

Pipe module offers three options for the liquid, gas, or steam pipe sizing calculations:

CALCULATE:   
 Project: FLOW RATE  
 Client Name: LINE SIZE  
 PRESS. DROP

**Flow Rate,  
Line Size, and  
Pressure Drop.**

Each calculation option lets you select flow type and formula best suited for the piping design.

**SELECT PIPE FLOWRATE CALCULATION FORMULA**

Type of Flow  
 Compressible Flow  
 Non-Compressible Flow

Formula  
 Darcy's Formula (CRANE 3-5)  
 Hazen and Williams Formula for Water (CRANE 3-10)  
 Isothermal Compressible Flow (CRANE 3-7)  
 Simplified Compressible Flow (CRANE 3-7a)  
 Babcock Formula for Steam Flow (CRANE 3-10)

C-max provides a built-in fluid property database. It has vapor pressure, viscosity, density, heat capacity, molecular weight, and other properties for over 60 fluids most commonly used in the industry. In addition, you can customize or create your own custom fluid database by using the following dialog box.

**LIQUID DENSITY**

Select a type of Correlation:  Empirical Equation  Lab Data

Empirical Equation  
 Formula:  $LiqDensity = A * B^{((1 - Tr) ^ {2/7})}$   
 Formula:  $VapDensity = ((CF * R * T) / P) / (MW)$   
 Constant A:  Constant B:   
 Range:  deg F to  deg F

Lab Data

	1.	2.	3.	4.	5.
Temperature, deg F	<input type="text" value="0"/>	<input type="text" value="100"/>	<input type="text" value="200"/>	<input type="text" value="300"/>	<input type="text" value="400"/>
Density, lbs/ft3	<input type="text" value="45.552"/>	<input type="text" value="42.432"/>	<input type="text" value="39.312"/>	<input type="text" value="36.192"/>	<input type="text" value="32.448"/>

**C-MAX - PIPE Test Examples**

File Pump Fan/Blower Compressor Pipe Properties Utilities LC Cost Window Help

**PIPE Test Examples-PIPE SIZING FORM**

General Information  
 CALCULATE:  Job No.: Unicade/Rel 2.0 Pipe Material: Steel/Wrought Iron  
 Project: CMAX Test Line No.: Example 2/Pg.3-1 Roughness: 0.00015 inches  
 Client Name: Crane TP No. 410 Pipe Length: 100 feet Service Class: PCS 20  
 Location: Pg. 3-10 Unit: Prepared By: PSP

Properties  
 Fluid Name: Fuel Oil #3  
 Fluid Type: LIQUID  
 Oper. Temp: 60 deg F  
 Molec. Weight: 20  
 Density: 56.02 lbs/ft3  
 Mean Density: 0 lbs/ft3  
 Abs. Viscosity: 9.4 cPoise  
 Compress. Fac.: 0

Pipe Specification  
 Dsgn Temp.: 0 deg F  
 Dsgn Press.: 0 psig  
 Inlet Press.: 100 psig  
 Outlet Press.: 90.08 psig  
 Max Press. Drop: 0 psi  
 Max Velocity: 0 feet/sec  
 Sonic Velocity: 0 feet/sec  
 Mean Vel. Head: 0 feet

Calculated Values  
 Elevation Head: 0 feet  
 Fric. Factor: 0.03  
 Total Eqv. Len: 100.00 feet  
 Reynolds No: 14835  
 Flow Rate: 45774 lbs/hr  
 Pipe ID: 2.07 inches  
 Line Fric. Loss: 9.92 psi  
 Velocity: 9.71 feet/sec

Number of Valves/Fittings  
 Str. Len: 0.00 45-El: 0 180-El: 0 Globe: 0 Foot: 0 Angle: 0 Misc. Val: 0  
 Sum L/D: 0.00 90-El: 0 W. Off: 0 Gate: 0 Check: 0 Tees: 0 Misc. Fit: 0  
 Entrances: 0 Exits: 0

Pipe From: Pipe 101 Pipe To: Pipe 103

Easy-To-Learn and Use Unique "All-In-One" Pipe Sizing Form

## Selected Features of Pipe Module

- Built-in pipe material and roughness selector.
- Calculates Reynolds number, fluid velocity, and sonic velocity for gas and steam.
- Computes or defaults the friction factor, or accepts user input.
- Accounts for pipe elevation head (or drop) in calculations of outlet pressure.
- Provides the following equation choices:

### Non-Compressible Flow:

- Darcy-Weisbach formula For Non-Compressible Flow
- Hazen and Williams Formula for Water
- Poiseuille's Formula for Laminar Non-Compressible Flow

### Compressible Flow:

- Darcy-Weisbach formula For Compressible Flow
- Babcock formula for Steam Flow
- Isothermal Flow of Gas Formula
- Simplified Compressible Flow

- Supports actual and standard volumetric and mass flow rate.
- Provides equivalent length for various fittings and valves.
- Supports U.S. and metric units.

The Pipe module is designed using **Crane Technical Paper No. 410, "Flow of Fluids Through Valves, Fittings, and Pipe."**



The Systems Analysis Software for All Fluid Flow Applications

# Pipe Module

You can create these industry-standard, ready-to-use reports from C-MAX Pipe module !

PROJECT: CMAXTest

LINE NO	FLUID	FLOW RATE	WT% VAP	INLET PRESS.	TEMP	WISC	DENS	VEL	PRESS DROP	EQUIV LEN	PIPE SIZE	TOTAL AP	UPSET PRESS	EIP TEMP	CODE	TEST	PIPE SPEC	INSTR. TRACE	FROM	TO	P & ID	REF. DRWG.
Example 2Pg 3-10	Fuel Oil #2	4574	0	100	60	34	56.02	9.71	9.92	100.00	2.07	9.92					PCS 20		Pipe 101	Pipe 103		
Example 2Pg 3-12	Lube Oil	5060	0	100	60	95	54.04	4.99	3.28	100.00	3.08	3.28					PCS 20		Lube Tank	Pipe 203		
Example 2Pg 3-20	Natural Gas	69000	100	250	60	0.911	1.03	53.53	0.67	100.0	7.981	0.67					PCS 20		NO Line 1	NO Line 3		
Example 1Pg 3-16	Steam	27582	100	600	650	0.026	0.8196	117.92	7.65	100.0	3.82	7.65					PCS 20		Boiler	Control Valve		

PIPE SYSTEM FORM	
GENERAL INFORMATION	
PIPE SYSTEM	Job No: Unicade/Rel 2.0
Project: CMAX Test	Line No: Example 2/Pg 3-10
Client Name: Crane TP No. 410	Pipe Length: 100 feet
Location: Pg. 3-10	Unit:
PIPE MATERIAL: Steel/Wrought Iron	ROUGHNESS: 0.00015 inches
SERVICE CLASS: PCS 20	PREPARED BY: PSP
PROPERTIES	
Fluid Name: Fuel Oil #3	Design Temperature: 0 deg F
Fluid Type: LIQUID	Design Pressure: 0 psig
Operating Temperature: 60 deg F	Inlet Pressure: 100 psig
Molecular Weight: 20	Outlet Pressure: 90.08 psig
Density: 56.02 lbs/ft <sup>3</sup>	Max. Pressure Drop: 0 psi
Mean Density: 0 lbs/ft <sup>3</sup>	Max. Velocity: 0 feet/sec
Absolute Viscosity: 9.4 Cpoise	Sonic Velocity: 0 feet/sec
Compressibility Factor: 0	Mean Velocity Head: 0 feet
CALCULATED VALUES	
Elevation Head: 0 feet	Friction Factor: 0.03
Total Eqv. Length: 100.00 feet	Reynolds No: 14835
Flow Rate: 45774 lbs/hr	Pipe ID: 2.07 inches
Pressure Drop: 9.92 psi	Velocity: 9.71 feet/sec
NUMBER OF VALVES / FITTINGS	
Straight Length: 0.00	45-El: 0
Sum L/D: 0.00	90-El: 0
Foot Valve: 0	Angle Valves: 0
Check Valves: 0	Tees: 0
Globe Valve: 0	W. Off: 0
Gate Valve: 0	Misc. Valve: 0
Entrances: 0	Misc. Fitting: 0
Exits: 0	

C-MAX Pipe module lets you compute fittings and valves equivalent length. You can select the amount and diameter of valve/fitting, and choose either L/D method or resistance coefficient (K) method to calculate the equivalent length. The designed pipes can be selectively connected to other C-MAX modules such as pumps, fans, and compressors.

**TOTAL EQUIVALENT LENGTH - FITTINGS -**

Amount	Diameter	L/D
Welded 90 Degree Elbows		
Short Radius (R/D = 1.0) Opt:	0	22.626
Short Radius (R/D = 1.0) Avg:	0	22.626
Standard Radius (R/D = 1.5) Opt:	0	22.626
Standard Radius (R/D = 1.5) Avg:	0	22.626
Flanged 90 Degree Elbows		
Standard Radius (R/D = 1.0):	0	22.626
Long Radius (R/D = 1.5):	0	22.626
Screwed 90 Degree Elbows		
Std Radius (R/D = 1.0), Dia 3":	0	22.626
Std Radius (R/D = 1.0), Dia 3":	0	22.626
Welded Offset		
C = 1.67D:	0	22.626
C = 2.37D:	0	22.626
Entrances/Exits (Based on l = 0.017)		
Entrances:	0	22.626
Exits:	0	22.626

**TOTAL EQUIVALENT LENGTH - VALVES -**

Amount	Diameter	L/D
Conventional Gate Valves		
Fully Open:	0	22.626
Three Quarters Open:	0	22.626
Half Open:	0	22.626
One Quarter Open:	0	22.626
Conventional Globe Valve		
With No Obstruction:	0	22.626
With Wing or Pin Guided Disc:	0	22.626
Y Pattern Globe Valve		
With 60 Degree Stem:	0	22.626
With 45 Degree Stem:	0	22.626
Foot Valves		
With Strainer and Lift Disc:	0	22.626
With Strainer and Hinged Disc:	0	22.626
ButterFly / Check Valves		
ButterFly:	0	22.626
Conventional Swing Check:	0	22.626
Clearway Check:	0	22.626
Welding Tees		
100% Flow Through Run:	0	22.626
100% Out of Side:	0	22.626
100% Entering Side:	0	22.626
Conventional Angle Valve		
With No Obstruction:	0	22.626
With Wing/Pin Guided Disc:	0	22.626
Other Valves		
Other Valves:	0	22.626

- C-MAX Modules**
- ⇒ Centrifugal Pump
  - ⇒ Fans & Blowers
  - ⇒ Compressors
  - ⇒ Centrifugal Recip. & Rotary Screw
  - ⇒ Flow of Fluids (Piping)
  - ⇒ ECM Compare
  - ⇒ Economic Evaluation
  - ⇒ Non-Energy Benefits
  - ⇒ Performance Charts
  - ⇒ Utility Rates
  - ⇒ Properties Database
  - ⇒ US/SI Units