel, long. seams		14						26
SUBTOTAL		2				20.00	73.30	66.41	
GRAND TOTALS:				**0.0**	**0.0**	**85.00**	**272.27**	**246.68**	
RECTANGULAR DUCTS:									
	Galv. steel, long. seams			35 10	18 10				26
SUBTOTAL		2				55.00	238.33	215.93	
GRAND TOTALS:				**45.0**	**28.0**	**55.00**	**238.33**	**215.93**	

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:44:17AM on 1/9/2012
Bill Of Materials: Sections Report Page 1 of 1

Bill Of Materials: Fittings

Quantity	Type	Description	Inlet: in. D	Inlet: in. W	Inlet: in. H	Outlet: in. D	Outlet: in. W	Outlet: in. H	Branch 1: in. D	Branch 1: in. W	Branch 1: in. H	Branch 2: in. D	Branch 2: in. W	Branch 2: in. H	Upstream* Section ID	Angle/ Diameter
3	Elbow	CD3-1 90 deg., die-stamped, r/D=1.5														
			12			12									0006	
			14			14									0007	
			12			12									0009	
1	Elbow	CR3-1 smooth radius without vanes														
				10	10		10	10							0003	
1	Elbow	CR3-13 mitered, single thickness vanes														
				35	18		35	18							0001	
2	Entry	ED1-2 bellmouth														
				35	18			14							0002	
				35	18			14							0002	
1	Entry	SR1-1 conical bellmouth from plenum														
				35	18		10	10							0002	
1	Exit	SR2-1 abrupt exit														
				35	18		35	18							0001	
2	Junction	SD5-12 div., tee w/ 45 deg. entry branch														
			14			12			12						0004	
			14			12			12						0007	
4	Transition	SD4-1 round to round														
			12			8									0006	90.00
			12			8									0005	90.00
			12			8									0009	90.00
			12			8									0008	90.00
1	Transition	SD4-2 rectangular to round														
				10	10			8							0003	11.42

Number Of Fittings Specified For This System: 16
*** Inline Fittings List The Duct Section They Reside In.**

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:44:36AM on 1/9/2012
Bill Of Materials: Fittings Report Page 1 of 1

Design Results: Static Pressure Runout Analysis

VAV Box ID	Upstream Section ID	SP Available in. wg	SP Required in. wg	Box SP Loss in. wg	Downstream SP in. wg	Static Over-Pressurization in. wg	Orifice Diameter in.	Damper Angle °ang	Distance From Fan ft
0001 *	0010	0.5915	0.5915	0.3415	0.2500				32.0
0002	0011	0.5962	0.5915	0.3415	0.2500	0.0047			42.0
0003	0012	0.5993	0.5915	0.3415	0.2500	0.0078			32.0
0004	0013	0.6040	0.5915	0.3415	0.2500	0.0126			42.0
0005	0014	0.6028	0.5915	0.3415	0.2500	0.0114			57.0

*** Denotes Critical Path**

Number Of VAV Boxes Specified For This System: 5

File: C:\Documents and Settings\cds\Desktop\Duct\Tutorials\advancedtutorial.PRJ

VariTrane™ Duct Designer 4.1 calculated at 9:47:58AM on 1/9/2012
Design Results: Static Pressure Runout Analysis Report Page 1 of 1

Ductulator®

VariTrane™ Duct Designer

Duct ID	Airflow cfm	Length ft	Width in.	Height in.	Diameter in.	Velocity fpm	Friction Rate in. wg/100 f	Circular Equivalent in.	Pressure Drop in. wg	Section Area ft²	Perimeter in.	Aspect Ratio	Reynolds Number	Altshul Friction Factor	Cole-Brook Friction Factor	Density lb/cu ft
41b	1,075	15.0	12.0	12.0		1,075.00	0.125	13.2	0.0188	1.00	48.0	1.00	126,967	0.02	0.02	0.077
42a	775	15.0	10.6	10.6		988.41	0.125	11.6	0.0187	0.78	42.5	1.00	103,372	0.02	0.02	0.077
42b	325	6.0	7.7	7.7		791.88	0.125	8.4	0.0075	0.41	30.8	1.00	59,918	0.02	0.02	0.077
43b	250	6.0	7.0	7.0		740.40	0.125	7.6	0.0075	0.34	27.9	1.00	50,814	0.02	0.02	0.077
43c	300	6.0	7.5	7.5		775.82	0.125	8.2	0.0075	0.39	29.8	1.00	56,980	0.02	0.02	0.077
44c	200	6.0	6.4	6.4		699.08	0.125	7.0	0.0075	0.29	25.7	1.00	44,163	0.02	0.02	0.077
45b	450	15.0	8.7	8.7		860.53	0.125	9.5	0.0187	0.52	34.7	1.00	73,498	0.02	0.02	0.077

Number of Duct Sections Specified: 7

VariTrane™ Duct Designer 4.1 calculated at 11:37:02AM on 03/21/2012
Ductulator Report Page 1 of 1

Fitting Loss Calculator

VariTrane™ Duct Designer

Fitting Number	Fitting Type	Description	Angle / Length in. / Dia. in.		Width in.	Height in.	Diameter in.	Airflow cfm	Velocity fpm	Velocity Pressure in. wg	Loss Coefficient	Total Pressure Loss in. wg
0001	Junction	SD5-12 div., tee w/ 45 deg. entry branch		Inlet			18	6,000	3,395	0.7378		
				Outlet			16	3,500	2,507	0.4022	0.14	0.0570
				Branch 1			12	2,500	3,183	0.6485	0.43	0.2756
				Branch 2								
0002	Junction	SD5-9 div., tee with straight branch		Inlet			18	6,000	3,395	0.7378		
				Outlet			16	3,500	2,507	0.4022	0.14	0.0570
				Branch 1			12	2,500	3,183	0.6485	1.37	0.8886
				Branch 2								

Number Of Fittings Specified For This System: 2

File: C:\Users\cds\Documents\VariTrane Duct Designer Projects\Fitting Loss Calculator.FLC

VariTrane™ Duct Designer 4.1 calculated at 11:18:22AM on 03/21/2012
Project Summary Report Page 1 of 1

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