YARWAY WYE-TYPE PIPELINE STRAINERS

900 SERIES

Protecting pipeline components from damaging particles with minimal pressure drop

FEATURES

- Body material - ASTM and/or ASME as permitted under boiler code and power piping code. Provides assurance of quality and suitability for pressure/temperature adjustment in non-shock service.
- Straight threads on cap - for easy removal when screen replacement is necessary.
- Clad, non asbestos, spark-plug-type gasket provides reliable seal on machined body and cap.
- Guided screen - screens fit into controlled machined bores in body and cap, and are not crushed. This fit provides good screen alignment and reliable capture of particles.
- Installation - can be installed in vertical and horizontal piping with the blowdown connection oriented in any preferred direction.
- Design - meets ASME B31.1.
  Conforms to recognized codes and standards for assurance of quality.

GENERAL APPLICATION

Yarway wye type strainers are suitable for use in a variety of fluid systems such as air, chemical, condensate, gas, oil, petroleum or water lines, for the protection of valves, pumps, compressors, condensers, flow meters, nozzles, steam traps and other vulnerable equipment.

TECH DATA

Size range:	NPS ⅜ to 2 (DN 10 - 50)

HOW TO SELECT

There are three important components in selection:

1. Design and operating pressures and temperatures - look at the curves in Figure 2. Select the strainer rating that meets both the design and the operating requirements.
2. Flow rate and pressure drop - select a strainer pipe size that will yield a pressure drop of 1½ psi or less. This will accommodate increases in pressure drop due to dirt or alternate screens without causing the screen to rupture.
3. Look at the selection table on page 4 and pick the strainer series that meets the conditions of 1 and 2 above, and is compatible with the flowing medium.

INSTALLATION

Strainers should be installed upstream of pipeline equipment to protect against damage from solid particles of dirt, chips, scale, packing shreds, pipe sealants and welding debris.
The strainer should be fitted with a pipe nipple in the cap and a full ported straight through valve (e.g., gate or ball).
Install the strainer in a horizontal or vertical line with flow in the direction of the arrow.
For freeze protection, install the strainer on its side or upside down in a horizontal line or vertically to assist in draining the blowdown line and strainer cavity.
Inspect the strainer regularly. Clean the screen before it becomes more than one-third clogged. Pressure gages before and after the strainer will indicate excessive pressure losses due to clogging.

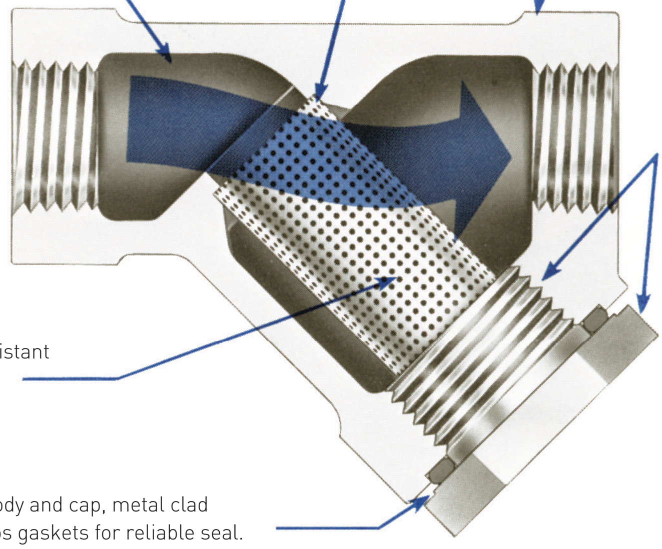
HOW TO SPECIFY THREADED CAP

Body shall be wye-type. Threaded cap shall have straight machined threads for easy removal. Body and cap shall have machined surfaces for metallic clad, non-asbestos gaskets. Strainer screen shall fit into non-tapered machined bores. Thread end strainers hall be machined to ASME B1.20.1. Socketwelding ends shall be to ASME B16.11; flanged ends shall conform to ASME B16.4 (iron) or B16.5 (steel).

HOW TO ORDER

Specify pipe size, Yarway series and pipe connection. Example: ¾", Yarway series 921, NPT ends.

900 SERIES, THREADED CAP



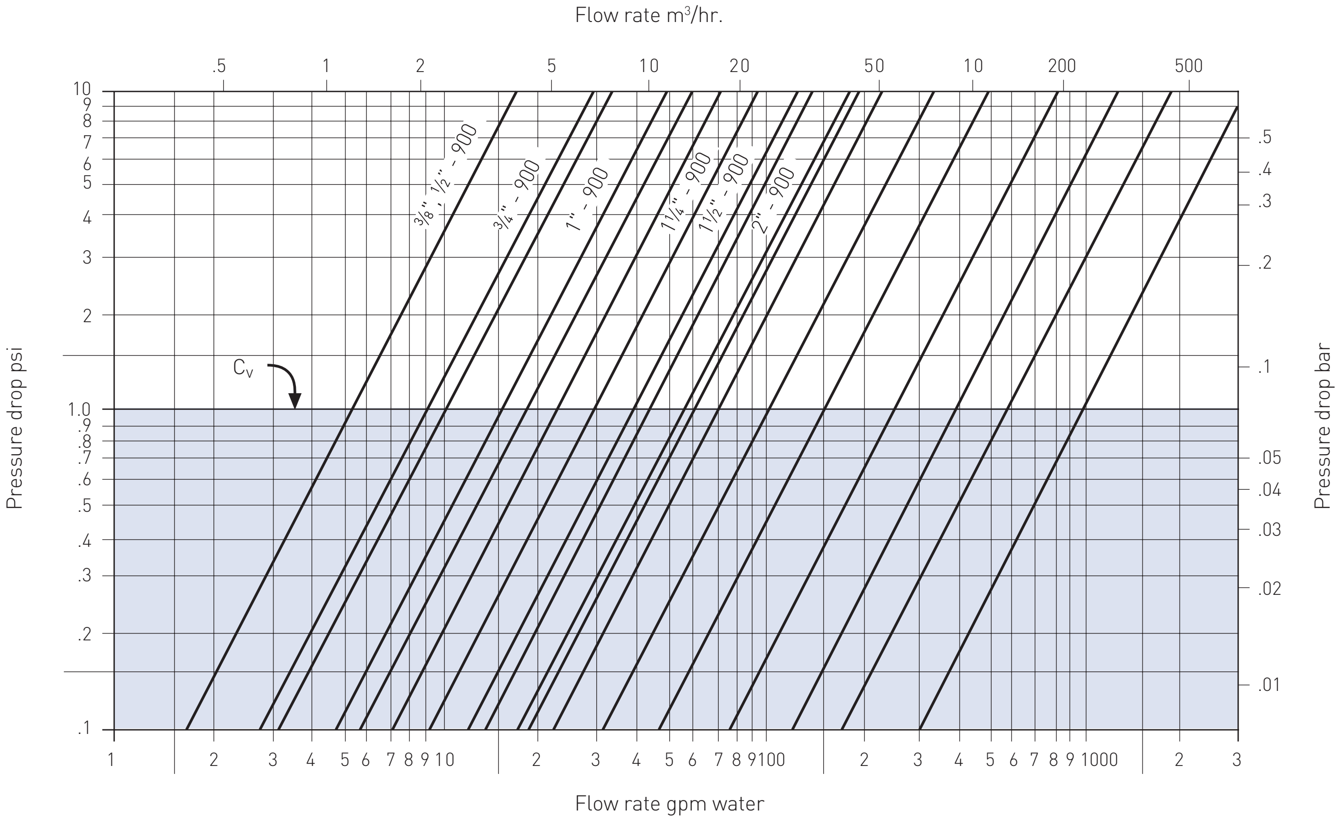
THREADED SOCKETWELDING STRAINERS

Strainer figure number	End connection and nominal	Material				Available pipe sizes
(DN)	ASME class ratings[1]	Body	Threaded cap 900	Gasket	Screen type and material[2]	NPS (DN)
901	Threaded b16.4	Cast iron	Carbon steel	Copper clad	1/32" perf.	⅜ - 2
	Cl 250	A-278 cl 35		Non-asbestos	18-8 s/s	(10 - 50)
921	Threaded b1.20.1	Cast steel	Carbon steel	S/S clad	1/32" perf.	½ - 2
	Cl 600	A-216 wcb		Non-asbestos	18-8 s/s	(6 - 50)
921SW	Socketwelding	Cast steel	Carbon steel	S/S clad	1/32" perf.	⅜ - 2
	B16.11 Cl 600	A-216 wcb		Non-asbestos	18-8 s/s	(10 - 50)

NOTES

1. See Chart, Figure 2 for pressure/temperature ratings.
2. See page 7 for optional screen materials and openings.

FIGURE 1 - WATER FLOW VS. PRESSURE DROP



$$C_V = \frac{GPM}{\sqrt{\frac{\Delta P}{S.G.}}}$$

S.G. = Specific gravity

Clogged Screens - This chart represents the results of tests conducted with strainers containing clean screens. With screens 50% clogged, pressure drop results are approximately double those shown in charts.

Multiplying Factor - All results are based upon the use of 0.033 dia. through ¼" dia. perforations. When using .020 perforations, multiply pressure drop from graph by 1.10. For mesh lined perforated metal screens, multiply pressure drop by 1.25.

Pressure drop through Yarway wye strainers
In the application of wye strainers, the most frequent concern is pressure drop. Since the strainers can have a variety of fluids passing through them, there are a variety of equations and conditions that affect the flow.
Our objective is to present methods for calculating pressure drops across Yarway's wye type strainers. The calculations are based on a series of formulas and the use of a C_V, and covers liquids, steam and gases.
The following assumptions are made:
1. Control valve equations and the use of C_V is appropriate.
2. For liquid flow:
- Flashing and cavitation are not present.
- There is no significant change in density.
- Flow is fully turbulent and viscosity is not a significant factor in the calculations for pressure drop.
3. For steam, gas and air flows, pressure drops are not critical, and a change in density (if it occurs) is not significant.

The examples of pressure drop calculations are based on new, clean strainers. If clogged screens are a significant concern, follow the footnote under Figure 1.

Determine the strainer C_V
The first thing to determine is the strainer C_V. This can be obtained from Figure 1 the water flow vs pressure drop curve where C_V = gpm when the pressure drop is one (1) psi.
Example:
What is the C_V for a 2" 900 Yarway Wye strainer?
Solution:
1. Enter the left, vertical axis at one (1.0) psi.
2. Move horizontally to the right until you reach the 2" 900 curve.
3. Then, move vertically down and read 56 gpm.
4. Answer - The C_V for a 2" 900 is 56.

This solution is for water; specific gravity is approximately one.

Liquid flow with specific gravity not equal to one
Example:
What is the pressure drop if the fluid is kerosene, flowing at 150 gpm for a 2" 900 strainer?
Solution:
1. Enter a table of various liquids.
2. Find kerosene with a specific gravity of 0.82.
3. Solve the equation

Equation 1:

$$\Delta PI = G \left(\frac{VI}{C_V}\right)^2$$

=[0.82](150/56)^2 = 5.88 psi

Where:
ΔPI = Liquid/pressure drop, psi
VI = Liquid flow, gpm =150
C_V = Strainer C_V = 56 (previous example)
GI = Specific gravity of liquid.
For kerosene GI = 0.82

Liquid flow, viscosity consideration
With the turbulent flow, the pressure drop equations are independent of Reynolds number. When viscous fluids are present, Reynolds numbers can be changed to the point where Laminar flow is achieved. The use of Equation 2 and 3 determines if the flow is turbulent.
If it is turbulent, Equation 4 can be used.
If Reynolds Number is less than 4000, Equation 4 will predict a greater than expected pressure drop.

Equation 2:

$$Re = 3160 \frac{VI}{vd}$$

Re = Reynolds No.
VI = GPM
v = Kinematic viscosity, centistokes

Equation 3:

$$VI = C_V \frac{\Delta Pv}{GI}$$

GI = Specific gravity of liquid
ΔPv = Viscous fluid, pressure drop, psi
d = Pipe I.D. inch

Combining **Equation 2** and **3** and assuming Re = 4000 minimum for turbulent flow, and 'd' is a controlling factor for the strainer:

$$4000 = (3160) \frac{(C_V)}{vd} \frac{\Delta Pv}{GI}$$

or
Equation 4:

$$\Delta Pv = (1.6023)(GI) \frac{(vd)^2}{C_V}$$

Example:
Assume the same 2" strainer flowing kerosene. The specific gravity is 0.82, but the kinematic viscosity is 2.69. Pipe I.D. is 3.068 inches. Using **Equation 4:**

$$\Delta Pv = (1.6023)(0.82) \frac{(2.69 \times 3.068)^2}{56}$$

= 1.598 psi minimum for a Reynolds number of 4000 to maintain turbulent flow.

This means that if the pressure drop and Reynolds number are too low, Laminar flow may result and the influence of viscosity can alter the results. The approximate Reynolds number for 150 gpm flow in the example is:

$$Re = \frac{(3160)(150)}{(2.69)(3.068)}$$

is over 57,400 from equation (2) and the ΔPv like in equation (3) approaches 2.20 from equation (3).

GAS AND VAPOR FLOW

The flow of gases and vapors is more complicated than liquid flow. This is due to changes in density. If pressure drops are too great, the nature of the gas or vapor changes. These equations are assumed to apply:
In the above, it is assumed that the control valve formulas for non-critical steam and gas flow are applicable.

ΔPs = Pressure drop across strainer, steam psi
ΔPg = Pressure drop across strainer, gas, air, etc.
P1 = Strainer inlet pressure, psia
W = lb/hr steam flow
Q = SCFH gas flow
Ts = Degrees F superheat above saturation
T = Degrees R gas temperature (F+ 460)
G = Specific gravity, gas (air = 1)

SATURATED STEAM FLOW

Let's assume we have a 2" steam line. Steam flow is 2000 lb/hr and the steam pressure is 100 psig, saturated. What is the pressure drop through the 2" Yarway Hancock 921 wye strainer?
From Figure 1 we see that the 2" 921 has a C_V equal to 55.

P1 = 100 psig = 115 psia
W = 2000 lb/h
C_V = 55
Ts = 0, because the steam is saturated

SUPERHEATED STEAM

Assume the same strainer and conditions as for saturated steam, except the steam temperature is 500°F.
We use the same equation except

Ts = 500-338
T_s = 162°F, degrees superheat
500 = Steam temp, F
338 = Sat. temp, F for 100 psi

GASES

If we keep the same strainer, but now consider natural gas flow at 50,000 SCFH and at a temperature of 100°F.

C_V = 55
P1 = 115 psia
G = 0.667
T = 460 + 100 = 560R
Q = 50,000

STEAM (SATURATED OR SUPERHEAT)

Equation 5:

$$\Delta Ps = P_1 - \sqrt{(P_1)^2 - \left[\frac{(W)(1 + 0.0007\,T_s)}{(2.1)(C_V)}\right]^2}$$

GASES (INCLUDING AIR)

Equation 6:

$$\Delta Pg = P_1 - \sqrt{(P_1)^2 - (G)(T)\left[\frac{(Q)}{(963)(C_V)}\right]^2}$$

From Equation 5:

$$\Delta Ps = (115) - \sqrt{(115)^2 \left[\frac{(2000)(1 + 0)}{(2.1)(55)}\right]^2}$$

$$= 1.31 \text{ psi drop}$$

The steam pressure drop is calculated to be 1 to 1½ psi.

$$\Delta Ps = (115) - \sqrt{(115)^2\left[\frac{(2000)(1 + 0.0007 \times 162)}{(2.1)(55)}\right]^2}$$

$$\Delta Ps = 1.63 \text{ psi}$$

The superheated steam will produce a pressure drop nearly ¼ more than the saturated condition.

$$\Delta Pg = (115) - \sqrt{(115)^2 - (0.667)(560)\left[\frac{50{,}000}{(963)(55)}\right]^2}$$

$$= 1.46 \text{ psi}$$

Pressure drop is approximately 1½ psi.

DIMENSIONS NPS (DN)

Strainer size	901		921, 921 SW	
NPS (DN)	A	B	A	B
⅜ (10)	3⅛ (80)	2⁵⁄₃₂ (55)	3⁵⁄₁₆ (84)	2⁵⁄₃₂ (55)
½ (15)	3⅛ (80)	2⁵⁄₃₂ (55)	3⁵⁄₁₆ (84)	2⁵⁄₃₂ (55)
¾ (20)	3⅝ (92)	2¹⁵⁄₃₂ (63)	3¹³⁄₁₆ (97)	2¹⁵⁄₃₂ (63)
1 (25)	4⅜ (111)	3¹⁄₃₂ (77)	4⁹⁄₁₆ (116)	3¹⁄₃₂ (77)
1½ (40)	6 (152)	4⁹⁄₃₂ (109)	6⅛ (156)	4⁹⁄₃₂ (109)
2 (50)	7⅛ (181)	5⁷⁄₃₂ (133)	7½ (191)	5⁷⁄₃₂ (133)

WEIGHT lb (kg)

	Strainer weights	
Strainer size NPS (DN)	901	921, 921W
⅜ (10)	1 (0.5)	1½ (0.7)
½ (15)	1¼ (0.6)	1½ (0.7)
¾ (20)	1½ (0.7)	2 (0.9)
1 (25)	3 (1.4)	3½ (1.6)
1½ (40)	6½ (2.9)	7¼ (3.3)
2 (50)	11¼ (5.1)	13 (5.9)

STANDARD BLOW OFF CONNECTIONS DIMENSION C[1] NPS (DN)

Series 900, Strainer size NPS (DN)	Connection NPT NPS (DN)
⅜ to ½ (10-15)	⅜ (10)
1 (20-25)	½ (15)
1½ to 2 (40-50)	¾ (20)

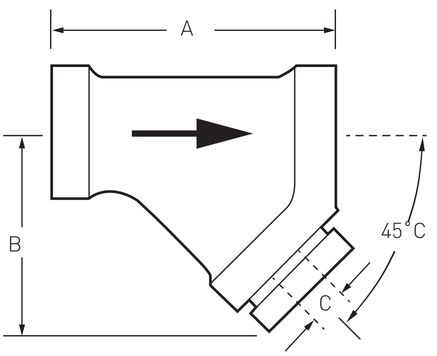
NOTES

1. Threaded blow-off connection standard. Contact your sales representative for optional sizes and socketwelding.

EASILY REMOVABLE SCREEN CAPS

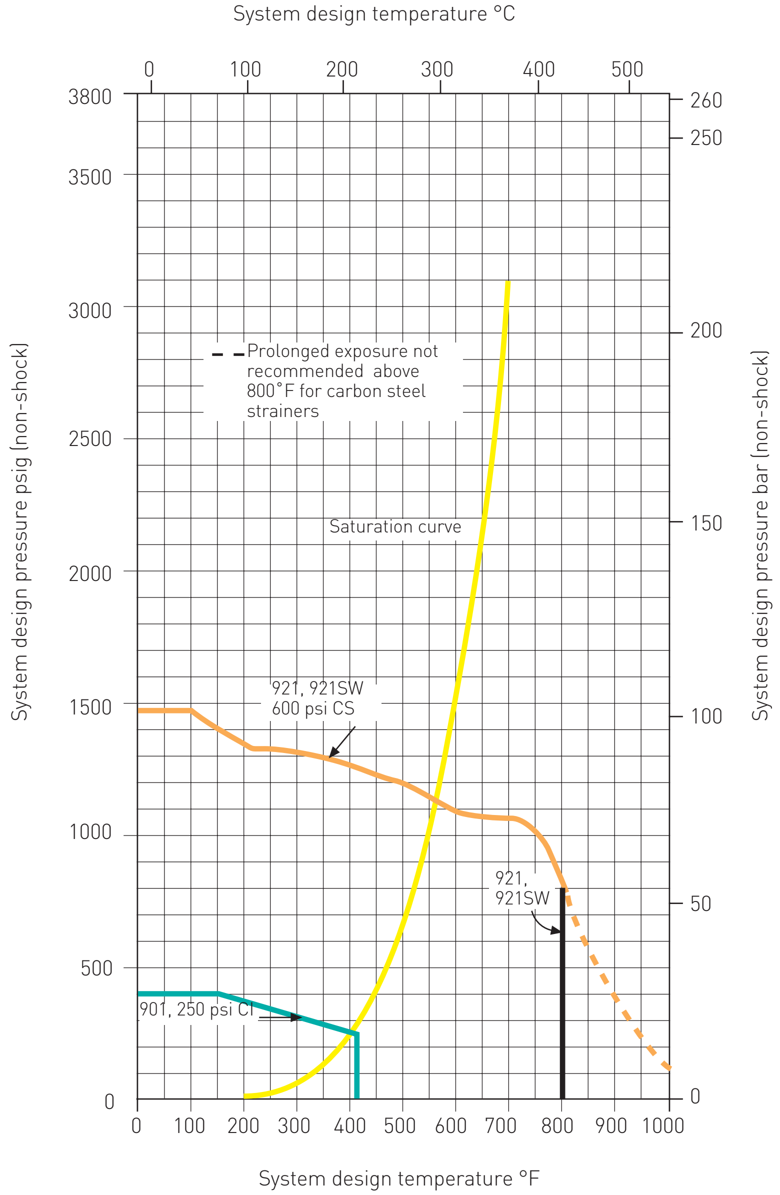
Straight threads permit easy removal from the strainer body when the screen must be cleaned, and assure proper alignment of the screen when re-assembled. Machined faces and "spark plug" type gasket provide a good joint without excessive tightening.

THREADED AND SOCKETWELDING STRAINERS



Series 901, 921 and 921SW, threaded, socketwelding ends (with threaded screen caps).

FIGURE 2 - PRESSURE/TEMPERATURE RATINGS

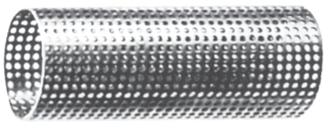


SCREEN EQUIVALENT

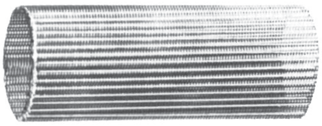
Perforations			Approximate Equivalent	
Diameter		Number of perf.		
NPS	(mm)	per square inch	Mesh	Fraction (in.)
0.020	(0.51)	625	42	1/64
0.0331	(0.84)	324	27	1/32
0.045	(1.14)	225	20	3/64
0.062	(1.57)	96	15	1/16
0.125	(3.18)	33	8	1/8
0.0052	(0.13)	20 x120 Dutchweave	100	-

SCREENS

Two types of screens for a range of process conditions: Perforated stainless steel or Monel® in a wide range of opening sizes with high open area ratios for low pressure drops. Fine mesh stainless steel Dutchweave screens also available. Both types provide greater mechanical strength than ordinary square mesh. Machined recesses in the body and cap assure the proper fit of the screen and its alignment in the body.



Perforated screen - easy to clean, less susceptible to clogging.



Dutchweave screen for applications requiring retention of small particles.

SCREEN SELECTOR GUIDE - SERIES 900

Type of service	Screen opening (in.)
Air or gas	Dutchweave (100 mesh)
Oil, low viscosity	0.033" or 0.045" perf.
Oil, medium or high viscosity	0.045" or 0.062" perf.
Steam	0.020" or 0.033" perf.
Water, gasoline or light fuel oil	0.020" or 0.033" perf.