234 Abby Road
Manchester, NH 03103
Tel: 603-627-2340
Fax: 603-627-2019

Advanced Mixing Technologies

800-466-2369
web site: www.admix.com
email: mixing@admix.com

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SIZING THE ADMIXER™ STATIC MIXER AND SANITARY STATIC BLENDER

INTRODUCTION

This article provides the necessary information for sizing an Admixer™ for liquid / liquid (single phase) mixing. It is designed to be an accurate yet simple method for obtaining the correct static mixer for various liquid applications.

The proceeding calculations will determine the length, diameter, number of elements and pressure drop of the static mixer. These calculations do not apply to gas/liquid or gas/gas dispersions or emulsions, please contact Admix directly regarding any such cases, or refer to Tech Note #105.

Step 1: Tell us the Facts!

Before actual sizing can begin, the initial conditions must be identified. The following chart has been provided for this use:

SIZING VARIABLE	VALUE	UNITS
Mixing Medium(s)		
(Q) Flow Rate		GPM
(D) Existing Pipe Diameter		Inches
(μ) Absolute Viscosity		CPS
(SG) Specific Gravity		
(ΔP) Max Allowable Head Loss		PSI
(T/P) Temperature / Pressure		ºF/PSI
Existing Pipe Material		
Sidestream Injection?		
Special Requirements?		

Step 2: Go With The Flow!

(Calculate Reynold's Number)

Reynold's number must be calculated in order to identify if the pipe flow is turbulent, laminar, or transitional. Reynold's number can calculated as follows:

$$\text{Reynold's \# (Re)} = \frac{3157 \bullet Q \bullet SG}{\mu \bullet D}$$

Q = Flow Rate (GPM)
SG = Specific Gravity
μ = Absolute Viscosity (cps)
D = Pipe Inside Diameter (inches)

Step 3: It's Elementary!

(Select the Number of Elements)

Using the pipe Reynold's Number (Re) determined above, locate the proper flow regime and Re to select the number of elements required. As explained by the table, it is necessary to add more elements when a wide ratio of fluid viscosities and/or volumes are present. Please remember that these values are guidelines, and should be checked by your local representative or home office.

Flow Regime	Reynold's Number (Re)	No. of Element	Number of Elements to add if Viscosity ratio between fluids exceeds 1000:1	Number of Elements to add if Volumetric ratio between fluids exceeds 100:1
Laminar	<1	24	6	6
	1-10	18	6	6
	11-50	14	6	6
	51-100	12	6	6
	101-500	10	6	6
Transitional	501-1000	8	4	4
	1001-2000	6	4	4
Turbulent	2001-5000	4	2	2
	5001 +	2	2	2

Diameter and Length

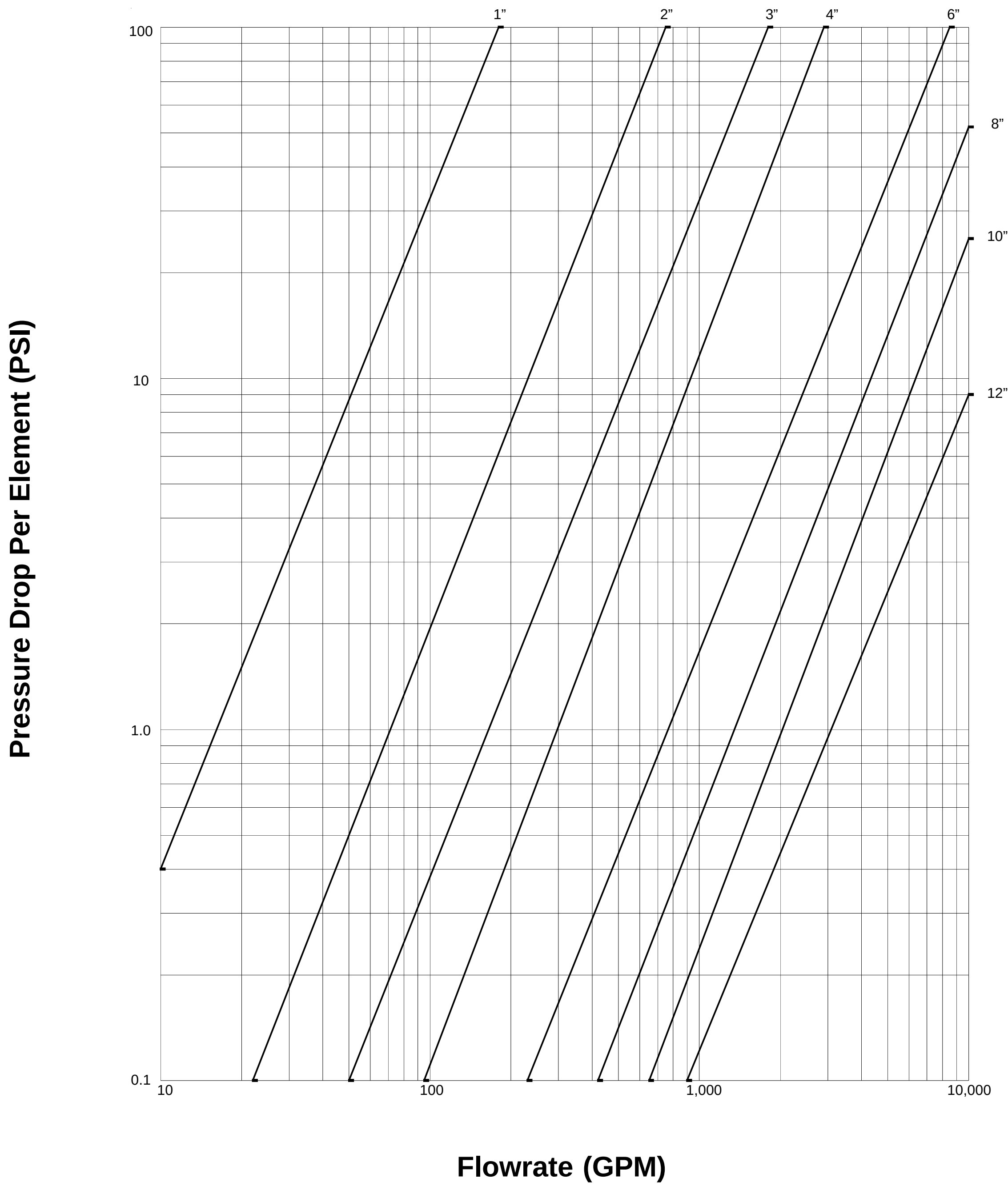
For most circumstances, the in-situ piping will determine the mixer diameter. However, it is possible that alternate sizes are needed to accomplish more thorough mixing, reduce pressure drop, or increase dispersion capability. The mixer length will be based on the number of elements required. An approximate length can be determined by multiplying the number of elements by 1.5.

Step 4: Check Your Pressure!
(Calculate Pressure Drop ΔP)

1. To graphically determine pressure drop:

   If the process materials are waterlike, with S.G. = 1.0 and viscosity less than 10 cps, the graph below will provide an approximate value of expected pressure drop per element. If the fluids have properties other than that of water, a manual calculation of pressure drop follows.

PRESSURE DROP PER ELEMENT VERSUS FLOWRATE
For 1” through 12” Diameter Static Mixers



2. For non waterlike materials where viscosity is greater than 10:

a) Recheck the value for Reynold's number calculated at step #2. Using this value, determine the associated friction factor for the mixer housing using the graph on page 4 (Friction Factors for Clean Commercial Steel and Wrought Iron Pipe).

b) Now calculate P_H of the empty housing without mixing elements.

$$P_H = \frac{0.0135 \cdot f \cdot L \cdot SG \cdot Q^2}{D^5}$$

where f = friction factor
L = length of pipe (ft)

c) Using the Reynold's number from Step #2, calculate the flow factor, Ff to compensate for the headloss caused by the mixing elements.

if Re<10,	$Ff = 6.5$
if 10<Re<1000,	$Ff = 1.53\,(Re)^{0.45}$
if Re>1000,	$Ff = 8.5\ln(Re) - 16$

d) Does this compute?

The total mixer pressure drop or head loss can now be found by multiplying the housing head loss (P_H) by the element flow factor (Ff)

$$\Delta P\ (PSI) = P_H \times Ff$$

Step 5: Watch your Speeed!
(Check Mixer Velocity)

For turbulent flow applications, it is generally recommended that a minimum velocity of 1.0 Ft/sec be maintained. For best performance, specific applications such as liquid-liquid dispersions may require as high as 7-8 Ft/Sec. For most blending applications, a velocity of 2-3 Ft/Sec. is sufficient.

$$(V) = 0.408\,\frac{Q}{D^2}$$

V = Velocity in Ft/Sec

SAMPLE WORKSHEET

Results:

Step 2: Re ______________________________

Step 3: n (# of elements) ____________________

Dia _____________ Length ___________

Step 4: f ______________________________

P_H ______________________________

Ff ______________________________

ΔP (PSI) _________________________

Step 5: V ______________________________

Friction Factor Example

From the chart on page 4, a mixer with a Reynold's Number (Re) of 200,000 within a 4" Sched. 40 pipe will have a friction factor (f) of .0185.

FRICTION FACTORS FOR CLEAN COMMERCIAL STEEL AND WROUGHT IRON PIPE