144 Harvey Road
Londonderry, NH 03053
Tel: 603-627-2340
Fax: 603-627-2019
www.admix.com

ADMIX
Advanced Mixing Technologies

Visit us on the web at:
www.admix.com

Call us toll free at:
800-466-2369

Tech. Note No. 102

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 calculation 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		°F / PSI
Existing Pipe Material		
Sidestream Injection		
Special Requirements		

Step 2: Go with the FLOW!

Reynold's number must be calculated in order to identify if the pipe flow is turbulent, laminar or transitional. Reynolds number can be 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, 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 wide ratios of fluid viscosities and/or volumes are present. Please remember that these values are guidelines, and should be checked by your local rep or home office.

Flow Regime	Reynold's Number (Re)	No. of Elem ents	# of elements to add if Viscosity ratio between fluids exceeds 1000:1	# of Elements to add if Viscosity 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

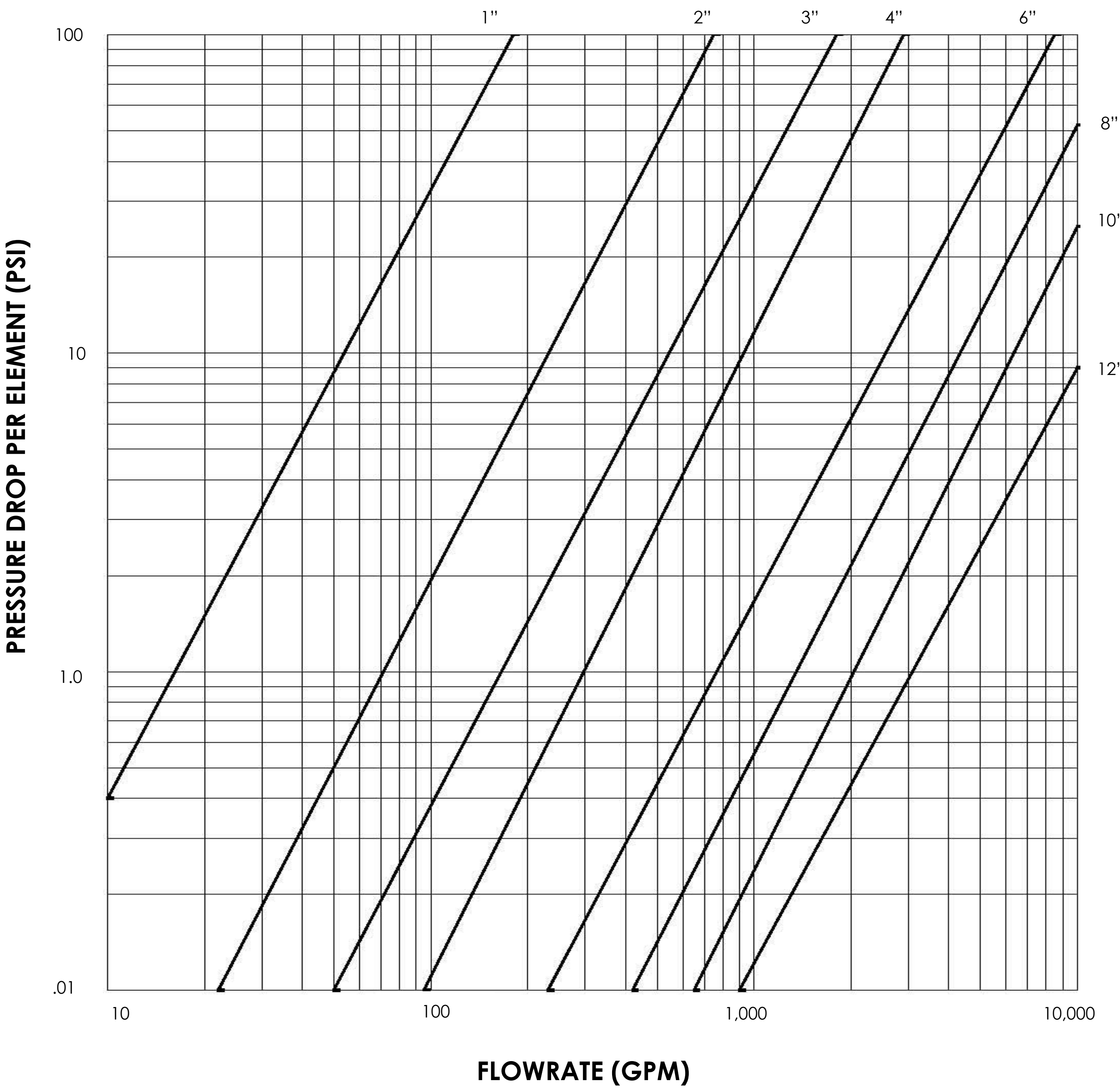
For most circumstances, the in-situ piping will determine the mixer diameter. However, it is possible that alternate sizes are needed to accomplish more through mixing, reduce pressure drop, or increase dispersion capability. The mixer length will be based on the number of elements required. An approximate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

<u>Step 3:</u> Check Your Pressure!
(Calculate Pressure Drop ΔP)

1. To graphically determine pressure drop:

If the process materials are water like, 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 FLOWMATE
FOR 1" THROUGH 12" DIAMETER STATIC MIXERS



2. Non-water like 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 mixing 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.

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

Where F= Friction Factor
L= Length of Pipe

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

If Re<10,	Fƒ=6.5
If 10<Re<1000,	Fƒ= 1.53(Re) 0.45
If Re>1000,	Fƒ= 8.5ln (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 element flow factor (Fƒ)

$$\Delta P \text{ (PSI)} = P_H \times F_f$$

Step 5: Watch your speed

(Check Mixer Velocity)

For turbulent flow applications, it is generally recommended that a minimum velocity of 1.0 Ft/sec be maintained.

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

V- Velocity in Ft/Sec

SAMPLE WORKSHEET

Results:

Step 2:
Re ____________________

Step 3:
N (# of elements) ____________________
Diameter ____________________
Length ____________________

Step 4:
ƒ ____________________
P_H ____________________
Fƒ ____________________
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 (ƒ) of .0185.

FRICTION FACTORS FOR CLEAN COMMERCIAL STEEL AND WROUGHT IRON PIPE