HIPER II

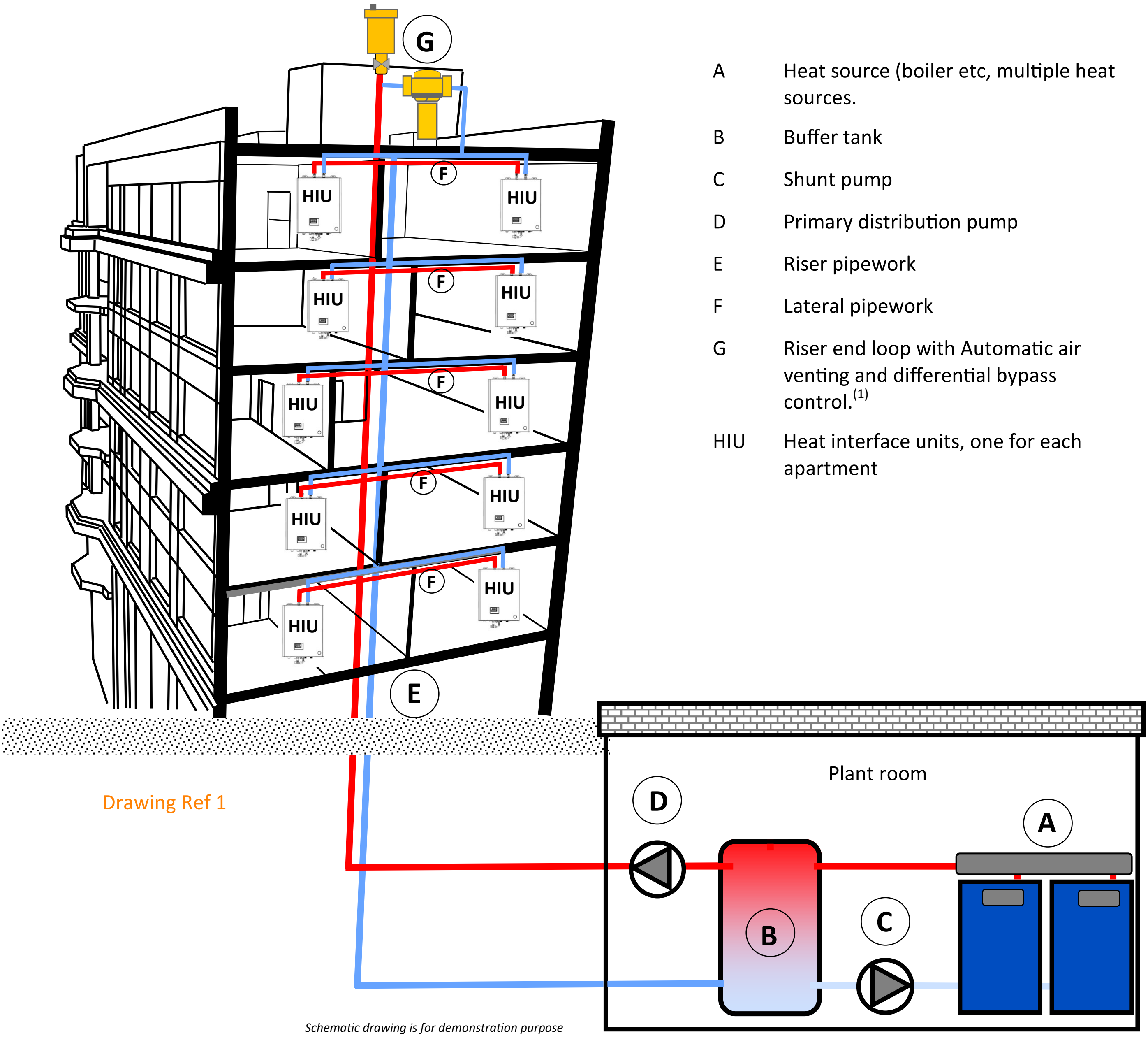
An introduction to heat network design

mibec

Heat network basics.

Schematics, drawings and example figures do not constitute an actual design, and each project should be reviewed individually as a unique design process.

A	Heat source (boiler etc, multiple heat sources.
B	Buffer tank
C	Shunt pump
D	Primary distribution pump
E	Riser pipework
F	Lateral pipework
G	Riser end loop with Automatic air venting and differential bypass control.(1)
HIU	Heat interface units, one for each apartment



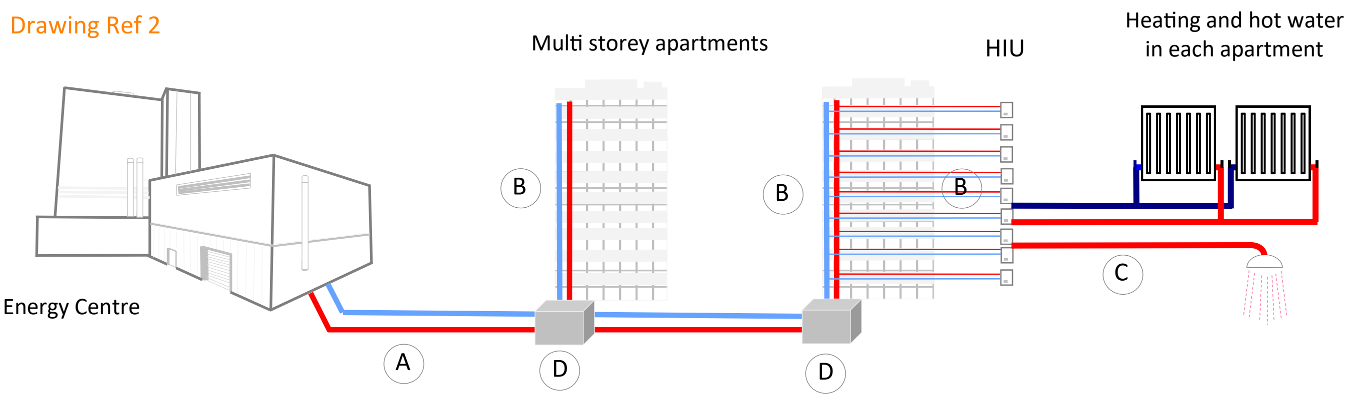
Drawing Ref 1

Schematic drawing is for demonstration purpose only, and does not constitute actual plantroom design.

Note 1 (Ref G in the drawing).
The reverse acting differential pressure controller (RADPCV) is sensing the pressure differential between flow and return riser pipes as the HIU control valves close down, the head pressure will increase causing the increase in the pressure difference between flow and return pipes. When there is no demand from the HIUs, then this valve provides the alternative flow path.
The valve opens to compensate, and bypasses the flow into the return bringing the pressure difference back to the set value.
The valve will continually modulate the pressure differential. In most cases, the valve is set to control a value about 10% above the operating point of the system at the design conditions.

Heat network basics.

Drawing Ref 2



Pipework terminology - District Heating.
As described in the CIBSE CP1 Heat networks code of practice.

A Primary pipework (or primary heat network)

B Secondary pipework (or secondary heat network)

C Tertiary pipework (or tertiary heat network, heating and DHWS internal to the apartment and separated from the primary network

D Sub Station (2)

Typical sub station construction.

Note 2 (Ref D in the above drawing).
The Substation separates the buildings from the district heating pipe network.

Where the temperatures and pressures of the building's heating systems differ from those of the district heating network, it is usually necessary to utilise a Substation. A Substation consists of a plate heat exchanger which creates pressure break between the district network and consumer system.

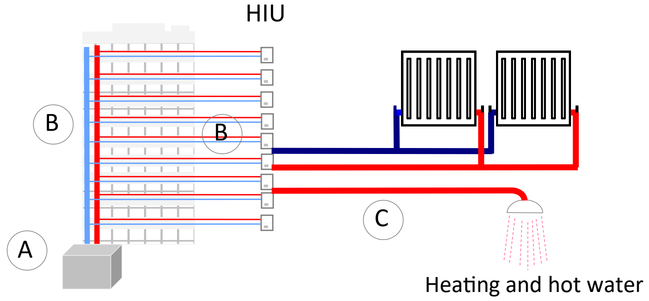
The district heating supplier will provide information on the actual minimum and maximum differential pressures, as measured at the service connection valves. This data should be used for determining the sizes and capacities of control valves and heat exchangers.

Pipework terminology - Communal Heating System.

A Boiler plant room

B Primary pipework

C Secondary pipework



Drawing Ref 3

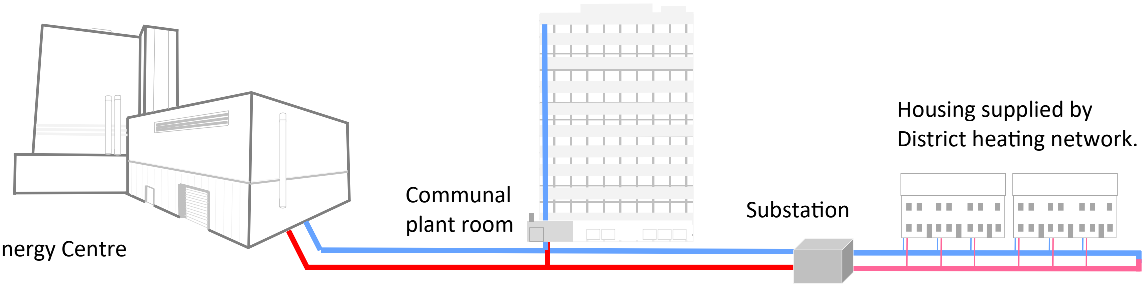
Heat network basics.

District heating networks in some cases can cover large areas and service multiple buildings and homes. They can be added to later and also linked to other schemes to form an even larger network. As such it is important that the M&E consultants and Developers understand where the key lines of responsibility lie.

Demarcation and ownership is important and should be clear to ensure that the responsibility for maintenance and metering understood by all involved. Demarcation is important for small community heating schemes as well as larger networks.

Centralised plantrooms in large buildings and separate substations for smaller buildings are recommended. The plate heat exchangers in these plantrooms and substations creates clear demarcation lines that separate the main network from each individual building or estate, and providing a pressure break.

Pressure breaks in communal heating plant rooms and substations ensure that taller buildings do not affect the pressure other parts of the network.



Drawing Ref 4

Heat network system

Heat source

The design engineer will be looking to achieve the most efficient source of heat that is practical for each individual project. Gas condensing boilers, multi stage boilers, heat pumps, and to a lesser degree combined heat and power (CHP) or biomass boilers. Other low carbon methods such as solar thermal are also to be considered as secondary heat sources. Larger systems can tap into waste heat recovery projects.

Shunt pump.

Usually a twin pump set for circulating water and heat from the heat source to the buffer tank at constant speed / flow.
The pump will be moving heat from the heat source and into the buffer as required.

Buffer Vessel.

The purpose of the buffer vessel is to provide heat to meet peaks of maximum demand which occur over short periods, storing heat for later use and supplementing the heat source when demand is high. Stored heat is immediately available without the heat source needing to get up to temperature. The buffer should be sized correctly to match the load demand with consideration to the heat source, building construction, and even the number of people that possibly can create a demand during peak demand times, usually morning and evening.

Primary distribution pump (or secondary pump in the case of a district heating network).

Variable speed circulating pump capable of efficiently operating at operating at part load. The pump should be sized to meet speed and flow design requirements and be controlled so that there is always sufficient pressure and flow available to feed all the HIUs in the network equally.

Riser end loop with Automatic air venting and differential bypass control * also see note 1)

Provision for venting air from the Risers, Provision for maintaining circulation when all control valves in the HIUs are closed.

Design examples

Example for demonstration,
30 apartments each with it's own HIU.
Each apartment is the same.
DHW peak load 38.6 kW for this demonstration.

Schematics, drawings and example figures do not constitute an actual design, and each project should be reviewed individually as a unique design process.

Exercise 1	Calculate each apartment's heating peak load
Exercise 2	Estimate each apartment's hot water peak load
Exercise 3	Coincidence factors and calculate diversity
Exercise 4	Calculate the flow rates to size each section of pipe that to serve all HIUs at peak load

Heating peak load exercise 1

Building systems are designed to meet peak heating demand and ignore working at part load. Designing a system to peak outputs and factoring in a margin for additional capacity to guarantee meeting performance capacity is mostly the chosen method.
Peak demand may only occur for a few hours and would differ from year to year. While heating systems consume energy for nearly half the year, and the system works at peak load for only week or so, then the rest of the year it is over-sized.
Using a diversity factor very much depends on judging the building on its 1) occupants 2) geographical location of the building and climate 3) the building fabric. So coincidence factors can be used, up to 80%. It needs to be evaluated from project to project.

For Heating design, refer to - **BS EN 12831-1:2017**

Energy performance of buildings. Method for calculation of the design heat load. Space heating load, Module M3-3

Types of heating in apartments;
- panel radiators, inc LST
- Underfloor heating wet systems

For dwellings over 150m2 Part L as good practice recommends two space heating circuits each with independent time and temperature control, and thermostatic radiator valves.

The use of pre-settable radiator valves is recommended for the correct balancing of radiators.

Exercise 1 - or the purpose of this exercise, we assume heat losses are calculated and there is a heating load for each apartment type of 5kW.

Hot water peak load exercise 2

For each apartment type, the demand flow rate has to be calculated. This is determined by the number of outlets (taps and showers). It is unlikely that all will open at the same time, but again a peak load has to be estimated. First calculate the flow rate the apartment users will expect, and the calculate in kW the power needed to deliver the design flow rate and the temperature for the hot water. A key influence is the cold water in temperature, 10C is set as the base line, so to achieve 55C DHWS then the temperature 'lift' is 45C. In some HIU's data sheets the temperature for HIU performance tables is 50C, so then 'lift' value is less, and the power rating for the HIU is greater. Here are four possible examples.

Example 1 Hot water table, where the total flow though the outlet is the maximum and then mixed 70% hot with 30% cold, with the exception of the kitchen sink tap which we assume the user is using maximum temperature. Hot water temperature is 55C, and the cold inlet 10C. We are not saying this is this is what always happens, its just one way of looking at DHW use.

Table 1

Shower 7.75 L/min (70% HW) Ensuite shower	Shower 9 L/min (70% HW) Main shower	Basin 6 L/min (70% HW)	Basin 4 L/min (70% HW)	Kitchen Sink 6 L/min (100% HW)	Bath 12 L/min (70% HW)	Total flow in ltr/hr hot water requirement	Power
Ltr/hr	Ltr/hr	Ltr/hr	Ltr/hr	Ltr/hr	Ltr/hr	Ltr/hr	kW
325.5	378	216	168	360	504		
outlets in use simultaneously - flow rate in ltr/hr							
OFF	378	OFF	OFF	OFF	OFF	378	19.8 kW
325.5	OFF	OFF	OFF	360	OFF	685.5	35.9kW
OFF	378	OFF	OFF	360	OFF	738 *	38.6 kW
OFF	OFF	OFF	OFF	360	504	864	45.2 kW

Note, figures are examples of possible flow rates and should not be used as actual design parameters. Each project should be calculated by the design engineer.

Example 2 Now we change one thing, we now carry out the same exercise but with the cold inlet at 15C. Less power is now required as the temperature lift is less. An example in deciding which is the most realistic profile for sizing.

Table 2

Shower 7.75 L/min (70% HW) Ensuite shower	Shower 9 L/min (70% HW) Main shower	Basin 6 L/min (70% HW)	Basin 4 L/min (70% HW)	Kitchen Sink 6 L/min (100% HW)	Bath 12 L/min (70% HW)	Total flow in required for heating to hot water	Power
325.5	378	216	168	360	504	l/h	kW
outlets in use simultaneously - flow rate in L/h							
OFF	378	OFF	OFF		OFF	378	17.6 kW
325.5	OFF	OFF	OFF	360	OFF	685.5	31.9 kW
OFF	378	OFF	OFF	360	OFF	738 *	34.3 kW
OFF	OFF	OFF	OFF	360	504	864	40.1 kW
OFF	378	OFF	168	360	OFF	906	42.1 kW

Note, figures are examples of possible flow rates and should not be used as actual design parameters. Each project should be calculated by the design engineer.

* For example purposes only, we will select this value as our peak DHW flow design rate, 738 l/hr converted to 0.205 l/s

Power calculation

$$P = \frac{\Delta t \times Q}{860} \qquad \frac{\text{Temperature 'lift'} \times \text{design flow rate DHW l/h}}{\text{The value 'constant' of 860}}$$

$$\frac{45 \times 738}{860} = \mathbf{38.6\ kW}$$

Hot water peak load

Example 3 - NHBC standards 2020—DHW flow rates (supplied by NHBC reprinted with their permission)

Table 3: Flow rate and temperature requirements

Outlet	Design flow rate (1)		Minimum flow rate (2)		Supply temperature °C (3)
	L/sec	(L/min)	L/sec	(L/min)	
Bath (from storage)	0.30	(18)	0.15	(9)	48
Bath (from combi)	0.20	(12)	0.15	(9)	40
Shower (non-electric)	0.20	(12)	0.10	(6)	40
Wash basin	0.15	(9)	0.10	(6)	40
Sink	0.20	(12)	0.10	(6)	55

Notes

1 The design flow rate should be used to establish the hot and cold pipe sizes to provide the flow rate quoted at each outlet when that outlet is used on its own.

2 The minimum flow rate should be available at each fitting when that fitting is used simultaneously with one or more other fitting(s) as shown in Table 4.

3 The supply temperature is the temperature at the outlet. In accordance with BS 8558 the water temperature at an outlet or thermostatic mixing valve should be at least 50°C within 1 minute of running the water.

Recalculate using NHBC Table 3 for design hot water use. Take into account that using these guidelines the hot tap is the total flow, and these are figures used for stored water systems (bath figures used are from combi figures).
DHW set temperature 55C, Cold water supply temperature 10C.

Table 3

Shower 9 L/min 100% hot water	Basin 6 L/min 100% hot water	Kitchen Sink 12 L/min 100% hot water	Bath 12 l/min 100% hot flow	Total flow in ltr/hr hot water requirement	Power kW
540 Ltr/hr	360 Ltr/hr	720 Ltr/hr	720 Ltr/hr		
540				540	28.25 kW
			720	720	37.67 kW
540		720		1260	65.9 kW
		720	720	1440	75.34kW

Example 4 - what can we consider the most realistic DHW peak load flow rates?
Flow rate reference is BREEAM Wat 01 Water consumption performance level 3.
Factor in a more realistic boosted cold water supply to the apartment at 17C
Factor in TMV2 mixing on showers to maintain Basin and shower temperature of 41C, and bath at 44C (mix ratio 8.5 : 1.5)
DHW set temperature 55C, so now the temperature lift is 38C.

Table 4

Shower 9 L/min 85% mixed hot water	Basin 6 L/min 85% mixed hot water	Kitchen Sink 12 L/min 85% mixed hot water	Bath 12 l/min 85% mixed hot water	Total flow in ltr/hr mixed hot water	Power kW
459 Ltr/hr	306 Ltr/hr	612 Ltr/hr	612 Ltr/hr		
459				459	20.28 kW
			612	612	27.04 kW
459		612		1071	47.32 kW
459	306	612		1377	60.84kW
		612	612	1244	54.08 kW

Power calculation $$P = \frac{38 \times Q}{860}$$ $$\frac{\text{Temperature 'lift' } \times \text{ design flow rate DHW l/h}}{\text{The value 'constant' of 860}}$$

Coincidence factors and calculate diversity

Diversity Factor (F) Calculation

$$F = \frac{DFR}{MFR} = \frac{\text{Hot water Design Flow Rate l/sec}}{\text{Maximum hot water design Flow Rate l/sec}}$$

DHWS demand is difficult to predict as it's down to multiple factors involving peoples' lifestyles, numbers of occupants per apartment, seasonal conditions, and work patterns. For this reason, a 'factor' is applied to attempt to replicate the situation where not everyone will be using hot water at the same time. In basic terms, the more apartments or homes the less likely it becomes that they are all running simultaneously, so we can reduce the peak design load. The design standards in Scandinavian countries have often been held as an example for this factor, such as the Danish Standard DS439. There is much debate as to whether this is suitably applicable to the UK, and other variations on this have been discussed but there is no printed standard.

The DS439 standard identifies 37.6 kW as the peak load for a standard apartment. The coincidence factor simulates how unlikely it is for all the individual apartments to be peaking at the same time, to prevent oversizing of the overall system. The diversity factor is the reciprocal of the coincidence factor.

For larger apartments or homes, then a common practice is to scale up the factor proportionately. In fact, this is not always true, because the larger apartment would not mimic the DHW requirements of two smaller households, though may have larger peak load. So, each project must be judged on its own requirements, and the coincidence and diversity factors are at best a guide.

Table 5 - Coincidence factor

Qty HIU	DHW Load (kW)	Factored load per HIU	Max Power per HIU	Coincidence Factor
1	37.6	37.6	37.59	100.00%
2	46.6	23.3	75.18	61.94%
3	53.7	17.9	112.77	47.65%
4	60	15	150.36	39.88%
5	65.6	13.1	187.95	34.90%
6	70.8	11.8	225.54	31.39%
7	75.7	10.8	263.13	28.76%
8	80.3	10	300.72	26.70%
9	84.7	9.4	338.31	25.04%
10	89	8.9	375.9	23.66%
11	93	8.5	413.49	22.50%
12	97	8.1	451.08	21.51%
13	100.9	7.8	488.67	20.64%
14	104.6	7.5	526.26	19.88%
15	108.3	7.2	563.85	19.20%
16	111.8	7	601.44	18.60%
17	115.3	6.8	639.03	18.05%
18	118.8	6.6	676.62	17.56%
19	122.2	6.4	714.21	17.10%
20	125.5	6.3	751.8	16.69%
25	141.4	5.7	939.75	15.04%
30	156.3	5.2	1127.7	13.86%

Qty HIU	DHW Load (kW)	Factored load per HIU	Max Power per HIU	Coincidence Factor
35	170.5	4.9	1315.65	12.96%
40	184.1	4.6	1503.6	12.24%
45	197.3	4.4	1691.55	11.66%
50	210	4.2	1879.5	11.18%
60	234.6	3.9	2255.4	10.40%
70	258.2	3.7	2631.3	9.81%
85	292.1	3.4	3195.15	9.14%
90	303.1	3.4	3383.1	8.96%
100	324.6	3.2	3759	8.64%
110	345.7	3.1	4134.9	8.36%
120	366.3	3.1	4510.8	8.12%
130	386.7	3	4886.7	7.91%
147	420.5	2.9	5525.73	7.61%
150	426.4	2.8	5638.5	7.56%
175	474.6	2.7	6578.25	7.21%
200	521.5	2.6	7518	6.94%
250	612.4	2.4	9397.5	6.52%
337	763.8	2.3	12667.83	6.03%
400	869.6	2.2	15036	5.78%
500	1033	2.1	18795	5.50%
1000	1802.1	1.8	37590	4.79%
10000	13797.6	1.4	375900	3.67%

Based on Danish standard DS439

Diversity and coincidence factors

The likelihood of everybody opening all their taps and using their showers at the same time is extremely remote, in fact, it would never happen. So as mentioned before, system designs incorporate this into their pipework sizing. Over-sizing has obvious disadvantages in increased capital costs, as well as increased network heat loss. For Risers, the effect over oversizing vertical pipes is less critical, air and dirt can be easily eliminated, and low temperatures on the return riser pipework limits heat loss issues. In general, sizing with a ‘safety’ factor to allow for unknowns reduces thermal efficiency.

Applying the co-incidence factor allows each section of pipework to be sized in accordance to its position in the network, and the peak loads it will have to carry

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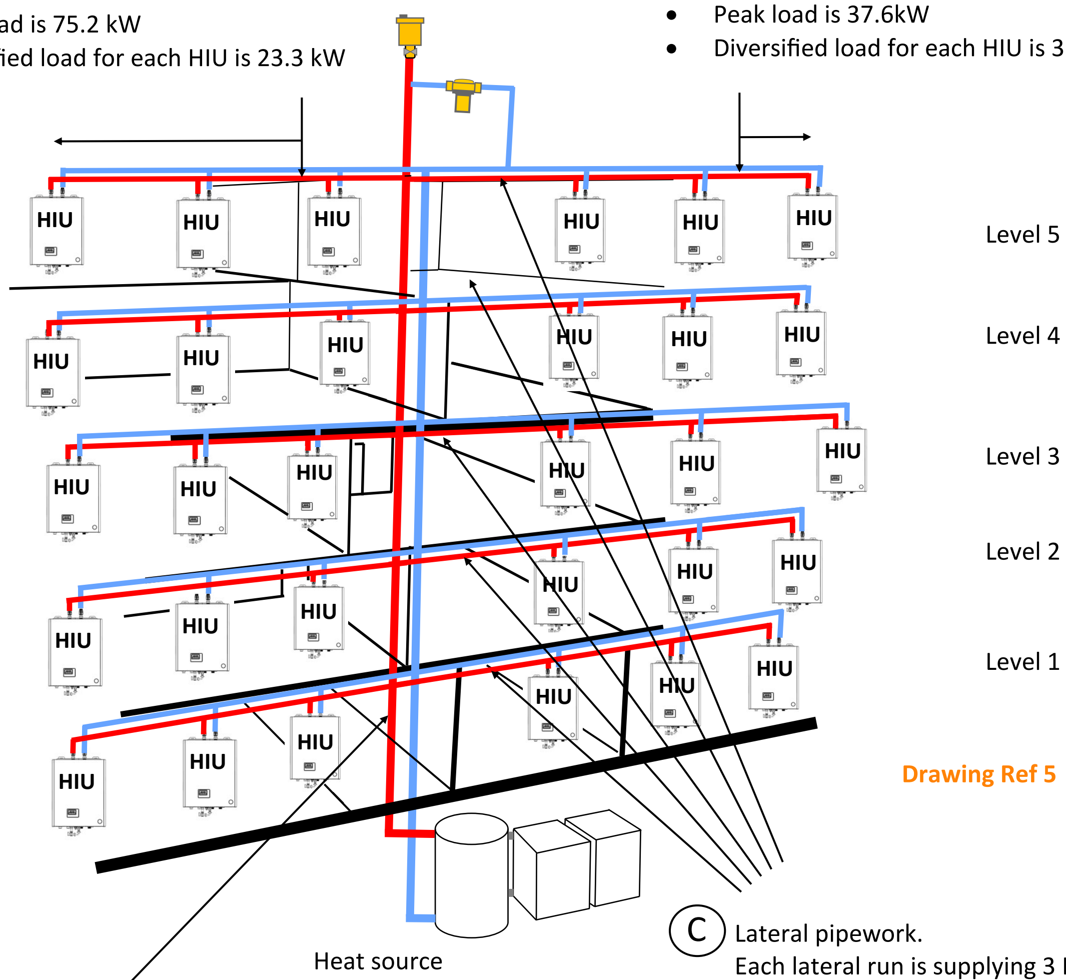
B At this point, and on all lateral pipes the supply is for 2 x HIU.

- Coincidence factor 61.94%
- Peak load is 75.2 kW
- Diversified load for each HIU is 23.3 kW

A At this point, and on all lateral pipes the supply is for 1 x HIU.

- Coincidence factor 100%
- Peak load is 37.6kW
- Diversified load for each HIU is 37.6kW



C Lateral pipework.
Each lateral run is supplying 3 HIUs

- Coincidence factor 47.65%
- Peak load is 112.80 kW
- Diversified load for each HIU is 17.9kW

D Main Riser pipework - the heat source is supplying all 30 HIUs.
Using the diversity factor table;

- Coincidence factor for 30 HIU is 13.86%
- Peak load is 1128 kW
- Diversified load for each HIU is 5.2 kW

Design example for demonstration,

30 apartments each with its own HIU.
Each apartment is the same.
Peak load hot water is 38.6 kW for this demonstration. (DS439 is 37.6 kW)
Heating load for this example is 5kW

Exercise 1 **Calculate each apartment's peak heating load in kW**
(for the purpose of this demonstration has been calculated at 5kW)

Exercise 2 **Estimate each apartment's peak hot water load in power (Kw)**
(for the purpose of this demonstration has been calculated at 0.205 l/s as in hot water peak load Table 1)

Exercise 3 **Calculate diversity**
(using the DS439 figure in Table 5, our estimated example load is 38.6kW)

Exercise 4 **Calculate the flow rates to size each section of pipe that to serve all HIUs at peak load**
(using the information from the previous exercises, using peak heating and hot water power calculations)

Exercise 4A - applying a calculation formula

Primary flow rate (peak) for heating

$$\frac{\text{Power kW (heating)}}{\text{4.2 (constant value)} \times \text{primary temperature differential}}$$

As in exercise 1, calculated at 5kW
Hiper factory setting heating flow is 60C
Heating return temperature is 40C

$$\frac{5\text{ kW}}{4.2 \times 20} = \mathbf{0.0595\ l/s}$$

Exercise 4B- applying a calculation formula

Primary flow rates (peak) for hot water

$$\frac{\text{Power kW (hot water)}}{\text{4.2 (constant value)} \times \text{primary temperature differential}}$$

As in exercise 2, calculated at 38.6 kW
Hiper factory setting DHW at 55C
Cold at 10C, ΔT at 40C

$$\frac{38.6\text{ kW}}{4.2 \times 40} = \mathbf{0.229\ l/s}$$

Exercise 4C- applying a calculation formula

Formula for the total design flow rate = **(coincidence factor x DHW peak flow)** + **Heating peak flow rate**

See example block of 30 apartments, and apply the calculation to each section of pipework.

Continue next page

Calculate pipe flow rates for each pipework section

Example reference see Drawing 5

- **Sizing using the coincidence factor tables Table 3**
- **Heating load primary flow rate calculated in exercise 4A at 0.0595 l/s**
- **Hot water load primary flow rate calculated as exercise 4B at 0.229 /s**

To calculate the TOTAL load, each pipe section, A,B,C & D is looked at individually.

Formula for the total design flow rate = (coincidence factor x DHW design peak flow) + Heating peak demand flow rate

Diversified flow rates

Example - Drawing 5, Position A, 1 x HIU
DHW Power = 37.6 kW
Heating Power = 5 Kw

(1 x 0.229 l/s) + 0.0595 l/s = 0.2885 l/s

Size the pipework in this section to this flow rate

Example - Drawing 5, Position B, 2 x HIU
DHW Power = 75.2 kW
Heating Power = 10 kW

(0.6194 x 0.458l/s) + 0.119 l/s = 0.4027 l/s

Size the pipework in this section to this flow rate

Example - Drawing 5, Position C, 3 x HIU
DHW Power = 112.8 kW
Heating Power = 15 kW

(0.4765 x 0.687 l/s) + 0.1785 l/s = 0.5058 l/s

Size the pipework in this section to this flow rate

Example - Drawing 5, Position D, 30 x HIU
DHW Power = 1128 kW
Heating Power = 150 kW

(0.1386 x 6.87 l/s) + 1.785 l/s = 2.7378 l/s

Size the pipework in this section to this flow rate

Buffer tanks

A buffer tank can be incorporated into the system to provide a storage reservoir that absorb the demands of peak load demands. This energy reservoir provides an energy buffer to cope with demand and allow the boilers or heat source to react in the most efficient way. The buffer can be supplied with heat by multiple sources, and should be designed to hold adequate heat for the design peak load, with stable temperatures no less than two thirds down the height of the tank.

In deciding how long a time the buffer would be required one of the factors is the type of heat source. Gas boiler, heat pump, CHP, Biomass etc.

The calculation can then be applied; Time in seconds multiplied by the diversified DHW heat load.

Using again the 30 x apartments example of demonstration;
Example: 15 minutes peak demand? 900 (seconds) x (0.1386 x 6.87 l/s) = 857 Ltrs Buffer capacity
Example: 10 minutes peak demand? 600 (seconds) x (0.1386 x 6.87 l/s) = 571Ltrs buffer capacity

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Pressure differential

An efficient system should be balanced and deliver to each HIU the design flow rate. Across the system there will be a pressure differential, and for each HIU to work to its designed flow rates they must share an stable pressure drop in matching the system's design requirement.

Controlling pressure differential;

- **Balances the system to the design flow rates**
- **Improves control valve accuracy**
- **Protects control vales against high pressures that prevent opening and closing**
- **To preserve stability in variable flow networks**

Explaining Differential Pressure Control Valves (DPCV)

There is a direct relationship between differential pressure and flow rate. The DPCV controls the flow rate by controlling the differential pressure between two points within the HIU primary circuit. The pressure drop created in the HIU is made by the volume of water passing through it, and as the flow rate increases so the pressure drop increases.

By understanding this relationship, having control over the differential pressure drop between the primary flow and return connections on the HIU, the flow rate can also be controlled. Maintaining the flow rate allows the HIU to function efficiently and accurately, delivering Heating and DHWS as designed. No differential control and the HIU will not perform correctly or efficiently, or in extreme cases, work at all.

This is the definition of a DPCV (Differential Pressure Control Valve), to create stability in a variable flow system.
Generally installed on the return pipe, a pilot tube connects the valve body to a connection on the other side of the HIU circuit, i.e. on the Primary Flow. The DPCV has two chambers, one connected with the flow, and one side with the return, and separated by a diaphragm. The upper chamber pressure acts to close the DPCV, and the lower chamber acts to open the DPCV, the resulting modulations maintain a constant differential pressure as set in the adjustment on the valve stem.

It is the design engineer's objective to design a variable volume system that can meet both maximum and minimum load . conditions with the control valve operating with full authority. DPCV's are critical in protecting these control valves.
Within a HIU, The secondary side DP is set by the valve and can range from 5 kPa to 500 kPa dependent upon valve size and spring rating. Conventional residential spec TRVs will close tightly and silently up to 30 kPa to 60 kPa DP (see manufacturers datasheet) so the secondary DP should be set lower than this point. The lower the set DP the higher authority and better control the TRVs will have.

Hiper II HIU using PICV Control

Pressure Independent Control Valves (PICV) - 3 valves in one;

- **Differential pressure control valve**
- **Modulating control valve**
- **Flow regulation valve**

In the Hiper II, a PICV provides modulating control with full authority regardless of any fluctuations in the differential pressure of the system. Having one modulating valve with control of pressure differential means that it must adapt to the different demands of either hot water or central heating which is not possible with a thermostatic valve. The Hiper HIU controller electronically maintains the temperature set points and limits the flowrates to presets within the controller.

The pressure drop is created by the primary control valve and not the heat exchanger itself. For a low secondary flow, the primary valve is only going to open a small amount (10-15%). This will create a very high pressure drop from the valve itself. The pressure drops over the heat exchanger will be low. When the flow rate is high, this causes the primary valve to open wider or fully, and then decreasing the pressure drop over this valve significantly.

In Hiper II the total pressure drop decreases as the primary flow increases. The maximum pressure differential across the PICV is 400 kPa giving a good scope for consultants to size pipes according even for the closest connections to the pump.

Balanced heating circuits

The Inta PTRV

- **Pressure differential control maintaining pre-set flow rates**
- **Pre-set flow rates for commissioning**
- **Thermostatic control**

For too long the HIU has been carrying the blame for high Secondary Return temperatures that are actually the result of poor commissioning or balancing of the secondary (tertiary) system. Making the use of pre-settable radiator valves mandatory would go a long way to resolving this.

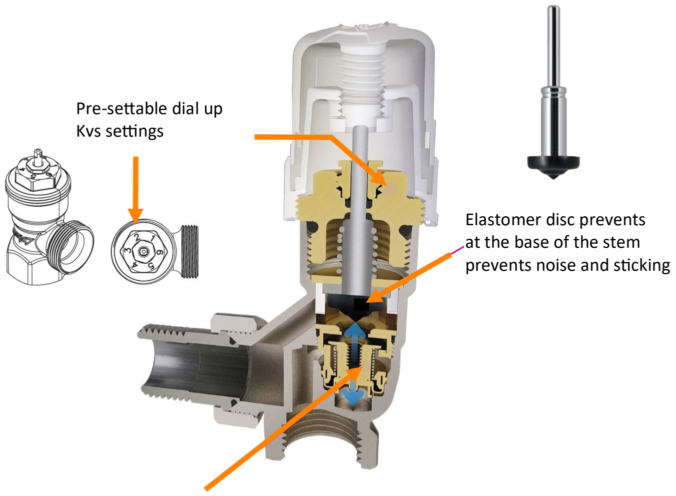
The **thermostatic valve with pre-setting independent from pressure** is a radiator valve that performs the functions of a thermostatic valve and a differential pressure regulator. Each pre-settable thermostatic valve comes with six pre-set Kv values. The valve comes complete with the EN215, class A efficiency rated Inta i-therm TRV valve head.

The flow rate pre-setting limits the maximum flow passing through the radiator and thereby ensures simple and effective radiator circuit balancing. The differential pressure regulator integral with the rad valve maintains a constant pressure differential so therefore maintaining the set flow rate.

The benefits of PTRV are;

- Maintaining the design efficiency of the system
- System remains balanced under fluctuating conditions
- Prevention of uncontrolled high secondary return temperatures under low load
- Reduced system noise

Pre-settable dial up Kvs settings for PTRV		Thermostatic head temperature settings	
1	25 l/h	*	7°C
2	35 l/h	1	10°C
3	55 l/h	2	15°C
4	80 l/h	3	20°C
5	95 l/h	4	25°C
6	120 l/h	5	30°C



Examples for setting the PTRV , min pressure for constant flow 0.1 bar. Heating is 60 / 40 with calculated *flow rated using the formula ;

$$Q = \frac{P}{1.16 * \Delta T}$$

Pressure-independent Thermostatic Radiator control valves
PTRV angle valve with 1/2" female threaded connection rad valve with i-therm white TRV Head
PTRV straight valve with 1/2" female threaded connection rad
PTRV angle valve with 15mm connection rad valve with i-therm
PTRV angle valve with 15mm connection rad valve with i-therm

Heat Load	ΔT	*Flow l/h	Setting Number
600 W	20°C	25 l/h	1
800 W	20°C	34.5 l/h	2
1200 W	20°C	53.88 l/h	3
1800 W	20°C	77.58 l/h	4
2200 W	20°C	94.8 l/hr	5
2800 W	20°C	120.68 l/hr	6

Primary flow temperature

The HIU performance is dependant on it's supply flow rate and temperature.

Continuing with this exercise, and referring now to all the calculations we have for the demonstration on Drawing Ref 5 Summary 30 apartments each with its own HIU.

- Each apartment is the same,.
- Peak load hot water is 38.6 kW for this demonstration.
- Heating load for this example is 5kW
- Primary flow at 1 x HIU is 0.229 l/s when in peak DHW mode (0.824 m^3/hr)
- DHW peak flow is calculated on 738 l/hr from table 1. (12.3 l/min)
- DHW temperature is 55C, and the temperature lift is based on 10C cold incoming mains supply temperature.

Using the tables of tested performance for Hiper II HIU, the primary temperature effect on the performance can be selected to meet the requirements of each apartment, i.e. we estimate we need minimum 12.3 l/min DHW using the above figures.

Primary flow and return temperatures should be as low as possible, but not at the sacrifice of user comfort levels. The apartment occupants will have expectations of DHW performance and these should not be less than something comparable that has been experienced in the past by for example a combi

		ΔT 45°C (10/55°C)			
primary circuit flow rate	primary circuit supply temp.	primary circuit return temp.	primary circuit pressure drop	heat exchanger max. capacity	flowrate DHW
m3/h	°C	°C	kPa	kW	l/min
0.8	60	26.4	74.5	**28**	8.9

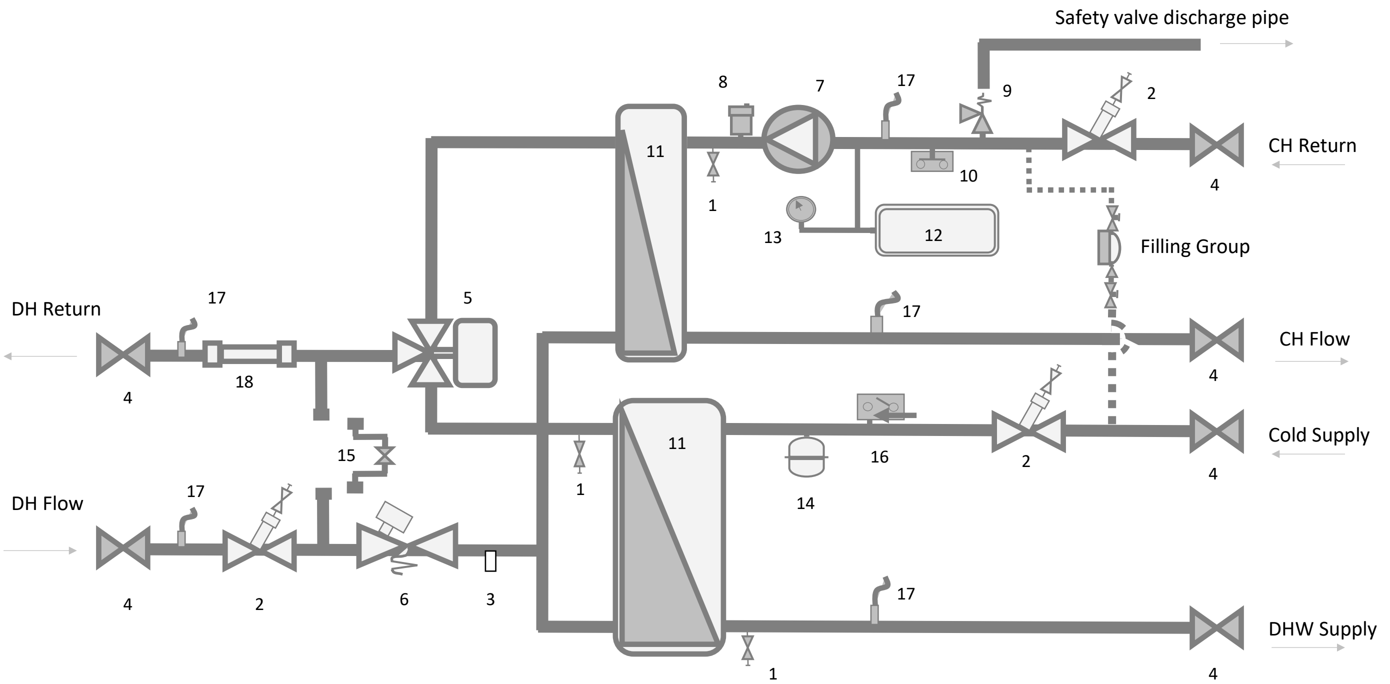
		ΔT 45°C (10/55°C)			
primary circuit flow rate	primary circuit supply temp.	primary circuit return temp.	primary circuit pressure drop	heat exchanger max. capacity	flowrate DHW
m3/h	°C	°C	kPa	kW	l/min
0.8	70	20.4	73.8	**41**	13.2

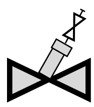
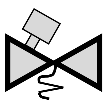
		ΔT 45°C (10/55°C)			
primary circuit flow rate	primary circuit supply temp.	primary circuit return temp.	primary circuit pressure drop	heat exchanger max. capacity	flowrate DHW
m3/h	°C	°C	kPa	kW	l/min
0.8	75	18.2	73.4	**46**	14.5

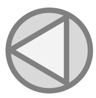
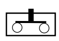
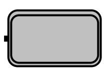
In conclusion, the Hiper II HIU will deliver the design requirements at a minimum 70C primary temperature at 0.8 m^3/h flow. Performance can be increased by reducing the temperature lift figure ΔT 45°C (10/55°C) or changing the DHW set temperature. This can be reviewed in the following performance tables of the Hiper II HIU. The complete test results are printed in the Hiper II brochure or available on request as a document.

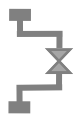
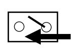
		ΔT 45°C (10/55°C)			
primary circuit flow rate	primary circuit supply temp.	primary circuit return temp.	primary circuit pressure drop	heat exchanger max. capacity	flowrate DHW
m3/h	°C	°C	kPa	kW	l/min
0.4	60	21.1	85.4	**16**	4.9
0.6	60	24.6	80.6	**22**	7.0
0.8	60	26.4	74.5	**28**	8.9
1	60	28.2	66.9	**35**	11.1
1.3	60	31.0	57.8	**47**	13.8
0.4	65	18.5	85.4	**19**	5.8
0.6	65	20.5	80.5	**27**	8.3
0.8	65	22.7	74.4	**35**	11.2
1	65	24.4	66.9	**42**	13.2
1.3	65	28.9	57.7	**50**	15.8
0.4	70	16.9	85.4	**22**	6.9
0.6	70	18.7	80.4	**32**	10.3
0.8	70	20.4	73.8	**41**	13.2
1	70	21.0	66.7	**50**	15.9
1.3	70	22.4	57.5	**63**	18.8
0.4	75	15.4	85.2	**24**	7.6
0.6	75	17.1	80	**35**	11.0
0.8	75	18.2	73.4	**46**	14.5
1	75	19.7	66.4	**56**	17.4
1.3	75	22.2	57.4	**67**	20.9
0.4	80	14.0	85	**26**	8.0
0.6	80	16.0	79.9	**38**	12.0
0.8	80	17.9	73	**49**	15.5
1	80	19.5	66.2	**61**	19.5
1.3	80	21.9	57.4	**77**	24.8

		ΔT 40°C (10/50°C)			
primary circuit	primary circuit	primary circuit	primary circuit	heat exchanger	flowrate
flow rate	supply temp.	return temp.	pressure drop	max. capacity	DHW
m3/h	°C	°C	kPa	kW	l/min
0.4	60	16.3	85.4	**18**	6.2
0.6	60	19.7	80.6	**25**	8.8
0.8	60	21.1	74.5	**31**	11.1
1	60	22.8	66.9	**40**	14.0
1.3	60	25.0	57.8	**53**	17.6
0.4	65	15.62	85.4	**19**	6.8
0.6	65	18.15	80.5	**28**	10.1
0.8	65	19.25	74.4	**38**	13.3
1	65	20.24	66.9	**47**	15.9
1.3	65	22.88	57.7	**57**	19.6
0.4	70	15.3	85.4	**22**	8.0
0.6	70	16.7	80.4	**33**	12.1
0.8	70	17.6	73.8	**43**	15.7
1	70	18.3	66.7	**53**	18.7
1.3	70	19.5	57.5	**65**	22.7
0.4	75	12.8	85.2	**25**	8.6
0.6	75	15.3	80	**36**	12.8
0.8	75	16.3	73.4	**48**	16.8
1	75	17.3	66.4	**58**	20.4
1.3	75	18.2	57.4	**70**	25.1
0.4	80	12.8	85	**26**	9.1
0.6	80	14.5	79.9	**39**	13.8
0.8	80	16.3	73	**50**	17.8
1	80	17.2	66.2	**63**	22.4
1.3	80	18.4	57.4	**81**	28.5

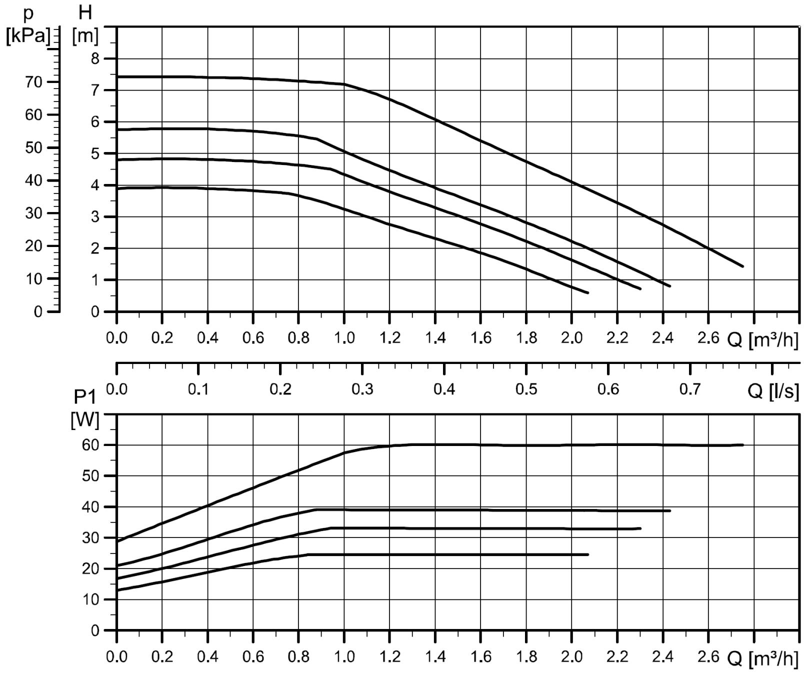


1		Drain valve / air venting
2		Strainer with drain valve
3		Pocket for heat meter sensor
4		Isolation Valves Red - Flow Blue - Return
5		Diverter Valve
6		Pressure independent control valve (PICV)

7		CH Circulating Pump
8		Automatic air vent
9		Safety pressure relief valve
10		Low pressure switch
11		Plate heat exchanger (PHE)
12		Expansion Vessel

13		Pressure gauge
14		Shock arrestor
15		Flushing bypass accessory
16		Flow meter switch
17		Temperature sensor
18		Heat meter position 110mm pipe

Grundfos pump performance data



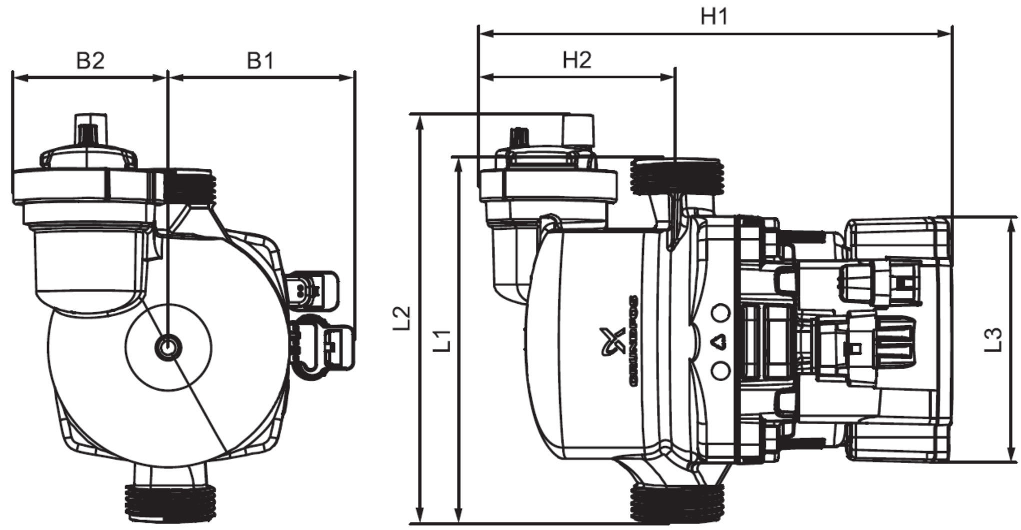
Performance curve

High efficiency

Setting	Max. head $_{nom}$
Curve 1	4 m
Curve 2	5 m
Curve 3	6 m
Curve 4	7.5 m

Setting	Max. $P_{1\ nom}$
Curve 1	25 W
Curve 2	33 W
Curve 3	39 W
Curve 4	60 W

EEI ≤ 0.20 Part 3
$P_{L,avg}$ ≤ 28 W



Pump type	Dimensions [mm]							Connections [inch]	Weight [kg]
	L1	L2	L3	B1	B2	H1	H2		
UPM3(K) FLEX AS 15-75 CIAO2	130	148	90	72	55	173	77	R 1/2 / G 1	1.3

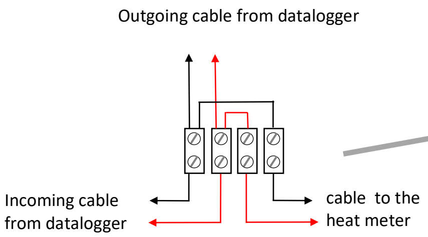
Technical data

System pressure	Max. 0.3 MPa (3 bar)	**Enclosure class**	IP44 (non-condensing) K: IPX4D (condensing)
Minimum inlet pressure	0.05 MPa (0.50 bar) at 95 °C liquid temperature	**Motor protection**	No external protection needed
Liquid temperature	+2 °C to +95 °C (TF95)	**Approval and marking**	VDE, CE

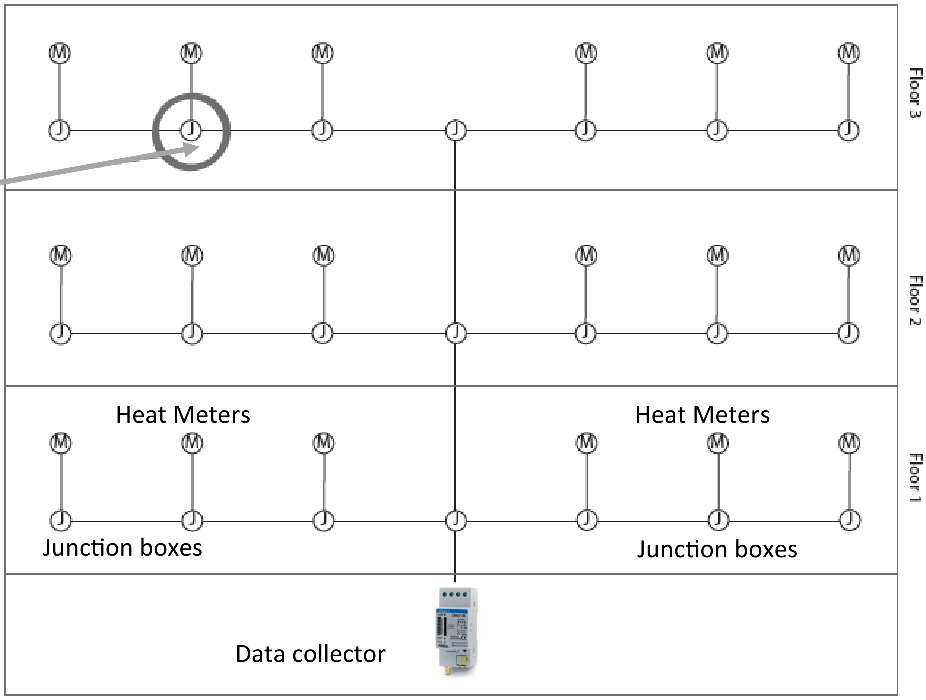
Heat Metering and M Bus

Example M-Bus wiring schematic

Schematic is for illustration purpose only.



Junction box



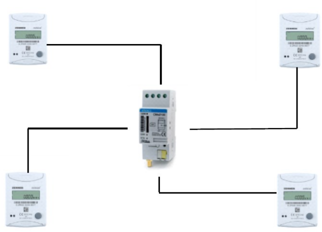
Schematics, drawings and example figures do not constitute an actual design, and each project should be reviewed individually as a unique design process.

M-Bus (Meter Bus) is a European standard for the remote reading of heat consumption by heat interface units. and was developed to fill the need for the networking and remote reading of utility meters.
The M-us interface is made for communication on two wires as the most cost effective solution, but a wireless version is also available.

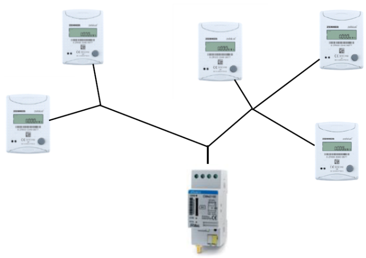
The principle is based on a master - slave procedure, the master is the data logger, and the slave being the heat meter. When interrogated, the meters deliver the data they have collected to the common master. Another method is to transmit meter readings vis GPRS or GSM. The data is then stored until required for billing. M-Bus cable is protected against reverse polarity, the wires are interchangeable.

Wiring can be in these recommended topographies;

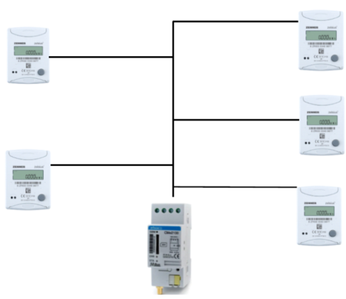
Star



Tree



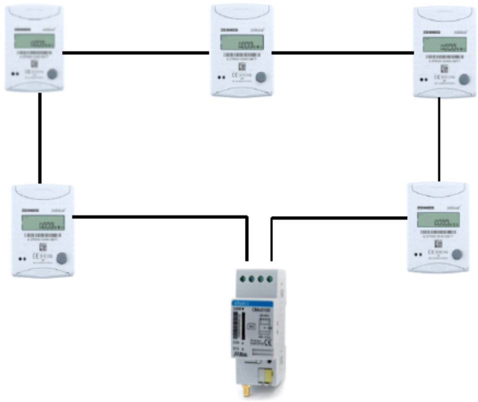
Linear



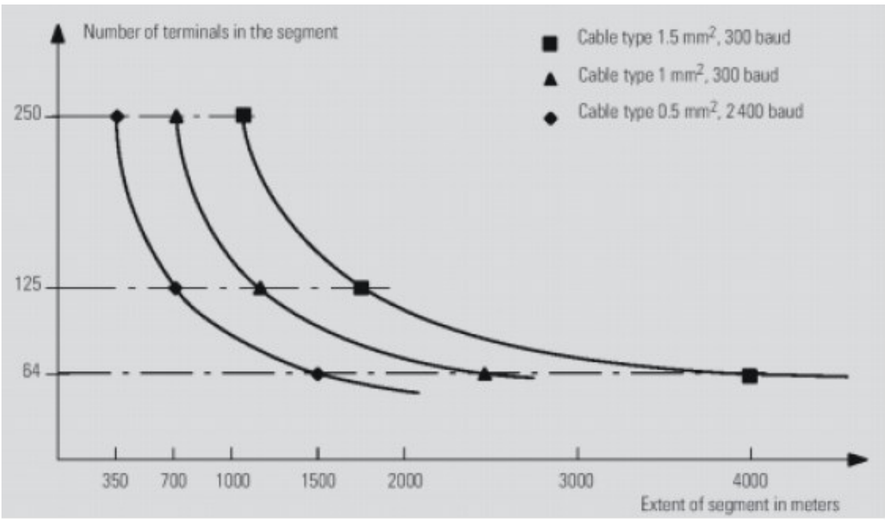
Ring - DO NOT USE!

This method of connecting the heat meters is not to be used.

In this formation the weakness is that is one component fails, the entire system is out of operation.



For M-Bus wiring use two core no smaller than 2.5mm cable, and wire the heat meters as directly as possible avoiding excess cable. Label all the wiring and distribution and junction connection points. The maximum length of cable can be from 1000m to 4000m, and is dependant on the number of meters and the character of the cable, the lower the resistance the better. High resistance caused by using for example smaller cables, may risk of transmission errors.
Up to 128 heat meters can be connected to a M-Bus network, (up to 250 when broadband connection used) and data loggers come in different sizes, so select the appropriate option. The more meters in connection, then the shorter the maximum cable length, and for 250 meters to one data logger then the total maximum length of cable is 1000m.



SY008DC	Data Collection unit. Max 8 MBus meters – 230v Power supply required. Enclosure included. Input – MBus. Output – GSM
SY032DC	Data Collection unit. Max 32 MBus meters – 230v Power supply required. Enclosure included. Input – MBus. Output – GSM
SY064DC	Data Collection unit. Max 64 MBus meters – 230v Power supply required. Enclosure included. Input – MBus. Output – GSM
SY250DC	Data Collection unit. Max 128 MBus meters – 230v Power supply required. Enclosure included. Input – MBus. Output – GSM

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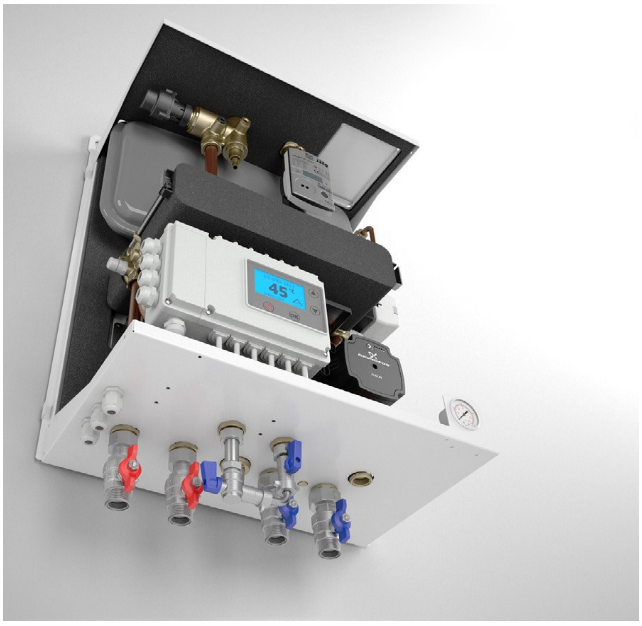
HIPER II

HEAT INTERFACE UNIT

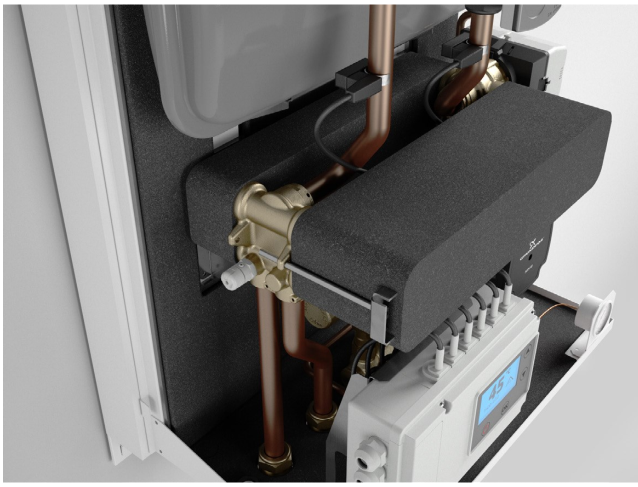


Main HIU Features

- Auto Fault Diagnostics.
- Modbus communications to report system conditions or fault conditions to a central monitor or BMS.
- Pay As You Go (Prepayment) switching.
- Integral shut off for Pay As You Go (PAYG) - no external Valve required!
- Test Ports
- Heating Radiators or Under Floor (UFH) selection.
- Optimised or Constant temperature Heating option
- Viewing access to Heat Meter calculator by lift up panel.

Functional and Safety Features

- Integral Flushing and Bypass Filter Valve
- Pump protection against Pump sticking.
- Automatic closing of the Control valve when power lost for Anti-Scald and stop unnecessary heat returns
- UFH slab drying cycle
- Frost protection function.
- PWM pump speed control.
- Pressure Differential and Flow Control by fast acting PICV with Stepper Actuator.
- Integral Shock Arrestor for cold water supply
- 3 Strainers, one for each circuit
- Filling group for Heating Circuit



Functional and Commissioning Features

- Start Up Menu for Commissioning
- Set time and date.
- Heating Flow limitation setting.
- Programmable Return Temperature limitation control.
- Manual pump override (for test).
- Room Thermostat Normally OPEN or CLOSED option.
- Additional switch for adding a second pump to load a cylinder or use as an alarm.
- Optional programme to add a temperature controlled hot water storage cylinder.
- Programmable Anti-Legionella cycle
- Keep Warm function by temperature and time, programmable or switch off options.
- Select which plate heat exchanger to use for the Keep Warm function to limit scale formation.

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