## **Aquatherm Technical Bulletin**

## 201503B - AQTTB **Equivalent Length of Fittings** Date Issued: 2 March 2015

The flow rates, friction loss data and velocities for a few given flow rates are shown in the catalog. This data are the result of calculations made with the Hazen-Williams formula which is also given in the catalog. The data shows the results of the calculations showing the friction loss of the pipe in feet per hundred feet (ft./100 ft.) of pipe. Note that the pipe data in the catalog includes the losses associated with one joint (socket or butt-weld) per length of pipe, so these joints do not need to be added separately to the friction loss calculations. The velocity of the fluid flowing in the pipe per pipe size and gpm flow rate is also calculated.

Friction loss data for the fittings is found on the pages of the catalog directly following the friction loss data for the pipe. These pages show the friction loss of the fittings in equivalent lengths of straight pipe.

For example an 8" 90 deg, elbow SDR 17.6 shows an equivalent length of 14.0 ft. This means that for every 8" 90 deg. elbow you have in your system you need to add 14.0 ft. equivalent length of pipe to the total length of pipe in your system when calculating the total friction loss.

Engineers and system designers need to know equivalent lengths of fittings and the total length of pipe in a system in order to size the system pump and ensure proper flows and pressures at fixtures and equipment.

Consider the sketch below of a pumping/piping system. It can be a cooling system or a heating system or both. If we need to determine the pump size, we need to know the length of pipe involved in the system, the resulting friction head and the flow rate in gallons per minute.



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We can set up a table that looks like this:

			Total		Flow		Flow
		Equivalent	Length,		Rate,		Rate,
Pipe or Fitting	Number	Length, ft.	ft.	Unit	GPM	Unit	GPM
6" SDR 17.6 Blue Pipe	580	580	580	AH-1	30	AH-10	30
6" SDR 17.6 90 Elbows	7	11.2	78.4	AH-2	45	AH-11	30
2" Fusion Outlet	32	2.1	67.2	AH-3	30	AH-12	45
Total system Length			725.6	AH-4	30	AH-13	30
				AH-5	45	AH-14	30
				AH-6	45	AH-15	20
				AH-7	20	AH-16	30
				AH-8	20		
				AH-9	45		
				Sub-Totals	310		215
				Grand Total			525





825 W 600 N | Lindon UT, 84042 801-805-6657 aquatherm.com Elbow 90° ¾″ 25 mm 1 ½″ 50 mm 2 ½″ 75 mm 3″ 90 mm 3 ½" 110 mm **4"** 125 mm 1″ 32 mm 1 ¼" 40 mm 2‴ 63 mm }⁄2‴ 20 mm Socket fusion 2.0 6.2 7.4 9.0 12.6 1.6 2.6 3.3 4.1 5.2 8" 200 mm 10" 250 mm 14" 355 mm 6" 160 m 12" 315 mm 16" 400 mr 24" 630 mm 18" 450 mm 20" 500 mm 22" 560 mr Butt welded SDR 7.4 14.3 17.9 22.3 18.0 20.3 SDR 11 10.3 12.9 16.1 20.3 22.9 25.8 29.0 SDR 17.6 11.2 14.0 17.4 22.0 24.8 27.9 31.4 34.9 39.1 44.0

Figure 1: Equivalent Length Table from Catalog – Elbows

Fusion outlet		}⁄2″	<b>¾″</b>	1″	1 ¼*	1 ½″	2"	2 ½″	3"	3 ½"	4"	6″	8"
		20 mm	25 mm	32 mm	40 mm	50 mm	63 mm	75 mm	90 mm	110 mm	125 mm	160 mm	200 mm
	Side-wall fusion (based on branch size)	0.6	0.8	1.0	1.3	1.7	2.1	2.5	3.0	3.6	5.0	5.8	6.5

Figure 2: Equivalent Length Table from Catalog - Fusion Outlets

With the total system pipe length determined (725.6 ft.) and the flow rate in gpm (525 gpm) we can size the pump. Using the Hazen-Williams formula we find that 6" pipe at 525 gpm has a friction head of 2.5 ft./100 ft. In other words for every 100 feet of pipe we will lose 2.5 ft. of head.

Another way of looking at it is friction loss in psi. In our case, we lose 1.1 psi per 100 ft. of pipe; so for every 100 feet of pipe we lose 1.1 psi of head.

With the friction head of 2.5 ft./100 ft. of pipe we can multiply this friction head by the total length of pipe, including the equivalent lengths of pipe for the fittings:

2.5 ft/100 ft. x 725.6 ft. = <u>18.14 ft.</u>

Our pump will need to have a head capacity of at least 18.14 ft. The velocity in the system will be 6.9 ft. per second.



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