



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		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A
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 (standard)	[kg]	1.34	2.21	2.53	2.53	3.37	3.73	3.11	5.04
Base refrigerant charge (low noise)	[kg]	1.50	2.73	3.05	3.05	3.05	3.41	5.77	5.77
0-10 m	Discharge gas line	[mm-in]	12.7-1/2	12.7-1/2	12.7-1/2	12.7-1/2	15.9-5/8	15.9-5/8	19-3/4
	Liquid line	[mm-in]	9.5-3/8	9.5-3/8	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2
	Refrigerant addition x line metre	[kg]	0.051	0.051	0.051	0.051	0.101	0.101	0.108
	Oil addition x single siphon***	[g]	10	10	10	10	20	20	34
11-20 m	Discharge gas line	[mm-in]	12.7-1/2	12.7-1/2	15.9-5/8	15.9-5/8	19-3/4	19-3/4	19-3/4
	Liquid line	[mm-in]	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	12.7-1/2	12.7-1/2
	Refrigerant addition x line metre	[kg]	0.05	0.05	0.10	0.10	0.11	0.11	0.11
	Oil addition x single siphon***	[g]	10	10	20	20	34	34	34
21-30 m	Discharge gas line	[mm-in]	12.7-1/2	12.7-1/2	15.9-5/8	15.9-5/8	19-3/4	19-3/4	22.2-7/8
	Liquid line	[mm-in]	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	12.7-1/2	15.9-5/8
	Refrigerant addition x line metre	[kg]	0.05	0.05	0.10	0.10	0.11	0.11	0.16
	Oil addition x single siphon***	[g]	10	10	20	20	34	34	54
Refrigerant compressor limit**	[kg]	4.7	4.7	11.3	11.3	11.3	11.3	11.3	11.3
Compressor brand	[-]	Copeland	Sanyo	Sanyo	Sanyo	Sanyo	Sanyo	Sanyo	Sanyo
Suggested oil type	[-]	ICI Emkarate RL 32 3MAF	FV68S	FV68S	FV68S	FV68S	FV68S	FV68S	FV68S

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		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	
Model	[-]	201	251	281	272*	311	302*	362*	401	422*	
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 (standard)	[kg]	9.53	9.53	10.63	6.71	10.63	6.71	6.71	12.88	8.00	
Base refrigerant charge (low noise)	[kg]	9.53	9.53	10.63	6.71	12.08	7.43	7.43	14.16	8.64	
0-10 m	Discharge gas line	[mm-in]	19-3/4	19-3/4	22.2-7/8	15.9-5/8	22.2-7/8	19-3/4	19-3/4	28.6 1 1/8	22.2-7/8
	Liquid line	[mm-in]	15.9-5/8	15.9-5/8	19-3/4	12.7-1/2	19-3/4	15.9-5/8	15.9-5/8	22.2-7/8	15.9-5/8
	Refrigerant addition x line metre	[kg]	0.16	0.16	0.25	0.10	0.25	0.16	0.16	0.33	0.17
	Oil addition x single siphon***	[g]	34	34	54	20	54	34	34	115	54
11-20 m	Discharge gas line	[mm-in]	19-3/4	22.2-7/8	22.2-7/8	15.9-5/8	22.2-7/8	19-3/4	19-3/4	28.6 1 1/8	22.2-7/8
	Liquid line	[mm-in]	15.9-5/8	15.9-5/8	19-3/4	12.7-1/2	19-3/4	15.9-5/8	15.9-5/8	22.2-7/8	15.9-5/8
	Refrigerant addition x line metre	[kg]	0.16	0.17	0.25	0.10	0.25	0.16	0.16	0.33	0.17
	Oil addition x single siphon***	[g]	34	54	54	20	54	34	34	115	54
21-30 m	Discharge gas line	[mm-in]	22.2-7/8	22.2-7/8	22.2-7/8	15.9-5/8	28.6 1 1/8	19-3/4	22.2-7/8	28.6 1 1/8	22.2-7/8
	Liquid line	[mm-in]	15.9-5/8	15.9-5/8	19-3/4	12.7-1/2	19-3/4	15.9-5/8	15.9-5/8	22.2-7/8	15.9-5/8
	Refrigerant addition x line metre	[kg]	0.17	0.17	0.25	0.10	0.27	0.16	0.17	0.33	0.17
	Oil addition x single siphon***	[g]	54	54	54	20	115	34	54	115	54
Refrigerant compressor limit**	[kg]	11.3	20	22	11.3	22	11.3	11.3	22	11.3	
Compressor brand	[-]	Sanyo	Danfoss	Danfoss	Sanyo	Sanyo	Danfoss	Sanyo	Danfoss	Sanyo	
Suggested oil type	[-]	FV68S	Oil Maneurop 160SZ	Oil Maneurop 160SZ	FV68S	FV68S	Oil Maneurop 160SZ	FV68S	Oil Maneurop 160SZ	FV68S	

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		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	
Model	[-]	452*	532*	592*	602*	692*	762*	1002	1204	
T ev. Dew Point	[°C]	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	0 / +10	
Base refrigerant charge (standard)	[kg]	8.00	8.96	8.96	11.42	11.42	11.42	15.06	31.45	
Base refrigerant charge (low noise)	[kg]	8.64	9.97	9.97	12.94	12.94	18.34	25.69	31.45	
0-10 m	Discharge gas line	[mm-in]	22.2-7/8	22.2-7/8	22.2-7/8	22.2-7/8	22.2-7/8	28.6 1 1/8	28.6 1 1/8	34.9 1 3/8
	Liquid line	[mm-in]	15.9-5/8	19-3/4	19-3/4	19-3/4	19-3/4	22.2-7/8	22.2-7/8	22.2-7/8
	Refrigerant addition x line metre	[kg]	0.17	0.25	0.25	0.25	0.25	0.33	0.33	0.36
	Oil addition x single siphon***	[g]	54	54	54	54	54	115	115	210
11-20 m	Discharge gas line	[mm-in]	22.2-7/8	22.2-7/8	22.2-7/8	28.6 1 1/8	28.6 1 1/8	28.6 1 1/8	28.6 1 1/8	34.9 1 3/8
	Liquid line	[mm-in]	15.9-5/8	19-3/4	19-3/4	22.2-7/8	22.2-7/8	22.2-7/8	22.2-7/8	22.2-7/8
	Refrigerant addition x line metre	[kg]	0.17	0.25	0.25	0.33	0.33	0.33	0.33	0.36
	Oil addition x single siphon***	[g]	54	54	54	115	115	115	115	210
21-30 m	Discharge gas line	[mm-in]	22.2-7/8	22.2-7/8	22.2-7/8	28.6 1 1/8	28.6 1 1/8	28.6 1 1/8	28.6 1 1/8	34.9 1 3/8
	Liquid line	[mm-in]	15.9-5/8	19-3/4	19-3/4	22.2-7/8	22.2-7/8	22.2-7/8	22.2-7/8	22.2-7/8
	Refrigerant addition x line metre	[kg]	0.17	0.25	0.25	0.33	0.33	0.33	0.33	0.36
	Oil addition x single siphon***	[g]	54	54	54	115	115	115	115	210
Refrigerant compressor limit**	[kg]	22	22	22	22	22	22	21.3	44	
Compressor brand	[-]	Danfoss	Danfoss	Danfoss	Danfoss	Danfoss	Danfoss	Copeland	Danfoss	
Suggested oil type	[-]	Oil Maneurop 160SZ	Oil Maneurop 160SZ	Oil Maneurop 160SZ	Oil Maneurop 160SZ	Oil Maneurop 160SZ	Oil Maneurop 160SZ	ICI Emkarate RL 32 3MAF	Oil Maneurop 160SZ	

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.



ADNOV@ units											
Refrigerant		R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	R410A	
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]	0.73	0.73	1.42	1.42	1.42	2.12	2.12	2.88	2.88	
0-10 m	Suction line	[mm-in]	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	15.9-5/8	15.9-5/8	19-3/4	19-3/4
	Liquid line	[mm-in]	7.9-5/16	7.9-5/16	7.9-5/16	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	12.7-1/2
	Refrigerant addition x line metre	[kg]	0.03	0.03	0.03	0.05	0.05	0.09	0.09	0.09	0.09
	Oil addition x single siphon***	[g]	4	4	10	10	10	20	20	34	34
11-20 m	Suction line	[mm-in]	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	15.9-5/8	15.9-5/8	15.9-5/8	19-3/4	19-3/4
	Liquid line	[mm-in]	7.9-5/16	7.9-5/16	7.9-5/16	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	12.7-1/2
	Refrigerant addition x line metre	[kg]	0.03	0.03	0.03	0.05	0.05	0.09	0.09	0.09	0.09
	Oil addition x single siphon***	[g]	4	10	10	10	20	20	20	34	34
21-30 m	Suction line	[mm-in]	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	15.9-5/8	15.9-5/8	19-3/4	19-3/4	22.2-7/8
	Liquid line	[mm-in]	7.9-5/16	7.9-5/16	7.9-5/16	9.5-3/8	9.5-3/8	12.7-1/2	12.7-1/2	12.7-1/2	15.9-5/8
	Refrigerant addition x line metre	[kg]	0.03	0.03	0.03	0.04	0.05	0.09	0.09	0.09	0.15
	Oil addition x single siphon***	[g]	4	10	10	10	20	20	34	34	54
Refrigerant compressor limit**	[kg]	2.2	2.2	2.3	2.9	4.7	4.7	11.3	11.3	11.3	
Compressor brand	[-]	LG	LG	LG	LG	LG	Sanyo	Sanyo	Sanyo	Sanyo	
Suggested oil type	[-]	FVC68D	FVC68D	FVC68D	FVC68D	FVC68D	FV68S	FV68S	FV68S	FV68S	

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:

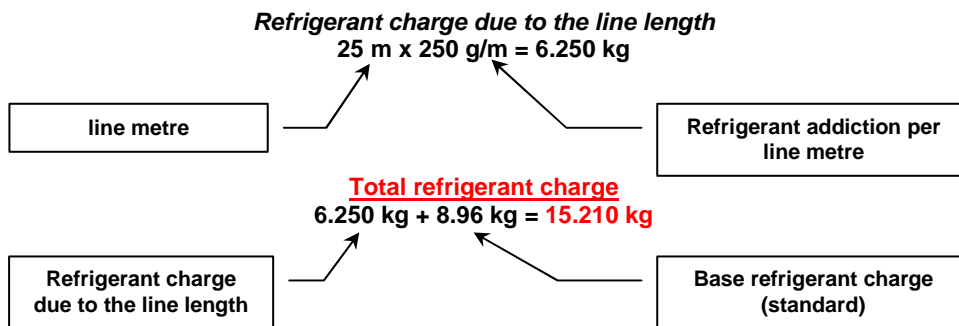
Unit: DHADR 532 (double circuit unit)

Line length: 25m (10m vertical)

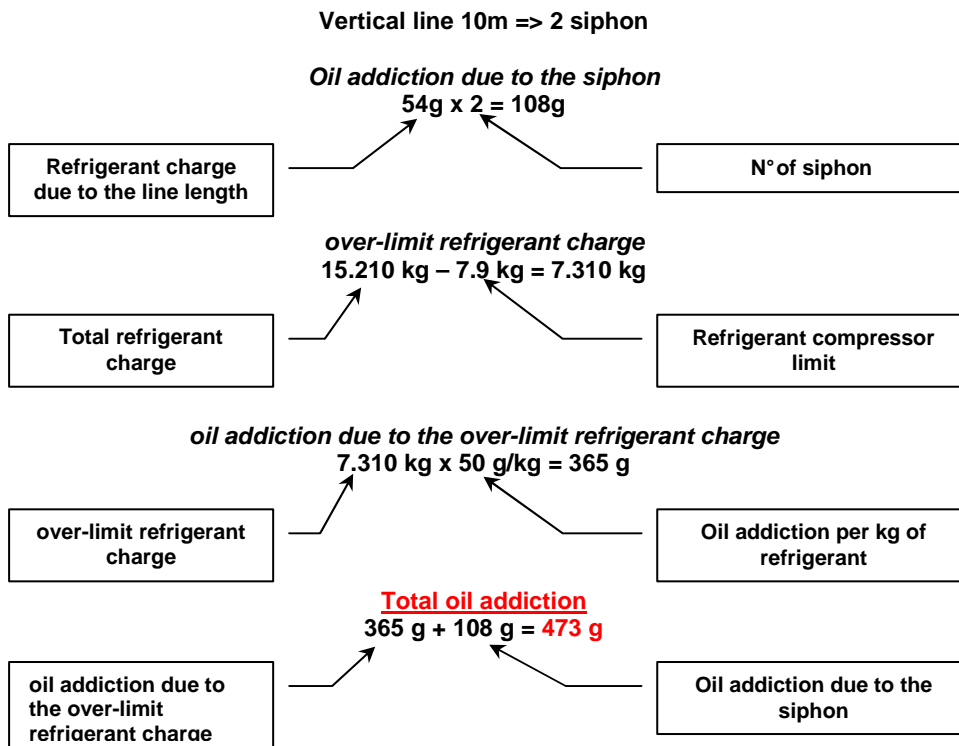
From the related table it is possible to find these values:

- Discharge gas line diameter: 22.2 mm - 7/8"
- Liquid line diameter: 19.0 mm - 5/8"
- Base refrigerant charge (standard): 8.96 kg
- Base refrigerant charge (low noise): 9.97kg
- Refrigerant addition per line meter: 250 g/m
- Oil addition for single siphon: 54 g
- Refrigerant compressor limit: 7.9 kg

REFRIGERANT CHARGE



OIL ADDITION



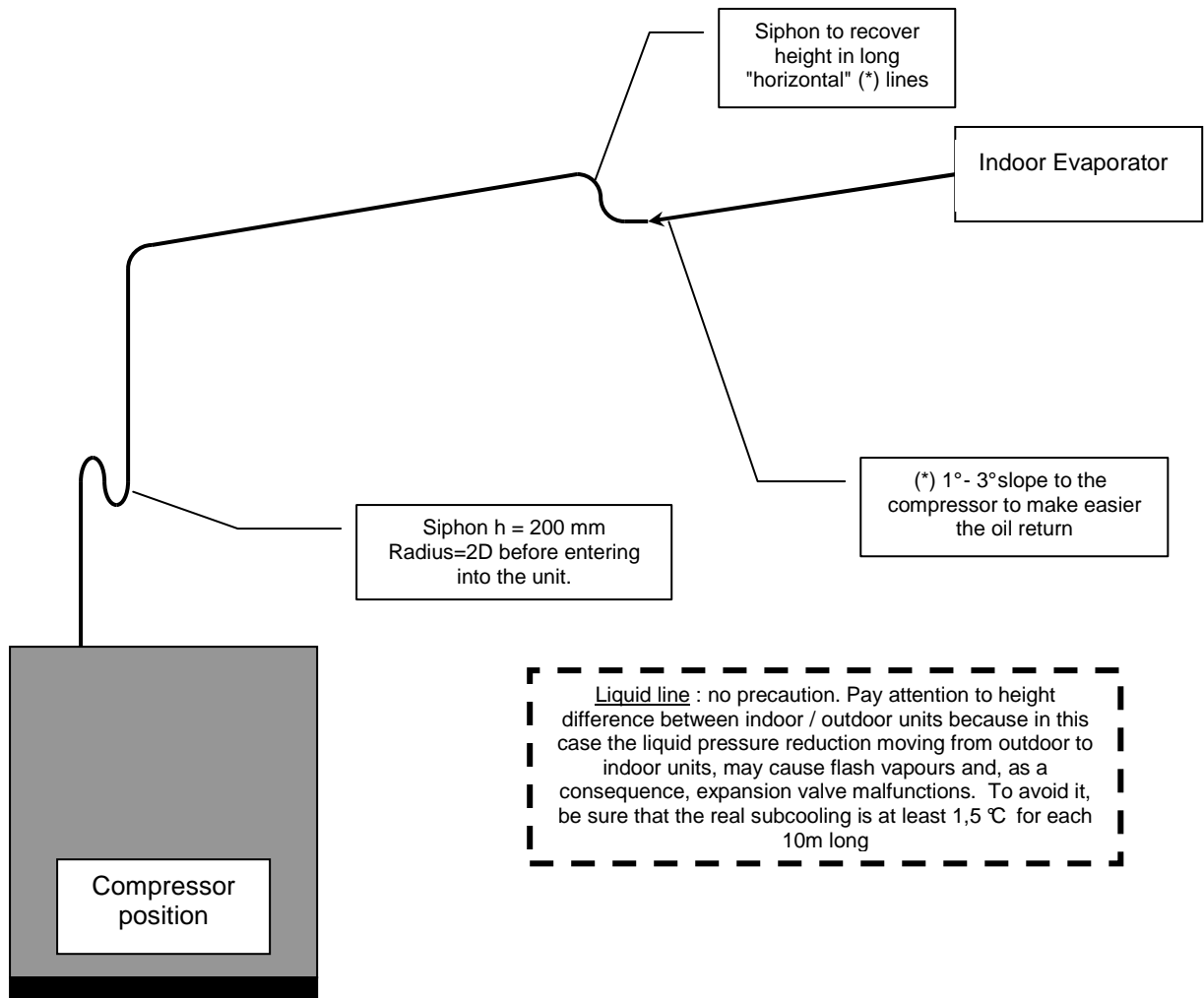
(*) Calculated values are referred to a single circuit.

Reference for on-site installed pipes

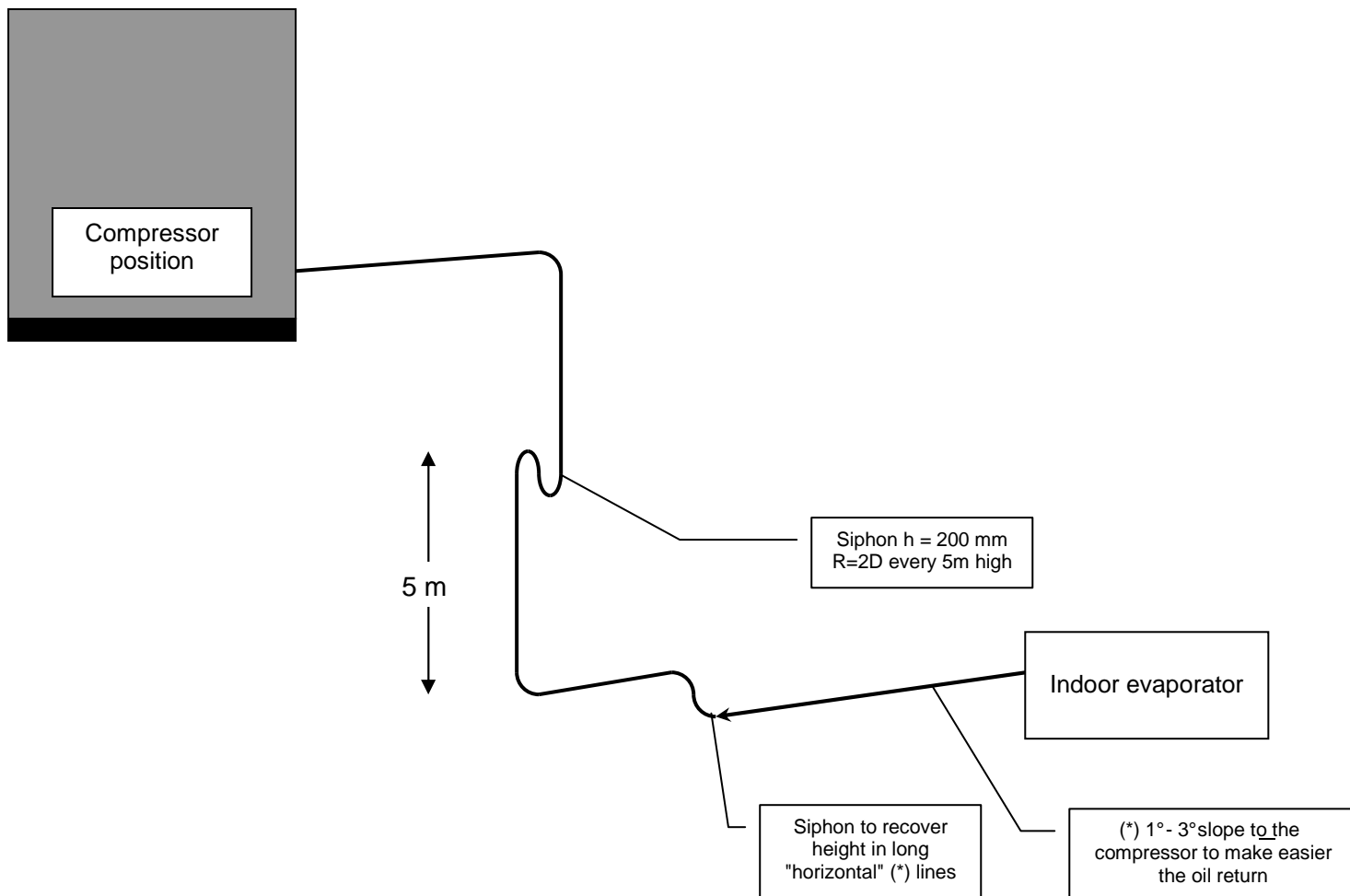


Diameter [mm]	Thickness [mm]	Minimum bending radius [mm]	System design pressure PS [bar]	PED Category	Max Copper σ_s [N/mm ²]	Real copper σ [N/mm ²]	Safety ratio
10	1	36	42	A3 P3	227	16.8	13.5
12	1	36	42	A3 P3	227	21.0	10.8
16	1	46	42	A3 P3	227	29.4	7.7
18	1	56	42	A3 P3	227	33.6	6.8
22	1,5	67	42	A3 P3	227	26.6	8.5
28	1,5	96	42	A3 P3	227	35.0	6.5
35	1.5	70	42	A3P3	227	44.8	5.0
42	1.5	84	42	A3P3	227	54.6	4.2
54	2.0	108	42	A3P3	227	52.5	4.3

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

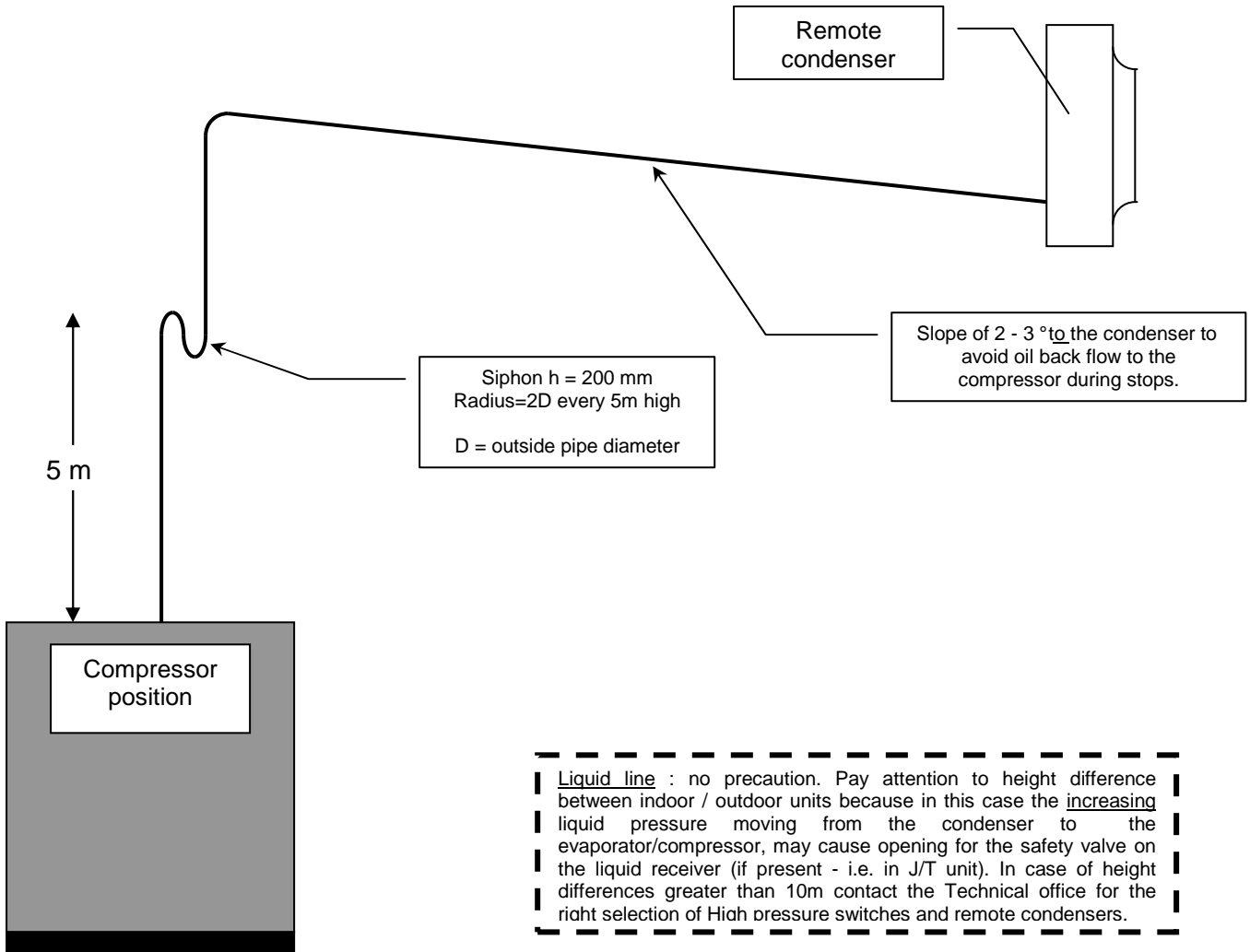


Installation of the suction line (Evaporator below condenser / compressor)



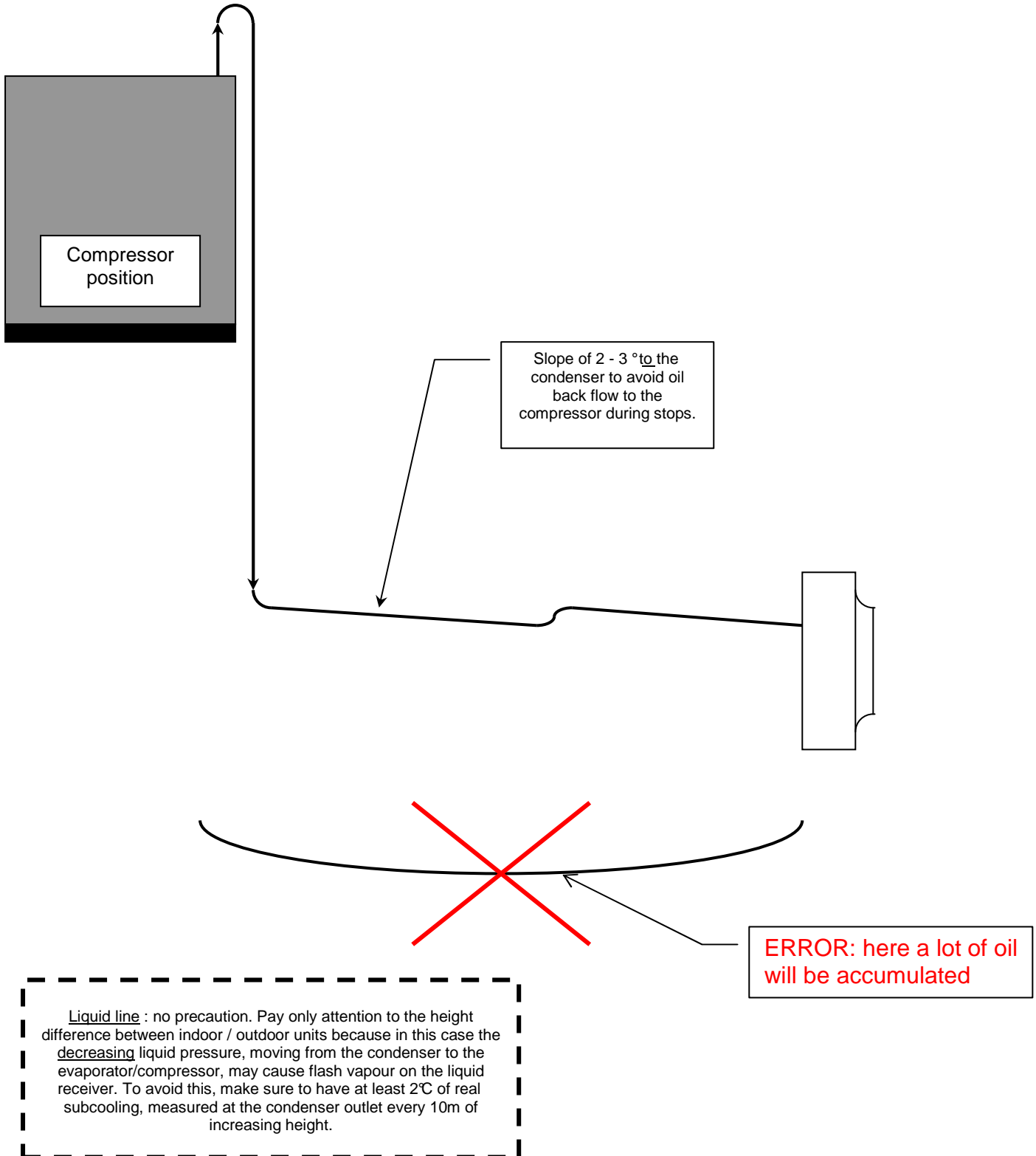
Liquid line : no precaution. Pay attention to height difference between indoor / outdoor units because in this case the increasing liquid pressure moving from the condenser to the evaporator/compressor, may cause opening for the safety valve on the liquid receiver (if present).
Max height difference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

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



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 - i.e. in J/T unit). In case of height differences greater than 10m contact the Technical office for the right selection of High pressure switches and remote condensers.

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 T units - option on J 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)
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 $\pm 20\%$

Approved Oil Types for Copeland Scroll Compressors

1. ICI Emkarate RL 32 3MAF

Approved Oil Types for Danfoss Maneurop Scroll Compressors

2. Oil Maneurop 160SZ 32 cSt Polyolester Oil

Approved Oil Types for Sanyo Scroll Compressors

3. FV68S

Approved Oil Types for LG Scroll Compressors

4. FVC68D