FACTBOOK

Hoval Modul-plus

High-output calorifier.
Favourite choice for refined domestic hot water convenience.

Hoval | Responsibility for energy and environment

Content

Outstanding application for a Hoval Modul-plus system.

The Hoval Modul-plus system is an ideal solution for all applications where a big demand of fresh domestic hot water is needed in a short time.

Ideal fields of application would be for example:

- Hospitals
- Hotels
- Day schools
- Sport centers
- Restaurants
- Universities
- Factories
- Appartements > 10 units

Benefits of a Hoval Modul-plus system

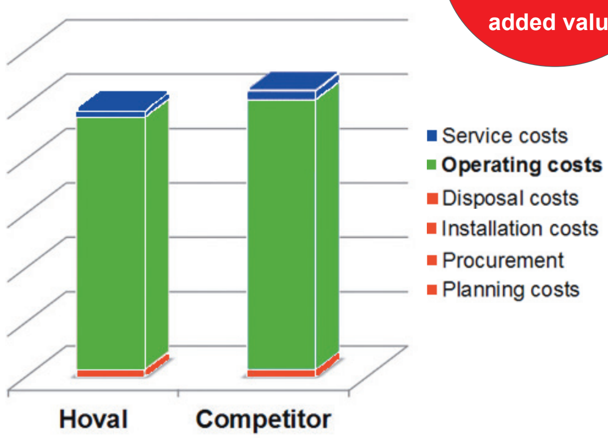
Our best cost of ownership philosophy is part of the Hoval Modul-plus system which means: Related over the product lifetime, the best price performance ratio for our end-users.

This takes in consideration following aspects:

Planning costs	1. Planning
Procurement costs	2. Purchase
	3. Product
	4. Administration
Installation costs	5. Installation
	6. System integration
	7. Commissioning
Operating costs	8 .Operating
	9. Environmental
	10. Maintenance
Service costs	11. Service
Disposal costs	12. Disposal

Hoval is worldwide known as technological leading supplier of innovative easy-systems for heat and ventilation technology with a high measurably economical and ecological added value for the customer.

Innovative easy-systems with measurable added value



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Advantages for planner, installer and owner.

1. **Planner:** Easy to plan (providing fast information in the required quality and quantity)
2. **Installer:** Easy to purchase (one order, one supplier)
3. **Owner:** Product costs are not necessarily to be low (high quality material and manufacturing, high efficiency, Swiss engineered products)
4. **Installer:** Administration cost (responsible one stop shop)
5. **Installer:** Installation cost (principle P&I including all information and supply of components for a perfect functional system)
6. **Installer:** System integration (Hoval System technology and controls matches all building requirements, eg. BMS, lead lag, etc.)
7. **Installer:** Commissioning costs (since all components match from the beginning,checked by Hoval engineers and Hoval on site engineers fast commissioning is possible)
8. **Owner:** Running cost (high efficiency, engineered products with focus to conservation of energy and environment lead to low running cost. Cheap products are not always cheap in the long run time.)
9. **Owner:** Environmental costs (all our products comply with the latest regulations and they are even better)
10. **Owner**: Maintenance costs (engineered products with focus to easy maintenance lead to lower costs)
11. **Owner:** Service cost's (engineered quality products usually need less Service in life)
12. **Owner:** Disposal cost's (Construction in combination with the selected materials allow a cost effective disposal)

Last but not least, a Hoval Modul-plus system provides you further advantages, such as:

- Thanks to the internal construction, long life time calcium carbonate or difficult / bad water qualities will not reduce the long life time of Modul-plus
- Less fuel consumption since our hot water systems operate on highest efficiency
- More safety by using two boilers with smaller capacity instead of one large boiler
- Less pipe work & fittings
- Less space required in comparison to storage tanks, therefore more usable space for other applications
- Less weight in comparison to storage tanks leads to less static in the building construction
- More than 35 years experience with semi-instantaneous heaters

And finally, behind all you will find the Hoval family; friendly, professional, solution oriented, enthusiastic and responsible for energy and environment.

Product overview

The following Hoval Modul-plus types are available:

F (21), F (31), F (41), F (51) and
F (32), F (42), F (52)

You can combine all Hoval Modul-plus types with:

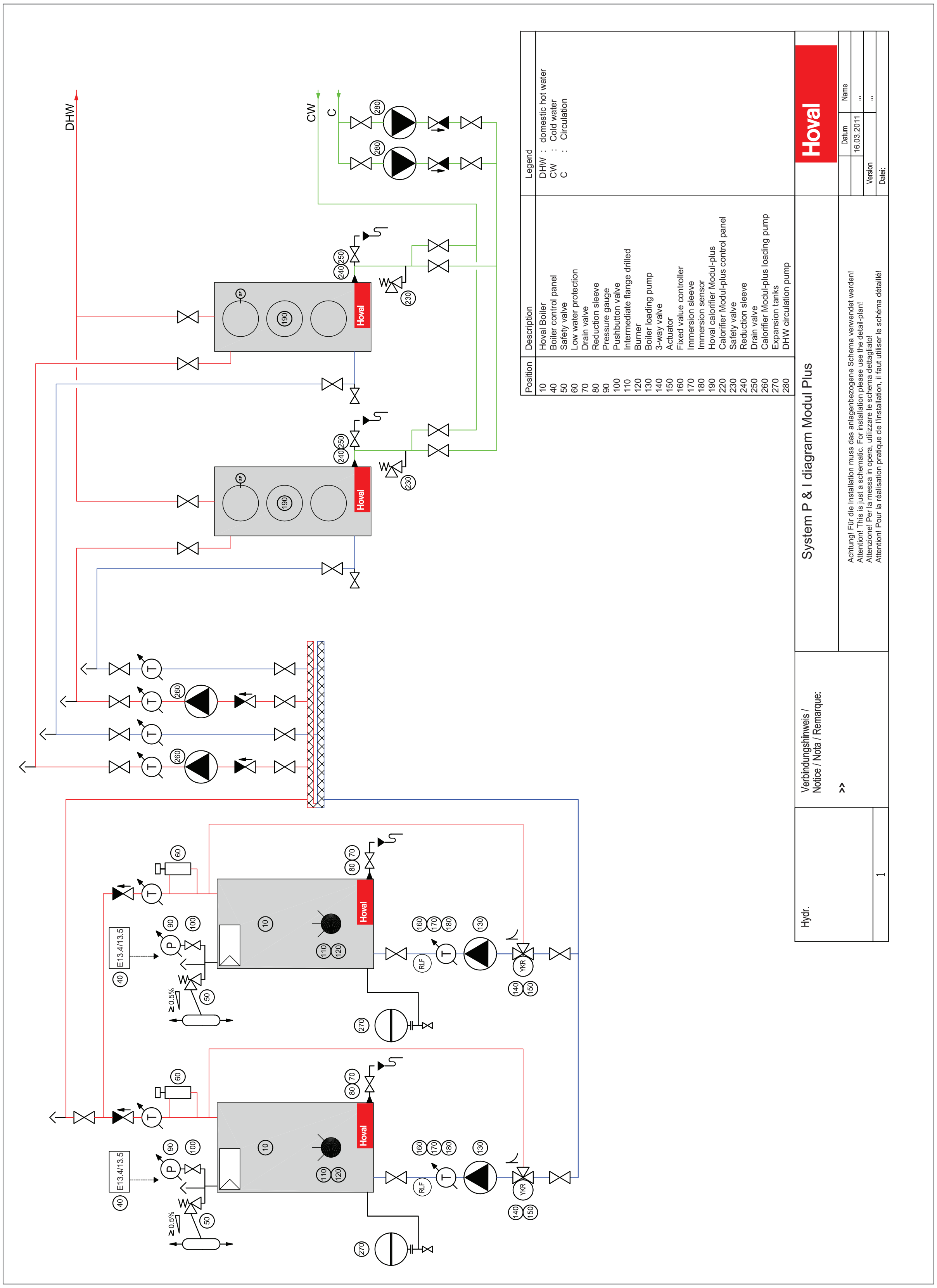
- Hoval UltraOil® (oil condensing boiler)
- Hoval Max-3 (traditional 3-pass hot water boiler with possibility of low NOx firing)
- Hoval CompactGas (high efficiency near condensing high temperature boiler with the possibility on low NOx firing)
- Hoval UltraGas® (fully condensing high efficiency, high tech boiler)
- Hoval Control panel
- Hoval selected and matched control valves, safety valves, pressure gauges, etc.

All types of the Modul-plus can be used for different domestic hot water qualities.

Modul-plus type	Maximum chloride content of drinking water [mg/liter]	Working pressure [bar]	
		Drinking water	Heating
F (21), F (31), F (41), F (51), F (32), F (42), F (52)	30	6	5
	100	6	5
	100	10	8
	200	6	5
	200	10	8
	300	10	8

System P&I Diagram

(Cascade with digital control panel)



Domestic hot water demand and selection of Modul-plus

Four steps to design the main components of the Modul-plus hydraulic.

To be able to calculate the size of the Modul-plus and boiler capacity, it is necessary to know the peak demand rate and the average demand rate. If no demand values are given, the values below can be used for further calculation. The load factors given in the end columns indicate the typical distribution of the demands. It is highly recommended that these values are accepted by the design agency. One should always ask for details of hot water peak requirement!

Step 1: Calculation of the maximum demand rate at 60 °C

Installation litres per hour at 60 °C	Private Hand Basin	Public Hand Basin	Shower [1]	Bath	Slop Sink	Bar Sink	Kitchen Sink	Pantry Sink	Laboratory Sink	Average Load Factor	10 min Peak Load Factor
Hospital	10	15	70	60	50		80			0.80	0.30
Hotel (> 100 rooms) and residential hall	5	15	50	50	50	100	80			0.75	0.25
Day school	5	20	180		40		80			0.80	0.40
Sport centre	5	15	220		40	100	80			1.00	0.50
Restaurant	5	25			100	100	140	120		1.00	0.50
University	5	20	220		40		80		40	0.80	0.40
Offices	5	10			40		40		40	1.00	0.50
Factory	5	20	120		50		80		40	1.00	0.75
Apartments (> 30 units)	5		50	100			45			0.50	0.20

[1] Where shower and bath are combined in one single cubicle it is only necessary to use one demand rate and the total number of cubicles.

Example: Hotel with 200 rooms & residental hall

Installation - Hotel	Quanities	Consumption each item according table page 8		Total
Hotel, Combined baths/showers [1]	200 pcs.	50 l/h	=	10'000 l/h
Hotel, Private hand basins [1]*	200 pcs.	5 l/h	=	1'000 l/h
Hotel, Pubilc hand basins [1]	10 pcs.	15 l/h	=	150 l/h
Hotel, slop sinks [1]	10 pcs.	50 l/h	=	500 l/h
Hotel, Kitchen sinks [1]	10 pcs.	80 l/h	=	800 l/h
		Maximum Demand Rate		**12'450 l/h**

Hotel, Average Load Factor	**0.75**
Hotel, 10 Minutes Peak Load Factor	**0.25**

[1] estimated number of consumption fittings (to be checked locally)

Step 2: Calculation of the average demand rate at 60 °C

You need this average demand on page 11 for the required boiler output.

Average Demand Rate =

Maximum Demand Rate x Average Load Factor

Average Demand Rate =

$$12'450 \left[\frac{\text{liters}}{\text{hour}}\right] \times 0.75 = 9'338 \left[\frac{\text{liters}}{\text{hour}}\right]$$

Step 3: Calculation of the 10 minutes peak demand rate at 60 °C

Peak Demand Rate $_{(10\ \text{min},\ 60\ °C)}$ =

Maximum Demand Rate x Peak Load Factor $_{(10\ \text{min})}$

Peak Demand Rate $_{(10\ \text{min},\ 60\ °C)}$ =

$$12'450 \times \left[\frac{\text{liters}}{\text{h}}\right] \times 0.25 = 3'113 \left[\frac{\text{liters}}{10\ \text{min}}\right]$$

Step 4: Selection of Modul-plus calorifier

In the end, you have to decide which flow temperature for your plant you want.

Hot water output at a flow temperature of 90 °C:
See table page 10.

Hot water output at a flow temperature of 80 °C and 70 °C:
For hot water outputs and charging pump details at a flow temperature of 80 °C and 70 °C see detail curves at Hoval catalogue.

The formula of how many Modul-plus calorifier are needed is the following:

Number of Modul-plus calorifier =

$$\frac{\text{Calculated Peak Demand Rate}_{(10\ \text{min},\ 60\ °C)}}{\text{litres /10 min}_{(60\ °C,\ \text{according table})}}$$

Remark:
The result must always be rounded up to a whole number.

In our example we have chosen a flow temperature of 90 °C.
According to the table “Hot water output at a flow temperature of 90 °C” you can calculate the number of Modul-plus calorifiers as follows:

Modul-plus F (32)
Number of Modul-plus calorifier F (32) =
3'113/2163 = 1,74 (rounded up) = 2

Modul-plus F (42)
Number of Modul-plus calorifier F (42) =
3'113/2593 = 1,2 (rounded up) = 2

Modul-plus F (52)
Number of Modul-plus calorifier F (52) =
3'113/3607 = 0.86 (rounded up) = 1

What we have chosen for the example is 2 times Modul-plus F (42) because there´s more “reserve” as if using 2 x F (32).
The calorifier Modul-plus F (52) would be a possible solution too but needs more heigth and there´s no reserve in case of pump, calorifier or control service and/or breakdown.

Hot water outputs at a flow temperature of 90 °C

Use only if high performance is permanently expected (e.g. industry, commercial enterprise). Heating flow connected on the top of the calorifier (crosscurrent).

Modul-plus Type	Number of modules	Volume	Heat Surface			Charging pump		Hot Water Output dm³ / 10 min. 3)	dm³ / h 4)		
		dm³	m²	m³/h	mbar 1)	Type	mWC 2)	45 °C	60 °C	45 °C	kW 5)
F (21) 7)	2	249	2.84	8	128	SPS-I 12	6.5	695	1960	3480	140.1
F (31) 7)	3	367	4.26	12	403	Yonos Maxo plus 40/12	4.5	1082	3300	5800	233.5
F (41) 7)	4	485	5.68	10.5	397	Yonos Maxo plus 40/12	5.5	1480	4150	7500	301.9
F (51) 7)	5	603	7.10	12	677	Yonos Maxo plus 50/16	7.5	1862	5250	9100	366.3
F (32) 7)	6	721	8.52	24	450	Yonos Maxo plus 65/16	7.5	2163	6600	11600	466.9
F (42) 7)	8	957	11.36	16	256	Yonos Maxo plus 40/12	4.5	2593	7000	12800	515.2
F (52) 7)	10	1193	14.20	21	617	Yonos Maxo plus 65/16	4.9	3607	10000	17500	704.4

1) mbar = Flow resistance in the calorifier
2) mWC = residual overpressure
3) dm³/10 min. = Calorifier heated up to 60 °C
4) dm³/h = Continual output per hour, cold water temperature 10 °C
5) kW = Power input at 45 °C / 10 °C
6) Flats = Performance figure in accordance with DIN 4708 = number of flats which can be supplied with hot water if the water heater is heated with the boiler and is permanently after-heated (standard flat: 1 bath - 4 rooms - 3.5 persons)
7) = valid for all Modul-plus types F (21-52), FH (21-52), F (21-52) S, FH (21-52) S, F (21-52) SM, FH (21-52) SM, FH (21-52) SX

2 x Modul-plus F (32) with a Wilo pump Yonos Maxo plus 65/16.

For hot water outputs and charging pump details at a flow temperature of 80 °C and 70 °C see detail curves at Hoval catalogue!

Required boiler output

For applications such as first-class hotels, hospitals etc. where hot water is of great importance, we recommend for safety and redundancy reasons, to choose two boilers working as a cascade. Each of them being able to cover 2/3 of the total average hot water demand. This is for safety reasons important if one boiler failed.

Required boiler output [kW] =

$$\left[\frac{2}{3}\right] \times \text{Average Demand Rate} \times c \times \Delta t$$

Average Demand Rate:
9'338 [l/h], (1 liter of water = 1 kg)

c: Specific thermal capacity of water

$$\left[\ 0.00116 \ \frac{kWh}{kg \times k}\right]$$

t1: DHW target temperature [60 °C]
t2: Cold water temperature [10 °C]
Δt: t1 - t2 Kelvin, [K]

Required boiler output [kW] =

$$\left[\frac{2}{3}\right] \times 9'338 \left[\frac{kg}{h}\right]$$

$$\times\ 0.00116 \left[\frac{kWh}{kg \times K}\right] \times (60 - 10)\ K = 361\ kW$$

We choose two heating boilers of the type **Hoval Max-3 (420)**, with a capacity range of - in depending of the used burner - 320 up to 500 kW.

Determination of the heating power
If a heating circuit is required by the building, the engineer (planner) must define the required capacity [kW].

General - Calculation of pressure losses

The total pressure losses are determined by adding the individual pressure losses.

These are:
- Pressure losses in the piping, comprising:
  - Pressure losses in straight piping
  - Pressure losses at the individual points of resistance (fittings, heat exchanger, elbow bends, etc.)

Calculation of total pressure losses

P: Total pressure loss

Δp: Pressure loss due to friction in straight piping

Z: Pressure loss at the individual points of resistance (fittings, heat exchanger, elbow bends, etc.)

R: Pressure gradients $\left[\frac{\text{mbar}}{\text{m}} \right]$

L: Piping length [m]

$P = \Delta p + Z$ [mbar]

$\Delta p = R \times L$

ξ values for calculating the pressure loss at the individual points of resistance

The zeta values of the fittings are dependent on their type and size. The manufacturer must provide these zeta values!

The values in the table are based on comparative values which were determined in experiments. They can be used as a rough guide.

Individual point of resistance	ξ value
Straight-way cock	0.2
Right angle stopcock	2
Elbow bend 90°	0.5
Tiered elbow bend	0.5
Y-piece	1.5
Straight-way T-piece	0.5
T-piece branch	1

Nominal width DN	10 15	20 25	32 40	50 > 50
Straight-seated valve	10	7	5	4
Angled-seated valve	3.5	3	2.5	2
Non-return valve	5	4	4	3.5
Check valve	2	1.5	1.2	1

Fittings

Straight-way stopcock

Elbow bend 90°

T-piece straight stopcock

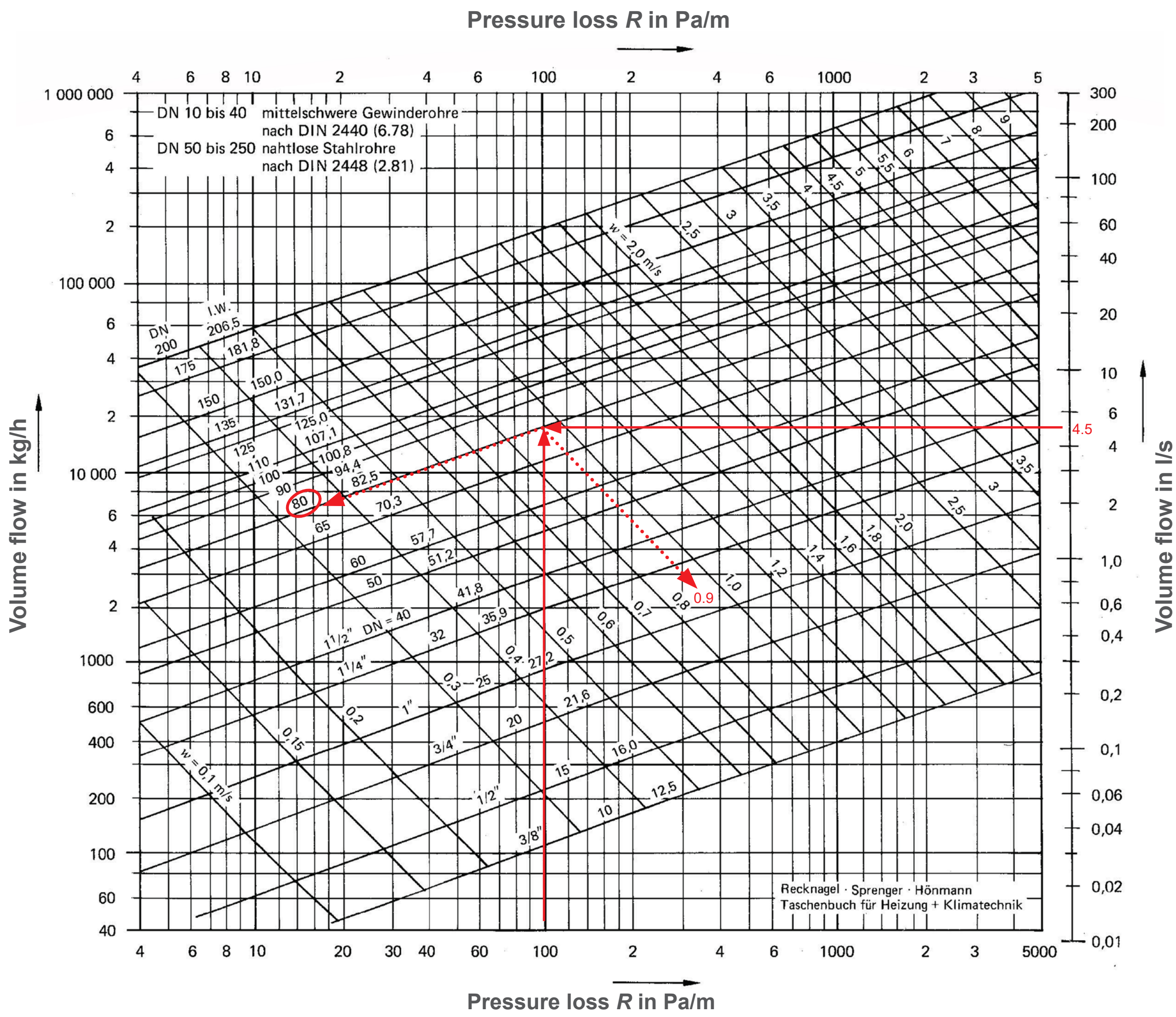
Angle-seated valves

Straight-seated valve

Non-return valve

Pressure loss calculation

(Heating distributor to Modul-plus)



According to the pipe friction chart for steel pipes, a pipe diameter of DN 80 needs to be chosen for the piping between heating distributor to Hoval Calorifier Modul-plus.

Needed pump volume flow of Wilo Yonos Maxo plus 40/12 is 16 m³/h (see page 10).

In our example we have:

$$m = \frac{Q}{c \times \Delta T} =$$

$$= \frac{371\ \text{kW}}{(0.00116\ \text{kWh / kg x K}) \times 20\ \text{K}} = 16.2\ \text{m}^3/\text{h}$$

Assumption:
Maximum temperature rise, ΔT 20K

Volume flow m =

$$16'000\ \left[\frac{l}{h}\right] = \frac{16'000}{3'600}\ \left[\frac{L}{s}\right] = 4.44\ \left[\frac{l}{s}\right]$$

The pressure loss R in our case is:

$$\text{ca. } 100\ \left[\frac{Pa}{m}\right] = \frac{1\ \text{mbar}}{m}$$

At the end we get the result of a pipe diameter of **DN 80** and a flow speed of **< 0.9 m/s.**

Pressure losses in straight piping (Heating distributor to Modul-plus)

The resistance of the piping is normally calculated by using a design program.
This procedure is indispensable for large systems with complex hydraulics.

$\Delta p = R \times L$

Δp: Pressure loss due to friction in straight piping sections [mbar]

R: Pressure loss (see diagram, page 14)

$$100 \left[\frac{Pa}{m}\right] = \frac{1.0\ mbar}{m}$$

L: Piping length 21 m (flow and return pipes)

$$\Delta p = 1.0 \left[\frac{mbar}{m}\right] \times 21\ [m] = 21\ [mbar]$$

Pressure loss at individual points of resistance (Heating distributor to Modul-plus)

$$Z = \sum \xi \times \left[\frac{\vartheta \times v^2}{200}\right] [mbar]$$

Z: Pressure losses caused by individual points of resistance [mbar]

ϑ: Density of medium in $\left[\frac{kg}{m^3}\right]$

v: Flow speed $\left[\frac{m}{s}\right]$

The following individual points of resistance are used as examples for calculation:

	Number	ξ value	∑ξ
Elbow bend 90°	8	0.5	4.0
Straight-way cock	4	0.2	0.8
Non-return valve	1	4.0	4.0
		∑ξ total	**8.8**

ϑ: $1000 \left[\frac{kg}{m^3}\right]$ (water)

v: $0.9 \left[\frac{m}{s}\right]$ (from pressure loss diagram, page 14

$$Z = 8.8 \times \left[\frac{1000\ (kg/m^3) \times 0.9\ (m/s)^2}{200}\right]$$

$= 35.64 \approx 36\ [mbar]$

Total pressure loss P (Heating distributor to Modul-plus)

$P = \Delta p + Z$

$P = 21\ mbar + 36\ mbar = 57\ mbar \approx 0.6\ MWC$

(MWC = meter water column)

Determination of the boiler volume flow

Each Hoval calorifier Modul-plus needs according table page 10 a Wilo pump "Yonos Maxo plus 40/12" with a volume flow of 16.0 m^3 per hour. In total the whole system needs 32.0 m^3 per hour.
We would like to have a balanced system with two boilers installed, the volume flow of each boiler has to be 16.0 m^3 per hour.

Determination of the boiler pump

The boiler volume flow is identical to the Modul-plus volume flow. Therefore we choose once more a Wilo pump "Yonos Maxo plus 40/12" as boiler pump.

Pressure loss calculation (Boiler to Heating distributor)

The calculation of the pipe pressure losses is identical to the calculation we did on page 14 (Pressure loss calculation, Heating distributor to Modul-plus).

Selection of the correct control panel

Top Tronic® E - Digital control panel
The two boilers of our hydraulic are working as a cascade system. Therefore you have to choose as control panel a Hoval TropTronic® E. With the choice of the cascade and the TTE you will have an optimal efficiency of the system (Hydraulic, see page 7).

	Digital control panel	
How high is your operating temperature?	90 °C	105 °C
Your safety temperature for boiler control is	110 °C	120 °C

Your Hoval control panel is	Control panel with TTE 13.4	Control panel with TTE 13.5
If you have a building control system, you have to choose	select from several modules - see boiler catalogue!	

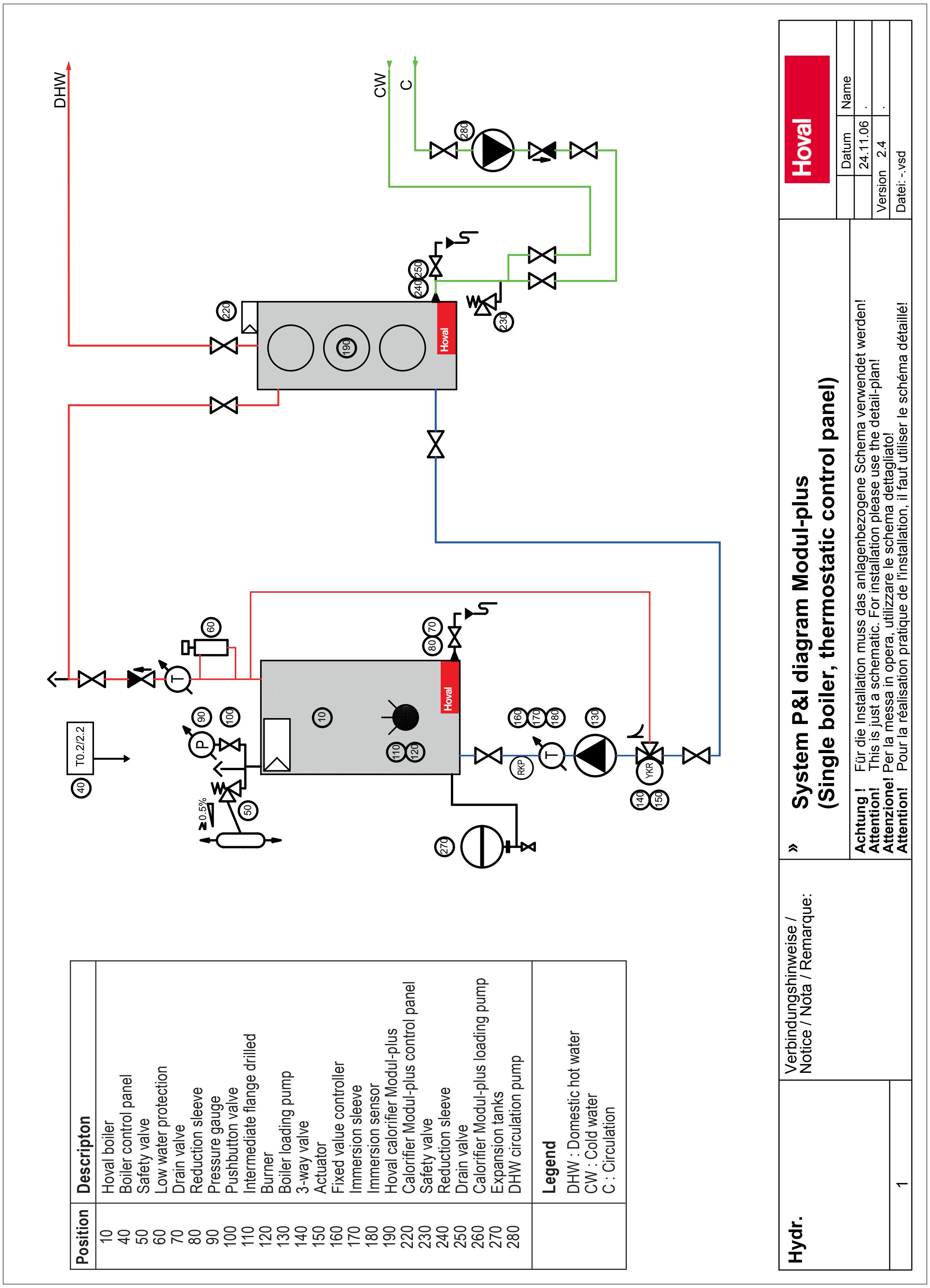
Thermostatic control panel
If you have a single boiler in combination with one Modul-plus then it is also possible to design the hydraulic with thermostatic control panels (Hydraulic, see page 17).

	Thermostatic control panel	
How high is your operating temperature?	90 °C	105 °C
Your safety temperature for boiler control is	110 °C	120 °C

Your Hoval control panel is	Control panel with thermostat T 2.2	Control panel with thermostat T 0.2
If you have a building control system, you have to choose	BMS Box	

System P&I Diagram

(Single Boiler with thermostatic control panel)



Expansion vessel

Individual plant protection

If flow and return pipes of total pipeline system can be interrupted by components (valves etc.), each part of the separately locked plant must be equipped with a single expansion vessel!

Total plant protection

Only one expansion vessel for the whole plant. You have to be be sure that flow and return cannot be locked.

Determination of the expansion vessel

For reasons of simplification we decided to make a total plant protection with one expansion vessel for the whole plant.

Determination of thermal expasion coefficient (f)

$$T = \frac{(Tv + Tr)}{2} \; [°C]$$

T Average temperature [°C]
Tv 90 °C - Flow temperature
Tr 70 °C - Return temperature
f Thermal expansion coefficient

$$T = \frac{(90 + 70)°C}{2} = 80\ °C \Longrightarrow f = 0.029$$

T [°C]	30	40	60	80	100
f	0.004	0.008	0.017	**0.029**	0.043

Determination of allowance factor (X)

Boiler capacity	<= 30 kW	30 kW - 150 kW	> 150 kW
Allowance factor	3	2	**1.5**

The calculated boiler capacity is 377 kW.
Therefore the allowance factor has to be 1.5.

Expansion volume (VN)

VN = 1.1 x Va x f x X [liters]

VN: Expansion volume
Va: Water volume of the plant: 2 x boiler, piping (estimated)
= 2 x 552 + 420 = 1524 liters
f: Thermal expansion coefficient
X: Allowance factor

VN [Liter]=1.1*1524*0.029*1.5=72.93 ≈73.0 [Liter]

Selction of expansion vessel

Assumption: Plant height: 12 m = 1.2 bar

Minimum pre – pressure [bar] =
plant height [bar] + 0.3 [bar]

Minimum pre-pressure [bar] =
1.2 [bar] + 0.3 [bar] = 1.5 bar

Selection table for Reflex NG/ N
with safety valve 3 bar
capacity V_N of the empty container in litres
at a pre-pressure of

Type		0.5 bar	0.8 bar	1.0 bar	1.2 bar	1.5 bar	1.8 bar	2.1 bar
18/6	L	10	9	7	6	4	2	1.5
25/6	L	14	12	10	8	6	3	2
35/6	L	20	17	14	12	8	5	2.5
50/6	L	25	22	18	15	11	7	3
80/6	L	42	36	30	26	18	11	4
100/6	L	61	54	44	37	27	17	4.5
140/6	L	79	70	57	48	35	22	5
200/6	L	119	106	86	73	53	33	6
250/6	L	142	126	103	87	63	39	7.5
300/6	L	165	146	119	101	73 (VN)	45	9
400/6	L	210	187	151	128	93	58	11
500/6	L	269	239	194	164	119	74	14
600/6	L	324	288	234	198	144	90	18
800/6	L	420	373	302	257	186	116	22
1000/6	L	525	467	380	321	233	145	28
max, possible plant height [1]		2 m	5 m	7 m	9 m	12 m	15 m	18 m

[1] Plant height = centre of expansion chamber to topmost point of the heating system / solar plant

Selection: Expansion chamber, type Reflex N 300/6

Water quality – Desalination

Generally
For detail requests about water quality see operating manual / catalogue of related boiler series.

To decide whether the plant filling water has to be desalinated or not we need to know the following data:

- Heating power
- Water volume of the plant
- Total hardness of filling water
- Conductance of filling water

With this data and maximum three further steps, we are able to qualify if the plant has to be desalinated or not.

In our example:

Heating power: 361 kW (lowest bolier capacity)

Water volume of the plant: 1524 liters

Filling water: Total hardness: 11 d°H

Conductance: 520 µS/cm

(You get the filling water information from the water supply).

Remark:
If you have multiple boilers with different capacities installed, it is necessary to always operate with the boiler of the lowest capacity.

Desalination Table

Maximum filling quantity according to VDI 2035

	Degrees of water hardness					
f°H	< 1.0	< 5.0	< 10	< 15	< 20	< 25
d°H	< 0.56	< 2.8	< 5.6	< 8.4	< 11.2	< 14
e°H	< 0.71	< 3.6	< 7.1	< 10.7	< 14.2	< 17.8
Conductance (µS/cm)	< 20	> 100	> 200	> 300	> 400	> 500
Boiler Capacity						
50 to 200 kW	No desalination necessary			<= 20 l/kW		
200 to 600 kW		<= 50 l/kW				
over 600 kW		Desalination or water analysis				

<= 20 l/kW	Check if you have more than 20 liters per kW heating water, if yes desalination is necessary
<= 50 l/kW	Check if you have more than 50 liters per kW heating water, if yes desalination is necessary

f°H French degrees of water hardness
d°H German degrees of water hardness
e°H English degrees of water hardness

Step 1 – Conductance of filling water

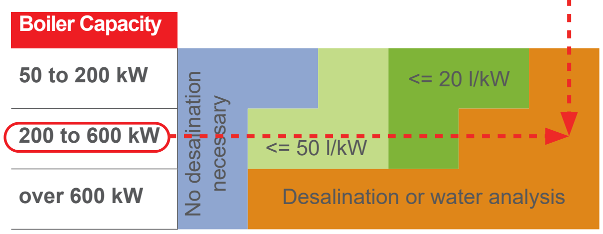
We need to check the conductance of the filling water.
In our example we have a value of 520 µS/cm.

We have to search the intersection inside the installed boiler capacity. In our case the boiler with the lowest capacity has 361 kW which refers to line “200 to 600 kW”.
The intersection gives us the result Desalination or water analysis.

Now we have the choice to make a desalination - without checking the water quality - or to check if the desalination is definitely a must.

Maximum filling quantity according to VDI 2035

	Degrees of water hardness					
f°H	< 1.0	< 5.0	< 10	< 15	< 20	< 25
d°H	< 0.56	< 2.8	< 5.6	< 8.4	< 11.2	< 14
e°H	< 0.71	< 3.6	< 7.1	< 10.7	< 14.2	< 17.8
Conductance (µS/cm)	< 20	> 100	> 200	> 300	> 400	> 500



<= 20 l/kW	Check if you have more than 20 liters per kW heating water, if yes desalination is necessary
<= 50 l/kW	Check if you have more than 50 liters per kW heating water, if yes desalination is necessary

f°H French degrees of water hardness
d°H German degrees of water hardness
e°H English degrees of water hardness

In our example we would like to check if desalination is definitely a must. This can be checked with the value “Degrees of water hardness”. This value is a result of the now necessary water analysis. We will do this in step 2.

Step 2 – Hardness of filling water

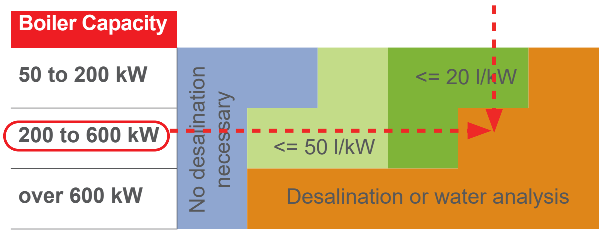
Now we need to check the hardness of the filling water. In our example we have an amount of 11 d°H (German degrees of water hardness) of the filling water.

First search the line in the table where d°H is written. Then find the appropriate cell in this row to which the specified water hardness of 11°dH fits. In our case it is < 11.2 d°H

Now we have to search the intersection inside the installed boiler capacity. In our case the boiler with the lowest capacity has 361 kW which refers to line “200 to 600 kW”. After the water analysis the intersection gives us the result “Desalination”. You have to desalinate the water!

Maximum filling quantity according to VDI 2035

	Degrees of water hardness					
f°H	< 1.0	< 5.0	< 10	< 15	< 20	< 25
d°H	< 0.56	< 2.8	< 5.6	< 8.4	< 11.2	< 14
e°H	< 0.71	< 3.6	< 7.1	< 10.7	< 14.2	< 17.8
Conductance (µS/cm)	< 20	> 100	> 200	> 300	> 400	> 500



<= 20 l/kW	Check if you have more than 20 liters per kW heating water, if yes desalination is necessary
<= 50 l/kW	Check if you have more than 50 liters per kW heating water, if yes desalination is necessary

f°H French degrees of water hardness
d°H German degrees of water hardness
e°H English degrees of water hardness

Corrosion protection

A professional installation and commissioning as well as compliance with the required operating parameters are as a corrosion protection measure, mandatory. As a rule, no additional corrosion protection measures such as the addition of corrosion inhibitors are required. The treatment of water with chemicals should only be used if all other measures have been exhausted.

Notes:

Hoval

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Hoval is one of the leading international companies for heating and indoor climate solutions. Drawing on more than 75 years of experience and benefiting from a close-knit team culture, the Hoval Group delivers exciting solutions and develops technically superior products. This leadership role requires a sense of responsibility for energy and the environment, which is expressed in an intelligent combination of different heating technologies and customised indoor climate solutions.

Hoval also provides personal consultations and comprehensive customer service. With around 2200 employees in 16 companies around the world, Hoval sees itself not as a conglomerate, but as a large family that thinks and acts globally.
Hoval heating and indoor climate solutions are currently exported to more than 50 countries.

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2023 - 04 | Subject to modifications

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