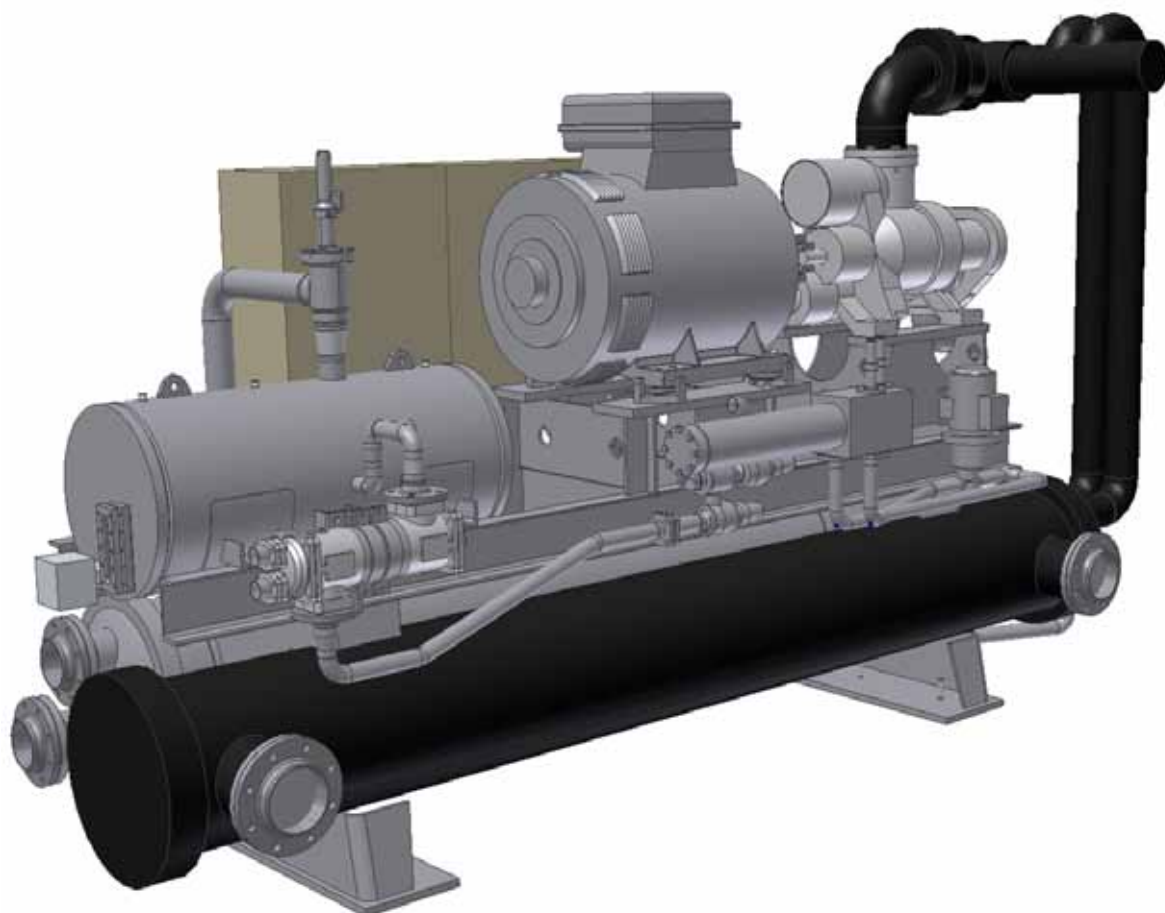


## Liquid Chiller Grasso DX R 200 ... 1600

### Product Information



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## **LEGAL NOTICE**

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## **SYMBOLS USED IN THIS MANUAL**



**Danger!**

This is an important warning. Non-observance these warnings can cause accidents with relevant damages on persons or serious damages on the compressor or refrigerating plant.



**Warning!**

Attention! Caution! Important!



**Hint!**

Tip! Note!



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## 1 FUNCTION AND DESIGN

### Introduction

The Ammonia Liquid Chillers (ALC) Programme for dry evaporation (DX) provides for proven components as complete refrigeration systems for medium and large refrigeration and/or air conditioning needs.

Generally, these refrigeration systems use ammonia as refrigerant which is characterized by a high refrigeration capacity, low energy consumption and a beneficial price and which is completely neutral towards the environment.

Equipped with the Grasso screw compressor series, the DX chiller range covers the refrigeration range of 200 to 1600 kW for cold water.

The performance ranges are determined by 12 type sizes of the screw compressor series

The whole DX chiller programme consists of 3 series with different condenser types working according to principle of dry evaporation.

Ammonia liquid chillers for dry evaporation (DX chiller) consists of the following main components:

1. Drive-line (screw compressor, driving motor, oil separator)
2. Evaporator with basic frame, carrying the drive-line
3. Condenser, alternative
  - built on shell and tube type
  - external evaporative condenser or air cooled condenser
4. Low-voltage supply with control unit

DX chiller can be delivered in version RR for complete capacity range of model types 200 - 1600 as standard ready for connecting, complete with pipes and wiring.

The complete combination of drive line and evaporator can be delivered for versions LR and VR, so that the condenser only have to connect on site.

The DX chillers are designed according to the 3 different concepts of Grasso screw compressors.

Because of that compact designed DX chiller carried out.

The standard model types valid for the named conditions (see overview - cold water 12°C/ 6°C and cooling water 26°C/ 32°C).

Each model size can be delivered with exact adapted evaporators and condensers deviating of standard as well as with different secondary refrigerants and cooling mediums.

These special models require changes concerning the standard dimensions.

You'll find defined power parameters as selection tables in this product information. These table values serve for a first model type selection. For the concrete application field the values have to confirm by Grasso.

Ammonia liquid chiller DX types are equipped with a standard PLC (control device).

A background illumination LCD display allows reading of all operating and fault messages as well as process variables.

The display is operated via a robust keypad having 6 function and 24 system keys..

Each DX chiller can optionally be equipped with an absorption device for additional safety in case of havary.

The use of the absorption facility depends upon the installation conditions of the DX chiller and the design of the machine room and ought to be checked in each individual case taking into account the relevant provisions.

The DX chillers are delivered with a dry nitrogen charge (0.5 bar g.p.).


Refrigerant and special refrigeration oil are included in scope of supply.

A user manual with description of refrigeration circuit, and instructions for commissioning, operating and maintenance are belonging to each DX chiller supply.

For detailed informations regarding screw compressors see separate product informations.



**2 PRODUCT RANGE**

Basis for chiller series:	<b>Screw compressor series</b>		
	Screw compressor SH Series	Screw compressor MC Series	Screw compressor LT Series
Screw compressor:	4 types: C, D, E, G $V_{th} = 231 \dots 375 \text{ m}^3/\text{h}$	4 types: H, L, M, N $V_{th} = 450 \dots 690 \text{ m}^3/\text{h}$	4 types: P, R, S, V $V_{th} = 805 \dots 1,640 \text{ m}^3/\text{h}$
			
Chiller design:		<b>DX</b>	
Series:	<b>RR</b>	<b>LR</b>	<b>VR</b>
Working principle:	dry evaporation		
Condenser types:	water cooled shell and tube heat exchanger <b>R</b>	air cooled condenser <b>L</b>	evaporative condenser <b>V</b>
Evaporator type:	<b>R</b> shell and tube heat exchanger	<b>R</b> shell and tube heat exchanger	<b>R</b> shell and tube heat exchanger

The DX chiller series consists of 12 model types with established Grasso screw compressors.

The capacity range covers from 200 kW up to 1600 kW regarding air conditioning application for manufacturing cold water.

The only used refrigerant is ammonia.

The working principle is the dry evaporation with shell and tube heat exchangers as evaporator and condenser.

Only a very small refrigerant content is required for all models of this series complying with the highest safety and environmental standards.

The standard RR Chiller is complete factory-assembled, with electric and tube lines and a l.v. switching station.

The complete combination of drive line and evaporator can be delivered for versions LR and VR.

The condenser has to be connected on site.

**Series RR - overview**

Chiller Type:	Compressor	Chiller capacity (kW) <sup>1</sup>	Motor nom. capacity (kW)
RR 200	C	191	55
RR 250	D	227	75
RR 300	E	272	75
RR 350	G	322	90
RR 450	H	411	110
RR 500	L	485	132
RR 600	M	615	160
RR 750	N	748	200
RR 800	P	798	200
RR 1000	R	966	250
RR 1200	S	1198	315
RR 1600	V	1547	355

**Series LR - overview**

Chiller Type:	Compressor	Chiller capacity (kW) <sup>2</sup>	Motor nom. capacity (kW)
LR 200	C	187	75
LR 250	D	221	75
LR 300	E	265	90
LR 350	G	314	110
LR 450	H	402	132
LR 500	L	474	160
LR 600	M	601	200
LR 750	N	731	250
LR 800	P	787	250
LR 1000	R	945	315
LR 1200	S	1171	355
LR 1600	V	1506	450

<sup>1</sup> water outlet evaporator 6°C, water outlet condenser 32°C

<sup>2</sup> water outlet evaporator 6°C, condensing temperature 50°C

**Series VR - overview**

Chiller Type:	Compressor	Chiller capacity (kW) <sup>3</sup>	Motor nom. capacity (kW)
VR 200	C	191	55
VR 250	D	227	75
VR 300	E	272	75
VR 350	G	322	90
VR 450	H	411	110
VR 500	L	485	132
VR 600	M	615	160
VR 750	N	748	200
VR 800	P	798	200
VR 1000	R	966	250
VR 1200	S	1198	315
VR 1600	V	1547	355



**Hint!**

For information on the dimensions, weights, charging quantities and connections see separate data sheets.

<sup>3</sup> water outlet evaporator 6°C, condensing temperature 32°C

### 3 DESIGNATION

Explanations on the product key, example: **DX RR 800 S NH<sub>3</sub>**

<b>DX</b>	Series:	dry evaporation
<b>R</b>	Condenser type:	<b>R</b> - shell and tube heat exchanger <b>L</b> - air-cooled condenser <b>V</b> - evaporative condenser
<b>R</b>	Evaporator type:	<b>R</b> - shell and tube heat exchanger
<b>800</b>	Nominal chiller capacity (kW) related to cold water operation	
<b>S</b>	Design of liquid chiller:	<b>without marking</b> - Standard design <b>S</b> - Special design related to heat exchangers and optional equipment
<b>NH<sub>3</sub></b>	Refrigerant	

## **4 DESCRIPTION OF DESIGN AND FUNCTION**

### **4.1 Structure**

Ammonia liquid chillers for dry evaporation (DX Series) consists of the following main components:

1. Drive line (screw compressor, driving motor, oil separator)
2. Evaporator with basic frame, carrying the drive line
3. Condenser, alternative
  - built on shell and tube type
  - external evaporative condenser or
  - air cooled condenser
4. Low voltage system with control
5. common base frame

Ammonia liquid chiller can be delivered in version RR for complete capacity range of model types 200 - 1600 as standard ready for connecting, complete with pipes and wiring.

The complete combination of drive line and evaporator can be delivered for versions LR and VR.

So the condenser only have to connect on site.

### **4.2 Mode of operation**

Compressor sucks refrigerant gas out of evaporator and brought up to condensation pressure. The refrigerant turns to liquid as it is cooled and ease about a solenoid valve directly into the evaporator. The solenoid valve is controlled by suction gas overheat. The refrigerant evaporates by taking up heat (delivered by secondary refrigerant).

During the operation of the screw compressor, oil is injected into the working chamber and then separated again from the refrigerant in the discharge side oil separator. The oil in compressor heated is either cooled via a oil cooler to inlet temperature or liquid refrigerant is injected into the screw compressor for reaching a discharge temperature, which is agree with the permissible oil temperature.

The oil passes through oil filter before it returns to the compressor.

Despite of the highly effective oil separation system, oil penetrates to the low pressure side of the Chiller. A special, by Grasso GmbH Refrigeration Technology used oil, makes the oil able to flowing so that it can be sucked from screw compressor again. This is a basic precondition for a fault-free operation of the evaporator system.

The capacity control of the screw compressor operates infinitely variable by volume flow control (internal bypass) and thus adapts optimally to the refrigeration capacity being effectively required and ranging from 100% to approx. 15%.

### **4.3 Shell and tube evaporator**

- one- or double-circuit design, as a water-(glycol)-cooler with plain tubes
- in accordance with pressure vessel regulations, valid on site of installation
- standard insulation with insulating material Armaflex
- with ports for draining and venting

#### **4.4 Condenser type**

Three design series of DX R Chillers are offered.

All series are equipped with shell and tube heat exchangers as evaporator.

The condenser can be a shell and tube heat exchanger (standard), air cooled condenser or evaporative condenser as required.

DX Chiller with water cooled shell and tube heat exchangers as condenser (RR types) are equipped with a water-cooled oil cooler.

The types LR and VR are designed with a thermosysphon oil cooler



**Hint!**

**Pay attention to altitude differences between chiller and condenser!**

The required HP-receiver is built-on the chiller.

Chillers RR series are delivered with condenser. Chillers LR and VR series require general a separate delivery (without condenser).

The components are connected on site (split installation).

#### **4.5 Control unit**

In the standard design, the ALC are equipped with a standard SPC. The SIMATIC guarantees the control and safety monitoring for all chiller components. A background illumination LCD display allows reading of all operating and fault messages as well as process variables. The display is operated via a robust keypad having function and system keys.

#### **4.6 Low voltage Power Panel**

The low voltage power panel is completely wired with all chiller sensors and actuators as well as prepared for connection with the external incoming-feeder cable.

#### **4.7 safety devices against pressure exceedings**

The chiller is equipped with a safety pressure limiter (TÜV-application) and a pressure transducer, which prevent exceeding the discharge pressure limitation value (demand of UVV VBG 20).

The pressure relief valve prevents pressure exceeding higher than the permissible limitation value.

Blow-off safety valves are mounted only in that case, if it is required by specifications valid on site of installation.

#### **4.8 Reduce effects of released Ammonia**

Effects of released Ammonia can be reduced depending on installation conditions by:

- enforced venting with ventilators,
- absorption by insertion into a water vessel or
- neutralization with suited substances as CO<sub>2</sub> or venegar acidity.

Grasso GmbH Refrigeration Technology offers fittings for required precautions.

Depending on machine room situation and refrigerant charging Grasso GmbH Refrigeration Technology offers a series of absorption devices.

## 4.9 Optional equipment

### 4.9.1 Pressure gauge kit

The pressure gauge kit in addition to compressor control device consists of pressure gauges for:

- suction pressure (evaporator, compressor),
- discharge pressure (compressor, condenser),
- Oil pressure

### 4.9.2 Dual oil filter

A second oil filter can be installed for changing oil filter during compressor operation.

### 4.9.3 Connection flanges

Evaporator Connection flanges without counter flange are the standard application for all model types.

Counter flanges at evaporator are optional.

Condensers are without flanges for DX chiller model types RR 200 - RR 350 (standard application).

Counter flanges for condensers are optional.

### 4.9.4 Hydraulic Adjustment of the internal volume ratio ( $V_i$ )

The compressor may have a fixed or a hydraulically adjustable internal volume ratio ( $V_i$ ) depending on its design.

A hydraulic  $V_i$ -adjusting system guarantees compression at the lowest loss possible under the respective operating conditions and thus saves drive power (see the Screw Compressor Datasheet).

The internal volume ratio is variable, depending on the design and type of the compressor, across a range from  $V_i = 2.6$  to  $V_i = 5.5$ .

### 4.9.5 L2-Bus communication of compressor control device

All analogue signals of DX chiller can pass on via the SINEC-L2 interface.

The master control has to be controlled with the same software protocol.

One master control can be connect with up to 32 chillers.

### 4.9.6 Anti-vibration mounting

In this form of installation, the DX chiller is erected on vibration isolators which are bolted by screws to the DX chiller but not to the levelled concrete foundation.

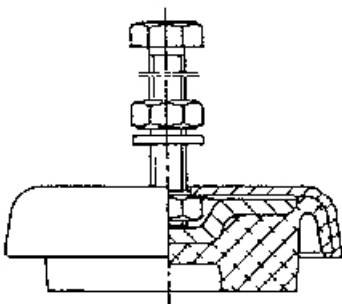


fig. 1: Isolator without foundation fixation

The isolators retain their permanent resilience under design load. The levelling range is 20 mm. The Chiller has a firm stand due to its design surface pressure and the resulting friction coefficient between isolator and foundation.

**5 P + I DIAGRAMS**

**5.1 P+I diagram for standard ammonia liquid chiller DX series, type RR 200 - RR 350**

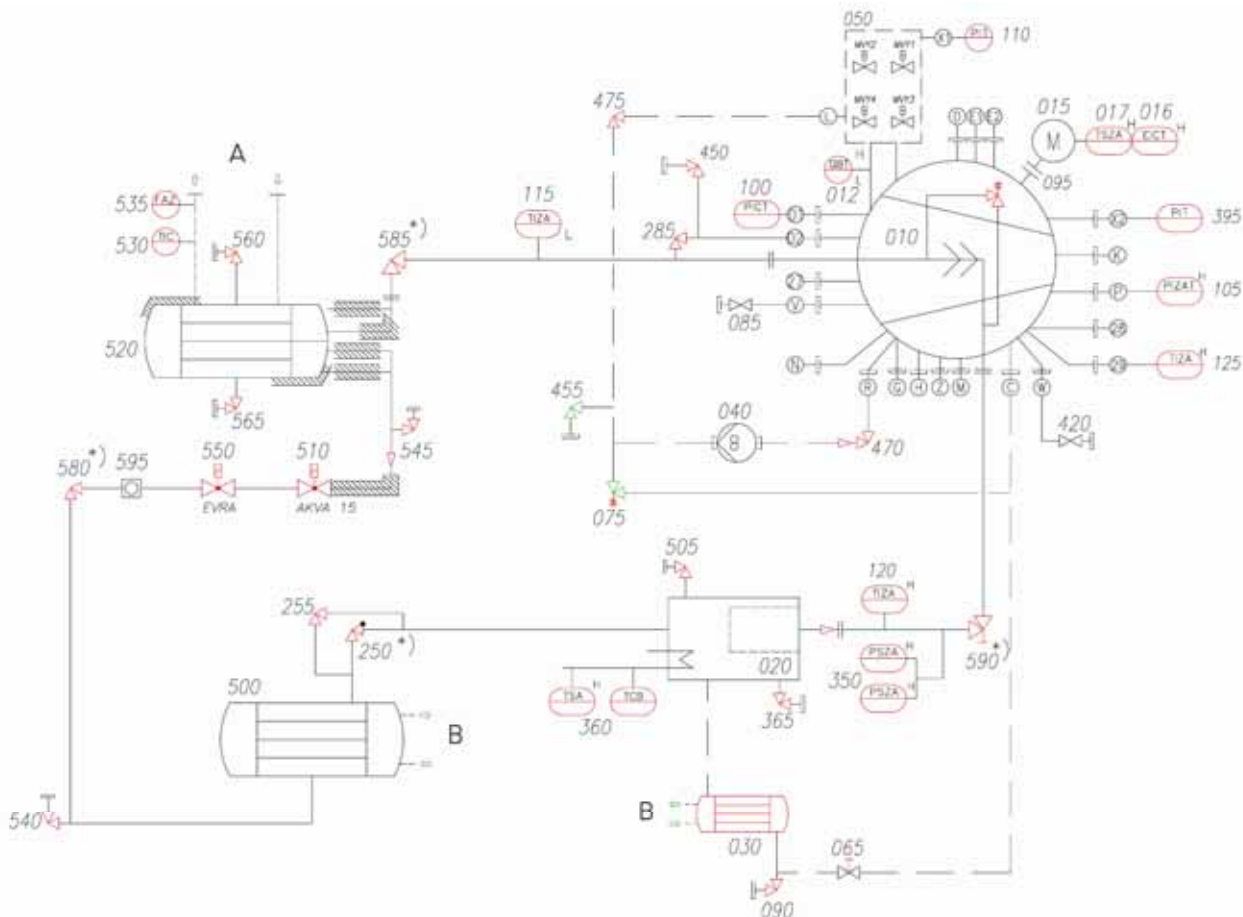


fig. 2: P+I diagram for standard ammonia liquid chiller DX series, type RR 200 - RR 350

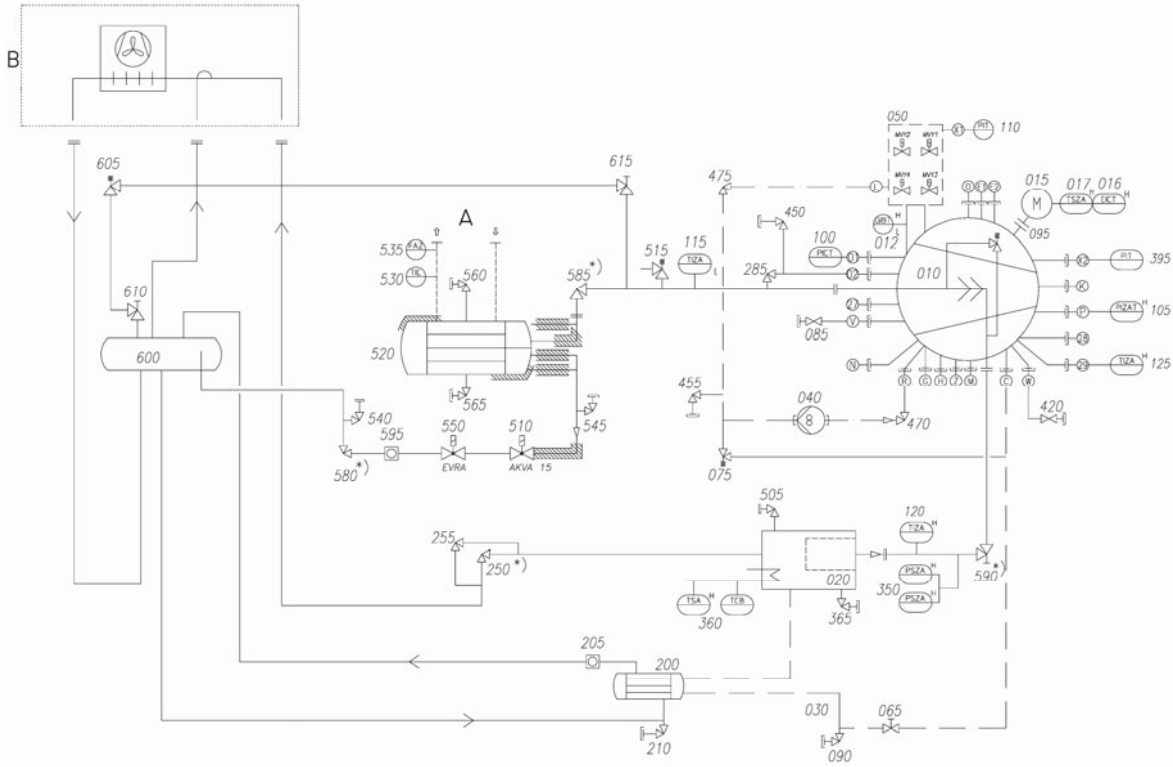
A	Water
W	Cooling water

010	Compressor
012	Control slide position indicator
015	Compressor drive motor
016	Motor current limiter
017	Motor winding protection
020	Oil separator
030	Water cooled oil cooler
040	Oil pump
050	Solenoid valve block for capacity control
065	Stop valve - oil circuit
075	Oil pressure regulating valve



085	Stop valve - venting
090	Stop valve - oil draining, oil charging
095	Coupling
100	Pressure transducer - suction pressure
105	Pressure transducer - discharge pressure
110	Pressure transducer - oil pressure
115	Resistance thermometer - suction temperature
120	Resistance thermometer - compression end temperature
125	Resistance thermometer - oil temperature
250	Check valve - hot gas line
255	Stop valve - bypassing valve (250)
285	Stop valve - bypassing integrated check valve
350	Safety pressure limiter
360	Oil heater
365	Stop valve - oil separators oil drain
395	Pressure transducer - oil pressure after filter
420	Stop valve - compressor housing draining
450	Service port
455	Service port
470	Stop valve - oil pump suction side
475	Stop valve - oil pump discharge side
500	Condenser
505	Service port
510	Expansion valve
520	Evaporator
530	Resistance thermometer - water flow
535	Flow controller
540	refrigerant draw-in valve
545	Service port
550	Solenoid valve – liquid line
560	Venting - water side
565	Draining - water side
580	Stop valve - liquid line
585	Stop valve – suction line
590	Stop valve – discharge line
595	Sight glass - liquid line

**5.2 P+I diagram for standard ammonia liquid chiller DX series, type LR 200 - LR 350 (VR 200 - VR 350)**



**fig. 3: P+I diagram for standard ammonia liquid chiller DX series, type LR 200 - LR 350 (VR 200 - VR 350)**

A	Water
B	Scope of supply Grasso

010	Compressor
012	Control slide position indicator
015	Compressor drive motor
016	Motor current limiter
017	Motor winding protection
020	Oil separator
040	Oil pump
050	Solenoid valve block for capacity control
065	Stop valve - oil circuit
075	Oil pressure regulating valve
085	Stop valve - venting
090	Stop valve - oil draining, oil charging
095	Coupling
100	Pressure transducer – suction pressure
105	Pressure transducer – discharge pressure
110	Pressure transducer – oil pressure

115	Resistance thermometer - suction temperature
120	Resistance thermometer - compression end temperature
125	Resistance thermometer – oil temperature
200	Refrigerant cooled oil cooler
205	Sight glass - oil cooler
210	Stop valve – oil cooler oil drain, refrigerating side
250	Check valve – hot gas line
255	Stop valve - bypassing valve (250)
285	Stop valve – bypassing integrated check valve
350	Safety pressure limiter
360	Oil heater
365	Stop valve - oil separators oil drain
395	Pressure transducer – oil pressure after filter
420	Stop valve - compressor housing draining
450	Service port
455	Service port
470	Stop valve - oil pump suction side
475	Stop valve - oil pump discharge side
500	Condenser
505	Service port
510	Expansion valve
515	Safety valve
520	Evaporator
530	Resistance thermometer - water flow
535	Flow controller
540	refrigerant draw-in valve
545	Service port
550	Solenoid valve – liquid line
560	Venting - water side
565	Draining - water side
580	Stop valve - liquid line
585	Stop valve – suction line
590	Stop valve – discharge line
595	Sight glass - liquid line
600	Liquid receiver
605	Safety valve – liquid receiver
610	Stop valve – pressure relief line
615	Stop valve – pressure relief line

**5.3 P+I diagram for standard ammonia liquid chiller DX series, type RR 450 - RR 800**

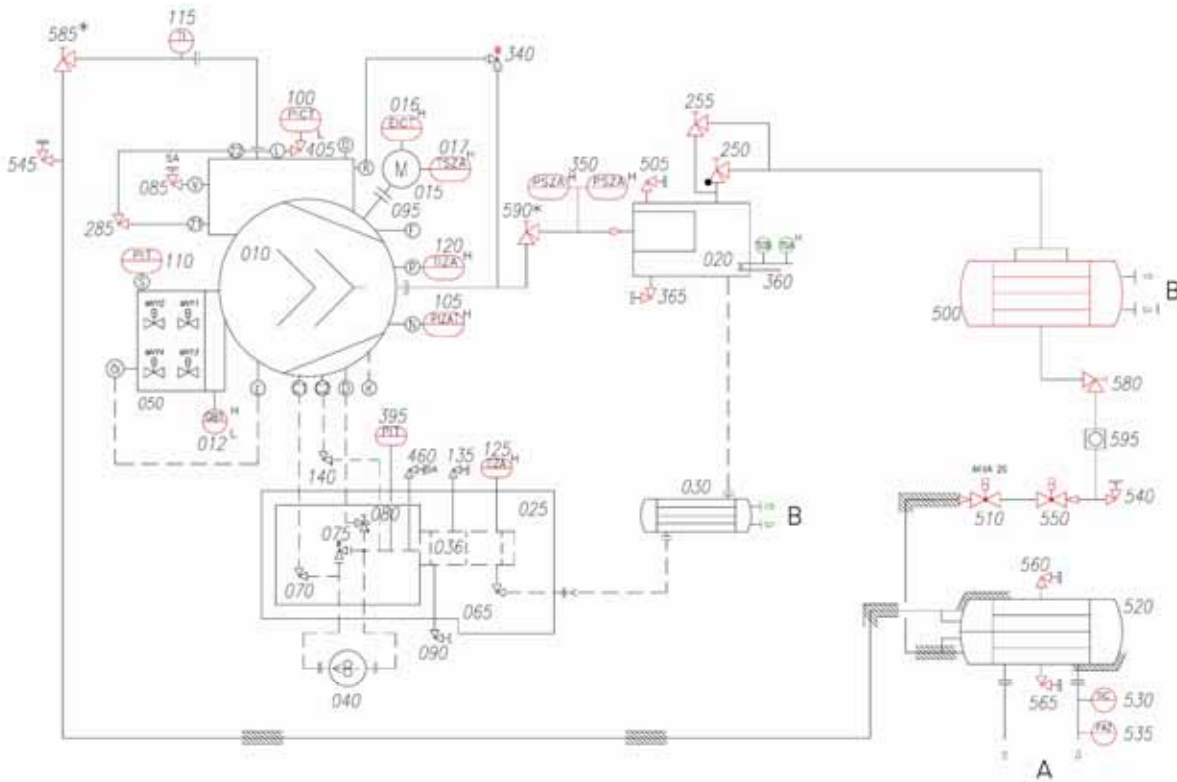


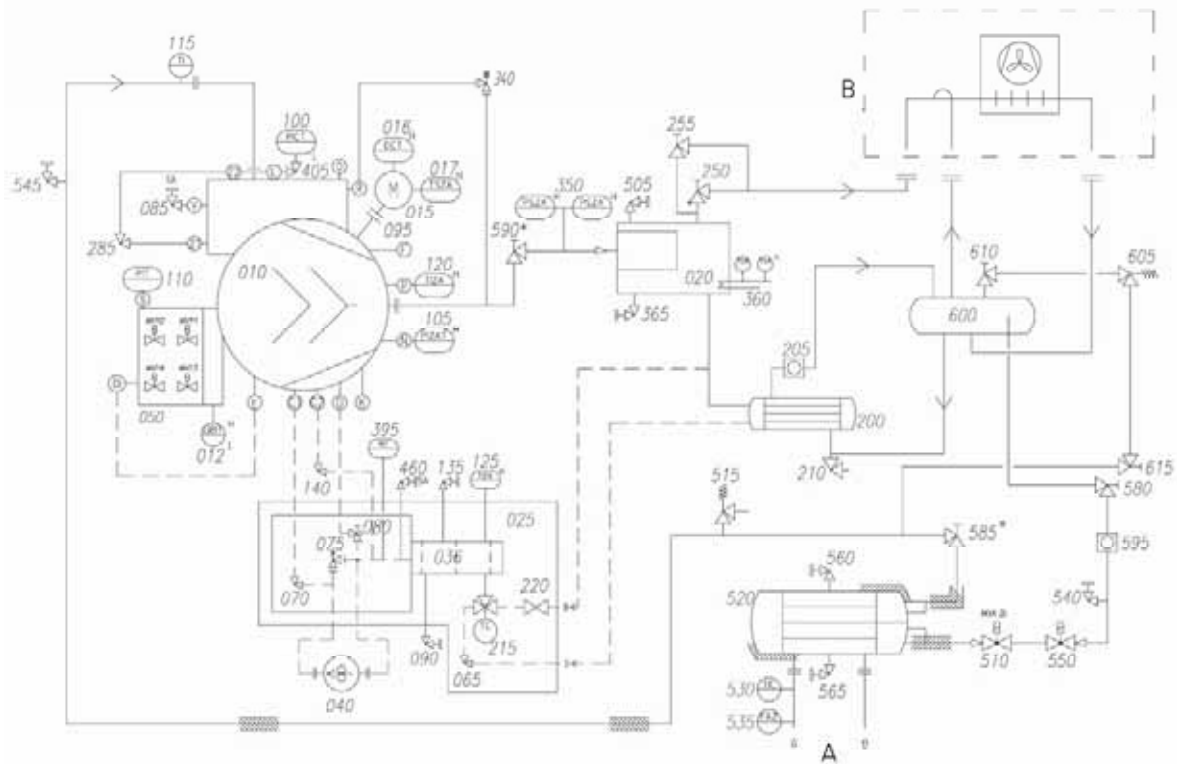
fig. 4: P+I diagram for standard ammonia liquid chiller DX series, type RR 450 - RR 800

A	Water
B	Cooling water

010	Compressor
012	Control slide position indicator
015	Compressor drive motor
016	Motor current limiter
017	Motor winding protection
020	Oil separator
025	Oil filter with multi-function block
030	Water cooled oil cooler
036	Oil filter element
040	Oil pump
050	Solenoid valve block for capacity control
065	Stop valve - oil circuit
070	Stop valve - oil pump discharge side
075	Oil pressure regulating valve
080	Control valve – injection oil
085	Stop valve - venting suction filter

090	Stop valve - oil draining, oil charging
095	Coupling
100	Pressure transducer – suction pressure
105	Pressure transducer – discharge pressure
110	Pressure transducer – oil pressure
115	Resistance thermometer - suction temperature
120	Resistance thermometer - compression end temperature
125	Resistance thermometer – oil temperature
135	Vent valve – oil circuit
140	Check valve – function oil
250	Check valve – hot gas line
255	Stop valve - bypassing valve (250)
285	Stop valve – bypassing integrated check valve
340	Overflow valve
350	Safety pressure limiter
360	Oil heater
365	Stop valve - oil separators oil drain
395	Pressure transducer – oil pressure after filter
405	Stop valve – suction pressure transducer
460	Service port
500	Condenser
505	Service port
510	Expansion valve
520	Evaporator
525	Service port
530	Resistance thermometer - water flow
535	Flow controller
540	refrigerant draw-in valve
545	Service port
550	Solenoid valve – liquid line
560	Venting - water side
565	Draining - water side
580	Stop valve - liquid line
585	Stop valve – suction line
590	Stop valve – discharge line
595	Sight glass - liquid line

**5.4 P+I diagram for standard ammonia liquid chiller DX series, type LR 450 - LR 800 (VR 450 - VR 800)**



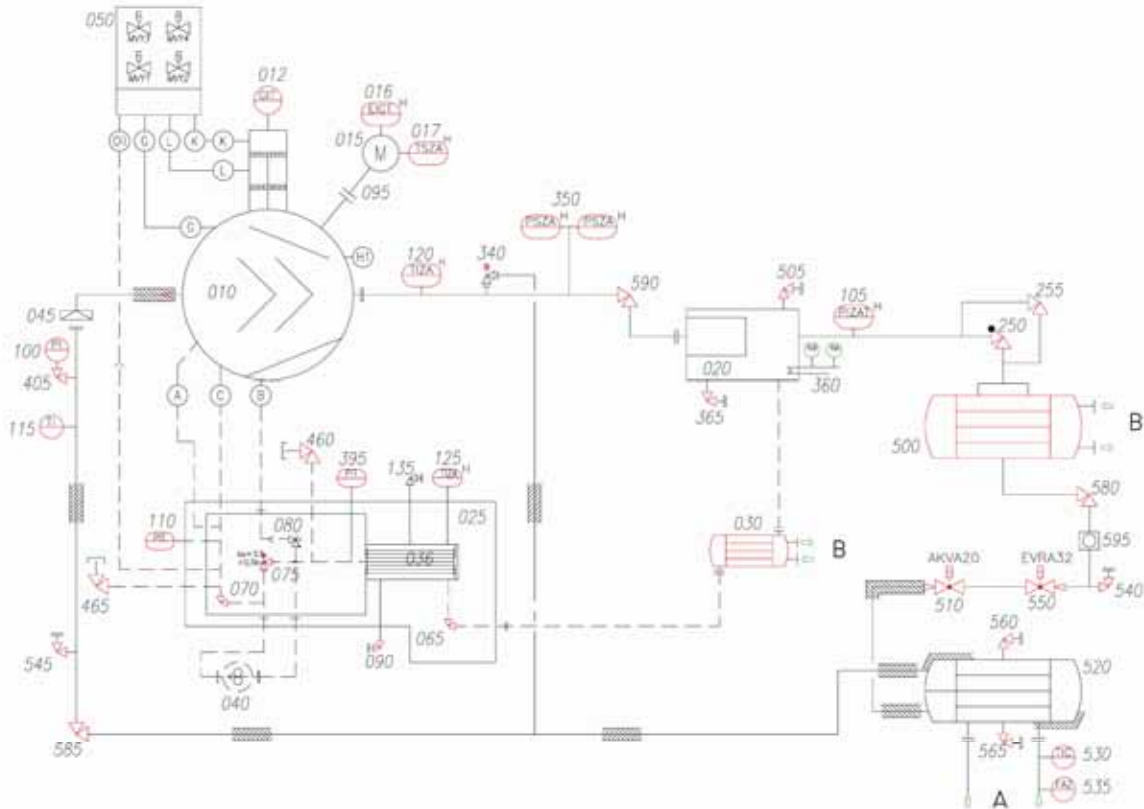
**fig. 5: P+I diagram for standard ammonia liquid chiller DX series, type LR 450 - LR 800 (VR 450 - VR 800)**

A	Water
B	Scope of supply Grasso

010	Compressor
012	Control slide position indicator
015	Compressor drive motor
016	Motor current limiter
017	Motor winding protection
020	Oil separator
025	Multi-function block
036	Oil filter element
040	Oil pump
050	Solenoid valve block for capacity control
065	Stop valve - oil circuit
070	Stop valve - oil pump discharge side
075	Oil pressure regulating valve
080	Control valve – injection oil
085	Stop valve - venting suction filter
090	Stop valve - oil draining, oil charging
095	Coupling
100	Pressure transducer - suction pressure

105	Pressure transducer - discharge pressure
110	Pressure transducer - oil pressure
115	Resistance thermometer - suction temperature
120	Resistance thermometer - compression end temperature
125	Resistance thermometer - oil temperature
135	stop valve - oil filter venting
140	Check valve - function oil
200	Refrigerant cooled oil cooler
205	Sight glass - oil cooler
210	Stop valve - oil cooler oil drain, refrigerating side
215	thermostatic 3-way-valve - oil temperature control
220	stop valve - bypassing oil cooler
250	Check valve - hot gas line
255	Stop valve - bypassing valve (250)
285	Stop valve - bypassing integrated check valve
340	Overflow valve
350	Safety pressure limiter
360	Oil heater
365	Stop valve - oil separators oil drain
395	Pressure transducer - oil pressure after filter
405	Stop valve - suction pressure transducer
460	Service port
505	Service port
510	Expansion valve
515	Safety valve
520	Evaporator
530	Resistance thermometer - water flow
535	Flow controller
540	refrigerant draw-in valve
545	Service port
550	Solenoid valve – liquid line
560	Venting - water side
565	Draining - water side
580	Stop valve - liquid line
585	Stop valve – suction line
590	Stop valve – discharge line
595	Sight glass - liquid line
600	Liquid receiver
605	Safety valve – liquid receiver
610	Stop valve – pressure relief line
615	Stop valve – pressure relief line

**5.5 P+I diagram for standard ammonia liquid chiller DX series, type RR 750 - RR 1600**



**fig. 6: P+I diagram for standard ammonia liquid chiller DX series, type RR 750 - RR 1600**

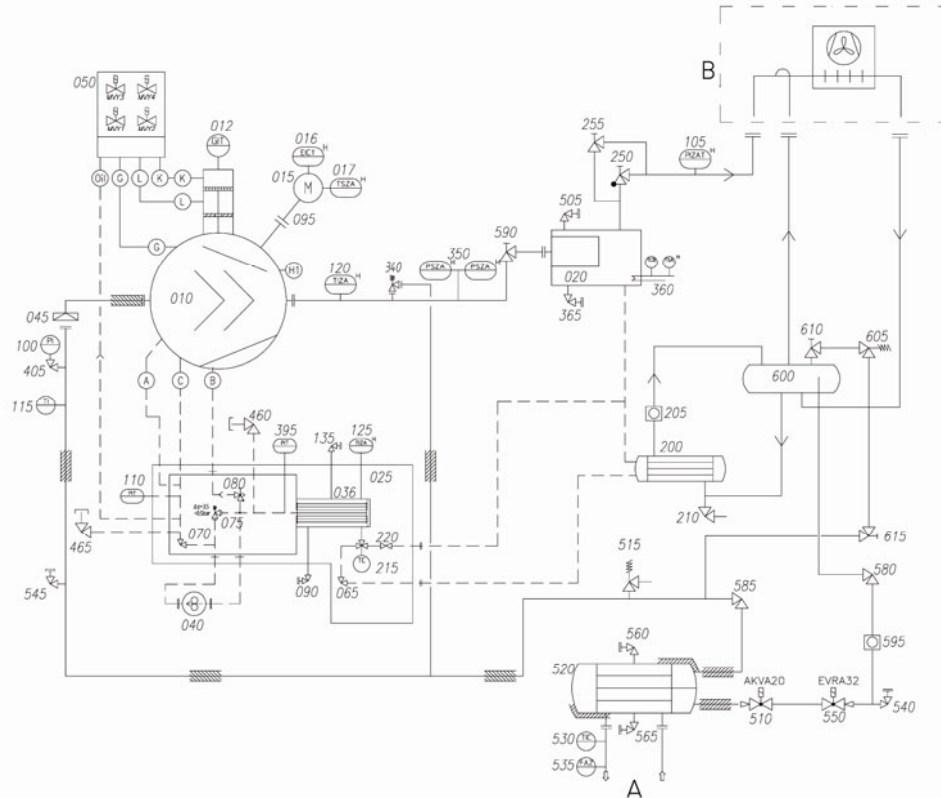
A	Water
B	Cooling water

010	Compressor
012	Control slide position indicator
015	Compressor drive motor
016	Motor current limiter
017	Motor winding protection
020	Oil separator
025	Oil filter with multi-function block
030	Water cooled oil cooler
036	Oil filter element
040	Oil pump
045	Suction filter
050	Solenoid valve block for capacity control
065	Stop valve - oil circuit
070	Stop valve - oil pump discharge side
075	Oil pressure regulating valve



080	Control valve – injection oil
090	Stop valve - oil draining, oil charging
095	Coupling
100	Pressure transducer – suction pressure
105	Pressure transducer - discharge pressure
110	Pressure transducer – oil pressure
115	Resistance thermometer - suction temperature
120	Resistance thermometer - compression end temperature
125	Resistance thermometer - oil temperature
135	Vent valve – oil circuit
250	Check valve – hot gas line
255	Stop valve - bypassing valve (250)
340	Overflow valve
350	Safety pressure limiter
360	Oil heater
365	Stop valve - oil separators oil drain
395	Pressure transducer – oil pressure after filter
405	Stop valve – suction pressure transducer
460	Service port
465	Service port
500	Condenser
505	Service port
510	Expansion valve
520	Evaporator
530	Resistance thermometer - water flow
535	Flow controller
540	refrigerant draw-in valve
545	Service port
550	Solenoid valve – liquid line
560	Venting - water side
565	Draining - water side
580	Stop valve - liquid line
585	Stop valve – suction line
590	Stop valve – discharge line
595	Sight glass - liquid line

**5.6 P+I diagram for standard ammonia liquid chiller DX series, type LR 750 - LR 1600 (VR 750 - VR 1600)**



**fig. 7: P+I diagram for standard ammonia liquid chiller DX series, type LR 750 - LR 1600 (VR 750 - VR 1600)**

A	Water
B	Scope of supply Grasso

010	Compressor
012	Control slide position indicator
015	Compressor drive motor
016	Motor current limiter
017	Motor winding protection
020	Oil separator
025	Multi-function block
036	Oil filter element
040	Oil pump
045	Suction filter
050	Solenoid valve block for capacity control
065	Stop valve - oil circuit
070	Stop valve - oil pump discharge side
075	Oil pressure regulating valve
080	Control valve – injection oil
090	Stop valve - oil draining, oil charging
095	Coupling

100	Pressure transducer – suction pressure
105	Pressure transducer – discharge pressure
110	Pressure transducer – oil pressure
115	Resistance thermometer - suction temperature
120	Resistance thermometer - compression end temperature
125	Resistance thermometer – oil temperature
135	Stop valve - oil filter venting
200	Refrigerant cooled oil cooler
205	Sight glass - oil cooler
210	Stop valve – oil cooler oil drain, refrigerating side
215	Thermostatic 3-way-valve - oil temperature control
220	Stop valve - bypassing oil cooler
250	Check valve – hot gas line
255	Stop valve - bypassing valve (250)
340	Overflow valve
350	Safety pressure limiter
360	Oil heater
365	Stop valve - oil separators oil drain
395	Pressure transducer – oil pressure after filter
405	Stop valve – suction pressure transducer
460, 465, 505	Service port
510	Expansion valve
515	Safety valve
520	Evaporator
530	Resistance thermometer - water flow
535	Flow controller
540	refrigerant draw-in valve
545	Service port
550	Solenoid valve – liquid line
560	Venting - water side
565	Draining - water side
580	Stop valve - liquid line
585	Stop valve – suction line
590	Stop valve – discharge line
595	Sight glass - liquid line
600	Liquid receiver
605	Safety valve – liquid receiver
610	Stop valve – pressure relief line
615	Stop valve – pressure relief line

## 6 POWER PARAMETERS

*Italic lettering = Standard dimenstions*

### DX chiller type RR 200

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>222</b> <b>47</b>	<b>191</b> <b>46</b>	<b>163</b> <b>45</b>	151 44	139 43	117 42	98 41
	38	<b>213</b> <b>54</b>	<b>183</b> <b>52</b>	<b>156</b> <b>51</b>	144 50	133 50	112 48	93 47
	45	208 58	178 56	152 55	140 54	129 54	108 53	90 51

### DX chiller type RR 250

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>264</b> <b>55</b>	<b>227</b> <b>54</b>	<b>193</b> <b>53</b>	178 52	164 52	139 50	116 49
	38	<b>253</b> <b>64</b>	<b>217</b> <b>62</b>	<b>185</b> <b>60</b>	171 59	157 58	132 57	111 56
	45	246 69	211 67	180 65	166 64	152 64	128 63	107 61

### DX chiller type RR 300

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>316</b> <b>65</b>	<b>272</b> <b>64</b>	<b>232</b> <b>63</b>	214 61	197 60	166 59	139 57
	38	<b>304</b> <b>75</b>	<b>261</b> <b>73</b>	<b>222</b> <b>70</b>	206 68	188 69	159 67	133 66
	45	295 81	253 78	216 76	199 76	183 75	154 73	128 72

**DX chiller type RR 350**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>374</b> <b>77</b>	<b>322</b> <b>75</b>	<b>275</b> <b>74</b>	253 73	233 72	196 70	165 68
	38	<b>359</b> <b>89</b>	<b>308</b> <b>86</b>	<b>263</b> <b>83</b>	243 81	223 81	188 80	157 78
	45	349 96	300 93	256 90	235 88	216 88	182 87	152 85

**DX chiller type RR 450**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>478</b> <b>93</b>	<b>411</b> <b>91</b>	<b>351</b> <b>90</b>	324 88	298 87	251 84	211 83
	38	<b>460</b> <b>108</b>	<b>395</b> <b>104</b>	<b>337</b> <b>101</b>	310 100	285 99	240 96	201 95
	45	447 116	383 113	327 110	301 109	277 108	233 106	194 103

**DX chiller type RR 500**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>564</b> <b>110</b>	<b>485</b> <b>108</b>	<b>414</b> <b>106</b>	382 104	351 103	296 100	248 97
	38	<b>541</b> <b>128</b>	<b>465</b> <b>123</b>	<b>397</b> <b>119</b>	366 118	336 116	283 114	237 112
	45	527 137	452 133	385 130	355 128	326 127	274 125	229 121

**DX chiller type RR 600**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>715</b> <b>140</b>	<b>615</b> <b>136</b>	<b>525</b> <b>134</b>	484 132	445 130	376 126	315 123
	38	<b>688</b> <b>162</b>	<b>591</b> <b>156</b>	<b>503</b> <b>151</b>	464 149	426 147	359 144	300 141
	45	669 179	574 169	488 164	450 162	413 161	348 158	290 154

**DX chiller type RR 800**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>923</b> <b>180</b>	<b>798</b> <b>177</b>	<b>681</b> <b>173</b>	630 170	581 167	493 163	415 159
	38	<b>890</b> <b>208</b>	<b>768</b> <b>201</b>	<b>659</b> <b>195</b>	608 192	561 190	475 185	400 182
	45	875 225	754 218	643 212	594 209	548 207	463 203	389 196

**DX chiller type RR 750**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>878</b> <b>167</b>	<b>748</b> <b>161</b>	<b>654</b> <b>159</b>	606 157	560 154	476 149	401 145
	38	<b>854</b> <b>194</b>	<b>739</b> <b>186</b>	<b>635</b> <b>180</b>	588 177	543 174	461 170	388 165
	45	838 209	724 201	622 195	576 192	532 190	451 185	380 178

**DX chiller type RR 1000**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>1134</b> <b>216</b>	<b>966</b> <b>211</b>	<b>845</b> <b>206</b>	782 203	723 199	614 192	518 187
	38	<b>1103</b> <b>251</b>	<b>954</b> <b>241</b>	<b>821</b> <b>232</b>	760 228	701 225	595 219	502 214
	45	1082 269	936 260	804 252	744 249	687 245	583 239	490 230

**DX chiller type RR 1200**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>1406</b> <b>268</b>	<b>1198</b> <b>262</b>	<b>1048</b> <b>256</b>	970 251	896 247	762 238	643 232
	38	<b>1368</b> <b>311</b>	<b>1183</b> <b>298</b>	<b>1018</b> <b>288</b>	942 283	870 279	738 271	622 265
	45	1342 334	1160 322	997 313	922 308	852 304	722 297	608 285

**DX chiller type RR 1600**

Refrigerating capacity in kW Driving capacity in kW		Secondary refrigerant outlet temperature at evaporator (°C)						
		10	6	2	0	-2	-6	-10
Cooling medium outlet temperature at condenser (°C)	32	<b>1812</b> <b>334</b>	<b>1547</b> <b>320</b>	<b>1356</b> <b>320</b>	1256 314	1162 308	988 298	834 290
	38	<b>1758</b> <b>387</b>	<b>1524</b> <b>373</b>	<b>1313</b> <b>360</b>	1216 354	1124 349	955 340	805 331
	45	1722 427	1492 402	1285 390	1189 385	1099 380	933 371	786 362

**7 WEIGHTS AND CHARGES - TYPES RR 200 ... RR 350**

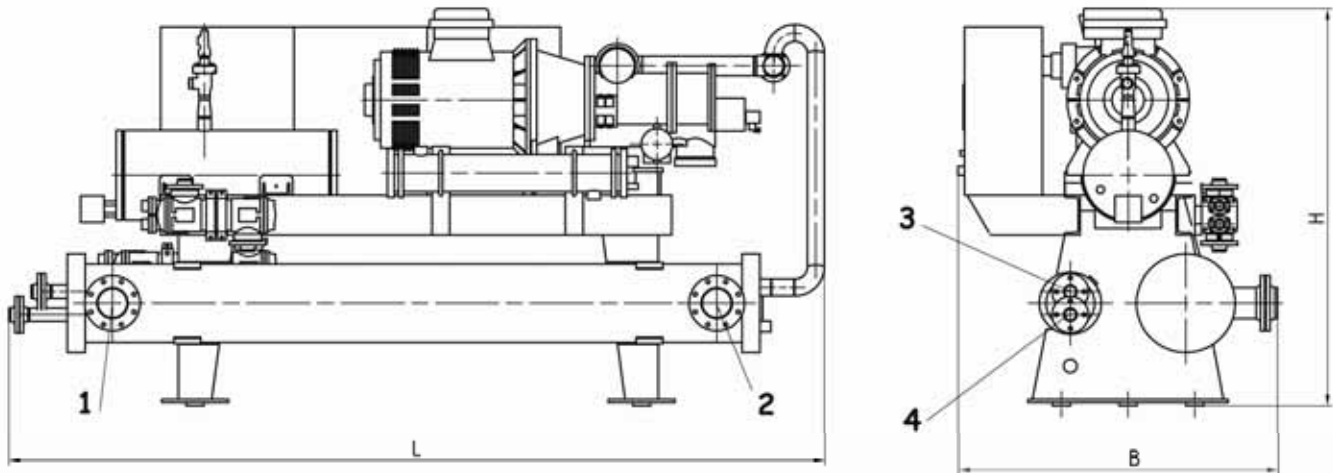


fig. 8: Ammonia liquid chiller - Types RR 200 ... RR 350

1	Cold water outlet
2	Cold water inlet
3	Cooling water outlet
4	Cooling water inlet

**Dimensions and weights**

For standard conditions water outlet evaporator 6°C, water outlet condenser 32°C

Chiller Type:	L (mm)	W (mm)	H (mm)	Weight without charging (kg)	Operating weight (kg)
RR 200	3500	1480	1820	2538	2781
RR 250	3500	1480	1820	2719	2981
RR 300	3500	1480	1820	3043	3359
RR 350	3500	1480	1820	3272	3617

**Charging quantities**

Chiller Type:	Oil charge (dm <sup>3</sup> )	Refrigerant charge (kg)	Standard connection cold water	Standard connection cooling water
RR 200	90	13	NB 100	NB 80
RR 250	90	17	NB 100	NB 80
RR 300	90	20	NB 100	NB 80
RR 350	90	23	NB 100	NB 80

 **Hint!**  
Project-related deviations are possible!



**8 WEIGHTS AND CHARGES - TYPES RR 450 ... RR 800**

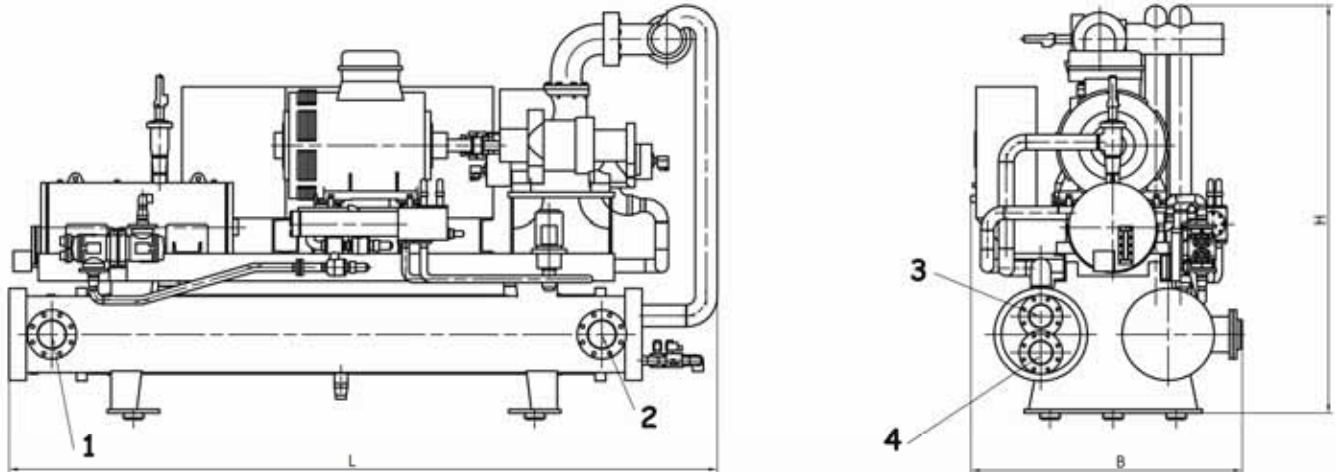


fig. 9: Ammonia liquid chiller - Types RR 450 ... RR 800

1	Cold water outlet
2	Cold water inlet
3	Cooling water outlet
4	Cooling water inlet

**Dimensions and weights**

For standard conditions water outlet evaporator 6°C, water outlet condenser 32°C

Chiller Type:	L (mm)	W (mm)	H (mm)	Weight without charging (kg)	Operating weight (kg)
RR 450	3800	1550	1800	3661	4094
RR 500	3800	1550	1800	4086	4569
RR 600	4200	1550	2100	4985	5521
RR 800	4200	1550	2100	5500	6154

**Charging quantities**

Chiller Type:	Oil charge (dm <sup>3</sup> )	Refrigerant charge (kg)	Standard connection cold water	Standard connection cooling water
RR 450	110	30	NB 100	NB 125
RR 500	110	33	NB 125	NB 125
RR 600	110	40	NB 125	NB 125
RR 800	110	53	NB 150	NB 150



**Hint!**  
Project-related deviations are possible!

**9 WEIGHTS AND CHARGES - TYPES RR 750 ... RR 1600**

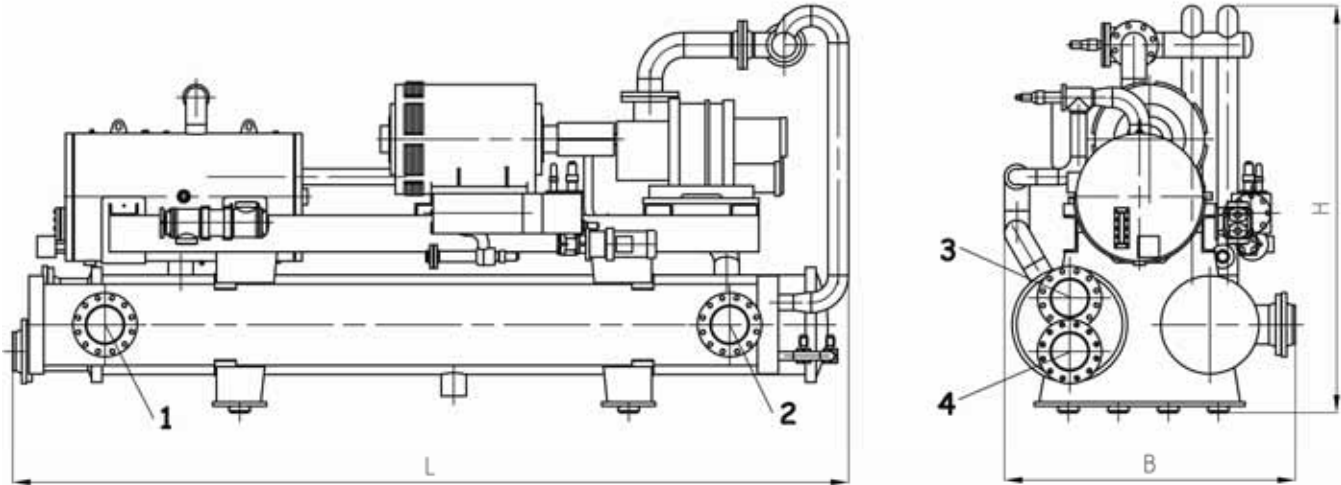


fig. 10: Ammonia liquid chiller - Types RR 750 ... RR 1600

1	Cold water outlet
2	Cold water inlet
3	Cooling water outlet
4	Cooling water inlet

**Dimensions and weights**

For standard conditions water outlet evaporator 6°C, water outlet condenser 32°C

Chiller Type:	L (mm)	W (mm)	H (mm)	Weight without charging (kg)	Operating weight (kg)
RR 750	4000	1650	2000	5889	6569
RR 1000	4500	1860	2250	6998	7887
RR 1200	4500	1860	2250	7769	8833
RR 1400	4500	1860	2350	8780	10150
RR 1600	4500	1860	2350	9789	11464

**Charging quantities**

Chiller Type:	Oil charge (dm <sup>3</sup> )	Refrigerant charge (kg)	Standard connection cold water	Standard connection cooling water
RR 750	150	50	NB 150	NB 150
RR 1000	150	66	NB 150	NB 200
RR 1200	150	79	NB 200	NB 200
RR 1400	150	85	NB 200	NB 200
RR 1600	150	100	NB 200	NB 200

 **Hint!**  
Project-related deviations are possible!

## 10 MODULAR CONTROL

Type : Grasso System Control

### General



fig. 11: Display of the Grasso System Control (GSC)

Programmed control, that is adapted to specific requirements of Packages and Chillers.

The number of analogue and binary inputs and outputs is adapted the demand by selecting the appropriate components.

Programming is carried out using defined and tested software modules that the contents of this documentation and the enclosed drawings, sketches and diagrams are intended only for plant users and operating personnel.

Any changes in software modules are principally **not** allowed.

Package and Chiller control organization:

1. Ensuring unit/chiller safety by monitoring of pressure and temperatures.
2. Running a fail-safe startup and shutdown routine.
3. Screw compressor capacity control, either manually or automatically.
4. Automatic refrigerant injection into the evaporator (for chillers DX Series only).

### Technical data

Model type:	Standard housing with an engineered modular Grasso configuration and a standard terminal.
Power supply:	115/ 230 V AC, 50/ 60 Hz
Control and display unit:	Controls are installed in the door of the housing and labelled. The terminal has a 4-line text display. All analogue process data are displayed at the terminal. Texts can be displayed in various languages.
Parameterization:	Process parameters are parameterized, after having entered a password, from the controls at the terminal to adapt the controller to the process.
Behaviour after power return:	Return to the state prior to power failure.
Elapsed-time meter:	Available software function.

**Analog inputs**

All process variables are processed in analogue mode.  
Sensor inputs are designed for standardized input signal (4 - 20) mA.

**Digital inputs**

Suitable for 24 V DC.

**Analog outputs**

Control slide position as non-floating signal (4 - 20) mA.

**Digital outputs**

Floating contacts for signal transfer to L. V. Switching Station and Master Control.  
All solenoid valves are designed for 24 V DC.

**Field of application**

No maritime or airborne applications.  
Maritime application on request.

**Controlled variable**

Process temperature in °C (Standard: evaporating temperature or temperature of secondary refrigerant.)  
Controlled by a three-position controller.  
Set point and neutral zone can be parameter.

**Set point adjustment**

Setpoints can be adjusted through the unit controller by a higher-level master control using analog signal (4 - 20) mA.

**Start-up modes**

MANUAL	SC unit/ chiller is switched ON / OFF manually, independently of the refrigerating demand.
AUTO	SC unit/ chiller is switched ON / OFF automatically depending on local refrigerating demand.

**Operating modes**

MANUAL	Manual key-operated capacity control (the control slide is shifted manually).
AUTO	Automatic setpoint-dependent capacity control (the control slide is shifted automatically).

**Control modes**

LOCAL	SC unit/ chiller can be operate independently (no master control).
CENTRAL	SC unit/ chiller is controlled by master control only.

### **Fault messages**

Each fault is displayed as an on-line message and stored in a histogram buffer.

A fault log printer can be connected.

### **Sequence Control**

Simple sequential routine can be achieved by using a master control via floating contacts.

### **Communication with a higher level control (master control)**

All status messages and all analogue data sent to a higher-level master control via a MPI interface (standard) or via a PROFIBUS-DP (Master-Slave) interface (optionally).

#### **1. via BUS-coupling**

Up to 32 SCP/ chiller controls can be connected to a higher-level master control using this method.

The master control must know the MPI or PROFIBUS-DP Master-Slave protocol.

#### **2. via floating contacts**

##### **- To higher-level control**

Status messages

- SCP/ Chiller ready

- SCP/ Chiller fault

The control slide position may be passed on as an analogue signal using a buffer amplifier.

##### **- From higher-level control**

Status messages

- SCP/ Chiller/ ON/ OFF

- Fault acknowledgement

'MORE' (increase SC capacity)

'LESS' (reduce SC capacity)

### **BUS coupling**

MPI (standard) or PROFIBUS-DP Master-Slave (optionally).

### **Documentation**

Hardware descriptions: German, English

Circuit diagrams: German (acc. to DIN), English

User manual: German, English

Operating instructions: Native language (Europe), otherwise English

Quick Reference Card Native language (Europe), otherwise English

List of parameters: German, English

## **11 ABSORPTION DEVICE**

### **11.1 General Information**

The operation of ammonia liquid chillers in refrigerating plants is subject to venting the machine room in accordance with the Regulations on the Prevention of Accidents (VBG 20), § 12 and § 17.

In case of leakage, the machinery room air shall be let off to the outside in a non-hazardous manner.

Should this be impossible, the machinery room air shall be led through an absorption tank and to be resupplied to the machinery room after cleaning.

For this case, Grasso has developed a series of ammonia absorption facilities the size of which depends upon the quantity of refrigerant in the NH<sub>3</sub> liquid chillers and refrigerating plants.

If there are several liquid chillers, the absorption facility shall be selected with regard to the liquid chiller having the largest filling weight.

If the maximum amount should be exceeded, a combination of several absorption facilities is possible.

The absorption facilities have been designed to be integrated into usual ventilation systems.

### **11.2 Functional description**

The high-pressure ventilator is put into operation by an ammonia warning device if the maximum permissible ammonia concentration of 50 ppm is exceeded.

It sucks the air-ammonia mixture off and forces it into the plastic vessel which is filled with water.

The amount of water in the plastic vessel is sufficient to absorb the total refrigerant charge, with the decrease in solubility by warming-up being taken into account.

After leaving the gas distribution pipe the air bubbles through the water, and the ammonia is absorbed.

The cleaned air is recirculated to the machine room.

If the ammonia concentration falls below the threshold value, the ventilator is switched off.

After the operation of the absorber due to an increased ammonia concentration in the machine room, the contaminated water must be disposed off in a workmanlike manner.

If the absorber is not operating over a longer period, exchange the water every three months to prevent rotting.

This occasion may be utilized to check the plant and clean the gas distribution pipe, if required.

Due to the design of the gas distribution pipe it is not recommended to add chemicals to the water charge to neutralize the ammonia.

### **11.3 Installation**

The absorber is placed on an even support.

Particular measures other than the selection of a frost-free location are not required.

The charging connection (unpressurized) may be integrated in an existing water system.

The electrical installation of the high-pressure ventilator and ammonia warning device shall be performed according to the technical specification in such a way that its function is ensured even when the main switch of the refrigerating plant is off.

The integration into venting systems should take place according to the local conditions and requirements.

If desired, the bleed line of the refrigerating plant may be connected to the absorber.

#### 11.4 Main dimensions

Type	Length (mm)	Width (mm)	Height (mm)
ABSA 50/I	approx. 1400	approx. 1100	approx. 2200
ABSA 100/I	approx. 1400	approx. 1100	approx. 2200
ABSA 150/II	approx. 2200	approx. 1300	approx. 2200
ABSA 200/II	approx. 2200	approx. 1300	approx. 2200
ABSA 250/III	approx. 2200	approx. 1600	approx. 2200
ABSA 300/IV	approx. 2700	approx. 1600	approx. 2400
ABSA 350/IV	approx. 2700	approx. 1600	approx. 2400
ABSA 25/V	approx. 1200	approx. 700	approx. 1600

## 11.5 Assembly

### 11.5.1 Positioning

The absorber is positioned as shown in the Figure.

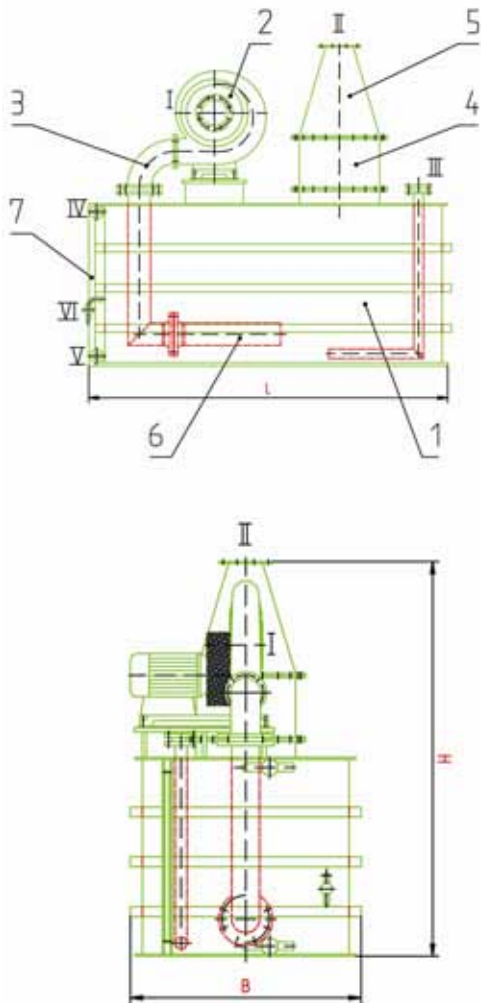


fig. 12: Absorption device ABSA, view

1	Vessel made of ammonia-resistant plastic
2	High-pressure ventilator
3	Connecting sleeve
4	Demister with separating package
5	Diffuser laid out for connection to venting systems
6	Gas distribution pipe
7	Liquid level indicator



**11.5.2 Table of connecting sleeves**

I	Suction connection of high-pressure ventilator	Ø 76, Ø 103, Ø 140, Ø160 <sup>4</sup>
II	Diffuser air outlet	Ø 160
III	Safety pipe connection	NB 40
IV	Charging connection	DN 32 <sup>5</sup>
V	Discharging connection	NB 32 <sup>2</sup>
VI	Sampling connection	NB 10 <sup>2</sup>

<sup>4</sup> according to type of ventilator

<sup>5</sup> ball-cock design

## 12 TECHNICAL DATA - SELECTION TABLE

Type	NH <sub>3</sub> -Filling weight <sup>6</sup>	Vessel type and Dimensions L/W/H (in mm)	Required water volume (l)	Filling height (mm)
ABSA 50/I	up to 50	I 1200/1000/1000	420	350
ABSA 100/I	up to 100	I 1200/1000/1000	840	700
ABSA 150/II	up to 150	II 2000/1200/1000	1260	525
ABSA 200/II	up to 200	II 2000/1200/1000	1680	700
ABSA 250/III	up to 250	III 2000/1500/1200	2100	700
ABSA 300/IV	up to 300	IV 2500/1500/1200	2500	670
ABSA 350/IV	up to 350	IV 2500/1500/1200	2920	780
ABSA 25/V	up to 25	I 1000/600/750	210	350

Type	Required air flow m <sup>3</sup> /h	Fan type	Motor output <sup>7</sup>	Gas distribution pipe, diameter x l (mm)	Weight (without filling) (kg)
ABSA 50/I	680	HRD 14/5	2,2	110 x 500	200
ABSA 100/I	1080	HRD 60/4	4,0	110 x 750	230
ABSA 150/II	1410	HRD 65/4	4,0	137 x 750	350
ABSA 200/II	1710	HRD 65/5	5,3	137 x 750	360
ABSA 250/III	1985	HRD 65/7	7,5	137 x 750	440

<sup>6</sup> The specified data refer to the highest NH<sub>3</sub>-filling weight of the refrigerating system/ chiller.

<sup>7</sup> Motor output 230/ 400V, 3~, 50Hz, others on request

Type	Required air flow m <sup>3</sup> /h	Fan type	Motor output <sup>7</sup>	Gas distribution pipe, diameter x l (mm)	Weight (without filling) (kg)
ABSA 300/IV	2240	HRD 65/7	7,5	137 x 750	510
ABSA 350/IV	2485	HRD 65/7	7,5	137 x 1000	510
ABSA 25/V	430	HRD 1/5	1,1	70 x 500	130

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