Air Conditioners

Technical Data

VRV

VRV Air-cooled Selection Procedure

EEDEN13-200_2

Air Conditioners

Technical Data

VRV Air-cooled Selection Procedure

EEDEN13-200_2

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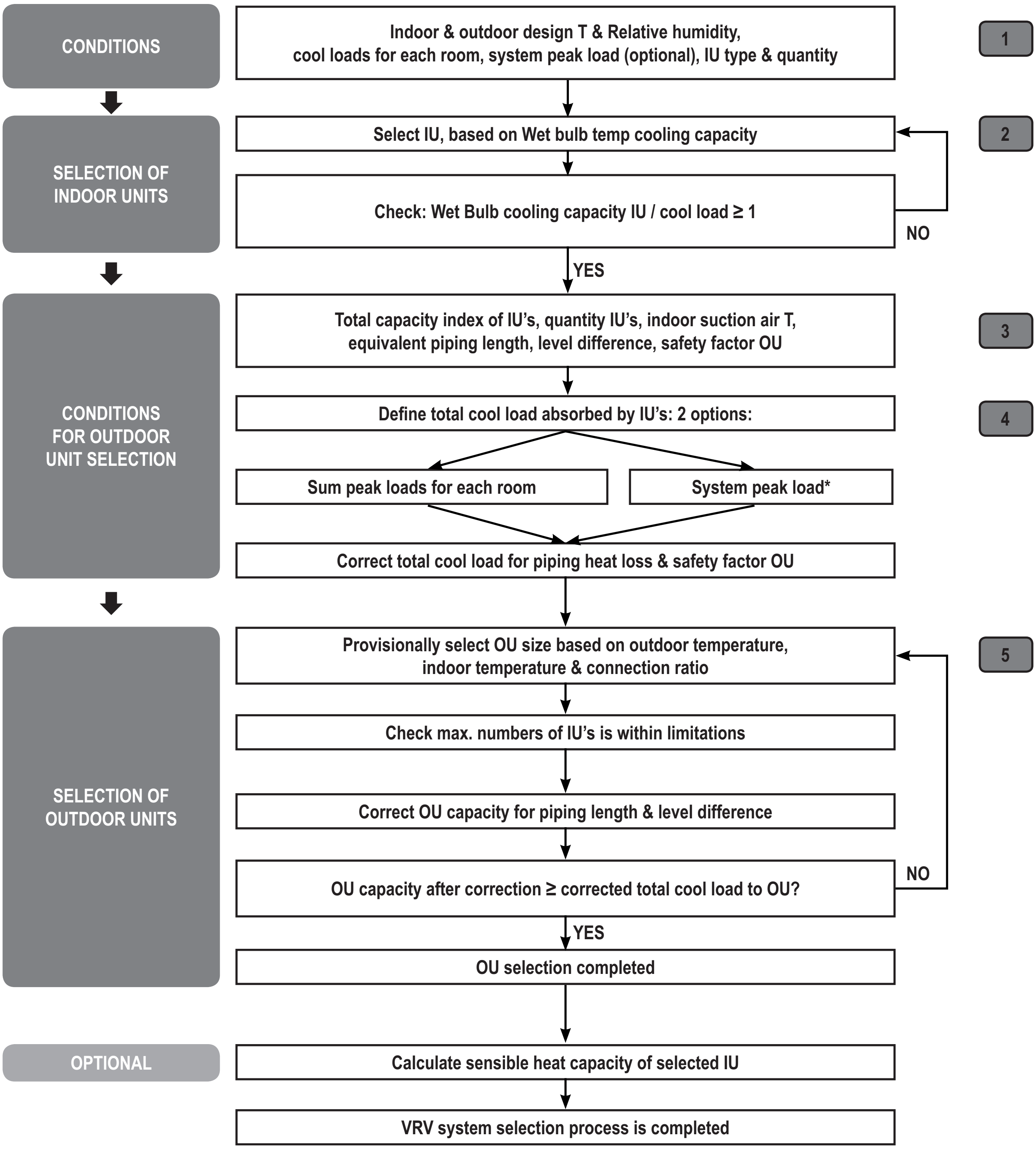
II Air-cooled selection procedure

1 Selection procedure VRV system based on cooling load

1 - 1 Flowchart

1



* System peak load = maximum load which has to be convered at the same time by all indoor units which are connected to the same outdoor unit

1 Selection procedure VRV system based on cooling load

1 - 2 Step by step

1 - 2 - 1 Design conditions:

To start designing a VRV system in cooling mode, following information is needed:

- Indoor conditions: Wet bulb temperature (°CWB) & Dry bulb temperature (°CDB)
- Cooling loads per room: total cool load, sensible cool load (optional)
- Outdoor conditions: Dry bulb temperature (°CDB)
- System peak load: the maximum total cool load that occurs at a certain moment of the day that has to be handled by all indoor units connected to a same outdoor unit system

  System peak load Þ sum of peak loads

  Sum of peak loads = the sum of all individual peak loads of every indoor unit/room at its own peak of the day. Depending on the sun positioning and the orientation of the room. A room oriented to the east probably has its peak load in the morning, while a room oriented at the west has its peak load in the afternoon.

1 - 2 - 2 Selection of indoor unit

Select indoor unit based on total cool load at design indoor wet bulb temperature(°CWB) & nominal outdoor dry bulb temperature (35°CDB)

➔ See cooling capacity table of selected type of indoor unit

1 - 2 - 3 Check cool load

Check if the cooling capacity of the indoor unit is bigger than the cool load.

1 - 2 - 4 Conditions for outdoor unit selection:

Following data is needed to select correct outdoor unit system:

- Total capacity index of indoor units (= sum of capacity indexes of all indoor units)
- Total number of connected indoor units
- Indoor suction air temperature (°CWB/°CDB) & design outdoor temperature (°CDB)
- Equivalent piping length between furthest indoor unit and outdoor unit
- Level difference between indoor units & outdoor unit

1 Selection procedure VRV system based on cooling load

1 - 2 Step by step

1 - 2 - 5 Define cooling capacity to be given by outdoor unit system:

Step 1: Define Total cooling load to be absorbed by connected indoor units: two options:

- Sum of peak loads for each room
- System peak load

Step 2: Correct total cool load indoor units by piping heat loss factor & (optional) safety factor outdoor unit

Cooling capacity to be given by outdoor unit system = total cooling load x (1 + (heat loss factor x actual pipe run))

Heat loss factor is function of design outdoor temperature (see below table)

Design outdoor temperature (°CDB)	Piping heat loss factor (%/m)
< 10	0%
15	0.004%
20	0.009%
25	0.014%
30	0.022%
35	0.030%
40	0.038%

NOTE

1 The table for the cooling and heating correction factors consist of limitation temperatures. If the ambient temperatures are outside the range in the table, the closest temperature needs to be considered.

1 - 2 - 6 Selection of outdoor unit

- Provisionally select outdoor unit size & type based on outdoor temperature (°CDB), indoor temperature (°CWB) & connection ratio
  - ➔ See cooling capacity table of selected outdoor unit in ED
- Check if maximum number of indoor units and connection ratio is within limitations
- Correct the outdoor unit capacity by piping correction factor (α) based on pipe run and level difference between indoor unit and outdoor unit
  - ➔ See piping correction diagrams in ED
- Check if available cooling capacity after piping correction is still bigger than the cooling capacity to be given by the outdoor unit (see chapter 5.)
- Outdoor unit size is selected.

NOTE

1 In the VRV selection software, the heat loss correction factor is applied to the outdoor unit and not to the requested capacity. This is because the requested capacity is known by the user and is needed to be filled in. It would be strange to see another figures being used in the calculations than the one put in in the system.

1 - 2 - 7 Sensible heat capacity

Sensible capacity is the capacity required to lower the temperature and latent capacity is the capacity to remove the moisture from the air. The sensible heat can influence selection in case of really humid area's (gym), or dry room (computer rooms).

When sensible capacity is larger than normal, bigger IU need to be selected to be able to reach the full required capacity.

1 Selection procedure VRV system based on cooling load

1 - 3 Example

1 - 3 - 1 Design conditions

- Determine indoor / outdoor design temperature

  Indoor: 20° CWB / 28° CDB

  Ambient: 33° CDB

- Determine room peak loads (and if possible, system peak loads = optional)

Design loads in kW (total cooling capacity)

Time	A	B	C	D	E	F	G	H	Sum
9h00	*2.9*	2	1.5	3.3	3	*4*	3	1.7	21.4 kW
13h00	2	*2.7*	1	3.3	*4*	3.4	*3.9*	1.9	22.2 kW
17h00	1.9	1.8	*2.5*	*4.3*	3.3	3	2.3	*2.9*	22 kW

Sum Room Peak loads 27.2 kW

System Peak Load 22.2 kW Max capacity requested from outdoor unit

1 - 3 - 2 Selection of indoor unit

FXCQ indoor unit

	A	B	C	D	E	F	G	H	Sum
FXCQ	**25**	**25**	**25**	**40**	**40**	**40**	**40**	**25**	**260**
kW	**3.0**	**3.0**	**3.0**	**4.8**	**4.8**	**4.8**	**4.8**	**3.0**	**31.2**

* the capacity is selected according to the design conditions (indoor 20° CWB / 28° CDB; ambient 35° CDB)

NOTE

1 The new selection method, for the indoor unit selection, does not take into account the outdoor temperature. Therefore take the rated outdoor temperatures when looking up in the indoor unit capacity table (35° CDB for cooling, 7° CDB for heating)

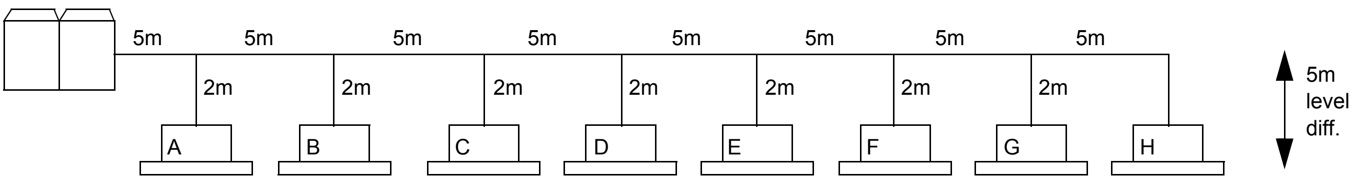
1 - 3 - 3 Check cool load

Total cooling capacity of indoors > cool load

31.2>22.2 kW

1 - 3 - 4 Conditions for outdoor unit selection:

- Total capacity index of indoor units = 260 OK
- Number of Selected indoors = 8 OK
- Equivalent piping length and level difference



Equivalent pipe length (*) = 43.5 meter

(*) Length to furthest indoor unit including equiv. Pipe length of refnets (0.5 meter per refnet)

1 Selection procedure VRV system based on cooling load

1 - 3 Example

1 - 3 - 5 Define cooling capacity to be given by outdoor unit system:

Total cooling load

- Sum of peak loads = 27.2 kW
- System peak load = 22.2 kW

Correct total cool load

Table: Coefficient of loss per meter of piping with insulation thickness of 10mm

1

Correction factor	HLC (%/m)	HLH (%/m)
Ambient temperature	Cooling	Heating
-15		0.100
-10		0.093
-5		0.086
0		0.078
5	0.000	0.071
10	0.000	0.064
15	0.004	0.057
20	0.009	0.049
25	0.014	
30	0.022	
35	0.030	
40	0.038	

For 33° CDB ambient temperature, the heat loss factor is 0.0268% (interpolated).

For the piping length, the first 7.5m is not considered

⇨ 43.5m - 7.5m = 36m

Heat loss factor * actual piping run

⇨ 0.0268% * 36m = 0.009648

total cooling load x (1 + (heat loss factor x actual pipe run))

⇨ 22.2*(1 + 0.009648) = 22.4

1 Selection procedure VRV system based on cooling load

1 - 3 Example

1 - 3 - 6 Selection of outdoor unit

- select outdoor unit type
  RXYQ8P outdoor unit

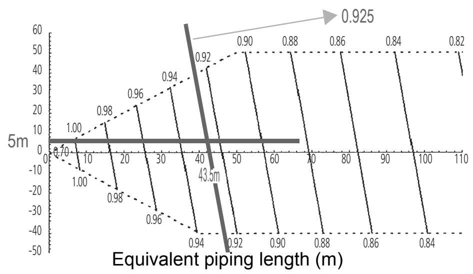
Indoor unit combination total capacity index table

Outdoor unit	Indoor unit combination ratio								
	130 %	120 %	110 %	100 %	90 %	80 %	70%	60 %	50 %
4HP	130	120	110	100	90	80	70	60	50
5HP	162.5	150	137.5	125	112.5	100	87.5	75	62.5
6HP	182	168	154	140	126	112	98	84	70
8HP	260	240	220	200	180	160	140	120	100
10HP	325	300	275	250	225	200	175	150	125
12HP	390	360	330	300	270	240	210	180	150
14HP	455	420	385	350	315	280	245	210	175
16HP	520	480	440	400	360	320	280	240	200
18HP	585	540	495	450	405	360	315	270	225
20HP	650	600	550	500	450	400	350	300	250
22HP	715	660	605	550	495	440	385	330	275
24HP	780	720	660	600	540	480	420	360	300
26HP	845	780	715	650	585	520	455	390	325
28HP	910	840	770	700	630	560	490	420	350
30HP	975	900	825	750	675	600	525	450	375
32HP	1,040	960	880	800	720	640	560	480	400
34HP	1,105	1,020	935	850	765	680	595	510	425
36HP	1,170	1,080	990	900	810	720	630	540	450
38HP	1,235	1,140	1,045	950	855	760	665	570	475
40HP	1,300	1,200	1,100	1,000	900	800	700	600	500
42HP	1,365	1,260	1,155	1,050	945	840	735	630	525
44HP	1,430	1,320	1,210	1,100	990	880	770	660	550
46HP	1,495	1,380	1,265	1,150	1,035	920	805	690	575
48HP	1,560	1,440	1,320	1,200	1,080	960	840	720	600
50HP	1,625	1,500	1,375	1,250	1,125	1,000	875	750	625
52HP	1,690	1,560	1,430	1,300	1,170	1,040	910	780	650
54HP	1,755	1,620	1,485	1,350	1,215	1,080	945	810	675

- Determine max. allowed connection ratio
  Max. 130% connection ratio

At 33°CDB ambient, 20° CWB/28° CDB indoor, the cooling capacity outdoor = 24.4 kW (cfr. Capacity table in databook)
In the capacity the outdoor unit can deliver following losses have to be incorporated:

1 pipe length / level difference correction factor for given equiv. Pipe length (43.5m) and level difference (5 m) = 0.925



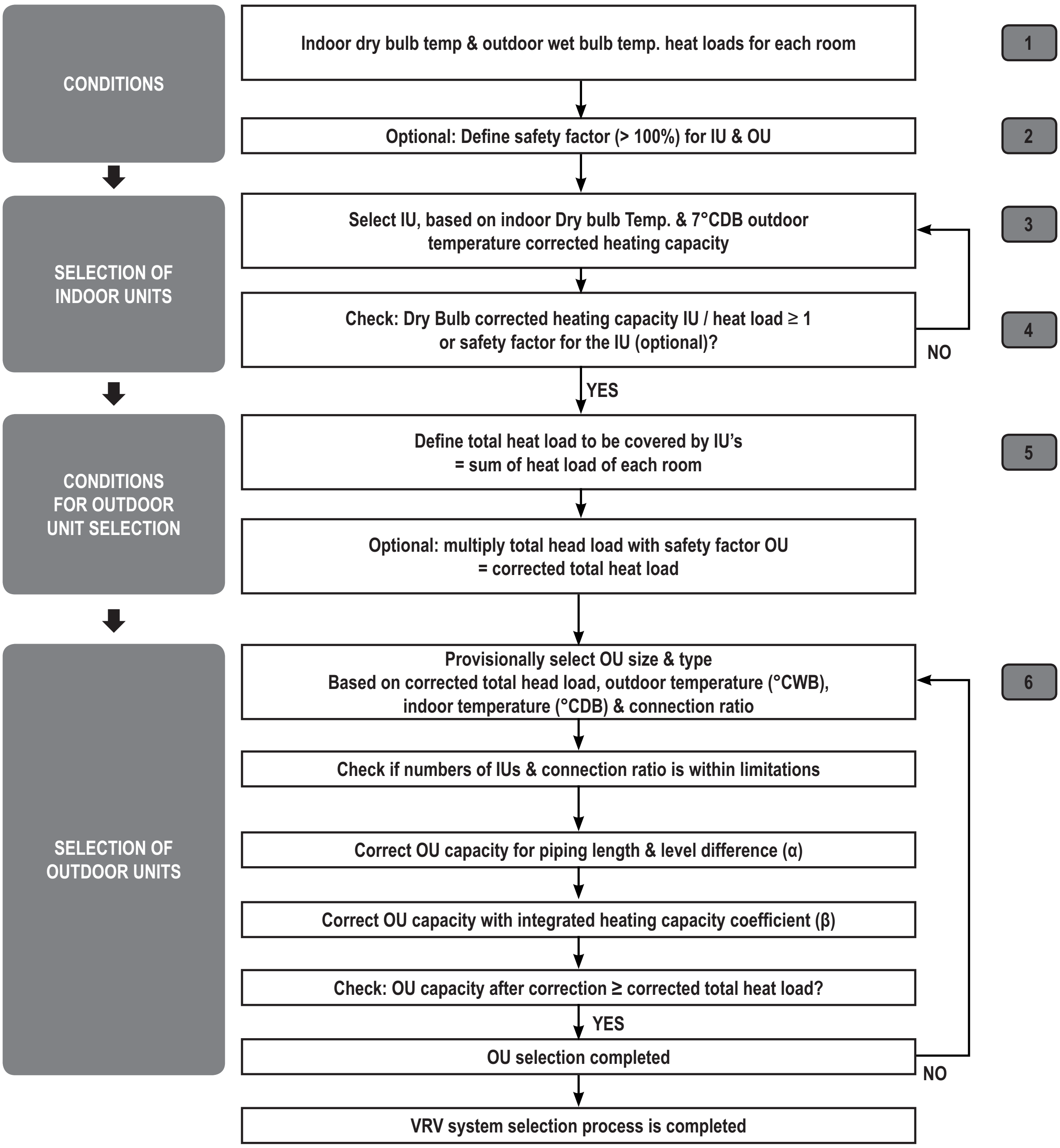
2 losses due to defrost = not applicable (since cooling mode)
=> 24.4 kW * 0.925 = 22.57 kW

The outdoor unit gives 22.57 kW whereas the required capacity is 22.4 kW

2 Selection in heating mode

2 - 1 Flowchart

2



2 Selection in heating mode

2 - 2 Step by step

2 - 2 - 1 Design conditions:

To start designing a VRV system in heating mode, following information is needed:

- Indoor conditions: Dry bulb temperature (°CDB)
- Heat loads per room: total heat load
- Outdoor conditions: Wet bulb temperature (°CWB) & Dry bulb temperature (°CDB)

2 - 2 - 2 Safety factor:

Optionally it is possible to increase the calculated heat loads by a certain factor (>1) to have extra safety when selecting indoor unit size & outdoor unit size

2 - 2 - 3 Selection of indoor unit

Select indoor unit based on total heat load at design indoor dry bulb temperature(°CDB) & nominal outdoor temperature (6°CWB / 7°CDB)

➔ See heating capacity table of selected type of indoor unit

2 - 2 - 4 Check heat load

If a safety factor has been applied to the heat load, please check if the heating capacity of the indoor unit is bigger than the corrected heat load.

2 - 2 - 5 Conditions for outdoor unit selection:

Following data is needed to select correct outdoor unit system:

- Total capacity index of indoor units (= sum of capacity indexes of all indoor units)
- Total number of connected indoor units
- Indoor suction air temperature (°CDB) & design outdoor temperature (°CWB)
- Equivalent piping length between furthest indoor unit and outdoor unit
- Level difference between indoor units & outdoor unit
- Safety factor for outdoor unit (optional)

2 - 2 - 6 Define heating capacity to be given by outdoor unit system:

The total heating capacity to be given by outdoor unit system is defined by the sum of all heating loads to be absorbed by the indoor units connected to the to be selected outdoor unit

2 Selection in heating mode

2 - 2 Step by step

2 - 2 - 7 Selection of outdoor unit

- Provisionally select outdoor unit size & type based on outdoor temperature (°CDB), indoor temperature (°CDB) & connection ratio
  - ➔ See heating capacity table of selected outdoor unit in ED
- Check if maximum number of indoor units and connection ratio is within limitations
- Correct the outdoor unit capacity by piping correction factor (a) based on pipe run and level difference between indoor unit and outdoor unit
  - ➔ See piping correction diagrams in ED
- Correct the outdoor unit capacity by integrated heating capacity coefficient (b) influence of the defrost operation on the integrated heating capacity)
- ➔ See integrated heating capacity table in ED
- Check if available heating capacity after piping & defrost correction is still bigger than the heating capacity to be given by the outdoor unit
- Outdoor unit size is selected.

REMARK

Calculation of HT Hydrobox:

- Available heating capacity HXHD125 = 14 kW
  - ➔ this remains always available irrespective of outdoor temperature or leaving water temperature (LWT)
- Capacity index HXHD125 = 125
  - ➔ to be used for definition of total capacity index & connection ratio of REYAQ
- Power input HXHD125 depends on Leaving Water Temperature (LWT) (see table 1)
- Requested heating capacity from REYAQ depends on Leaving Water (LWT) (see table 1)

Table 1:

Leaving Water Temperature [°C]	35	45	55	65	75
Requested heating capacity from REYAQ [kW]	12.98	12.60	12.60	12.10	11.09
Power input HXHD125 [kW]	1.50	1.79	1.83	2.33	3.25

In case less than 14 kW capacity is needed to produce hot water:

When less than 14 kW heating capacity is required from the hydrobox, the values of requested outdoor capacity and power consumption are adjusted proportionally.

2 Selection in heating mode

2 - 3 Example

2 - 3 - 1 Design conditions

- Determine indoor / outdoor design temperature

  Indoor: 18° CDB

  Ambient: 2.2° CWB / 3° CDB

- Determine room peak loads (and if possible, system peak loads = optional)

Design loads in kW (total heating capacity)

Time	A	B	C	D	E	F	G	H	Sum
9h00	*3.1*	2.3	1.9	3.8	3.2	*4.1*	3.5	2	23.9 kW
13h00	2.8	*2.9*	1.5	3.7	*4.1*	3.7	*4*	2.2	24.9 kW
17h00	2.2	2	*2.7*	*4.5*	3.6	3.3	2.7	*3.2*	24.2 kW

Sum Room Peak loads 28.6 kW

System Peak Load 24.9 kW Max capacity requested from outdoor unit

2 - 3 - 2 Safety factor

In this example, safety factor does not use.

2 - 3 - 3 Selection of indoor unit

FXCQ indoor unit

	A	B	C	D	E	F	G	H	Sum
FXCQ	**25**	**25**	**25**	**40**	**40**	**40**	**40**	**25**	**260**
kW	**3.4**	**3.4**	**3.4**	**5.2**	**5.2**	**5.2**	**5.2**	**3.4**	**34.4**

* the capacity is selected according to the design conditions (indoor 18° CDB; ambient 6° CWB / 7° CDB)

NOTE

1 The new selection method, for the indoor unit selection, does not take into account the outdoor temperature. Therefore take the rated outdoor temperatures when looking up in the indoor unit capacity table (35° CDB for cooling, 7° CDB for heating)

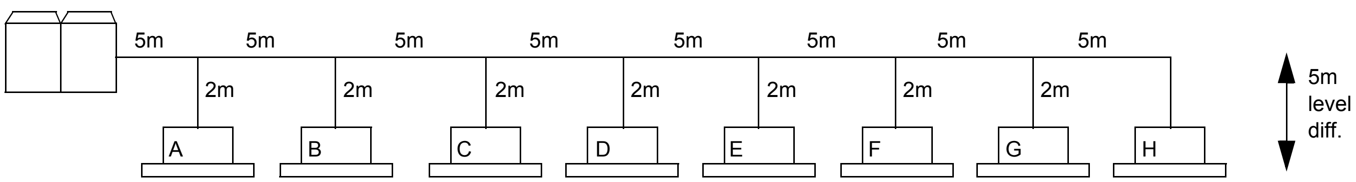
2 - 3 - 4 Check heat load

Total heating capacity of indoors > heat load

33.4>24.9 kW

2 - 3 - 5 Conditions for outdoor unit selection:

- Total capacity index of indoor units = 260 OK
- Number of Selected indoors = 8 OK
- Equivalent piping length and level difference



Equivalent pipe length (*) = 43.5 meter

(*) Length to furthest indoor unit including equiv. Pipe length of refnets (0.5 meter per refnet)

2 Selection in heating mode

2 - 3 Example

2 - 3 - 6 Define heating capacity to be given by outdoor unit system:

Total heating load

- Sum of peak loads = 28.6 kW
- System peak load = 24.9 kW

Correct total heat load

Table: Coefficient of loss per meter of piping with insulation thickness of 10mm

2

Correction factor	HLC (%/m)	HLH (%/m)
Ambient temperature	Cooling	Heating
-15		0.100
-10		0.093
-5		0.086
0		0.078
5	0.000	0.071
10	0.000	0.064
15	0.004	0.057
20	0.009	0.049
25	0.014	
30	0.022	
35	0.030	
40	0.038	

For 3° CDB ambient temperature, the heat loss factor is 0.0752% (interpolated).

For the piping length, the first 7.5m is not considered

⇨ 43.5m - 7.5m = 36m

Heat loss factor * actual piping run

⇨ 0.0752% * 36m = 0.027072

total cooling load x (1 + (heat loss factor x actual pipe run))

⇨ 24.9*(1 + 0.027072) = 25.6

2 Selection in heating mode

2 - 3 Example

2 - 3 - 7 Selection of outdoor unit

- select outdoor unit type
  RXYQ8P outdoor unit

Indoor unit combination total capacity index table

Outdoor unit	Indoor unit combination ratio								
	130 %	120 %	110 %	100 %	90 %	80 %	70%	60 %	50 %
4HP	130	120	110	100	90	80	70	60	50
5HP	162.5	150	137.5	125	112.5	100	87.5	75	62.5
6HP	182	168	154	140	126	112	98	84	70
8HP	260	240	220	200	180	160	140	120	100
10HP	325	300	275	250	225	200	175	150	125
12HP	390	360	330	300	270	240	210	180	150
14HP	455	420	385	350	315	280	245	210	175
16HP	520	480	440	400	360	320	280	240	200
18HP	585	540	495	450	405	360	315	270	225
20HP	650	600	550	500	450	400	350	300	250
22HP	715	660	605	550	495	440	385	330	275
24HP	780	720	660	600	540	480	420	360	300
26HP	845	780	715	650	585	520	455	390	325
28HP	910	840	770	700	630	560	490	420	350
30HP	975	900	825	750	675	600	525	450	375
32HP	1,040	960	880	800	720	640	560	480	400
34HP	1,105	1,020	935	850	765	680	595	510	425
36HP	1,170	1,080	990	900	810	720	630	540	450
38HP	1,235	1,140	1,045	950	855	760	665	570	475
40HP	1,300	1,200	1,100	1,000	900	800	700	600	500
42HP	1,365	1,260	1,155	1,050	945	840	735	630	525
44HP	1,430	1,320	1,210	1,100	990	880	770	660	550
46HP	1,495	1,380	1,265	1,150	1,035	920	805	690	575
48HP	1,560	1,440	1,320	1,200	1,080	960	840	720	600
50HP	1,625	1,500	1,375	1,250	1,125	1,000	875	750	625
52HP	1,690	1,560	1,430	1,300	1,170	1,040	910	780	650
54HP	1,755	1,620	1,485	1,350	1,215	1,080	945	810	675

- Determine max. allowed connection ratio
  Max. 130% connection ratio

At 2.2° CWB/3° CDB ambient, 18° CDB indoor, the heating capacity outdoor = 26,8 kW (cfr. Capacity table in databook)

The outdoor unit gives 26.8 kW whereas the required capacity is 25.6 kW.

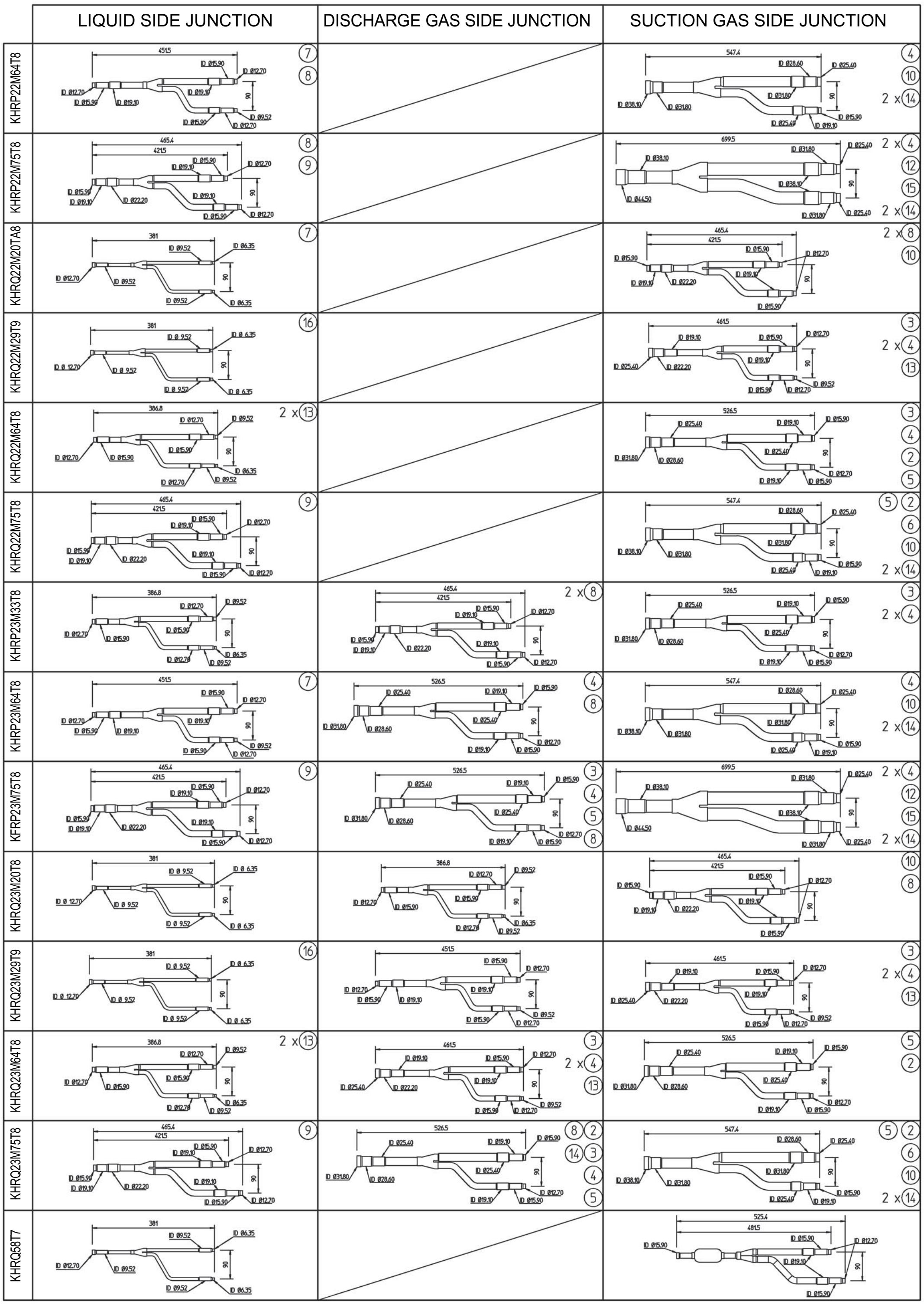
2 - 3 - 8 Defrost factor

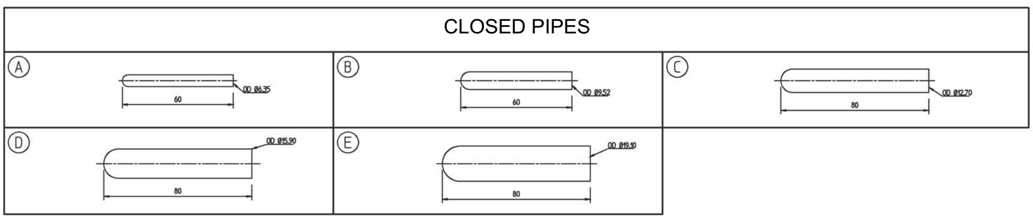
The outdoor unit gives 26.8 kW, but still a defrost factor needs to be considered.
The defrost factor for 3° CDB, is 0.83, so this factor decreases the total outdoor unit capacity.
⇨ 26.8 kW * 0.83 = 22.24 kW.

This means that the 8 HP unit is not sufficient to reach the required capacity of 25.6 kW.
Size up to 10 HP and recheck the values.
⇨ The heating capacity outdoor is 33.6 kW, and after defrost factor correction it is 27.9 kW.

3 Refnet pipe systems

3 - 1 Refnet pipe systems





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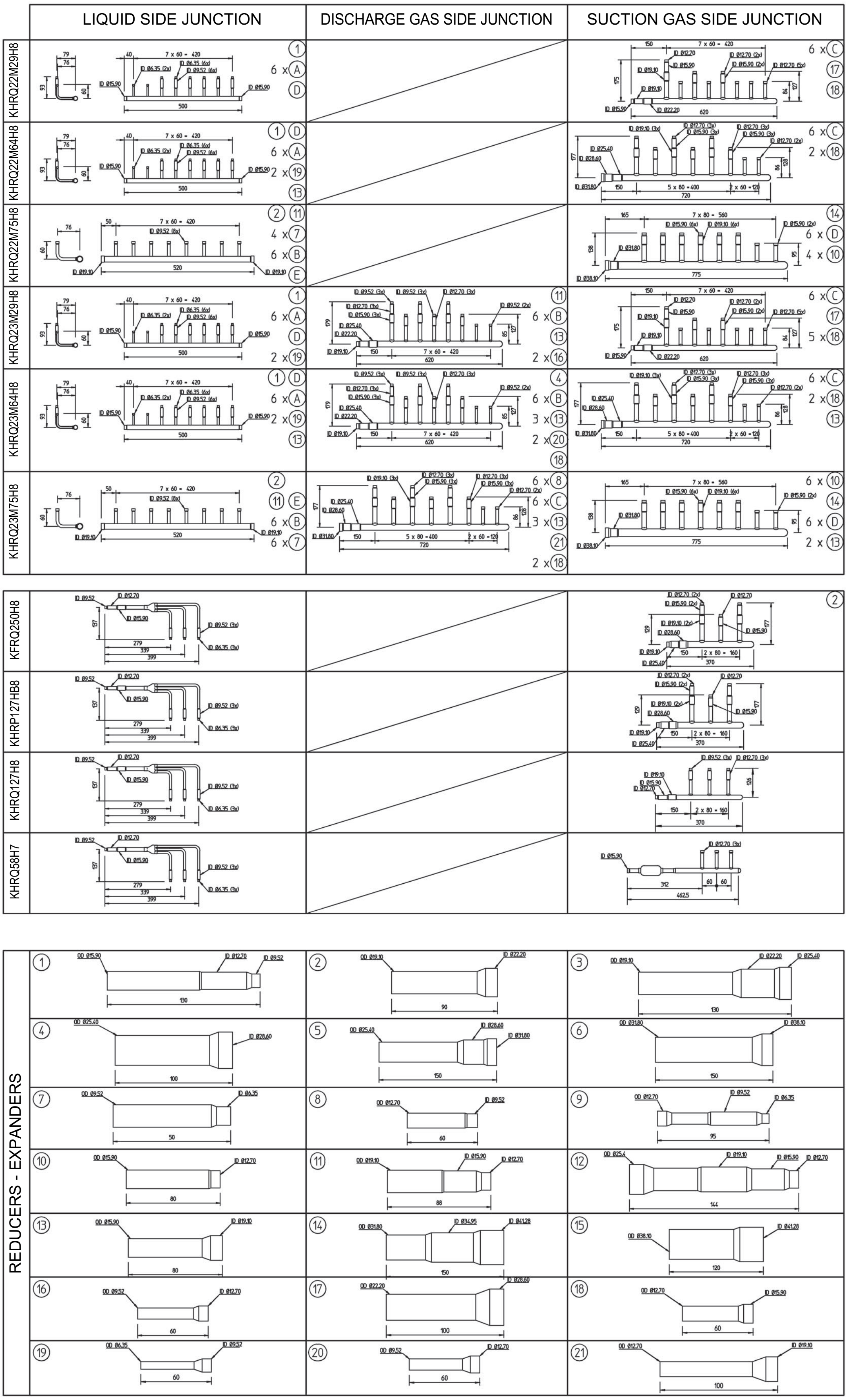
3 Refnet pipe systems

3 - 1 Refnet pipe systems



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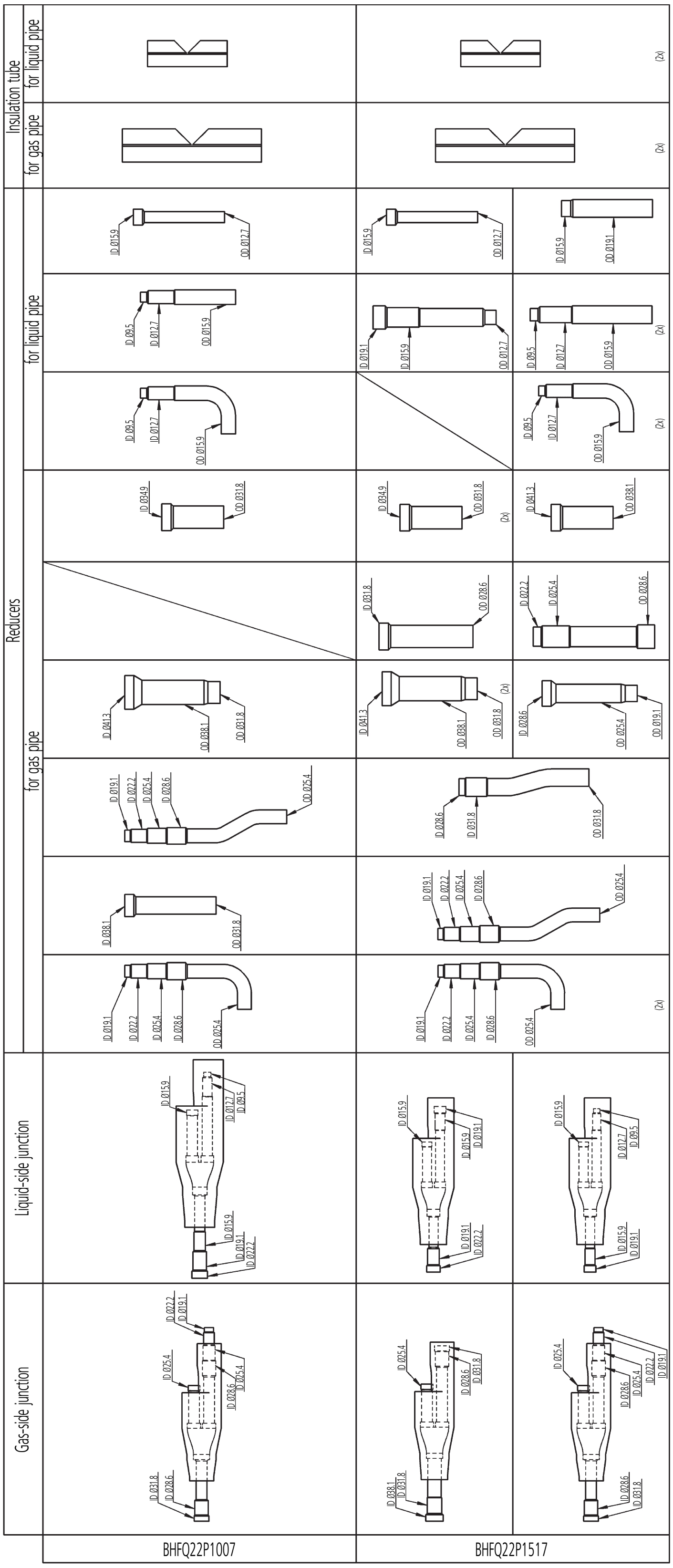
3 Refnet pipe systems

3 - 1 Refnet pipe systems



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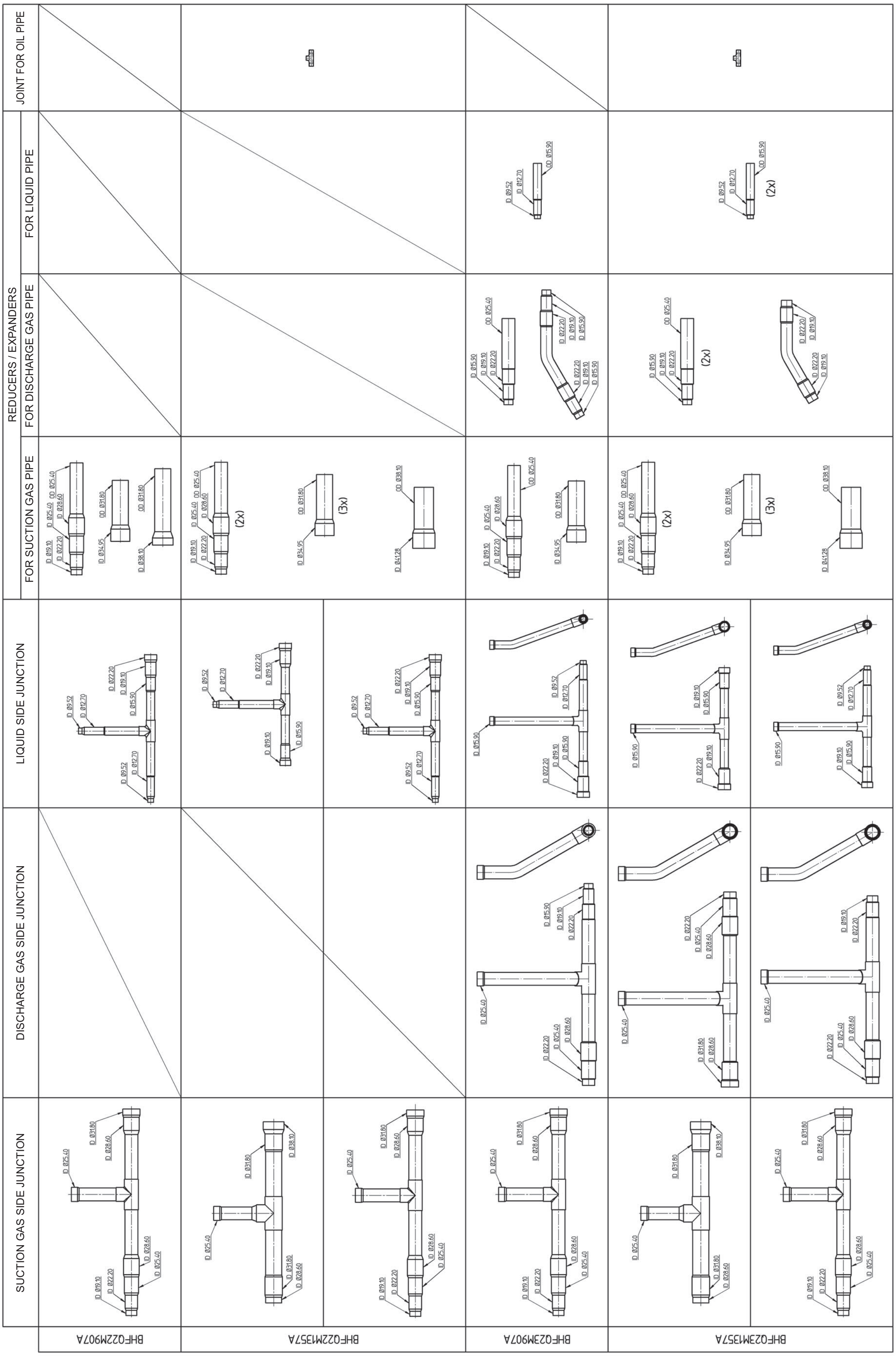
3 Refnet pipe systems

3 - 1 Refnet pipe systems



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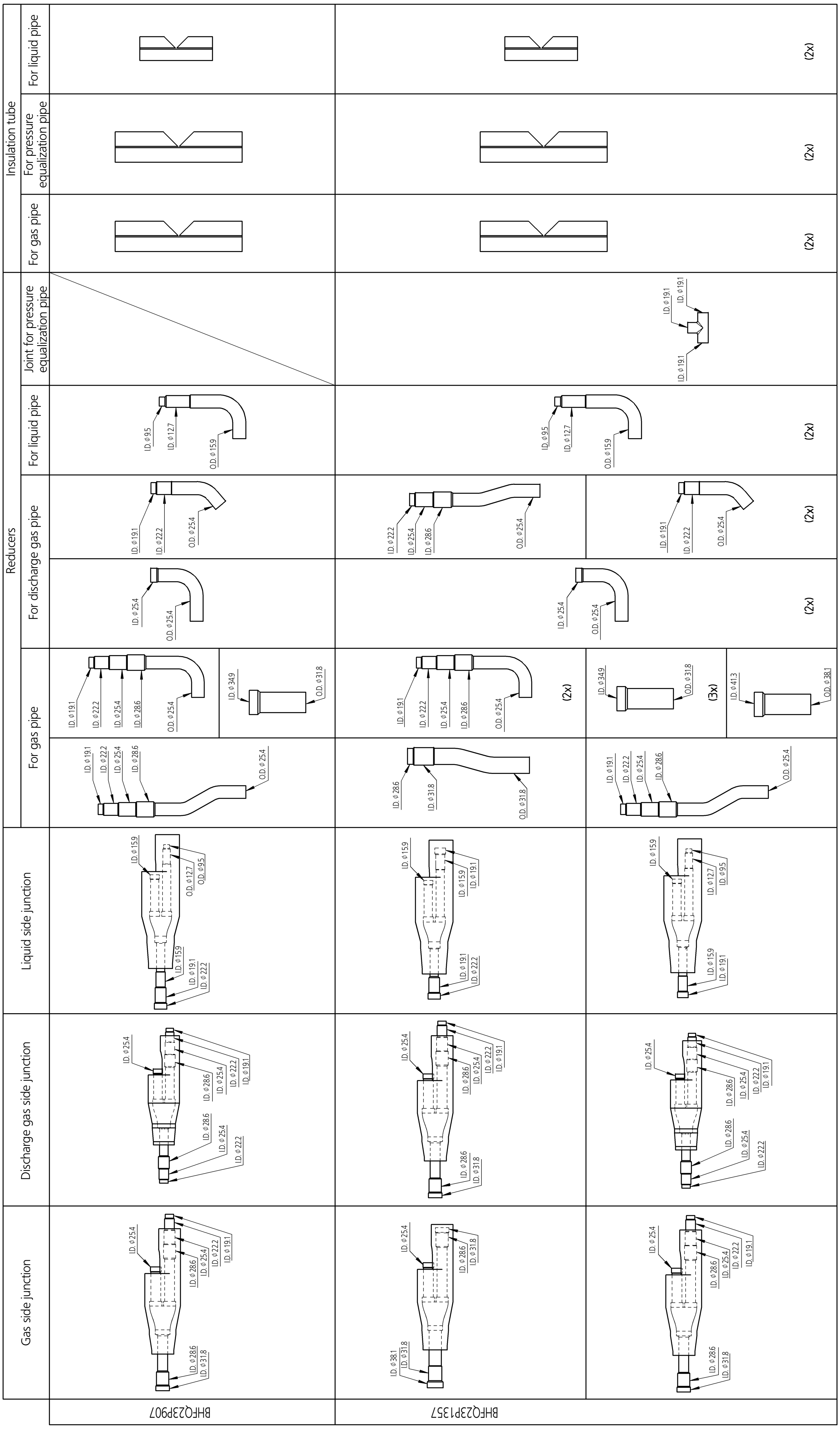
3 Refnet pipe systems

3 - 1 Refnet pipe systems



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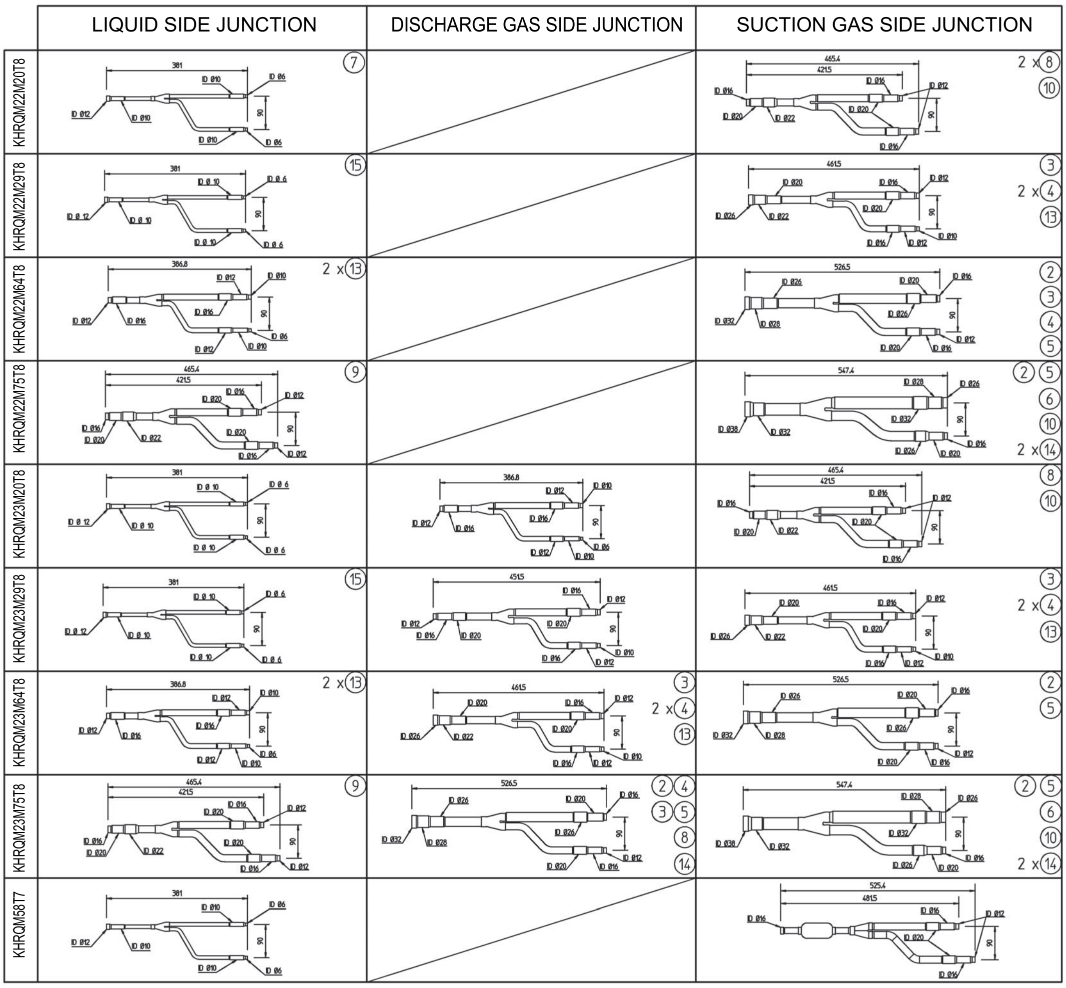
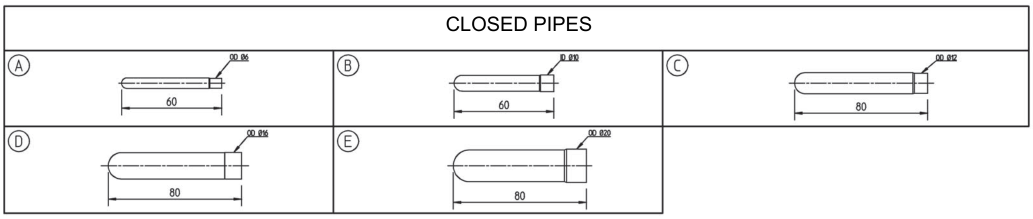
3 Refnet pipe systems

3 - 1 Refnet pipe systems





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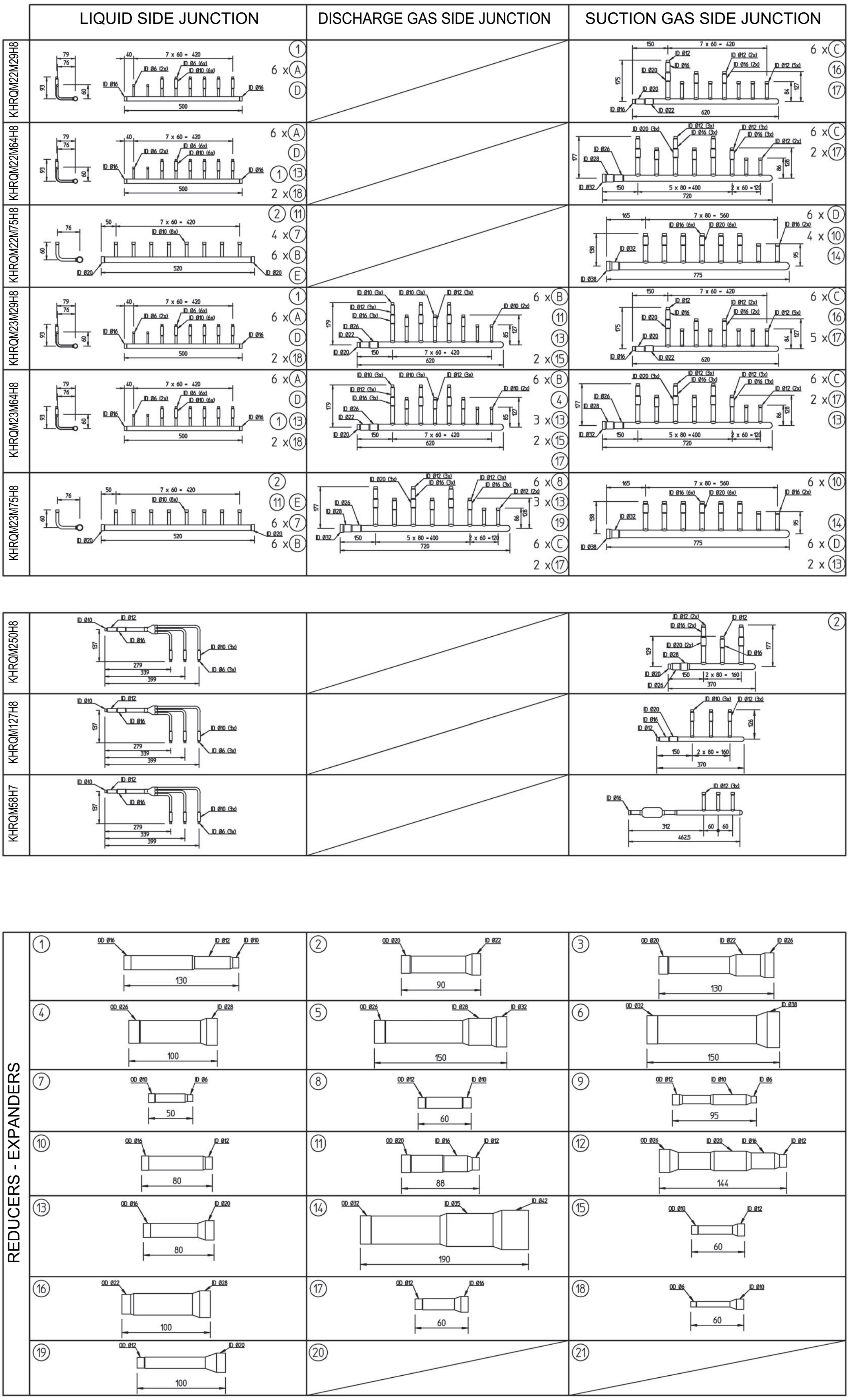
3 Refnet pipe systems

3 - 1 Refnet pipe systems



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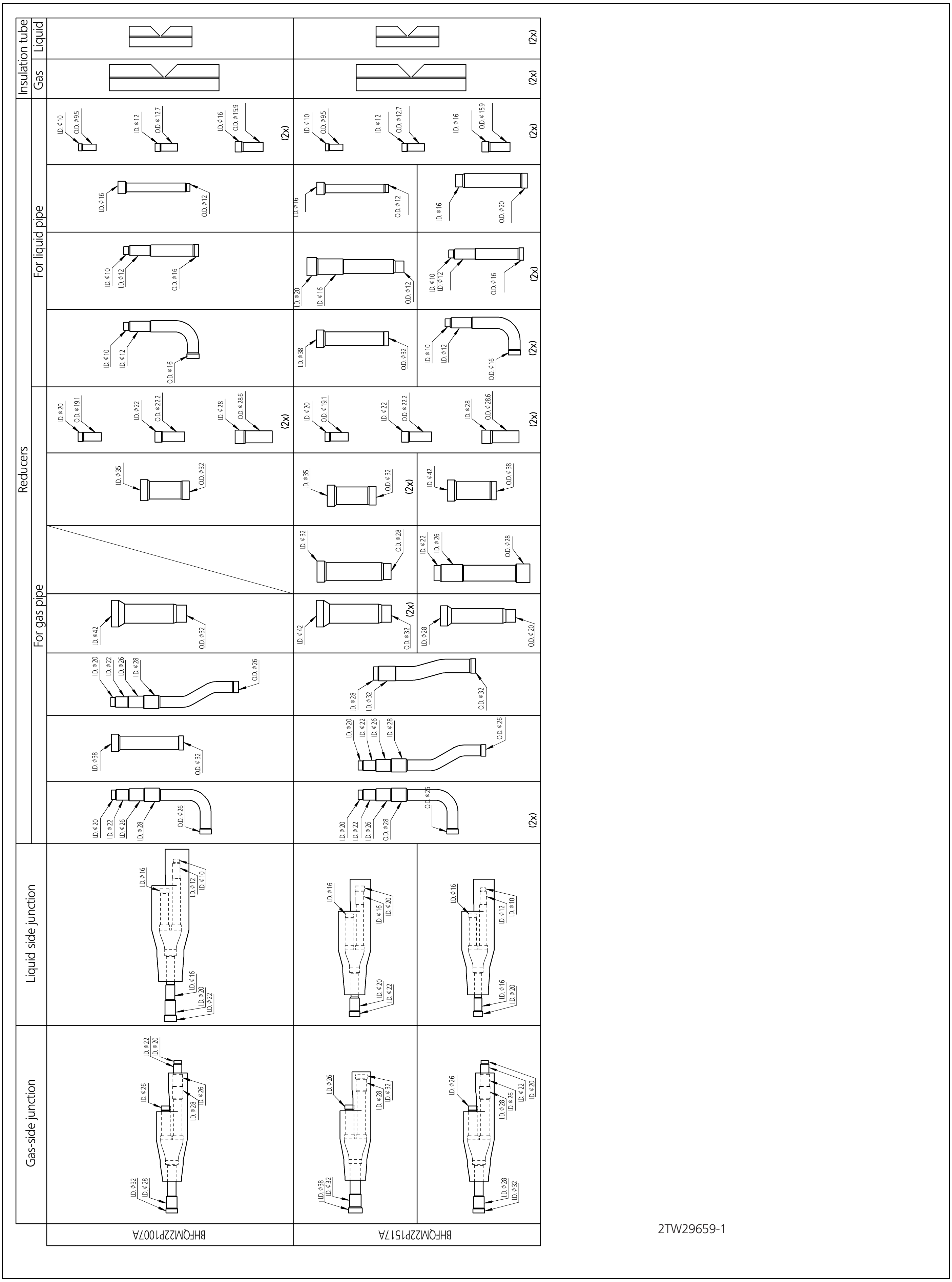
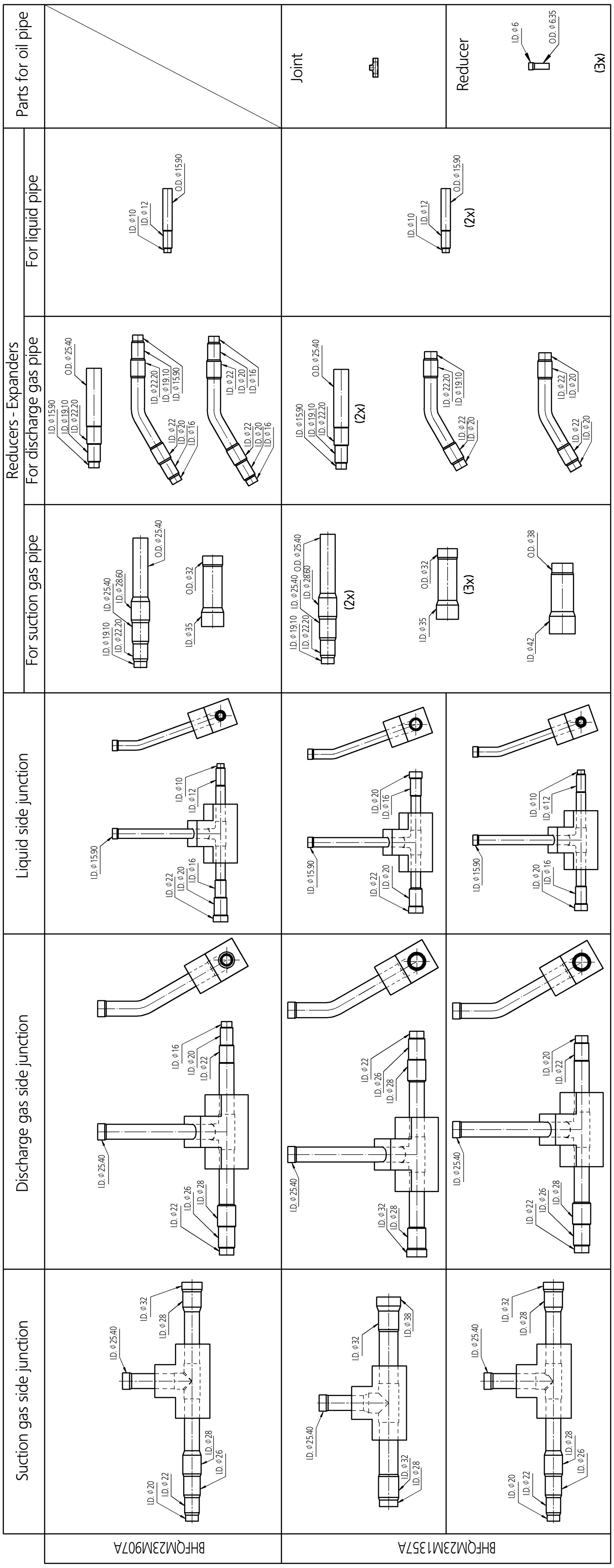
3 Refnet pipe systems

3 - 1 Refnet pipe systems



3 Refnet pipe systems

3 - 1 Refnet pipe systems



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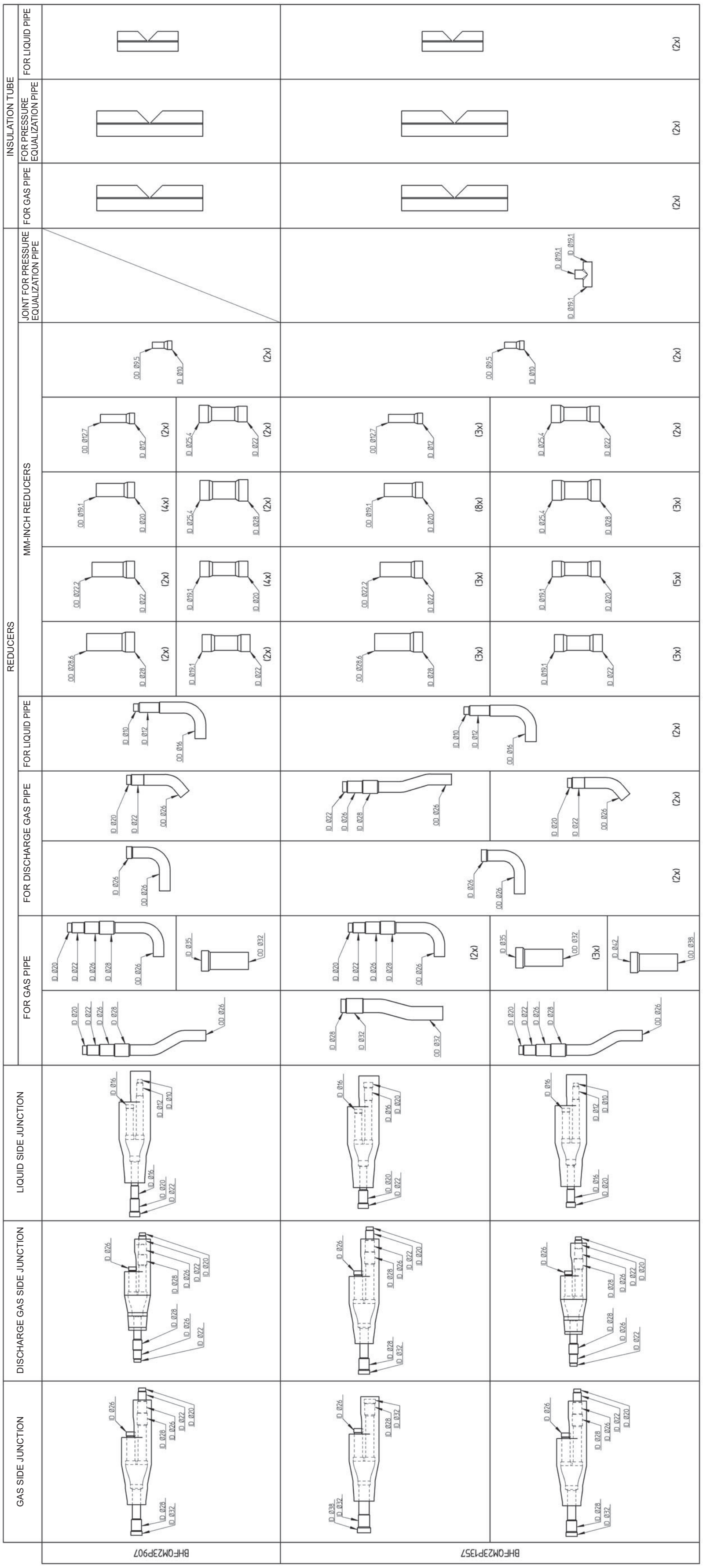
3 Refnet pipe systems

3 - 1 Refnet pipe systems



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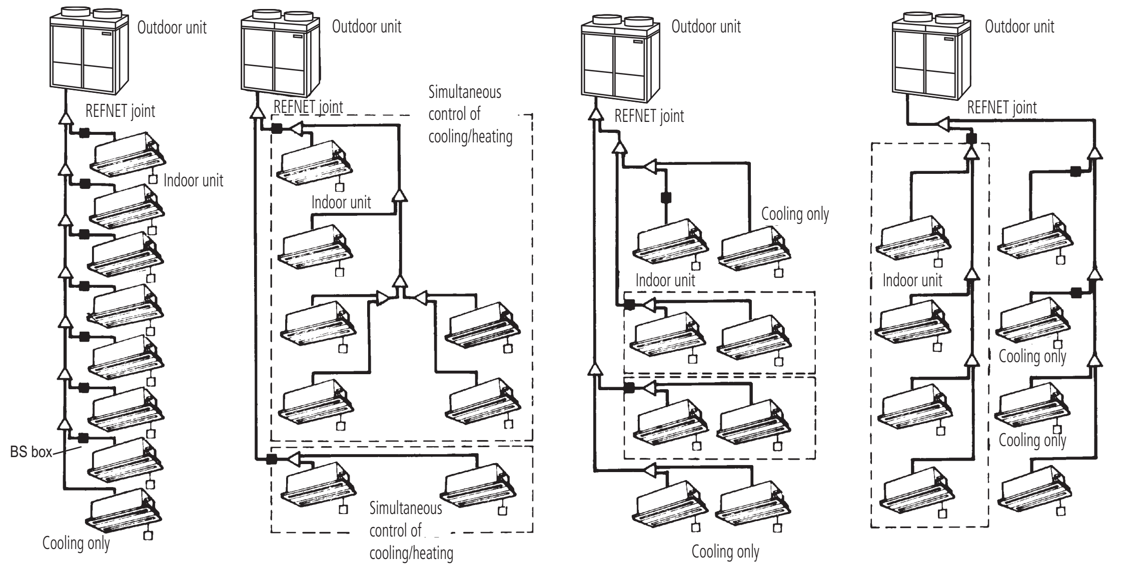
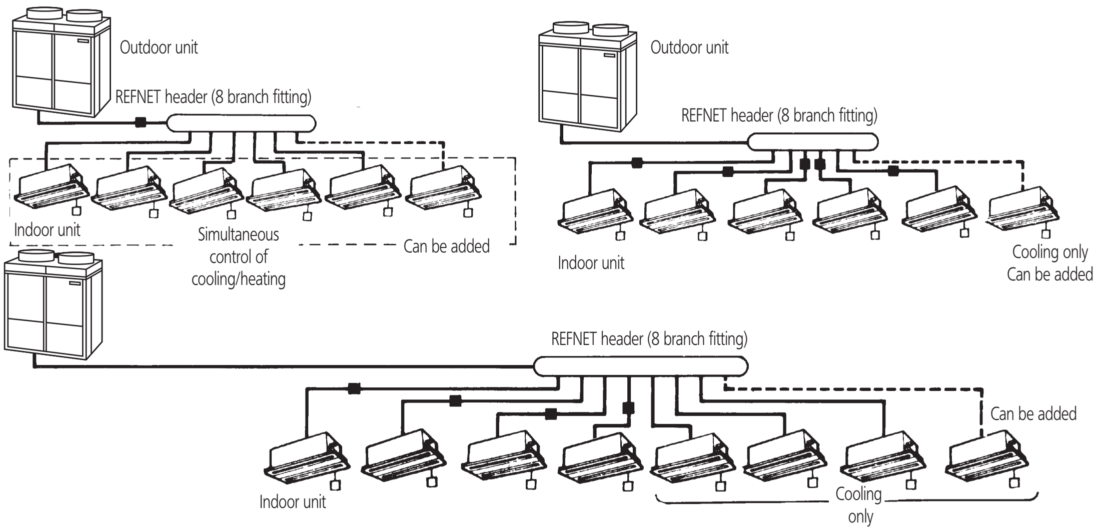
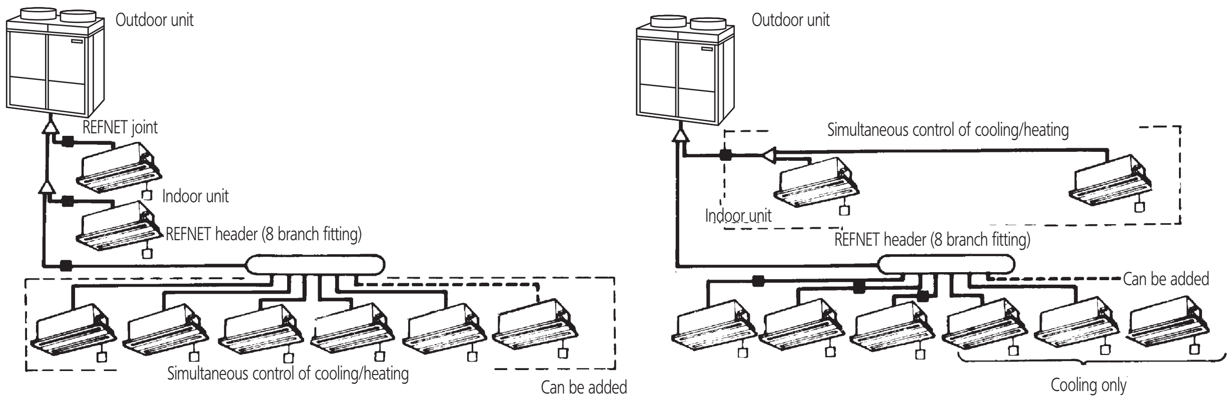
3 Refnet pipe systems

3 - 2 Refnet piping layouts

Type of fitting	Sample systems
Distribution by REFNET joints	
Distribution by REFNET header	
Distribution by REFNET joints and headers	

3 Refnet pipe systems

3 - 3 Piping thickness

Piping diameter	Material	Minimum thickness [mm]
Ø 6.4	O	0.8
Ø 9.5	O	0.8
Ø 12.7	O	0.8
Ø 15.9	O	0.99
Ø 19.1	1/2H	0.8
Ø 22.2	1/2H	0.8
Ø 25.4	1/2H	0.88
Ø 28.6	1/2H	0.99
Ø 31.8	1/2H	1.10
Ø 34.9	1/2H	1.21
Ø 38.1	1/2H	1.32
Ø 41.3	1/2H	1.43

O annealed

1/2H half-hard

For half hard pipes the maximum allowed tensile stress is 61 N/mm^2. For this reason the 0.2% proof strength of the half hard pipe shall be minimum 61 N/mm^2.

The bending radius is more than or equal to 3 times the diameter of the pipe.

In all of us, a green heart

Daikin's unique position as a manufacturer of air conditioning equipment, compressors and refrigerants has led to its close involvement in environmental issues. For several years Daikin has had the intention to become a leader in the provision of products that have limited impact on the environment. This challenge demands the eco design and development of a wide range of products and an energy management system, resulting in energy conservation and a reduction of waste.

VRV products are not within the scope of the Eurovent certification programme.

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