



Installation, operating and maintenance **CCU - Piping design criteria**



- Providing IT Climate Technology



Design criteria for refrigerant piping

[Version 1.5]

Piping for refrigerating systems should be designed according to 3 main principles:

1. Reduction of the pressure drops to avoid significant decrease of the performances
2. Ensure correct oil return also at partial load, when the refrigerant speed is reduced. Please note that the pressure drop depends also on the surface friction between gas and pipe. Surface friction is the "engine" for the oil drag. The oil drag is much critical in the suction line because of the lower temperatures and of the consequent higher oil viscosity.
3. Avoid the making of "flash vapours" on the liquid line and consequent dysfunction of the expansion valve. Avoid having high liquid speeds to avoid pressure peaks when the solenoid valve is closing.

General Parameters

- ❑ minimum gas speed to ensure oil drag even in vertical piping, for discharge lines is 4 m/s
- ❑ minimum gas speed to ensure oil drag even in vertical piping, for suction lines is 5 m/s
- ❑ For liquid line, the miscibility between oil and refrigerant is 100 % (in our T field) so that no minimum speed is required.

In the following pages are shown the tables with all the most important parameters, for the whole range of models.

INNOV@ units									
Refrigerant		R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C
Model	[-]	060	080	100	110	130	160	190	205
T ev. Dew Point	[°C]	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10
Base refrigerant charge	[kg]	2.26	3.86	4.36	4.38	6.21	6.58	7.72	8.24
0-10 m	Discharge gas line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	16-5/8	16-5/8
	Liquid line	[mm-in]	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	91	91	98	98	98	98	98
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	50
11-20 m	Discharge gas line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4
	Liquid line	[mm-in]	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	91	91	98	98	98	101	101
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	52
21-30 m	Discharge gas line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4
	Liquid line	[mm-in]	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	91	91	98	98	98	101	101
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	52
Refrigerant compressor limit**	[kg]	7	7	7	7	9	11	11	11

Please contact the technical office before ordering the units.

Note:

*If the total refrigerant charge (base charge + refrigerant addition due to line length) exceeds the refrigerant compressor limit (**), an oil charge of 50g, per exceeding refrigerant kg, must be added.*

*(***) A siphon has to be installed on every 5m of vertical suction or discharge line.*

INNOV@ units										
Refrigerant		R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	
Model	[-]	201	251	261	271	272*	301	302*	362*	
T ev. Dew Point	[°C]	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	
Base refrigerant charge	[kg]	8.18	8.18	8.36	9.43	6.35	10.57	6.12	7.49	
0-10 m	Discharge gas line	[mm-in]	22-7/8	22-7/8	22-7/8	22-7/8	16-5/8	22-7/8	16-5/8	16-5/8
	Liquid line	[mm-in]	16-5/8	16-5/8	16-5/8	16-5/8	12-1/2	16-5/8	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	193	193	193	193	98	193	98	98
	Oil addition x single siphon***	[g]	52	52	52	52	50	52	50	50
11-20 m	Discharge gas line	[mm-in]	22-7/8	22-7/8	22-7/8	22-7/8	16-5/8	28-1/1/8	18-3/4	18-3/4
	Liquid line	[mm-in]	16-5/8	16-5/8	16-5/8	16-5/8	12-1/2	18-3/4	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	193	193	193	193	98	262	102	102
	Oil addition x single siphon***	[g]	52	52	52	52	50	108	50	50
21-30 m	Discharge gas line	[mm-in]	22-7/8	22-7/8	22-7/8	22-7/8	16-5/8	28-1/1/8	18-3/4	18-3/4
	Liquid line	[mm-in]	16-5/8	16-5/8	16-5/8	16-5/8	12-1/2	18-3/4	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	193	193	193	193	98	262	102	102
	Oil addition x single siphon***	[g]	52	52	52	52	50	108	50	50
Refrigerant compressor limit**	[kg]	8.5	8.5	10	10	9	10	9	11	

Please contact the technical office before ordering the units.

Note:

If the total refrigerant charge (base charge + refrigerant addition due to line length) exceeds the refrigerant compressor limit (**), an oil charge of 50g, per exceeding refrigerant kg, must be added.

(***) A siphon has to be installed on every 5m of vertical suction or discharge line.

(*) All values for double circuit units are referred to a single circuit.

INNOV@ units									
Refrigerant		R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C
Model	[-]	401	422*	452*	512*	552*	602*	692*	762*
T ev. Dew Point	[°C]	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10
Base refrigerant charge	[kg]	12.03	7.37	7.55	7.55	8.33	8.33	8.33	9.74
0-10 m	Discharge gas line	[mm-in]	22-7/8	22-7/8	22-7/8	22-7/8	22-7/8	22-7/8	22-7/8
	Liquid line	[mm-in]	16-5/8	16-5/8	16-5/8	16-5/8	16-5/8	16-5/8	16-5/8
	Refrigerant addition x line metre	[g]	193	193	193	193	193	193	193
	Oil addition x single siphon***	[g]	52	52	52	52	52	52	52
11-20 m	Discharge gas line	[mm-in]	28-1/1/8	22-7/8	22-7/8	22-7/8	22-7/8	28-1/1/8	28-1/1/8
	Liquid line	[mm-in]	18-3/4	16-5/8	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4
	Refrigerant addition x line metre	[g]	262	193	193	193	193	262	262
	Oil addition x single siphon***	[g]	108	52	52	52	52	108	108
21-30 m	Discharge gas line	[mm-in]	28-1/1/8	22-7/8	22-7/8	22-7/8	22-7/8	28-1/1/8	28-1/1/8
	Liquid line	[mm-in]	18-3/4	16-5/8	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4
	Refrigerant addition x line metre	[g]	262	193	193	193	193	262	262
	Oil addition x single siphon***	[g]	108	52	52	52	52	108	108
Refrigerant compressor limit**	[kg]	12.5	8.5	8.5	10	10	10	12.5	12.5

Please contact the technical office before ordering the units.

Note:

*If the total refrigerant charge (base charge + refrigerant addition due to line length) exceeds the refrigerant compressor limit (**), an oil charge of 50g, per exceeding refrigerant kg, must be added.*

*(***) A siphon has to be installed on every 5m of vertical suction or discharge line.*

() All values for double circuit units are referred to a single circuit.*

SWRC/MCR chillers with remote condenser @ w. 7/12 °C

Refrigerant		R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	
Model	[-]	055	070	100	120	150	180	205	220	270	310	390	
T ev. Dew Point	[°C]	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	
Base refrigerant charge	[kg]	1.83	1.83	3.68	3.79	5.62	5.62	6.34	6.39	7.21	7.21	8.47	
0-10 m	Discharge gas line	[mm-in]	12-1/2	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	16-5/8	22-7/8	22-7/8	22-7/8	
	Liquid line	[mm-in]	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	
	Refrigerant addition x line metre	[g]	91	91	91	97	97	97	97	193	193	193	
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	50	52	52	52	
11-20 m	Discharge gas line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4	22-7/8	22-7/8	22-7/8	28-1/1/8
	Liquid line	[mm-in]	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4
	Refrigerant addition x line metre	[g]	91	91	97	97	97	102	102	193	193	193	262
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	50	52	52	52	108
21-30 m	Discharge gas line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4	22-7/8	22-7/8	22-7/8	28-1/1/8
	Liquid line	[mm-in]	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4
	Refrigerant addition x line metre	[g]	91	91	97	97	97	102	102	193	193	193	262
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	50	50	52	52	52
Refrigerant compressor limit**	[kg]	7	7	7	9	12	11	11	8.5	10	10	12.5	

Please contact the technical office before ordering the units.

Note:

*If the total refrigerant charge (base charge + refrigerant addition due to line length) exceeds the refrigerant compressor limit (**), an oil charge of 50g, per exceeding refrigerant kg, must be added.*

*(***) A siphon has to be installed on every 5m of vertical suction or discharge line.*

@DNOVA units											
Refrigerant		R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	R407C	
Model HTS	[-]	025*	035*	045	056	073	090	105	120	145	
T ev. Dew Point	[°C]	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	
Base refrigerant charge	[kg]	1.35	1.71	2.62	2.97	3.85	4.56	5.21	6.62	8.62	
0-10 m	Suction line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	16-5/8	16-5/8	22-7/8	22-7/8
	Liquid line	[mm-in]	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	55	55	58	58	58	58	58	93	93
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	50	52	52
11-20 m	Suction line	[mm-in]	12-1/2	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4	22-7/8	22-7/8
	Liquid line	[mm-in]	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	12-1/2	12.70-1/2
	Refrigerant addition x line metre	[g]	56	56	58	58	58	60	60	93	93
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	50	52	52
21-30 m	Suction line	[mm-in]	12-1/2	16-5/8	16-5/8	16-5/8	18-3/4	18-3/4	22-7/8	22-7/8	22-7/8
	Liquid line	[mm-in]	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	10-3/8	12-1/2	12-1/2
	Refrigerant addition x line metre	[g]	56	58	58	58	59	60	62	93	93
	Oil addition x single siphon***	[g]	50	50	50	50	50	50	52	52	52
Refrigerant compressor limit**	[kg]	3	3	5	7	7	7	7	9	12	

Please contact the technical office before the order of the units

Note:

- *If the total refrigerant charge (base charge + refrigerant addition due to line length) exceeds the refrigerant compressor limit (**), an oil charge of 50g, per exceeding refrigerant kg, must be added.*
- **Max difference height 10mt**

(*) The units with rotary compressor are not in warranty for pipe line more than 15mt long.

(*) A siphon has to be installed on every 5m of vertical suction or discharge line.**

Example:

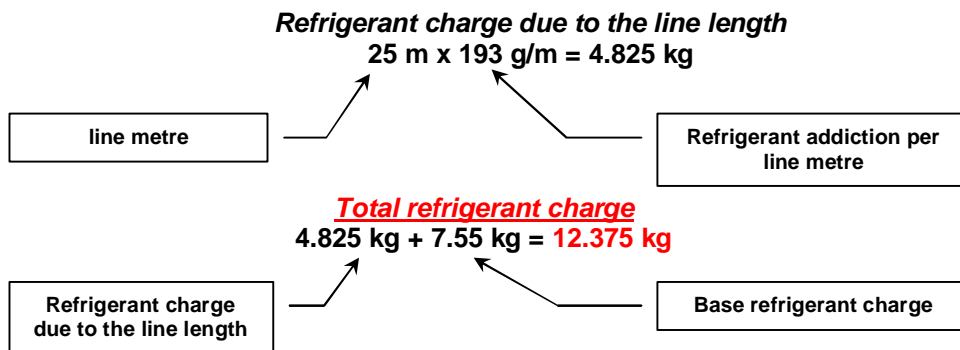
Unit: DHADR 512 (double circuit unit)

Line length: 25m (10m vertical)

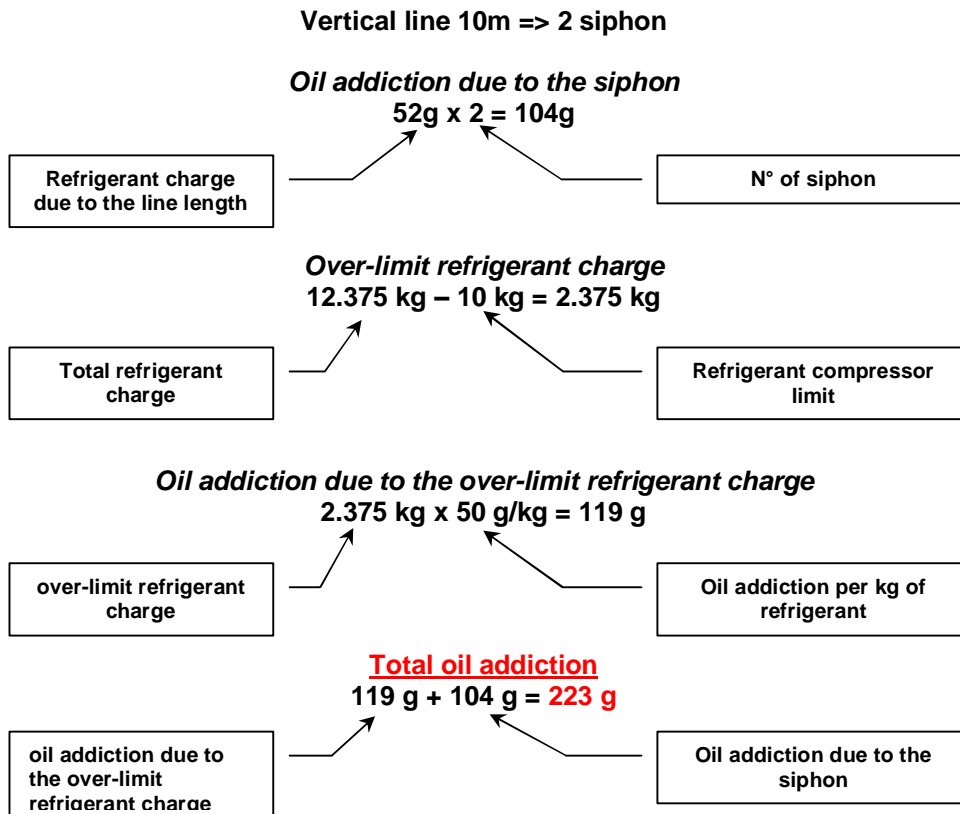
From the related table it is possible to find these values:

- Discharge gas line diameter: 22 mm - 7/8"
- Liquid line diameter: 16 mm - 5/8"
- Base refrigerant charge: 7.55 kg
- Refrigerant addition per line meter: 193 g/m
- Oil addition for single siphon: 52 g
- Refrigerant compressor limit: 10 kg

REFRIGERANT CHARGE



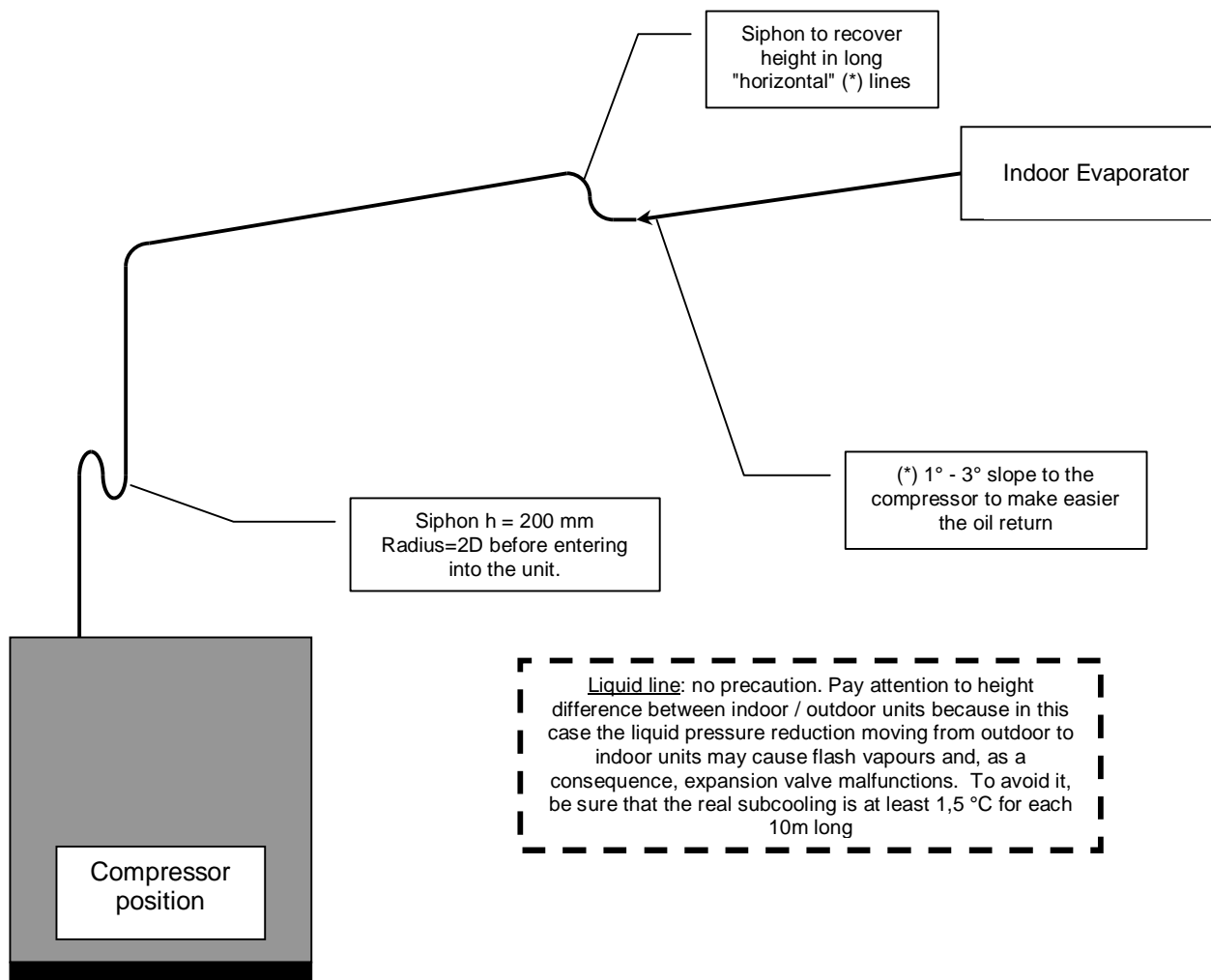
OIL ADDITION



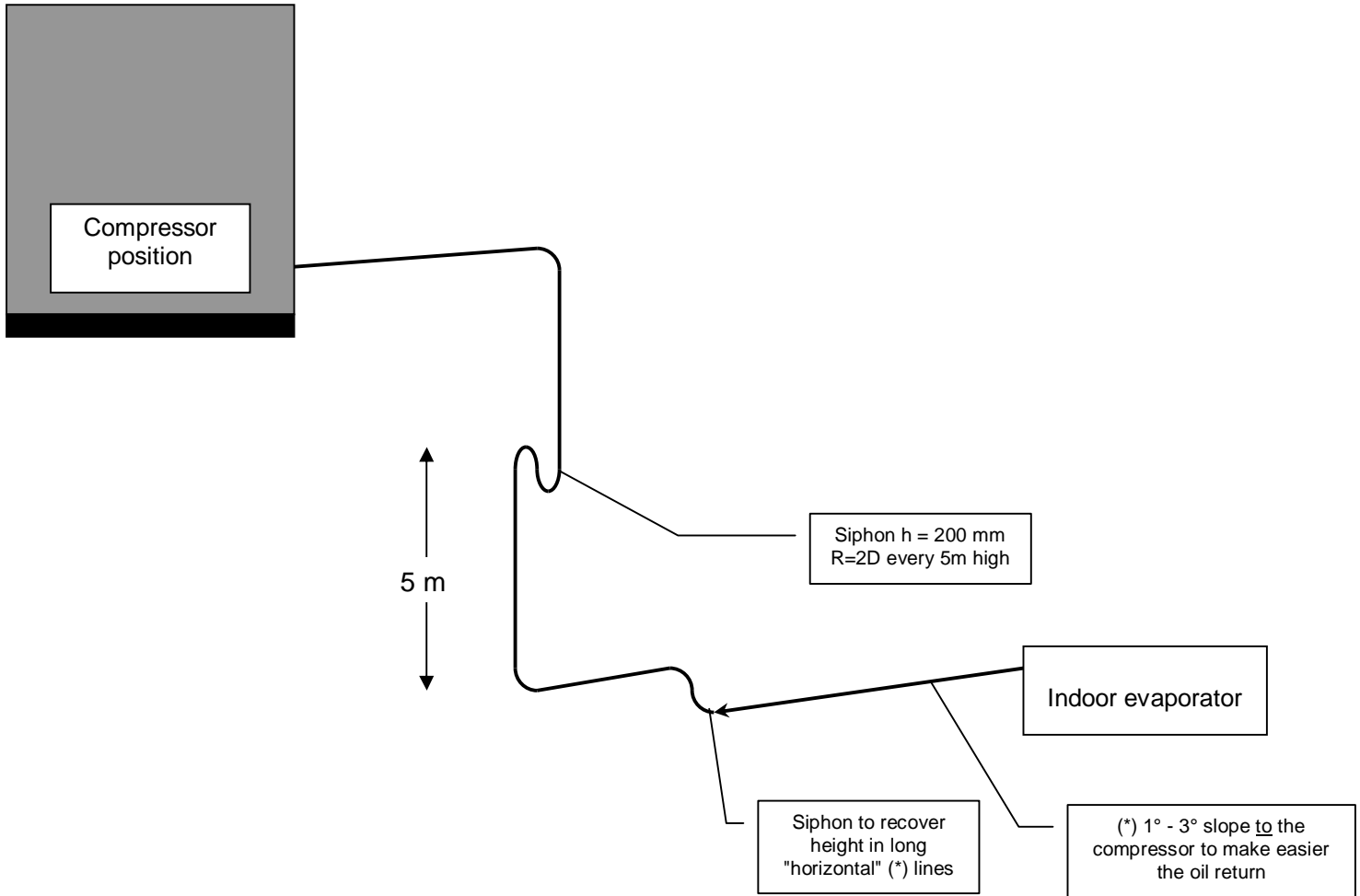
(*) Calculated values are referred to a single circuit.
 Reference for on-site installed pipes

External Diameters [mm]	Thickness [mm]	Bending Radius [mm]	Design pressure [bar]	Pipes PED Category	σ_s copper strength [N/mm ²]	σ real stress [N/mm ²]	Safety Coefficient.
10	1	36	28	A3 P3	227	11.2	20.3
12	1	36	28	A3 P3	227	14	16.2
16	1	46	28	A3 P3	227	19.6	11.6
18	1	56	28	A3 P3	227	21	10.8
22	1,5	67	28	A3 P3	227	17.3	13.1
28	1,5	96	28	A3 P3	227	23.3	9.8
35	1.5	70	28	A3P3	227	29.8	7.6
42	1.5	84	28	A3P3	227	36.4	6.2
54	2.0	108	28	A3P3	227	35	6.4

Installation of the suction line (Evaporator above condenser / compressor)

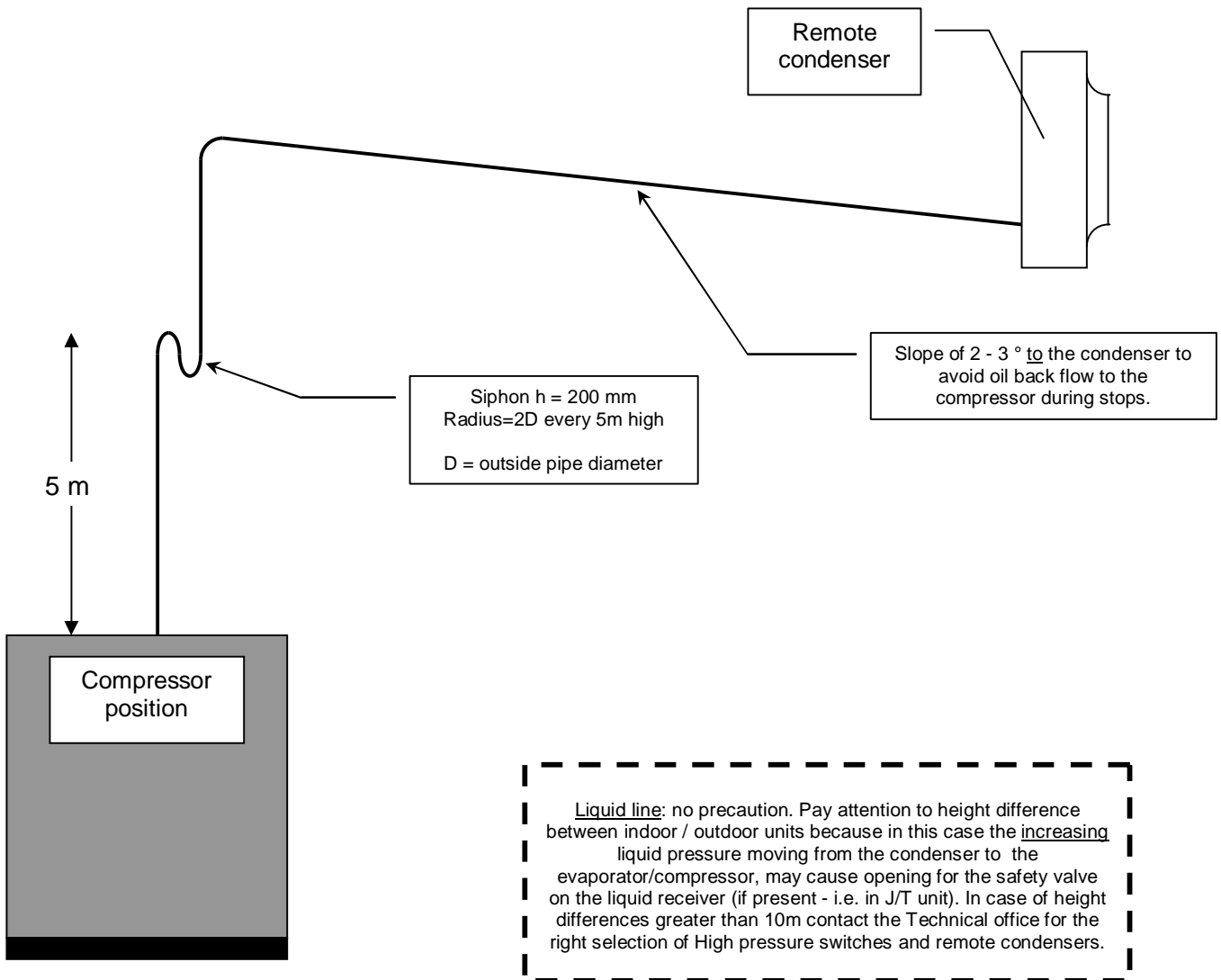


Installation of the suction line (Evaporator below condenser / compressor)

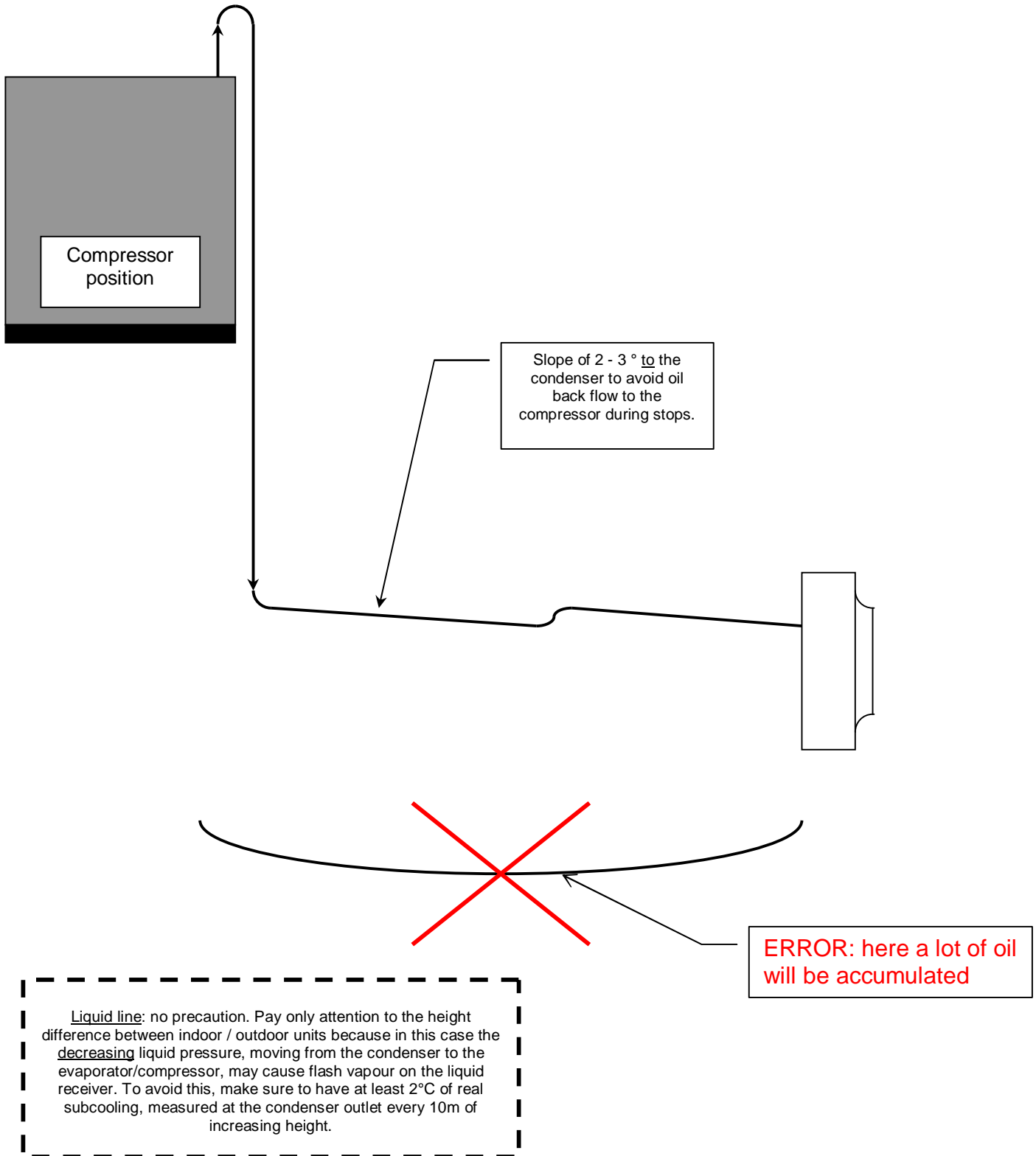


Liquid line: no precaution. Pay attention to height difference between indoor / outdoor units because in this case the increasing liquid pressure moving from the condenser to the evaporator/compressor, may cause opening for the safety valve on the liquid receiver (if present). **Max height difference 10mt**

Installation of the discharge line (Condenser above evaporator / compressor)



Installation of the discharge line (Condenser below evaporator / compressor)



Special Precautions for lines more than 20 m long

1. Install a solenoid valve on the liquid line (standard on 201÷762 units - option on 060÷205 units) with five-second delay on closing (to be specified on the order)
2. Install piping according to the specification contained in this file
3. Install a check valve on the discharge side (mandatory). It is also advisable to install one also on the liquid line
4. Install a crankcase heater (standard on INNOV@ units from 04 - 2004)
5. Long lines means higher refrigerant charge and consequently more oil dilution (3-5 % in weight of the refrigerant charge) → add oil to the system as specified in the previous tables.

From the previous tables, the refrigerant charge can be estimated with an accuracy of ±20%

Approved Oil Types for Copeland Scroll Compressors

1. ICI Emkarate RL 32 CF
2. Mobil Eal Artic 22 CC

Approved Oil Types for Danfoss Maneurop Scroll Compressors

3. Oil Maneurop 160SZ 32 cSt Polyolester Oil



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