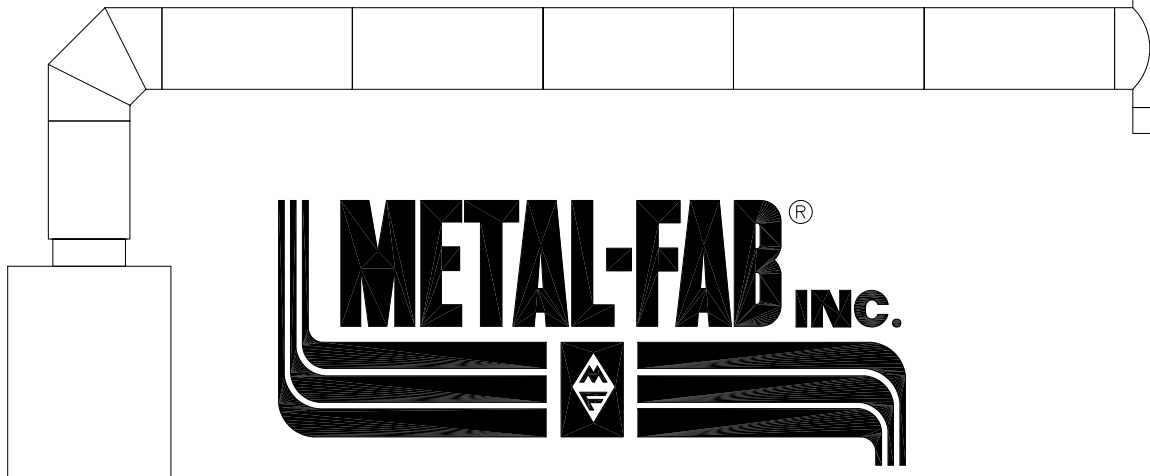
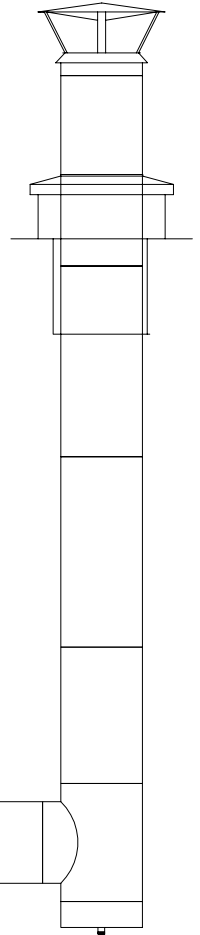


# METAL-FAB

## CHIMNEY SIZING PROGRAM

### INSTRUCTION MANUAL



### Introduction/Overview

Metal-Fab Sizing Program is software specifically designed to assist an engineer in the task of sizing a chimney stack, using Metal-Fab Pipe Products. This software is a combination of ASHRAE calculations and Metal-Fab Inc. specific details that will enable a user to size a chimney stack making best use of space and minimizing costs.

### Quick Start:

If you are experienced with pipe sizing and have used the Vent Right software provided by Metal-Fab, the following steps will get you up and going quickly.

1. Insert CD into CD drive, wait for Installation program to begin.
2. Install the CD onto your hard drive. It is strongly recommended that you accept the default file locations.
3. Start the Metal-Fab Inc. Sizing Program from the Program Files menu.
4. Enter your data into the appropriate boxes. Most information directly corresponds to the information entered into the Vent Right program.

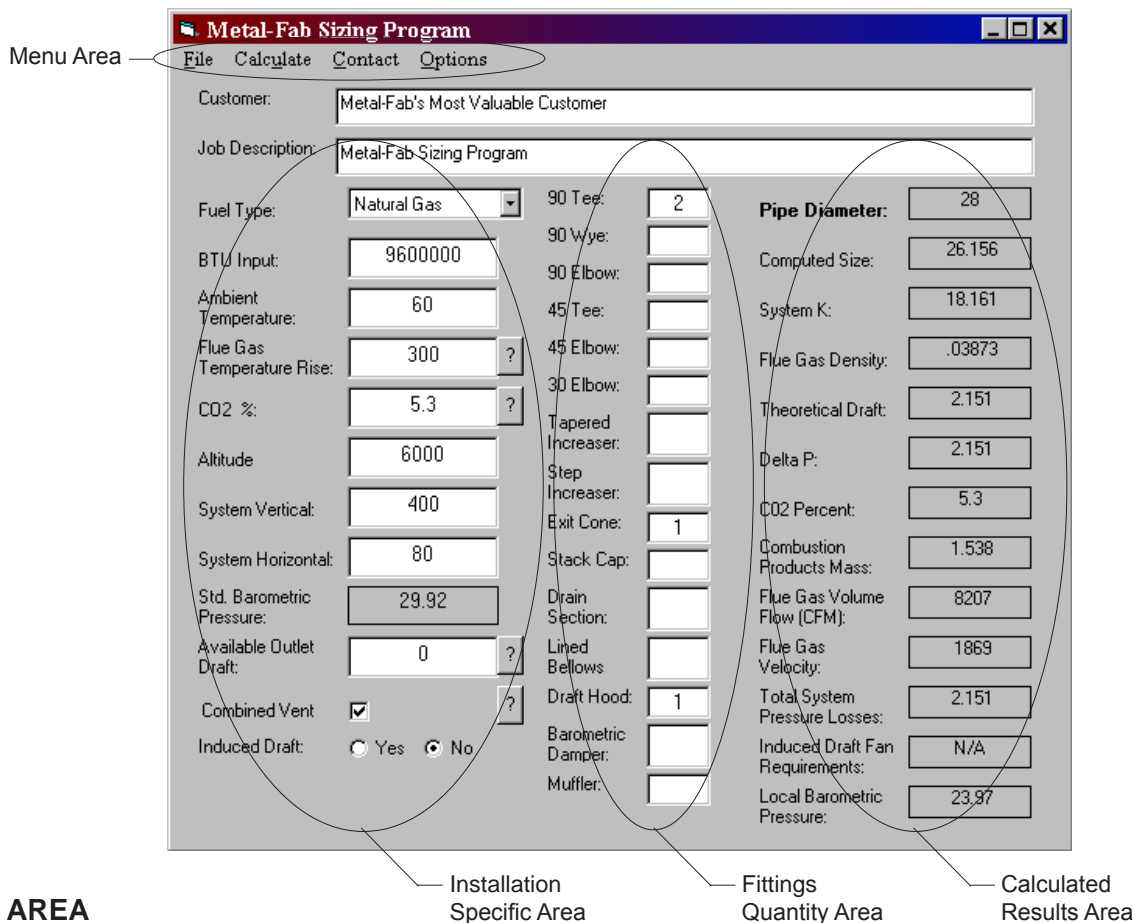
**NOTE:** You no longer enter total system length; you enter a horizontal length and vertical length.

5. Click on Calculate, or press ENTER, for pipe sizing.
6. You can save, print or even E-mail the resulting calculations by selecting from the File menu.

**NOTE:** If you E-mail the results as an attachment, the recipient must also have the sizing program.

### Metal-Fab Inc. Sizing Program Environment:

The sizing program environment can be broken down into a few distinct areas. The first area is the MENU AREA. This section contains options that can be accessed before/during/after the pipe sizing is initiated. The INSTALLATION SPECIFIC INFORMATION is a section of data that is input by the user and is required to calculate a pipe diameter. The FITTING QUANTITIES AREA is a section that details all the special fittings required for the installation. The CALCULATED RESULTS AREA displays the results of the information provided.



## MENU AREA

The menu system allows users access to an assortment of information and options at anytime the program is in use. Below is a detail of the options available:

### File

- Open.....Use to open previously saved sizing data.
- Save As .....Use to save the current data to a size file for future retrieval.
- Print Form.....Used to print a copy of the form as shown on the screen.
- Print Report .....Used to print a text report of current sizing. Good for fax.
- Email.....Used to email the current sizing info. Requires email and Internet Connection.
- Exit .....Quits Program.

Calculate..... Causes program to calculate results from data entered.

### Contact

- Address .....Brings up a form that stores the users contact information.

### Options

- K-Factor.....Shows a list of K-Factors for each Metal-Fab Inc. Fitting.
- Clear All .....Clears all data from the input boxes.
- Background .....Colors Allows user to customize background colors.
- Altitude of Cities.....Gives a list of some U.S. Cities over 1000ft with their Altitude.

## INSTALLATION SPECIFIC INFORMATION

The Installation Specific Information Area contains information required to compute the pipe sizing and is specific to the particular job being sized. All input must be provided to complete the calculations. The following is an explanation of the data required:

**Fuel Type:** Product being burned in appliance.

**BTU Input:** (BTU/Hour Input) Maximum input capacity for the burner in the appliance(s).

**Ambient Temperature:** (°F) Maximum outside temperature expected during the operation of the appliance.

**Flue Gas Temperature Rise:** (°F) Temperature of exhaust gases minus the ambient temperature.

**CO<sub>2</sub> %:** (%) Carbon Dioxide content of the exhaust gas. This information is supplied by the appliance manufacture.

**Altitude:** (Ft.) Elevation above sea level where the appliance will operate.

**System Vertical:** (Ft.) Total vertical rise of vent system from the connection of the tallest appliance to the termination.

**System Horizontal:** (Ft.) Longest horizontal distance from any one appliance to the termination of the system.

**Std Barometric Pressure:** (In/Hg) This is a constant value of 29.92 inches mercury.

**Available Outlet Draft:** (Inches Water Column) Positive pressure available or negative pressure required by appliance. This information is supplied by appliance manufacture.

**Combined Vent:** (Check for Yes) Check only if the application is a system that has multiple appliances with draft hoods.

**Induced Draft:** Check only if the application is a system that is utilizing an induced draft fan.

**Diameter:** (Inches) Use only when sizing a system with an induced-draft fan; enter desired diameter of pipe.

## FITTING QUANTITIES AREA

This area is where specific fittings are identified. Each possible fitting has an input box associated with it where the quantity is entered. If a quantity of two 90 Tees are used then 2 should be entered into the appropriate box. If none of the fittings are used a quantity is not necessary. However 0 (zero) can be entered.

**NOTE:** If combined vent is used, at least one draft hood must be used.

## CALCULATED RESULTS AREA

This section is an area that cannot be edited by the user. It displays the results of the calculations performed. Each item displays a different piece of information about the system specified. The following is a description of the results:

**Pipe Diameter:** (Inches) This is the minimum standard size of pipe available from Metal-Fab Inc. that is required for the data provided. It is determined from the computed size.

**Computed Size:** (Inches) This is the actual minimum size of pipe required for the data provided. It is determined through 2000 ASHRAE calculations for chimney venting. Refer to the 2000 ASHRAE Handbook – HVAC Systems and Equipment I-P Edition, or contact Metal-Fab for more information on the calculations used.

**System K:** Resistance coefficient for the entire chimney system including piping and fittings.

**Flue Gas Density:** (lb/ft<sup>3</sup>) Mass per unit volume of gas at an average temperature and local barometric pressure.

**Theoretical Draft:** *The difference in weight between a given column of warm (light) chimney gas and an equal column of cold (heavy) ambient air. Chimney gas density or temperature, chimney height, and barometric pressure determine theoretical draft; flow is not a factor. (2000 ASHRAE Handbook – HVAC Systems and Equipment I-P Edition)*

**Delta P:** Flow losses resulting from gas velocity and resistance (friction) of the pipe to flow.

**CO<sub>2</sub> %:** Percentage of Carbon Dioxide in the gas. Ratio is determined by fuel type.

**Combustion Products Mass:** Weight of flue gases conveyed through the flue.

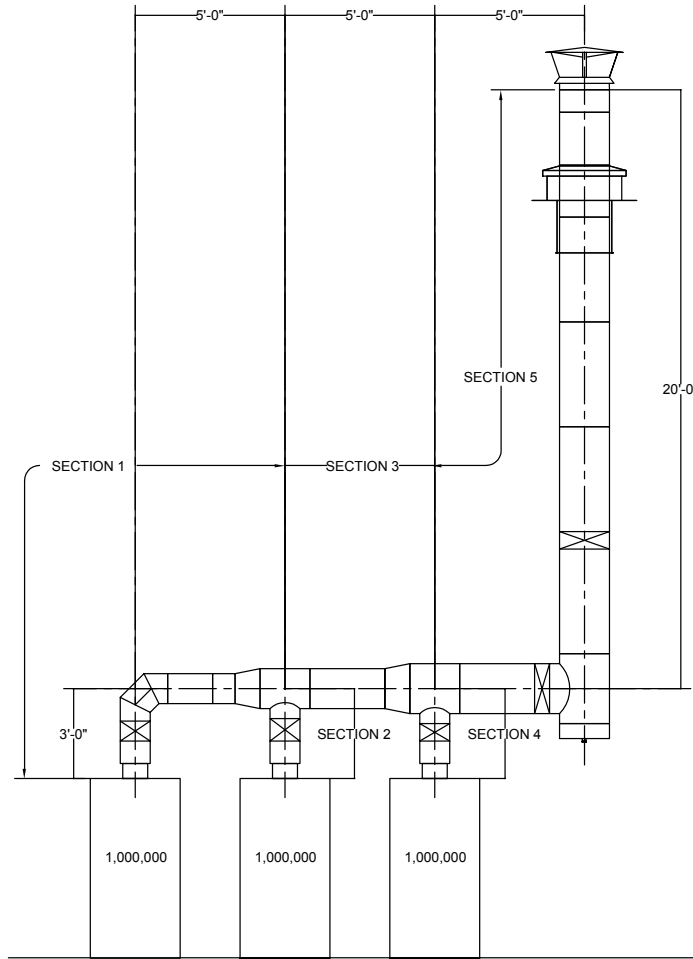
**Flue Gas Volume:** Amount of gas being transferred through the flue during a given amount of time. Measured in CFM (ft<sup>3</sup>/min).

**Flue Gas Velocity:** Distance that the Flue Gas will move in a given amount of time. Measured in ft/min

**Total System Pressure Losses:** Total of all losses in the chimney. Measured in inches water column.

**Induced Draft Fan Requirements:** Amount of assist required by a fan to properly vent chimney.

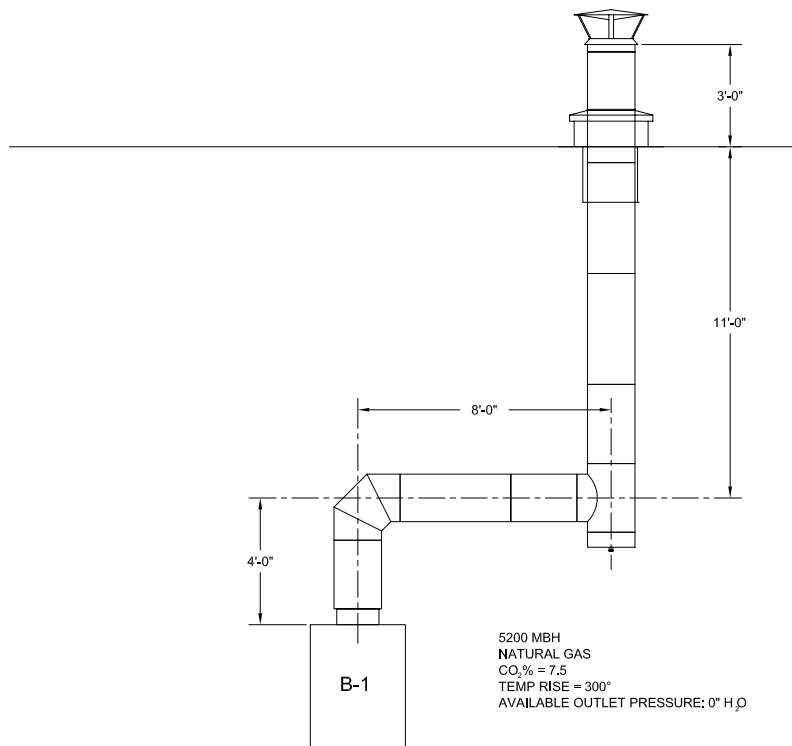
**Local Barometric Pressure:** Barometric pressure at installation site based on elevation.



**TABLE 1**

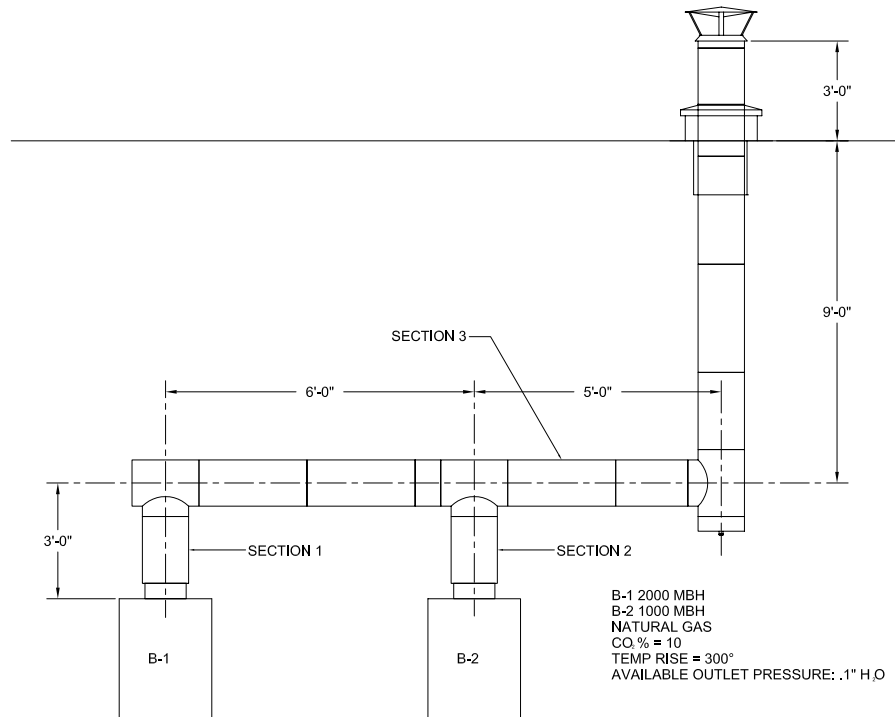
SECTION	BTU'S	SYSTEM HEIGHT	TOTAL LENGTH	FITTINGS
SECTION 1	1,000,000	23'-0"	38'-0"	1 TEE, 1 CAP, 1 ELBOW, 2 INCREASERS
SECTION 2	1,000,000	23'-0"	33'-0"	2 TEES, 1 CAP, 1 INCREASER
SECTION 3	2,000,000	20'-0"	30'-0"	2 TEES, 1 CAP, 1 INCREASER
SECTION 4	1,000,000	23'-0"	28'-0"	2 TEES, 1 CAP
SECTION 5	3,000,000	20'-0"	25'-0"	2 TEES, 1 CAP

## EXAMPLE 1



Metal-Fab Sizing Program			
<div style="display: flex; justify-content: space-between;"> <span>File   Calculate   Contact   Options</span> <span>⏮ ⏪ ⏩ ⏭</span> </div>			
Customer:		Example 1	
Job Description:		From B - 1 to Termination	
Fuel Type:	Natural Gas	90 Tee:	1
BTU Input:	5200000	90 Wye:	
Ambient Temperature:	60	90 Elbow:	1
Flue Gas Temperature Rise:	300 ?	45 Tee:	
CO <sub>2</sub> %:	7.5 ?	45 Elbow:	
Altitude:	0 ?	30 Elbow:	
System Vertical:	18	Tapered Increaser:	
System Horizontal:	8	Step Increaser:	
Std. Barometric Pressure:	29.92	Exit Cone:	
Available Outlet Draft:	0 ?	Stack Cap:	1
Combined Vent:	<input type="checkbox"/> ?	Drain Section:	
Induced Draft:	<input type="radio"/> Yes <input checked="" type="radio"/> No	Lined Bellows:	
		Draft Hood:	
		Barometric Damper:	
		Muffler:	
		<b>Pipe Diameter:</b>	20
		Computed Size:	19.412
		System K:	2.57
		Flue Gas Density:	.04834
		Theoretical Draft:	.097
		Delta P:	.097
		CO <sub>2</sub> Percent:	7.5
		Combustion Products Mass:	1.12
		Flue Gas Volume Flow (CFM):	2116
		Flue Gas Velocity:	912
		Total System Pressure Losses:	.097
		Induced Draft Fan Requirements:	N/A
		Local Barometric Pressure:	29.92

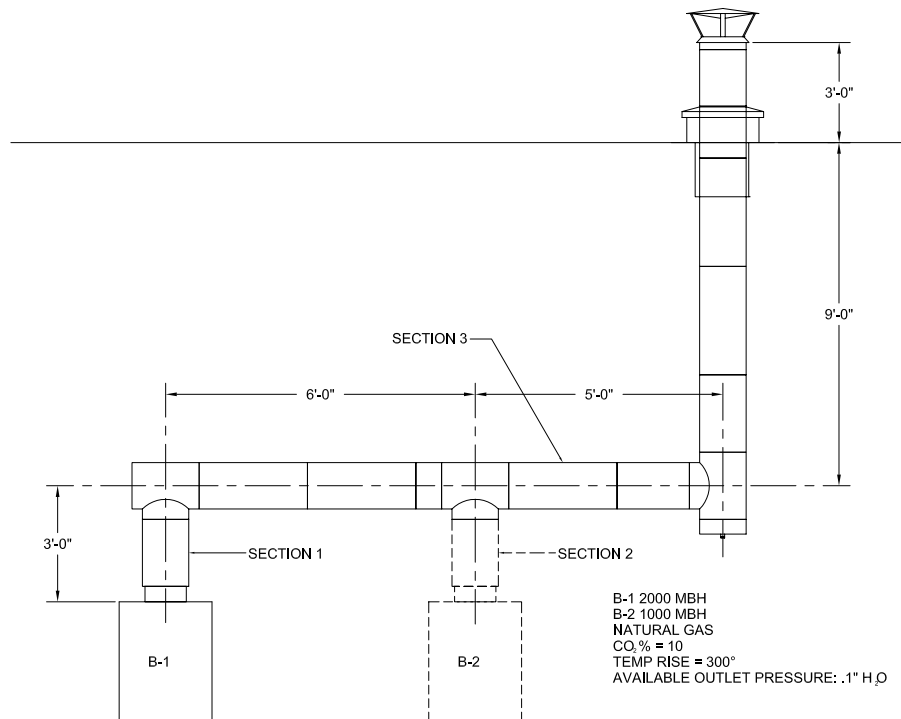
## EXAMPLE 2



SEE EXAMPLE BREAK DOWNS ON FOLLOWING PAGES



## EXAMPLE 2 SECTION 1



**Metal-Fab Sizing Program**

File Calculate Contact Options

Customer: Example 2

Job Description: Connector Size for B - 1

Fuel Type: Natural Gas

BTU Input: 2000000

Ambient Temperature: 60

Flue Gas Temperature Rise: 300

CO<sub>2</sub> %: 10

Altitude: 0

System Vertical: 15

System Horizontal: 11

Std. Barometric Pressure: 29.92

Available Outlet Draft: .1

Combined Vent: ☐

Induced Draft: ☐ Yes ☒ No

90 Tee: 2

90 Wye:

90 Elbow:

45 Tee:

45 Elbow:

30 Elbow:

Tapered Increaser:

Step Increaser: 1

Exit Cone:

Stack Cap: 1

Drain Section:

Lined Bellows:

Draft Hood:

Barometric Damper:

Muffler:

Pipe Diameter: 12

Computed Size: 10.322

System K: 4.317

Flue Gas Density: .04834

Theoretical Draft: .081

Delta P: .181

CO<sub>2</sub> Percent: 10

Combustion Products Mass: .868

Flue Gas Volume Flow (CFM): 803

Flue Gas Velocity: 755

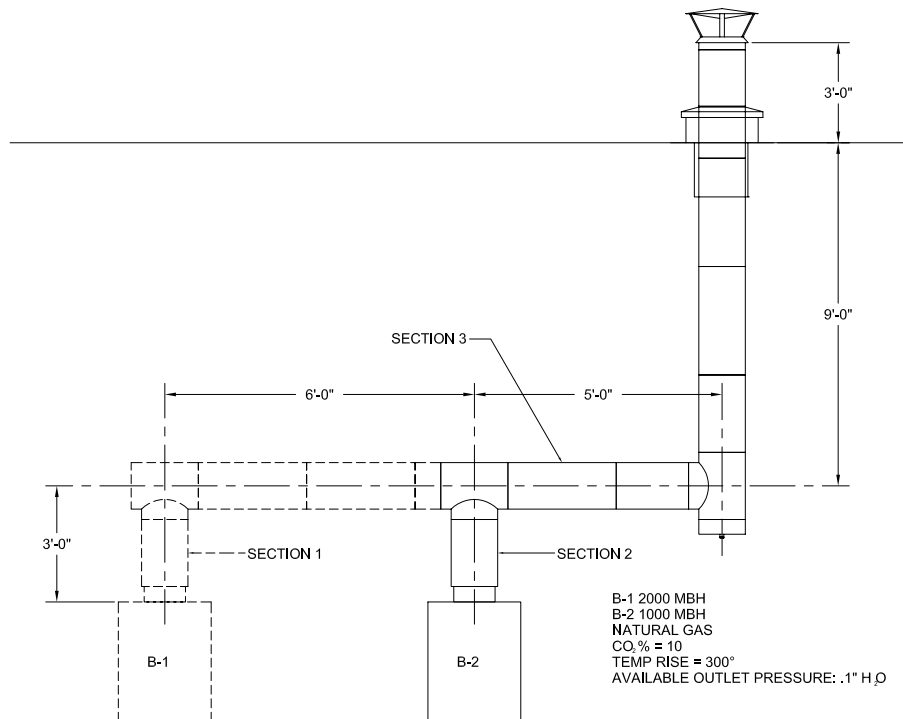
Total System Pressure Losses: .181

Induced Draft Fan Requirements: N/A

Local Barometric Pressure: 29.92

Example output from program

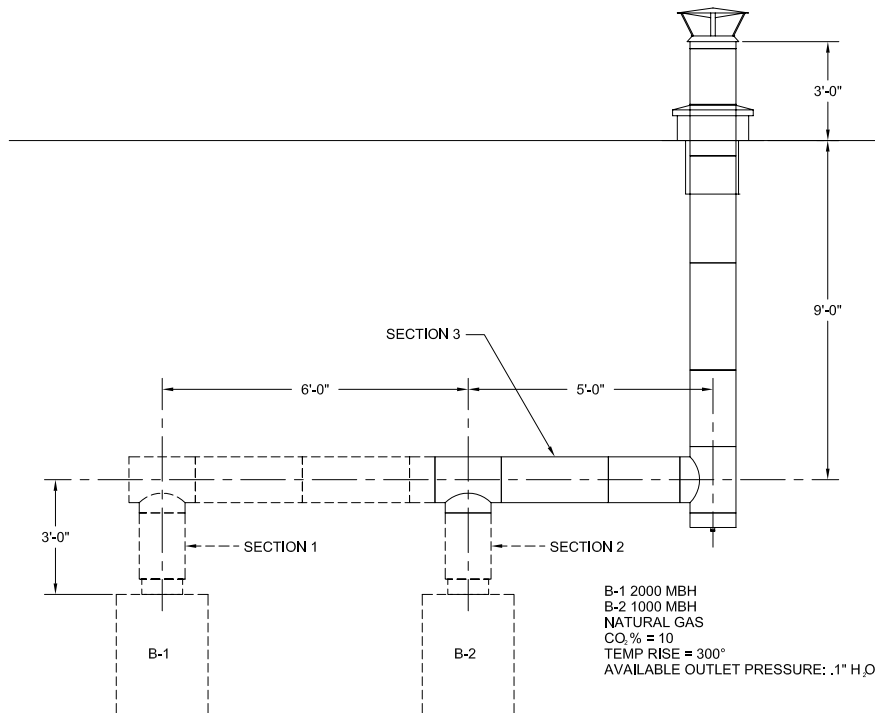
## EXAMPLE 2 SECTION 2



<b>Metal-Fab Sizing Program</b> <span style="float: right;">_ □ ×</span>									
File   Calculate   Contact   Options									
Customer:		Example 2							
Job Description:		Connector Size for B - 2							
Fuel Type:	Natural Gas ▾	90 Tee:	2	<b>Pipe Diameter:</b>		8			
BTU Input:	1000000	90 Wye:		Computed Size:		7.355			
Ambient Temperature:	60	90 Elbow:		System K:		4.45			
Flue Gas Temperature Rise:	300 ?	45 Tee:		Flue Gas Density:		.04834			
CO <sub>2</sub> %:	10 ?	45 Elbow:		Theoretical Draft:		.081			
Altitude	0 ?	30 Elbow:		Delta P:		.181			
System Vertical:	15	Tapered Increaser:		CO <sub>2</sub> Percent:		10			
System Horizontal:	5	Step Increaser:	1	Combustion Products Mass:		.868			
Std. Barometric Pressure:	29.92	Exit Cone:		Flue Gas Volume Flow (CFM):		351			
Available Outlet Draft:	.1 ?	Stack Cap:	1	Flue Gas Velocity:		849			
Combined Vent	<input type="checkbox"/> ?	Lined Bellows		Total System Pressure Losses:		.181			
Induced Draft:	<input type="radio"/> Yes <input checked="" type="radio"/> No	Draft Hood:		Induced Draft Fan Requirements:		N/A			
		Barometric Damper:		Local Barometric Pressure:		29.92			
		Muffler:							

Example output from program

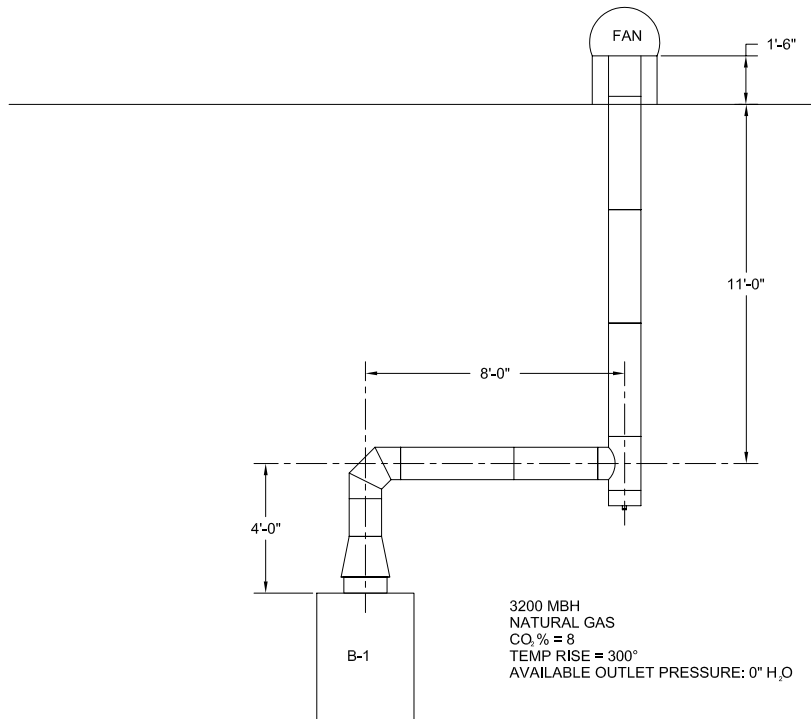
## EXAMPLE 2 SECTION 3



Metal-Fab Sizing Program									
File Calculate Contact Options									
Customer:		Example 2							
Job Description:		Common Breeching and Stack Size							
Fuel Type:	Natural Gas	90 Tee:	2	Pipe Diameter:	14				
BTU Input:	3000000	90 Wye:		Computed Size:	12.645				
Ambient Temperature:	60	90 Elbow:		System K:	3.936				
Flue Gas Temperature Rise:	300	45 Tee:		Flue Gas Density:	.04834				
CO <sub>2</sub> %:	10	45 Elbow:		Theoretical Draft:	.065				
Altitude:	0	30 Elbow:		Delta P:	.165				
System Vertical:	12	Tapered Inserter:		CO <sub>2</sub> Percent:	10				
System Horizontal:	5	Step Inserter:	1	Combustion Products Mass:	.868				
Std. Barometric Pressure:	29.92	Exit Cone:		Flue Gas Volume Flow (CFM):	1092				
Available Outlet Draft:	.1	Stack Cap:	1	Flue Gas Velocity:	832				
Combined Vent:	<input type="checkbox"/>	Lined Bellows:		Total System Pressure Losses:	.165				
Induced Draft:	<input type="radio"/> Yes <input checked="" type="radio"/> No	Draft Hood:		Induced Draft Fan Requirements:	N/A				
		Barometric Damper:		Local Barometric Pressure:	29.92				
		Muffler:							

Example output from program

### EXAMPLE 3



Metal-Fab Sizing Program			
File Calculate Contact Options			
Customer:	Example 3		
Job Description:	B-1 to Termination Fan		
Fuel Type:	Natural Gas	90 Tee:	1
BTU Input:	3200000	90 Wye:	
Ambient Temperature:	60	90 Elbow:	1
Flue Gas Temperature Rise:	300	45 Tee:	
CO <sub>2</sub> %:	8	45 Elbow:	
Altitude:	0	30 Elbow:	
System Vertical:	16.5	Tapered Increaser:	1
System Horizontal:	8	Step Increaser:	
Std. Barometric Pressure:	29.92	Exit Cone:	
Available Outlet Draft:	0	Stack Cap:	
Combined Vent:	<input type="checkbox"/>	Drain Section:	
Induced Draft:	<input checked="" type="radio"/> Yes <input type="radio"/> No	Lined Bellows:	
Diameter:	12	Draft Hood:	
		Barometric Damper:	
		Muffler:	
		Pipe Diameter:	12
		Computed Size:	12
		System K:	2.667
		Flue Gas Density:	.04834
		Theoretical Draft:	.089
		Delta P:	.236
		CO <sub>2</sub> Percent:	8
		Combustion Products Mass:	1.057
		Flue Gas Volume Flow (CFM):	1166
		Flue Gas Velocity:	1485
		Total System Pressure Losses:	.236
		Induced Draft Fan Requirements:	.232
		Local Barometric Pressure:	29.92

Example output from program

## APPENDIX

**TABLE 1**  
CONVERSION FACTORS (FOR CHIMNEY DESIGN PURPOSES)

input BTU/HR	= boiler horsepower * 33,475 / (% efficiency/100)
	= BHP (75% efficiency) * 44,500
	= BHP (80% efficiency) * 42,000
	= gallons per hour oil (No. 1 or 2) * 140,000
	= gallons per hour oil (No 4 or 6) * 150,000
	= lbs. per hour coal (bituminous) * 13,000
	= lbs. per hour coal (anthracite) * 15,000
	= watt rating * 3,412
	= MBH (thousand BTU per hour) * 1,000

**TABLE 2**  
TYPICAL CHIMNEY AND VENT DESIGN CONDITIONS

Fuel	Appliance	%CO <sub>2</sub>	Temperature Rise Degrees Fahrenheit	M, per 1000 BTU Burned	SEA LEVEL	
					Gas Density LB/CF	CFM per 1000 BTU/HR at Gas Temperature
Natural Gas	Draft Hood	5.30	300°	1.60	0.0483	0.522
LP Gas	Draft Hood	6.00	300°	1.64	0.0483	0.566
Natural Gas	No Draft Hood	8.00	400°	1.10	0.0431	0.425
No. 2 Oil	Residential	9.00	500°	1.24	0.0389	0.531
Oil	Forced Draft (Over 400 MBH)	13.50	300°	0.86	0.0483	1.297

**TABLE 2a**  
MASS FLOW EQUATIONS FOR COMMON FUELS

Fuel	M, Pounds Total Product /1000 BTU Burned
Natural Gas	0.72 (0.15 + 11.0 / % CO <sub>2</sub> )
LP Gas	0.72 (0.15 + 12.8 / % CO <sub>2</sub> )
No. 2 Oil (Light)	0.72 (0.15 + 14.4 / % CO <sub>2</sub> )
No. 6 Oil (Heavy)	0.72 (0.12 + 15.8 / % CO <sub>2</sub> )
Bituminous Coal	0.76 (0.11 + 18.2 / % CO <sub>2</sub> )

% CO<sub>2</sub> is determined in products with water condensed (dry basis)

## APPENDIX

**TABLE 3**  
TYPICAL CHIMNEY AND VENT DESIGN CONDITIONS

Gas Temp. Rise ° F.	Dt INWC	Gas Temp. Rise ° F.	Dt INWC	Gas Temp. Rise ° F.	Dt INWC
50°	0.129	600°	0.787	1300°	1.050
100°	0.237	650°	0.816	1400°	1.071
150°	0.329	700°	0.843	1500°	1.091
200°	0.408	750°	0.868	1600°	1.109
250°	0.477	800°	0.891	1700°	1.140
300°	0.537	850°	0.912	1800°	1.154
350°	0.591	900°	0.931	2000°	1.166
400°	0.639	950°	0.950	2200°	1.188
450°	0.682	1000°	0.967	2400°	1.207
500°	0.720	1100°	0.998	2600°	1.224
550°	0.755	1200°	1.025	2800°	1.239

Chimney gas density same as that of air .  
Sea level barometric pressure (29.92 in Hg)  
Draft is relative to ambient air at 60° F or 520° R.

**TABLE 4**  
ALTITUDE CORRECTION

Altitude, ft.	Factor	B, in Hg
Sea Level	1.00	29.92
2,000	1.08	27.80
4,000	1.16	25.80
6,000	1.25	24.00
8,000	1.34	22.30
10,000	1.45	20.60

Multiply operating input by factor to obtain design input  
 $m = ft * 0.3048$

**TABLE 5**  
RESISTANCE LOSS COEFFICIENTS

Piping (Including Pipe, Expansion Joint, Variable Length, Single Wall Boiler Adapter, Flange Adapter, and Flip Top) .....	0.40L/D
90° Tee .....	1.25
45° Tee .....	0.40
30° Elbow .....	0.12
45° Elbow .....	0.15
90° Elbow .....	0.30
90° Wye .....	0.60
Exit Cone .....	1.25
Stack Cap .....	0.50
Drain Section .....	0.25
Lined Bellows .....	0.08
Nozzle Section .....	0.25
Duct Drain .....	0.25

Step Increaser .....	$\frac{\left[1 - \left(\frac{\text{small diameter}}{\text{large diameter}}\right)^2\right]^2}{\left(\frac{\text{small diameter}}{\text{large diameter}}\right)^4}$	$\frac{.51\left[1 - \left(\frac{\text{small diameter}}{\text{large diameter}}\right)^2\right]^2}{\left(\frac{\text{small diameter}}{\text{large diameter}}\right)^4}$
Tapered Increaser .....		





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