

ENGINEERING DATA

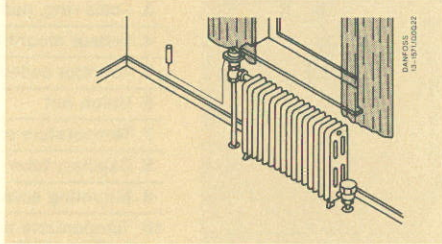
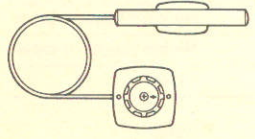
RA thermostatic operators

For use with valves
type RA on hot water
and 2-pipe steam heating systems



Typical installations

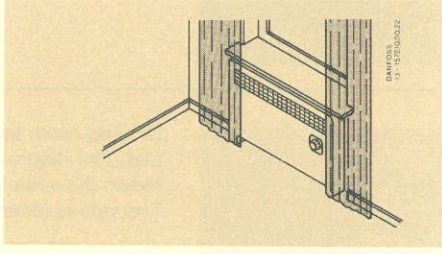
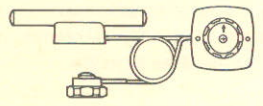
Operator with valve mounted dial and remote sensor



For use on all installations where the dial is accessible to the user.

Shown with angle valve on free standing radiator.

Operator with separate remote mounted sensor and dial



For use on enclosed radiator and convectors where a remote dial is required.

Shown on convector radiation.

Features

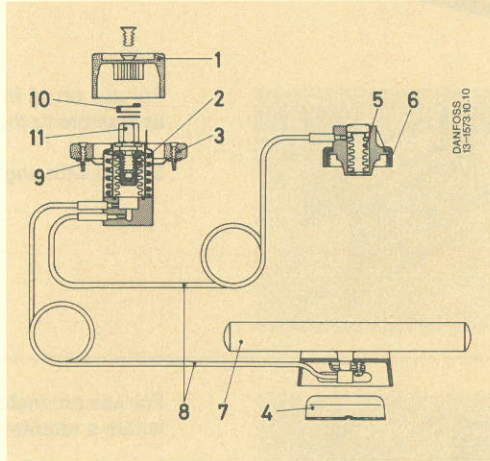
- Packless design
- Friction-free bellows design
- Accurate to within $\pm 1^\circ\text{F}$
- Wide adjustment range
- Temperature setting dial can be locked or limited
- Several capillary tube lengths
- Frost protection on the lowest setting
- Tamper and vandal proofing available
- Fail-safe design
- Armored model available

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Function and operating principle

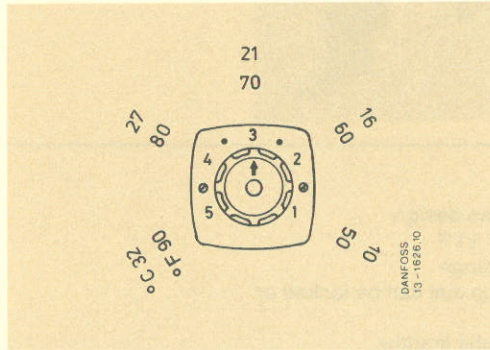
The thermostatic operator has a liquid filled bellows system and works with a modulating action. The sensor is actuated by the ambient temperature. A given pressure in the bellows system corresponds to the temperature of the liquid. This pressure is balanced by the regulating spring force. When used in conjunction with a valve, it can automatically regulate the amount of heat being supplied to a room, loop or zone.

On a rise in temperature the liquid expands, and the valve cone is moved towards its closed position via the actuator bellows and pressure pin. This continues until equilibrium exists between the bellows force and the spring force. On a drop in temperature the liquid volume decreases and the valve cone is moved in the opposite direction until equilibrium exists again.



Parts	Materials
1. Temperature adjustment dial	ABS
2. Adjustment bellows	Stainless steel
3. Scale ring, numbered 1-5	ABS
4. Sensor mounting clip	
5. Actuator bellows	Tin bronze
6. Union nut	Brass
7. Temperature sensor	Nickel plated copper
8. Capillary tube	Nickel plated copper
9. Mounting screw	Steel
10. Temperature locking/limiting rings	Steel
11. Spindle	Brass

Setting



Desired room temperature is set by turning the dial. The diagram shows the relationship between the scale numbers and room temperature. The values stated are to be used as a guide.



The lowest setting still provides frost protection. The set temperature can be limited or locked.

For details, refer to the RA installation instructions.




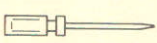
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RA thermostatic operators
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Ordering

Operators RA

Design	Code no.	Description	Design	Capillary length from dial feet		Temp. range	Max. sensor temp.
				To sensor	To valve		
	013-7001	"RA-6"	Operator with valve-mounted dial and remote sensor	6	-	50-90°F (10-32°C)	140°F (60°C)
	013-7101	"Armored RA-6"	Operator with valve-mounted dial and remote sensor and armored capillary tube	6	-		
	013-7002	"RA-33"	Operator with separate remote-mounted sensor and dial	3	3		
	013-7003	"RA-36"	Operator with separate remote-mounted sensor and dial	3	6		
	013-7004	"RA-66"	Operator with separate remote-mounted sensor and dial	6	6		

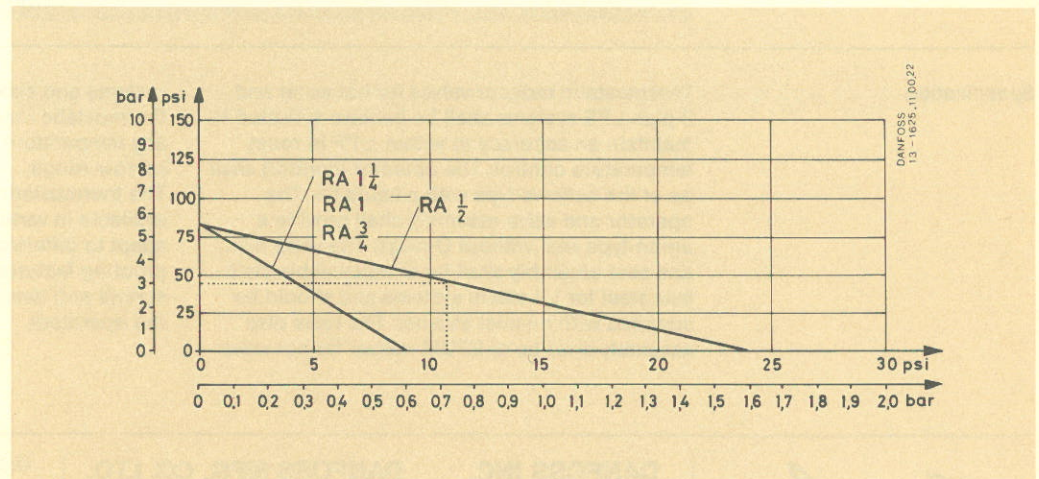
Accessories

Design	Code no.	Description
	013-0030	Sensor guard
	013-7064	Tamper kit (replaces dial and knob)
	681X2902	Tamper screw for selector knob
	948U2103	Screwdriver for above

Max. positive shut-off (pump head) for 2-pipe hot water systems

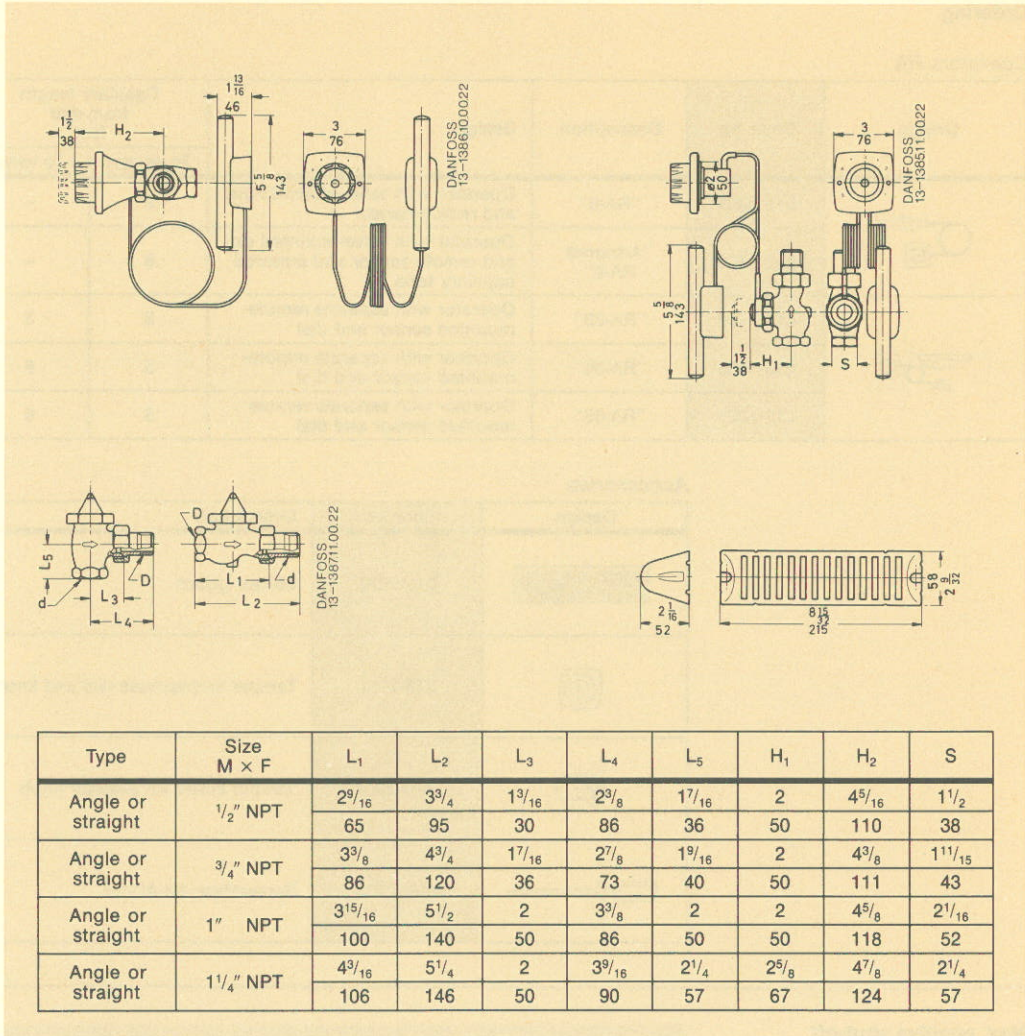
How to use the graph

1. Determine static pressure of system (e.g. 40 psi).
2. Draw horizontal line to desired valve size (e.g. 1/2").
3. Draw vertical line down to determine the maximum differential pressure (e.g. 11 psi).
4. In this example the maximum pump differential pressure (pump head) should not exceed 11 psi.



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Dimensions



Specification

Thermostatic radiator valves for hot water and 2-pipe LPS systems shall be bellows activated to maintain an accuracy to within $\pm 1^\circ\text{F}$ in room temperature control. The operator (control) shall be of the bellows type with a liquid fill. The operator and valve assembly shall provide a union-type seal without O-rings. The valve disc and seat assembly shall be of replaceable stainless steel for LP steam systems and should be supplied with an inlet strainer. The valve disc assembly shall be of EPDM rubber for hot water

systems and should also be replaceable. The thermostatic radiator valve shall be lockable at any temperature setting or limited within a narrow range. The thermostatic operators and valves must be available in various configurations and sizes to adapt to differing mounting conditions. Vandal proofing features such as sensor guards, special screws and tamper covers must be available for the operators.



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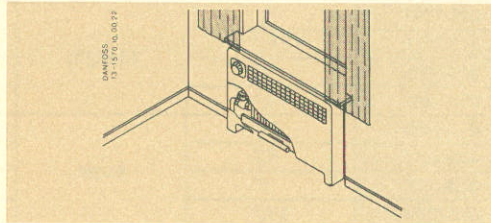
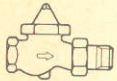
RA Valves

For use with operators type RA on hot water and 2-pipe L.P. steam heating systems



Typical installations

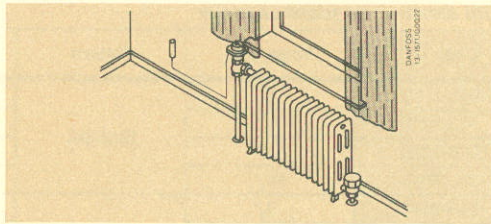
Straight valve



For all in-line installations.

Shown: Operator with separate remote-mounted sensor and dial.

Angle valve



For all angle installations.

Shown: Operator with valve-mounted dial and remote sensor.

Features

- Packless design
- Stainless steam disc and seat for steam
- Strainers for steam service
- Back seating gasket
- No special tools needed for routine maintenance
- Stainless steel return spring

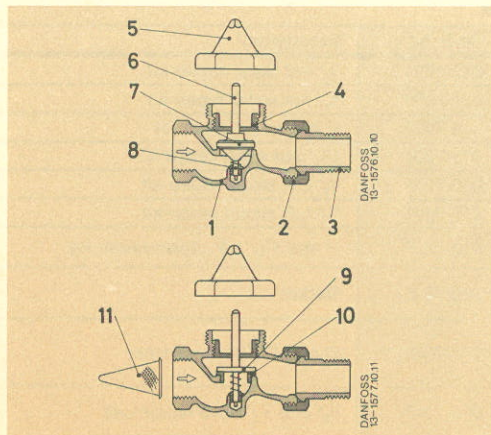
Supplied with

- Protective cap
- Separate valves for steam and hot water
- Color coded caps for easy identification
- Replaceable disc and seat for steam application

Function and design

The valve type RA for hot water and two-pipe low-pressure steam can be combined with any thermostatic operator type RA.

When installed in the inlet of a radiator, convector, etc., they automatically control the flow of steam or hot water entering the unit.



Parts	Material
1. Valve body	Brass
2. Union nut	Brass
3. Tail piece	Brass
4. Retainer	Brass
5. Protective cap (Red for steam, blue for HW)	ABS
6. Pressure stem	Brass
7. Disc, water applications	EPDM-rubber
8. Return spring	Stainless steel
9. Disc, steam applications	Stainless steel
10. Seat, steam applications	Stainless steel
11. Steam strainer	Stainless steel

ENGINEERING DATA
RA Valves
 For use with operators type
 RA on hot water and
 2-pipe L.P. steam heating systems



Technical data

Appl.	Limitations				
	Max. temp.	Max. diff. pressure	Max. static pressure	Max. steam pressure	Max. test pressure
Water	250°F 120°C	5 psi * 0.3 bar	80 psi 5.5 bar		228 psi 16 bar
Steam	250°F 120°C			15 psig 1 bar	228 psi 16 bar

* Recommended for quiet operation



Ordering

Valves for hot water



Design	Code no.	Valve size	Pattern	C _v *	Connections Inlet × outlet
	013-7011	1/2"	Straight	3.8	FPT × MPT
	013-7015	3/4"		5.7	
	013-7019	1"		8.3	
	013-7023	1 1/4"		9.0	
	013-7012	1/2"	Angle	3.8	FPT × MPT
	013-7016	3/4"		5.7	
	013-7020	1"		8.3	
	013-7024	1 1/4"		9.0	

* C_v refers to the flow through a full open valve at Δp = 1 psi

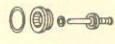





Valves for low pressure steam – standard capacity

Design	Code no.	Valve size	Pattern	MBh at Δp = 1 psi	Connections Inlet × outlet
	013-7013	1/2"	Straight	12	FPT × MPT
	013-7017	3/4"		51	
	013-7058	1"		51	
	013-7055	1 1/4"		54	
	013-7014	1/2"	Angle	12	FPT × MPT
	013-7018	3/4"		51	
	013-7059	1"		51	
	013-7054	1 1/4"		54	

Valves for low pressure steam – reduced capacity

Design	Code no.	Valve size	Pattern	MBh at Δp = 1 psi	Connections Inlet × outlet
	013-7051	3/4"	Straight	12	FPT × MPT
	013-7057	1"			
	013-7066	1 1/4"			
	013-7052	3/4"	Angle	12	FPT × MPT
	013-7053	1"			
	013-7065	1 1/4"			

Parts and accessories

Design	Code no.	Description
	013-7031	1/2" hot water repair kit
	013-7032	3/4" hot water repair kit
	013-7033	1" hot water repair kit
	013-7034	1 1/4" hot water repair kit
	013-7035	1/2" L.P. steam repair kit
	013-7091	3/4" L.P. steam repair kit
	013-7037	1" and 1 1/4" L.P. steam repair kit
	013-7045	Gasket
	013-7046	1" and 1 1/4" stem retainer
	013-7047	1/2" and 3/4" valve repair tool

ENGINEERING DATA

RA Valves

For use with operators type RA on hot water and 2-pipe L.P. steam heating systems

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Water application

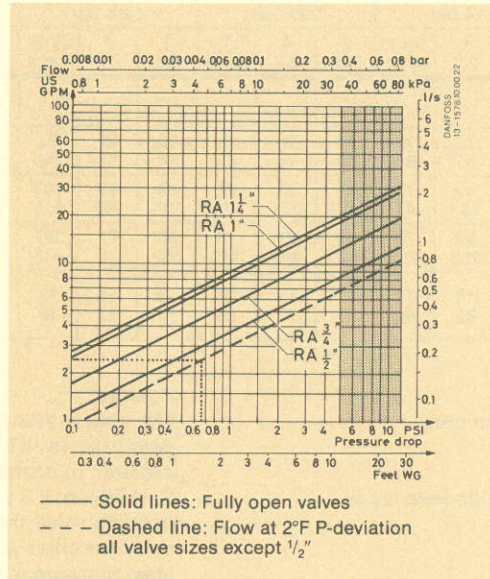
Capacity and selection chart

C_v -values: Flow in gpm at $\Delta p = 1$ psi w/RA operator

Type	P-deviation					
	°F	2.0	4.0	6.0	8.0	fully open
RA 1/2"	1.7	2.4	3.1	3.5	3.8	
RA 3/4"	2.7	4.2	5.2	5.5	5.7	
RA 1"	2.8	4.3	5.6	6.6	8.3	
RA 1 1/4"	2.8	4.4	5.8	6.9	9.0	

Recommended P-deviation is 2-4°F. P-deviation is the difference between set point and sensor temperature (room temperature). It relates to the degree of opening of the valve and is used when selecting the proper valve size. See further definition under "Steam application", page 4.

Quick selection capacity diagram



Shaded area represents differential pressures above those recommended for quiet operation. These conditions should be avoided in system design.

C_v values
Previously stated C_v values indicate water flow (Q) in gpm at a pressure drop of 1 psi through a fully open valve

$$C_v = \frac{Q}{\sqrt{\Delta p}}$$

The maximum differential pressure ratings indicate the maximum pressure at which valves regulate satisfactorily. In order to prevent noise, pumps which provide only the required pressure should be recommended.

Experience shows that in most systems a differential pressure of 0.5-2.5 psi across the valve is sufficient to provide the required flow. When high differential pressures are a concern they can be reduced by using Danfoss differential pressure regulator types AVD, AVDS and IVD-IVR.

Selection
Example - using diagram

Known
2.5 gpm flow required
3/4" valve desired (due to pipe size)

Solution
Dotted line indicates that 3/4" valve will give required flow at a P-deviation of 2°F at a pressure drop of 0.7 psi. Therefore, 0.7 psi should be added to the pipe loss calculation to determine the total system pressure drop.

Detailed selection method

Step by step selection technique

1. Before selecting valves, consider P-deviation.
2. Check that static pressure is below 80 psi (185 ft).
3. Determine gpm requirements of the index valve (generally farthest from the pump).

To convert
psi to feet of head = psi × 2.31
Feet of head to psi = feet of head × 0.433
Btu/h to sq ft EDR - Btu/h ÷ 240
One MBh = 1,000 Btu/h

Note

Some 2-pipe systems operate with differential pressures above 5 psi across the valve. Consideration should be made to maximum positive

shut-off and noise. See operator engineering data sheet for maximum positive shut-off curves.

Hot water capacity table

Pressure drop		1 psi 0.7 bar			2 psi 0.14 bar			3 psi 0.21 bar			4 psi 0.28 bar			6 psi 0.42 bar		
P-deviation °F		2	4	fully open	2	4	fully open	2	4	fully open	2	4	fully open	2	4	fully open
°C		1.1	2.2		1.1	2.2		1.1	2.2		1.1	2.2		1.1	2.2	
Valve size	Rating code															
1/2"	MBh	17	24	38	24	34	53	29	41	66	34	48	76	41	58	93
	kW	4.9	7.0	11.1	7.0	9.9	15.5	8.5	12.0	19.3	9.9	14.0	22.2	12.0	16.9	27.2
3/4"	MBh	27	42	57	38	59	80	46	72	98	54	84	114	66	102	139
	kW	7.9	12.3	16.6	11.1	17.3	23.4	13.5	21.1	28.7	15.8	24.6	33.4	19.3	29.8	40.7
1"	MBh	28	43	83	39	61	117	48	75	143	56	86	166	68	105	203
	kW	8.2	12.5	24.2	11.4	17.8	34.3	14.1	21.9	41.9	16.4	25.2	48.6	19.9	30.7	59.5
1 1/4"	MBh	28	44	90	29	62	127	48	76	155	56	88	180	68	107	220
	kW	8.2	12.1	26.2	8.4	18.1	27.0	14.1	22.2	45.2	16.4	25.8	52.5	19.9	31.3	64.2

Capacity is based on a 20°F temperature drop through radiation where 1 gpm flow = 10,000 Btu/h

Selection
Example - using chart

Known
35 MBh required (design heat load)
Available pressure drop 2.0 psi* (pump differential minus system frictional loss or available pressure drop produced by Venturi fittings).

Solution
The column for 2.0 psi shows that either a 3/4" or 1" valve will provide the required capacity at a deviation of 2°F. The valve which best meets the installation should be selected.

* When not available, an estimate must be made. Typically systems should operate with pressure drops of between 0.5 psi and 2.5 psi at the valve.

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ENGINEERING DATA
RA Valves
 For use with operators type
 RA on hot water and
 2-pipe L.P. steam heating systems

Steam application

2-pipe low pressure steam saturated

Step-by-step selection technique

1. Before selecting valves, consider P-deviation.
2. Check that system pressure is below 15 psig (1 bar).
3. Determine load requirements of each valve.

Maximum pressure: 15 psig (1.0 bar gauge)

Maximum steam temperature: 250°F (121°C)

Important

P-deviation refers to the difference between the thermostat setting and the actual sensor temperature (i.e. room temperature), for best comfort and long life, valves should be selected which provide the design heating load at a deviation between 2°F and 4°F.

Steam capacity table

Pressure drop*		1 psi 0.07 bar			2 psi 0.14 bar			3 psi 0.21 bar			4 psi 0.28 bar			6 psi 0.42 bar			15 psi 1 bar		
P-deviation		2 1.1	4 2.2	fully open	2 1.1	4 2.2	fully open	2 1.1	4 2.2	fully open	2 1.1	4 2.2	fully open	2 1.1	4 2.2	fully open	2 1.1	4 2.2	fully open
Valve size	Rating code																		
1/2"	MBh	7	10	12	9	15	16	11	18	20	13	21	23	16	26	28	26	41	44
	EDR	29	42	50	37	62	66	46	75	83	54	87	96	66	108	117	108	171	183
3/4" + 1"	MBh	15	32	51	22	45	72	27	55	89	32	63	102	39	78	126	61	123	200
	EDR	62	133	212	92	187	300	112	229	371	133	262	425	162	325	525	254	512	833
1 1/4"	MBh	19	36	54	28	50	76	34	62	93	39	71	107	48	87	131	75	138	207
	EDR	79	150	225	117	208	317	142	258	387	162	296	446	200	362	546	312	575	862
3/4" + 1" + 1 1/4" reduced to 1/2" capacity	MBh	7	10	12	9	15	16	11	18	20	13	21	23	16	26	28	26	41	44
	EDR	29	42	50	37	62	66	46	75	83	54	87	96	66	108	117	108	171	183

* Across valve

Rating abbreviations

MBh = Thousands of Btu/h
 EDR = Equivalent Direct Radiation

Conversion factors

sq ft EDR to Btu/h = sq ft EDR × 240 (steam)
 Btu/h to sq ft EDR = Btu/h ÷ 240
 One MBh = 1,000 Btu/h

Selection

Example - using steam chart

Known

18 MBh required (design heat load)
 Pipe size - 1"

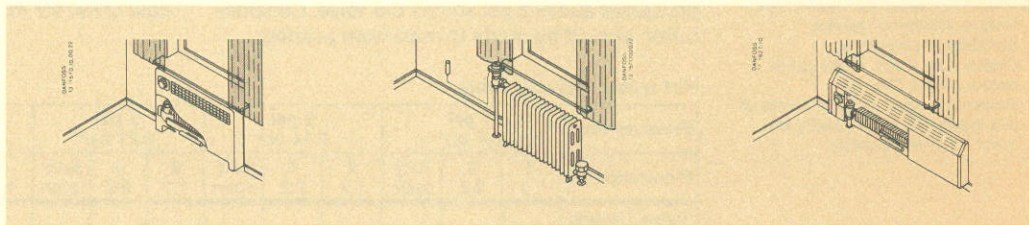
Desired

P-deviation of 4°F or less

Solution

The intersection between a 1" valve with *reduced capacity* and 18 MBh shows that only 3 psi is required to provide the necessary flow at a 4°F P-deviation. If 3 psi is available, the 1" *reduced capacity* valve should be selected, if not you may consider other valve capacities or sizes. The system pressure may also be adjusted accordingly taking pipe losses and other factors into consideration.

Mounting



The valve body is designed for installation in the inlet of the radiator with flow in the direction of arrow.

The sensor must always be placed so that free air can circulate around it.

Dimensions

See operator engineering data sheet for dimensions of assembled thermostatic radiator valves, (form number VD.11.S2.22).

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