



**Installation, Operation and Maintenance Manual**  
**D-EIMAC00708-16EN**

**Air-cooled single circuit screw chiller**

**EWAD100 ÷ 410 E**

**ERAD120 ÷ 490 E- (condensing unit)**

**50 Hz - Refrigerant R134a**



**Original Instructions**



## ▲ IMPORTANT

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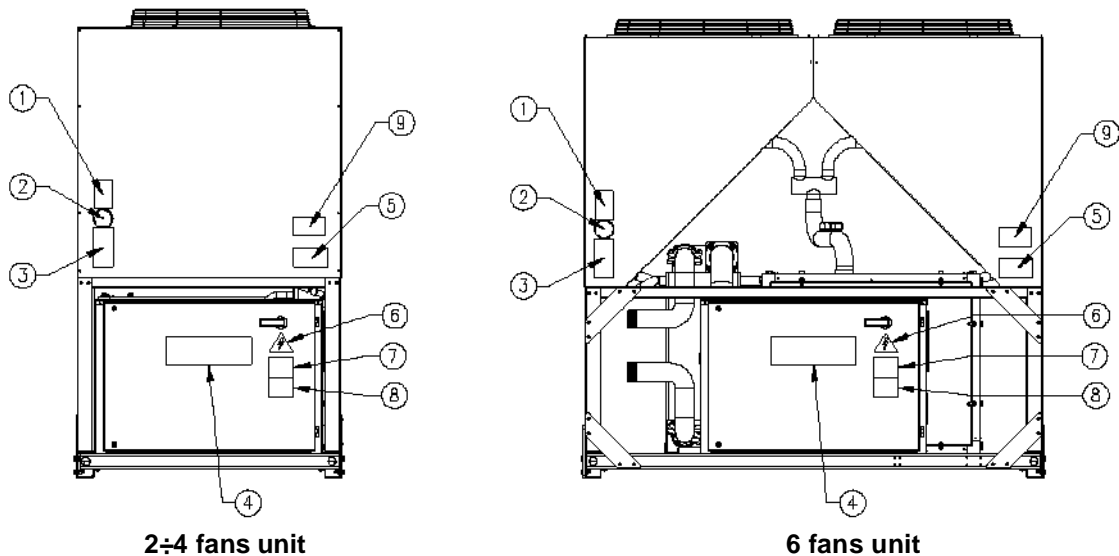
## ▲ WARNING

Before starting the installation of the unit, please read this manual carefully. Starting up the unit is absolutely forbidden if all instructions contained in this manual are not clear.

Key to symbols

- △ Important note: failure to respect the instruction can damage the unit or compromise operation
- ⚠ Note regarding safety in general or respect of laws and regulations
- ⚡ Note regarding electrical safety

### Description of the labels applied to the electrical panel



#### Label Identification

1 – Non flammable gas symbol	6 – Electrical hazard symbol
2 – Gas type	7 – Hazardous Voltage warning
3 – Unit nameplate data	8 – Cable tightening warning
4 – Manufacturer's logo	9 – Lifting instructions
5 – Water circuit filling warning	

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## **General Information**

### **▲ ATTENTION**

The units described in the present manual represent a high value investment, maximum care should be taken to ensure correct installation and appropriate working conditions.  
Installation and maintenance must be performed by qualified and specifically trained personnel only.  
Correct maintenance of the unit is indispensable for its safety and reliability. Manufacturer's service centres are the only having adequate technical skill for maintenance.

### **▲ ATTENTION**

This manual provides information about the features and standard procedure for the complete series.

All units are delivered from the factory complete with wiring diagrams and dimensional drawings including size and weight for each model.

#### **WIRING DIAGRAMS AND DIMENSIONAL DRAWINGS MUST BE CONSIDERED ESSENTIAL DOCUMENTS OF THIS MANUAL**

In case of any discrepancy between this manual and the equipment's document please refer to the wiring diagram and dimensional drawings.

## **Receiving the machine**

The machine must be inspected for any possible damage immediately upon reaching its final place of installation. All components described in the delivery note must be carefully verified and checked; any damage must be reported to the transporter. Check on the machine nameplate, before connecting it to earth, that the model and power supply voltage are as ordered. Responsibility for any damage after acceptance of the machine cannot be attributed to the manufacturer.

## **Checks**

Please perform the following checks upon receipt of the machine, for your protection in the event that it is incomplete (any missing parts) or has incurred damage during transport:

- a) Before accepting the machine, please verify every single component in the consignment. Check for any damage.
- b) In the event that the machine has been damaged, do not remove the damaged material. A set of photographs are helpful in ascertaining responsibility.
- c) Immediately report the extent of the damage to the transporter and immediately request that they inspect the machine.
- d) Immediately report the extent of the damage to the manufacturer representative, so that arrangements can be made for the required repairs. In no case must the damage be repaired before the machine has been inspected by the representative of the transportation company.

## **Purpose of this Manual**

The purpose of this Manual is to allow the installer and the qualified operator to carry out all required operations in order to ensure proper installation and maintenance of the machine, without risking any damage to people, animals and/or objects.

This Manual is an important supporting document for qualified personnel but it is not intended to replace such personnel. All activities must be carried out in compliance with local laws and regulations.

# Nomenclature

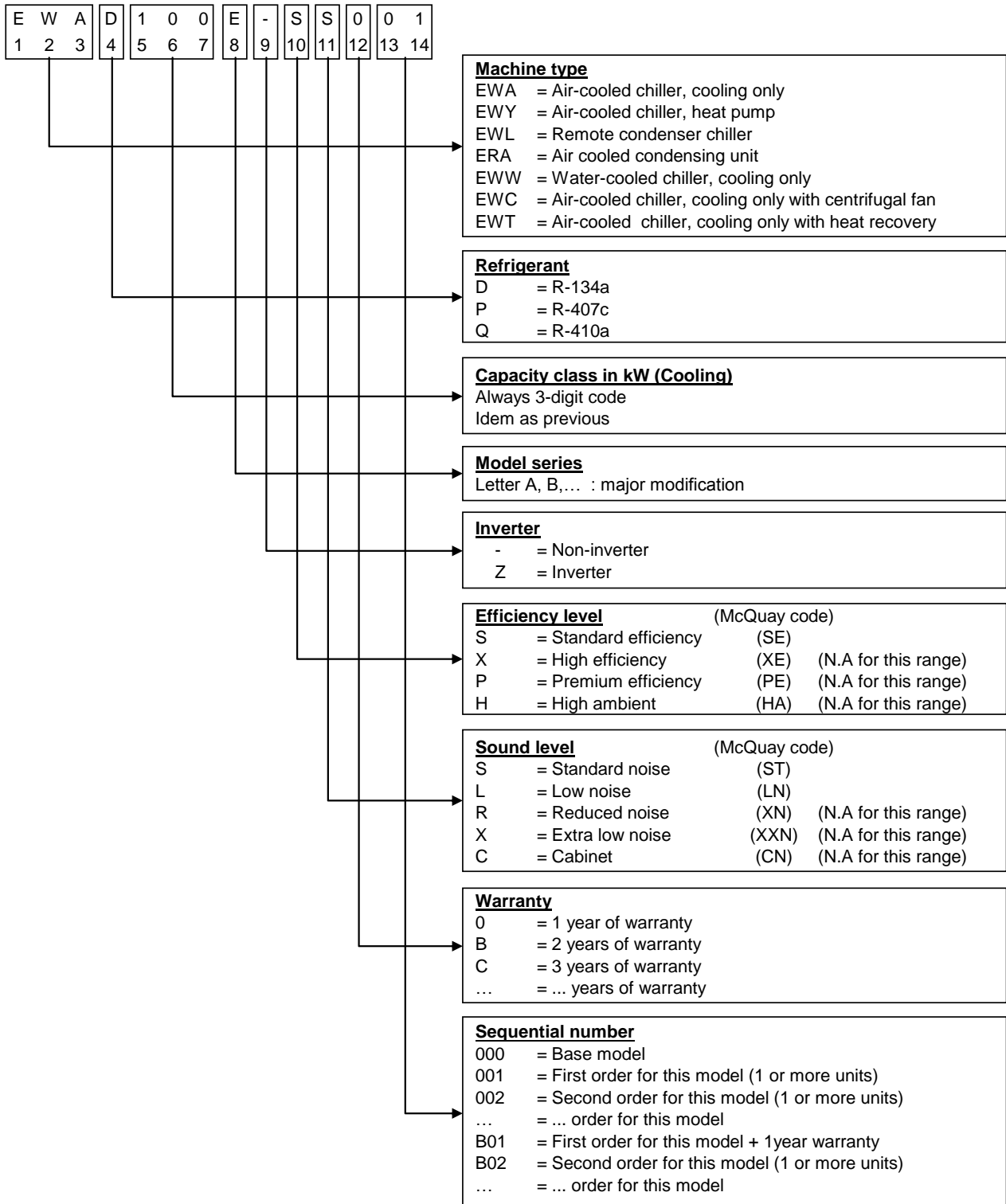


Figure 1 - Nomenclature

**Table 1 – EWAD 100E ÷ 180E-SS - HFC 134a - Technical Data**

			Unit Size	100	120	140	160	180	
Capacity (1)	Cooling		kW	101	121	138	163	183	
Capacity control	Type		---	Stepless					
	Minimum capacity		%	25	25	25	25	25	
Unit power input (1)	Cooling		kW	38.7	46.9	53.4	60.3	68.5	
EER (1)			---	2.61	2.57	2.58	2.70	2.67	
ESEER			---	2.93	2.93	2.75	2.93	2.81	
IPLV			---	3.36	3.25	2.98	3.13	3.25	
Casing	Colour		---	Ivory White					
	Material		---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2273	2273	2273	2273	2273	
		Width	mm	1292	1292	1292	1292	1292	
		Length	mm	2165	2165	3065	3065	3965	
Weight	Unit		kg	1651	1684	1806	1861	2023	
	Operating Weight		kg	1663	1699	1823	1881	2047	
Water exchanger	heat	Type	---	Plate to Plate					
		Water volume	l	12	15	17	20	24	
		Nominal water flow rate	l/s	4.83	5.76	6.58	7.77	8.74	
		Nominal Water pressure drop	kPa	24	25	24	24	22	
		Insulation material		Closed cell					
Air heat exchanger	Type		---	High efficiency fin and tube type with integral subcooler					
Fan	Type		---	Direct propeller type					
	Drive		---	DOL					
	Diameter		mm	800	800	800	800	800	
	Nominal air flow		l/s	10922	10575	16383	15863	21844	
	Model	Quantity		No.	2	2	3	3	4
		Speed		rpm	920	920	920	920	920
Motor input			kW	1.75	1.75	1.75	1.75	1.75	
Compressor	Type		---	Semi-hermetic single screw compressor					
	Oil charge		l	13	13	13	13	13	
	Quantity		No.	1	1	1	1	1	
Sound level	Sound Power	Cooling	dB(A)	91.5	91.5	92.3	92.3	93.0	
	Sound Pressure (2)	Cooling	dB(A)	73.5	73.5	73.7	73.7	73.9	
Refrigerant circuit	Refrigerant type		---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge		kg.	18	21	23	28	30	
	N. of circuits		No.	1	1	1	1	1	
Piping connections	Evaporator water inlet/outlet		"	3	3	3	3	3	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
Water freeze protection controller									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								



**Table 2 - EWAD 210E ÷ 410E-SS - HFC 134a - Technical Data**

			Unit Size	210	260	310	360	410	
Capacity (1)	Cooling		kW	214	256	307	360	413	
Capacity control	Type		---	Stepless					
	Minimum capacity		%	25	25	25	25	25	
Unit power input (1)	Cooling		kW	71.7	86.7	111	133	146	
EER (1)			---	2.98	2.95	2.77	2.71	2.84	
ESEER			---	3.02	3.18	3.05	3.23	3.34	
IPLV			---	3.48	3.68	3.57	3.61	3.65	
Casing	Colour		---	Ivory White					
	Material		---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2273	2223	2223	2223	2223	
		Width	mm	1292	2236	2236	2236	2236	
		Length	mm	3965	3070	3070	3070	3070	
Weight	Unit		kg	2086	2522	2745	2855	2919	
	Operating Weight		kg	2116	2547	2775	2891	2963	
Water exchanger	heat	Type	---	Plate to Plate					
		Water volume	l	30	25	30	36	44	
		Nominal water flow rate	l/s	10.22	12.22	14.65	17.21	19.74	
		Nominal Water pressure drop	kPa	21	48	48	48	45	
		Insulation material		Closed cell					
Air heat exchanger	Type		---	High efficiency fin and tube type with integral subcooler					
Fan	Type		---	Direct propeller type					
	Drive		---	DOL					
	Diameter		mm	800	800	800	800	800	
	Nominal air flow		l/s	21150	32767	32767	31725	31725	
	Model	Quantity		No.	4	6	6	6	6
		Speed		rpm	920	920	920	920	920
Motor input			kW	1.75	1.75	1.75	1.75	1.75	
Compressor	Type		---	Semi-hermetic single screw compressor					
	Oil charge		l	13	16	19	19	19	
	Quantity		No.	1	1	1	1	1	
Sound level	Sound Power	Cooling	dB(A)	94.2	94.2	94.5	94.5	95.2	
	Sound Pressure (2)	Cooling	dB(A)	75.1	75.0	75.3	75.3	76.0	
Refrigerant circuit	Refrigerant type		---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge		kg.	33	46	46	56	60	
	N. of circuits		No.	1	1	1	1	1	
Piping connections	Evaporator water inlet/outlet		"	3	3	3	3	3	
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
Water freeze protection controller									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								

**Table 3 – EWAD 100E ÷ 180E-SL – HFC134a - Technical Data**

			Units Size		100	120	130	160	180
Capacity (1)	Cooling	kW	97.9	116	134	157	177		
Capacity control	Type	---	Stepless						
	Minimum capacity	%	25	25	25	25	25		
Unit power input (1)	Cooling	kW	38.8	47.9	53.0	60.6	67.8		
EER (1)		---	2.52	2.42	2.53	2.60	2.61		
ESEER		---	3.01	2.97	2.85	3.00	3.07		
IPLV		---	3.32	3.21	3.30	3.46	3.28		
Casing	Colour	---	Ivory White						
	Material	---	Galvanized and painted steel sheet						
Dimensions	Unit	Height	mm	2273	2273	2273	2273	2273	
		Width	mm	1292	1292	1292	1292	1292	
		Length	mm	2165	2165	3065	3065	3965	
Weight	Unit	kg	1751	1784	1906	1961	2123		
	Operating Weight	kg	1766	1799	1923	1981	2147		
Water exchanger	heat	Type	---	Plate to Plate					
		Water volume	l	12	15	17	20	24	
		Nominal water flow rate	l/s	4.68	5.54	6.40	7.51	8.47	
		Nominal Water pressure drop	kPa	23	23	23	23	21	
		Insulation material		Closed cell					
Air heat exchanger	Type	---	High efficiency fin and tube type with integral subcooler						
Fan	Type	---	Direct propeller type						
	Drive	---	DOL						
	Diameter	mm	800	800	800	800	800		
	Nominal air flow	l/s	8372	8144	12558	12217	16744		
	Model	Quantity	No.	2	2	3	3	4	
		Speed	rpm	715	715	715	715	715	
Motor input		kW	0.78	0.78	0.78	0.78	0.78		
Compressor	Type	---	Semi-hermetic single screw compressor						
	Oil charge	l	13	13	13	13	13		
	Quantity	No.	1	1	1	1	1		
Sound level	Sound Power	Cooling	dB(A)	89.0	89.0	89.8	89.8	90.5	
	Sound Pressure (2)	Cooling	dB(A)	71.0	71.0	71.2	71.2	71.4	
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a		
	Refrigerant charge	kg.	18	21	23	28	30		
	N. of circuits	No.	1	1	1	1	1		
Piping connections	Evaporator water inlet/outlet	"	3	3	3	3	3		
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
Water freeze protection controller									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								

**Table 4 – EWAD 210E ÷ 400E-SL - HFC 134a - Technical Data**

			Units Size		210	250	300	350	400
Capacity (1)	Cooling	kW	209	249	296	345	398		
Capacity control	Type	---	Stepless						
	Minimum capacity	%	25	25	25	25	25		
Unit power input (1)	Cooling	kW	72.1	84.5	110	134	150		
EER (1)		---	2.89	2.95	2.69	2.58	2.65		
ESEER		---	3.32	3.55	3.41	3.34	3.45		
IPLV		---	3.48	3.86	3.75	3.63	3.76		
Casing	Colour	---	Ivory White						
	Material	---	Galvanized and painted steel sheet						
Dimensions	Unit	Height	mm	2273	2223	2223	2223	2223	
		Width	mm	1292	2236	2236	2236	2236	
		Length	mm	3965	3070	3070	3070	3070	
Weight	Unit	kg	2186	2633	2856	2966	3029		
	Operating Weight	kg	2216	2658	2886	3002	3073		
Water exchanger	heat	Type	---	Plate to Plate					
		Water volume	l	30	25	30	36	44	
		Nominal water flow rate	l/s	9.97	11.90	14.15	16.50	19.01	
		Nominal Water pressure drop	kPa	20	46	45	44	42	
		Insulation material		Closed cell					
Air heat exchanger	Type	---	High efficiency fin and tube type with integral subcooler						
Fan	Type	---	Direct propeller type						
	Drive	---	DOL						
	Diameter	mm	800	800	800	800	800		
	Nominal air flow	l/s	16289	25117	25117	24433	24433		
	Model	Quantity	No.	4	6	6	6	6	
		Speed	rpm	715	715	715	715	715	
		Motor input	kW	0.78	0.78	0.78	0.78	0.78	
Compressor	Type	---	Semi-hermetic single screw compressor						
	Oil charge	l	13	16	19	19	19		
	Quantity	No.	1	1	1	1	1		
Sound level	Sound Power	Cooling	dB(A)	91.7	91.7	92.0	92.0	92.7	
	Sound Pressure (2)	Cooling	dB(A)	72.6	72.5	72.8	72.8	73.5	
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a		
	Refrigerant charge	kg.	33	46	46	56	60		
	N. of circuits	No.	1	1	1	1	1		
Piping connections	Evaporator water inlet/outlet	"	3	3	3	3	3		
Safety devices	High discharge pressure (pressure switch)								
	High discharge pressure (pressure transducer)								
	Low suction pressure (pressure transducer)								
	Compressor motor protection								
	High discharge temperature								
	Low oil pressure								
	Low pressure ratio								
	High oil filter pressure drop								
	Phase monitor								
Water freeze protection controller									
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: evaporator 12/7°C; ambient 35°C, unit at full load operation.								
Notes (2)	The values are according to ISO 3744 and are referred to: evaporator 12/7°C, ambient 35°C, full load operation.								

**Table 5 – ERAD 120E ÷ 220E-SS - HFC 134a - Technical Data**

		Units Size	120	140	170	200	220	
Capacity (1)	Cooling	kW	121	144	165	196	219	
Capacity control	Type	---	Stepless					
	Minimum capacity	%	25	25	25	25	25	
Unit power input (1)	Cooling	kW	41.8	51.0	57.4	65.2	73.7	
EER (1)		---	2.90	2.83	2.87	3.00	2.97	
Casing	Colour	---	Ivory White					
	Material	---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2273	2273	2273	2273	
		Width	mm	1292	1292	1292	1292	
		Length	mm	2165	2165	3065	3065	
Weight	Unit	kg	1561	1584	1700	1741	1894	
	Operating Weight	kg	1591	1617	1768	1781	1936	
Air heat exchanger	Type	---	High efficiency fin and tube type with integral subcooler					
Fan	Type	---	Direct propeller type					
	Drive	---	DOL					
	Diameter	mm	800	800	800	800	800	
	Nominal air flow	l/s	10922	10575	16383	15863	21844	
	Model	Quantity	No.	2	2	3	3	4
		Speed	rpm	920	920	920	920	920
Motor input		kW	1.75	1.75	1.75	1.75	1.75	
Compressor	Type	---	Semi-hermetic single screw compressor					
	Oil charge (3)	l	13	13	13	13	13	
	Quantity	No.	1	1	1	1	1	
Sound level	Sound Power	Cooling	dB(A)	91.5	91.5	92.3	92.3	93.0
	Sound Pressure (2)	Cooling	dB(A)	73.5	73.5	73.7	73.7	73.9
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge (3)	kg.	17	20	22	27	29	
	N. of circuits	No.	1	1	1	1	1	
Piping connections	Suction	mm	76	76	76	76	76	
	Liquid	mm	28	28	28	28	28	
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
Phase monitor								
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: SST 7°C; ambient 35°C, unit at full load operation.							
Notes (2)	The values are according to ISO 3744 and are referred to: SST 7°C, ambient 35°C, full load operation.							
Notes (3)	Refrigerant and oil charge is for the unit only; doesn't include external suction and liquid line. Units are shipped without refrigerant and oil charge; holding charge nitrogen 1 bar							

**Table 6 – ERAD 250E ÷ 490E-SS - HFC 134a - Technical Data**

		Units Size	250	310	370	440	490	
Capacity (1)	Cooling	kW	252	306	370	435	488	
Capacity control	Type	---	Stepless					
	Minimum capacity	%	25	25	25	25	25	
Unit power input (1)	Cooling	kW	76.6	92.8	122	147	161	
EER (1)		---	3.28	3.30	3.04	2.96	3.03	
Casing	Colour	---	Ivory White					
	Material	---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2273	2273	2273	2273	
		Width	mm	1292	2236	2236	2236	
		Length	mm	3965	3070	3070	3070	
Weight	Unit	kg	1936	2353	2557	2640	2679	
	Operating Weight	kg	1981	2414	2621	2713	2756	
Air heat exchanger	Type	---	High efficiency fin and tube type with integral subcooler					
Fan	Type	---	Direct propeller type					
	Drive	---	DOL					
	Diameter	mm	800	800	800	800	800	
	Nominal air flow	l/s	21150	32767	32767	31725	31725	
	Model	Quantity	No.	4	6	6	6	6
		Speed	rpm	920	920	920	920	920
Motor input		kW	1.75	1.75	1.75	1.75	1.75	
Compressor	Type	---	Semi-hermetic single screw compressor					
	Oil charge (3)	l	13	16	19	19	19	
	Quantity	No.	1	1	1	1	1	
Sound level	Sound Power	Cooling	dB(A)	94.2	94.2	94.5	94.5	95.2
	Sound Pressure	Cooling	dB(A)	75.1	75.0	75.3	75.3	76.0
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge (3)	kg.	32	45	45	54	58	
	N. of circuits	No.	1	1	1	1	1	
Piping connections	Suction	mm	76	76	139.7	139.7	139.7	
	Liquid	mm	28	35	35	35	35	
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
Phase monitor								
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: SST 7°C; ambient 35°C, unit at full load operation.							
Notes (2)	The values are according to ISO 3744 and are referred to: SST 7°C, ambient 35°C, full load operation.							
Notes (3)	Refrigerant and oil charge is for the unit only; doesn't include external suction and liquid line. Units are shipped without refrigerant and oil charge; holding charge nitrogen 1 bar							

**Table 7 – ERAD 120E ÷ 210E-SL - HFC 134a - Technical Data**

		Units Size	120	140	160	190	210	
Capacity (1)	Cooling	kW	116	137	159	187	209	
Capacity control	Type	---	Stepless					
	Minimum capacity	%	25	25	25	25	25	
Unit power input (1)	Cooling	kW	42.3	52.5	57.6	66.3	73.9	
EER (1)		---	2.74	2.61	2.75	2.82	2.83	
Casing	Colour	---	Ivory White					
	Material	---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2273	2273	2273	2273	
		Width	mm	1292	1292	1292	1292	
		Length	mm	2165	2165	3065	3065	3965
Weight	Unit	kg	1658	1684	1795	1841	1991	
	Operating Weight	kg	1688	1717	1830	1881	2033	
Air heat exchanger	Type	---	High efficiency fin and tube type with integral subcooler					
Fan	Type	---	Direct propeller type					
	Drive	---	DOL					
	Diameter	mm	800	800	800	800	800	
	Nominal air flow	l/s	8372	8144	12558	12217	16744	
	Model	Quantity	No.	2	2	3	3	4
		Speed	rpm	715	715	715	715	715
Motor input		kW	0.78	0.78	0.78	0.78	0.78	
Compressor	Type	---	Semi-hermetic single screw compressor					
	Oil charge (3)	l	13	13	13	13	13	
	Quantity	No.	1	1	1	1	1	
Sound level	Sound Power	Cooling	dB(A)	89.0	89.0	89.8	89.8	90.5
	Sound Pressure (2)	Cooling	dB(A)	71.0	71.0	71.2	71.2	71.4
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge (3)	kg.	17	20	22	27	29	
	N. of circuits	No.	1	1	1	1	1	
Piping connections	Suction	mm	76	76	76	76	76	
	Liquid	mm	28	28	28	28	28	
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
Phase monitor								
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: SST 7°C; ambient 35°C, unit at full load operation.							
Notes (2)	The values are according to ISO 3744 and are referred to: SST 7°C, ambient 35°C, full load operation.							
Notes (3)	Refrigerant and oil charge is for the unit only; doesn't include external suction and liquid line. Units are shipped without refrigerant and oil charge; holding charge nitrogen 1 bar							

**Table 8 – ERAD 240E ÷ 460E-SL - HFC 134a - Technical Data**

		Units Size	240	300	350	410	460	
Capacity (1)	Cooling	kW	243	295	352	409	462	
Capacity control	Type	---	Stepless					
	Minimum capacity	%	25	25	25	25	25	
Unit power input (1)	Cooling	kW	78.2	91.5	122.4	150.1	167.2	
EER (1)		---	3.11	3.23	2.88	2.73	2.76	
Casing	Colour	---	Ivory White					
	Material	---	Galvanized and painted steel sheet					
Dimensions	Unit	Height	mm	2273	2273	2273	2273	
		Width	mm	1292	2236	2236	2236	
		Length	mm	3965	3070	3070	3070	
Weight	Unit	kg	2036	2455	2662	2755	2789	
	Operating Weight	kg	2081	2516	2726	2828	2886	
Air heat exchanger	Type	---	High efficiency fin and tube type with integral subcooler					
Fan	Type	---	Direct propeller type					
	Drive	---	DOL					
	Diameter	mm	800	800	800	800	800	
	Nominal air flow	l/s	16289	25117	25117	24433	24433	
	Model	Quantity	No.	4	6	6	6	6
		Speed	rpm	715	715	715	715	715
Motor input		kW	0.78	0.78	0.78	0.78	0.78	
Compressor	Type	---	Semi-hermetic single screw compressor					
	Oil charge (3)	l	13	16	19	19	19	
	Quantity	No.	1	1	1	1	1	
Sound level	Sound Power	Cooling	dB(A)	91.7	91.7	92.0	92.0	92.7
	Sound Pressure	Cooling	dB(A)	72.6	72.5	72.8	72.8	73.5
Refrigerant circuit	Refrigerant type	---	R-134a	R-134a	R-134a	R-134a	R-134a	
	Refrigerant charge (3)	kg.	32	45	45	54	58	
	N. of circuits	No.	1	1	1	1	1	
Piping connections	Suction	mm	76	76	139.7	139.7	139.7	
	Liquid	mm	28	35	35	35	35	
Safety devices	High discharge pressure (pressure switch)							
	High discharge pressure (pressure transducer)							
	Low suction pressure (pressure transducer)							
	Compressor motor protection							
	High discharge temperature							
	Low oil pressure							
	Low pressure ratio							
	High oil filter pressure drop							
Phase monitor								
Notes (1)	Cooling capacity, unit power input in cooling and EER are based on the following conditions: SST 7°C; ambient 35°C, unit at full load operation.							
Notes (2)	The values are according to ISO 3744 and are referred to: SST 7°C, ambient 35°C, full load operation.							
Notes (3)	Refrigerant and oil charge is for the unit only; doesn't include external suction and liquid line. Units are shipped without refrigerant and oil charge; holding charge nitrogen 1 bar							

**Table 9 - Sound levels EWAD E-SS – ERAD E-SS**

Unit size EWAD	Unit size ERAD	Sound pressure level at 1 m from the unit in semispheric free field (rif. $2 \times 10^{-5}$ Pa)									Power	
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dB(A)	dB(A)	
100	120	75.5	70.8	68.9	75.3	64.3	61.7	53.0	47.3	73.5	91.5	
120	140	75.5	70.8	68.9	75.3	64.3	61.7	53.0	47.3	73.5	91.5	
140	170	75.7	71.0	69.1	75.5	64.5	61.9	53.2	47.5	73.7	92.3	
160	200	75.7	71.0	69.1	75.5	64.5	61.9	53.2	47.5	73.7	92.3	
180	220	75.9	71.2	69.3	75.7	64.7	62.1	53.4	47.7	73.9	93.0	
210	250	77.1	72.4	70.5	76.9	65.9	63.3	54.6	48.9	75.1	94.2	
280	310	77.0	72.3	70.4	76.8	65.8	63.2	54.5	48.8	75.0	94.2	
310	370	77.3	72.6	70.7	77.1	66.1	63.5	54.8	49.1	75.3	94.5	
360	440	77.3	72.6	70.7	77.1	66.1	63.5	54.8	49.1	75.3	94.5	
410	490	78.0	73.3	71.4	77.8	66.8	64.2	55.5	49.8	76.0	95.2	

**Note:** The values are according to ISO 3744 and are referred to units without pumps kit.

**Table 10 - Sound levels EWAD E-SL – ERAD E-SL**

Unit size EWAD	Unit size ERAD	Sound pressure level at 1 m from the unit in semispheric free field (rif. $2 \times 10^{-5}$ Pa)									Power	
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dB(A)	dB(A)	
100	120	73.0	68.3	66.4	72.8	61.8	59.2	50.5	44.8	71.0	89.0	
120	140	73.0	68.3	66.4	72.8	61.8	59.2	50.5	44.8	71.0	89.0	
130	160	73.2	68.5	66.6	73.0	62.0	59.4	50.7	45.0	71.2	89.8	
160	190	73.2	68.5	66.6	73.0	62.0	59.4	50.7	45.0	71.2	89.8	
180	210	73.4	68.7	66.8	73.2	62.2	59.6	50.9	45.2	71.4	90.5	
210	240	74.6	69.9	68.0	74.4	63.4	60.8	52.1	46.4	72.6	91.7	
250	300	74.5	69.8	67.9	74.3	63.3	60.7	52.0	46.3	72.5	91.7	
300	350	74.8	70.1	68.2	74.6	63.6	61.0	52.3	46.6	72.8	92.0	
350	410	74.8	70.1	68.2	74.6	63.6	61.0	52.3	46.6	72.8	92.0	
400	460	75.5	70.8	68.9	75.3	64.3	61.7	53.0	47.3	73.5	92.7	

**Note:** The values are according to ISO 3744 and are referred to units without pumps kit.



## Operating limits

### Storing

The environment conditions have to be in the following limits:

Minimum ambient temperature	:	-20°C
Maximum ambient temperature	:	57°C
Maximum R.H.	:	95% not condensing

#### **ATTENTION**

Storing below the minimum temperature above mentioned may cause damage to components such as the electronic controller and its LCD display.

#### **WARNING**

Storing above the maximum temperature cause opening of the safety valves on the compressors' suction line.

#### **ATTENTION**

Storing in condensing atmosphere may damage the electronic components.

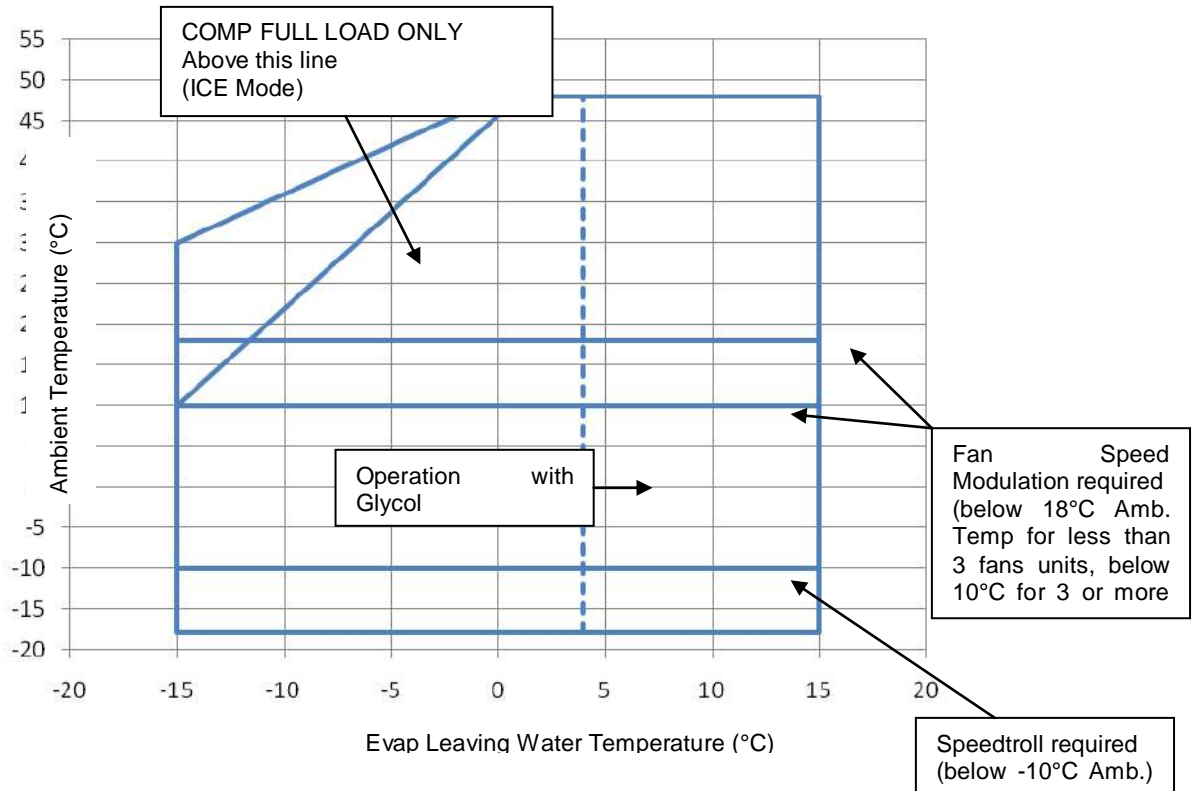
### Operation

Operation is allowed within the limits mentioned in the following diagrams.

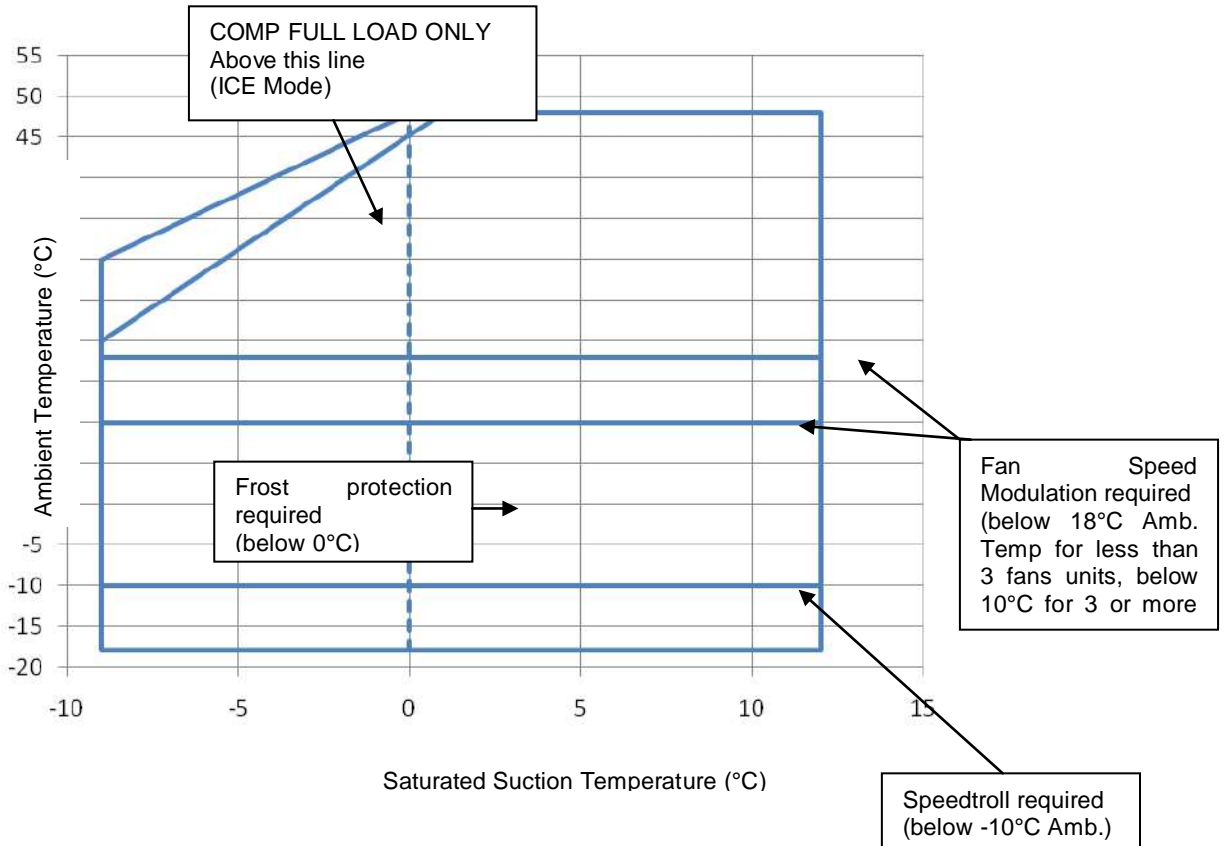
#### **ATTENTION**

Operation out of the mentioned limits may damage the unit.  
For any doubts contact the factory.

**Figure 2 - Operating limits – EWAD E-SS/SL**



**Figure 3 - Operating limits – ERAD E-SS/SL**



Check on rating tables for actual operating limit at full load.

# Mechanical Installation

## Shipping

The stability of the machine during shipping must be ensured. If the machine is shipped with a wooden cross-plank on its base, this cross-plank must only be removed after the final destination has been reached.

## Responsibility

The manufacturer declines all present and future responsibility for any damage to persons, animals or things caused by negligence of operators failing to follow the installation and maintenance instructions in this Manual.

All safety equipment must be regularly and periodically checked in accordance with this manual and with local laws and regulations regarding safety and environment protection.

## Safety

The machine must be securely fixed to the ground.

It is essential to observe the following instructions:

- The machine can only be lifted using the hoist points marked in yellow that are fixed to its base. These are the only points that can support the entire weight of the unit.
- Do not allow unauthorised and/or unqualified personnel access to the machine.
- It is forbidden to access the electrical components without having opened the machine's main switch and switched off the power supply.
- It is forbidden to access the electrical components without using an insulating platform. Do not access the electrical components if water and/or moisture are present.
- All operations on the refrigerant circuit and on components under pressure must be carried out only by qualified personnel.
- Replacement of a compressor or addition of lubricating oil must be carried out only by qualified personnel.
- Sharp edges and the surface of the condenser section could cause injury. Avoid direct contact.
- Switch off the machine's power supply, by opening the main switch, before servicing the cooling ventilators and/or compressors. Failure to observe this rule could result in serious personal injury.
- Avoid introducing solid objects into the water pipes while the machine is connected to the system.
- A mechanical filter must be applied to the water pipe to be connected to the heat exchanger inlet.
- The machine is supplied with safety valves, that are installed both on the high-pressure and on the low-pressure sides of the refrigerant gas circuit.
- In case of sudden stop of the unit, follow the instructions on the **ControlPanelOperatingManual** which is part of the on-board documentation delivered to the end user with this manual.
- It is recommended to perform installation and maintenance with other people. In case of accidental injury or unease, it is necessary to:
  - keep calm
  - press the alarm button if present in the installation site
  - move the injured person in a warm place far from the unit and in rest position
  - contact immediately emergency rescue personnel of the building or if the Health Emergency Service
  - wait without leaving the injured person alone until the rescue operators come
  - give all necessary information to the the rescue operators



## WARNING

Before carrying out any operation on the machine, please read carefully the instruction and operating manual. Installation and maintenance must be carried out solely by qualified personnel that is familiar with provisions of the law and local regulations and has been trained properly or has experience with this type of equipment.



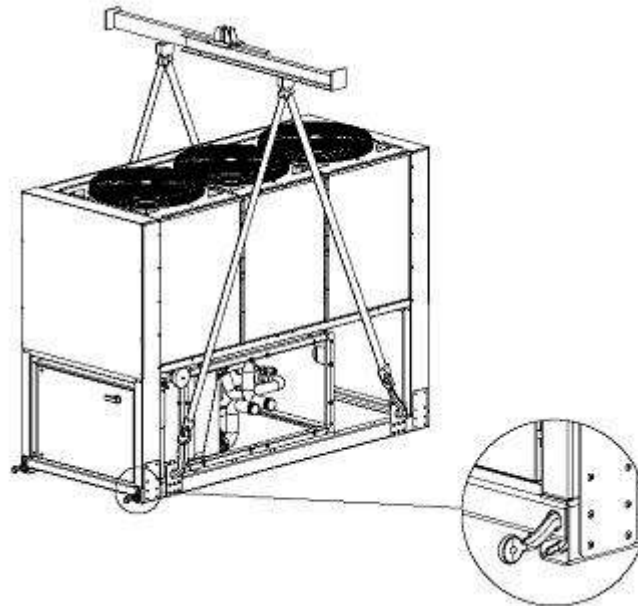
## WARNING

Avoid to install the chiller in areas that could be dangerous during maintenance operations, like for example platforms without parapets or railings or areas not complying with the clearance requirements around the chiller.

## Moving and lifting

Avoid bumping and/or jolting during unloading from the lorry and moving the machine. Do not push or pull the machine from any part other than the base frame. Block the machine from sliding inside the lorry in order to prevent damage to the panels and to the base frame. Avoid any part of the machine falling during unloading and/or moving, as this could cause serious damage.

All units of the series are supplied with four lifting points marked in yellow. Only use these points for lifting the unit, as shown in figure 2.



Procedure for extracting the unit from the container.  
(Container kit Optional)

**Note:** The length and the width of the unit can be different from this drawing but the lifting method remains the same

### Figure 4 - Lifting the unit

#### **⚠ WARNING**

Both the lifting ropes and the spacing bar and/or scales must be of sufficient size to support the machine safely. Please verify the unit's weight on the machine's nameplate.

The weights shown in the "Technical data" tables in the "General Information" chapter refer to standard units. Specific machines could have accessories that increase their overall weight (pumps, heat recovery, copper-copper condenser coils, etc.).

#### **⚠ WARNING**

The machine must be lifted with the utmost attention and care. Avoid jolting when lifting and lift machine very slowly, keeping it perfectly level.

## Positioning and assembly

All units are produced for installation outdoors, on balconies or on the ground, provided that the area is free from obstacles that could hamper air flow towards the condenser batteries.

The machine must be installed on a robust and perfectly level foundation; should the machine be installed on balconies and/or attics, it could be necessary to use weight distribution beams.

For installation on the ground, a strong cement base that is at least 250 mm wider and longer than the machine must be foreseen. Also, this base must be able to support the weight of the machine as declared in the technical specifications.

If the machine is installed in places that are easily accessible for people and animals, it is advisable to install battery and compressor section protection grates.

To measure the best possible performance on the installation site, the following precautions and instructions must be followed:

Avoid air flow recirculation

Make sure that there are no obstacles to hamper air flow.

Air must circulate freely to ensure proper intake and expulsion.

Ensure strong and solid flooring to reduce noise and vibrations as much as possible.

Avoid installation in particularly dusty environments, in order to reduce soiling of condenser batteries.

The water in the system must be particularly clean and all traces of oil and rust must be removed. Installation of a mechanical water filter is required for the machine's input piping.

## Minimum space requirements

It is fundamental to respect minimum distances on all units, in order to ensure optimum ventilation for the condenser batteries. Limited installation space could reduce the normal air flow, thus significantly reducing the machine's performance and considerably increasing consumption of electrical energy.

When deciding where to position the machine and to ensure a proper air flow, the following factors must be taken into consideration: avoid any warm air recirculation and insufficient supply to the air-cooled condenser.

Both these conditions can cause an increase of condensing pressure, which leads to a reduction in energy efficiency and refrigerating capacity. Thanks to the geometry of their air-cooled condensers, the units are less affected by bad air circulation situations.

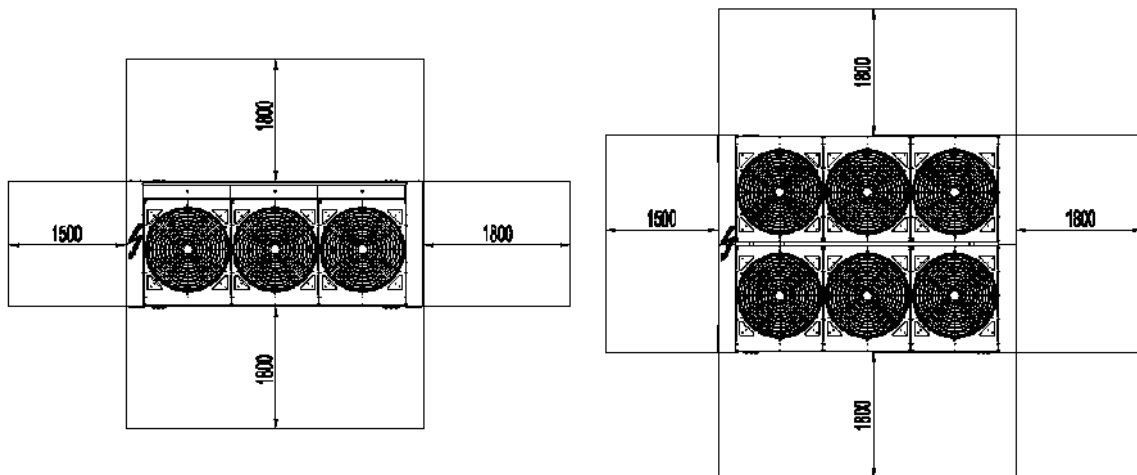
Also, the software has a particular ability for calculating the machine's operating conditions and for optimising the load under abnormal operating conditions.

Every side of the machine must be accessible for post-installation maintenance operations. Figure 3 shows the minimum space required.

Vertical air expulsion must not be obstructed as this would significantly reduce capacity and efficiency.

If the machine is positioned in such a way as to be surrounded by walls or with obstacles of the same height as the machine, it must be installed at a distance of at least 2500 mm. If these obstacles are higher, the machine must be installed at a distance of at least 3000 mm.

Should the machine be installed without observing the recommended minimum distances from walls and/or vertical obstacles, there could be a combination of warm air recirculation and/or insufficient supply to the air-cooled condenser which could cause a reduction of capacity and efficiency.



**Figure 5 - Minimum space requirements for machine maintenance**

In any case, the microprocessor will allow the machine to adjust to new conditions by producing the maximum available capacity, even if the lateral distance is lower than recommended.

When two or more machines are positioned side by side, a distance of at least 3600 mm between condenser batteries is recommended.

For further solutions, please consult Daikin technicians.

THE WIDTH OF THE UNIT CAN BE DIFFERENT BUT THE MINIMUM RECOMMENDED INSTALLATION DISTANCES REMAIN THE SAME

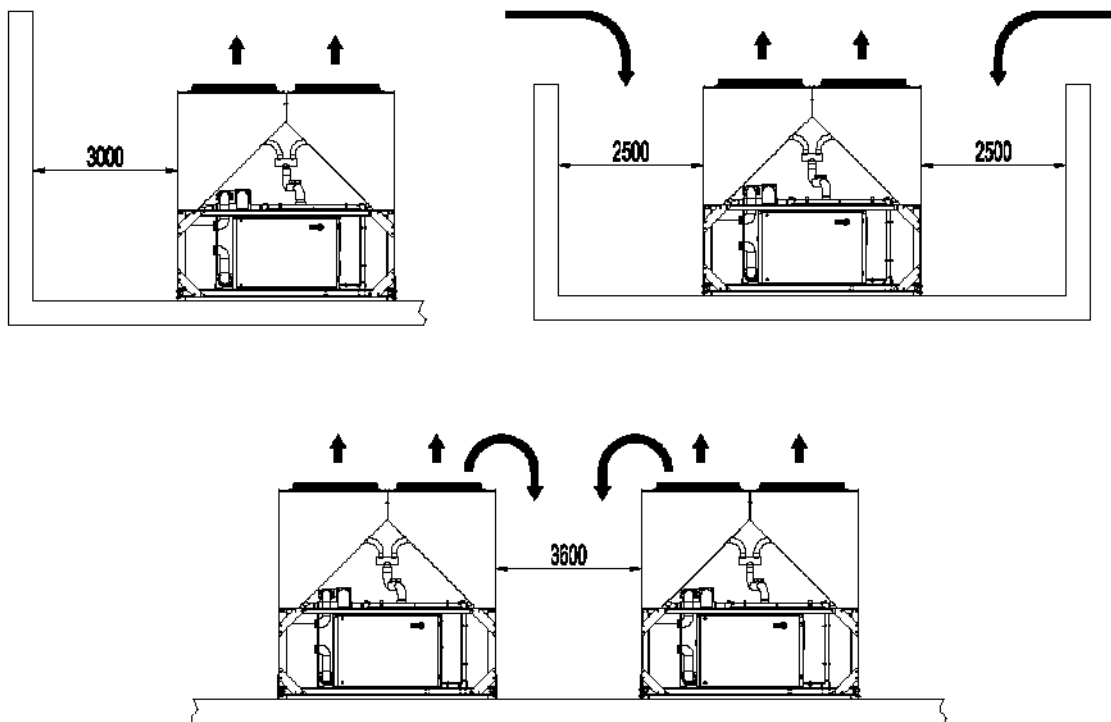


Figure 6 - Minimum recommended installation distances

## Sound protection

When sound levels require special control, great care must be exercised in isolating the machine from its base, by appropriately applying antivibration devices (supplied optionally). Flexible joints must be installed on the water connections, as well.

## Water piping

The following instructions are applicable to units supplied with the evaporator installed in the package (EWAD E-SS/SL); that may also be considered as general guidelines for water piping in units supplied without evaporator (ERAD E-SS/SL) when used in conjunction with refrigerant to water evaporator.

Water piping must be designed with the lowest number of curves and the lowest number of vertical changes of direction. In this way, installation costs are reduced considerably and system performance is improved.

The water system must have:

Anti-vibration supports in order to reduce transmission of vibrations to the underlying structure.

Sectioning valves to isolate the machine from the hydraulic system during servicing.

Manual or automatic air bleeding device at the system's highest point. Drainage device at the system's lowest point. Both the evaporator and the heat recovery device must not be positioned at the system's highest point.

A device that can maintain the hydraulic system under pressure (expansion tank, etc.)

Water temperature and pressure indicators on the machine to aid servicing and maintenance operations.

A filter or device that can remove extraneous particles from the water before it enters the pump (Please consult the pump manufacturer's recommendations for an appropriate filter to prevent cavitation). Use of a filter prolongs the life of the pump and helps keep the hydraulic system in best condition. Evaporator filter is supplied for EWAD E-SS/SL.

Another filter must be installed on the pipe conveying incoming water to the machine, near the evaporator and heat recovery (if installed). The filter avoids solid particles entering the heat exchanger, as they could damage it or reduce its heat exchanging capacity.

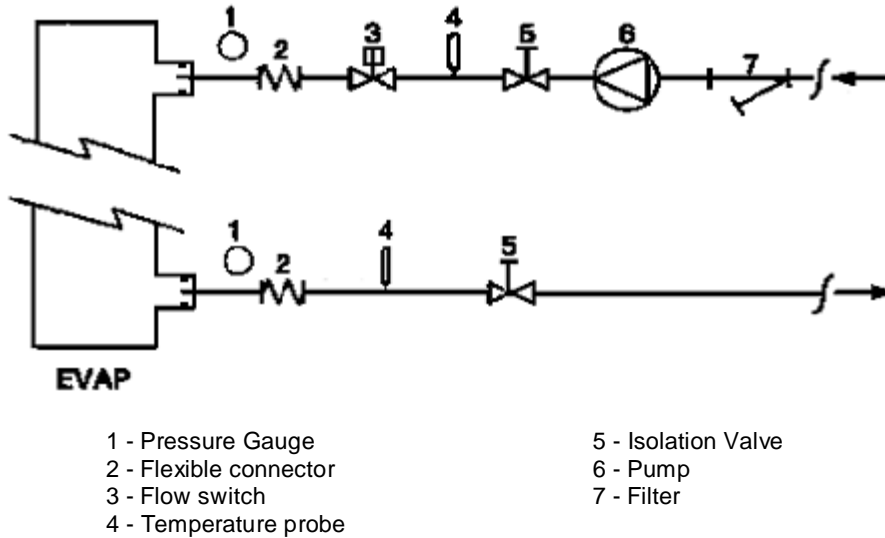
The shell and tube heat exchanger has an electrical resistance with a thermostat that ensures protection against water freezing up to an outdoor temperature of  $-25^{\circ}\text{C}$ . All the other hydraulic piping outside the machine must therefore be protected against freezing.

The heat recovery device must be emptied of water during the winter season, unless an ethylene glycol mixture in appropriate percentage is added to the water circuit.

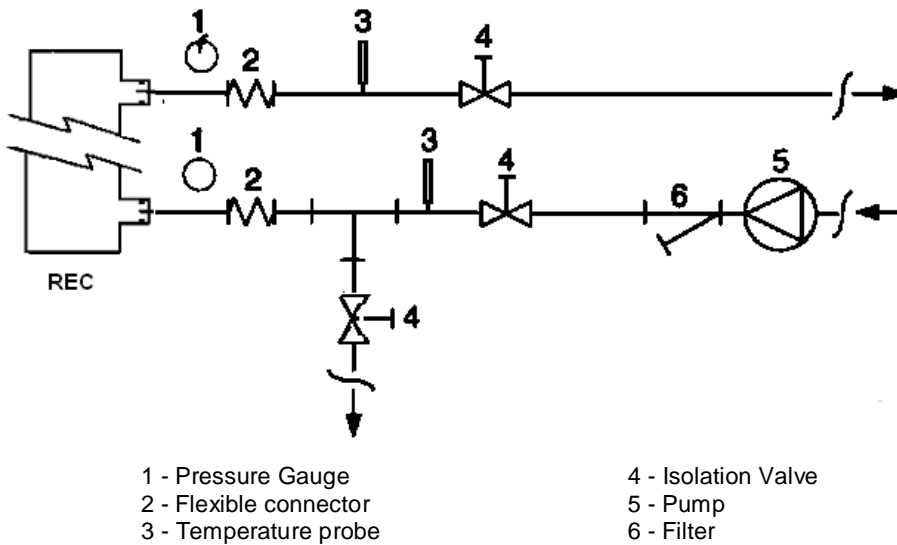
If the machine is installed in order to replace another, the entire hydraulic system must be emptied and cleaned before the new unit is installed. Regular tests and proper chemical treatment of water are recommended before starting up the new machine.

In the event that glycol is added to the hydraulic system as anti-freeze protection, pay attention to the fact that intake pressure will be lower, the machine's performance will be lower and water pressure drops will be greater. All machine-protection methods, such as anti-freeze, and low-pressure protection will need to be reset.

Before insulating water piping, check that there are no leaks.



**Figure 7 - Water piping connection for evaporator**



**Figure 8 - Water piping connection for heat recovery exchangers**

**Water treatment**

Before putting the machine into operation, clean the hydraulic circuit. Dirt, scales, corrosion residue and other extraneous material can accumulate inside the heat exchanger and reduce its heat exchanging capacity. Pressure drops can increase, as well, thus reducing water flow. Proper water treatment therefore reduces the risk of corrosion, erosion, scaling, etc. The most appropriate water treatment must be determined locally, according to the type of system and to the local characteristics of the process water.

The manufacturer is not responsible for damage to or malfunctioning of equipment caused by failure to treat water or by improperly treated water.

**Table 11 - Acceptable water quality limits**

PH (25°C)	6,8÷8,0	Total Hardness (mg CaCO <sub>3</sub> / l)	< 200
Electrical conductivity μS/cm (25°C)	<800	Iron (mg Fe / l)	< 1.0
Chloride ion (mg Cl <sup>-</sup> / l)	<200	Sulphide ion (mg S <sup>2-</sup> / l)	Nessuno
Sulphate ion (mg SO <sub>4</sub> <sup>2-</sup> / l)	<200	Ammonium ion (mg NH <sub>4</sub> <sup>+</sup> / l)	< 1.0
Alkalinity (mg CaCO <sub>3</sub> / l)	<100	Silica (mg SiO <sub>2</sub> / l)	< 50

## Evaporator and recovery exchangers anti-freeze protection

All evaporators are supplied with a thermostatically controlled anti-freeze electrical resistance, which provides adequate anti-freeze protection up to -25°C. However, this method is not the only protection system against freezing, unless the heat exchangers are completely emptied and cleaned with anti-freeze solution.

Two or more protection methods should be foreseen when designing the system as whole:

Continuous water flow circulation inside piping and exchangers.

Addition of an appropriate amount of glycol inside the water circuit

Additional heat insulation and heating of exposed piping

Emptying and cleaning of the heat exchanger during the winter season

It is the responsibility of the installer and/or of local maintenance personnel to ensure two or more of the described anti-freeze methods. Continuously verify, through routine checks, that appropriate anti-freeze protection is maintained. Failure to follow the instructions above could result in damage to some of the machine's components. Damage from freezing is not covered by the warranty.

## Installing the flow switch

To ensure sufficient water flow through the evaporator, it is essential that a flow switch be installed on the water circuit. The flow switch can be installed either on the ingoing or outgoing water piping. The purpose of the flow switch is to stop the machine in the event of interrupted water flow, thus protecting the evaporator from freezing.

If the machine is supplied with total heat recovery, install another flow switch to ensure water flow before the machine's functioning is modified in Heat recovery Mode.

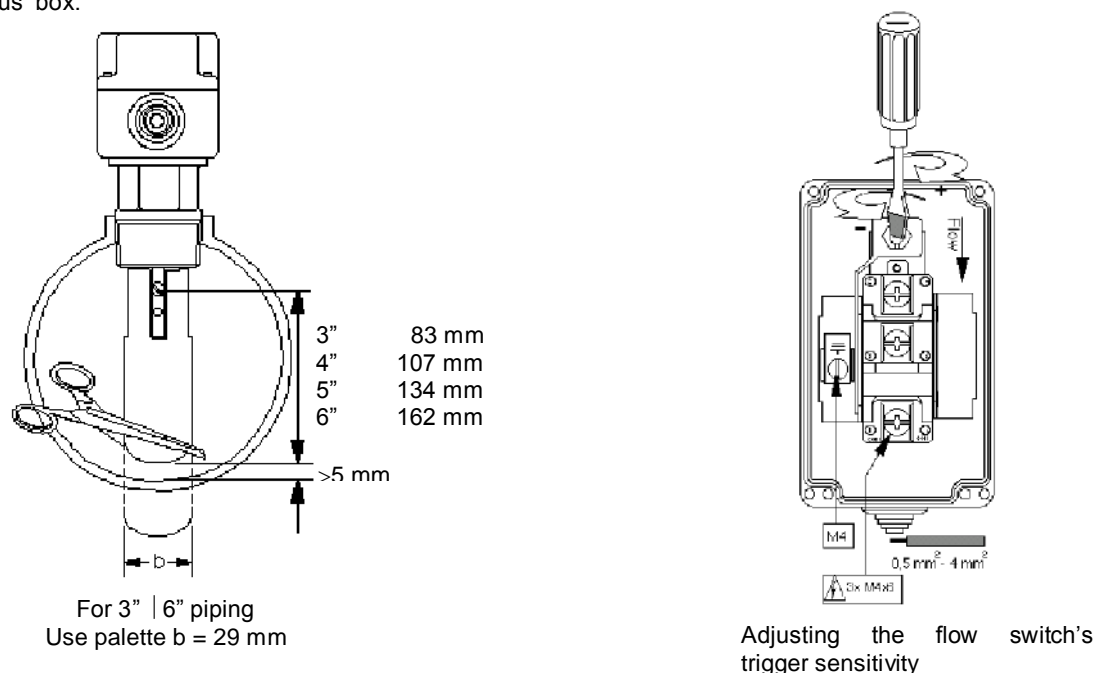
The flow switch on the recovery circuit prevents the machine turning off because of high pressure.

The manufacturer offers an optional flow switch that has been especially selected for this purpose; its identification code is 131035072.

This flow switch, of the palette type, is suitable for heavy-duty outdoor applications (IP67) and suitable for piping with 1" to 6" diameter.

The flow switch is provided with a clean contact which must be electrically connected to terminals 708 and 724 of terminal board MC24 (check the unit wiring diagram for further information).

For further information regarding device positioning and settings, please read the instruction leaflet placed inside the apparatus' box.

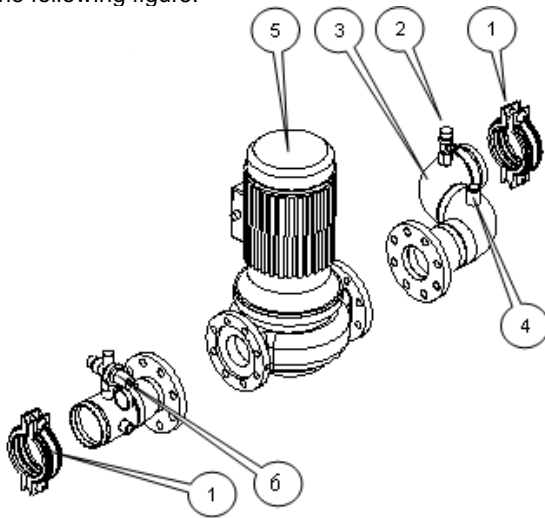


**Figure 9 - Adjusting the safety flow switch**

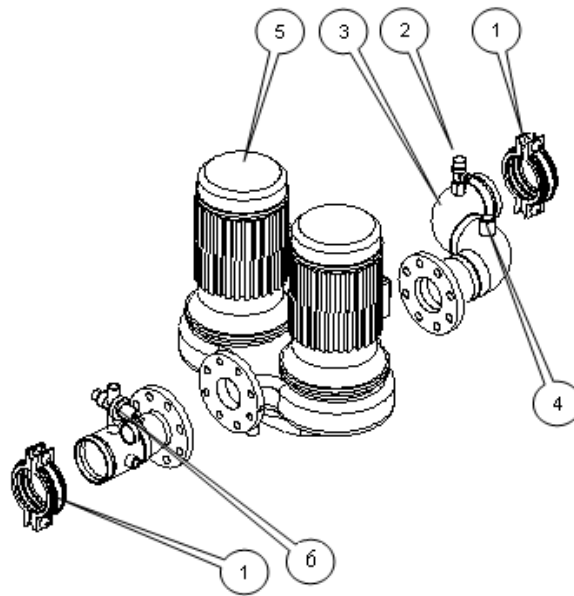


## Hydronic kit (optional)

The optional hydronic kit foreseen for this series of machines (except CU Model) can be composed of a single in-line pump or a twin in-line pump. According to the choice made when ordering the machine, the kit could be configured as in the following figure.



Single pump kit



Twin pump kit

- 1 Victaulic joint
- 2 Water safety valve
- 3 Connecting manifold
- 4 Anti-freeze electrical resistance
- 5 Water pump (single or twin)
- 6 Automatic filling unit

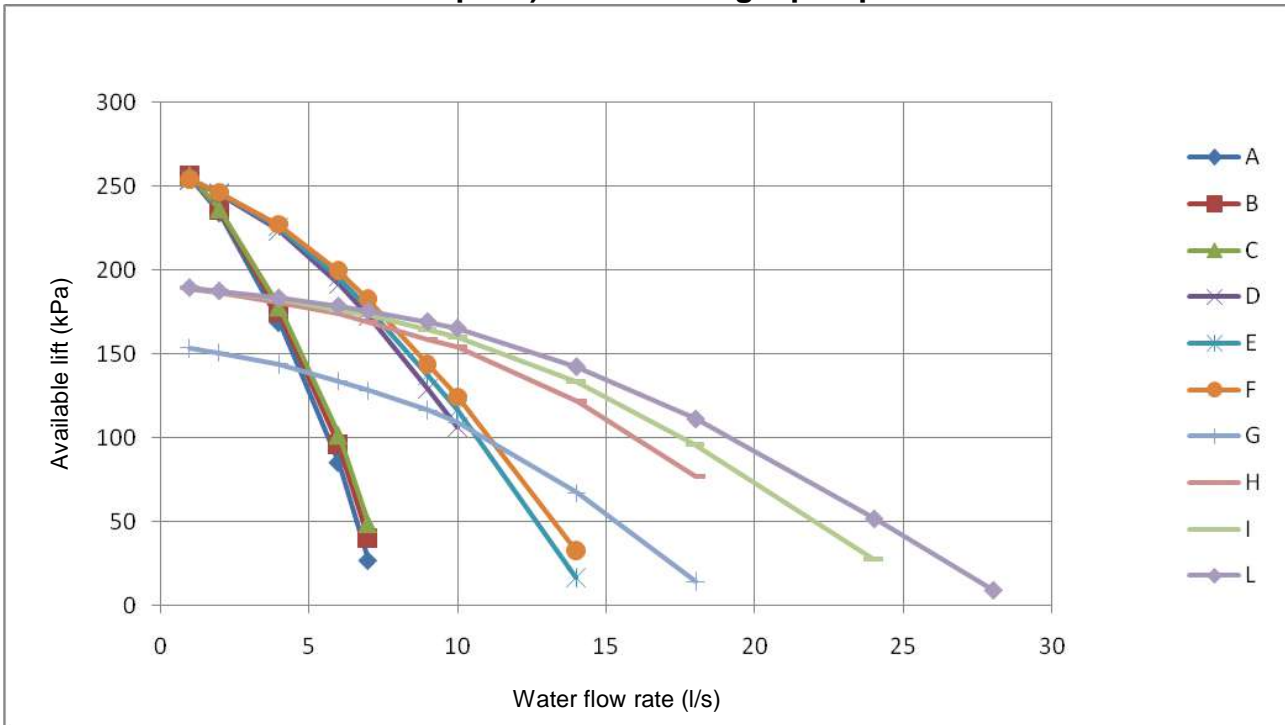
(\*) An expansion tank has to be installed in the plant. It is not included in the kit

N.B.: Components on some machines could be arranged differently.

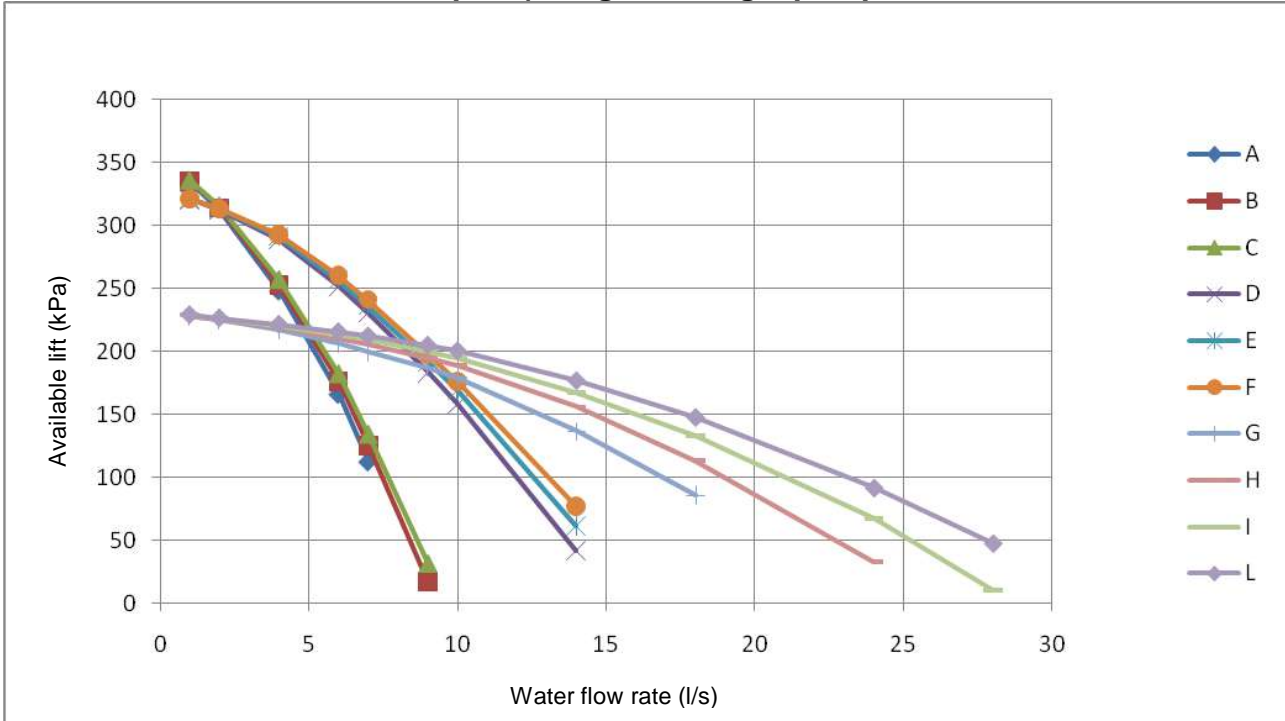
N.B.: Twin pumps are available only for some models. Check the price list for available combination

**Figure 10 – Single and twin pump hydronic kit**

**Figure 11 – EWAD E SS/SL - Available external lift for water pumps kit (option on request) - Low lift single pump**

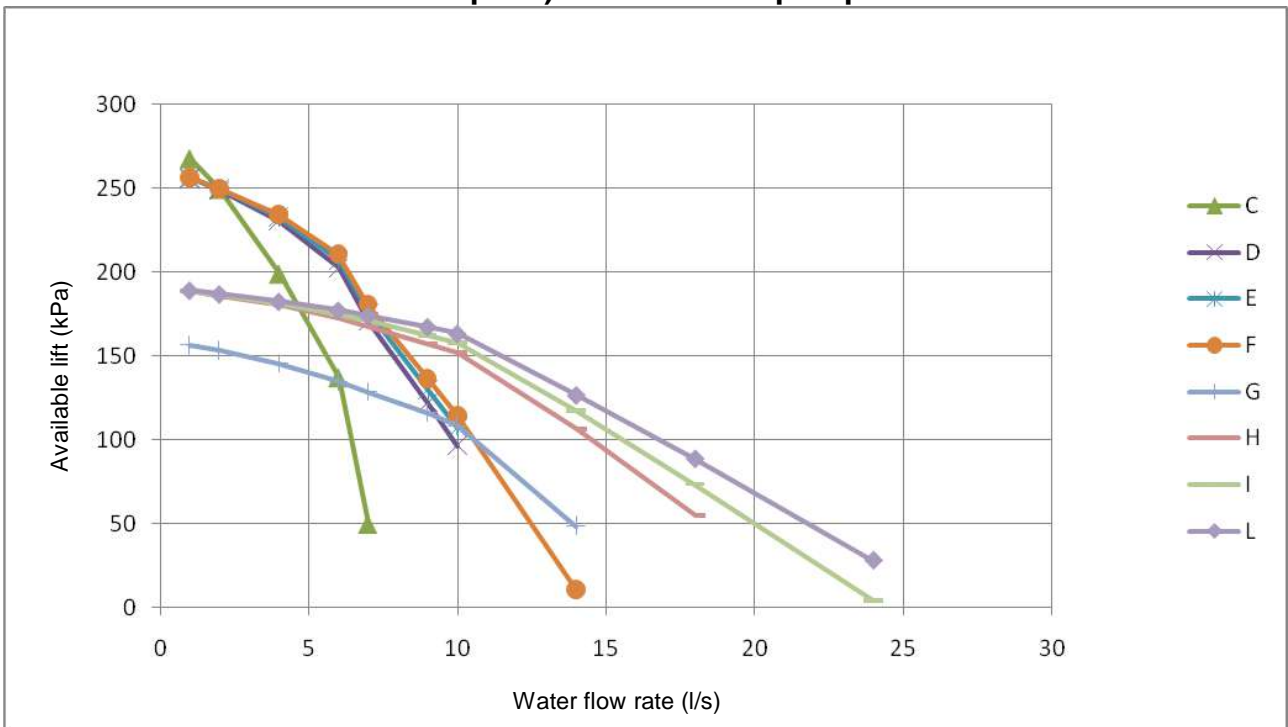


**Figure 12 – EWAD E-SS/SL - Available external lift for water pumps kit (option on request) - High lift single pump**

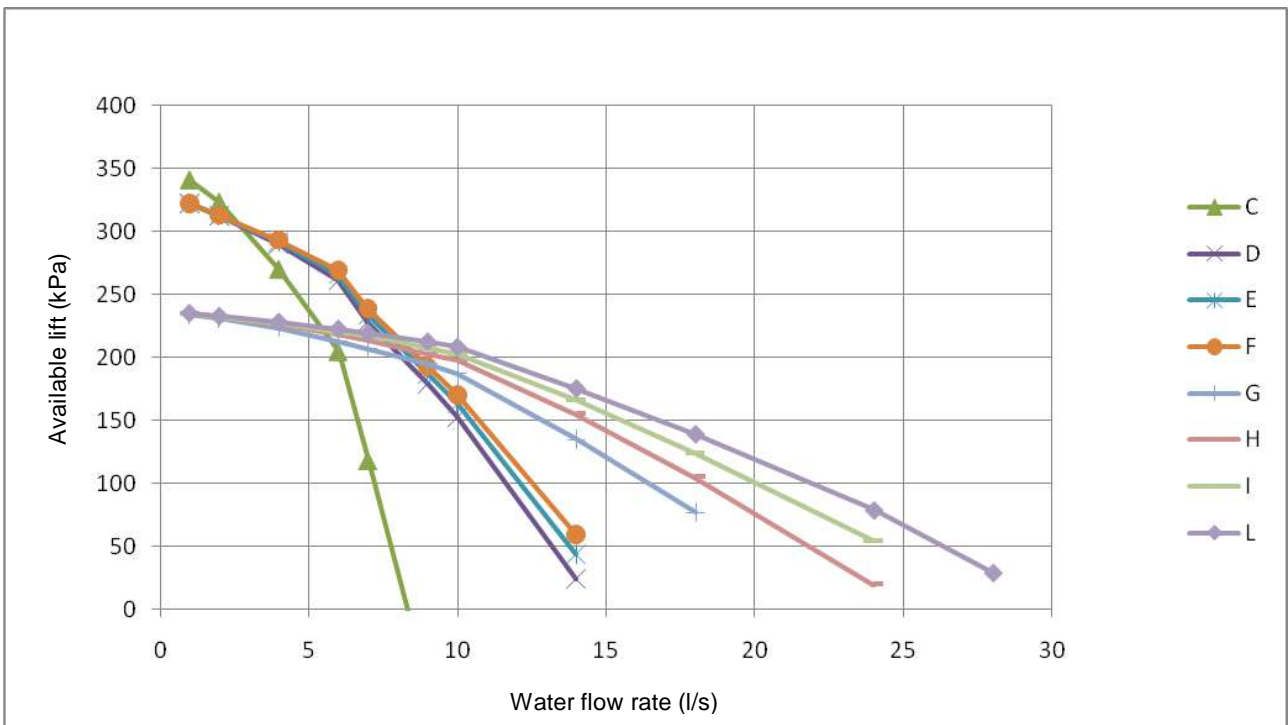


- |                              |                              |
|------------------------------|------------------------------|
| A. EWAD100E-SS / SL          | F. EWAD210E-SS / SL          |
| B. EWAD120E-SS / SL          | G. EWAD260E-SS / EWAD250E-SL |
| C. EWAD140E-SS / EWAD130E-SL | H. EWAD310E-SS / EWAD300E-SL |
| D. EWAD160E-SS / SL          | I. EWAD360E-SS / EWAD350E-SL |
| E. EWAD180E-SS / SL          | L. EWAD410E-SS / EWAD400E-SL |

**Figure 13 – EWAD E-SS/SL - Available external lift for water pumps kit (option on request) - Low lift twin pump**



**Figure 14 – EWAD E-SS/SL - Available external lift for water pumps kit (option on request) - High lift twin pump**



- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| <b>A.</b> EWAD100E-SS / SL          | <b>F.</b> EWAD210E-SS / SL          |
| <b>B.</b> EWAD120E-SS / SL          | <b>G.</b> EWAD260E-SS / EWAD250E-SL |
| <b>C.</b> EWAD140E-SS / EWAD130E-SL | <b>H.</b> EWAD310E-SS / EWAD300E-SL |
| <b>D.</b> EWAD160E-SS / SL          | <b>I.</b> EWAD360E-SS / EWAD350E-SL |
| <b>E.</b> EWAD180E-SS / SL          | <b>L.</b> EWAD410E-SS / EWAD400E-SL |

## Refrigerating circuit safety valves

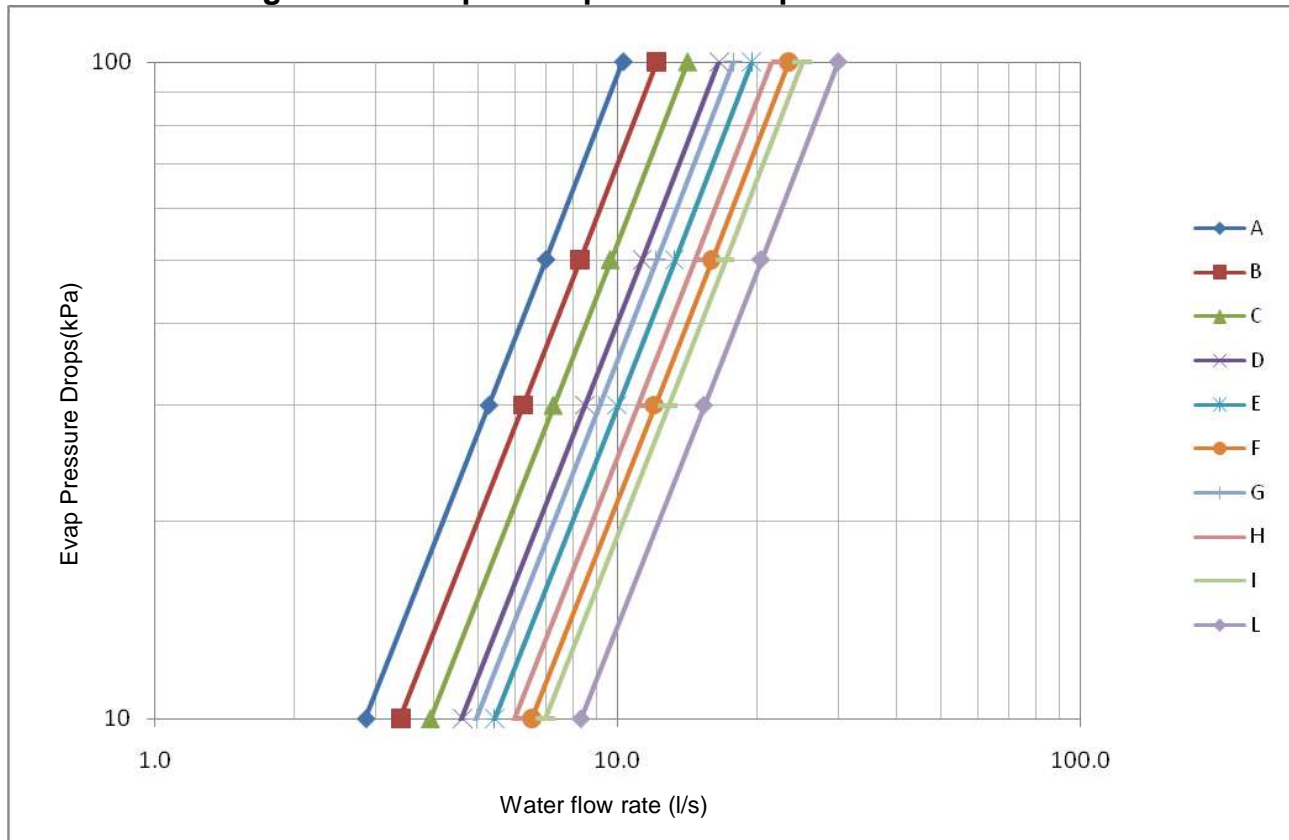
Each system comes with safety valves that are installed on each circuit, both on the evaporator and on the condenser. The purpose of the valves is to discharge the refrigerant inside the refrigerating circuit in the event of any malfunction.

### ⚠ WARNING

This unit is designed for installation outdoors. However, check that there is sufficient air circulation around the machine. If the machine is installed in closed or partly covered areas, possible damage from inhalation of refrigerant gases must be avoided. Avoid releasing the refrigerant in the environment.

The safety valves must be connected externally. The installer is responsible for connecting the safety valves to the discharge piping and for establishing their size.

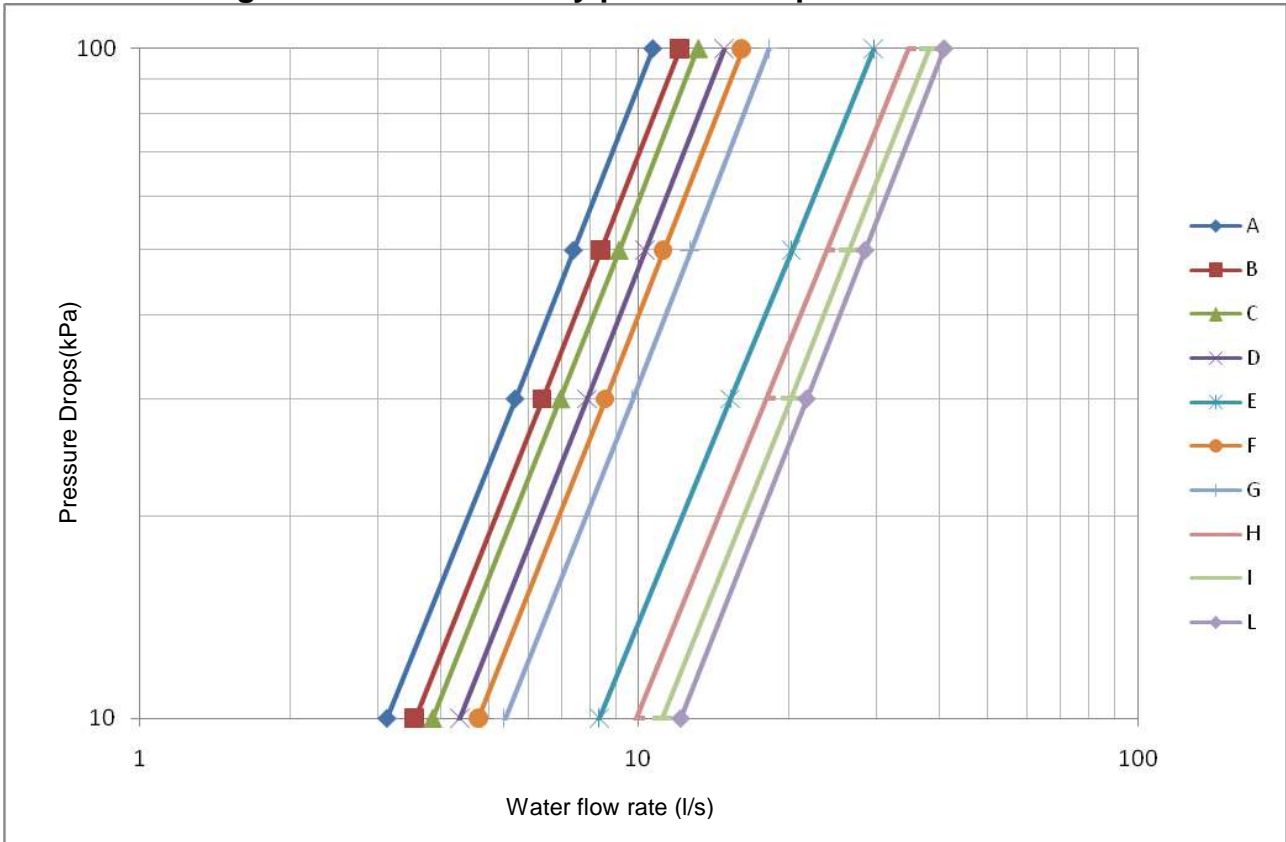
**Figure 15 - Evaporator pressure drop – EWAD E-SS/SL**



- J. EWAD100E-SS / SL
- K. EWAD120E-SS / SL
- L. EWAD140E-SS / EWAD130E-SL
- M. EWAD160E-SS / SL
- N. EWAD180E-SS / SL

- O. EWAD210E-SS / SL
- P. EWAD260E-SS / EWAD250E-SL
- Q. EWAD310E-SS / EWAD300E-SL
- R. EWAD360E-SS / EWAD350E-SL
- M. EWAD410E-SS / EWAD400E-SL

**Figure 16 - Heat recovery pressure drop – EWAD E-SS/SL**



- S. EWAD100E-SS / SL
- T. EWAD120E-SS / SL
- U. EWAD140E-SS / EWAD130E-SL
- V. EWAD160E-SS / SL
- W. EWAD180E-SS / SL

- X. EWAD210E-SS / SL
- Y. EWAD260E-SS / EWAD250E-SL
- Z. EWAD310E-SS / EWAD300E-SL
- Ā. EWAD360E-SS / EWAD350E-SL
- N. EWAD410E-SS / EWAD400E-SL

## **Guidelines for ERAD E-SS/SL Installation**

Design of condensing unit application, and, in particular, sizing of piping and piping path, is a responsibility of plant designer. This paragraph is only focused to give suggestion to plant designer, this suggestions have to be weighted with references to application peculiarities.

Condensing units are shipped with holding nitrogen charge. It is important to keep the unit tightly closed until the remote evaporator is installed and piped to the unit.

Installation of the refrigerant circuit must be done by a licensed technician and must comply with all relevant European and national regulations.

It is the contractor's responsibility to install the interconnection piping, leak test it and the entire system, evacuate the system and supply the refrigerant charge.

All piping must be conformed to the applicable local and state codes.

Use refrigerant grade copper tubing only and isolate the refrigeration lines from building structures to prevent transfer of vibration.

Do not use a saw to remove end caps. This might allow copper chips to contaminate the system. Use a tube cutter or heat to remove caps. When sweating copper joints it is important to flow dry nitrogen through the system prior to charging with refrigerant. This prevents scale formation and the possible formation of an explosive mixture of HFC-134a and air. This will also prevent the formation of toxic phosgene gas, which occurs when HFC-134a is exposed to open flame.

Soft solders are not to be used. For copper-to-copper joints use a phos-copper solder with 6% to 8% silver content. A high silver content brazing rod must be used for copper-to-brass or copper-to-steel joints. Only use oxy-acetylene brazing.

After the equipment is correctly installed, leak tested and evacuated , it can be charged with R134a refrigerant and started under the supervision of Daikin authorized technician.

### **Refrigerant piping design**

In order to minimize capacity loss, it is recommended to size the lines in such a way that the pressure drop of each line does not result in an evaporating temperature decrease of more than 1°C.

Design of refrigerant piping depends on operating condition and, in particular, on evaporating temperature and suction superheat, so values suggested in the following table have to be considered just as a reference; no claim may be submitted to Daikin for wrong design of piping coming from the use of tables.

**Table 12 - Recomendend maximum equivalent length (m) for Suction line**

		Full Load	100	120	140	160	180	200	240	280	320	360	400
		Cooling Capacity (kW)											
Piping Size	3" 1/8		100	80	60	50	40	30	23	17	13	10	9
	2" 5/8		45	35	25	20	16	13	9	7	5	4	3
	2" 1/4		15	12	9	7	6	5	3	2	2	1	1
	1" 5/8		5	3	2	2	1	1	-	-	-	-	-
	1" 3/8		2	1	1	1	-	-	-	-	-	-	-

**Table 13 - Recomendend maximum equivalent length (m) for Liquid line**

		Full Load	100	120	140	160	180	200	240	280	320	360	400
		Cooling Capacity (kW)											
Piping Size	1" 5/8		-	-	250	200	175	140	100	75	60	45	40
	1" 3/8		200	150	120	95	75	60	45	35	25	20	15
	1" 1/4		80	60	45	35	25	20	15	12	10	8	6
	7/8		20	15	12	9	7	6	4	3	3	-	-
	3/4		10	7	5	4	3	3	-	-	-	-	-

To assure oil return to the compressor also at partial load do not use suction piping in the upward direction with size above 2" 1/4" for full load cooling capacity in the range 100-150 kW; above 2" 5/8 for full load cooling capacity in the range 150-200 kW, above 3" 1/8 for full load cooling capacity in the range 200-300 kW. If necessary, use double suction riser constructions.

Make sure to install a sightglass in the liquid line as close as possible to the expansion device of the evaporator

## Expansion valve

Expansion valve has to be designed accordingly to the unit cooling capacity and pressure drops across the liquid line and the evaporator distributor.

In the following the reference values of condensing pressure

### ST Version

Design point (35°C ambient, 7°C suction)	:	14 barg
Max	:	18.5 barg
Min	:	9.0 barg

### LN Version

Design point (35°C ambient, 7°C suction)	:	15 barg
Max	:	18.5 barg
Min	:	9.0 barg

The expansion valve may be either thermostatic or electronic. In the case of electronic expansion valve, it has to be equipped with standalone controller and instrumentation.

Electronic expansion valve installation is suggested when the operating range of the chiller (and in particular of ambient temperature) is quite wide and when low saturated suction temperature are expected.

## Refrigerant Charge

Pre-charge of refrigerant may be evaluate accordingly to the following formula

Refrigerant charge [kg] = unit charge as per technical specification tables +  $l_d * F_l + s_d * F_s + V_e * 0.5$

$l_d$  = value in table 14

$s_d$  = value in table 14

$F_s$  = total length of the field suction line (m)

$F_l$  = total length of the field liquid line (m)

$V_e$  = refrigerant volume of the field evaporator (liter)

**Table 14 – Refrigerant charge for (m) of Liquid and suction line**

Liquid Piping Size	$l_d$	Suction Piping Size	$s_d$
1" 5/8	1.30	3" 1/8	0.076
1" 3/8	0.93	2" 5/8	0.053
1" 1/4	0.61	2" 1/4	0.035
7/8	0.36	1" 5/8	0.021
3/4	0.26	1" 3/8	0.015

The calculated refrigerant precharge has to be added before starting the unit (running compressor may damage the unit).

After precharge and prestart checks, the charge has to be tuned.

For fine-tuning of the refrigerant charge, the compressor must operate at full load (100%).

The charge has to be adjusted to have suction superheat and subcooling within allowable range and to have the sightglass totally sealed. As long as the liquid-line sightglass is not sealed, add refrigerant in steps of a few kgs and wait until the unit runs in stable conditions. The unit must have the time to stabilize which means that this charging has to be done in a smooth way.

During charge tuning verify the oil sightglass.

Note down the superheat and subcooling for future reference.

Fill out the total refrigerant charge on the unit nameplate and on the refrigerant charge label supplied with the product.

## **Installation of evaporator fluid sensors**

Two temperature sensors are supplied, cabled to the unit controller, with a cable length of 10 m. They have to be installed to measure the chilles fluid at the inlet (WIE) and at the outlet (WOE) of the evaporator, and the are used by the unit controller to adjust the unit capacity to the demand.

In case of air chilling, it is recomaned to install a frost sensor on the evaporator and to connect it to the controller external alarm terminal.



# **Electrical installation**

## **General specifications**

### **CAUTION**

All electrical connections to the machine must be carried out in compliance with laws and regulations in force.  
All installation, management and maintenance activities must be carried out by qualified personnel.  
Refer to the specific wiring diagram for the machine that you have purchased and which was sent with the unit. Should the wiring diagram not appear on the machine or should it have been lost, please contact your nearest manufacturer office, who will send you a copy.

### **CAUTION**

Only use copper conductors. Failure to use copper conductors could result in overheating or corrosion at connection points and could damage the unit.  
To avoid interference, all control wires must be connected separately from the power cables. Use different electrical passage ducts for this purpose.

### **CAUTION**

Before servicing the machine in any way, open the general disconnecting switch on the machine's main power supply.  
When the machine is off but the disconnecting switch is in the closed position, unused circuits are live, as well.  
Never open the terminal board box of the compressors before having opened the unit's general disconnecting switch.

### **CAUTION**

Contemporaneity of single-phase and three-phase loads and unbalance between phases could cause leakages towards ground up to 150mA, during the normal operation of the units of the series.

If the unit includes devices that cause superior harmonics (like VFD and phase cut), the leakage towards ground could increase to very higher values (about 2 Ampere).

The protections for the power supply system have to be designed according to the above mentioned values.

**Table 15 - Electrical Data EWAD 100E ÷ 180E-SS**

		Unit Size	100	120	140	160	180	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	159	159	207	207	304	
	Nominal running current cooling	A	67	81	92	102	119	
	Maximum running current	A	85	100	116	129	155	
	Maximum current for wires sizing	A	93	109	128	142	171	
Fans	Nominal running current in cooling	A	8	8	12	12	16	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	80	96	107	121	145	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.								

**Table 16 - Electrical Data EWAD 210E ÷ 410E SS**

		Unit Size	210	260	310	360	410	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	304	404	434	434	434	
	Nominal running current cooling	A	124	148	185	220	241	
	Maximum running current	A	161	195	238	276	291	
	Maximum current for wires sizing	A	177	214	262	303	320	
Fans	Nominal running current in cooling	A	16	24	24	24	24	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	145	171	224	264	264	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.								

**Table 17 - Electrical Data EWAD 100E ÷ 180E SL**

		Unit Size	100	120	130	160	180	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	156	156	203	213	298	
	Nominal running current cooling	A	67	82	91	113	118	
	Maximum running current	A	81	97	112	132	149	
	Maximum current for wires sizing	A	89	107	123	146	164	
Fans	Nominal running current in cooling	A	5.2	5.2	7.8	7.8	10.4	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	80	96	107	121	145	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
	Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.							

**Table 18 - Electrical Data EWAD 210E ÷ 400E-SL**

		Unit Size	210	250	300	350	400	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	298	395	425	425	425	
	Nominal running current cooling	A	124	144	184	223	248	
	Maximum running current	A	155	185	224	270	281	
	Maximum current for wires sizing	A	170	204	246	297	309	
Fans	Nominal running current in cooling	A	10.4	15.6	15.6	15.6	15.6	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	145	171	224	264	264	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
	Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.							

**Table 19 - Electrical Data ERAD 120E ÷ 220E-SS**

		Unit Size	120	140	170	200	220	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	159	159	207	207	304	
	Nominal running current cooling	A	72	87	98	110	127	
	Maximum running current	A	88	104	119	133	161	
	Maximum current for wires sizing	A	97	114	131	146	177	
Fans	Nominal running current in cooling	A	8	8	12	12	16	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	80	96	107	121	145	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + fans current							
	Nominal current in cooling mode is referred to the following conditions: SST 7°C; ambient 35°C; compressor + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
Maximum current for wires sizing: (compressors full load ampere + fans current) x 1.1.								

**Table 20 - Electrical Data ERAD 250E ÷ 490E-SS**

		Unit Size	250	310	370	440	490	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
Unit	Maximum starting current	A	304	354	434	434	434	
	Nominal running current cooling	A	131	156	203	243	265	
	Maximum running current	A	161	195	248	288	288	
	Maximum current for wires sizing	A	177	215	273	317	317	
Fans	Nominal running current in cooling	A	16	24	24	24	24	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	145	171	224	264	264	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.								

**Table 21 - Electrical Data ERAD 120E ÷ 210E-SL**

		Unit Size	120	140	160	190	210	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
Maximum		%	+10%	+10%	+10%	+10%	+10%	
Unit	Maximum starting current	A	156	156	203	203	298	
	Nominal running current cooling	A	73	90	98	111	127	
	Maximum running current	A	85	101	115	129	155	
	Maximum current for wires sizing	A	94	111	126	142	171	
Fans	Nominal running current in cooling	A	5.2	5.2	7.8	7.8	10.4	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	80	96	107	121	145	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.								

**Table 22 - Electrical Data ERAD 240E ÷ 460E-SL**

		Unit Size	240	300	350	410	460	
Power Supply	Phase	---	3	3	3	3	3	
	Frequency	Hz	50	50	50	50	50	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
Maximum		%	+10%	+10%	+10%	+10%	+10%	
Unit	Maximum starting current	A	298	346	426	426	426	
	Nominal running current cooling	A	133	154	203	248	274	
	Maximum running current	A	155	187	240	280	280	
	Maximum current for wires sizing	A	171	205	264	308	308	
Fans	Nominal running current in cooling	A	10.4	15.6	15.6	15.6	15.6	
Compressor	Phase	No.	3	3	3	3	3	
	Voltage	V	400	400	400	400	400	
	Voltage Tolerance	Minimum	%	-10%	-10%	-10%	-10%	-10%
		Maximum	%	+10%	+10%	+10%	+10%	+10%
	Maximum running current	A	145	171	224	264	264	
Starting method	---	Wye – Delta type (Y – Δ)						
Notes	Allowed voltage tolerance ± 10%. Voltage unbalance between phases must be within ± 3%.							
	Maximum starting current: starting current of biggest compressor + current of the compressor at 75% maximum load + fans current							
	Nominal current in cooling mode is referred to the following conditions: evaporator 12°C/7°C; ambient 35°C; compressors + fans current.							
	Maximum running current is based on max compressor absorbed current in its envelope and max fans absorbed current							
	Maximum unit current for wires sizing is based on minimum allowed voltage							
Maximum current for wires sizing: (compressors full load ampere + fans current) x 1,1.								

## Electrical components

All power and interface electrical connections are specified in the wiring diagram that is shipped with the machine. The installer must supply the following components:

- Power supply cables (dedicated conduit)
- Interconnection and interface cables (dedicated conduit)
- Suitable line protection devices (fuses or circuit breakers, please see electrical data).

## Power Circuit Wiring

A disconnect switch is factory-installed for isolating electrically the unit when switched off. Compressor overload and short-circuit protection is accomplished by fuses installed in the electrical panel.

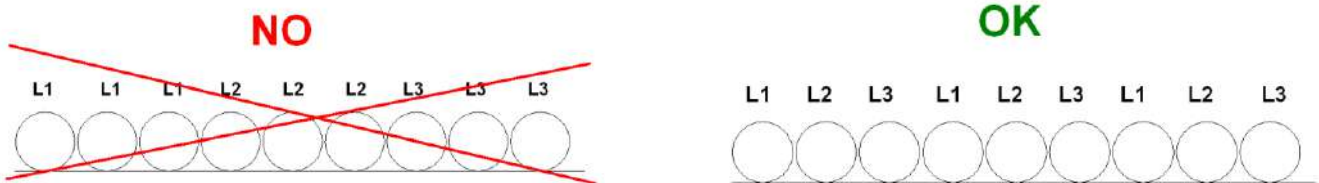
Proper phase sequence to the unit is required as far as the unit operation is concerned. All line-side wiring must be in accordance with local regulation and be made with copper wire and copper lugs only. The table below is a reference only for dimensioning protection devices and wiring.

**⚠ CAUTION**

In installations with power supply lines longer than 50 metres, phase-to-phase and phase-to-earth inductive couplings between phases generate significant phenomena, namely:

- unbalancing of phase currents
- excessive voltage drop

In order to limit this phenomena, it is good practice to lay out the phase wires symmetrically, as described in the figure.



**Figure 17 - Installation of long power supply wires**

**Table 23 - Recommended Fuses and Field Wire Sizing  
EWAD 100E ÷ 410E-SS**

Model	EWAD 100E-SS	EWAD 120E-SS	EWAD 140E-SS	EWAD 160E-SS	EWAD 180E-SS
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	125 A gG	160 A gG	160 A gG	200 A gG	200 A gG
Minimum Recommended Wire Size (note 2)	70 mm <sup>2</sup>	95 mm <sup>2</sup>	95 mm <sup>2</sup>	120 mm <sup>2</sup>	120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

Model	EWAD 210E-SS	EWAD 260E-SS	EWAD 310E-SS	EWAD 360E-SS	EWAD 410E-SS
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	200 A gG	250 A gG	315 A gG	355 A gG	355 A gG
Minimum Recommended Wire Size (note 2)	120 mm <sup>2</sup>	150 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

**Note 1:**

Short-circuit current ratings are referred to a 0.25 s duration of short circuit.

**Note 2:**

Correct wire sizing must take into account the actual ambient temperature of the installation and the protection device installed on-site. Recommended wire size is made according to standard EN60204-1 – Table 6.E with the following assumptions:

- Recommended protection devices (fuses)
- 70°C PVC stranded copper conductors
- 40°C ambient temperature

Wire sizing is different as installation and operation conditions are different from the above mentioned values. The voltage drop from the point of supply to the load must not exceed 5% of the nominal voltage under normal operating conditions. In order to comply with this requirement, it can be necessary to use conductors having a larger cross-sectional area than the minimum value reported on the above table.

**Note 3:**

Maximum wire size is the maximum allowed by the disconnect switch terminals. In case a larger conductor size is needed, contact factory for asking special incoming lugs.

## EWAD 100E ÷ 400E-SL

Model	EWAD 100E-SL	EWAD 120E-SL	EWAD 130E-SL	EWAD 160E-SS	EWAD 180E-SL
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	125 A gG	160 A gG	160 A gG	200 A gG	200 A gG
Minimum Recommended Wire Size (note 2)	70 mm <sup>2</sup>	95 mm <sup>2</sup>	95 mm <sup>2</sup>	120 mm <sup>2</sup>	120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

Model	EWAD 210E-SL	EWAD 250E-SL	EWAD 300E-SL	EWAD 350E-SL	EWAD 400E-SL
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	200 A gG	250 A gG	315 A gG	355 A gG	355 A gG
Minimum Recommended Wire Size (note 2)	120 mm <sup>2</sup>	150 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

**Note 1:**

Short-circuit current ratings are referred to a 0.25 s duration of short circuit.

**Note 2:**

Correct wire sizing must take into account the actual ambient temperature of the installation and the protection device installed on-site. Recommended wire size is made according to standard EN60204-1 – Table 6.E with the following assumptions:

- Recommended protection devices (fuses)
- 70°C PVC stranded copper conductors
- 40°C ambient temperature

Wire sizing is different as installation and operation conditions are different from the above mentioned values. The voltage drop from the point of supply to the load must not exceed 5% of the nominal voltage under normal operating conditions. In order to comply with this requirement, it can be necessary to use conductors having a larger cross-sectional area than the minimum value reported on the above table.

**Note 3:**

Maximum wire size is the maximum allowed by the disconnect switch terminals. In case a larger conductor size is needed, contact factory for asking special incoming lugs.

## ERAD 120E ÷ 490E-SS

Model	ERAD 120E-SS	ERAD 140E-SS	ERAD 170E-SS	ERAD 200E-SS	ERAD 220E-SS
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	125 A gG	160 A gG	160 A gG	200 A gG	200 A gG
Minimum Recommended Wire Size (note 2)	70 mm <sup>2</sup>	95 mm <sup>2</sup>	95 mm <sup>2</sup>	120 mm <sup>2</sup>	120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

Model	ERAD 250E-SS	ERAD 310E-SS	ERAD 370E-SS	ERAD 440E-SS	ERAD 490E-SS
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	200 A gG	250 A gG	315 A gG	355 A gG	355 A gG
Minimum Recommended Wire Size (note 2)	120 mm <sup>2</sup>	150 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

**Note 1:**

Short-circuit current ratings are referred to a 0.25 s duration of short circuit.

**Note 2:**

Correct wire sizing must take into account the actual ambient temperature of the installation and the protection device installed on-site. Recommended wire size is made according to standard EN60204-1 – Table 6.E with the following assumptions:

- Recommended protection devices (fuses)
- 70°C PVC stranded copper conductors
- 40°C ambient temperature

Wire sizing is different as installation and operation conditions are different from the above mentioned values. The voltage drop from the point of supply to the load must not exceed 5% of the nominal voltage under normal operating conditions. In order to comply with this requirement, it can be necessary to use conductors having a larger cross-sectional area than the minimum value reported on the above table.

**Note 3:**

Maximum wire size is the maximum allowed by the disconnect switch terminals. In case a larger conductor size is needed, contact factory for asking special incoming lugs.

## ERAD 120E ÷460E-SL

Model	ERAD 120E-SL	ERAD 140E-SL	ERAD 160E-SL	ERAD 190E-SL	ERAD 210E-SL
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	125 A gG	160 A gG	160 A gG	200 A gG	200 A gG
Minimum Recommended Wire Size (note 2)	70 mm <sup>2</sup>	95 mm <sup>2</sup>	95 mm <sup>2</sup>	120 mm <sup>2</sup>	120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

Model	ERAD 240E-SL	ERAD 300E-SL	ERAD 350E-SL	ERAD 410E-SL	ERAD 460E-SL
Disconnect Switch Size	400 A	400 A	400 A	400 A	400 A
Short circuit rating (note 1)	25 kA	25 kA	25 kA	25 kA	25 kA
Recommended Fuses	200 A gG	250 A gG	315 A gG	355 A gG	355 A gG
Minimum Recommended Wire Size (note 2)	120 mm <sup>2</sup>	150 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x95 mm <sup>2</sup>	2x120 mm <sup>2</sup>
Maximum Wire Size (note 3)	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>	2x185 mm <sup>2</sup>

### Note 1:

Short-circuit current ratings are referred to a 0.25 s duration of short circuit.

### Note 2:

Correct wire sizing must take into account the actual ambient temperature of the installation and the protection device installed on-site. Recommended wire size is made according to standard EN60204-1 – Table 6.E with the following assumptions:

- Recommended protection devices (fuses)
- 70°C PVC stranded copper conductors
- 40°C ambient temperature

Wire sizing is different as installation and operation conditions are different from the above mentioned values. The voltage drop from the point of supply to the load must not exceed 5% of the nominal voltage under normal operating conditions. In order to comply with this requirement, it can be necessary to use conductors having a larger cross-sectional area than the minimum value reported on the above table.

### Note 3:

Maximum wire size is the maximum allowed by the disconnect switch terminals. In case a larger conductor size is needed, contact factory for asking special incoming lugs.

Connect electrical power supply cables to the terminals of the main disconnect switch located on the machine's terminal board. The access panel must have a hole of appropriate diameter for the cable used and its cable gland. A flexible duct can also be used, containing the three power phases plus earth.

In any case, absolute protection against any water penetrating through the connection point must be ensured.

## Control Circuit Wiring

The control circuit on the unit is designed for 115V supply. Control power is supplied from a factory-wired transformer located in the electrical panel. No additional wiring is thus required.

However, a customer terminal board is available for field input/output connections (see Figure 18) to allow a remote control of the unit.

## Electrical heaters

EWAD E-SS/SL units have an electrical anti-freeze heater that is installed directly in the evaporator. Each circuit also has an electrical heater installed in the compressor, whose purpose is to keep the oil warm and avoid the transmigration of refrigerant within. Obviously, the operation of the electrical heaters is guaranteed only if there is a constant power supply. If it is not possible to keep the machine on when inactive during winter, apply at least two of the procedures described in the "Installation – Mechanical" section under the "Evaporator and recuperative exchangers antifreeze protection" paragraph.

In case a separate accumulation tank (optional) is requested, its electrical anti-freeze heater must have a separate power supply.

## Electrical power supply to the pumps

On request, a kit can be installed in EWAD E-SS/SL units for fully-cabled and microprocessor-controlled pumping. No additional control is required in this case.



**Table 24 - Electrical data for optional pumps**

Unit model		Engine power (KW)		Engine current requirement (A)	
		Low head	High head	Low head	High head
ST/LN	EWAD 100E ÷ 140E-SS EWAD 100E ÷ 130E-SL	1.5	2.2	3.5	5.0
	EWAD 160E ÷ 210E-SS EWAD 160E ÷ 210E-SL	2.2	3.0	5.0	6.0
	EWAD 260E-SS EWAD 250E-SL	3.0	5.5	6.0	10.1
	EWAD 310E ÷ 410E-SS EWAD 300E ÷ 400E-SL	4.0	5.5	8.1	10.1

Should the installation use pumps that are external to the machine (not supplied with the unit), a thermal-magnetic circuit breaker and a control contactor must be foreseen on the power supply line of each pump.

## Water pump control – Electrical Wiring

In case of external water pumps, control is managed by the on-board microprocessor of the unit. However, a minimum field wiring is required to the customer. Connect the pump contactor coil to terminals 527, 528 (pump #1) and 530, 531 (pump #2) of the customer terminal board MC115 and series connect it to an external power source. Check that the coil voltage matches the power supply voltage.

The microprocessor digital output port used for water pump control has the following commutation capacity:

Maximum voltage: 250 Vac  
 Maximum current: 2 A Resistive - 2 A Inductive  
 Reference standard: EN 60730-1

It is a good practice to install a pump status dry-contact on the pump circuit breaker and to series connect it to a flow switch.

## Alarm relays – Electrical wiring

The unit has a dry-contact digital output that changes state whenever an alarm occurs in one of the refrigerant circuits. Connect terminals 525, 526 of the terminal board MC115 to an external visual, sound alarm or to the BMS in order to monitor its operation.

## Unit On/ Off remote control – Electrical wiring

The machine has a digital input (terminals 703,745 of the terminal board MC24) that allows remote control with an external dry-contact. A startup timer, a circuit breaker or a BMS can be connected to this input. Once the contact has been closed, the microprocessor launches the startup sequence by first turning on the first water pump and then the compressors. When the remote contact is opened the microprocessor launches the machine shutdown sequence.

## Alarm from external device – Electrical wiring (Optional)

This function allow the unit to be stopped from an external alarm signal. Connect terminals 883, 884 of the terminal board MC24 to a dry-contact of a BMS or an external alarm device.

## Double Setpoint – Electrical wiring

The Double Setpoint function allows to switch the unit setpoint between two previously set values on the unit controller. An example of a typical application is ice production during the night and standard operation during the day. Connect a switch or a timer (dry-contact) between terminals 703 and 728 of the terminal board MC24.

## External water Setpoint reset – Electrical wiring (Optional)

The unit local setpoint can be set by means of an external analog 4-20 mA signal. Once this function is enabled, the microprocessor allows to adjust the setpoint from the set local value up to a differential of 3°C. 4 mA correspond to 0°C reset, 20 mA correspond to the setpoint plus the maximum differential allowed.

The signal wire must be directly connected to terminals 886 and 887 of the terminal board MC24. A shielded wire is recommended and it must not be laid in proximity of the power cables, so as not to induce interference with the electronic controller.

## **Unit limitation – Electrical wiring (Optional)**

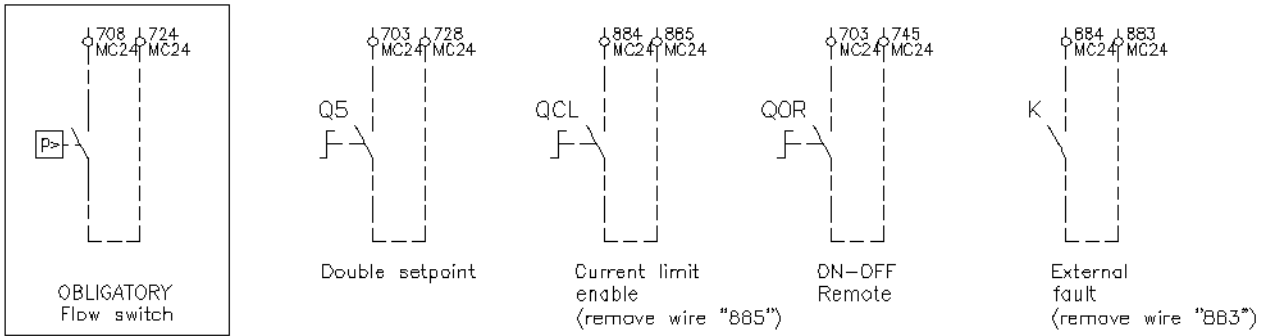
The unit microprocessor allows to limit the cooling capacity according to two different sets of criteria:

- Demand limit: The unit load can be varied by means of a 4-20 mA external signal released by a BMS. The signal wire must be directly connected to terminals 888 and 889 of the MC24 terminal board. A shielded wire is recommended and it must not be laid in proximity of the power cables, so as not to induce interference with the electronic controller.
- Current limit: The unit load can be varied by means of a 4-20 mA signal released by a BMS. In this case, a maximum current value must be set on the microprocessor so that the microprocessor controls compressor loading according to the reference value and to the measured feedback current (a current transformer is installed inside the panel). The signal wire must be directly connected to terminals 890 and 889 of the MC24 terminal board. A shielded wire is recommended and it must not be laid in proximity of the power cables, so as not to induce interference with the electronic controller. A digital input allows to enable the current limitation when required. Connect the enabling switch or a timer (dry-contact) to terminals 884 and 885 of terminal board MC24.

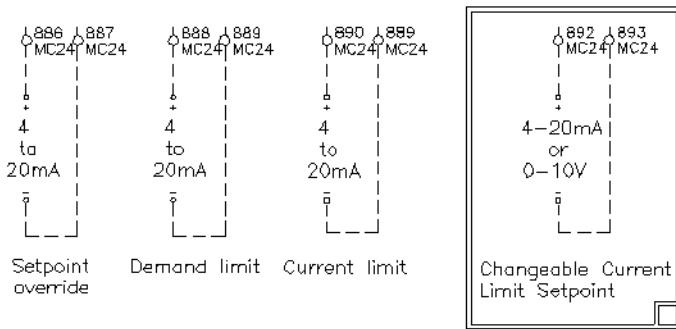
Attention: the two options cannot be enabled simultaneously. Setting one function excludes the other.

### Figure 18 – Field Wiring Diagram

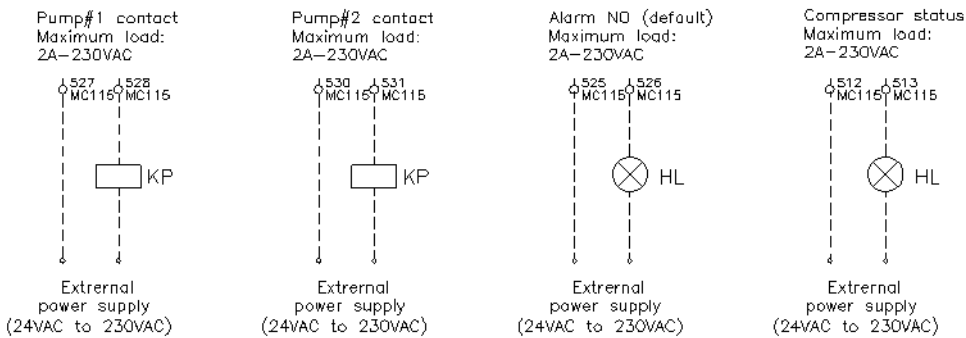
Digital input terminals



Analog input terminals



Digital output terminals



# Operation

## Operator's responsibilities

It is important that the operator is appropriately trained and becomes familiar with the apparatus before operating the machine. In addition to reading this manual, the operator must study the microprocessor operating manual and the wiring diagram in order to understand startup sequence, operation, shutdown sequence and operation of all the safety devices. During the machine's initial startup phase, a technician authorized by the manufacturer is available to answer any questions and to give instructions as to the correct operating procedures.

The operator is advised to keep a record of operating data for every installed machine. Another record should also be kept of all the periodical maintenance and servicing activities.

If the operator notes abnormal or unusual operating conditions, he is advised to consult the technical service authorized by the manufacturer.

## Description of the machine

This machine, of the air-cooled condenser type, is made up of the following main components:

- **Compressor:** the state-of-the-art single-screw compressor of the Fr3100 or Fr3200 series is of the semi-hermetic type and utilises gas from the evaporator to cool the engine and allow optimal operation under all foreseen load conditions. The oil-injection lubrication system does not require an oil pump as its flow is ensured by the pressure difference between delivery and intake. In addition to ensuring lubrication of ball bearings, oil injection seals the screw dynamically thus ensuring the compression process.

- **Evaporator:** For EWAD E-SS/SL only. High-efficiency direct-expansion plate type; the evaporator is of ample size in order to ensure optimum efficiency under all load conditions.

- **Condenser:** Finned-pack type with internally microfinned tubes, that expand directly on the high-efficiency open fin. The condenser batteries are provided with an undercooling section which, in addition to improving the machine's overall efficiency, compensates the thermal load variations by adapting the refrigerant load to every foreseen operating condition.

- **Ventilator:** High-efficiency axial type. Allows silent operation of the system, also during adjustment.

- **Expansion valve:** The standard machine has a thermostatic expansion valve with an external equaliser. Optionally, an electronic expansion valve can be installed, which is controlled by an electronic device called Driver that optimises its operation. Use of the electronic expansion valve is recommended in case of prolonged operation at partial loads with very low outdoor temperatures or if the machine is installed in variable flow rate systems.

## Description of the chilling cycle

### ▲ ATTENTION

In the following schemas position of component are indicative.

In particular position of connections (water or refrigerant connection to external plant) may be different.

Refer to on board certified drawings for exact position on specific unit.

## EWAD E-SS/SL

The low-temperature refrigerant gas from the evaporator is taken in by the compressor and crosses the electrical engine, cooling it. It is subsequently compressed and during this phase the refrigerant mixes with the oil from the separator.

The high-pressure oil-refrigerant mixture is introduced into the oil separator, which separates it, the oil owing to a pressure difference is sent once again to the compressor while the refrigerant that has been separated from the oil is sent to the condenser.

Inside the condenser, the refrigerant fluid is evenly distributed to all the battery circuits; during this process it cools after overheating and starts to condense.

The fluid condensed at saturation temperature travels through the undercooling section, where it yields further heat, thus increasing cycle efficiency. The heat taken from the fluid during the de-overheating, condensation and undercooling phase is yielded to the cooling air which is expelled at a higher temperature.

The undercooled fluid travels through the high-efficiency dehydration filter and then through the lamination organ which launches the expansion process by means of a pressure drop, vaporising part of the refrigerant liquid.

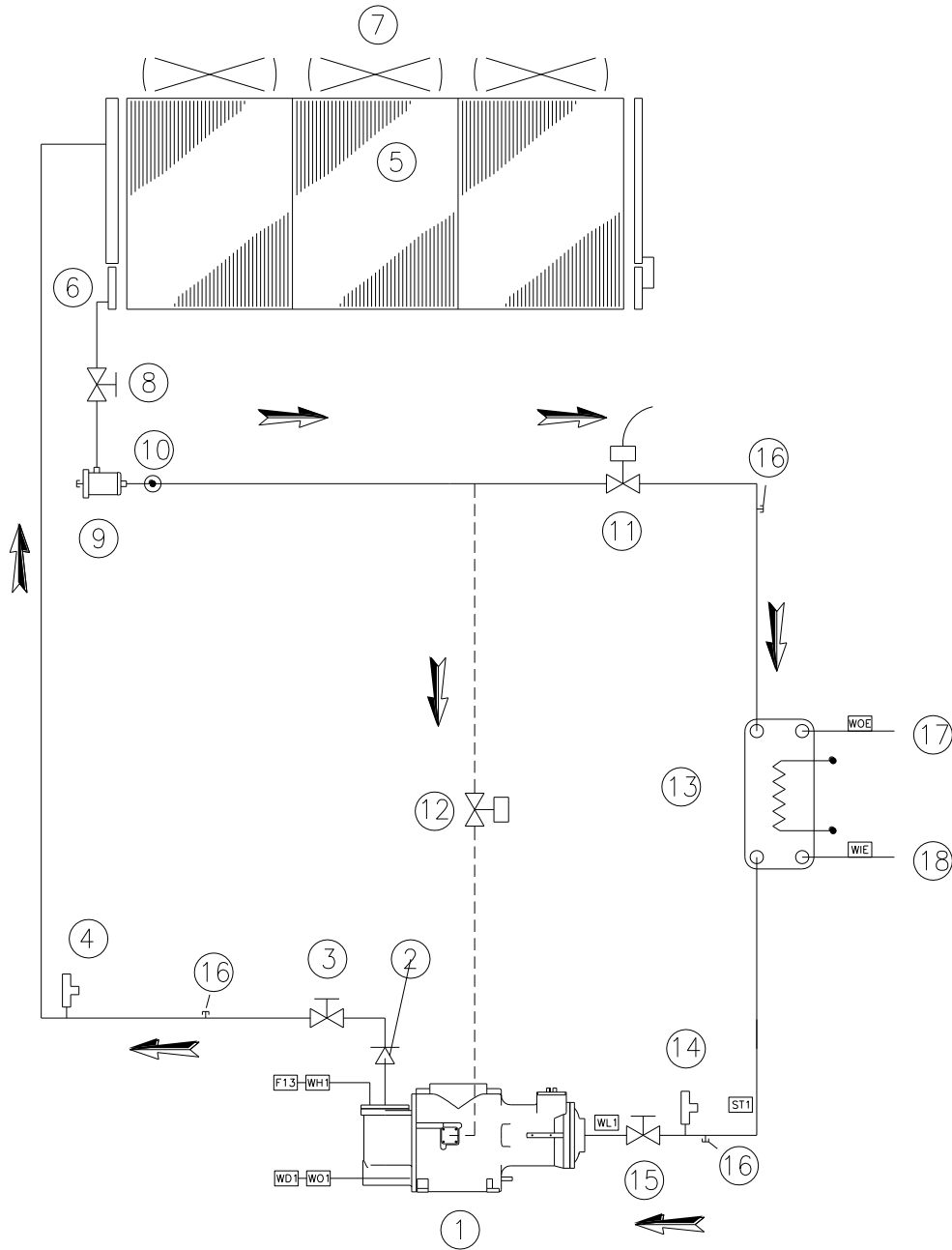
After the expansion the low-pressure and low-temperature liquid-gas mixture, requiring much heat, that is introduced into the evaporator.

After the liquid-vapour refrigerant has been evenly distributed in the direct-expansion evaporator tubes, it exchanges heat with the water to be cooled, thus reducing its temperature, and it gradually changes state until evaporating completely and then overheating.

Once it has reached the overheated-vapour state, the refrigerant leaves the evaporator and is once again taken into the compressor and restarts the cycle.

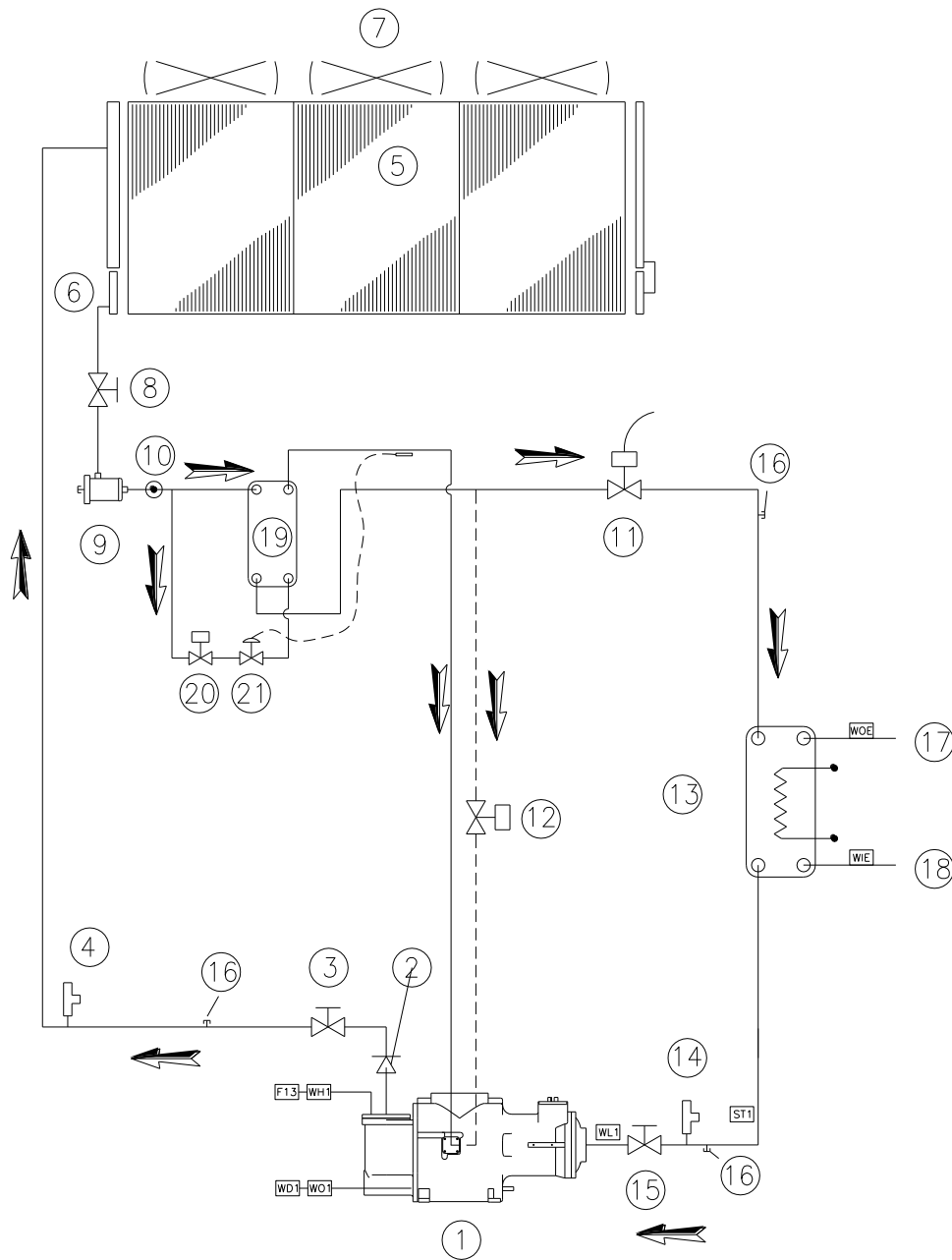
In economised units, before expansion, a portion of liquid is spilled from the subcooled condensate, expanded to an intermediate pressure and then flows through a heat exchanger where, on the other side, flows the remaining part of liquid. In this way the subcooling on the liquid is increased and a small amount of vapour at intermediate value is produced and injected in the compressor economiser port, so increasing compressor efficiency (reducing discharge superheat).

**Figure 19 – EWAD 100E ÷ 410E SS – EWAD 100E ÷ 400E SL**  
**Not economised refrigerant circuit**



- |     |                                       |      |  |
|-----|---------------------------------------|------|--|
| 1.  | Single-screw compressor               | 14.  | Low-pressure safety valve (15,5 bar)     |
| 2.  | Non-return valve                      | 15.  | Compressor suction shutoff valve         |
| 3.  | Compressor discharge shutoff valve    | 16.  | Service port                             |
| 4.  | High-pressure safety valve (25,5 bar) | 17.  | Water outlet connection                  |
| 5.  | Condenser coil                        | 18.  | Water inlet connection                   |
| 6.  | Built-in undercooling section         | ST1  | Suction temperature probe                |
| 7.  | Axial ventilator                      | WL1  | Low-pressure transducer (-0,5:7,0 bar)   |
| 8.  | Liquid line isolating tap             | WO1. | Oil pressure transducer (0,0:30,0 bar)   |
| 9.  | Dehydration filter                    | WH1. | High-pressure transducer (0,0:30,0 bar)  |
| 10. | Liquid and humidity indicator         | WD1. | Discharge temperature sensor/ Oil        |
| 11. | Electronic expansion valve            | F13. | High-pressure pressure switch (21,0 bar) |
| 12. | Liquid injection solenoid valve       | WIE. | Water entering temperature probe         |
| 13. | Direct expansion evaporator           | WOE. | Water leaving temperature probe          |

**Figure 20 - EWAD 100E ÷ 410E SS – EWAD 100E ÷ 400E SL  
Economised refrigerante circuit**



- |     |                                       |      |  |
|-----|---------------------------------------|------|--|
| 1.  | Single-screw compressor               | 16.  | Service port                             |
| 2.  | Non-return valve                      | 17.  | Water outlet connection                  |
| 3.  | Compressor discharge shutoff valve    | 18.  | Water inlet connection                   |
| 4.  | High-pressure safety valve (25,5 bar) | 19.  | Economiser                               |
| 5.  | Condenser coil                        | 20.  | Economiser solenoid valve                |
| 6.  | Built-in undercooling section         | 21.  | Economiser thermostatic expansion valve  |
| 7.  | Axial ventilator                      | ST1  | Suction temperature probe                |
| 8.  | Liquid line isolating tap             | WL1  | Low-pressure transducer (-0,5:7,0 bar)   |
| 9.  | Dehydration filter                    | WO1. | Oil pressure transducer (0,0:30,0 bar)   |
| 10. | Liquid and humidity indicator         | WH1. | High-pressure transducer (0,0:30,0 bar)  |
| 11. | Electronic expansion valve            | WD1. | Discharge temperature sensor/ Oil        |
| 12. | Liquid injection solenoid valve       | F13. | High-pressure pressure switch (21,0 bar) |
| 13. | Direct expansion evaporator           | WIE. | Water entering temperature probe         |
| 14. | Low-pressure safety valve (15,5 bar)  | WOE. | Water leaving temperature probe          |
| 15. | Compressor suction shutoff valve      |      |  |

## ERAD E-SS/SL

ERAD E-SS/SL units (Condensing Units) refrigerant cycle is identical to EWAD E-SS/SL refrigerant cycle except they are without evaporator, expansion valve and low pressure safety valve.

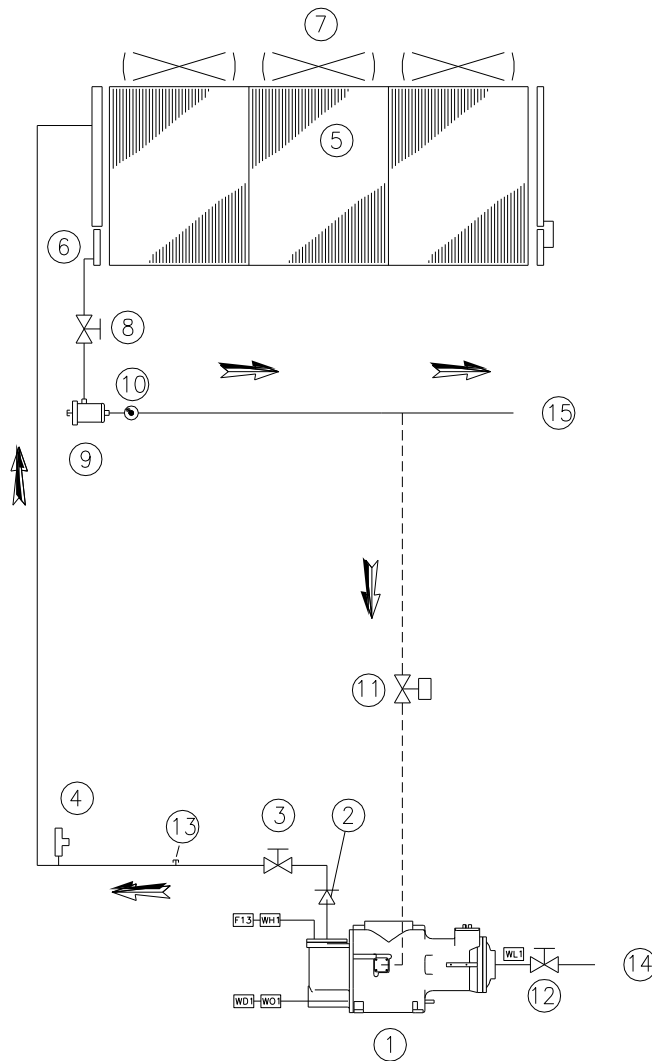
Units are designed to be used with external evaporator either for chilling water or air. Typical, but not exhaustive, use is for custom-made evaporator for process cooling and air-handling unit application.

Chilled fluid entering and leaving temperature probes are supplied with the unit with 12 m cables.

Selection and installation of expansion valve (either thermostatic or electronic), as well as the design of suction and liquid line is a responsibility of the plant designer.

Units are supplied with about 1 barg nitrogen holding charge.

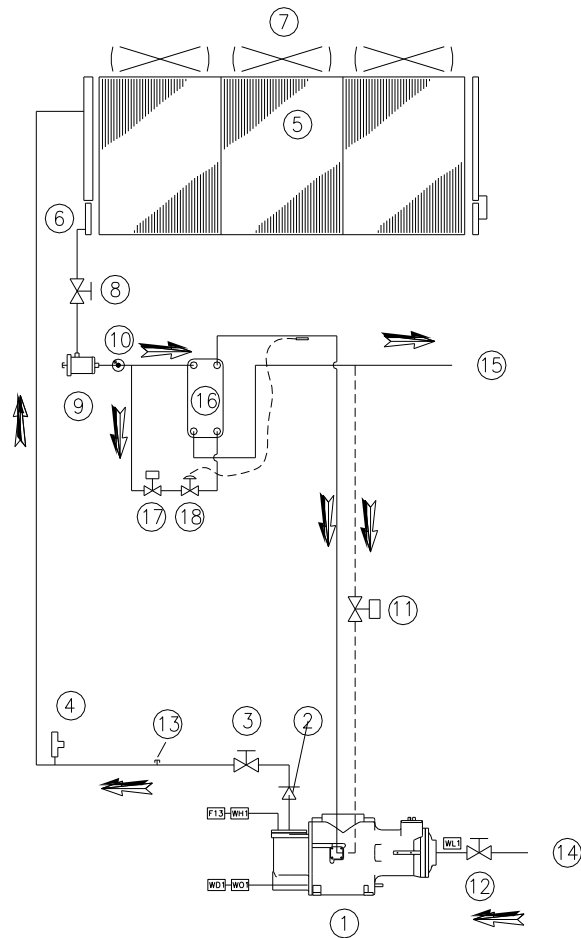
**Figure 21 – ERAD 120E ÷ 490E-SS – ERAD 120E ÷ 460E-SL  
Not economised refrigerante circuit**



- |     |                                       |      |  |
|-----|---------------------------------------|------|--|
| 1.  | Single-screw compressor               | 12.  | Compressor suction shutoff valve         |
| 2.  | Non-return valve                      | 13.  | Service port                             |
| 3.  | Compressor discharge shutoff valve    | 14.  | Suction line connection                  |
| 4.  | High-pressure safety valve (25,5 bar) | 15.  | Liquid line connection                   |
| 5.  | Condenser coil                        | WL1  | Low-pressure transducer (-0,5:7,0 bar)   |
| 6.  | Built-in undercooling section         | WO1. | Oil pressure transducer (0,0:30,0 bar)   |
| 7.  | Axial ventilator                      | WH1. | High-pressure transducer (0,0:30,0 bar)  |
| 8.  | Liquid line isolating tap             | WD1. | Discharge temperature sensor/ Oil        |
| 9.  | Dehydration filter                    | F13. | High-pressure pressure switch (21,0 bar) |
| 10. | Liquid and humidity indicator         | WIE. | Chilled fluid entering temperature probe |
| 11. | Liquid injection solenoid valve       | WOE. | Chilled fluid leaving temperature probe  |



**Figure 22 - ERAD 120E ÷ 490E-SS – ERAD 120E ÷ 460E-SL  
Economised refrigerante circuit**



- |     |                                       |      |  |
|-----|---------------------------------------|------|--|
| 1.  | Single-screw compressor               | 14.  | Suction line connection                  |
| 2.  | Non-return valve                      | 15.  | Liquid line connection                   |
| 3.  | Compressor discharge shutoff valve    | 16.  | Economiser                               |
| 4.  | High-pressure safety valve (25,5 bar) | 14.  | Economiser solenoid valve                |
| 5.  | Condenser coil                        | 18.  | Economiser thermostatic expansion valve  |
| 6.  | Built-in undercooling section         | WL1  | Low-pressure transducer (-0,5:7,0 bar)   |
| 7.  | Axial ventilator                      | WO1. | Oil pressure transducer (0,0:30,0 bar)   |
| 8.  | Liquid line isolating tap             | WH1. | High-pressure transducer (0,0:30,0 bar)  |
| 9.  | Dehydration filter                    | WD1. | Discharge temperature sensor/ Oil        |
| 10. | Liquid and humidity indicator         | F13. | High-pressure pressure switch (21,0 bar) |
| 11. | Liquid injection solenoid valve       | WIE. | Chilled fluid entering temperature probe |
| 12. | Compressor suction shutoff valve      | WOE. | Chilled fluid leaving temperature probe  |
| 13. | Service port                          |      |  |

## **Description of the chilling cycle with heat recovery**

With reference to standard refrigerant cycle (both for chiller and condensing units), the high pressure refrigerant that has been separated from the oil, before reaching the condenser coil, flows through the recovery heat exchanger, where it dissipates the heat (from gas de-superheating and partial condensation), warming the water which travels through the exchanger. On leaving the exchanger the refrigerant fluid enters the condenser coil where it is completely condensed by forced ventilation.

In not economised units, an additional subcooler is added on the liquid line, using evaporation of a small portion of liquid, drained from the main liquid flow and expanded to suction pressure, to guarantee subcooling of refrigerant reaching the expansion valve.

## **Controlling the partial recovery circuit and installation recommendations**

The heat recovery system is not managed and/or controlled by the unit to match the heat demand from the plant; the unit load is controlled from the chilled water demand and the heat not consumed by the recovery system is rejected in the condenser coil.

The installer should follow the suggestions below for best system performance and reliability:

Install a mechanical filter at exchanger entrances

Install sectioning valves to exclude the exchanger from the hydraulic system during periods of inactivity or during system maintenance.

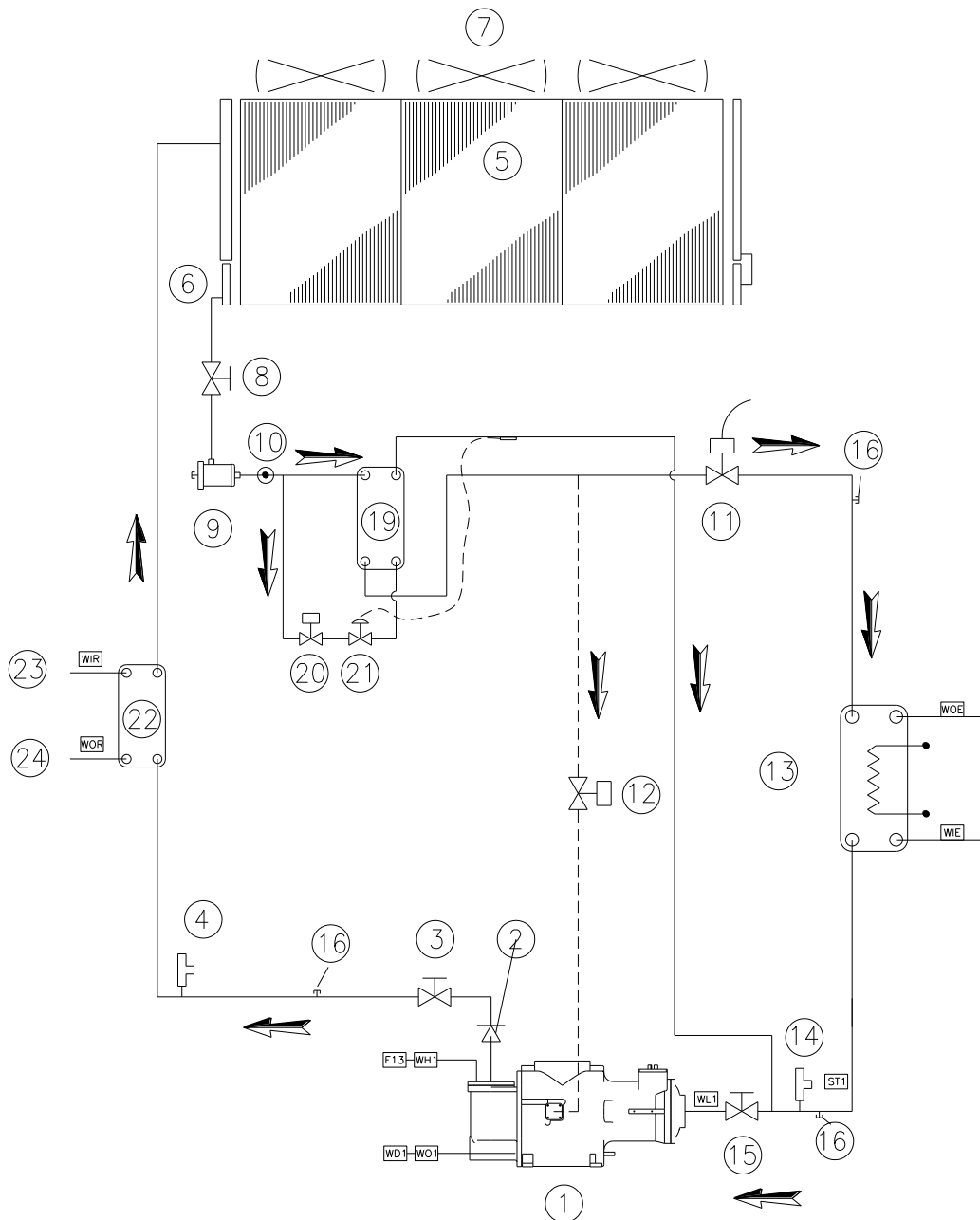
Install a discharge tap to empty the heat exchanger, in the event that air temperature can be expected to fall below 0°C during periods of inactivity of the machine.

Interpose flexible anti-vibration joints on recuperator water input and output piping, to keep transmission of vibrations, and therefore of noise, to the hydraulic system as low as possible.

Do not load exchanger joints with the weight of recuperator piping. Hydraulic joints of exchangers are not designed to support their weight.

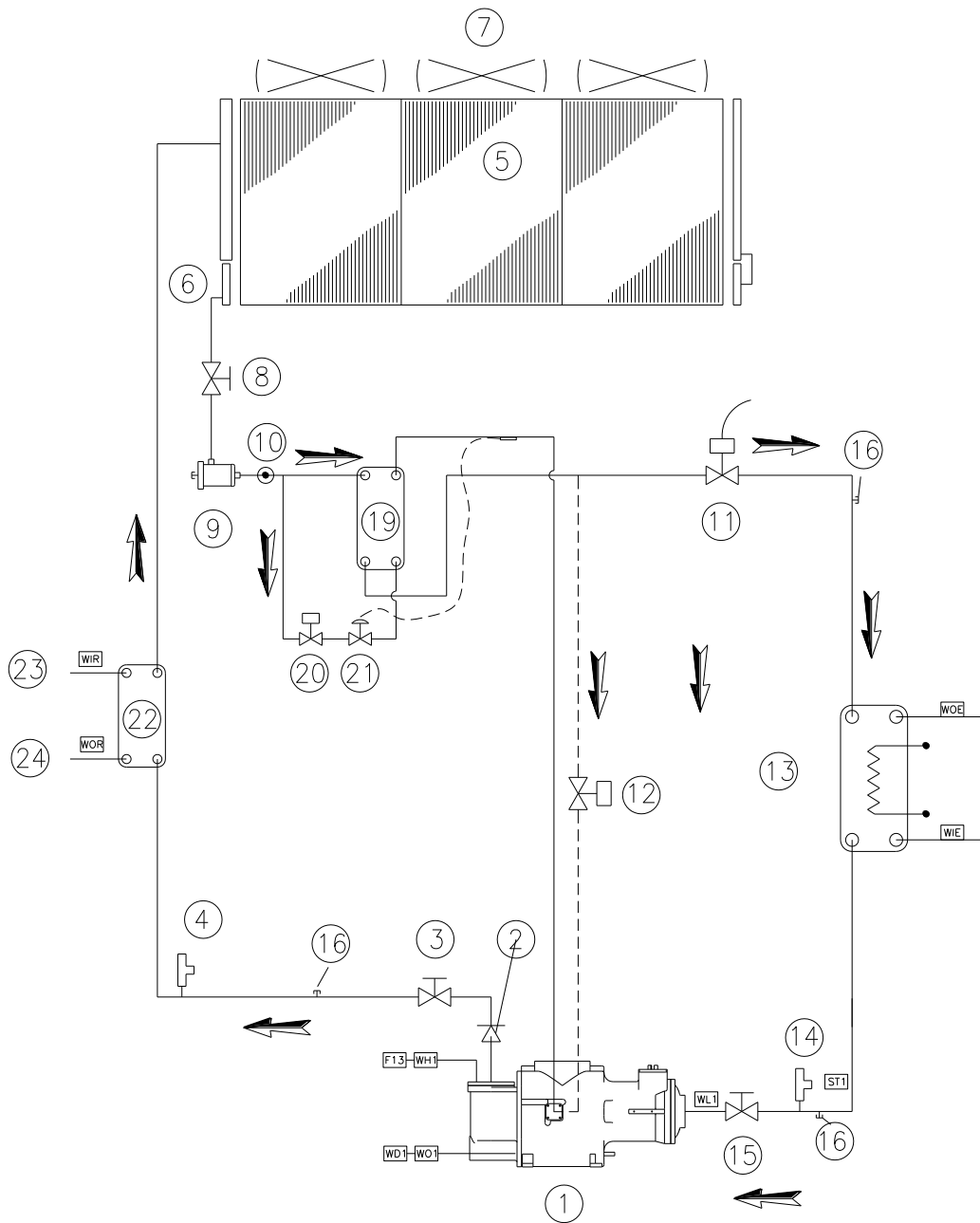
Should recovery water temperature be lower than ambient temperature, it is advised to switch off the recovery water pump 3 minutes after having switched off the last compressor.

**Figure 23 - EWAD 100E ÷ 410E SS – EWAD 100E ÷ 400E SL  
Heat recovery refrigerante circuit – Not Economised units**



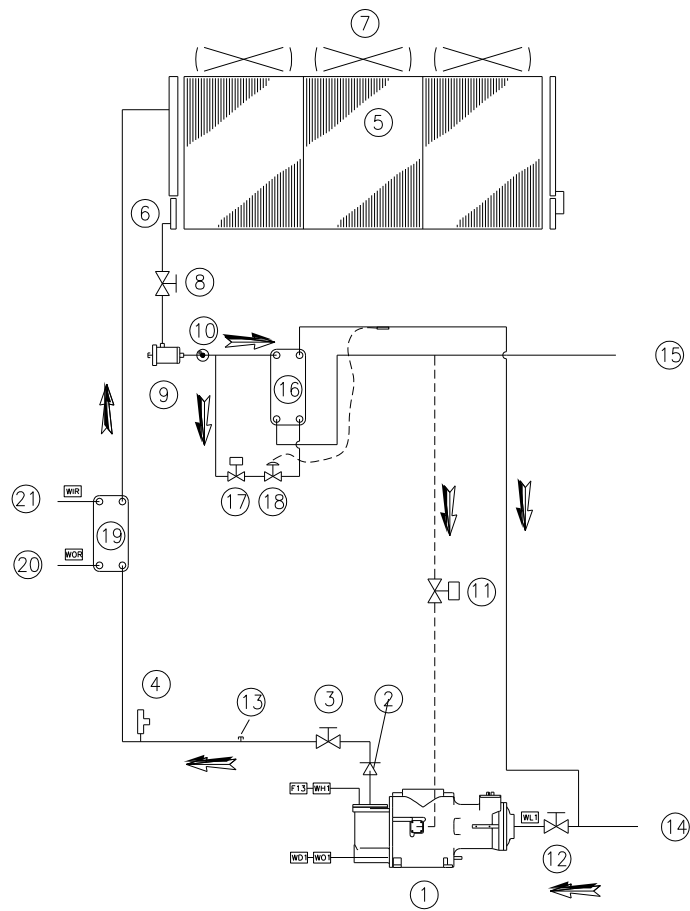
- |     |                                       |      |   |
|-----|---------------------------------------|------|---|
| 1.  | Single-screw compressor               | 18.  | Water inlet connection                            |
| 2.  | Non-return valve                      | 19.  | Additional Subcooler                              |
| 3.  | Compressor discharge shutoff valve    | 20.  | Additional Subcooler solenoid valve               |
| 4.  | High-pressure safety valve (25,5 bar) | 21.  | Additional subcooler thermostatic expansion valve |
| 5.  | Condenser coil                        | 22.  | Heat recovery exchanger                           |
| 6.  | Built-in undercooling section         | 23.  | Heat recovery water inlet                         |
| 7.  | Axial ventilator                      | 24.  | Heat recovery water outlet                        |
| 8.  | Liquid line isolating tap             | ST1  | Suction temperature probe                         |
| 9.  | Dehydration filter                    | WL1  | Low-pressure transducer (-0,5:7,0 bar)            |
| 10. | Liquid and humidity indicator         | WO1. | Oil pressure transducer (0,0:30,0 bar)            |
| 11. | Electronic expansion valve            | WH1. | High-pressure transducer (0,0:30,0 bar)           |
| 12. | Liquid injection solenoid valve       | WD1. | Discharge temperature sensor/ Oil                 |
| 13. | Direct expansion evaporator           | F13. | High-pressure pressure switch (21,0 bar)          |
| 14. | Low-pressure safety valve (15,5 bar)  | WIE. | Water entering temperature probe                  |
| 15. | Compressor suction shutoff valve      | WOE. | Water leaving temperature probe                   |
| 16. | Service port                          | WIR. | Heat recovery water entering temperature probe    |
| 17. | Water outlet connection               | WOR. | Heat recovery water leaving temperature probe     |

**Figure 24 - EWAD 100E ÷ 410E SS – EWAD 100E ÷ 400E SL  
Heat recovery refrigerante circuit - Economised units**



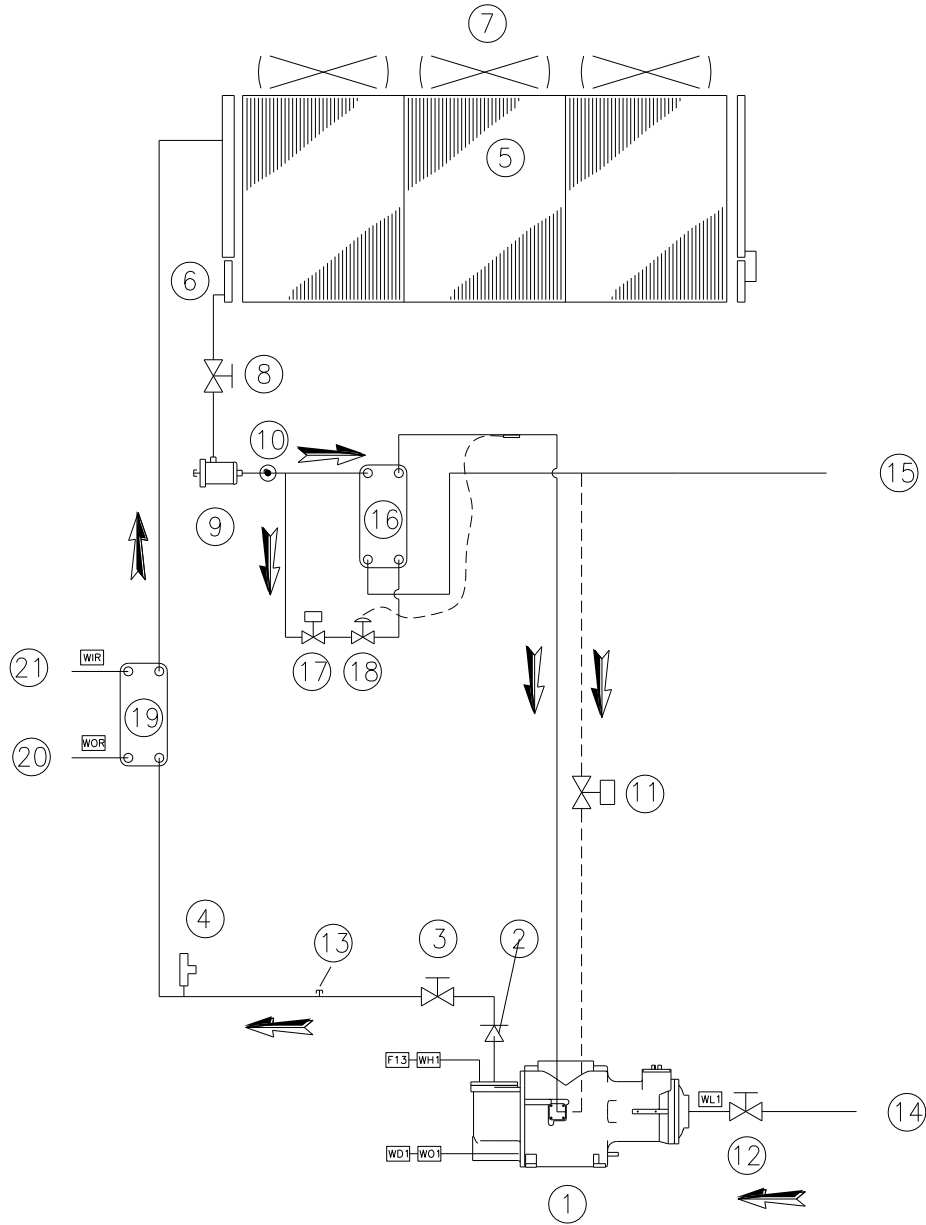
- |     |                                       |      |  |
|-----|---------------------------------------|------|--|
| 1.  | Single-screw compressor               | 18.  | Water inlet connection                         |
| 2.  | Non-return valve                      | 19.  | Economiser                                     |
| 3.  | Compressor discharge shutoff valve    | 20.  | Economiser solenoid valve                      |
| 4.  | High-pressure safety valve (25,5 bar) | 21.  | Economiser thermostatic expansion valve        |
| 5.  | Condenser coil                        | 22.  | Heat recovery exchanger                        |
| 6.  | Built-in undercooling section         | 23.  | Heat recovery water inlet                      |
| 7.  | Axial ventilator                      | 24.  | Heat recovery water outlet                     |
| 8.  | Liquid line isolating tap             | ST1  | Suction temperature probe                      |
| 9.  | Dehydration filter                    | WL1  | Low-pressure transducer (-0,5:7,0 bar)         |
| 10. | Liquid and humidity indicator         | WO1. | Oil pressure transducer (0,0:30,0 bar)         |
| 11. | Electronic expansion valve            | WH1. | High-pressure transducer (0,0:30,0 bar)        |
| 12. | Liquid injection solenoid valve       | WD1. | Discharge temperature sensor/ Oil              |
| 13. | Direct expansion evaporator           | F13. | High-pressure pressure switch (21,0 bar)       |
| 14. | Low-pressure safety valve (15,5 bar)  | WIE. | Water entering temperature probe               |
| 15. | Compressor suction shutoff valve      | WOE. | Water leaving temperature probe                |
| 16. | Service port                          | WIR. | Heat recovery water entering temperature probe |
| 17. | Water outlet connection               | WOR. | Heat recovery water leaving temperature probe  |

**Figure 25 - ERAD 120E ÷ 490E-SS – ERAD 120E ÷ 460E-SL  
Heat recovery refrigerante circuit - Not Economised units**



- |     |                                       |      |   |
|-----|---------------------------------------|------|---|
| 1.  | Single-screw compressor               | 16.  | Additional Subcooler                              |
| 2.  | Non-return valve                      | 17.  | Additional Subcooler solenoid valve               |
| 3.  | Compressor discharge shutoff valve    | 18.  | Additional subcooler thermostatic expansion valve |
| 4.  | High-pressure safety valve (25,5 bar) | 19.  | Heat recovery exchanger                           |
| 5.  | Condenser coil                        | 20.  | Heat recovery water inlet                         |
| 6.  | Built-in undercooling section         | 21.  | Heat recovery water outlet                        |
| 7.  | Axial ventilator                      | WL1  | Low-pressure transducer (-0,5:7,0 bar)            |
| 8.  | Liquid line isolating tap             | WO1. | Oil pressure transducer (0,0:30,0 bar)            |
| 9.  | Dehydration filter                    | WH1. | High-pressure transducer (0,0:30,0 bar)           |
| 10. | Liquid and humidity indicator         | WD1. | Discharge temperature sensor/ Oil                 |
| 11. | Liquid injection solenoid valve       | F13. | High-pressure pressure switch (21,0 bar)          |
| 12. | Compressor suction shutoff valve      | WIE. | Chilled fluid entering temperature probe          |
| 13. | Service port                          | WOE. | Chilled fluid leaving temperature probe           |
| 14. | Suction line connection               | WIR. | Heat recovery water entering temperature probe    |
| 15. | Liquid line connection                | WOR. | Heat recovery water leaving temperature probe     |

**Figure 26 - ERAD 120E ÷ 490E-SS – ERAD 120E ÷ 460E-SL  
Heat recovery refrigerante circuit - Economised units**



- |     |                                       |      |  |
|-----|---------------------------------------|------|--|
| 1.  | Single-screw compressor               | 16.  | Economiser                                     |
| 2.  | Non-return valve                      | 17.  | Economiser solenoid valve                      |
| 3.  | Compressor discharge shutoff valve    | 18.  | Economiser thermostatic expansion valve        |
| 4.  | High-pressure safety valve (25,5 bar) | 19.  | Heat recovery exchanger                        |
| 5.  | Condenser coil                        | 20.  | Heat recovery water inlet                      |
| 6.  | Built-in undercooling section         | 21.  | Heat recovery water outlet                     |
| 7.  | Axial ventilator                      | WL1  | Low-pressure transducer (-0,5:7,0 bar)         |
| 8.  | Liquid line isolating tap             | WO1. | Oil pressure transducer (0,0:30,0 bar)         |
| 9.  | Dehydration filter                    | WH1. | High-pressure transducer (0,0:30,0 bar)        |
| 10. | Liquid and humidity indicator         | WD1. | Discharge temperature sensor/ Oil              |
| 11. | Liquid injection solenoid valve       | F13. | High-pressure pressure switch (21,0 bar)       |
| 12. | Compressor suction shutoff valve      | WIE. | Chilled fluid entering temperature probe       |
| 13. | Service port                          | WOE. | Chilled fluid leaving temperature probe        |
| 14. | Suction line connection               | WIR. | Heat recovery water entering temperature probe |
| 15. | Liquid line connection                | WOR. | Heat recovery water leaving temperature probe  |

## Compressor

The single-screw compressor is of the semi-hermetic type with asynchronous three-phase two-pole engine which is directly splined to the main shaft. The intake gas from the evaporator cools the electrical engine before entering the intake ports. Inside the electrical engine, there are temperature sensors completely covered by the coil winding that constantly monitor engine temperature. Should the coil winding temperature become very high (120°C), a special external apparatus that is connected to the sensors and to the electronic controller will de-activate the corresponding compressor.

The compressors of EWAD100E÷210E-SS/SL, ERAD120E÷250E-SS, ERAD120E÷240E-SL units are Fr3100 and the compressors of EWAD260E÷410E-SS, EWAD250E÷400E-SL and ERAD310E÷490E-SS, ERAD300E÷460E-SL units are F3. Fr3100 compressor has one single satellite on the upper section of the main screw; F3 compressors have two satellites symmetrically positioned on the main screw sides.

There are only two moving rotating parts in Fr3100 compressor and three moving parts in F3 compressors and there are no other parts in the compressor with an eccentric and/or alternative movement.

The basic components are therefore only the main rotor and the satellites that carry out the compression process, meshing perfectly together.

Compression sealing is done thanks to a suitably shaped special composite material that is interposed between the main screw and the satellite. The main shaft on which the main rotor is splined is supported by 2 ball bearings. The system made up in this way is both statically and dynamically balanced before assembly.



**Figure 27 - Picture of Fr3100 compressor**



**Figure 28 - Picture of F3 compressor**

On the upper part of Fr3100 compressor, there is a large access cover allowing quick and easy maintenance; on F3 compressor, the access to the internal parts is allowed by two covers positioned sidewise.

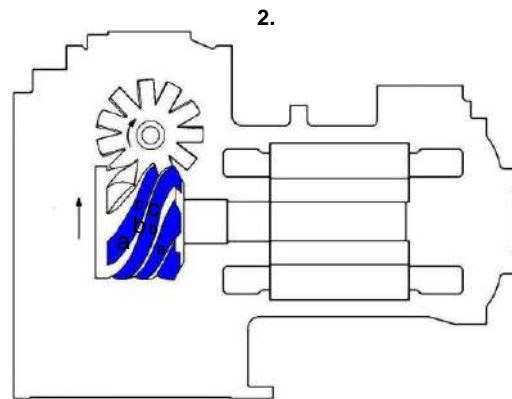
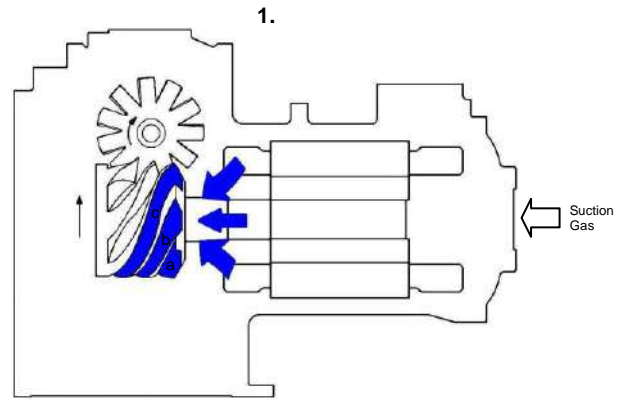
## Compression process

With the single-screw compressor the intake, compression and discharge process takes place in a continuous manner thanks to the satellite. In this process the intake gas penetrates into the profile between the rotor, the teeth of the satellite and the compressor body. The volume is gradually reduced by compression of the refrigerant. The compressed gas under high pressure is thus discharged in the built-in oil separator. In the oil separator the gas/ oil mixture and the oil are collected in a cavity in the lower part of the compressor, where they are injected into the compression mechanisms in order to ensure the compression's sealing and lubrication of the ball bearings.

### 1. and 2. Suction

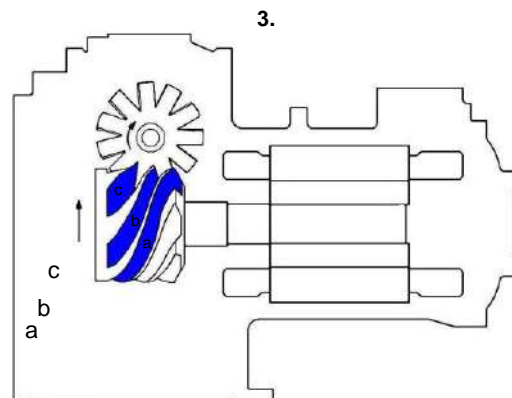
Main rotor flutes 'a', 'b' and 'c' are in communication at one end with the suction chamber via the bevelled rotor end face, and are sealed at the other end by the star rotor teeth. As the main rotor turns, the effective length of the flutes increases with a corresponding increase in the volume open to the suction chamber: Diagram 1 clearly shows this process. As flute 'a' assumes the position of flutes 'b' and 'c' its volume increases, inducing suction vapour to enter the flute.

Upon further rotation of the main rotor, the flutes which have been open to the suction chamber engage with the star teeth. This coincides with each flute being progressively sealed by the main rotor. Once the flute volume is closed off from the suction chamber, the suction stage of the compression cycle is complete.



### 3. Compression

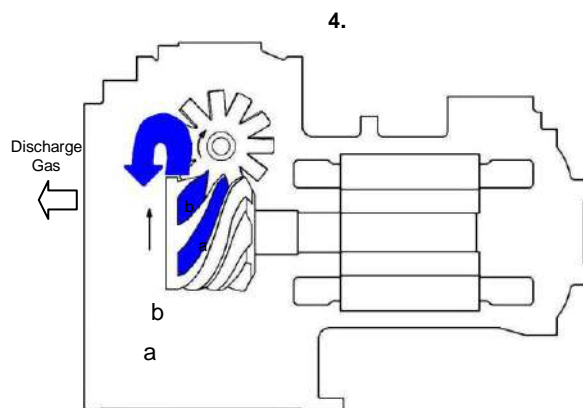
As the main rotor turns, the volume of gas trapped within the flute is reduced as the length of the flute shortens and compression occurs.



### 4. Discharge

As the star rotor tooth approaches the end of a flute, the pressure of the trapped vapour reaches a maximum value occurring when the leading edge of the flute begins to overlap the triangular shaped discharge port.

Compression immediately ceases as the gas is delivered into the discharge manifold. The star rotor tooth continues to scavenge the flute until the flute volume is reduced to zero. This compression process is repeated for each flute/star tooth in turn.



Oil separator not shown

Figure 29 – Compression process



## Cooling capacity control

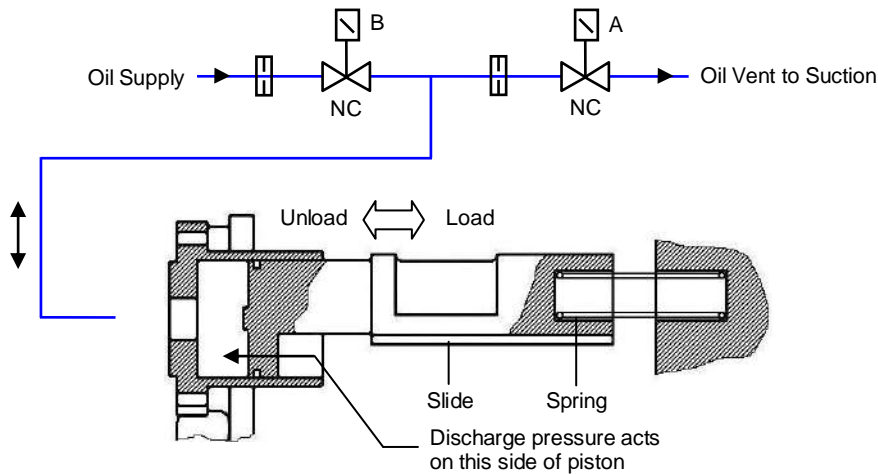
The compressors are factory-equipped with a stepless cooling capacity control system.

Unloading slides reduces the groove's intake capacity and reduces its actual length.

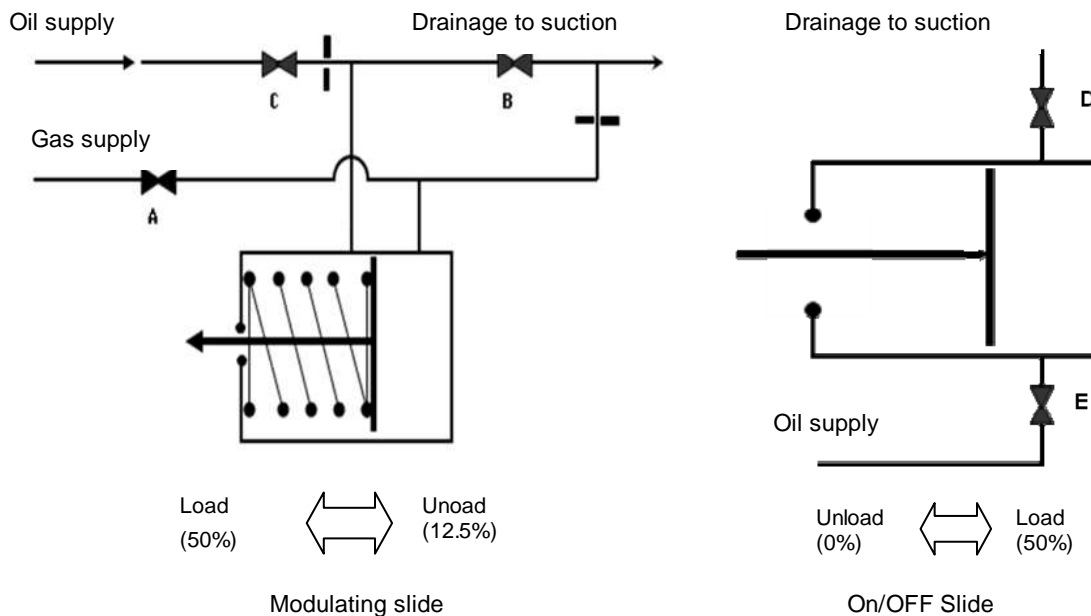
Unloading slides are controlled by the pressure of the oil coming from the separator or drained towards the compressor suction; springs acts for producing the forces for moving the slide.

The oil flow is controlled by solenoid valves, according to inputs from the unit controller.

Fr3100 compressor, having one satellite, has one slide only, while F3 compressors have two unloading slides. The first slide allows to change the load continuously while the second one has on/off operation.



**Figure 30 - Capacity control mechanism for Fr3100 compressor**



**Figure 31 - Capacity control mechanism for F3 compressor**

## Pre-startup checks

### General

Once the machine has been installed, use the following procedure to check that it has been done properly:

#### **ATTENTION**

Switch off the power supply of the machine before performing any checks.  
Failure to respect these rules at this stage can result in serious injury to the operator or even death.

Inspect all the electrical connections to the power circuits and to the compressors including the contactors, fuse carriers and electrical terminals and check that they are clean and well secured. Even though this is done at the factory to every machine that is shipped, vibrations from transport could have loosened some electrical connections.

#### **ATTENTION**

Check that the electrical terminals of cables are well tightened. A loose cable can overheat and give rise to problems with the compressors.

Open discharge, liquid, liquid injection and intake (if installed) taps.

#### **ATTENTION**

Do not start up the compressors if the exhaust, liquid, liquid injection and intake taps are closed. Failure to open these taps/ valves can cause serious damage to the compressor.

Place all the thermal-magnetic switches of the ventilators ( from F16 to F20 and from F26 to F30) on the On position.

#### **ATTENTION**

If all fan circuit breakers are kept off, both compressors will block due to high pressure when the machine is started up for the first time. Resetting the high-pressure alarm requires opening the compressor compartment and resetting the mechanical high-pressure switch.

Check the power supply voltage at the general disconnect switch terminals. The power supply voltage must be the same as that on the nameplate. Maximum allowed tolerance  $\pm 10\%$ .  
Voltage unbalance between the three phases must not exceed  $\pm 3\%$ .

The unit comes with a factory-supplied phase monitor that prevents compressors from starting in the event of an erroneous phase sequence. Properly connect the electrical terminals to the disconnect switch so as to ensure alarm-free operation. In the event that, after the machine has been powered on, the phase monitor should set off an alarm, only invert two phases at the general disconnect switch input (Unit input). Never invert the electrical wiring on the monitor.

#### **ATTENTION**

Starting up with the wrong sequence of phases irreparably compromises operation of the compressor. Ensure that phases L1, L2 and L3 correspond in sequence to R, S and T.

Fill the water circuit and remove air from the system's highest point and open the air valve above the evaporator skirt. Remember to close it again after filling. The design pressure on the water side of the evaporator is 10.0 bars. Never exceed this pressure at any time during the life of the machine.

## ▲ IMPORTANT

Before placing the machine into operation, clean the hydraulic circuit. Dirt, incrustation, corrosion residue and other extraneous material can accumulate in the heat exchanger and reduce its thermal exchange capacity. Pressure drops can also increase, consequently reducing water flow. Thus, correct water treatment reduces the risk of corrosion, erosion, scaling, etc. The most appropriate water treatment must be established locally, according to the type of installation and to the characteristics of the process water locally. The manufacturer is not responsible for damage or bad operation of the apparatus resulting from failure to treat water or from incorrectly treated water.

### Units with an external water pump

Start the water pump and check the hydraulic system for any leaks; repair these if necessary. While the water pump is in operation, adjust the water flow until the design pressure drop for the evaporator is reached. Adjust the flow switch trigger point (not factory-supplied), to ensure operation of the machine within a  $\pm 20\%$  flow range.

### Units with a built-in water pump

This procedure foresees factory installation of the optional single- or twin-water pump kit. Check that switches Q0 and Q1 are in the open position (Off or 0). Also check that the circuit breaker Q12 in the electrical panel is in the Off position. Close the general Q10 door-block switch on the main board and move the Q12 switch to the On position.

## ▲ ATTENTION

From this moment onwards, the machine will be under electrical power. Use extreme caution in subsequent operations. A lack of attention in the subsequent operations can cause serious personal injury.

**Single pump** To start the water pump, press the microprocessor On/Off button and wait for the unit on message to appear on the display. Turn the Q0 switch to the On (or 1) position to start the water pump. Adjust the water flow until reaching the evaporator design pressure drop. Adjust the flow switch (not included) at this point, to ensure that the machine operates within a  $\pm 20\%$  flow range.

**Twin pump** The system foresees the use of a twin pump having two motors, each as a backup to the other. The microprocessor enables one of the two pumps with a view to minimising the number of hours and of startups. To start one of the two water pumps, press the microprocessor On/Off button and wait for the unit on message to appear on the display. Turn the Q0 switch to the On (or 1) position to start it. Adjust the water flow until reaching the evaporator design pressure drop. Adjust the flow switch (not included) at this point, to ensure that the machine operates within a  $\pm 20\%$  flow range. To start the second pump, keep the first one on for at least 5 minutes, then open the Q0 switch, wait for the first pump to turn off. Close the Q0 switch again to start the second pump. Using the microprocessor keyboard it is possible, however, to set pump startup priorities. Please see the microprocessor manual for the relevant procedure.

### Electrical power supply

The machine's power supply voltage must be the same as that specified on the nameplate  $\pm 10\%$  while the voltage unbalance between phases must not be in excess of  $\pm 3\%$ . Measure the voltage between phases and if the value does not fall within the established limits, correct it before starting the machine.

## ▲ ATTENTION

Provide suitable power supply voltage. Unsuitable power supply voltage could cause malfunction of the control components and undesired triggering of the thermal protection devices, along with a considerable reduction in the life of the contactors and electric motors.

### Unbalance in power supply voltage

In a three-phase system, excessive unbalance between the phases causes overheating of the engine. The maximum allowed voltage unbalance is 3%, calculated as follows:

$$\text{Unbalance \%} = \frac{V_{MAX} - V_{AVG}}{V_{AVG}} \times 100 = \text{_____ \%}$$

AVG = Average

Example: the three phases measure respectively 383, 386 and 392 Volts, the average is:

$$\frac{383+386+392}{3} = 387 \text{ Volts}$$

thus the unbalance percentage is

$$\frac{392-387}{387} \times 100 = 1,29\% \quad \text{below the maximum allowed (3\%)}$$

## Electrical heater power supply

Each compressor comes with an electrical heater located at the bottom of the compressor. Its purpose is to warm up the lubricating oil and thus avoid the transmigration of refrigerant fluid within.

It is therefore necessary to ensure that the heaters are powered at least 24 hours before the planned startup time. To ensure that they are activated, it is sufficient to keep the machine on by closing the general disconnecting switch Q10.

The microprocessor, however, has a series of sensors that prevent the compressor being started up when the oil temperature is not at least 5°C above the intake-pressure equivalent saturation temperature.

Keep the Q0, Q1 and Q12 switches in the Off (or 0) position until the machine is to be started up.

# Startup procedure

## Turning on the machine

1. With the general switch Q10 closed, check that switches Q0, Q1 and Q12 are in the Off (or 0) position.
2. Close the thermal-magnetic switch Q12 and wait for the microprocessor and the control to start. Check that the oil temperature is warm enough. The oil temperature must be at least 5 °C above the saturation temperature of the refrigerant in the compressor. If the oil is not warm enough, it will not be possible to start the compressors and the phrase "Oil Heating" will appear on the microprocessor display.
3. Start the water pump should the machine not be supplied with one.
4. Position the Q0 switch on the On position and wait for Unit-On/ Compressor Stand-By to appear on the display. If the water pump is supplied with the machine, the microprocessor should start it at this point.
5. Check that the evaporator pressure drop is the same as the design pressure drop and correct it if necessary. The pressure drop must be measured at the factory-supplied loading joints placed on the evaporator piping. Do not measure pressure drops in points where any valves and/or filters are interposed.
6. Only at the first startup, position the Q0 switch on Off to check that the water pump stays on for three minutes before it, too, shuts down (both the on-board pump and any external pump).
7. Move the Q0 switch to On once again.
8. Check that the local temperature setpoint is set to the required value by pressing the Set button.
9. Turn the Q1 switch to On (or 1) to start compressor #1.
10. Once the compressor has started, wait at least 1 minute for the system to start stabilising. During this time the controller will perform a series of operations to empty the evaporator (Pre-Purge) to ensure a safe startup.
11. At the end of the Pre-Purge, the microprocessor will start loading the compressor, now running, in order to reduce outgoing water temperature. Check the proper functioning of the loading device by measuring the compressor's electrical current requirement..
12. Check refrigerant evaporation and condensation pressure.
13. Check that the cooling ventilators have started, in relation to and increase in condensation pressure.
14. Check that, after the time required for the refrigerant circuit to stabilise, the liquid pilot lamp located on the tube leading into the expansion valve is completely full (no bubbles) and that the humidity indicator shows "Dry". The passage of bubbles inside the liquid pilot lamp could indicate a low refrigerant level or an excessive pressure drop through the dehydration filter or an expansion valve that is blocked at the maximum open position.
15. In addition to checking the liquid pilot lamp, check the circuit operating parameters by verifying:
  - Compressor overheating during intake
  - Compressor overheating during exhaust
  - Undercooling of liquid coming out of the condenser batteries
  - Evaporation pressure
  - Condensation pressure

Except for liquid temperature and intake temperature for machines with a thermostatic valve, which require the use of an external thermometer, all other measurements can be carried out by reading the relevant values directly on the on-board microprocessor display.

**Table 25 - Typical working conditions with compressors at 100%**

Economised cycle?	Suction superheat	Discharge superheat	Liquid Subcooling
NO	4 ± 6 °C	20 ± 25 °C	5 ± 6 °C
SI	4 ± 6 °C	18 ± 23 °C	10 ± 15 °C

NB: Typical working condition are for unit working at about 2° suction saturated temperature and about 50°C saturated discharge temperature

### ▲ IMPORTANT

The symptoms of a low refrigerant charge are: low evaporation pressure, high intake and exhaust overheating (beyond the above limits) and a low undercooling level. In this case, add R134a refrigerant to the relevant circuit. A loading joint is foreseen in the system, between the expansion valve and the evaporator. Charge refrigerant until working conditions return to normal.

Remember to reposition the valve cap when finished.

To turn off the machine temporarily (daily or weekend shutdown) turn the Q0 switch to Off (or 0) or open the remote contact between terminals 58 and 59 on terminal board M3 (Installation of remote switch to be carried out by the customer). The microprocessor will activate the shutdown procedure, which required several seconds. Three minutes after the compressors have been shut down, the microprocessor will shut down the pump. Do not switch of the main power supply so as not to de-activate the electrical resistances of the compressors and of the evaporator.

## ▲ IMPORTANT

If the machine is not supplied with an onboard built-in pump, do not shut down the external pump before 3 minutes have elapsed after the last compressor has shut down. Early shutdown of the pump triggers a water-flow failure alarm.

### Seasonal shutdown

Turn switch Q1 to the Off (or 0) position to shut down the compressors, using the normal pumpdown procedure.

After the compressors have been shut down, turn switch Q0 to Off (or 0) and wait for the built-in water pump to shut down. If the water pump is managed externally, wait for 3 minutes after the compressors have shut down before turning off the pump.

Open the Q12 (Off position) thermal magnetic switch inside the control section of the electrical board then open the general disconnect switch Q10 to cut off the machine's power supply entirely.

Close the compressor intake taps (if any) and delivery taps and also the taps located on the liquid and liquid injection line. Place a warning sign on every switch that has been opened, advising to open all the taps before starting the compressors.

If no water and glycole mixture has been introduced into the system, discharge all the water from the evaporator and from the connected piping if the machine is to remain inactive during the winter season. One must remember that once the machine's power supply has been cut off, the antifreeze electrical resistance cannot function. Do not leave the evaporator and piping exposed to the atmosphere during the entire period of inactivity.

### Starting up after seasonal shutdown

With the general disconnect switch open, make sure that all the electrical connections, cables, terminals and screws are well tightened to ensure good electrical contact.

Verify that the power supply voltage applied to the machine is within  $\pm 10\%$  of the nominal nameplate voltage and that the voltage unbalance between phases is between  $\pm 3\%$ .

Verify that all control apparatus is in good condition and functioning and that there is a suitable thermal load for startup.

Verify that all the connection valves are well tightened and that there are no refrigerant leaks. Always reposition the valve caps.

Verify that switches Q0, Q1 and Q12 are in the open position (Off). Turn the general disconnect switch Q10 to the On position. Doing this will allow to turn on the electrical resistances of the compressors. Wait at least 12 hours for them to start up.

Open all intake, delivery, liquid and liquid injection taps. Always reposition tap covers.

Open the water valves to fill the system and bleed air from the evaporator through the air valve installed on its shell. Verify that there is no water leakage from piping.

## **System maintenance**

### **▲ WARNING**

All routine and extraordinary maintenance activities on the machine must be carried out solely by qualified personnel who is personally familiar with the apparatus, with its functioning, with the correct servicing procedures and who know all the safety requirements and are aware of the dangers.

### **▲ WARNING**

It's absolutely forbidden to remove all the protections of the moving parts of the unit

### **▲ WARNING**

The causes of repeated shutdowns deriving from triggering of safety devices must be investigated and put right. Only resetting the alarm can heavily damage the unit.

### **▲ WARNING**

A correct refrigerant and oil charge is essential for optimal operation of the machine and for environmental protection. Any oil and refrigerant recovery must conform to legislation in force.

## **General**

### **▲ IMPORTANT**

Besides the checks suggested in the routine maintenance program, it is recommended to schedule periodical inspections by qualified personnel according to as follows:

4 inspections per year (1 every 3 months) for units running about 365 days per year;

2 inspections per year (1 at seasonal start-up and the second one in the middle of the season) for units running about 180 days per year with seasonal operation.

It is important that during initial startup and periodically during operation, routine verifications and checks are performed. These must also include verification of intake and condensation pressure and the glass pilot lamp place on the liquid line. Verify through the on-board microprocessor that the machine operates within the normal overheating and undercooling parameter. A recommended routine maintenance programme is shown at the end of this chapter while a form for collecting operation data can be found at the end of this manual. Weekly recording of all the machine's operating parameters is recommended. Collecting this data will be very useful to the technicians in the event that technical assistance is called for.

## **Compressor maintenance**

### **▲ IMPORTANT**

Since the compressor is of the semi-hermetic type, it requires no scheduled maintenance. However, for granting the highest levels of performance and efficiency and for preventing malfunctions, it is recommended, about every 10.000 running hours, a visual check about wear status of the satellites and mating tolerances for the main screw and the satellite.

Such inspection has to be carried out by qualified and trained personnel.

The analysis of vibrations is a good method for verifying the mechanical conditions of the compressor. Verification of vibration readings immediately after startup and periodically on an annual basis is recommended. The compressor load will need to be similar to the previous measurement's load to ensure measurement reliability.

## Lubrication

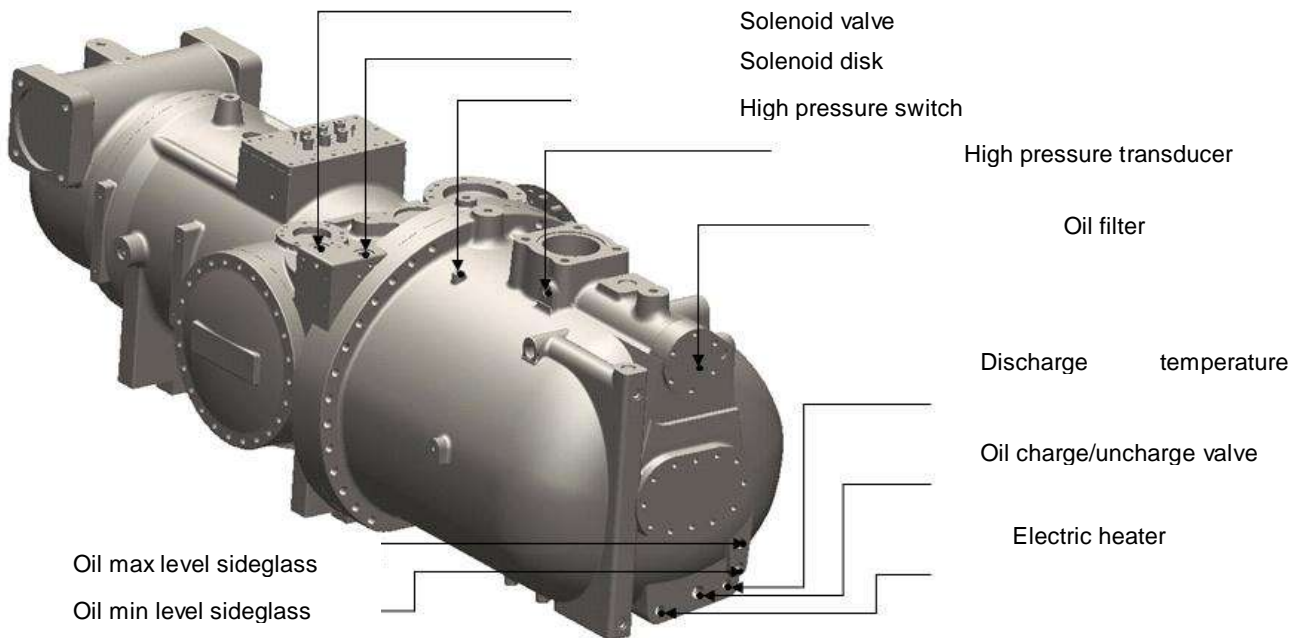
McEnergy units do not require a routine procedure for lubrication of components. The ventilator bearings have permanent lubrication and no additional lubrication is therefore required.

Compressor oil is of the synthetic type and is highly hygroscopic. It is therefore advised to limit its exposition to the atmosphere during the storage and loading phases. It is recommended that the oil be exposed to the atmosphere for no more than 10 minutes.

The compressor oil filter is positioned under the oil separator (delivery side). Its replacement is advised when its pressure drop exceeds 2.0 bars. The pressure drop through the oil filter is the difference between the compressor delivery pressure and the oil pressure. Both these pressures can be controlled through the microprocessor for both compressors.



**Figure 32 - Installation of control devices for Fr3100 compressor**



**Figure 33 - Installation of control devices for F3 compressor**



## Routine maintenance

**Table 26 - Routine maintenance programme**

List of Activities	Weekly	Monthly (Note 1)	Yearly (Note 2)
<b>General:</b>			
Collection of operating data (Note 3)	X		
Visual inspection of machine for any damage and/or loosening		X	
Verification of thermal insulation integrity			X
Clean and paint where necessary			X
Analysis of water (6)			X
<b>Electrical:</b>			
Verification of control sequence			X
Verify contactor wear – Replace if necessary			X
Verify that all electrical terminals are tightened – Tighten if necessary			X
Clean inside the electrical control board			X
Visual inspection of components for any signs of overheating		X	
Verify operation of compressor and of its electrical resistance		X	
Measure compressor engine isolation using the Megger			X
<b>Chilling circuit:</b>			
Test for any refrigerant leakage		X	
Verify refrigerant flow using the liquid pilot lamp – Pilot lamp full	X		
Verify dehydration filter pressure drop		X	
Verify oil filter pressure drop (Note 5)		X	
Analyse compressor vibrations			X
Analyse compressor oil acidity (7)			X
<b>Condenser section:</b>			
Clean condenser batteries (Note 4)			X
Verify that ventilators are well tightened			X
Verify battery fins – Comb if necessary			X

**Notes:**

- 1) Monthly activities include all the weekly ones
- 2) The annual (or early season) activities include all weekly and monthly activities
- 3) Machine operating values should be noted daily thus keeping the observation level high.
- 4) Battery cleaning could be more frequently necessary in environments with a high percentage of particles in the air.
- 5) Replace the oil filter when its pressure drop reaches 2.0 bars
- 6) Check for any dissolved metals
- 7) TAN (Total Acid Number) :  
 $\leq 0.10$  : No action  
 Between 0.10 and 0.19 : Replacement of anti-acid filters and verification after 1000 hours' operation. Continue substituting filters until the TAN falls below 0.10.  
 $> 0.19$  : Replace oil, oil filter and dehydration filter. Verify at regular intervals.

### Dehydration filter replacement

It is strongly advised that the dehydration filter cartridges be replaced in the event of a considerable pressure drop across the filter itself or of a passage of bubbles through the liquid pilot lamp while the undercooling value is within the accepted limits.

Replacement of the cartridges is advised when the pressure drop across the filter reaches 50 kPa with the compressor under full load.

The cartridges must also be replaced when the humidity indicator inside the liquid pilot lamp changes color and shows excessive humidity, or when the periodic oil test reveals the presence of acidity (TAN is too high)

### Dehydration filter cartridge replacement procedure

#### ▲ ATTENTION

Ensure proper water flow through the evaporator during the entire servicing period. Interrupting the water flow during this procedure would cause the evaporator to freeze, with consequent breakage of internal piping.

Shut down the relevant compressor by turning the Q1 or Q2 switch to Off  
Wait until the compressor has stopped and close the tap located on the liquid line  
Start the relevant compressor by turning the Q1 or Q2 switch to On.  
Check the relevant evaporation pressure on the microprocessor display.  
When the evaporation pressure reaches 100 kPa turn the Q1 or Q2 switch again to turn off the compressor.  
Once the compressor has stopped, place a label on the compressor startup switch that is under maintenance, to prevent undesired startups.  
Close the compressor intake tap (if any).  
Using a recovery unit remove surplus refrigerant from the liquid filter, until atmospheric pressure is reached. The refrigerant must be stored in a suitable and clean container.

### ▲ ATTENTION

To protect the environment, do not release removed refrigerant into the atmosphere. Always use a recovery and storage device.

Balance internal pressure with external pressure by pressing the valve vacuum pump installed on the filter cover.  
Remove the dehydration filter cover.  
Remove the filtering elements.  
Install the new filtering elements within the filter.  
Replace the cover gasket. Do not allow any mineral oil onto the filter gasket so as not to contaminate the circuit. Use only compatible oil for this purpose (POE).  
Close the filter cover.  
Connect the vacuum pump to the filter and evacuate up to 230 Pa.  
Close the vacuum pump tap.  
Recharge the filter with the refrigerant recovered during emptying.  
Open the liquid line tap.  
Open the intake tap (if any).  
Start the compressor by turning switch Q1.

## Oil filter replacement

### ▲ ATTENTION

The lubrication system has been designed to keep most of the oil charge inside the compressor. During operation, however, a limited quantity of oil circulates freely in the system, conveyed by the refrigerant. The quantity of replacement oil going into the compressor should therefore be equal to the quantity removed and not to the total quantity appearing on the nameplate; this will avoid there being too much oil at the following startup.  
The quantity of oil removed from the compressor must be measured after having allowed the refrigerant present in this oil to evaporate for a suitable amount of time. To reduce the refrigerant content in the oil to a minimum, it is advised that the electrical resistances be kept on and that the oil be removed only when it has reached a temperature of 35 ±45°C.

### ▲ ATTENTION

Oil filter replacement requires the best attention on the eventual oil recovering; the oil cannot be exposed to air for more than about 30 minutes.  
In case of doubts, verify oil acidity or, if it is not possible to carry out the measurement, replace the oil with other one stored in sealed tanks or stored complying with the supplier specifications.

The compressor oil filter is located under the oil separator (discharge side). It is strongly advised that it be replaced when its pressure drop exceeds 2.0 bars. The pressure drop across the oil filter is the difference between the compressor delivery pressure minus oil pressure. Both these pressure can be controlled through the microprocessor for both compressors.

Compatible oils:

Daphne PVE Hermetic oil FCV 68DICI Emkarate RL 68H

## Oil filter replacement procedure

- 1) Shut down both compressors by turning the switch to the Off position.
- 2) Turn the Q0 switch to Off, wait for the circulation pump to turn off and open the general disconnect switch Q10 to cut off the machine's electrical power supply.
- 3) Place a plate on the handle of the general disconnect switch in order to prevent accidental startups.
- 4) Close the suction, discharge and liquid injection valves.

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- 5) Connect the recuperator to the compressor and recover the refrigerant in a suitable and clean storage container.
- 6) Evacuate the refrigerant until the internal pressure has turned negative (compared to atmospheric pressure). The amount of refrigerant dissolved in the oil is reduced to a minimum in this way.
- 7) Remove the oil in the compressor by opening the discharge valve located under the motor
- 8) Remove the oil filter cover and remove the internal filtering element.
- 9) Replace the cover and internal sleeve gasket. Do not lubricate the gaskets with mineral oil in order not to contaminate the system.
- 10) Insert the new filtering element.
- 11) Reposition the filter closing cover and tighten the screws. The screws must be tightened alternately and progressively setting the torque wrench at 60Nm.
- 12) Charge the oil from the upper tap located on the oil separator. Considering the high hygroscopicity of ester oil, it should be charged as quickly as possible. Do not expose ester oil to the atmosphere for more than 10 minutes.
- 13) Close the oil charging tap.
- 14) Connect the vacuum pump and evacuate the compressor up to a vacuum level of 230 Pa.
- 15) On reaching the abovesaid vacuum level, close the vacuum pump tap.
- 16) Open the system's discharge, suction and liquid injection valves.
- 17) Disconnect the vacuum pump from the compressor.
- 18) Remove the warning plate from the general disconnect switch.
- 19) Close the general disconnecting switch Q10 to supply power to the machine.
- 20) Start the machine by following the startup procedure described above.

## Refrigerant charge

### ▲ ATTENTION

The units have been designed to function with R134a refrigerant. So DO NOT USE refrigerants other than R134a.

### ▲ WARNING

When refrigerant gas is added to or removed from the system, ensure proper water flow through the evaporator for the entire charge/discharge time. Interrupting the water flow during this procedure would cause the evaporator to freeze with consequent breakage of its internal piping.  
Damage from freezing voids the warranty.

### ▲ ATTENTION

Removal of the refrigerant and replenishing operations must be performed by technicians who are qualified to use the appropriate materials for this unit. Unsuitable maintenance can result in uncontrolled losses in pressure and fluid. Do not disperse the refrigerant and lubricating oil in the environment. Always be equipped with a suitable recovery system.

The units ship with a full refrigerant charge, but in some cases it could be necessary to replenish the machine in the field.

### ▲ WARNING

Always verify the causes of a loss of refrigerant. Repair the system if necessary then recharge it.

The machine can be replenished under any stable load condition (preferably between 70 and 100%) and under any ambient temperature condition (preferably above 20°C). The machine should be kept on for at least 5 minutes to allow the ventilator steps, and thus the condensation pressure, to stabilise.

Approximately 15% of the condenser batteries is dedicated to subcool the liquid refrigerant. The subcooling value is approximately 5-6°C (10-15°C for the economised machines).

Once the subcooling section has been completely filled, additional refrigerant does not increase system efficiency. However, a small additional quantity of refrigerant (1÷2 kg) makes the system slightly less sensitive.

**Note:** When the load and the number of active fans vary, so does the subcooling and it requires several minutes to stabilise again. However, it should never fall below 3°C under any condition. Also, the subcooling value can change slightly as the water temperature and the intake overheating vary. As the intake overheating value decreases, there is a corresponding decrease in subcooling.

One of the following two scenarios can arise in a machine without refrigerant:  
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If the refrigerant level is slightly low, the passage of bubbles can be seen through the liquid pilot lamp. Replenish the circuit as described in the replenishment procedure.

If the gas level in the machine is moderately low, the corresponding circuit could have some low-pressure stops. Replenish the corresponding circuit as described in the replenishment procedure.

## Refrigerant replenishment procedure

If the machine has exhausted the refrigerant, it is necessary first of all to establish the causes, before carrying out any replenishment operation. The leak must be looked for and repaired. Oil stains are a good indicator, as they can appear in the vicinity of a leak. However, this is not necessarily always a good search criterion. Searching with soap and water can be a good method for medium to large leaks, while an electronic leak searching device is required to find the position of small leaks.

Add refrigerant to the system through the service valve located on the intake pipe or through the Schrader valve located on the evaporator entry pipe.

The refrigerant can be added under any load condition between 25 and 100% of the circuit. Intake overheating must be between 4 and 6°C.

Add enough refrigerant to fill the liquid pilot lamp entirely, until the passage of bubbles inside stops. Add an extra 2 ÷ 3 kg of refrigerant as a reserve, to fill the undercooler if the compressor is operating at 50 – 100% load.

Check the undercooling value by taking the liquid pressure and the liquid's temperature near the expansion valve. The undercooling value must be between 4 and 8 °C and between 10 and 15°C machines with an economiser. The undercooling value will be lower 75 to 100% of the load and above 50% of the load.

With ambient temperature above 16°C, all ventilators should be on.

A system overcharge will entail a rise in the compressor's discharge pressure, owing to excessive filling of the condenser section pipes.

**Table 27 - Pressure/ Temperature**

Pressure/Temperature table for HFC-134a							
°C	Bars	°C	Bars	°C	Bars	°C	Bars
-14	0.71	12	3.43	38	8.63	64	17.47
-12	0.85	14	3.73	40	9.17	66	18.34
-10	1.01	16	4.04	42	9.72	68	19.24
-8	1.17	18	4.37	44	10.30	70	20.17
-6	1.34	20	4.72	46	10.90	72	21.13
-4	1.53	22	5.08	48	11.53	74	22.13
-2	1.72	24	5.46	50	12.18	76	23.16
0	1.93	26	5.85	52	13.85	78	24.23
2	2.15	28	6.27	54	13.56	80	25.33
4	2.38	30	6.70	56	14.28	82	26.48
6	2.62	32	7.15	58	15.04	84	27.66
8	2.88	34	7.63	60	15.82	86	28.88
10	3.15	36	8.12	62	16.63	88	30.14

## Standard Checks

### Temperature and Pressure Transducers

The unit comes factory-equipped with all the sensors listed below. Periodically check that their measurements are correct by means of sample instruments (manometers, thermometers); correct readings if necessary using the microprocessor keyboard. Well-calibrated sensors ensure better efficiency for the machine and a longer lifetime.

Note: refer to the microprocessor use and maintenance manual for a complete description of applications, setting and adjustments.

All sensors are preassembled and connected to the microprocessor. The descriptions of each sensor are listed below:

**Evaporator fluid leaving temperature sensor** – This sensor is located on the evaporator outgoing water connection and is used by the microprocessor to control the machine's load according to the system's thermal load. It also performs the evaporator's antifreeze protection.

**Evaporator fluid entering temperature sensor** – This sensor is located on the evaporator ingoing water connection and is used for monitoring the return water temperature.

**External air temperature sensor** – Optional. This sensor allows to monitor the external air temperature on the microprocessor display. It is also used to carry out the "OAT setpoint override".

**Compressor delivery pressure transducer** – This is installed on every compressor and allows to monitor the delivery pressure and to control the ventilators. Should a increase in condensation pressure arise, the microprocessor will control the compressor load in order to allow it to function even if choked. It contributes to complementing the oil control logic.

**Oil pressure transducer** - This is installed on every compressor and allows to monitor the oil pressure. Using this sensor, the microprocessor informs the operator on the conditions of the oil filter and on how the lubrication system is functioning. By working together with the high- and low-pressure transducers, it protects the compressor from problems deriving from poor lubrication.

**Low-pressure transducer** – This is installed on every compressor and allow to monitor the compressor intake pressure along with low pressure alarms. It contributes to complementing the oil control logic.

**Compressor discharge temperature sensor** – This is installed on each compressor and allows to monitor compressor discharge temperature and oil temperature. The microprocessor controls liquid injection by means of this sensor and shuts down the compressor in case of alarm in the event that the discharge temperature reaches 110°C. It also protects the compressor from possible startups with liquid.

# Test sheet

It is recommended that the following operation data are noted periodically in order to check that the machine is functioning properly over time. These data will also be extremely useful to the technicians who will be performing routine and/or extraordinary maintenance on the machine.

## Fluid side measurements

Chilled fluid setpoint	°C	_____
Evaporator fluid leaving temperature	°C	_____
Evaporator fluid entering temperature	°C	_____
Evaporator fluid flow rate	m <sup>3</sup> /h	_____

## Refrigerant side measurements

	Compressor Load	_____	%
	N° of active Ventilators	_____	
	N° of expansion valve cycles (electronic only)	_____	
Refrigerant/ Oils pressure	Evaporating pressure	_____	Bar
	Condensing pressure	_____	Bar
	Oil pressure	_____	Bar
Refrigerant temperature	Saturated evaporating temperature	_____	°C
	Suction gas pressure	_____	°C
	Suction superheating	_____	°C
	Saturated condensating temperature	_____	°C
	Discharge superheating	_____	°C
	Liquid temperature	_____	°C
	Subcooling	_____	°C

## Electrical measurements

Analysis of the unit's voltage unbalance:

Phases:	RS	ST	RT
	_____ V	_____ V	_____ V

$$\text{Unbalance \%} = \frac{V_{MAX} - V_{AVG}}{V_{AVG}} \times 100 = \text{_____ \%}$$

AVG = average

Compressors current – Phases:                      **R**                      **S**                      **T**

Compressor #1	_____ A	_____ A	_____ A
Compressor #2	_____ A	_____ A	_____ A

Ventilators current:	#1	_____ A	#2	_____ A
	#3	_____ A	#4	_____ A
	#5	_____ A	#6	_____ A
	#7	_____ A	#8	_____ A

## **Service and limited warranty**

All machines are factory-tested and guaranteed for 12 months as of the first startup or 18 months as of delivery. These machines have been developed and constructed according to high quality standards ensuring years of failure-free operation. It is important, however, to ensure proper and periodical maintenance in accordance with all the procedures listed in this manual.

We strongly advise stipulating a maintenance contract with a service authorized by the manufacturer in order to ensure efficient and problem-free service, thanks to the expertise and experience of our personnel.

It must also be taken into consideration that the warranty period requires maintenance, as well, as do the warranty terms. It must be borne in mind that operating the machine in an inappropriate manner, beyond its operating limits or not performing proper maintenance according to this manual can void the warranty.

Observe the following points in particular, in order to conform to warranty limits:

The machine cannot function beyond the catalogue limits

The electrical power supply must fall within the voltage limits and without voltage harmonics or sudden changes.

The three-phase power supply must not have an unbalance between phases exceeding 3%. The machine must stay turned off until the electrical problem has been solved.

No safety device, either mechanical, electrical or electronic must be disabled or bypassed.

The water used for filling the hydraulic circuit must be clean and suitably treated. A mechanical filter must be installed at the point closest to the evaporator entrance.

Unless there is a specific agreement at the time of ordering, the evaporator water flow rate must never be above 120% and below 80% of the nominal flow rate.

## **Periodic obligatory checks and starting up of appliances under pressure**

The standard units are included in category II (with liquid receiver category IV) of the classification established by the European Directive PED 2014/68/EU.

For chillers belonging to this category, some local regulations require a periodic inspection by an authorized agency. Please check with your local requirements.

## **Important information regarding the refrigerant used**

This product contains fluorinated greenhouse gases. Contains fluorinated greenhouse gases.  
Do not vent gases into the atmosphere.

Refrigerant type: R134a

GWP(1) value: 1430

(1)GWP = Global Warming Potential

The refrigerant quantity is indicated on the unit name plate.

Periodical inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.

## Factory and Field charged units instructions

(Important information regarding the refrigerant used)

The refrigerant system will be charged with fluorinated greenhouse gases.  
Do not vent gases into the atmosphere.

1 Fill in with indelible ink the refrigerant charge label supplied with the product as following instructions:

- the refrigerant charge for each circuit (1; 2; 3)
- the total refrigerant charge (1 + 2 + 3)
- **calculate the greenhouse gas emission with the following formula:**  
GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

- a Contains fluorinated greenhouse gases
- b Circuit number
- c Factory charge
- d Field charge
- e Refrigerant charge for each circuit (according to the number of circuits)
- f Total refrigerant charge
- g Total refrigerant charge (Factory + Field)
- h **Greenhouse gas emission** of the total refrigerant charge expressed as tonnes of CO<sub>2</sub> equivalent
- m Refrigerant type
- n GWP = Global Warming Potential
- p Unit serial number

2 The filled out label must be adhered inside the electrical panel.

Periodical inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.

### NOTICE

In Europe, the **greenhouse gas emission** of the total refrigerant charge in the system (expressed as tonnes CO<sub>2</sub> equivalent) is used to determine the maintenance intervals. Follow the applicable legislation.

#### Formula to calculate the greenhouse gas emission:

GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

Use the GWP value mentioned on the greenhouse gases label. This GWP value is based on the 4th IPCC Assessment Report. The GWP value mentioned in the manual might be outdated (i.e. based on the 3rd IPCC Assessment Report)



## Field charged units instructions

(Important information regarding the refrigerant used)

The refrigerant system will be charged with fluorinated greenhouse gases.  
Do not vent gases into the atmosphere.

1 Fill in with indelible ink the refrigerant charge label supplied with the product as following instructions:

- the refrigerant charge for each circuit (1; 2; 3)
- the total refrigerant charge (1 + 2 + 3)
- **calculate the greenhouse gas emission with the following formula:**  
GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

The diagram shows a refrigerant charge label with the following fields and labels:

- a**: Points to the warning text: "Its functioning relies on fluorinated greenhouse gases".
- b**: Points to the circuit number "1".
- c**: Points to the "Factory charge" field.
- d**: Points to the "Field charge" field.
- e**: Points to the "kg" unit for each circuit's total charge.
- f**: Points to the "kg" unit for the total refrigerant charge.
- g**: Points to the "kg" unit for the total refrigerant charge (Factory + Field).
- h**: Points to the "tCO<sub>2</sub>eq" unit for the greenhouse gas emission.
- m**: Points to the refrigerant type "R134a".
- n**: Points to the GWP value "1430".
- p**: Points to the unit serial number "CH-XXXXXXXX-KKKKXX".

- a Its functioning relies on fluorinated greenhouse gas
- b Circuit number
- c Factory charge
- d Field charge
- e Refrigerant charge for each circuit (according to the number of circuits)
- f Total refrigerant charge
- g Total refrigerant charge (Factory + Field)
- h **Greenhouse gas emission** of the total refrigerant charge expressed as tonnes of CO<sub>2</sub> equivalent
- m Refrigerant type
- n GWP = Global Warming Potential
- p Unit serial number

2 The filled out label must be adhered inside the electrical panel.

Periodical inspections for refrigerant leaks may be required depending on European or local legislation. Please contact your local dealer for more information.

### NOTICE

In Europe, the **greenhouse gas emission** of the total refrigerant charge in the system (expressed as tonnes CO<sub>2</sub> equivalent) is used to determine the maintenance intervals. Follow the applicable legislation.

#### Formula to calculate the greenhouse gas emission:

GWP value of the refrigerant x Total refrigerant charge (in kg) / 1000

Use the GWP value mentioned on the greenhouse gases label. This GWP value is based on the 4th IPCC Assessment Report. The GWP value mentioned in the manual might be outdated (i.e. based on the 3rd IPCC Assessment Report)

## Disposal

The unit is made of metal and plastic parts. All these parts must be disposed of in accordance with the local regulations in terms of disposal. Lead batteries must be collected and taken to specific refuse collection centres.





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