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Technical Data

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Air-cooled selection procedure

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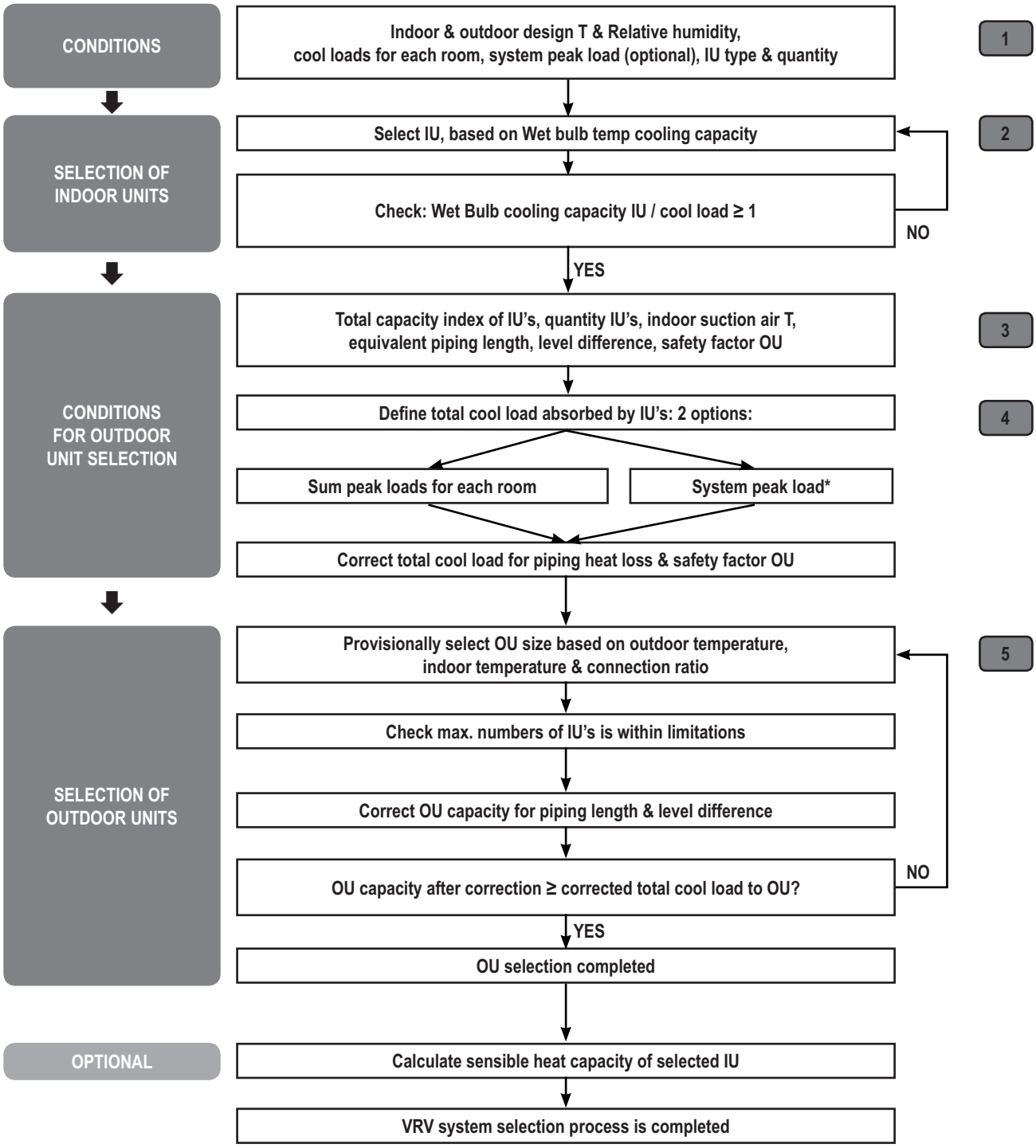
TABLE OF CONTENTS

II Air-cooled selection procedure

1 Selection procedure VRV system based on cooling load

1 - 1 Flowchart



* 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)

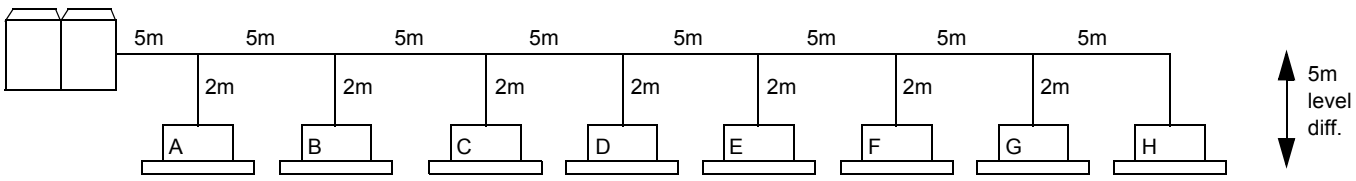
1 - 3 - 3 Check cool load

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

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

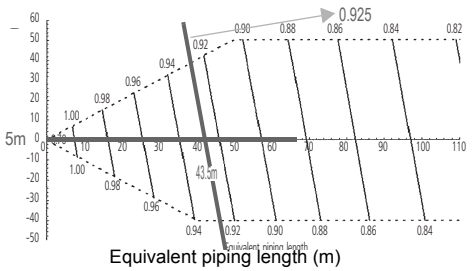
- Determine max. allowed connection ratio

  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



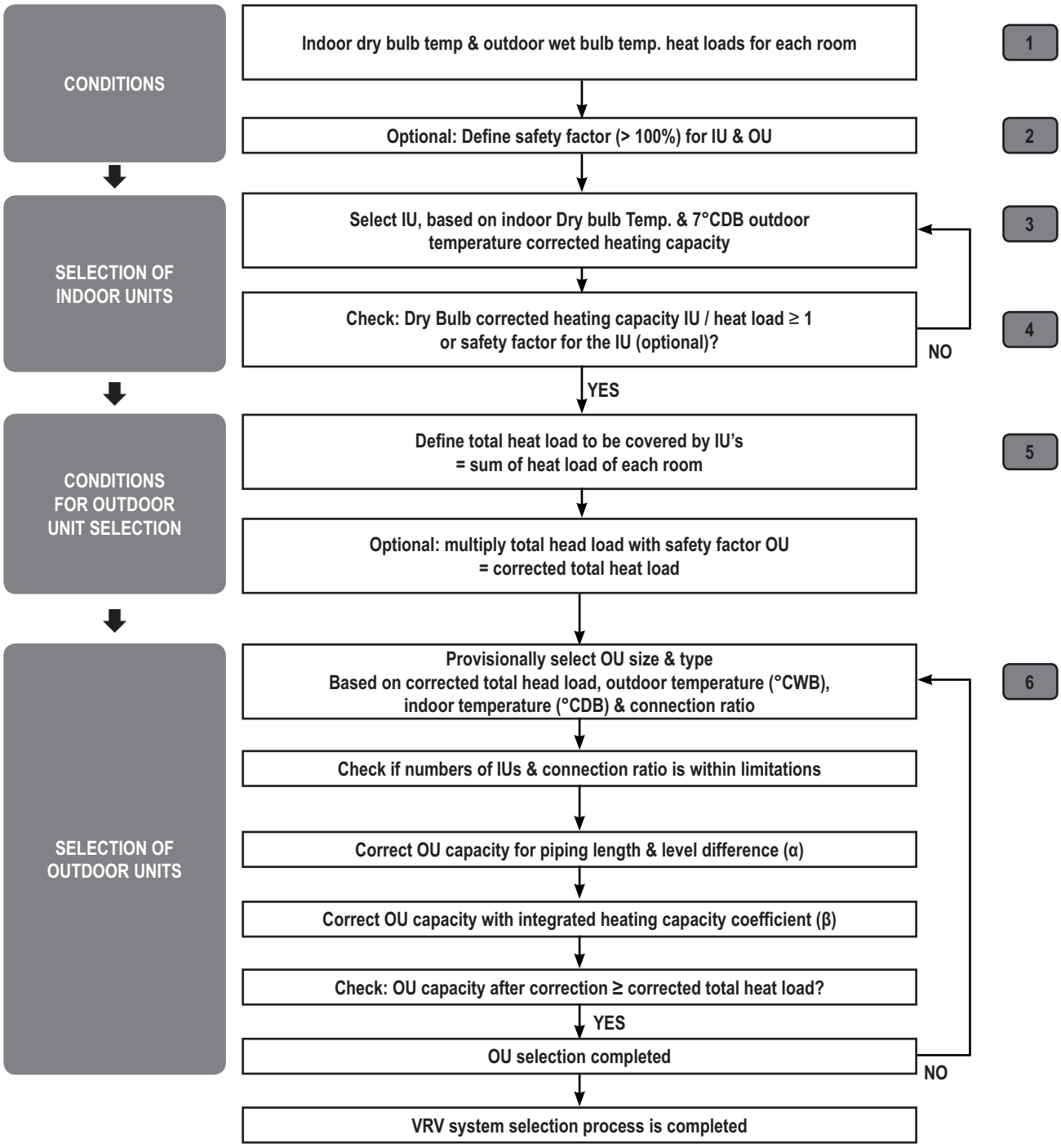
2 losses due to defrost = not applicable (since cooling mode)

=> 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 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.

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)

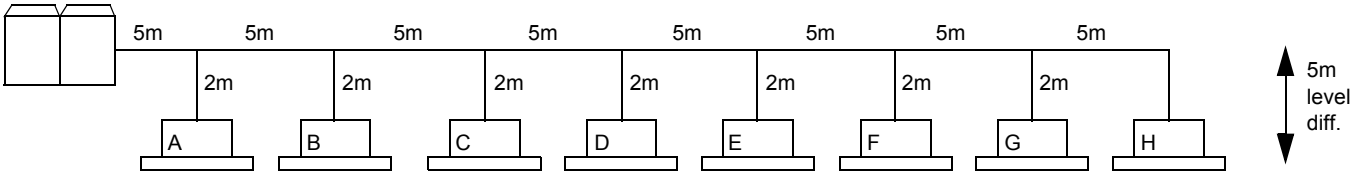
2 - 3 - 4 Check heat load

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

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.

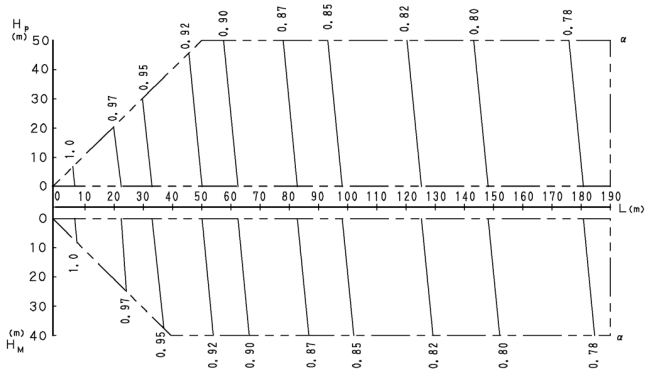
This means that the 8 HP unit is not sufficient to reach the required capacity of 25.6 kW.
Size up to 10 HP and recheck the values.
⇨ The heating capacity outdoor is 33.6 kW, and after defrost factor correction it is 27.9 kW.

3 Capacity correction ratio

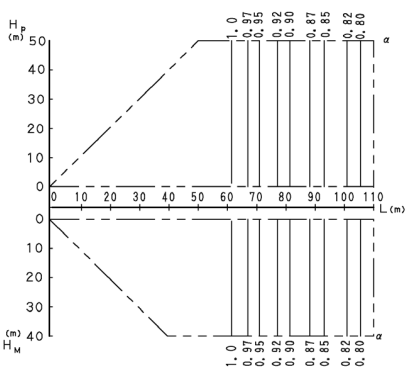
3 - 1 VRVIII heat recovery with connection to heating only hydrobox

RTSYQ10PA

1. Rate of change in cooling capacity



2. Rate of change in heating capacity



[Diameter of the main pipes (standard size)]

Model	Gas	Liquid
RTSYQ10PA	ø 22.2	ø 9.5

[Temper grade and thickness]

Temper grade	0 Type		1/2H Type	
Outer diameter	ø 9.5	ø 12.7	ø 22.2	ø 25.4
Minimum wall thickness	0.80	0.80	0.80	0.88

[Explanation of symbols]

Hp: Level difference (m) between indoor and outdoor units where indoor unit in inferior position

Hm: Level difference (m) between indoor and outdoor units where indoor unit in superior position

L: Equivalent pipe length (m)

α: Rate of change in cooling/heating capacity

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NOTES

1. These figures illustrate the rate of change in capacity of a standard indoor unit system at maximum load (with the thermostat set to maximum) under standard conditions. Moreover, under partial load conditions there is only a minor deviation from the rate of change in capacity shown in the above figures.
2. With this outdoor unit, evaporating pressure constant control when cooling an d condensing pressure constant control when heating is carried out.
3. Method of calculating A/C (cooling/heating) capacity:
   The maximum A/C capacity of the system will be either the total A/C capacity of the indoor units obtained from capacity characteristic table or the maximum A/C capacity of outdoor units as mentioned bellow, whichever smaller.
   Calculating A/C capacity of outdoor units.
   - Condition: Indoor unit combination ratio does not exceed 100%.

   Maximum A/C capacity of outdoor units = A/C capacity of outdoor units obtained from capacity characteristic table at the 100% combination
   x Capacity change rate due to piping length to the farthest indoor unit

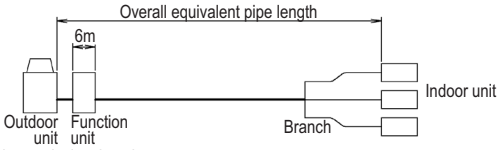
   - Condition: Indoor unit combination ratio exceeds 100%.

   Maximum A/C capacity of outdoor units = A/C capacity of outdoor units obtained from capacity characteristic table at the combination
   x Capacity change rate due to piping length to the farthest indoor unit

4. When overall equivalent pipe length is 90m or more, the diameter of the main gas and liquid pipes (outdoor unit-branch sections) must be increased. (Consider the equivalent pipe length of function unit as 6m.)
   [Diameter of above case]

Model	Gas	Liquid
RTSYQ10PA	ø 25.4 *	ø 12.7

*If available on the site, use this size, otherwise do not increase.

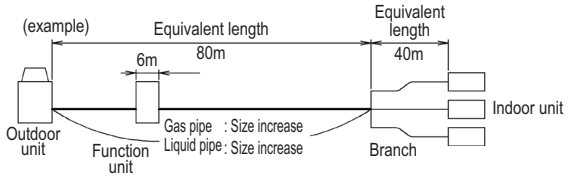


5. Read cooling/heating capacity rate of change in the above figures based on the following equivalent length.

   Overall equivalent length =(Equivalent length to main pipe) x Correction factor + (Equivalent length after branching)

   Choose a correction factor from the following table. [When cooling capacity is calculated: gas pipe size
   When heating capacity is calculated: liquid pipe size

Rate of change (object piping)	Correction factor	
	Standard size	Size increase
Cooling (gas pipe)	1.0	0.5
Heating (liquid pipe)	1.0	0.2



In the above case (Cooling) Overall equivalent length = 80m x 0.5 + 40m = 80m
(Heating) Overall equivalent length = 80m x 0.2 + 40m = 56m

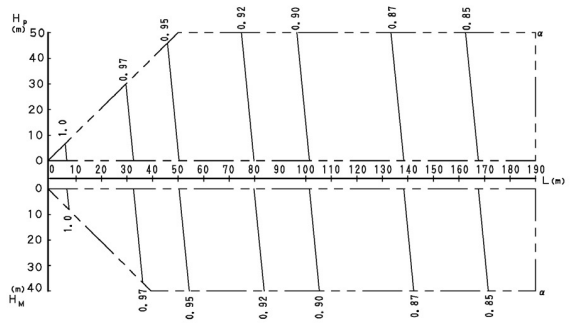
The rate of change in cooling capacity when Hp = 0m is thus approximately 0.87
heating capacity when Hp = 0m is thus approximately 1.0

3 Capacity correction ratio

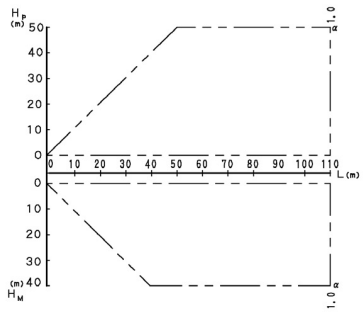
3 - 1 VRVIII heat recovery with connection to heating only hydrobox

RTSYQ14PA

1. Rate of change in cooling capacity



2. Rate of change in heating capacity



[Diameter of the main pipes (standard size)]

Model	Gas	Liquid
RTSYQ14PA	ø 28.6	ø 12.7

[Temper grade and thickness]

Temper grade	0 Type		1/2H Type
Outer diameter	ø 12.7	ø 15.9	ø 28.6
Minimum wall thickness	0.80	0.99	0.99

[Explanation of symbols]
Hp: Level difference (m) between indoor and outdoor units where indoor unit in inferior position
Hm: Level difference (m) between indoor and outdoor units where indoor unit in superior position
L: Equivalent pipe length (m)
α: Rate of change in cooling/heating capacity

3D060820A

NOTES

1. These figures illustrate the rate of change in capacity of a standard indoor unit system at maximum load (with the thermostat set to maximum) under standard conditions. Moreover, under partial load conditions there is only a minor deviation from the rate of change in capacity shown in the above figures.
2. With this outdoor unit, evaporating pressure constant control when cooling and condensing pressure constant control when heating is carried out.
3. Method of calculating A/C (cooling/heating) capacity:
   The maximum A/C capacity of the system will be either the total A/C capacity of the indoor units obtained from capacity characteristic table or the maximum A/C capacity of outdoor units as mentioned bellow, whichever smaller.
   Calculating A/C capacity of outdoor units.
   - Condition: Indoor unit combination ratio does not exceed 100%.

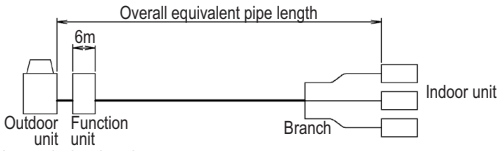
   Maximum A/C capacity of outdoor units = A/C capacity of outdoor units obtained from capacity characteristic table at the 100% combination
   x Capacity change rate due to piping length to the farthest indoor unit

   - Condition: Indoor unit combination ratio exceeds 100%.

   Maximum A/C capacity of outdoor units = A/C capacity of outdoor units obtained from capacity characteristic table at the combination
   x Capacity change rate due to piping length to the farthest indoor unit

4. When overall equivalent pipe length is 90m or more, the diameter of the main gas and liquid pipes (outdoor unit-branch sections) must be increased. (Consider the equivalent pipe length of function unit as 6m.)
   [Diameter of above case]

Model	Gas	Liquid
RTSYQ14PA	Not increased	ø 15.9



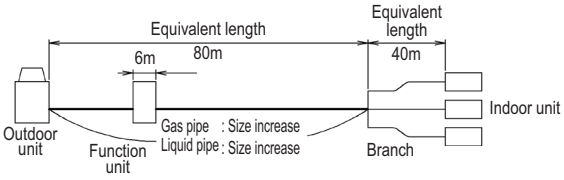
5. Read cooling/heating capacity rate of change in the above figures based on the following equivalent length.

   Overall equivalent length =(Equivalent length to main pipe) x Correction factor + (Equivalent length after branching)

   Choose a correction factor from the following table. [When cooling capacity is calculated: gas pipe size
   When heating capacity is calculated: liquid pipe size

Rate of change (object piping)	Correction factor	
	Standard size	Size increase
Cooling (gas pipe)	1.0	
Heating (liquid pipe)	1.0	0.3

(example)



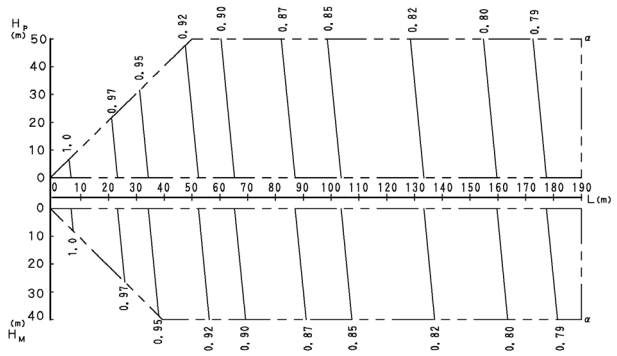
In the above case (Cooling) Overall equivalent length = 80m x 0.5 + 40m = 80m
(Heating) Overall equivalent length = 80m x 0.3 + 40m = 64m
The rate of change in cooling capacity when Hp = 0m is thus approximately 0.88
heating capacity when Hp = 0m is thus approximately 1.0

3 Capacity correction ratio

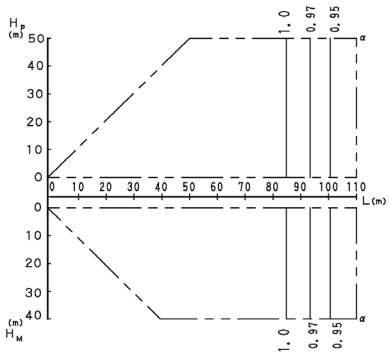
3 - 1 VRVIII heat recovery with connection to heating only hydrobox

RTSYQ16PA

1. Rate of change in cooling capacity



2. Rate of change in heating capacity



[Diameter of the main pipes (standard size)]

Model	Gas	Liquid
RTSYQ16PA	ø 28.6	ø 12.7

[Diameter of the main pipes (standard size)]

Temper grade	0 Type		1/2H Type	
Outer diameter	ø 12.7	ø 15.9	ø 28.6	ø 31.8
Minimum wall thickness	0.80	0.99	0.99	1.10

[Explanation of symbols]
Hp: Level difference (m) between indoor and outdoor units where indoor unit in inferior position
Hm: Level difference (m) between indoor and outdoor units where indoor unit in superior position
L: Equivalent pipe length (m)
α: Rate of change in cooling/heating capacity

3D060821A

NOTES

1. These figures illustrate the rate of change in capacity of a standard indoor unit system at maximum load (with the thermostat set to maximum) under standard conditions. Moreover, under partial load conditions there is only a minor deviation from the rate of change in capacity shown in the above figures.
2. With this outdoor unit, evaporating pressure constant control when cooling and condensing pressure constant control when heating is carried out.
3. Method of calculating A/C (cooling/heating) capacity:
   The maximum A/C capacity of the system will be either the total A/C capacity of the indoor units obtained from capacity characteristic table or the maximum A/C capacity of outdoor units as mentioned bellow, whichever smaller.
   Calculating A/C capacity of outdoor units.
   - Condition: Indoor unit combination ratio does not exceed 100%.

Maximum A/C capacity of outdoor units	=	A/C capacity of outdoor units obtained from capacity characteristic table at the 100% combination
	x	Capacity change rate due to piping length to the farthest indoor unit

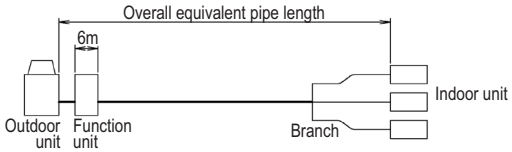
   - Condition: Indoor unit combination ratio exceeds 100%.

Maximum A/C capacity of outdoor units	=	A/C capacity of outdoor units obtained from capacity characteristic table at the combination
	x	Capacity change rate due to piping length to the farthest indoor unit

4. When overall equivalent pipe length is 90m or more, the diameter of the main gas and liquid pipes (outdoor unit-branch sections) must be increased. (Consider the equivalent pipe length of function unit as 6m.)
   [Diameter of above case]

Model	Gas	Liquid
RTSYQ16PA	ø 31.8 *	ø 15.9

   *If available on the site, use this size, otherwise do not increase.



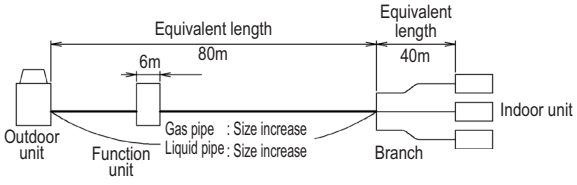
5. Read cooling/heating capacity rate of change in the above figures based on the following equivalent length.

Overall equivalent length =(Equivalent length to main pipe) x Correction factor + (Equivalent length after branching)

   Choose a correction factor from the following table. [When cooling capacity is calculated: gas pipe size / When heating capacity is calculated: liquid pipe size]

Rate of change (object piping)	Correction factor	
	Standard size	Size increase
Cooling (gas pipe)	1.0	0.5
Heating (liquid pipe)	1.0	0.3

   (example)



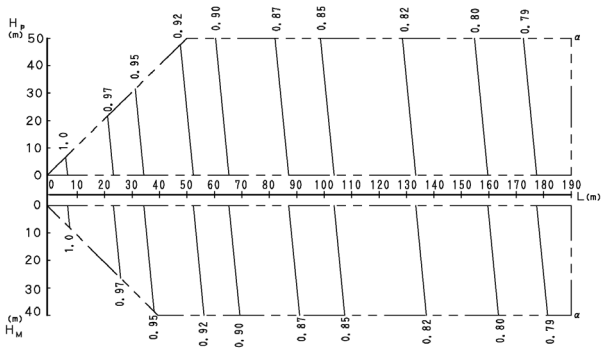
   In the above case (Cooling) Overall equivalent length = 80m x 0.5 + 40m = 80m
   (Heating) Overall equivalent length = 80m x 0.3 + 40m = 64m
   The rate of change in cooling capacity when Hp = 0m is thus approximately 0.88
   heating capacity when Hp = 0m is thus approximately 1.0

3 Capacity correction ratio

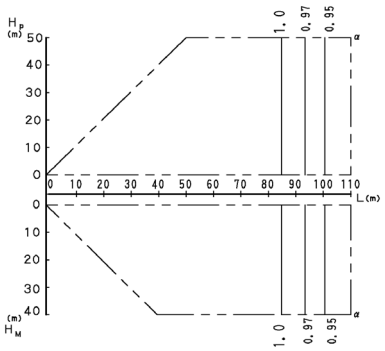
3 - 1 VRVIII heat recovery with connection to heating only hydrobox

RTSYQ20PA

1. Rate of change in cooling capacity



2. Rate of change in heating capacity



[Diameter of the main pipes (standard size)]

Model	Gas	Liquid
RTSYQ20PA	ø 28.6	ø 15.9

[Temper grade and thickness]

Temper grade	0 Type	1/2H Type		
Outer diameter	ø 15.9	ø 19.1	ø 28.6	ø 31.8
Minimum wall thickness	0.99	0.80	0.99	1.10

[Explanation of symbols]
Hp: Level difference (m) between indoor and outdoor units where indoor unit in inferior position
Hm: Level difference (m) between indoor and outdoor units where indoor unit in superior position
L: Equivalent pipe length (m)
α: Rate of change in cooling/heating capacity

3D060822A

NOTES

1. These figures illustrate the rate of change in capacity of a standard indoor unit system at maximum load (with the thermostat set to maximum) under standard conditions. Moreover, under partial load conditions there is only a minor deviation from the rate of change in capacity shown in the above figures.
2. With this outdoor unit, evaporating pressure constant control when cooling and condensing pressure constant control when heating is carried out.
3. Method of calculating A/C (cooling/heating) capacity:
   The maximum A/C capacity of the system will be either the total A/C capacity of the indoor units obtained from capacity characteristic table or the maximum A/C capacity of outdoor units as mentioned bellow, whichever smaller.
   Calculating A/C capacity of outdoor units.
   - Condition: Indoor unit combination ratio does not exceed 100%.

   Maximum A/C capacity of outdoor units = A/C capacity of outdoor units obtained from capacity characteristic table at the 100% combination
   x Capacity change rate due to piping length to the farthest indoor unit

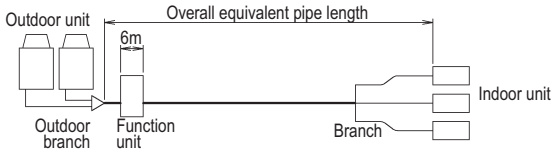
   - Condition: Indoor unit combination ratio exceeds 100%.

   Maximum A/C capacity of outdoor units = A/C capacity of outdoor units obtained from capacity characteristic table at the combination
   x Capacity change rate due to piping length to the farthest indoor unit

4. When overall equivalent pipe length is 90m or more, the diameter of the main gas and liquid pipes (outdoor unit-branch sections) must be increased. (Consider the equivalent pipe length of function unit as 6m.)
   [Diameter of above case]

Model	Gas	Liquid
RTSYQ20PA	ø 31.8 *	ø 19.1

   *If available on the site, use this size, otherwise do not increase.



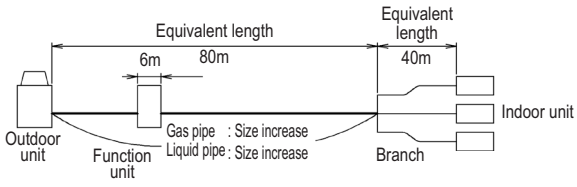
5. Read cooling/heating capacity rate of change in the above figures based on the following equivalent length.

   Overall equivalent length =(Equivalent length to main pipe) x Correction factor + (Equivalent length after branching)

   Choose a correction factor from the following table. [When cooling capacity is calculated: gas pipe size
   When heating capacity is calculated: liquid pipe size

Rate of change (object piping)	Correction factor	
	Standard size	Size increase
Cooling (gas pipe)	1.0	0.5
Heating (liquid pipe)	1.0	0.4

   (example)



   In the above case (Cooling) Overall equivalent length = 80m x 0.5 + 40m = 80m
   (Heating) Overall equivalent length = 80m x 0.4 + 40m = 72m
   The rate of change in cooling capacity when Hp = 0m is thus approximately 0.88
   heating capacity when Hp = 0m is thus approximately 1.0

4 Integrated heating capacity coefficient

RTSYQ-PA

INTEGRATED HEATING CAPACITY COEFFICIENT

The heating capacity tables do not take account of the reduction in capacity, when frost has accumulated or while the defrosting operation is in progress. The capacity values, which take these factors into account, in other words, the integrated heating capacity values, can be calculated as follows:

Formula:

Integrated heating capacity = A

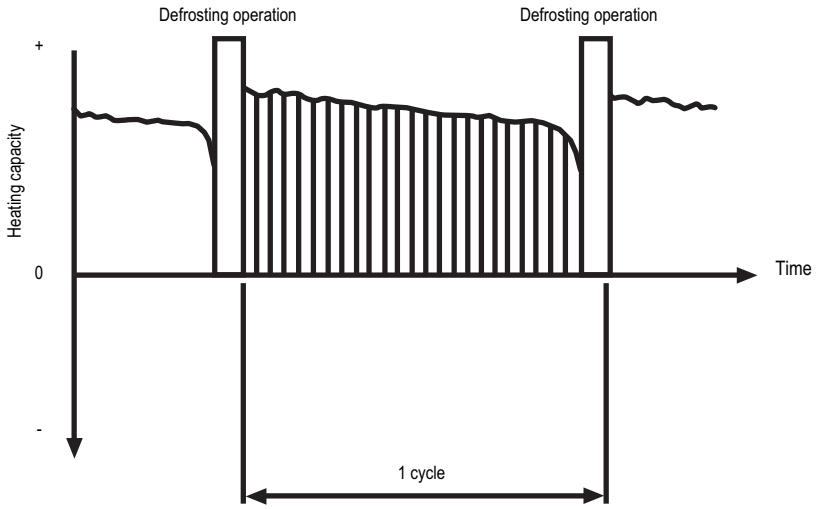
Value given in table of capacity characteristics = B

Integrated correction factor for frost accumulation = C

A = B x C

Integrating correction factor for finding integrated heating capacity

Outdoor Temperature° CDB (° CWB)	-7 (-7.6) or less	-5 (-5.6)	-3 (-3.7)	0 (-0.7)	3 (2.2)	5	7 (6.0)
Correction factor defrost	0.95	0.93	0.88	0.85	0.86	0.90	1.00



3TW27232-7

NOTE

1 The figure shows that the integrated heating capacity expresses the integrated capacity for a single cycle (from defrost operation to defrost operation) in terms of time.

Please note that, when there is an accumulation of snow against the outside surface of the outdoor unit heat exchanger, there will always be a temporary reduction in capacity, although this will of course vary in degree in accordance with a number of other factors, such as the outdoor temperature (°CDB), relative humidity (RH) and the amount of frosting which occurs.

5 Refnet pipe systems

As the VRV III-C is produced in Japan in some communications the DIL refnets are mentioned in stead of the DENV refnets. Below you can find a conversion table in order to select the correct DENV refnets.

Refnets

DIL	DENV
KHRP26A22T	KHRQ22M20T
KHRP26A33T	KHRQ22M29T9
KHRP26A72T	KHRQ22M64T
KHRP26A73T	KHRQ22M75T

Headers

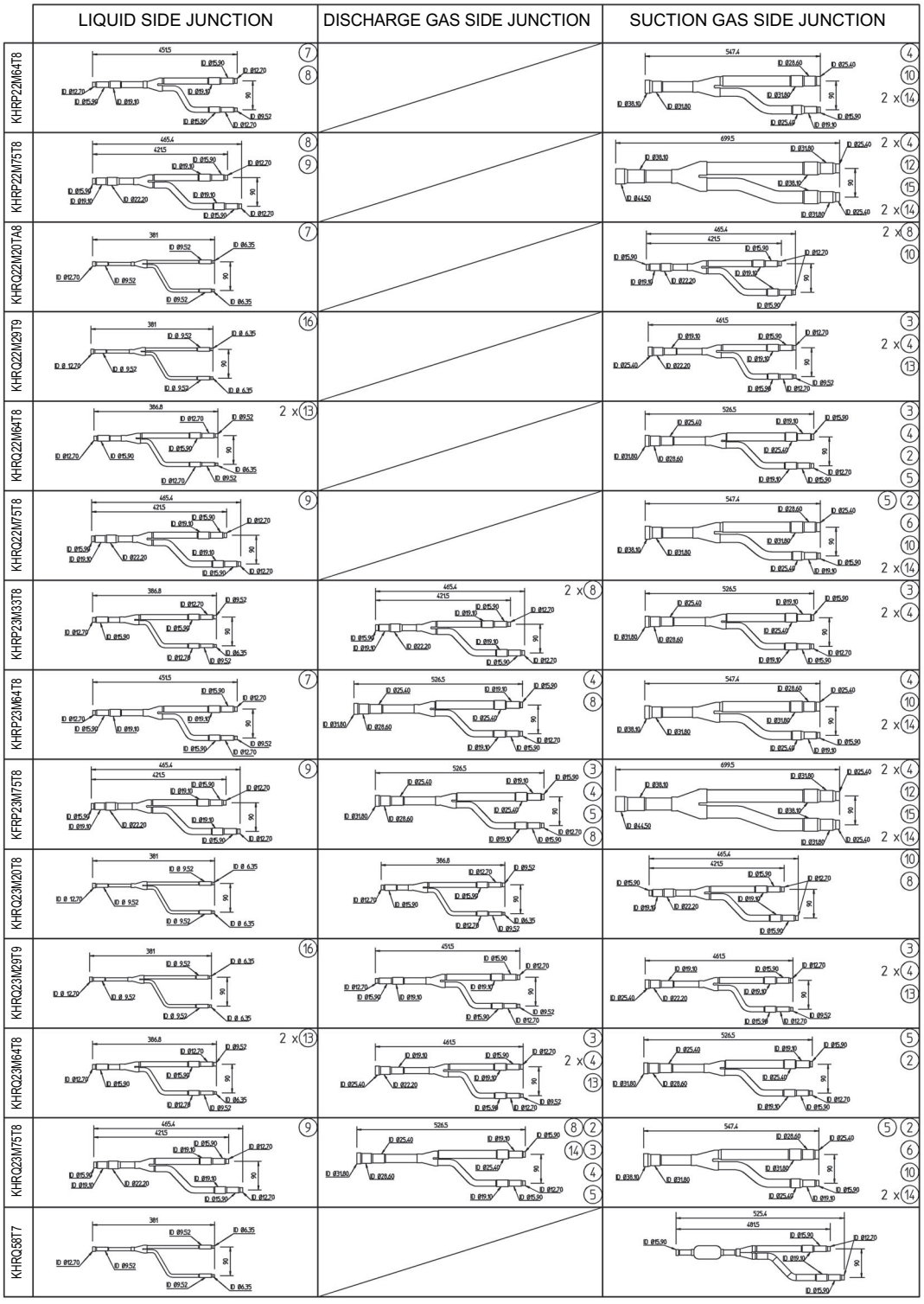
DIL	DENV	
KHRP26M22H	KHRQ22M29H	
KHRP26M33H	KHRQ22M29H	Remark!
KHRP26M72H + KHRP26M73HP	KHRQ22M64H	

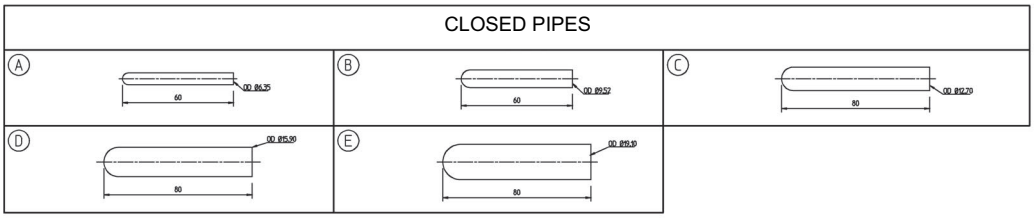
Remark: "ø25.4 gas pipe in" is not available for the DENV refnet. This is only required for the 10 HP model using size up AND with an indoor connection ratio of less than 80%.

Multi unit connection

DIL	DENV
BHFP30A56	BHFQ22P1007

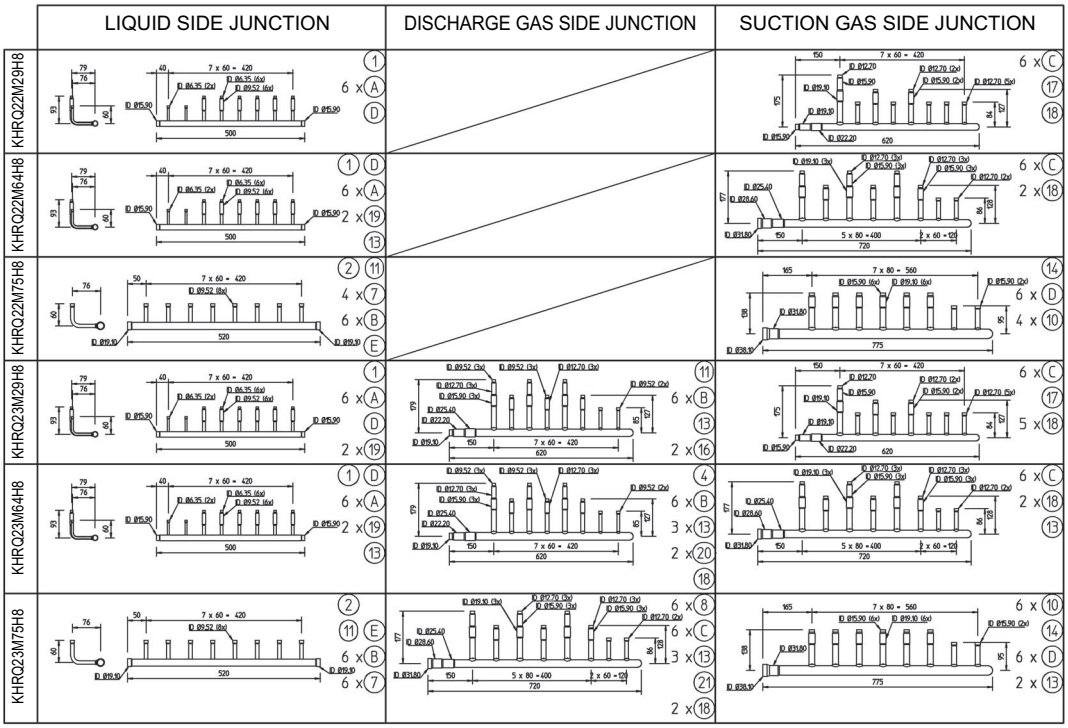
5 Refnet pipe systems

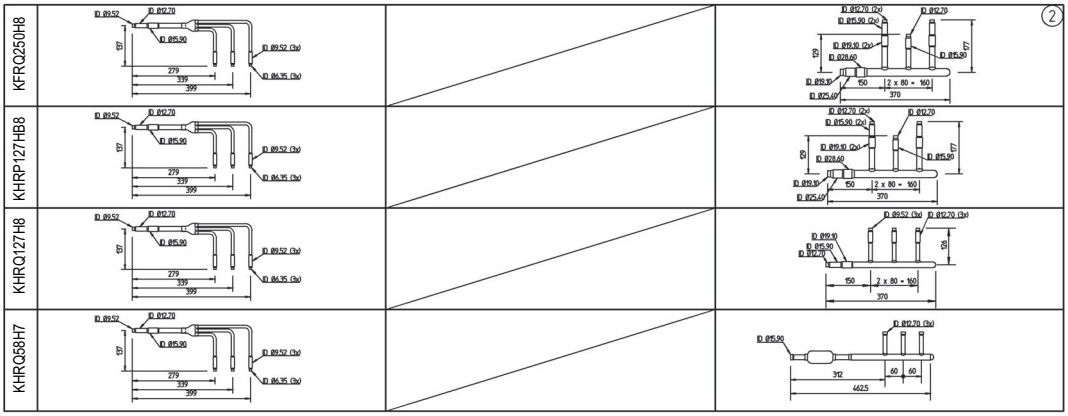


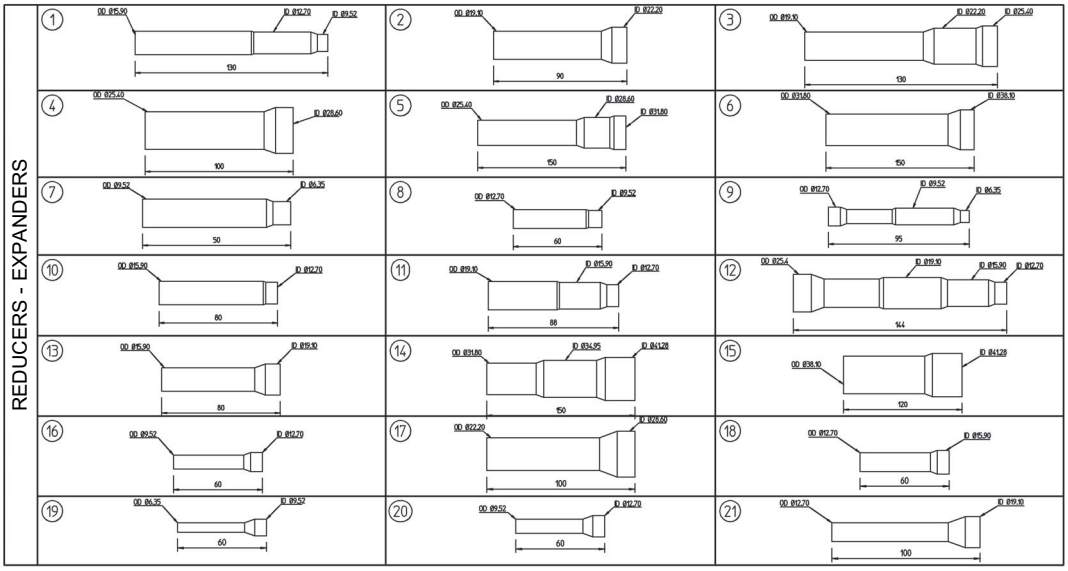


1TW25799-4D

5 Refnet pipe systems

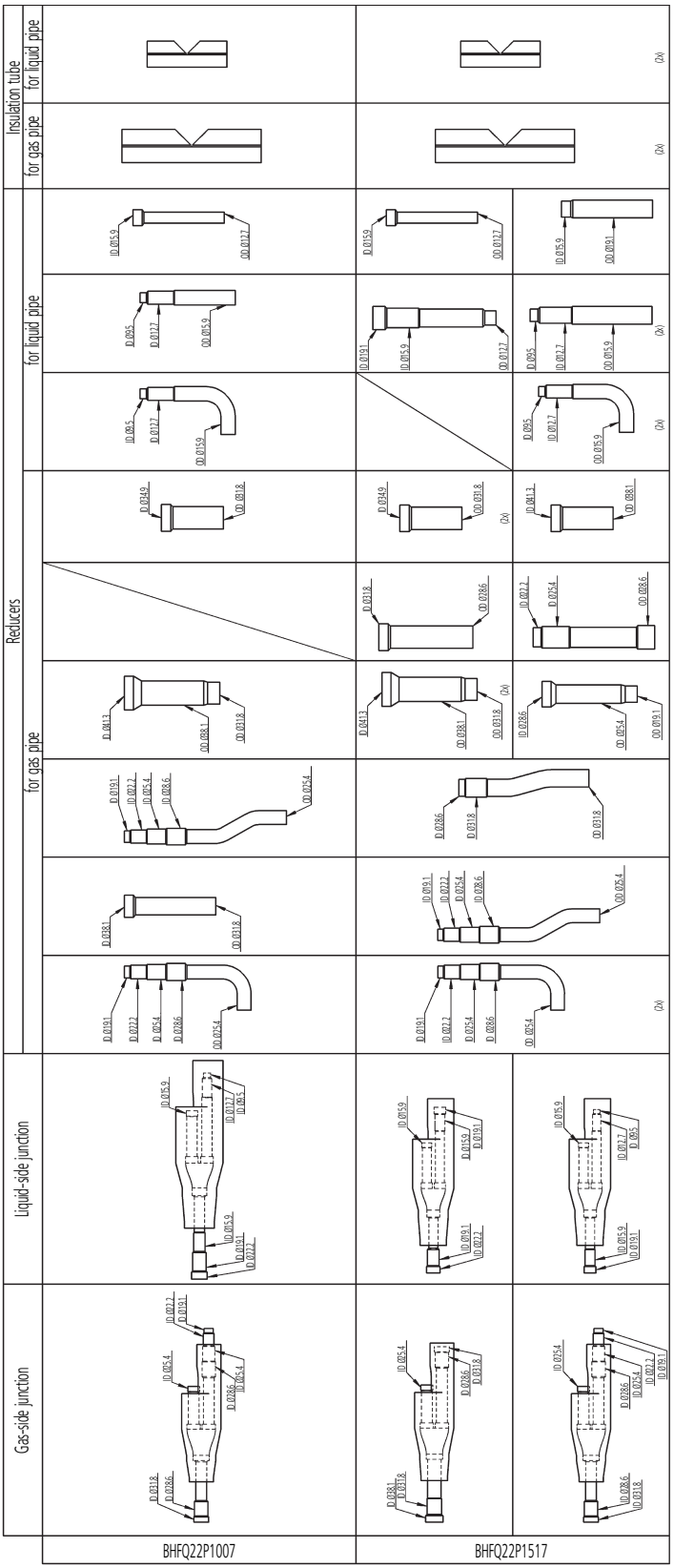






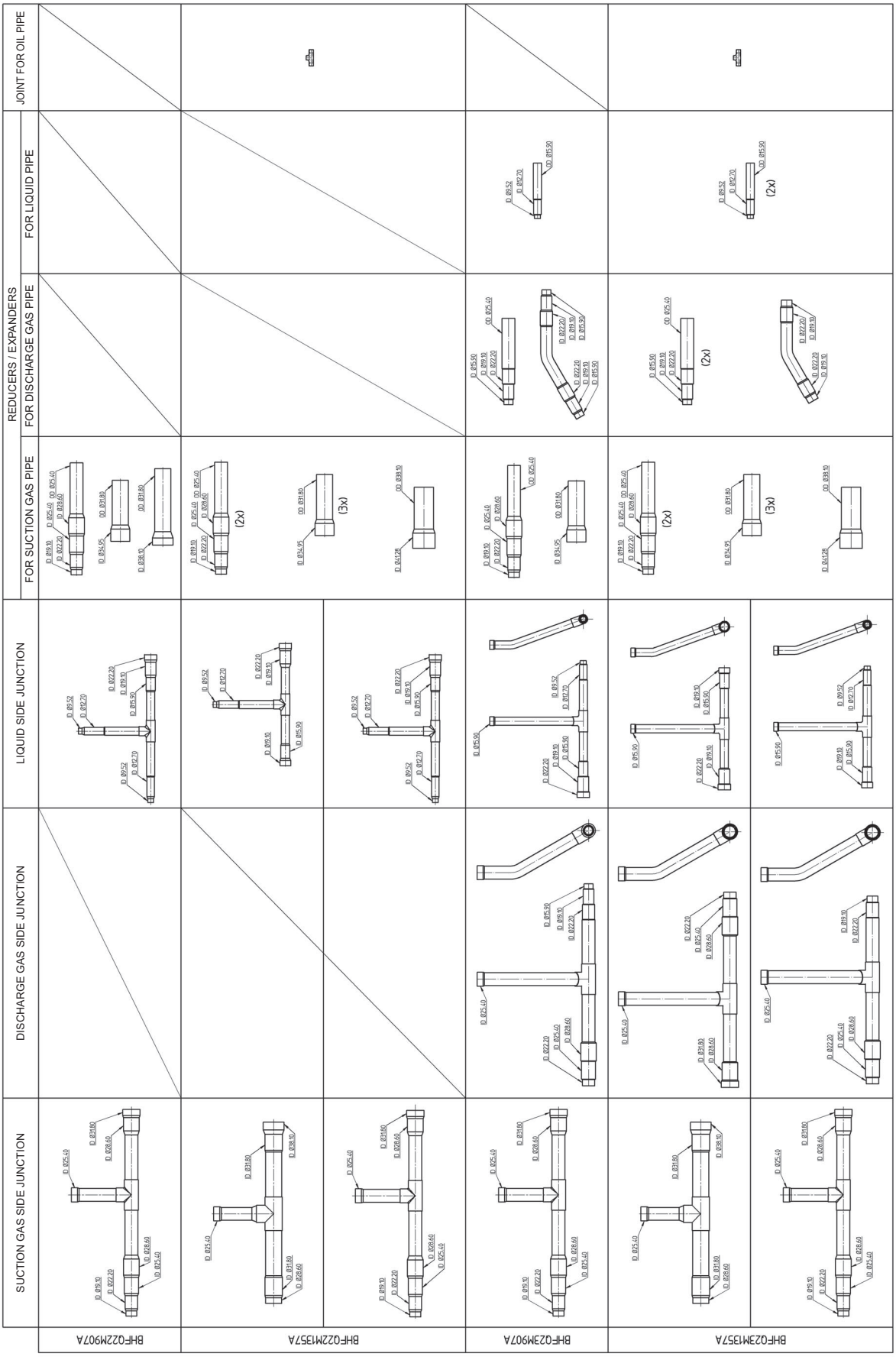
1TW25799-4D

5 Refnet pipe systems



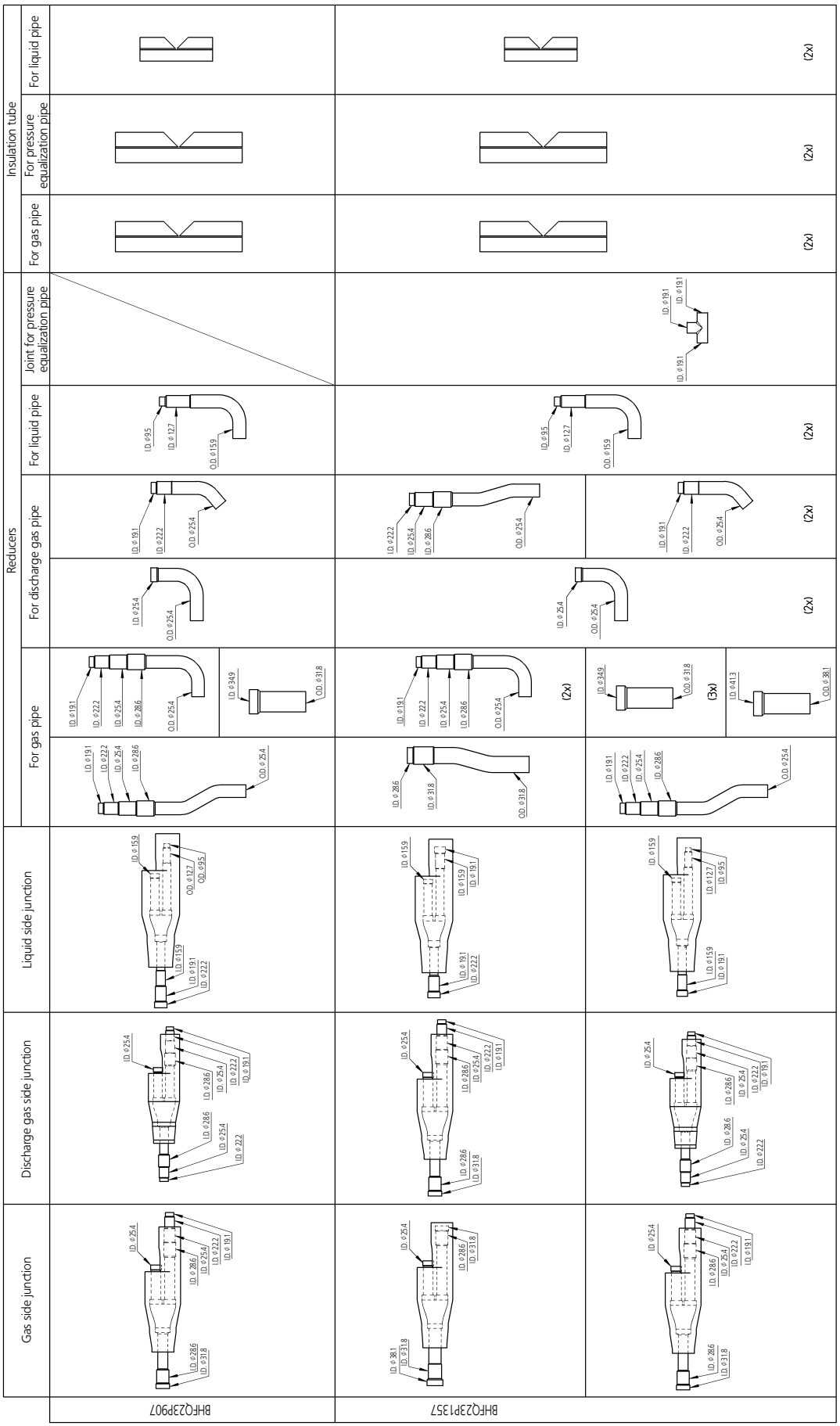
2TW27239-1

5 Refnet pipe systems

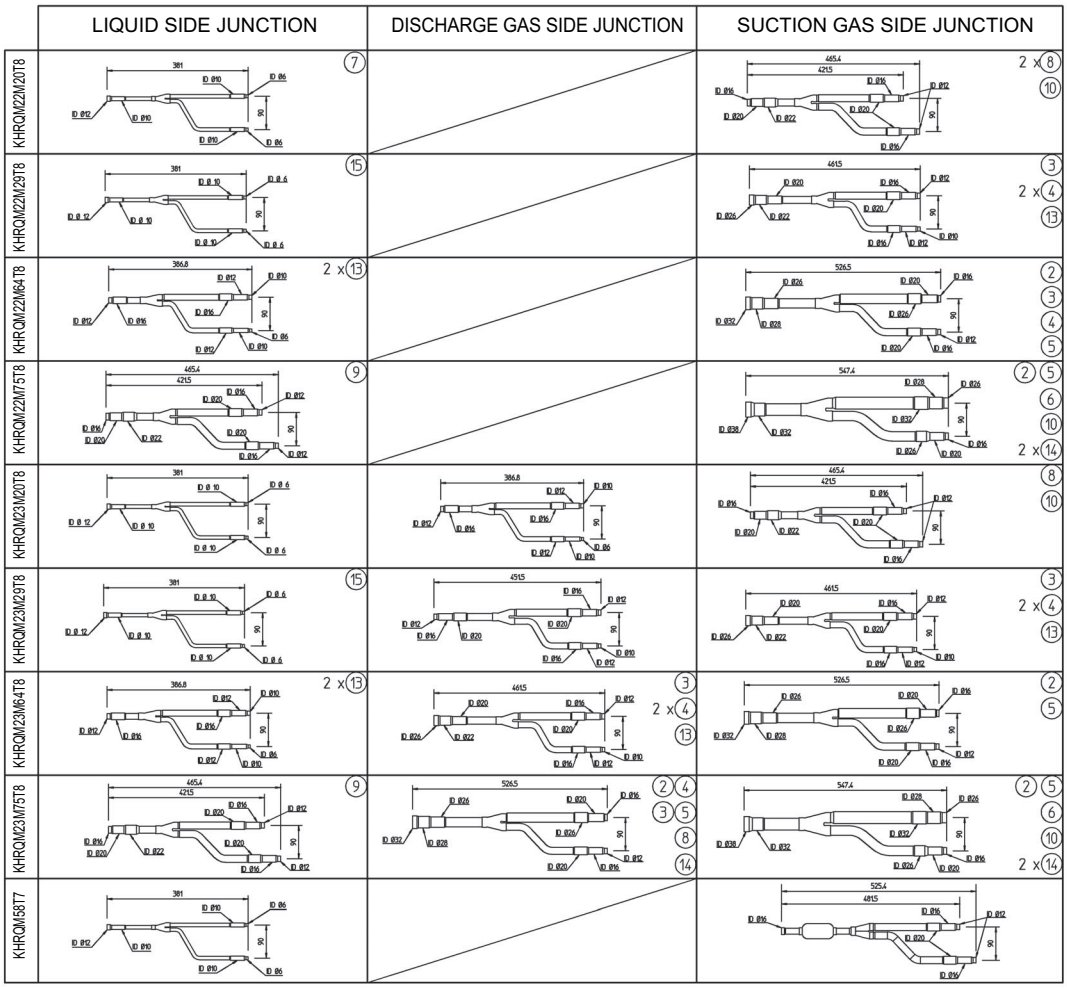


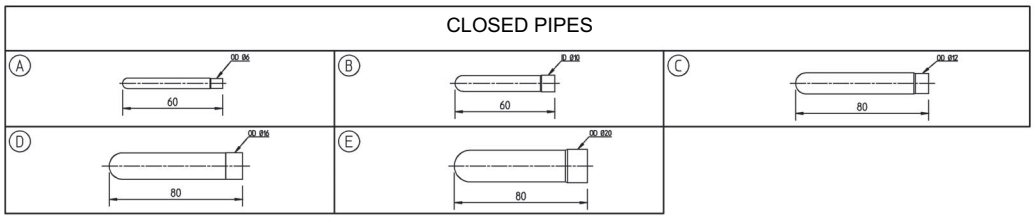
2TW25799-6

5 Refnet pipe systems



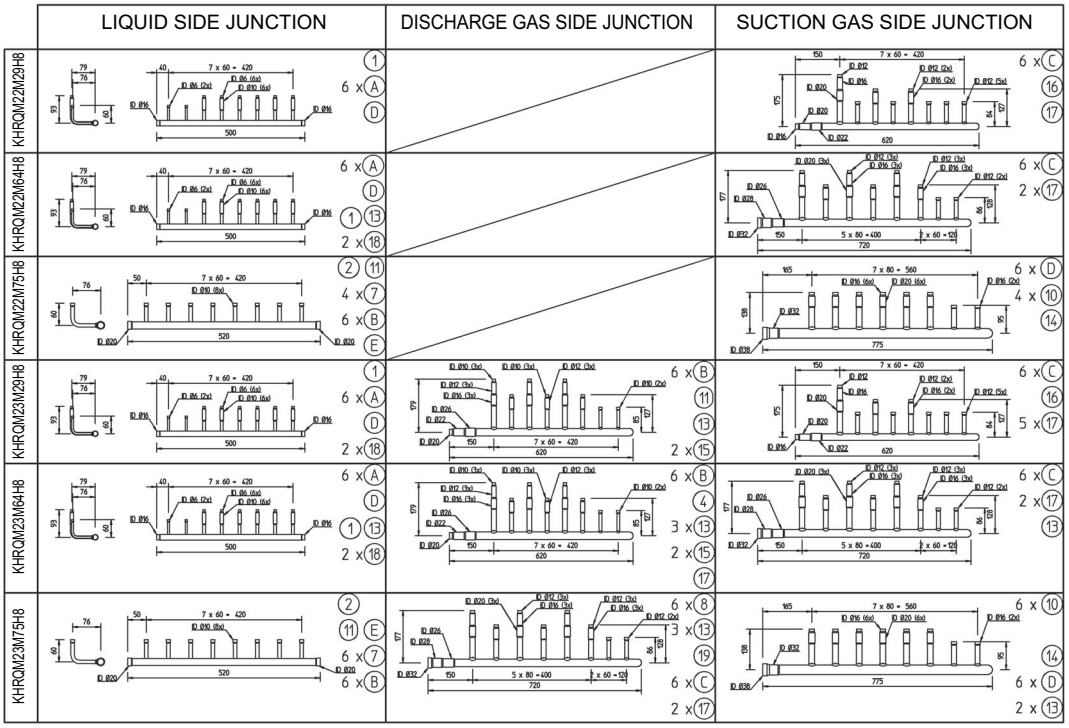
5 Refnet pipe systems

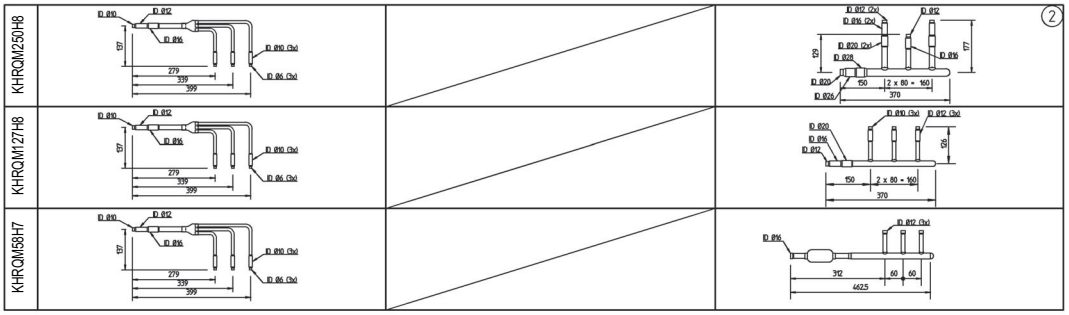


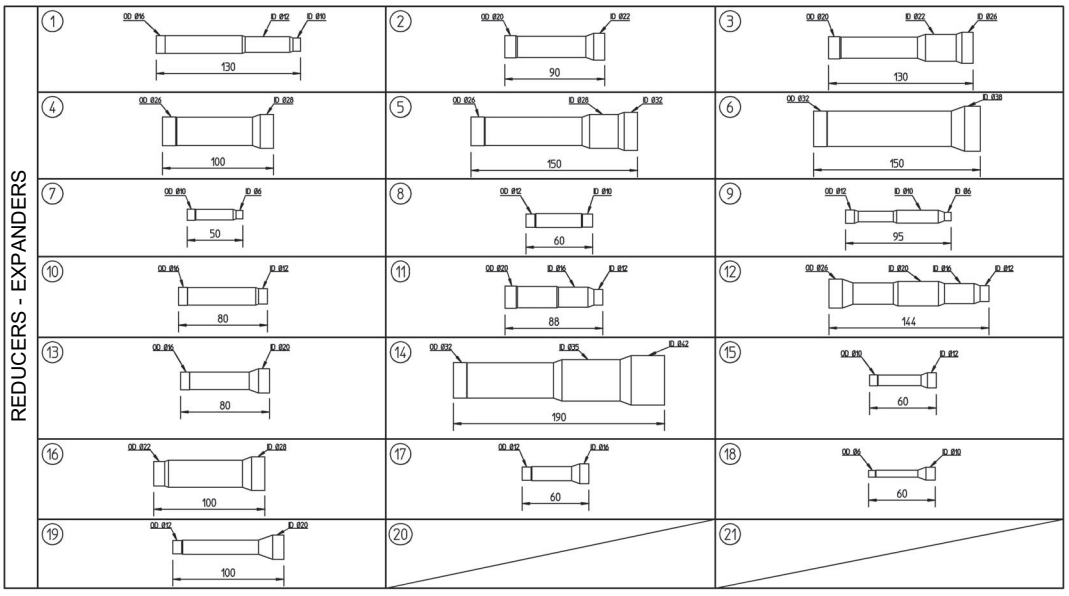


1TW29479-1A

5 Refnet pipe systems

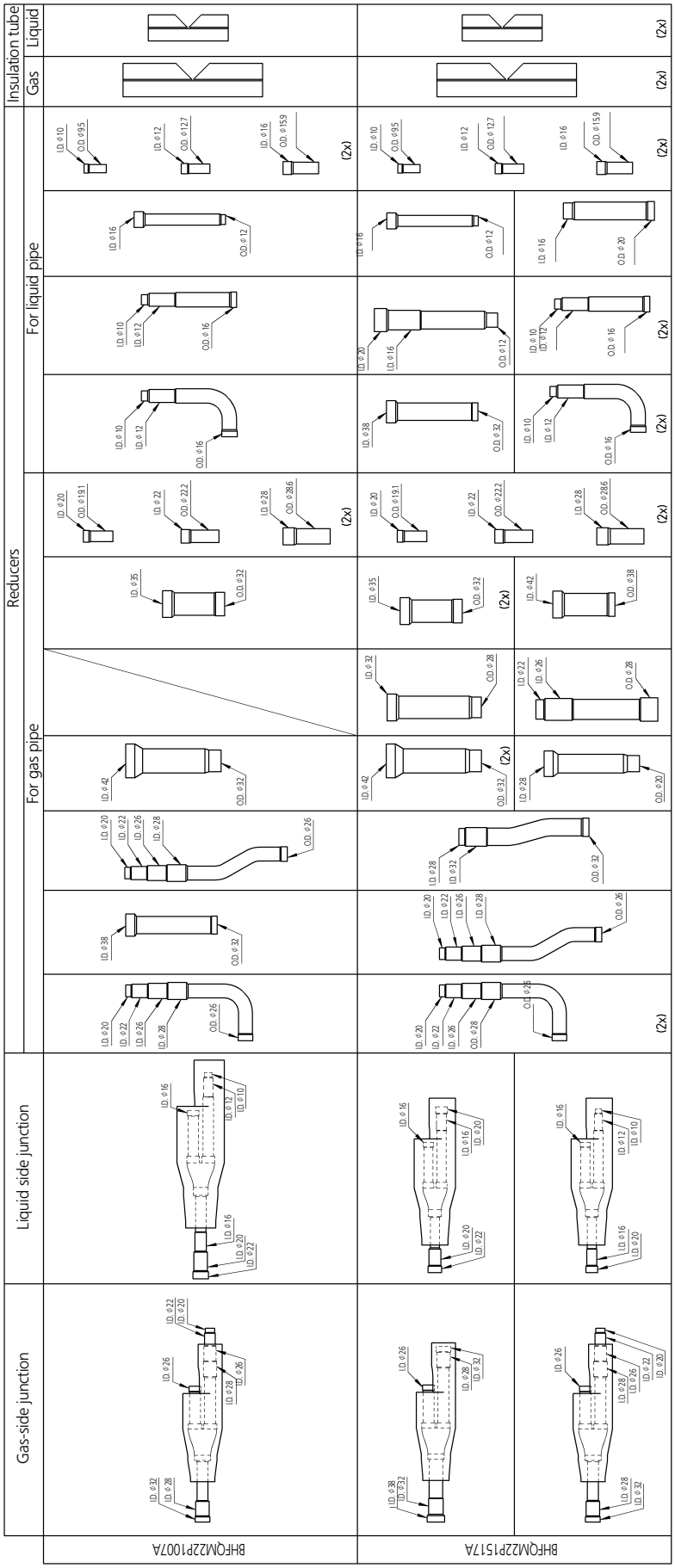




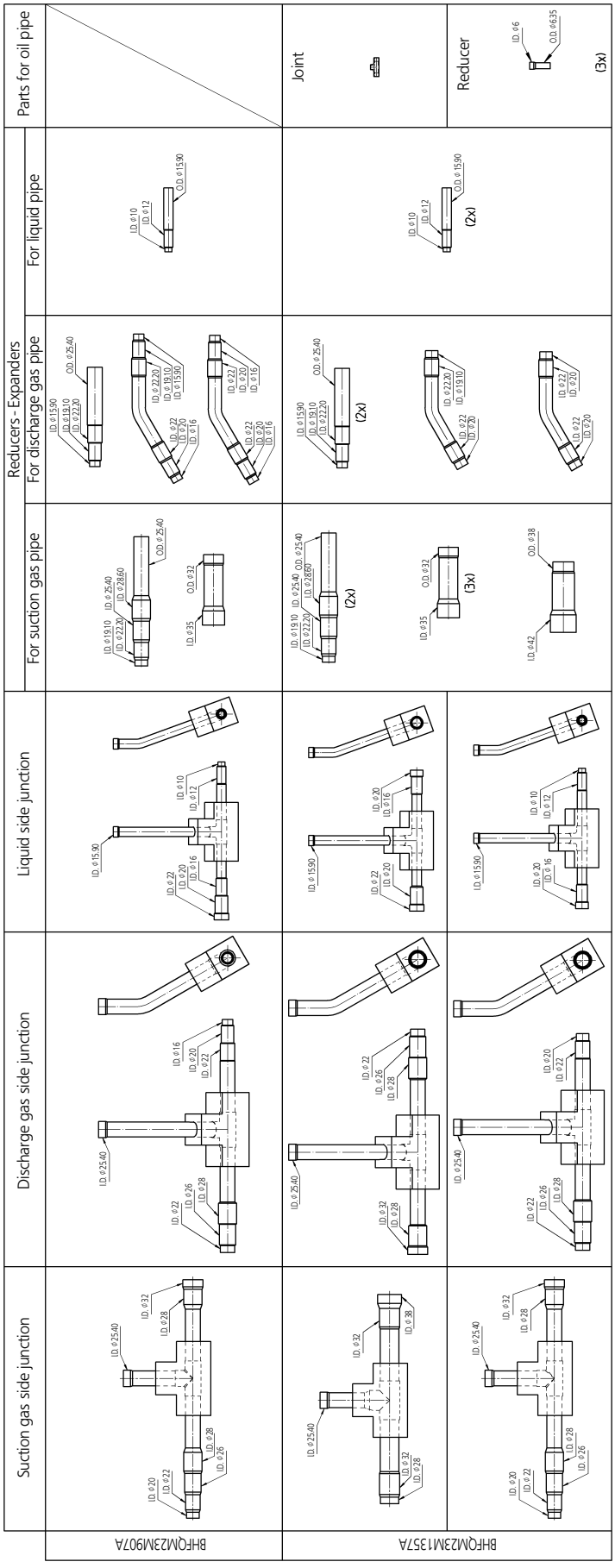


1TW29479-1A

5 Refnet pipe systems

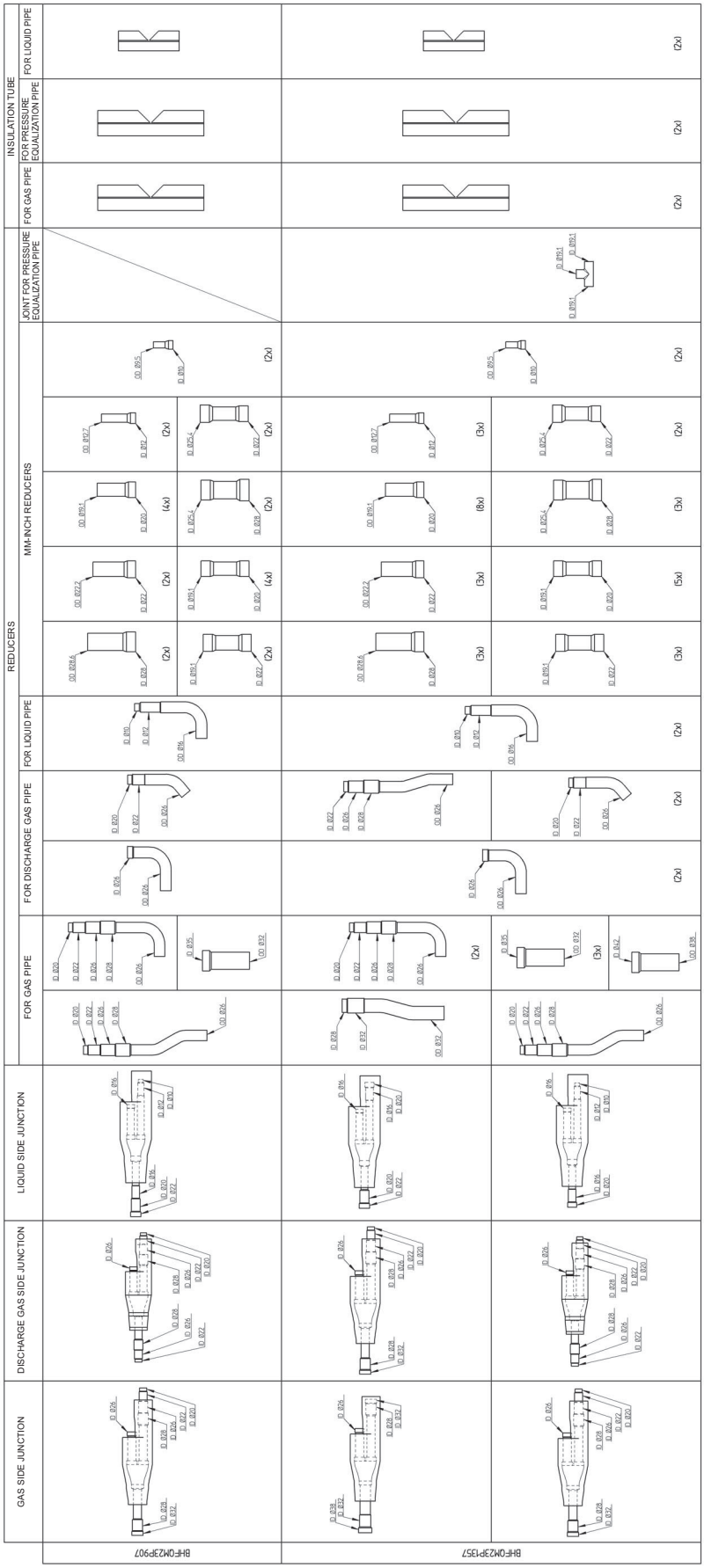


5 Refnet pipe systems



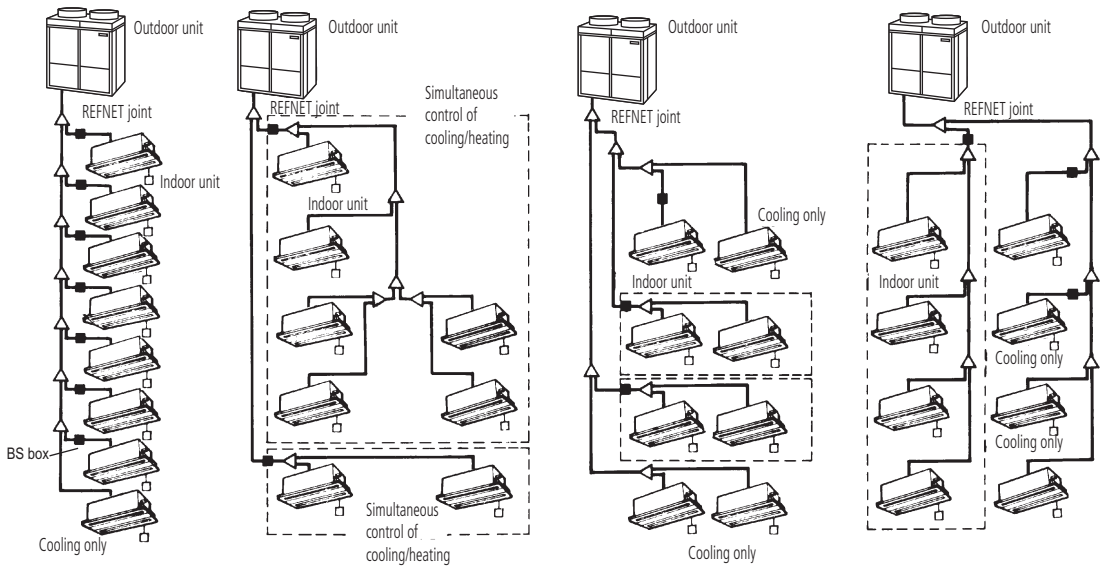
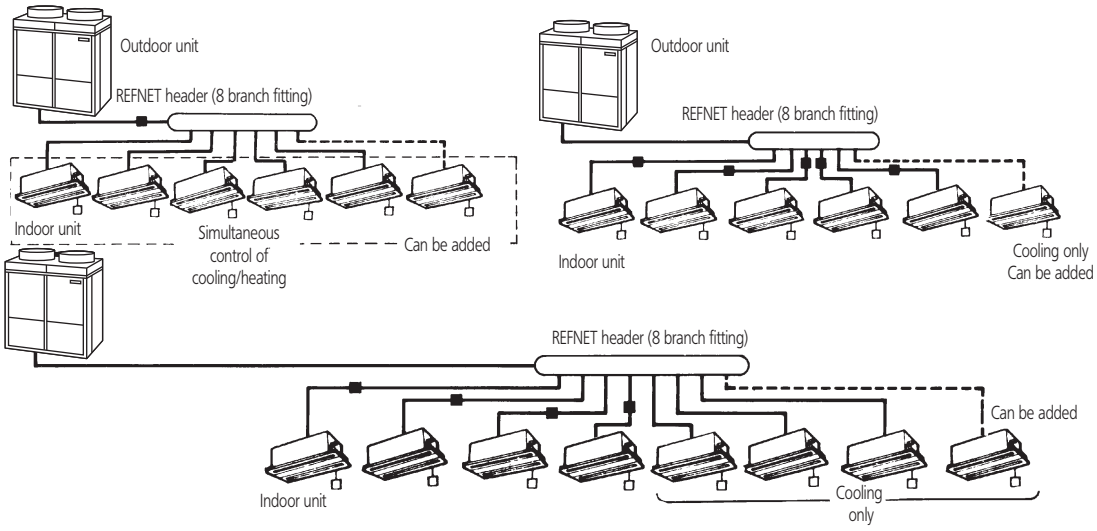
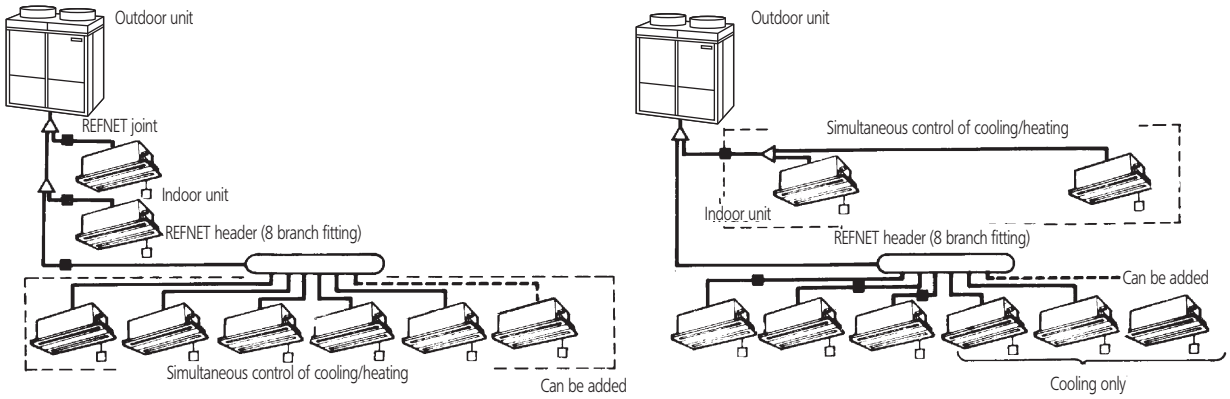
2TW29679-1

5 Refnet pipe systems



1TW29119-2

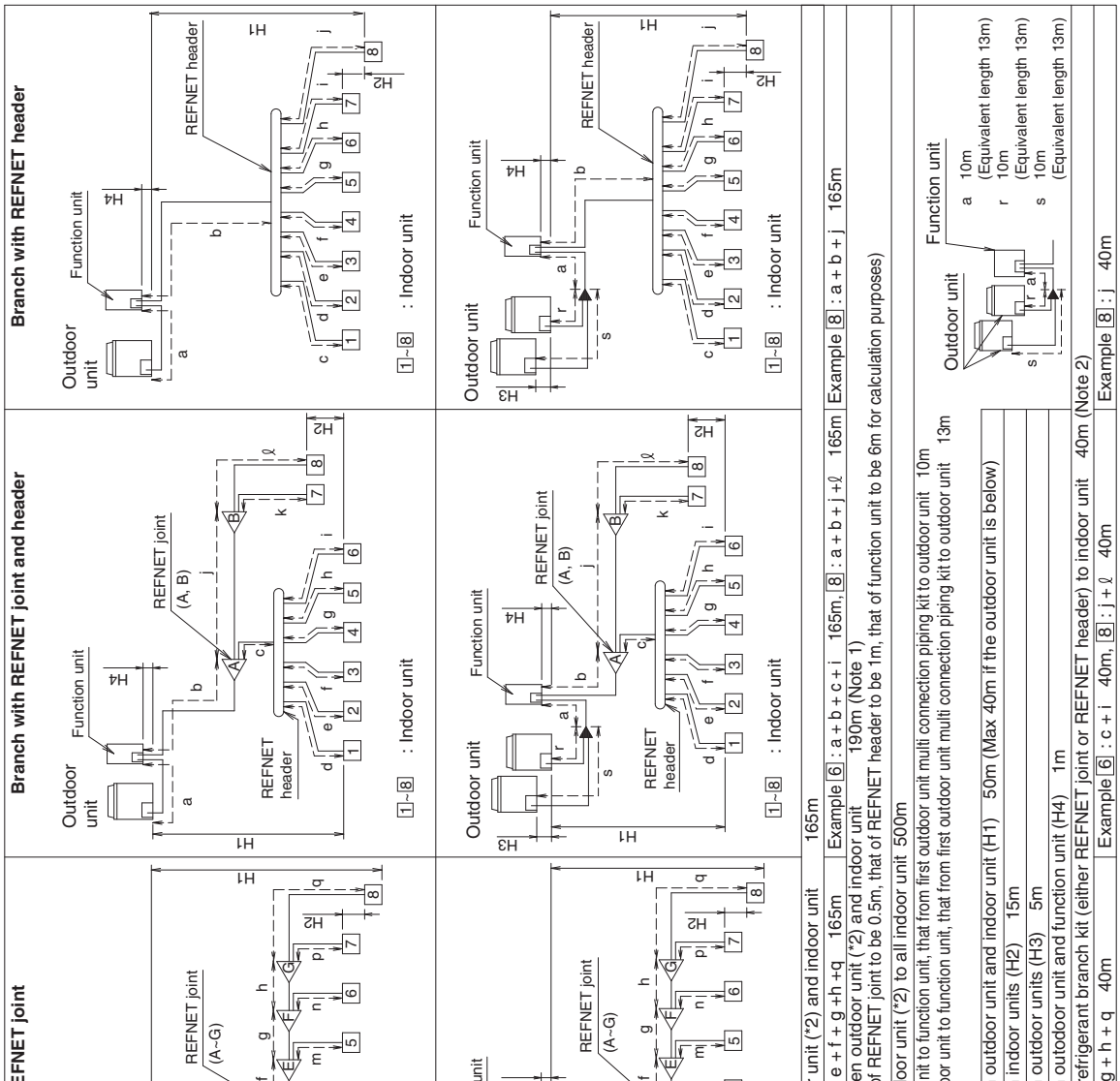
6 Example of Refnet piping layouts

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

7 Refrigerant pipe selection

7 - 1 VRVIII-C

RTSYQ-



Maximum allowable length	Between outdoor unit (*2) and indoor unit	Actual pipe length	Pipe length between outdoor unit (*2) and indoor unit	165m	
		Equivalent-length	Example 8 : a + b + c + d + e + f + g + h + q 165m	Example 6 : a + b + c + i 165m, 8 : a + b + j + ℓ 165m	Example 8 : a + b + j 165m
			Equivalent pipe length between outdoor unit (*2) and indoor unit 190m (Note 1)		
			(Assume eqivalent pipe length of REFNET joint to be 0.5m, that of REFNET header to be 1m, that of function unit to be 6m for calculation purposes)		
		Total extention length	Total piping length from outdoor unit (*2) to all indoor unit 500m		
	Between outdoor unit and function unit Between outdoor unit and outdoor unit multi connection piping kit	Actual and Equivalent pipe length	Actual pipe length from outdoor unit to function unit, that from first outdoor unit multi connection piping kit to outdoor unit 10m Equivalent pipe length from outdoor unit to function unit, that from first outdoor unit multi connection piping kit to outdoor unit 13m		
Allowable height difference	Between outdoor and indoor units	Difference in height	Difference in height between outdoor unit and indoor unit (H1) 50m (Max 40m if the outdoor unit is below)		
	Between indoor and indoor units	Difference in height	Difference in height between indoor units (H2) 15m		
	Between outdoor and outdoor units	Difference in height	Difference in height between outdoor units (H3) 5m		
	Between outdoor unit and function unit	Difference in height	Difference in height between outodoor unit and function unit (H4) 1m		
Allowable length after the branch		Actual pipe length	Actual pipe length from first refrigerant branch kit (either REFNET joint or REFNET header) to indoor unit 40m (Note 2)		
			Example 8 : c + d + e + f + g + h + q 40m	Example 6 : c + i 40m, 8 : j + ℓ 40m	Example 8 : j 40m

Outdoor unit multi connection piping kit and Refrigerant branch kit selection

- Refrigerant branch kits can only be used with R410A.
- When multi outdoor system are installed, be sure to use the special separately sold Outdoor unit multi connection piping kit. (BHFP30A56).
(For how to select the proper kit, follow the table at right.)

How to select the REFNET joint

- When using REFNET joint at the first branch counted from the outdoor unit side, choose from the following table in accordance with the outdoor system capacity type. (Example : REFNET joint A)

Outdoor system capacity type	Refrigerant branch kit name
10HP type	KHRP26A33T
14~20HP type	KHRP26A72T

- Choose the REFNET joints other than the first branch from the following table in accordance with the total capacity index of all the indoor units connected below the REFNET joint.

Indoor unit total capacity index	Refrigerant branch kit name
x < 200	KHRP26A22T
200 x < 290	KHRP26A33T
290 x < 640	KHRP26A72T

How to select the REFNET header

- Choose from the following table in accordance with the total capacity index of all the indoor units connected below the REFNET header.
- 250 type indoor unit can not be connected below the REFNET header.

Indoor unit total capacity index	Refrigerant branch kit name
x < 200	KHRP26M22H or KHRP26A33H
200 x < 290	KHRP26M33H
290 x < 640	KHRP26M72H
640 x	KHRP26M73H + KHRP26M73HP

How to select the outdoor unit multi connection piping kit

(This is required when the system is multi outdoor unit system.)

- Choose from the following table in accordance with the number of outdoor units.

Number of outdoor unit	Connecting piping kit name
2 units	BHFP30AP56

Example for indoor units connected downstream

Example REFNET joint C : Indoor units 3 + 4 + 5 + 6 + 7 + 8

Example REFNET joint B : Indoor units 7 + 8

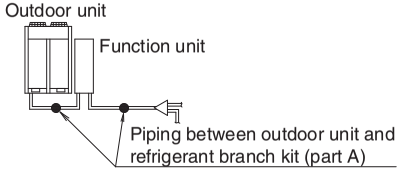
Example REFNET header : Indoor units 1 + 2 + 3 + 4 + 5 + 6

Example REFNET header : Indoor units 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8

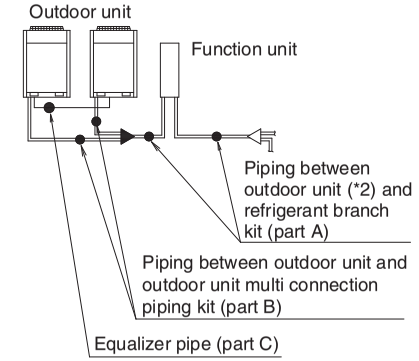
Pipe size selection

The thickness of the pipes in the table shows the requirements of Japanese High Pressure Gas Controll low. (As of Jan. 2003)
The thickness and material shall be selected in accordance with local code.

<In case of single outdoor unit system>



<In case of multi outdoor unit system>



Piping between outdoor unit (*2) and refrigerant branch kit (part A)

- Choose from the following table in accordance with the outdoor unit system capacity type.

(unit : mm)

Outdoor system capacity type	Piping size (O. D.)	
	Gas pipe	Liquid pipe
10HP type	22.2	9.5
14,16HP type	28.6	12.7
20HP type		15.9

Piping between outdoor unit multi connection piping kit and outdoor unit (part B)

- Choose from the following table in accordance with the capacity type ofthe outdoor unit connected.

(unit : mm)

Outdoor unit capacity type	Piping size (O. D.)	
	Gas pipe	Liquid pipe
RTSQ8 type	22.2	9.5
RTSQ12 type	28.6	12.7

Piping between refrigerant branch kits

- Choose from the following table in accordance with the total capacity type of all the indoor units connected downstream.
- Do not let the connection piping exceed the main refrigerant piping size (Part A). If the piping size selected from the following table exceeds the piping size of part A, decide the piping size in either of the following methods.
(1) Reduce the size of the connection piping to the piping size of part A.
(2) Replace the piping of part A with piping that is a size larger (see the table in Note 1) so that it will be the same as the size of the connection piping.

(unit : mm)

Indoor capacity index	Piping size (O. D.)	
	Gas pipe	Liquid pipe
x < 150	15.9	9.5
150 x < 200	19.1	
200 x < 290	22.2	
290 x < 420	28.6	12.7
420 x < 640		15.9

Piping between refrigerant branch kit, and indoor unit

- Match to the size of the connection piping on the indoor unit.

(unit : mm)

Indoor unit capacity type	Piping size (O. D.)	
	Gas pipe	Liquid pipe
20 · 25 · 32 · 40 · 50 type	12.7	6.4
63 · 80 · 100 · 125 type	15.9	9.5
200 type	19.1	
250 type	22.2	

Equalizer pipe (part D) (multi outdoor unit system only)

(unit : mm)

Piping size (O. D.)	19.1

Temper grade and wall thickness for pipes

(Temper grade, O type and 1/2H type indicate the material type specified in JIS H 3300.)

Copper tube O. D.	6.4	9.5	12.7	15.9	19.1	22.2	25.4	28.6	31.8	34.9	38.1	41.3
Temper grade	O type				1/2H type							
Wall thickness (Min. requirement)	0.80	0.80	0.80	0.99	0.80	0.80	0.88	0.99	1.10	1.21	1.32	1.43

How to calculate the additional refrigerant to be charged

Additional refrigerant to be charged : R(kg)
(R should be rounded off in units of 0.1 kg.)

$$R = \left(\left(\text{Total length(m) of liquid piping size at 22.2}\right) \times 0.37 + \left(\text{Total length(m) of liquid piping size at 19.1}\right) \times 0.26 + \left(\text{Total length(m) of liquid piping size at 15.9}\right) \times 0.18 + \left(\text{Total length(m) of liquid piping size at 12.7}\right) \times 0.12 + \left(\text{Total length(m) of liquid piping size at 9.5}\right) \times 0.059 + \left(\text{Total length(m) of liquid piping size at 6.4}\right) \times 0.022 \right) +$$

FOR THE SYSTEM	
SYSTEM NAME	THE AMOUNT OF REFRIGERANT
RTSYQ10PAY1	—
RTSYQ14PAY1	1.3kg
RTSYQ16PAY1	2.3kg
RTSYQ20PAY1	—

Example for refrigerant branch using REFNET joint and REFNET header for the systems and each pipe length as shown below.

System : RTSYQ20PAY1
Independent outdoor unit : RTSQ8PAY1, RTSQ12PAY1
Function unit : BTSQ20PY1

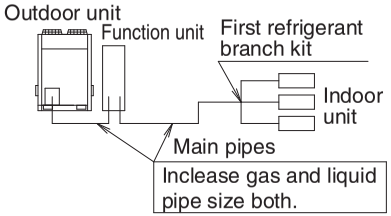
a : 15.9 × 10m	e : 6.4 × 10m	i : 6.4 × 10m	r : 12.7 × 5m
b : 15.9 × 30m	f : 6.4 × 20m	j : 9.5 × 20m	s : 9.5 × 10m
c : 12.7 × 20m	g : 6.4 × 20m	k : 9.5 × 10m	
d : 6.4 × 10m	h : 6.4 × 10m	ℓ : 9.5 × 10m	

$R = \underset{\text{a, b}}{40 \times 0.18} + \underset{\text{c, r}}{25 \times 0.12} + \underset{\text{j, k, ℓ, s}}{50 \times 0.059} + \underset{\text{d~i}}{80 \times 0.022} = 14.91 \Rightarrow \boxed{14.9kg}$
Round off in units of 0.1 kg.

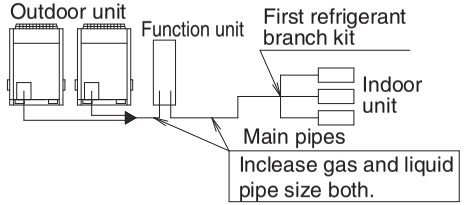
Note 1.
When the equivalent pipe length between outdor (*2) and indoor units is 90m or more, the size of main pipes (figure on right) must be increased according to the right table.

System	Gas		Liquid	
RTSYQ10PA type	22.2	25.4 (*)	9.5	12.7
RTSYQ14PA type	Not Increased		12.7	15.9
RTSYQ16PA type	28.6	31.8 (*)		
RTSYQ20PA type			15.9	19.1

(*) If available on the site, use this size.
Otherwise, it can not be increased.

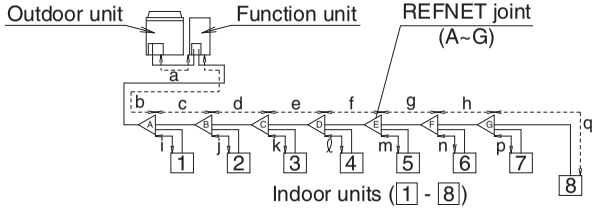


In case of single outdoor unit system



In case of multi outdoor unit system

Note 2. Allowable length after the first refrigerant branch kit to indoor units is 40m or less, however it can be extended up to 90m if all the following conditions are satisfied.

Required Conditions	Example Drawings (In case of "**Branch with REFNET joint**")	
1. It is necessary to increase the pipe size between the first branch kit and the final branch kit. (Reducers must be procured on site) However, the pipes that are same pipe size with main pipe must not be increased.	[8] c+d+e+f+g+h+q 90 m increase the pipe size of c, d, e, f, g, h	Increase the pipe size as follows 9.5 12.7 15.9 19.1 22.2 25.4* 34.9 38.1* 12.7 15.9 19.1 22.2 28.6 31.8*
2. For calculation of Total extension length, the actual length of above pipes must be doubled. (except main pipe and the pipes that are not increased)	a+b+c×2+d×2+e×2+f×2+g×2 +h×2+i+j+k+ℓ+m+n+p+q 500 m	
3. Indoor unit to the nearest branch kit 40 m	i, j..... p, q 40 m	
4. The difference between [Outdoor unit to the farthest indoor unit] and [Outdoor unit to the nearest indoor unit] 40 m	The farthest indoor unit [8] The nearest indoor unit [1] (a+b+c+d+e+f+g+h+q)-(a+b+i) 40 m	

*If available on the site, use this size. Otherwise it can not be increased.

7 Refrigerant pipe selection

7 - 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.

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