TECHNICAL FOCUS

SIZING OF HYDRAULIC AND DOMESTIC WATER SYSTEMS



Mixing valves and pressure reducing valves





DESIGN FLOW RATE CALCULATION CRITERIA

The main purpose of sizing a water mains is to ensure the correct delivery of hot or cold water at each point of use. In other words, each appliance must be able to provide the related nominal flow rates provided in any operating condition required by the users.

It is therefore necessary to adopt the calculation criteria for the estimate of the design flow rates.

Regulations for the distribution of domestic water

Both the European and the Italian regulations associate a nominal water flow rate value with each device with the aim of sizing the pipes of the water mains.

Furthermore they introduce a *simultaneity factor,* as the simultaneous delivery to all points of use is an unlikely situation. The design flow rate can not be considered as a simple sum of the nominal flow rates of the individual appliances but will have to be corrected with an appropriate simultaneity factor so as to avoid the provision of pipes with excessive diameters.

Sizing of components for hydraulic and domestic water systems

There are no specific standards or simultaneity criteria for *sizing components for hydraulic and domestic water systems*, such as, in particular, pressure reducing valves and mixing valves. It is, however, recommended to consider a simultaneity factor, even for such devices in order to avoid over-sizing and to ensure operation in the best working range.

The choice of simultaneity factor, depends on various factors such as in particular the type of user, the number and the type of delivery points. Since the simultaneity criteria are founded on a probabilistic basis it is clear that there may be differences between the various methods and that these may be more or less accurate or more or less conservative, depending on the specific case.

The adoption of the simultaneity criterion thus remains a choice of the designer.

Design flow rate calculation

The total flow rate is obtained depending on the type of appliance and the unitary flow rate (with reference to EN 806).

 $G_{TOTAL} = n \cdot G_{SINK} + n \cdot G_{WASHBASIN} + \dots$

where n is the number of appliances for each type.

TYPE OF APPLIANCE	UNIT FLOW RATE
kitchen sink	12 l/min
washbasin	6 l/min
bidet	6 l/min
shower	12 l/min
bath	24 l/min
WC with cistern	6 l/min
washing machine	12 l/min
dishwasher	12 l/min

Knowing the value of the total flow rate, the design flow rate is obtained from the graphs or tables referred to in the regulation. The relationship between the design flow rate and the total flow rate defines the simultaneity factor, whose value generally depends on the total flow rate and the type of user.

PRESSURE REDUCING VALVE

Pressure reducing valves are devices which, when installed on a private plumbing system, reduce and stabilise the inlet pressure from the water mains. This inlet pressure, in general, is too high and variable for domestic systems to operate correctly.

SIZING

Design flow rate calculation

The first step for sizing a pressure reducing valve is the calculation of the design flow rate according to the steps previously expressed.

Velocity calculation

In order to avoid noise phenomena and rapid wear of the delivery appliances it is advisable that the flow rate velocity in the pipes does not exceed the limit value of 2 m/s. As known, the flow rate velocity value depends on the pass-through flow rate and on the pipe cross section according to the relation:

$$v = \frac{10^3 \cdot 4}{60 \cdot \pi} \cdot \frac{G_{\text{design}}}{DN^2}$$

where:

V	= flow velocity	[m/s]
G	= fluid flow rate	[l/min]
DN	 nominal diameter 	[mm]

A recommended flow rate velocity range, except for more or less restrictive product specifications, can be:

Consequently the size of the pressure reducing valve will be selected so as to obtain a flow rate within the specified range.

SIZING WITH SOFTWARE

Sizing a pressure reducing valve for a building having 10 flats with single bathroom.

 $P_{AVAILABLE} = 6 \text{ bar}$ Pressure available from the mains

P_{SETTING} = 3 bar Reducing valve setting pressure

Depending on the type of appliance and the unitary flow rate (with reference to EN 806), through the software support it is possible to quickly obtain the total flow rate (G_{TOTAI}) and the design flow rate (G_{DESIGN}).

Pressure reducing valves	Mixing valves	🗍 Tanks	Expansion vessels	-Pressure valves	reducing 🖓	Mixing valves	Tanks	Expansion vesse
Flow rate calculation				Flow rate calcul		User type		×
Calculate flow rate				Calculate flo	I/min 🗘	Residential buildings	\$	
Design flow rate				Design flow rate	Appliances	Number of appliance		Flow rate
	m³/h 🗘				Kitchen sink	10	12 l/min	120 l/min
Design data					Wash basin	10	6 l/min	60 l/min
Design uata				Design data	Bidet	10	6 l/min	60 l/min
Upstream pressure [bar]	Downstream setting p	ressure [bar] Work	ing temperature [°C]	Upstream pressu	Shower	10	12 l/min	120 l/min
					Bathtub		24 l/min	0 l/min
					WC with cistern	10	6 l/min	60 l/min
			Calculate		Washing machine	10	12 l/min	120 l/min Calculate
					Dishwasher	10	12 l/min	120 l/min
					Other		0 l/min	0 l/min
							Total flow rate	660 l/min
							Design flow rate	65.1 l/min
						ОК		
								4

The operating conditions are checked automatically by the program inserting the available upstream pressure, the necessary downstream setting pressure and the design temperature.

Pressure reducing valves	Mixing valves	Tanks	Expansion vessels	Pressure reducing valves	Mixing valves	Tanks	Expansion vessels
Flow rate calculation				Flow rate calculation			
Calculate flow rate				Calculate flow rate Design flow rate 65.1	l/min ≎		
Design flow rate 65.1	l/min ≎			Design data	I/min 👻		
Design data				Upstream pressure [bar]	Downstream setting	pressure [bar]	Working temperature [°C]
Upstream pressure [bar] 6	Downstream setting p	oressure [bar] Work	king temperature [°C]	6	3		85 Working temperature is too high for available prssure reducing valves: maximum possible temperature is equal to 80 °C
			Calculate				Calculate

The list of products suitable to the design conditions, divided by range, is displayed with a simple click.

		PRE-ADJUSTABLE PRESSURE REDUCING VALVES	
Equipped		i replaceable cartridge with pre-adjustment cification resistant alloy body.	
Size	Velocity	Option	Code
		with pressure gauge, with 1" reduced cartridge	535075
		with pressure gauge connection	535070
1 1/4"	1.35 m/s	with pressure gauge	535071
		with pressure gauge connection, with 1" reduced cartridge	535074

		PRESSURE REDUCING VALVES	
	Equipped wi	th replaceable cartridge.	
			-00
Size	Velocity	Option	Code
Size	Velocity	Option With pressure gauge connection, ADZ alloy body	Code 536070

MIXING VALVE

The mixing valve (thermostatic or electronic) is used in systems that produce domestic hot water. It is designed to maintain the preset temperature of the mixed water delivered to the user outlet, when there are variations in the temperature and pressure of the hot and cold water at the inlet, or in the drawn-off flow rate.

SIZING

The mixing valves must be sized correctly in order to ensure the accurate supply of mixed water at the required temperature and in safe conditions. In particular it is necessary to know:

- the maximum design flow rate that the device must ensure during the period of increased use of the system. This flow rate must be evaluated according to a simultaneity criterion according to the type of user and appliances installed.
- the *head loss generated* by the design flow rate in the component. This value must not be excessively high depending on the pressure available in the mains, and at the same time can not be too low as this would not allow the correct mixing between hot and cold water.

Design flow rate calculation

It is appropriate to distinguish between small single-family users and medium-sized applications.

For single-family users practical design flow rate values are proposed and not those derived from national or European standards, for the following reasons:

- the standards generally provide much higher values than those really applicable in small houses;
- the power of boilers for domestic use would not be able to ensure hot water flow rates higher than those indicated.

For *medium and large-size users* it is possible to refer to design flow rate values evaluated by the simultaneity

criterion expressed in the standards.

These values are defined in the tables shown in the following paragraph.

Ideal ky calculation

It is necessary to make an assessment of the objective head loss $\Delta P_{OBJECTIVE}$, i.e. the head loss expendable from the mixing valve when switching to the design flow rate.

Even in this case the ideal value ranges are proposed within which to evaluate the objective head loss. In singlefamily users it should be between 3 and 7 m w.g. (however it is recommended to not go below 2 m w.g.); in medium and large-sized users it is preferable to be between 5 and 10 m w.g. and in any case not go below 2 m w.g..

SI	NGE-FAM	LY USERS	
DESIGN FLOW	/ RATE	SIZING HEA	AD LOSSES
OF 1 FLA	Т	minimum	2 m w.g.
with 1 bathroom	12 l/min	Objective	5 m w.g.
with 2 bathrooms	15 l/min	maximum	7 m w.g.
with 3 bathrooms	18 l/min	L	

MEDIUM AND LAR	JE-SIZED USE	RS
DESIGN FLOW RATE	SIZING HEA	AD LOSSES
	minimum	2 m w.g.
Evaluation through	Objective	C ma hu a

		minimu
Evaluation through		Objecti
simultaneity criterion		maximu
	1	

ATE	SIZING HEA	AD LOSSES
	minimum	2 m w.g.
gh	Objective	6 m w.g.
rion	maximum	10 m w.g.

Knowing the design flow rate G_{DESIGN} and establishing the objective head loss $\Delta P_{OBJECTIVE}$ it is possible to calculate the Kv flow coefficient value which characterizes the ideal size of the mixing valve:

$$Kv_{\text{IDEAL}} = \frac{G_{\text{design}}}{\sqrt{DP_{\text{objective}}}}$$

Among the commercially available Kv values, the ones closest to the ideal value calculated are chosen; of these it is verified that the actual head loss does not exceed the minimum or maximum limits indicated.

SIZING WITH SOFTWARE

Sizing a thermostatic mixing valve for a centralized system serving 10 flats with single bathroom.

Depending on the type of appliance and the unitary flow rate (with reference to EN 806), through the software support it is possible to quickly obtain the total flow rate (G_{TOTAI}) and the design flow rate (G_{DESIGN}).

essure reducing Mixing valve	s 🗍 Tanks	Expansion vessels	-IN- Pressure redu valves	cing C	Mixing valves	🗍 Tanks	
be m and large ♀			User type Medium and large	¢			
rate calculation			Flow rate calculatio	Unit of measure	User type Residential buildings factor according to UNI EN 806	\$	×
ign flow rate U/s \$			Design flow rate	Appliances Kitchen sink	Number of appliances	Single flow rate	Flow rate
ct mixing valve type			Select mixing valve	Wash basin Bidet	10	6 I/min 6 I/min	60 l/min 60 l/min
HERMOSTATIC mixing valves			Type THERMOSTATIC r	Shower Bathtub	10	12 l/min 24 l/min	120 l/min 0 l/min
Thermostatic mixing valves for SOLAR thermal systems			ELECTRONIC mix Thermostatic mb	Other		0 I/mir Total flow rate	0 l/min 360 l/min
ing head losses			Sizing head losses			Design flow rate	51 l/min
et head loss Unit of measure m.c.a. \$			Target head loss	m.e	ok .a. ≎		

Furthermore adding the information regarding the type of mixing valve and the objective head loss of the mixing valve completes the data necessary for the sizing.

For a more specific choice it is also possible to enter in the advanced options the of minimum and maximum head loss that the mixing valve can have.

Pressure reducing valves	Mixing valves	Tanks	Expansion vessels
User type			
Medium and large \$			
Flow rate calculation			
Calculate flow rate			
Design flow rate	l/min ≑		
Select mixing valve type			
Type THERMOSTATIC mixing valves ELECTRONIC mixing valves LEGIO Thermostatic mixing valves for 50			
Sizing head losses			
Target head loss	Unit of measure m.c.a.		

The list of products suitable to the design conditions, divided by range, is displayed with a simple click.

Size Recommended in a replaced without uninstalling the value body from the pipe. Brass body. Size Head loss Recommended inlamm flow Setting range Option Code 1/2" 5.97 m.c.a. 6.67 l/min 30-65 °C With check values 523040	THERMOSTATIC MIXING VALVES FOR MEDIUM-LARGE APPLICATIONS						
Size Head less minimum flew Setting range Option Code 1/2" 5.97 m.c.a. 6.67 l/min 30-65 °C 523040							
1/2" 5.97 m.c.a.	Size	Head loss		Setting range	Option	Code	
	1/2"	5.97 m.c.a.	6.67 l/min	30-65 °C		523040	
			6.67 l/min	30-65 °C	With check valves	523043	



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