1. General

HANBELL RC2-AVI series semi-hermetic screw compressor is developed for variable frequency drive (VFD) applications in air-conditioning and refrigeration. It inherits our experience in RC2 design and enhances the mechanism of capacity modulation and motor insulation for VFD applications. Each HANBELL compressor is precisely manufactured by THREAD SCREW ROTOR GRINDING MACHINE, CNC MACHINING CENTER, and inspected by 3D COORDINATE MEASURING MACHINE. The advanced 5-to-6 Patented Screw Rotor Profile ensures high efficiency in different range of operating conditions.

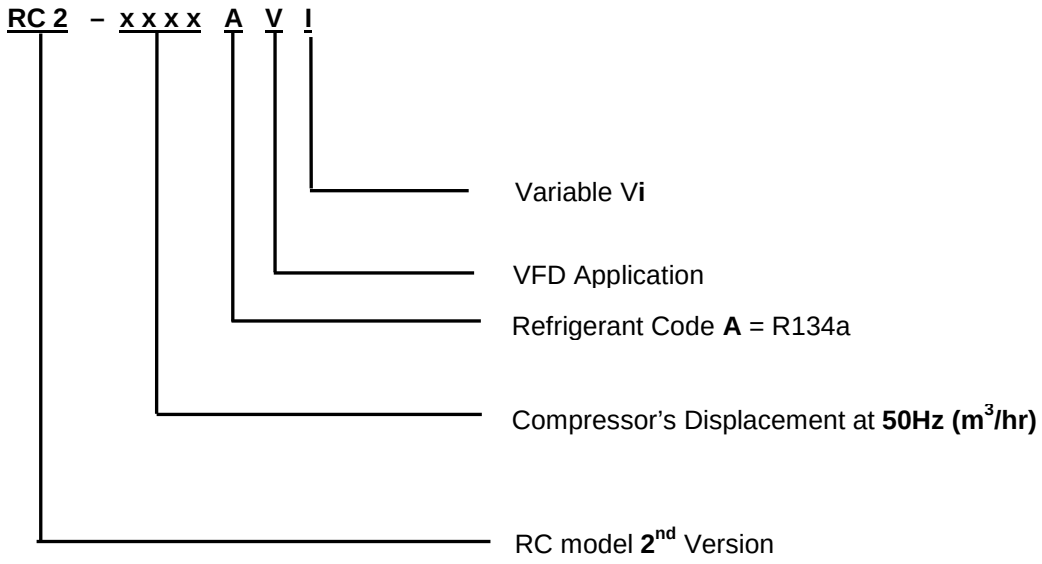
Quality management system in HANBELL complies with the ISO 9001 requirements. The ISO 9001 certification assures customers that HANBELL products are manufactured within a uniform and consistent quality system from the time an order is placed until shipment.

RC2-AVI series compressor is equipped with liquid injection connector, economizer port, PTC motor temperature thermistors, discharge temperature thermistors, motor protector, oil level switch and oil pressure differential switch connector for additional cooling and compressor protection. These accessories guarantee the compressor with the highest reliability and longest bearing life under heavy or strict operating conditions.

This Technical Manual contains information of compressor specifications, installation, environment setting, applications and basic trouble-shooting. To prevent any possible incorrect operations, it is highly recommended to read these instructions prior to installing and commissioning the compressor. Please contact HANBELL or its local distributors for farther information and assistance.

2. Specifications and designs

2.1 Compressor nomenclature



2.2 Compressor specifications

a. RC2-AVI

Model	Compressor			Motor						Lubricant Charge	Oil Heater	Hydrostatic Pressure Test	Weight
	Displacement 70Hz / 80Hz (m^3/hr)	Rated Speed (rpm)	Vi	Type	Nominal Hp	Starting	Voltage 80Hz(V)	Insulation	Protection	L	W	kg/cm^2g	kg
RC2-140AVI	189/219	1,200~4,800 (20~80Hz)	1.6 - 2.0 - 2.4 or 2.4 - 3.0 - 3.5	3 Phase, 2 Pole, Variable Speed, Induction Motor	42	Inverter staring	220/ 380~460	Class F	PTC	7	150/ 300	42	295
RC2-260AVI	356/411				78					14			575
RC2-300AVI	410/469				90					16			620
RC2-340AVI	475/542				102					16			630
RC2-410AVI	567/651				125					16			760
RC2-470AVI	660/754				144					18			830
RC2-550AVI	769/878				168					23			850
RC2-620AVI	867/990				182					23			880
RC2-830AVI	1159/1324	1150~4150 (20-70Hz)			243					28			1180
RC2-1020AVI	1428 (70Hz)				265 (70Hz)					40			1530
RC2-1270AVI	1775 (70Hz)				333 (70Hz)					53			2130

Note:

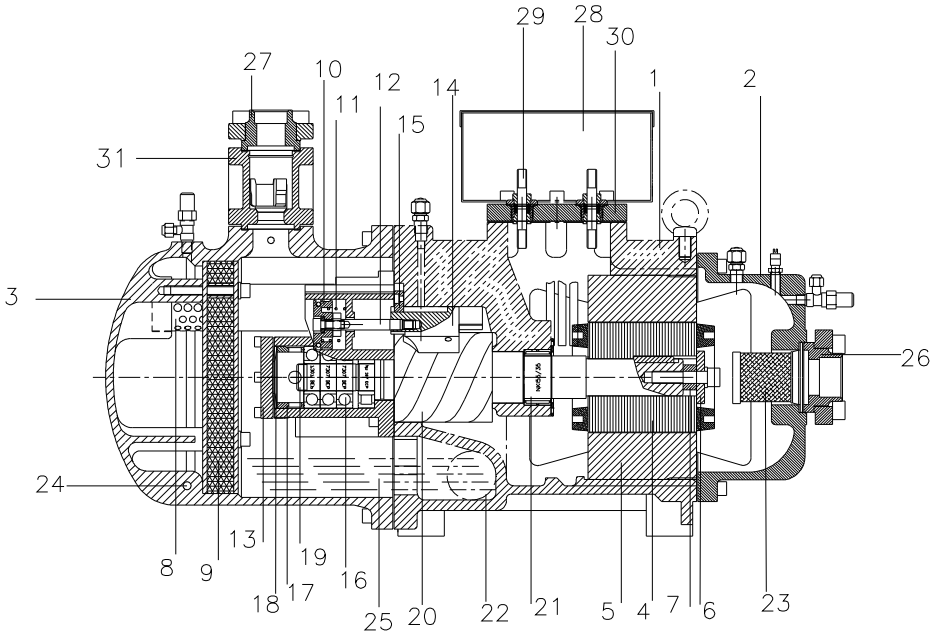
It is recommended to install a second oil separator if SCT is above 50℃ (122℉).

Nominal Horse Power:

All the above Nominal Hp's are not equal to the maximum compressor Hp. Please refer to Hanbell selection software's output for rated current according to various operating conditions while selecting contactor, cable, fuse and wire, etc…

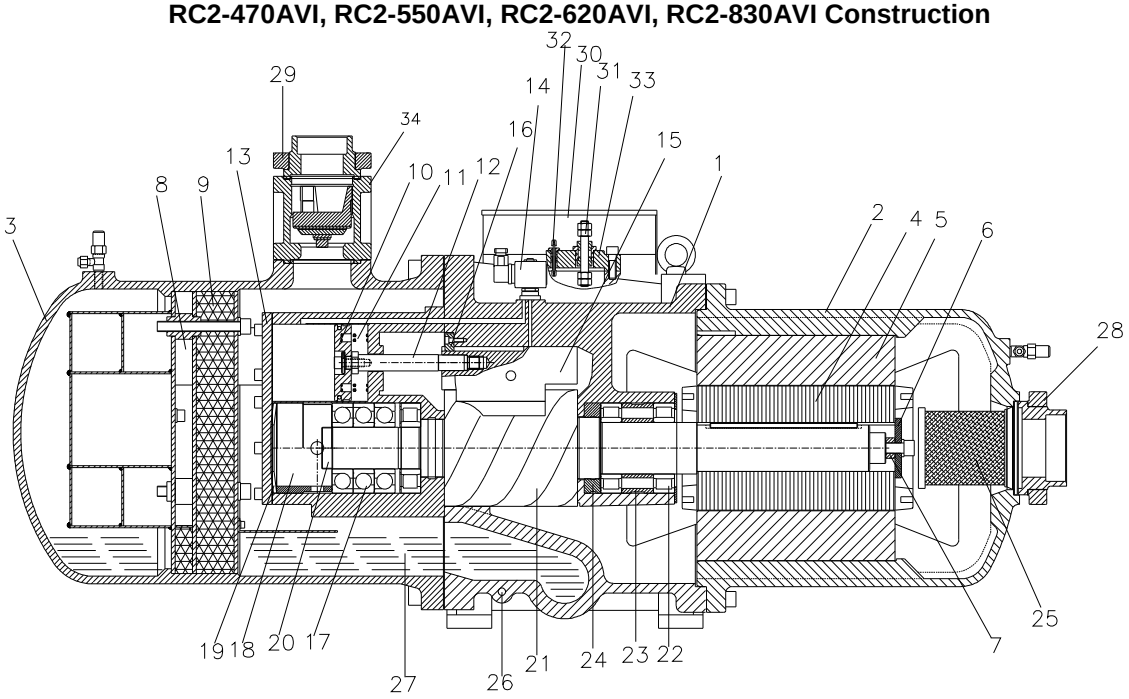
2.3 Compressor construction

Figure 2.1.1:**RC2-140AVI Construction**



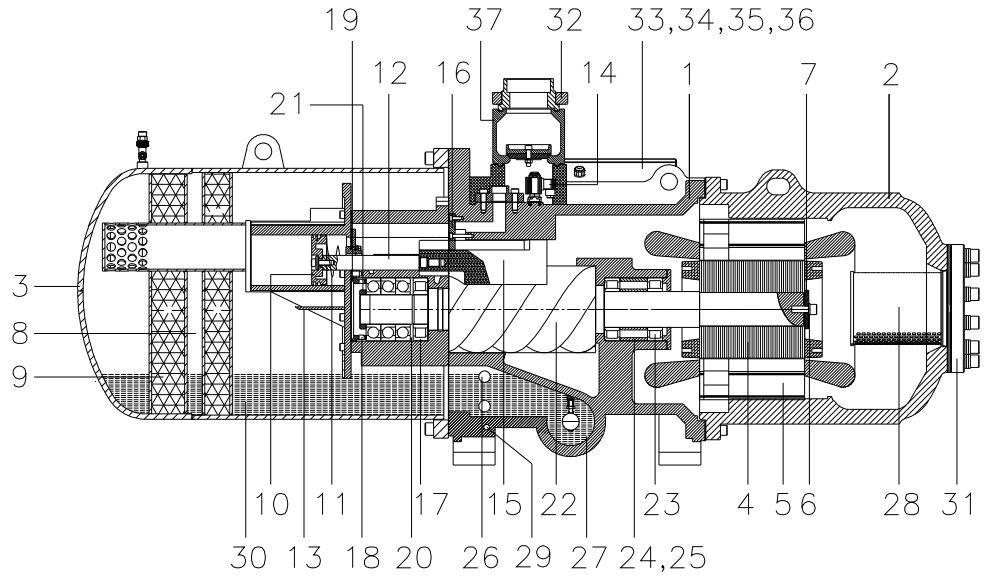
Item	Description	Item	Description	Item	Description	Item	Description
1	Compressor casing	9	Oil separator cartridge	17	Discharge fixed ring	25	Refrigeration Lubricant
2	Motor casing	10	Piston	18	Disc spring	26	Suction flange
3	Oil separator	11	Piston spring	19	Bearing lock nut	27	Discharge flange
4	Motor rotor assembly	12	Piston rod	20	Male rotor	28	Cable box
5	Motor stator assembly	13	Bearing seat's cover plate	21	Suction bearings	29	Power bolt
6	Motor rotor washer	14	Modulation slide valve	22	Oil filler cartridge	30	Motor cable cover plate
7	Motor rotor spacer ring	15	Slide valve key	23	Suction filter	31	Discharge check valve
8	Oil separator baffle	16	Discharge bearings	24	Oil heater		

Figure 2.1.2:**RC2-260AVI, RC2-300AVI, RC2-340AVI, RC2-410AVI, RC2-470AVI, RC2-550AVI, RC2-620AVI, RC2-830AVI Construction**



Item	Description	Item	Description	Item	Description	Item	Description
1	Compressor casing	10	Piston	19	Disc spring	28	Suction flange
2	Motor casing	11	Piston spring	20	Bearing lock nut	29	Discharge flange
3	Oil separator	12	Piston rod	21	Male rotor	30	Cable box
4	Motor rotor assembly	13	Bearing seat's cover plate	22	Suction bearings	31	Power bolt
5	Motor stator assembly	14	Modulation solenoid valve	23	Suction bearings inner/outer spacer ring	32	Thermostat terminals
6	Motor rotor washer	15	Modulation slide valve	24	Oil guiding ring	33	Motor cable cover plate
7	Motor rotor spacer ring	16	Slide valve key	25	Suction filter	34	Discharge check valve
8	Oil separator baffle	17	Discharge bearings	26	Oil heater		
9	Oil separator cartridge	18	Discharge fixed ring	27	Refrigeration Lubricant		

Figure 2.1.3:**RC2-1020AVI, RC2-1270AVI**



Item	Description	Item	Description	Item	Description	Item	Description
1	Compressor casing	11	Piston spring	21	Bearing slot nut	31	Suction flange
2	Motor casing	12	Piston rod	22	Male rotor	32	Discharge flange
3	Oil separator	13	Bearing seat cover plate	23	Suction bearings	33	Cable box
4	Motor rotor assembly	14	Modulation solenoid valve	24	Suction bearings inner/outer spacer ring	34	Power bolt
5	Motor stator assembly	15	Modulation slide valve	25	Oil guiding ring	35	Thermostat terminals
6	Motor rotor washer	16	Slide valve key	26	Oil level sight glass	36	Motor cable cover plate
7	Motor rotor spacer ring	17	Discharge bearings	27	Oil filler cartridge	37	Discharge check valve
8	Oil separator Baffle	18	Discharge fixed ring	28	Suction filter		
9	Oil separator cartridge	19	Disc spring	29	Oil heater		
10	Piston	20	Balance piston	30	Refrigeration Lubricant		

2.4 Design features

HANBELL screw compressors feature simple and robust construction by elimination of some components such as pistons, piston rings, valve plates, oil pumps which are usually found in reciprocating compressors. Without these components, screw compressors are running with minimum noise and vibration level and high reliability and durability. HANBELL screw compressors are of two-shaft rotary displacement design with the advanced 5:6 patented screw rotors. Screw rotors are precisely installed with roller bearings, i.e. radial bearings at both suction and discharge ends as well as angular contact ball bearings i.e. axial bearings at discharge end. A three-phase, two-pole, squirrel-cage dedicated induction motor drives the compressor. The motor rotor is affixed with the shaft of the male screw rotor. Cooling of the motor is achieved with suction refrigerant vapor.

Compressor technical features:

Automatic variable volume ratio- Compressor's Vi is adjustable, which reduce the risk of efficiency loss when the working condition may vary at job site. Peak and off-peak operation conditions can be taken into account at the same time. Automatic variable volume ratio ensures no loss of work in various working condition.

Variable frequency drive (VFD) - Variable frequency drive efficiently adjusts motor speed to match output requirements and save energy.

Full product range- RC2-AVI series compressor consists of 11 models with displacement ranging from 140 m^3/hr to 1775 m^3/hr.

Multinational patents of high-efficiency screw rotors- The new 5:6 high efficiency screw rotor profile is patented in Taiwan, UK, US, and China. This large-volume, high-efficiency rotor profile is designed especially for modern refrigerant characteristics. High-efficiency screw rotors are accomplished by using precise CNC machining centers, rotor milling machines, rotor grinding machines. Quality system certified by ISO 9001 with precise measuring equipment such as ZEISS 3D coordinate measuring machines, ensure high-efficiency, high-quality, low-noise and low-vibration HANBELL RC2-AVI series screw compressors.

High efficiency motor- Premium grade low-loss core steel with special motor cooling slot and refrigerant guide vane pilots the cold suction refrigerant gas going through the motor, providing high efficiency under different operating conditions. Its winding and insulation is specially made for variable speed drive applications.

Long life bearings and high reliability- The screw compressors utilize a combination of 10 axial and radial bearings with α axial balance piston to ensure longer bearing life and higher compressor reliability.

Double-walled rotor housing- Double-walled casing structure with high strength inner ribs is designed to minimize noise and vibration level. The rotor housing is made of high-strength gray cast iron FC25 that is extremely stable. These casings are machined by computer aided machining centers and inspected by precision measuring machines.

Direct flange-on oil separator- A vessel made of ductile material FC500 specially designed to withstand high pressure and provide the highest efficiency of oil separation. Simple oil management, three-staged oil separator, low-pressure-drop demister ensures the minimum refrigerant dilution in the oil and maintain high oil viscosity.

Perceptive protection modules- RC2-AVI series screw compressors are equipped with PTC thermistors and motor protection module which can monitor discharge and motor coil temperatures. Accessories also include oil level switch to monitor the level of oil, pressure differential switch connector, and optional pressure relief valve.

Adaptable with additional cooling- Liquid injection connectors on motor casing and the compression casing maintain proper temperature of lubricant and prevent the compressor from overheat. Similarly, oil cooler connectors for the external oil cooler application can reduce discharge temperature and gives better efficiency. The middle pressure economizer connection port can be used to achieve higher refrigeration capacity and system efficiency through a sub-cooling circuit and two-stage refrigeration expansion.

2.5 Compression process

(A) Suction and sealing:
At the beginning of the compression cycle, as the male rotor and female rotor unmesh, gas from suction port fills the interlobe space (refer to the dark area below). Refrigerant at suction pressure continues to fill it, until the trailing lobe crosses the suction area and the gas is trapped inside the interlobe space.

(B) Compression:
As the male rotor and female rotor mesh with each other, the interlobe space moves towards to discharge end and its volume shrinks so that gas pressure increases consequently.

(C) Discharge:
Gas is discharged from the interlobe space when the leading lobe crosses the discharge port with designed volume ratio.

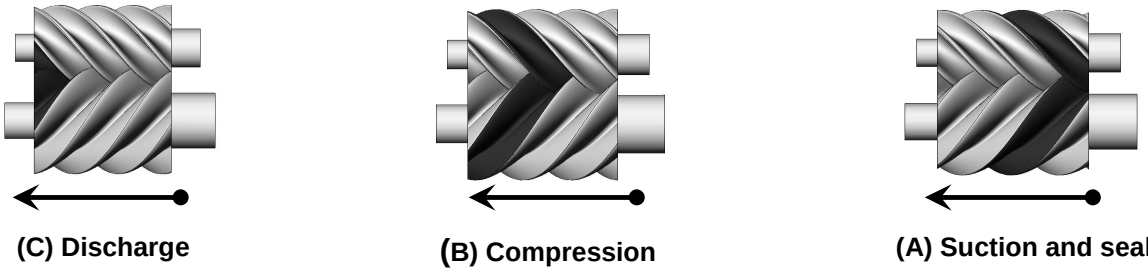


Figure 2.2: Compression process

2.6 VFD application

The following are the instructions that explain the variable frequency drive (VFD) applied in RC2-AVI series screw compressor. Please read all of the instructions before commissioning.

1. Maximum rotation frequency must be within nominal rotation frequency of the motor; minimum rotation frequency is variable under specified working condition (please refer 2.9 Application Limits).
2. If the compressor has to operate outside the frequency spectrum mentioned above, please consult Hanbell before commissioning. Higher or lower rotation frequency may result in lower efficiency or damage to the compressor and motor.
3. Wiring of chiller controller and compressor protection modules such as PTC thermistors or oil level switch should be insulated from wiring of the VFD's power input/output for prevention of interference.
4. The VFD and the compressor must be well-grounded respectively.
5. Nullify functions of phase loss and phase sequence in motor protector INT69HBY for their duplication in the VFD's protection and prevention of interference.
6. To prevent reverse running of compressors due to incorrect wiring, verification of high/low pressures should be monitored by pressure switches or programming in commissioning.
7. Compressor high/low pressure difference should be kept above 4kg/cm^2, especially under very low rotation speed. If an external oil circuit is used, the oil flow switch should be installed and oil pressure in the main oil return line should be monitored for adequate lubrication of compressors.
8. If high/low pressure difference or oil pressure in the main oil return line can't be maintained, an oil pump or pressure regulation valve must be installed.

2.7 Capacity control system

The mechanism of capacity modulation of RC2-AVI is achieved by the variation of motor's rotation speed. Compared to modulation by slide valve, adjustable rotation speed through VFD significantly enhances efficiency of compression, especially volumetric efficiency at part load. On the other hand, VFD can supply motor adequate voltage and power input based on the requirement; in this way, variation of power input during capacity modulation becomes more linear and that reduces unnecessary power losses. Overall, capacity modulation by VFD is superior to that by slide valve in volumetric efficiency and power consumption.

Capacity modulation by VFD is similar to stepless capacity modulation by slide valve. As long as VFD receives analog signals e.g. DC 0~10V or 4~20mA from PLC or microcontroller, it can make compressors run at corresponding rotation speed proportionally to achieve capacity modulation.

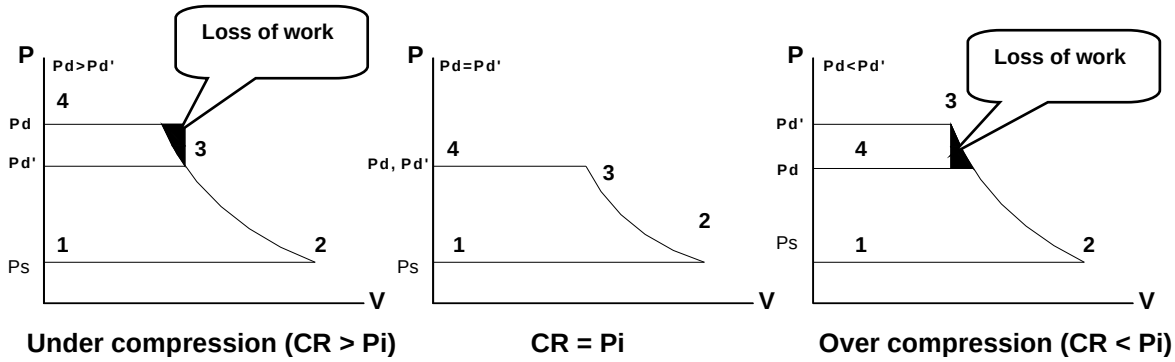
To let PLC or microcontroller control VFD stably, pay attention to the following notes:
1. Wiring for analog signals should be well-insulated to prevent interference and noise.
2. Wiring for signals connected to VFD should be isolated from VFD power supply at a distance.
3. PLC or microcontroller as well as VFD should be well-grounded respectively to prevent cross interference.

Procedures for initial setting are as follows:
1. When completing VFD setting, remove wiring of VFD power output, and check if VFD's output frequency and corresponding voltage comply with PLC or microcontroller's output signal, e.g. for DC 0~10V with 380V/3P/80Hz motor, when analog signal is 10V, VFD's output should be 80Hz and 380V; when analog signal is 7.14V, VFD's output should be 57Hz and 272V and so on.
2. VFD's output current can't be verified under no load but its frequency and output voltage still can be registered by VFD's display. Because VFD's output voltage is not normal A/C voltage, it can't be measured by general clamp meter.
3. In addition to analog signals, other communication between microcontroller and VFD should be checked as well, such as VFD's failure feedback or reset command…etc.

2.8 Volume ratio (Vi)

The volume ratio **(Vi)** of the compressor can be defined as the ratio of suction volume to discharge volume in the compressor. The smaller the concavity of slide valve in the discharge end, the larger the volume ratio. The volume ratio directly affects the internal compression ratio (Pi). Low Vi corresponds to low Pi and high Vi corresponds to high Pi. In the equation below, in order to prevent over or under compression, the system compression ratio **(CR)** should be equal to compressor's internal compression ratio **(Pi)**. Please refer to P-V (pressure – volume) diagram below to figure out this relation. Following the concept above, if the Vi varies with working condition, there will be less loss of work. High efficiency can be achieved. In RC2-AVI series, Vi 1.6-2.0-2.4 or Vi 2.4-3.0-3.5 is provided to correspond to various working condition.

CR = Pd/Ps
Pi = Vi ^{k}
Vi = Vs/Vd



Under compression (CR > Pi) **CR = Pi** **Over compression (CR < Pi)**

Figure 2.3: P-V Diagram

Where: **CR:** system compression ratio **Pi:** internal compression ratio
Vi: internal volume ratio **Pd:** system pressure (absolute pressure)
Pd': discharge pressure (absolute pressure) **Ps:** suction pressure (absolute pressure)
Vs: suction volume **Vd:** discharge volume **K:** refrigerant specific heat ratio

In RC2-AVI, compression volume is adjustable through two solenoid valves. The mechanism improves the power efficiency under different working conditions, especially when the compressor runs at part load. The control logic is based on the equations belows

Vi = Vs/Vd; Vs: suction volume, Vd: discharge volume
$(Vi)^{k}$= Pd/Ps; Ps: suction pressure (absolute pressure), Pd: system pressure (absolute pressure) k: coefficient

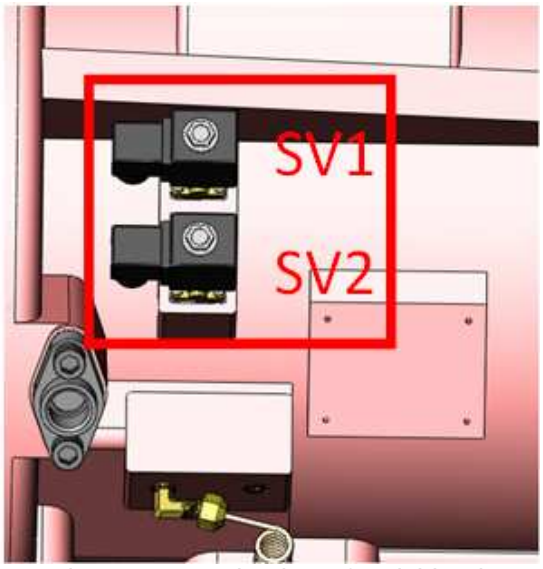


Figure 2:4: Mechanism of variable Vi

In water cooled and air cooled system, the volume ratio can be set at 1.6, 2.0, 2.4 and 2.4, 3.0, 3.5, respectively. Following tables show the control logic of solenoid valve under different Vi:

Vi	SV2	SV1
1.6	Off	Off
2.0	On	Off
2.4	Off	On

Figure 2.5: Vi control (Water-cooled system)

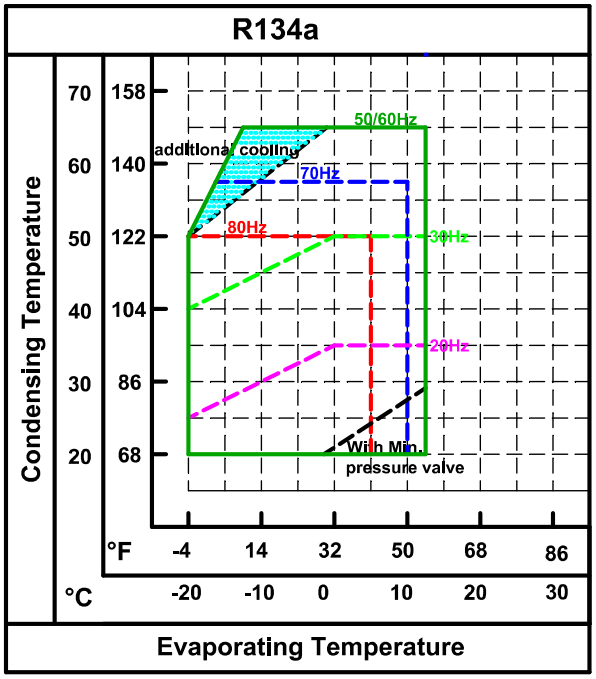
Vi	SV2	SV1
2.4	Off	Off
3.0	On	Off
3.5	Off	On

Figure 2.6: Vi control (Air-cooled system)

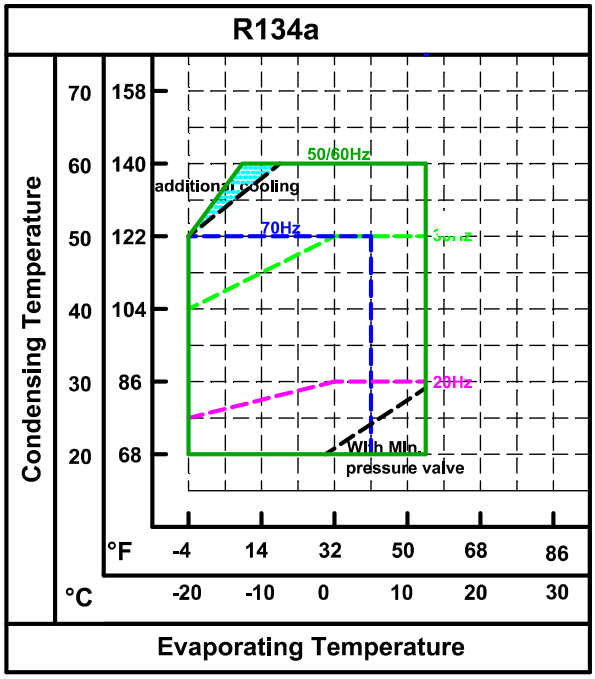
2.9 Application limits

The application limits shown below are based on saturated suction and discharge operating conditions, for continuous operation over extended periods of time. It is important to operate within these limits to maintain proper compressor life. Operating at extra low saturated suction temperature, may cause oil management and motor cooling problems, while operating at extra high saturated condensing temperature will shorten the compressor life due to insufficient motor and compressor chamber cooling.

RC2-140AVI~620AVI



RC2-830AVI~1270AVI



Notes:

1. When Hanbell screw compressors operate in partial or full load at application limits, motor coil and discharge temperature will rise simultaneously. In order to keep compressors' safe running continuously, Hanbell recommends usage of the following additional cooling devices :
   (1)Oil cooler or (2)Liquid injection to chamber or (3)Liquid injection to motor.
   Please refer to Hanbell selection software for application of additional cooling system.

2. Hanbell recommends monitoring oil pressure and keeping it 4 kg/cm^{2}g over the suction pressure for adequate seal, lubrication by pressure differential switch passively or by additional oil pump actively. Especially under operation conditions with low condensing temperature and high evaporating temperature like application in flooded water-cooled chillers, high-low pressure differential tends to be less than 4kg/cm^{2}g, installation of oil pump is recommended to ensure adequate oil pressure.
   Contact Hanbell to verify potential operating conditions outside the application limits as shown.

3. The minimum discharge superheat is recommended to be kept 10K higher than the condensing temperature (normally discharge superheat is around 20K for R134a) to avoid liquid's filling back to compressor and lubrication failure.

3. Lubricants

The main functions of lubrication oil in screw compressors are lubrication, internal sealing, and cooling. The design of positive pressure differential lubrication system makes RC2-AVI series normally omit an extra oil pump which is necessary for reciprocating compressors. However, in some special applications, it is still necessary to install an extra oil pump to screw compressors for safety.
Bearings installed in RC2-AVI series compressors require a small and steady quantity of oil for lubrication. Oil injection into the compression chamber creates a film of oil for sealing in the compression housing to increase efficiency and also can dissipate part of compression heat.
Please pay more attention to the oil temperature, which is crucial to compressor bearings' life. Oil has a much lower viscosity at high temperatures. Too low viscosity of oil will result in poor lubrication and heat dissipation in the compressor. Viscosity is recommended to keep over 10mm^2/s at any temperatures for oil. Oil temperature in the oil sump should be kept above the saturated condensing temperature to prevent refrigerant migration into lubrication system.
If the compressor operates under critical operating conditions, an extra oil cooler is required – please refer to Hanbell selection software for the required capacity and oil flow of the extra oil cooler. High-viscosity oil is recommended to apply in high operating conditions because high discharge temperatures will make viscosity of oil lower. Oil return from the evaporator may be insufficient in such as refrigeration systems, flooded chillers…etc. , in which it's difficult for oil to be carried back and it may cause oil loss in the compressor. If the system encounters the oil return problem, then an extra 2nd oil separator is recommended to be installed between the compressor discharge port and the condenser.

3.1 Lubricants table

Hanbell Authorized Lubricant for R134a

SPECIFICATION		UNITS	HBR-B05	HBR-B08	HBR-B09	HBR-B04
COLOR, ASTM			–	–	–	–
SPECIFIC GRVITY			0.945	0.94	0.95	0.95
VISCOSITY	40℃	mm^2/s (cSt)	64	131	175	215.9
	100℃		8.9	14.53	16.5	20.8
FLASH POINT		℃	266	254	265	271
POUR POINT		℃	-43	-36.5	-30	-25
T.A.N		mg KOH/g	–	–	–	–
COPPER STRIP 100℃/3hr			–	–	–	–
MOISTURE		ppm	–	–	–	–
FLOC POINT		℃	–	–	–	–
DIELETRIC STRENGTH 2.5mm		kV	–	–	46.6	–

Note: For using non-HBR lubricants, please consult HANBELL for more information.

3.2 Suggestions of changing oil

1. Use Hanbell certified oil and do not mix different brands of oil together. Choice of oil should match characteristics of the refrigerant used. Oil remained in the compressor should be totally cleaned up before charging different brands of oil. Charge the compressor with oil for the first start and then change it into new oil again to ensure that there's no mix at all.
2. When using polyester oil for chiller systems, please make sure not to expose oil to the atmosphere for prevention of change in its property. Therefore, it is necessary to vacuum the system completely when installing the compressor.
3. In order to ensure no moisture inside the system, it is suggested to clean the system by charging it with dry Nitrogen and then vacuum it repeatedly as long as possible.

4. It is a must to change oil especially if the motor has burned out because acid debris may still remain inside the system. Please follow the procedures mentioned above to change oil in the system. Check acidity of oil after 72 hours of operation and then change it again until acidity of oil becomes normal.

5. Please contact Hanbell local distributors/agents for selection of oil.

3.3 Oil change

1. Change oil periodically: Check lubrication oil every 10,000 hours of continuous running. For the first operation of the compressor, it is recommended to change the oil and clean the external oil filter after running 2,000 hours. Check the system whether clean or not and then change oil every 20,000 hours or after 3 years' continuous running while the system operates in good condition.

2. Avoid clogging in oil filter with debris or swarf which may cause bearings' failure. An optional oil pressure differential switch is recommended to be installed. The switch will trip when the oil pressure differential between the primary and secondary sides reaches the critical point and then the compressor will automatically shut down to prevent the bearings from damage due to oil loss.

4. Compressor lifting and installation

4.1 Compressor lifting

Each HANBELL screw compressor has been carefully tested at the factory and every precautionary measures have been taken to make sure that compressors will keep in perfect condition when reaching customers' work. After the compressor arrives at your warehouse, please check if its crate is kept in good condition and check all the compressor accessories with shipping documents to see if there is any discrepancy.

When lifting the compressor, it is recommended to use a steel chain or steel cable which can be used for loading capacity of minimum 1500 kg as shown in the figure below. Make sure that chains, cables or other lifting equipments are properly positioned to protect the compressor and its accessories from damaging. Keep the compressor in horizontal position when lifting, and prevent it from crashing or falling on the ground, hitting the wall or any other accident that may damage it or its accessories.

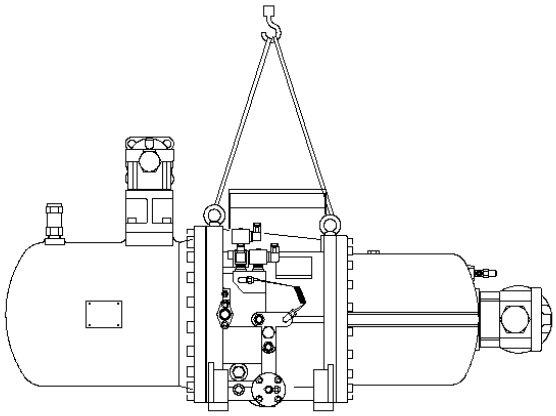


Figure 4.1: Lift the compressor with steel chain or steel cable

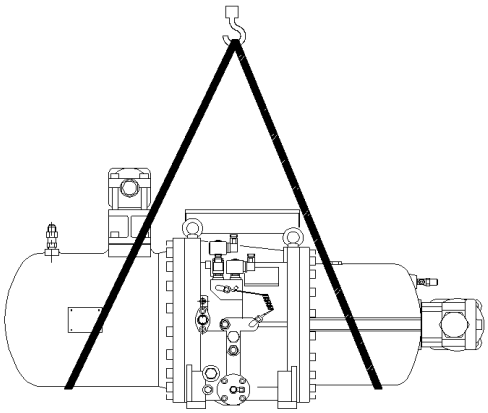


Figure 4.2: Lift the compressor with safety ropes

4.2 Compressor mounting

The installation of the compressor in the refrigeration system should be made accessible and make sure that the chiller base or site is far enough from the heat source to prevent heat radiation. The compressor should also be installed as close as possible to the electrical power supply for easier connection. Keep good ventilation and low humidity condition at the site. Make sure that the frame or support is strong enough to prevent excessive vibration and noise while the compressor is running and must reserve enough space for compressors' future overhauling work.
The compressor must be installed horizontally and in order to prevent excessive vibration transferred by the structure and piping of the chiller while in operation, cushion or anti-vibration pads should be installed. The installation of the anti-vibration pads is shown in Figure 4.3. The screws should only be tightened until slight deformation of the rubber pads is visible.

※ It is strongly recommended to position the compressor higher than the evaporator

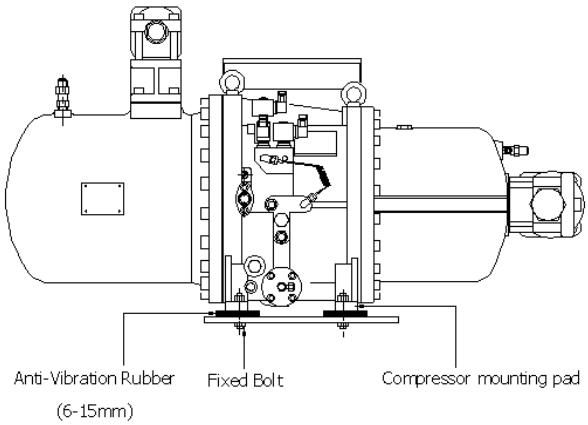


Figure 4.3: Installation of anti-vibration pads

Suggestions on piping works

The unsuitable piping works done to the compressor could cause abnormal vibration and noise that might damage the compressor. Take notice of the following points to prevent this situation from happening:

1. Cleanliness of the system should be kept after welding the piping to avoid any swarf or debris contained inside the system as it may cause serious damage to the compressor during operation.

2. In order to reduce the vibration on the piping tubes, it is recommended to use copper tubes for suction and discharge piping tubes. Copper tubes are better to minimize the vibration in the piping while the compressor is in operation. In case steel tubes are used in piping system, then welding jobs are very important to avoid any stress in the piping. This inner stress can cause harmonic vibration and noise that can reduce the life of the compressor. If a large-caliber copper tube is not easily accessible and a steel tube is used instead in suction piping, Hanbell also recommends use of a copper tube in discharge piping to best minimize abnormal vibration and noise.

3. Remove the oxidized impurities, swarf or debris caused by welding in the piping tubes, if these fall into the compressor, the oil filter might be clogged resulting in malfunctioning of lubrication system, bearings and capacity control system.

4. The material of suction and discharge flange bushing is forged steel and it can be welded directly with piping. After welding the flange bushings and pipes, it must be cooled down by ambient air. Do not use water to cool it down because water quenching is prohibited.

Installing the compressor in a sloping position

Figure 4.4 shows a 15° limit of oblique angle for installation of compressor. In case the oblique angle is higher than the limit, compressor will be shut down easily. For special applications like the installation in ships, fishing boats, etc…, where the oblique angle might exceed the limit, external oil separators, oil tanks and related accessories are recommended to be installed. Please contact HANBELL or local distributors for further layout recommendation.

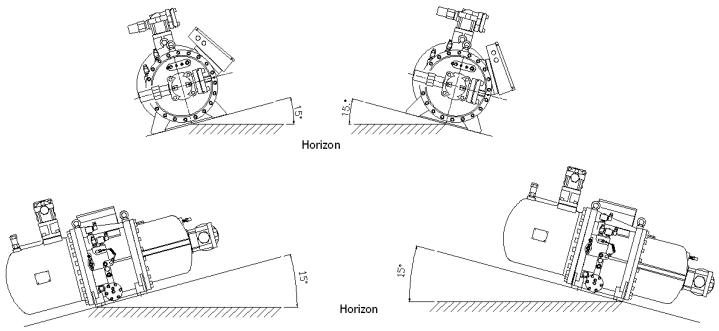
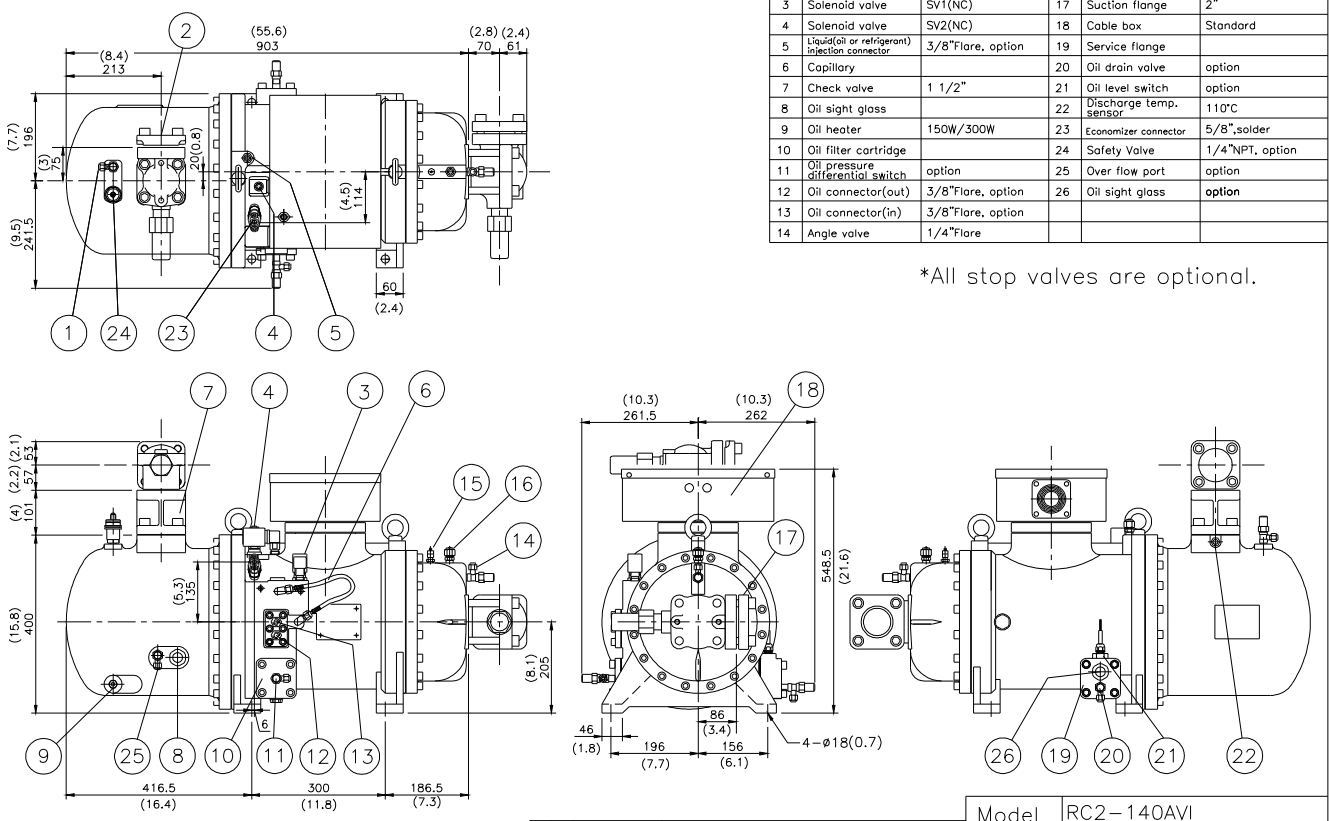


Figure 4.4: Limits of oblique angle for the installation of the compressor

4.3 Compressor outline

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	15	Refrigerant service valve	1/4"Flare
2	Discharge flange	1 1/2"	16	Liquid injection connector	3/8"Flare, option
3	Solenoid valve	SV1(NC)	17	Suction flange	2"
4	Solenoid valve	SV2(NC)	18	Cable box	Standard
5	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	19	Service flange	
6	Capillary		20	Oil drain valve	option
7	Check valve	1 1/2"	21	Oil level switch	option
8	Oil sight glass		22	Discharge temp. sensor	110°C
9	Oil heater	150W/300W	23	Economizer connector	5/8",solder
10	Oil filter cartridge		24	Safety Valve	1/4"NPT, option
11	Oil pressure differential switch	option	25	Over flow port	option
12	Oil connector(out)	3/8"Flare, option	26	Oil sight glass	option
13	Oil connector(in)	3/8"Flare, option			
14	Angle valve	1/4"Flare			

*All stop valves are optional.



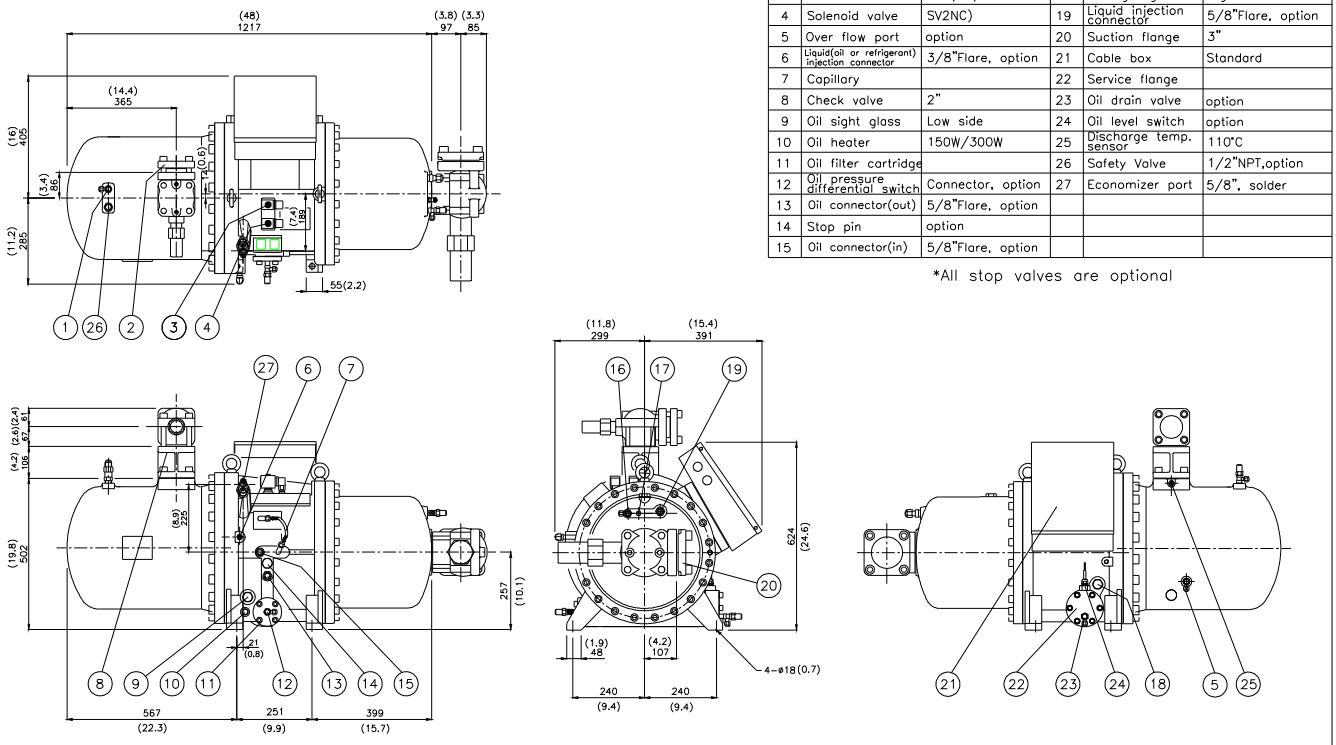
UNIT
SI: mm Imperial: (in)

Item	Date	Modification
3		
2		
1		

Model	RC2-140AVI
Name	Compressor outline
	HANBELL Ver. 01

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Angle valve	1/4"Flare
2	Discharge flange	2"	17	Refrigerant service valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Oil sight glass	High side
4	Solenoid valve	SV2NC)	19	Liquid injection connector	5/8"Flare, option
5	Over flow port	option	20	Suction flange	3"
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Cable box	Standard
7	Capillary		22	Service flange	
8	Check valve	2"	23	Oil drain valve	option
9	Oil sight glass	Low side	24	Oil level switch	option
10	Oil heater	150W/300W	25	Discharge temp. sensor	110°C
11	Oil filter cartridge		26	Safety Valve	1/2"NPT,option
12	Oil pressure differential switch	Connector, option	27	Economizer port	5/8", solder
13	Oil connector(out)	5/8"Flare, option			
14	Stop pin	option			
15	Oil connector(in)	5/8"Flare, option			

*All stop valves are optional



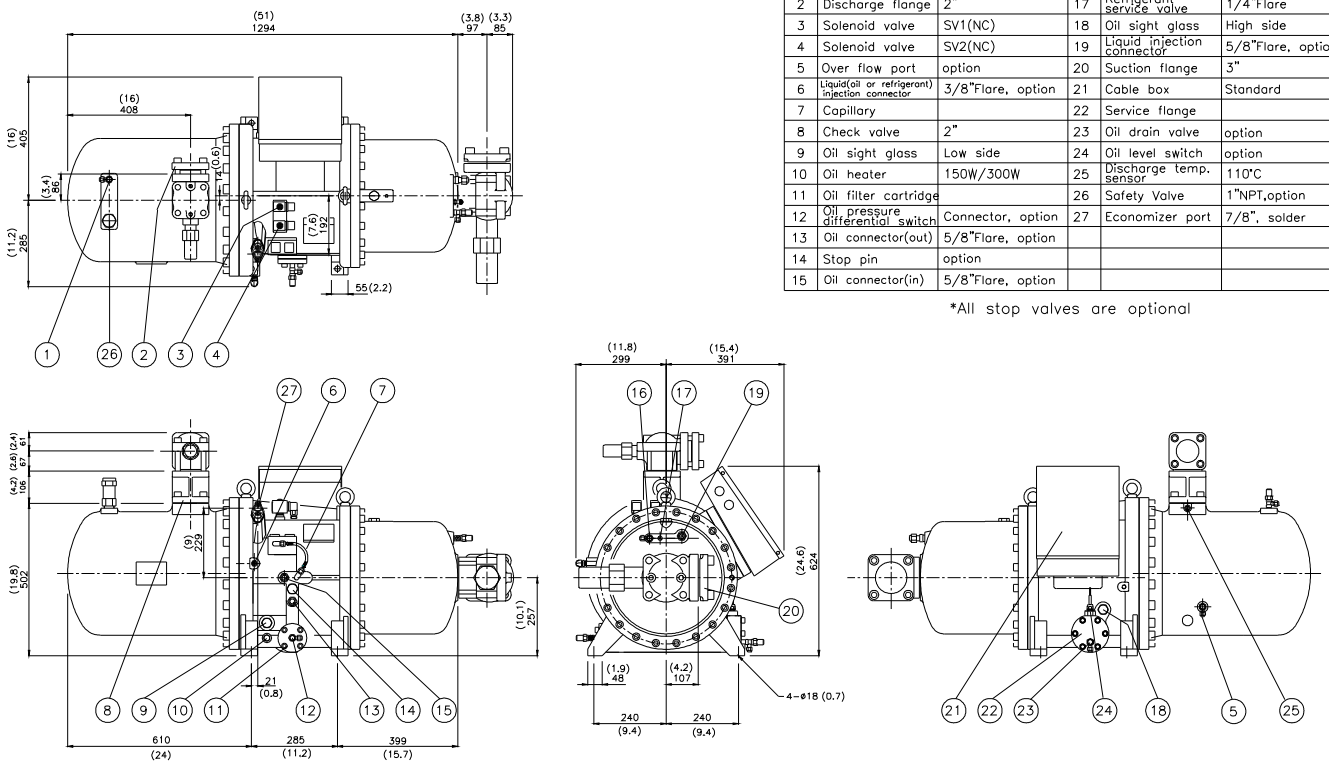
UNIT
SI: mm Imperial: (in)

Item	Date	Modification
3		
2		
1		

Model	RC2-260AVI
Name	Compressor outline
	HANBELL Ver. 01

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Angle valve	1/4"Flare
2	Discharge flange	2"	17	Refrigerant service valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Oil sight glass	High side
4	Solenoid valve	SV2(NC)	19	Liquid injection connector	5/8"Flare, option
5	Over flow port	option	20	Suction flange	3"
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Cable box	Standard
7	Capillary		22	Service flange	
8	Check valve	2"	23	Oil drain valve	option
9	Oil sight glass	Low side	24	Oil level switch	option
10	Oil heater	150W/300W	25	Discharge temp. sensor	110°C
11	Oil filter cartridge		26	Safety Valve	1"NPT,option
12	Oil pressure differential switch	Connector, option	27	Economizer port	7/8", solder
13	Oil connector(out)	5/8"Flare, option			
14	Stop pin	option			
15	Oil connector(in)	5/8"Flare, option			

*All stop valves are optional

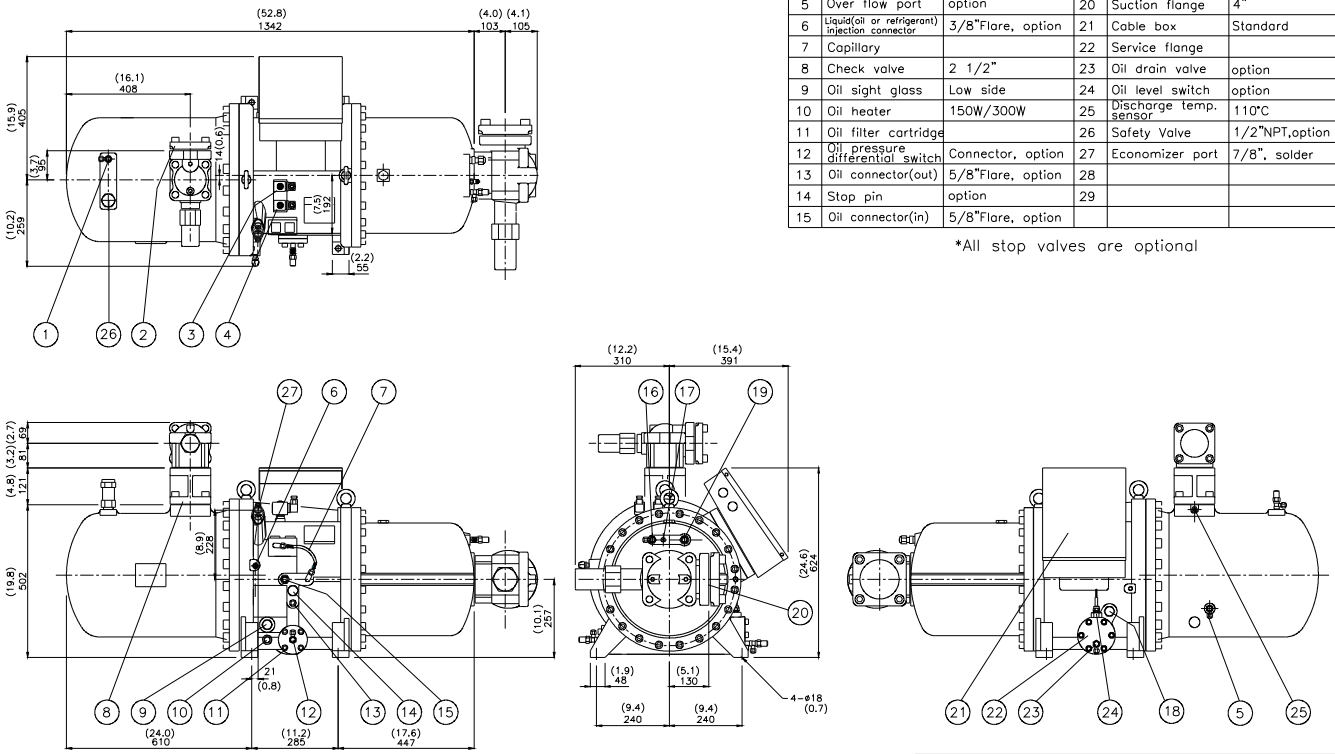


3			Model	RC2-300AVI
2			Name	Compressor outline
1				HANBELL Ver. 01
Item	Date	Modification		

UNIT
SI: mm Imperial: (in)

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Angle valve	1/4"Flare
2	Discharge flange	2 1/2"	17	Refrigerant service valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Oil sight glass	High side
4	Solenoid valve	SV2(NC)	19	Liquid injection connector	5/8"Flare, option
5	Over flow port	option	20	Suction flange	4"
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Cable box	Standard
7	Capillary		22	Service flange	
8	Check valve	2 1/2"	23	Oil drain valve	option
9	Oil sight glass	Low side	24	Oil level switch	option
10	Oil heater	150W/300W	25	Discharge temp. sensor	110°C
11	Oil filter cartridge		26	Safety Valve	1/2"NPT,option
12	Oil pressure differential switch	Connector, option	27	Economizer port	7/8", solder
13	Oil connector(out)	5/8"Flare, option	28		
14	Stop pin	option	29		
15	Oil connector(in)	5/8"Flare, option			

*All stop valves are optional

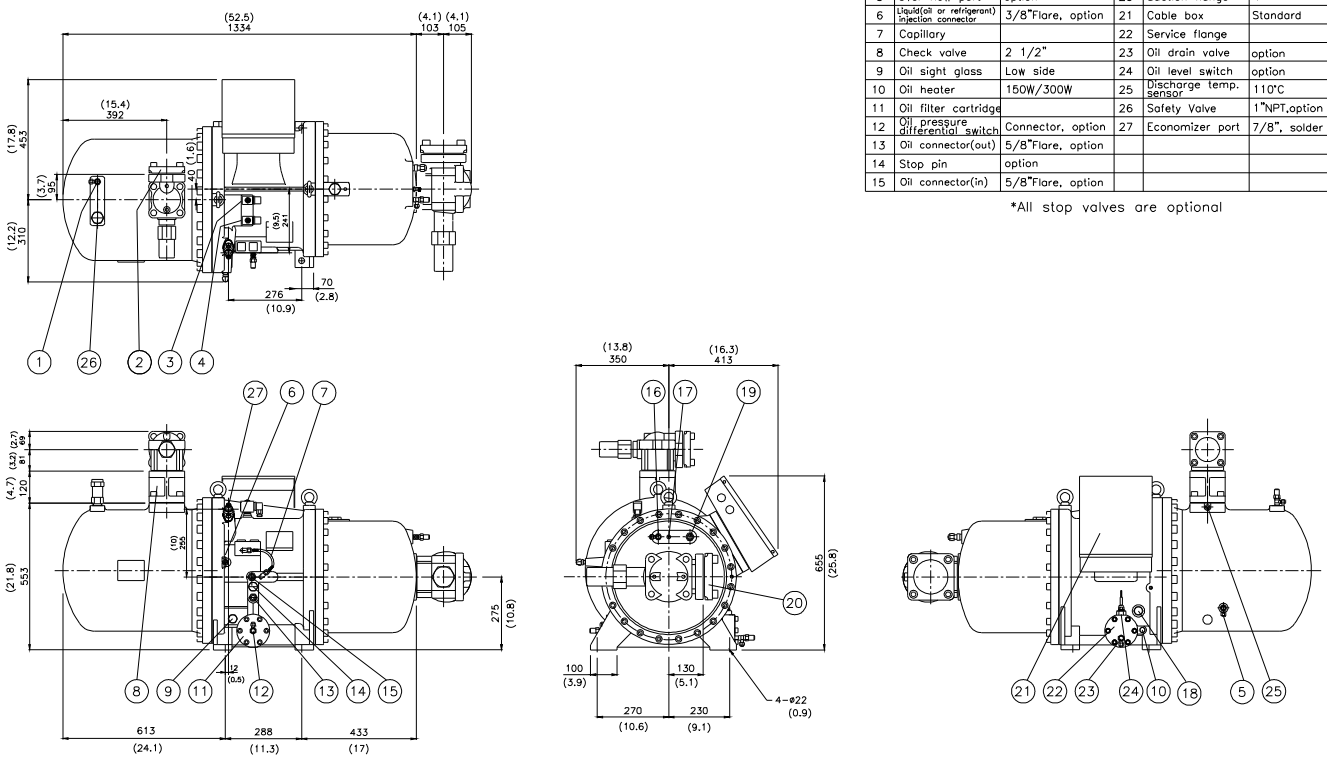


3			Model	RC2-340AVI
2			Name	Compressor outline
1				HANBELL Ver. 01
Item	Date	Modification		

UNIT
SI: mm Imperial: (in)

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Angle valve	1/4"Flare
2	Discharge flange	2 1/2"	17	Refrigerant service valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Oil sight glass	High side
4	Solenoid valve	SV2(NC)	19	Liquid injection connector	5/8"Flare, option
5	Over flow port	option	20	Suction flange	4"
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Cable box	Standard
7	Capillary		22	Service flange	
8	Check valve	2 1/2"	23	Oil drain valve	option
9	Oil sight glass	Low side	24	Oil level switch	option
10	Oil heater	150W/300W	25	Discharge temp. sensor	110°C
11	Oil filter cartridge		26	Safety Valve	1"NPT,option
12	Oil pressure differential switch	Connector, option	27	Economizer port	7/8", solder
13	Oil connector(out)	5/8"Flare, option			
14	Stop pin	option			
15	Oil connector(in)	5/8"Flare, option			

*All stop valves are optional



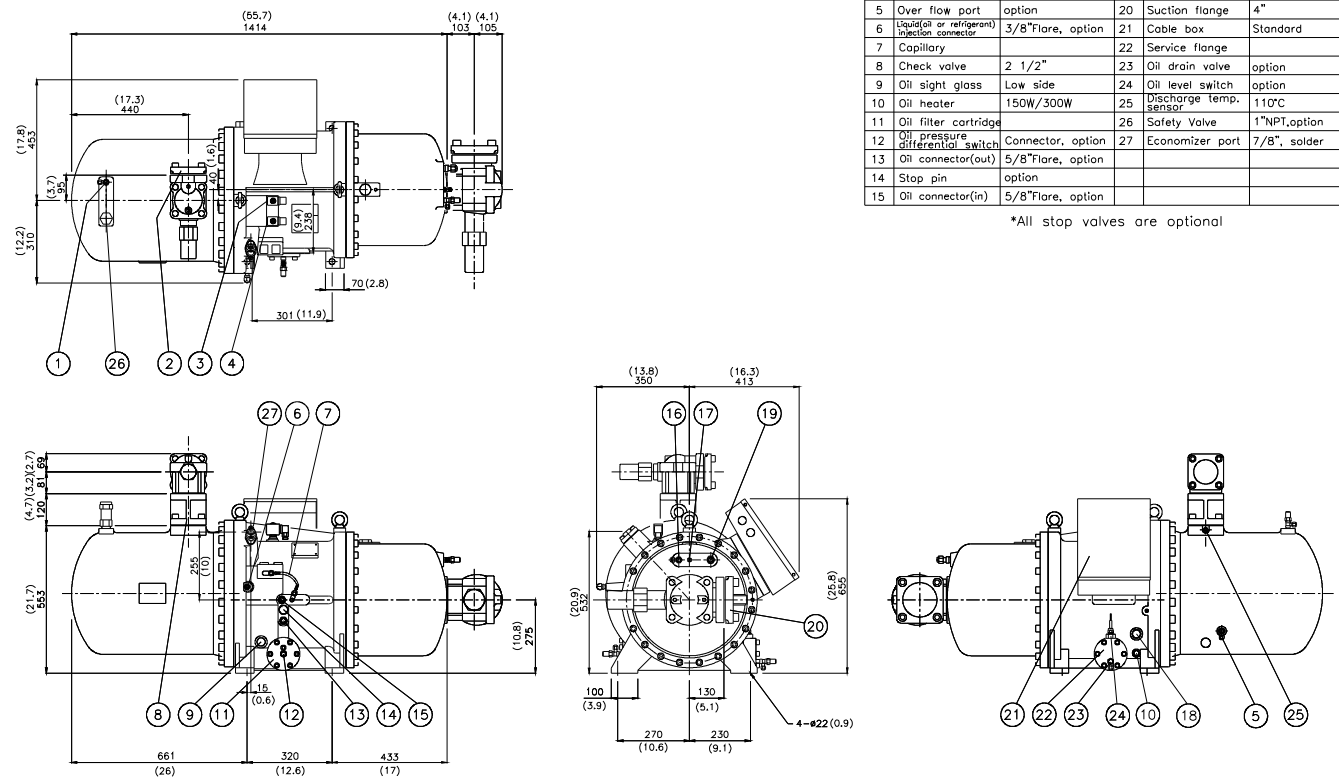
UNIT
SI: mm Imperial: (in)

Item	Date	Modification
3		
2		
1		

Model	RC2-410AVI
Name	Compressor outline
	HANBELL Ver. 01

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Angle valve	1/4"Flare
2	Discharge flange	2 1/2"	17	Refrigerant service valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Oil sight glass	High side
4	Solenoid valve	SV2(NC)	19	Liquid injection connector	5/8"Flare, option
5	Over flow port	option	20	Suction flange	4"
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Cable box	Standard
7	Capillary		22	Service flange	
8	Check valve	2 1/2"	23	Oil drain valve	option
9	Oil sight glass	Low side	24	Oil level switch	option
10	Oil heater	150W/300W	25	Discharge temp. sensor	110°C
11	Oil filter cartridge		26	Safety Valve	1"NPT,option
12	Oil pressure differential switch	Connector, option	27	Economizer port	7/8", solder
13	Oil connector(out)	5/8"Flare, option			
14	Stop pin	option			
15	Oil connector(in)	5/8"Flare, option			

*All stop valves are optional



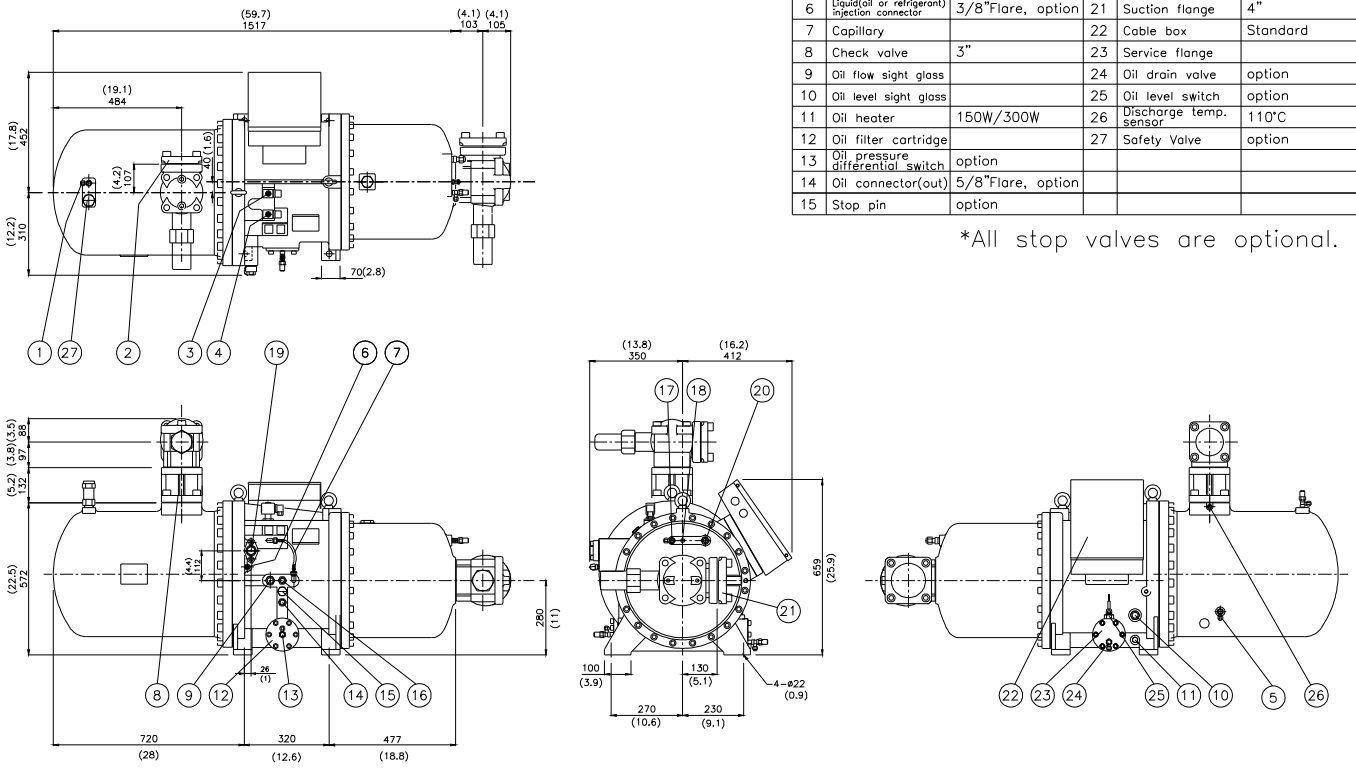
UNIT
SI: mm Imperial: (in)

Item	Date	Modification
3		
2		
1		

Model	RC2-470AVI
Name	Compressor outline
	HANBELL Ver. 01

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Oil connector(in)	5/8"Flare, option
2	Discharge flange	3"	17	Angle valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Refrigerant service valve	1/4"Flare
4	Solenoid valve	SV2(NC)	19	Economizer connector	1 1/8",solder
5	Over flow port	option	20	Liquid injection connector	5/8"Flare, option
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Suction flange	4"
7	Capillary		22	Cable box	Standard
8	Check valve	3"	23	Service flange	
9	Oil flow sight glass		24	Oil drain valve	option
10	Oil level sight glass		25	Oil level switch	option
11	Oil heater	150W/300W	26	Discharge temp. sensor	110°C
12	Oil filter cartridge		27	Safety Valve	option
13	Oil pressure differential switch	option			
14	Oil connector(out)	5/8"Flare, option			
15	Stop pin	option			

*All stop valves are optional.



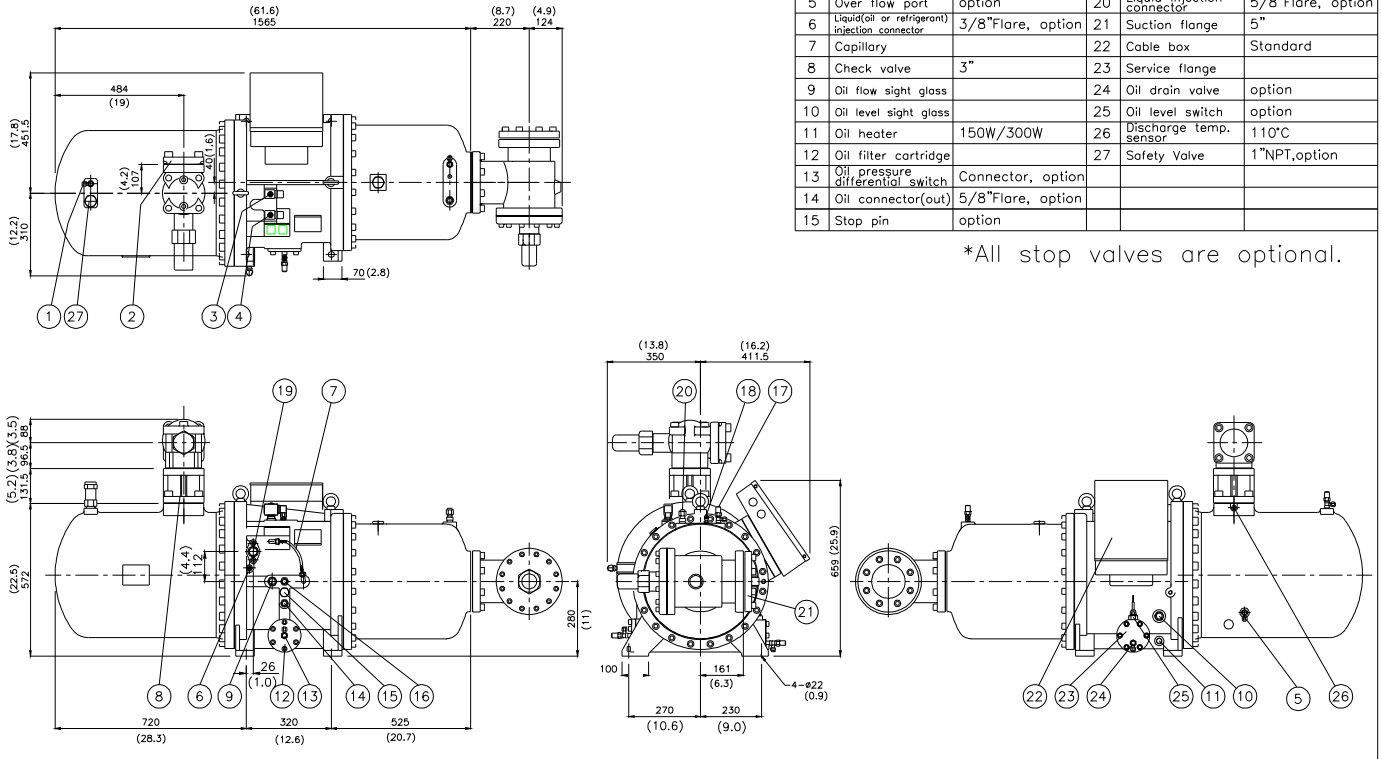
Item	Date	Modification
3		
2		
1		

Model	RC2-550AVI
Name	Compressor outline
	HANBELL Ver. 01

UNIT
SI: mm Imperial: (in)

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Oil connector(in)	5/8"Flare, option
2	Discharge flange	3"	17	Angle valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Refrigerant service valve	1/4"Flare
4	Solenoid valve	SV2(NC)	19	Economizer connector	1 1/8", solder
5	Over flow port	option	20	Liquid injection connector	5/8"Flare, option
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Suction flange	5"
7	Capillary		22	Cable box	Standard
8	Check valve	3"	23	Service flange	
9	Oil flow sight glass		24	Oil drain valve	option
10	Oil level sight glass		25	Oil level switch	option
11	Oil heater	150W/300W	26	Discharge temp. sensor	110°C
12	Oil filter cartridge		27	Safety Valve	1"NPT,option
13	Oil pressure differential switch	Connector, option			
14	Oil connector(out)	5/8"Flare, option			
15	Stop pin	option			

*All stop valves are optional.



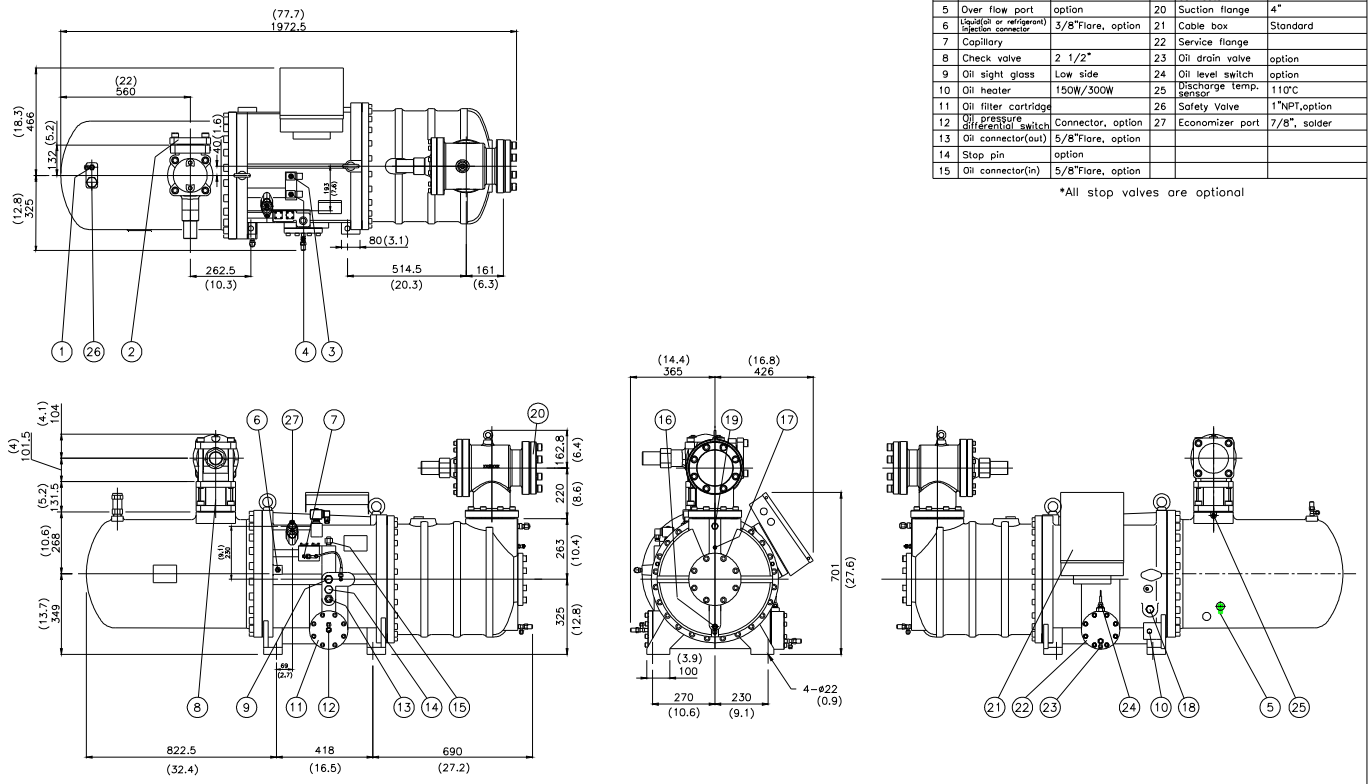
Item	Date	Modification
3		
2		
1		

Model	RC2-620AVI
Name	Compressor outline
	HANBELL Ver. 01

UNIT:
SI: mm Imperial: (in)

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	16	Angle valve	1/4"Flare
2	Discharge flange	2 1/2"	17	Refrigerant service valve	1/4"Flare
3	Solenoid valve	SV1(NC)	18	Oil sight glass	High side
4	Solenoid valve	SV2(NC)	19	Liquid injection connector	5/8"Flare, option
5	Over flow port	option	20	Suction flange	4"
6	Liquid(oil or refrigerant) injection connector	3/8"Flare, option	21	Cable box	Standard
7	Capillary		22	Service flange	
8	Check valve	2 1/2"	23	Oil drain valve	option
9	Oil sight glass	Low side	24	Oil level switch	option
10	Oil heater	150W/300W	25	Discharge temp. sensor	110°C
11	Oil filter cartridge		26	Safety Valve	1"NPT,option
12	Oil pressure differential switch	Connector, option	27	Economizer port	7/8", solder
13	Oil connector(out)	5/8"Flare, option			
14	Stop pin	option			
15	Oil connector(in)	5/8"Flare, option			

*All stop valves are optional



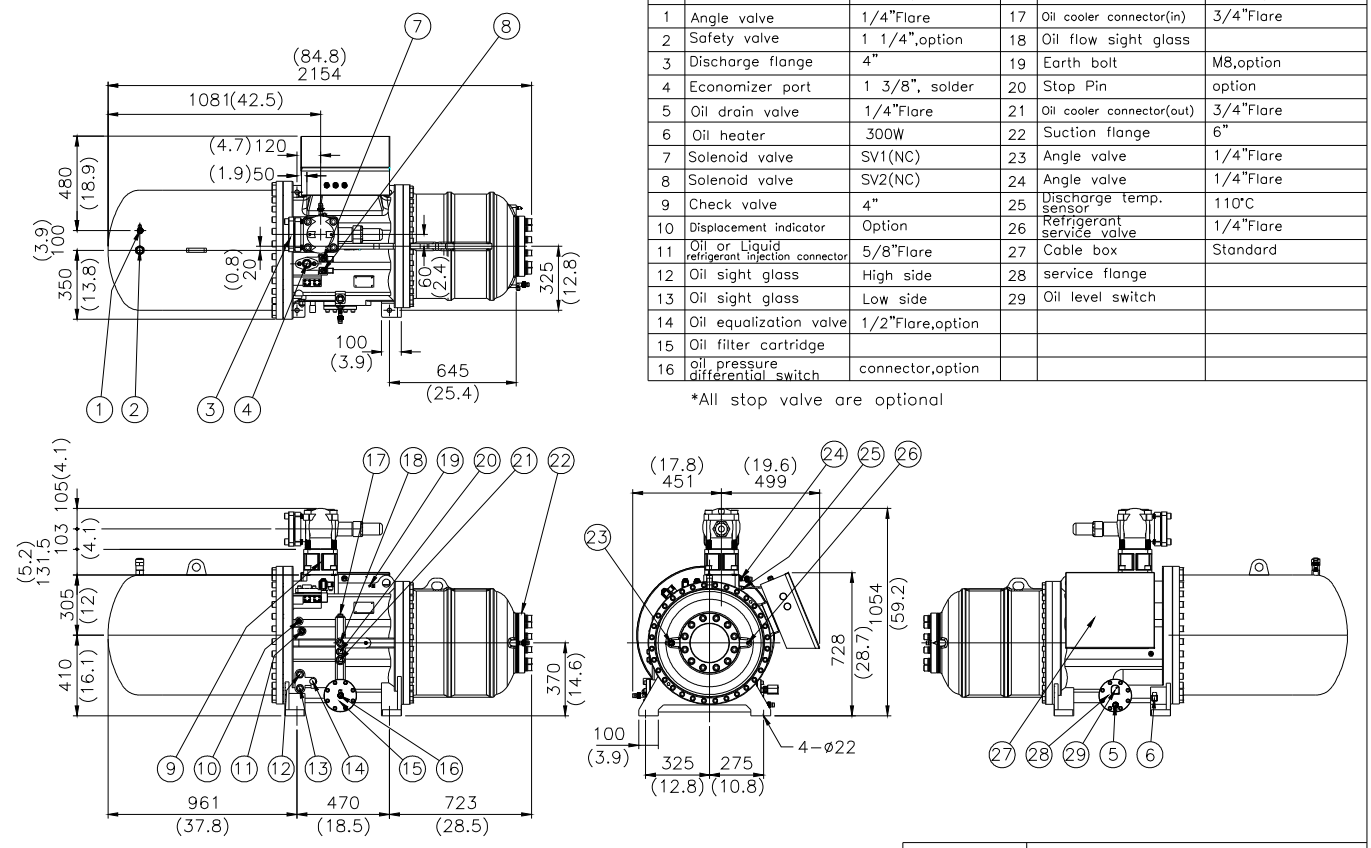
Item	Date	Modification
6	2014.08.21	Dimension correction
5	2012.11.07	Dimension correction
4	2012.04.16	Delete1.Connector 2.Oil temp. sensor

Model	RC2-830AVI
Name	Compressor outline
HANBELL	Ver. 01

UNIT:
SI: mm Imperial: (in)

No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	17	Oil cooler connector(in)	3/4"Flare
2	Safety valve	1 1/4",option	18	Oil flow sight glass	
3	Discharge flange	4"	19	Earth bolt	M8,option
4	Economizer port	1 3/8", solder	20	Stop Pin	option
5	Oil drain valve	1/4"Flare	21	Oil cooler connector(out)	3/4"Flare
6	Oil heater	300W	22	Suction flange	6"
7	Solenoid valve	SV1(NC)	23	Angle valve	1/4"Flare
8	Solenoid valve	SV2(NC)	24	Angle valve	1/4"Flare
9	Check valve	4"	25	Discharge temp. sensor	110°C
10	Displacement indicator	Option	26	Refrigerant service valve	1/4"Flare
11	Oil or Liquid refrigerant injection connector	5/8"Flare	27	Cable box	Standard
12	Oil sight glass	High side	28	service flange	
13	Oil sight glass	Low side	29	Oil level switch	
14	Oil equalization valve	1/2"Flare,option			
15	Oil filter cartridge				
16	oil pressure differential switch	connector,option			

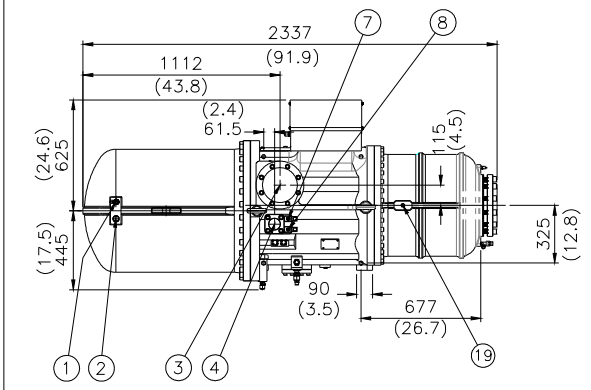
*All stop valve are optional



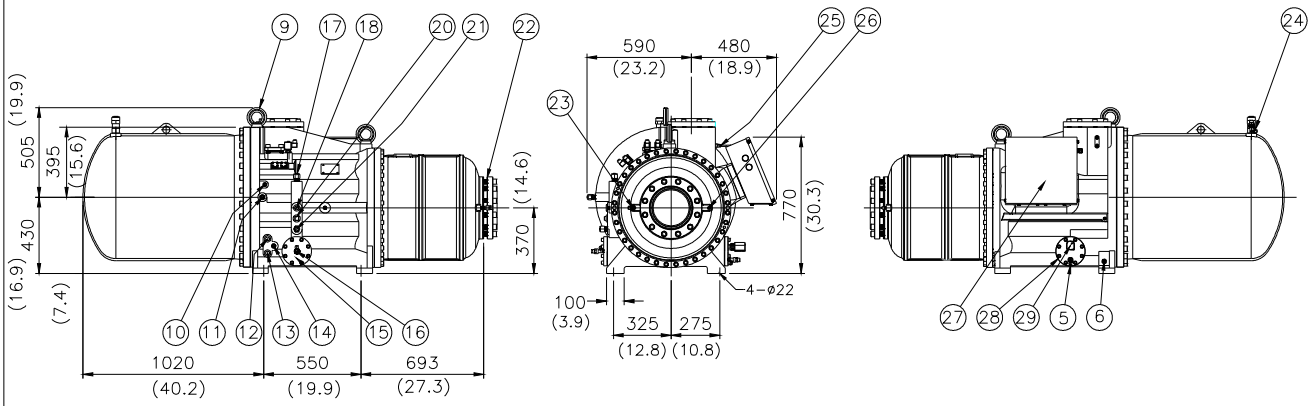
Item	Date	Modification
3		
2		
1		

Model	RC2-1020AVI
Name	Compressor outline
HANBELL	NO. 01

Unit:
SI:mm Imperial:(in)



No.	Name	Note	No.	Name	Note
1	Angle valve	1/4"Flare	17	Oil cooler connector(in)	3/4"Flare
2	Safety valve	1 1/4",option	18	Oil flow sight glass	
3	Discharge flange	5"	19	Service eyebolt hole	M20
4	Economizer port	2 1/8", solder	20	Stop Pin	option
5	Oil drain valve	1/4"Flare	21	Oil cooler connector(out)	3/4"Flare
6	Oil heater	300W	22	Suction flange	8"
7	Solenoid valve	SV1(NC)	23	Angle valve	1/4"Flare
8	Solenoid valve	SV2(NC)	24	Angle valve	1/4"Flare
9	Eyebolt	M30	25	Discharge temp. sensor	110°C
10	Displacement indicator	Option	26	Refrigerant service valve	1/4"Flare
11	Oil or Liquid refrigerant injection connector	5/8"Flare	27	Cable box	Standard
12	Oil sight glass	High side	28	service flange	
13	Oil sight glass	Low side	29	Oil level switch	
14	Oil equalization valve	1/2"Flare,option			
15	Oil filter cartridge				
16	oil pressure differential switch	connector,option			



Unit:
SI:mm Imperial:(in)

Item	Date	Modification
3		
2		
1		

Model	RC2-1270AVI		
Name	Compressor outline		
	HANBELL	NO.	01

4.4 Accessories

To supply “Total Solution” for customers, Hanbell designs complete standard and optional accessories according to various application requirements for safe and steady running and best performance of compressors.
1. Compressors standard and optional accessories

● : Standard, △ : Optional

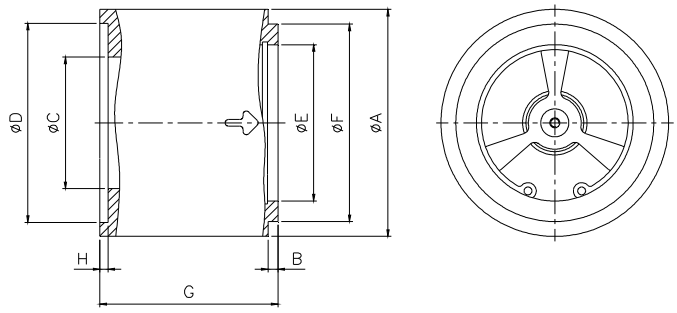
Model & Accessory	RC2 –AVI Series										
	RC2-140AVI	RC2-260AVI	RC2-300AVI	RC2-340AVI	RC2-410AVI	RC2-470AVI	RC2-550AVI	RC2-620AVI	RC2-830AVI	RC2-1020AVI	RC2-1270AVI
Discharge check valve	●	●	●	●	●	●	●	●	●	●	●
Suction & discharge connection bushings	●	●	●	●	●	●	●	●	●	●	●
Suction & discharge stop valves	△	△	△	△	△	△	△	△	△	△	△
PTC temp. sensor	●	●	●	●	●	●	●	●	●	●	●
INT69HBY motor protector	●	●	●	●	●	●	●	●	●	●	●
IP54 cable box	●	●	●	●	●	●	●	●	●	●	●
Oil heater	●	●	●	●	●	●	●	●	●	●	●
Oil level switch	△	△	△	△	△	△	△	△	△	△	△
Oil drain valve	△	△	△	△	△	△	△	△	△	△	△
Liquid injection system (solenoid valve + expansion valve)	△	△	△	△	△	△	△	△	△	△	△
Liquid injection system (solenoid valve + stop valve)	△	△	△	△	△	△	△	△	△	△	△
Horizontal check valve	△	△	△	△	△	△	△	△	△	△	△
External oil separator	△	△	△	△	△	△	△	△	△	△	△
External oil filter	△	△	△	△	△	△	△	△	△	△	△
Oil flow switch	△	△	△	△	△	△	△	△	△	△	△
Economizer	△	△	△	△	△	△	△	△	△	△	△
Economizer muffler	△	△	△	△	△	△	△	△	△	△	△
Oil cooler	△	△	△	△	△	△	△	△	△	△	△
Oil pump	△	△	△	△	△	△	△	△	△	△	△
Pressure regulation valve	△	△	△	△	△	△	△	△	△	△	△
Oil filter pressure differential switch connector	△	△	△	△	△	△	△	△	△	△	△
Safety valve	△	△	△	△	△	△	△	△	△	△	△
Explosion proof accessories	△	△	△	△	△	△	△	△	△	△	△
Mounting pads	△	△	△	△	△	△	△	△	△	△	△
Refrigeration oil	△	△	△	△	△	△	△	△	△	△	△
Micro controller	△	△	△	△	△	△	△	△	△	△	△
Sound jacket	△	△	△	△	△	△	△	△	△	△	△
Temperature sensors Pt100 or Pt1000 – for motor coil temp. monitoring	△	△	△	△	△	△	△	△	△	△	△

Note: The accessory chart is for reference only. Actual specification and accessories enclosed might vary with different quotation and agreement respectively. If any optional accessory is required and out of above mentioned standard accessory, please contact Hanbell for detailed specification and price.

2. Description of accessories

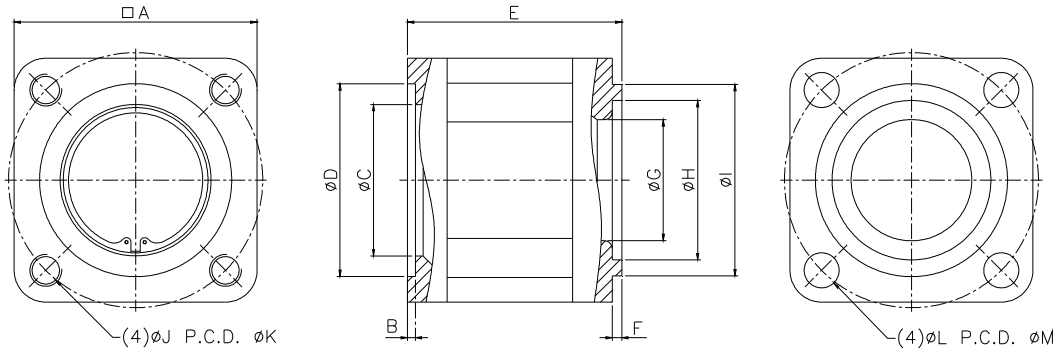
a. Suction and discharge check valve

Hanbell standard check valve is gravity-driven with characteristics of large flow volume and low pressure drop. After shut-down of the compressor, Teflon taper guider inside can simultaneously seal up the precisely machined base of check valve by gravity force to effectively prevent return of high-pressured gas to compressor. The gravity-driven check valve is equipped vertically. Due to limitation of space or piping requirements, alternative horizontal check valve is accessible.



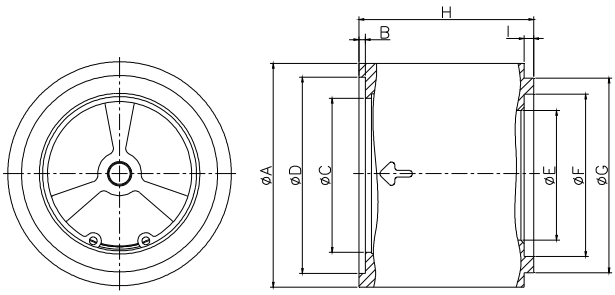
Dia.	Dimension unit: mm								
	A	B	C	D	E	F	G	H	I
2"	102	4	65	91	53	70	90	85	6
3"	138	4	95	121	80	100	120	108	6
4"	163	4	120	146	96	125	145	123	6
5"	203	5	150	176	122	150	175	150	6
6"	238	5	190	216	146	190	215	160	6

Figure 4.5: Suction check valve outline drawing



Dia.	Dimension unit: mm												
	A	B	C	D	E	F	G	H	I	J	K	L	M
1 1/2"	109	5	55	76	99	6	43	60	75	M16x2	105	18	105
2"	122	5	66	91	110	6	53	70	90	M16x2	120	18	120
2 1/2"	134	5	80	111	125	6	64	90	110	M16x2	140	18	140
3"	153	5	95	121	135	6	76	100	120	M20x2.5	160	22	160
4"	171	5	106.5	146	135	6	88	125	145	M20x2.5	185	22	185

Figure 4.6: Discharge check valve outline drawing (Vertical type)



Dia.	Dimension unit: mm								
	A	B	C	D	E	F	G	H	I
1 1/2"	86	4	55	76	42	60	75	81.5	6
2"	102	4	65	91	53	70	90	85	6
2 1/2"	122	4	85	111	67	90	110	97	6
3"	138	4	95	121	80	100	120	108	6
4"	163	4	120	146	96	125	145	123	6
5"	203	5	150	176	122	150	175	150	6
6"	238	5	190	216	146	190	215	160	6

Figure 4.7: Discharge check valve outline drawing (Horizontal type)

b. Suction and discharge connection bushings

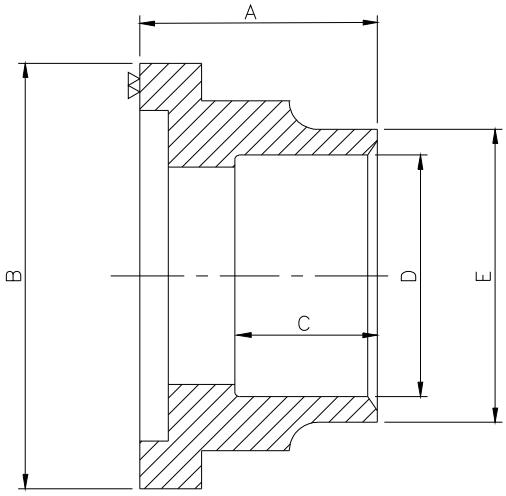


Figure 4.8: Flange bushing dimensions

Model	Standard Discharge Flange Bushing		Standard Suction Flange Bushing	
	Steel pipe	Copper pipe	Steel pipe	Copper pipe
RC2-140AVI	1 1/2"	1 5/8"	2"	2 1/8"
RC2-260AVI	2"	2 1/8"	3"	3 1/8"
RC2-300AVI	2"	2 1/8"	3"	3 1/8"
RC2-340AVI	2 1/2"	2 5/8"	4"	4 1/8"
RC2-410AVI	2 1/2"	2 5/8"	4"	4 1/8"
RC2-470AVI	2 1/2"	2 5/8"	4"	4 1/8"
RC2-550AVI	3"	3 1/8"	4"	4 1/8"
RC2-620AVI	3"	3 1/8"	5"	5 1/8"
RC2-830AVI	4"	4 1/8"	5"	5 1/8"
RC2-1020AVI	4"	4 1/8"	6"	
RC2-1270AVI	5"		8"	

Note: The above table lists specification of standard bushing for every model of RC2-AVI series compressors. Their dimensions refer to flange bushing dimensions and the table below. If bushing dimensions are not indicated in purchasing orders, Hanbell will provide standard type. Suitable piping of customers' choice is also shown in the table below. If non-standard bushing is needed, please double-check with Hanbell sales representatives when placing orders for compressors.

Specification and dimension of optional flange bushing

Model	Discharge / Suction port	Materials and Sizes of pipes		Dimension of flanges bushing				
				A	B	C	D	E
RC2-140AVI	Discharge	Copper	1 5/8"	52	75	35	41.6	52
			2 1/8"				54.3	65
		Steel	1 1/2"				49.3	64
	Suction	Copper	1 5/8"	50	90	30	41.6	55
			2 1/8"				54.3	65
			2 5/8"				67	74
		Steel	2"				61.3	74
RC2-260AVI RC2-300AVI	Discharge	Copper	1 5/8"	50	90	30	41.6	55
			1 3/4"				44.8	55
			2"				51.1	62
			2 1/8"				54.3	65
			2 1/2"				63.8	74
			2 5/8"				67	74
		Steel	1 1/2"				49.3	60
			2"				61.3	74
	Suction	Copper	2'	66	120	45	51.1	62
			2 1/8"				54.3	65
			2 3/8"				60.7	71
			2 1/2"				63.8	74
			2 5/8"				67	77
			3"				76.6	87
			3 1/8"				79.8	90
		Steel	2"				61.3	76
			2 1/2"				77.2	92
			3"				90.2	103
RC2-340AVI RC2-410AVI RC2-470AVI	Discharge	Copper	1 5/8"	60	110	35	41.6	52
			1 3/4"				44.8	55
			2"				51.1	62
			2 1/8"				54.3	65
			2 1/2"				63.8	74
			2 5/8"				67	77
			3 1/8"				79.8	90
		Steel	1 1/2"				49.3	64
			2"				61.3	76
			2 1/2"				77.2	90
	Suction	Copper	2 5/8"	76	145	50	67	87
			3"				76.6	87
			3 1/8"				79.8	90
			3 5/8"				92.4	103
			4"				102	112
			4 1/8"				105.1	116
		Steel	3"				90.2	105
			3 1/2"				102.8	117
			4"				115.6	128
RC2-550AVI	Discharge	Copper	2"	66	120	45	51.1	62
			2 1/8"				54.3	65
			2 3/8"				60.7	71
			2 1/2"				63.8	74
			2 5/8"				67	77
			3"				76.6	87
			3 1/8"				79.8	90
		Steel	2"				61.3	76
			2 1/2"				77.2	92
			3"				90.2	103
	Suction	Copper	2 5/8"	76	145	50	67	87
			3"				76.6	87
			3 1/8"				79.8	90
			3 5/8"				92.4	103
			4"				102	112
			4 1/8"				105.1	116
		Steel	3"				90.2	105
			3 1/2"				102.8	117
			4"				115.6	128
RC2-620AVI	Discharge	Copper	2"	66	120	45	51.1	62
			2 1/8"				54.3	65
			2 3/8"				60.7	71
			2 1/2"				63.8	74
			2 5/8"				67	77
			3"				76.6	87
			3 1/8"				79.8	90
		Steel	2"				61.3	76
			2 1/2"				77.2	92
			3"				90.2	103
	Suction	Copper	4 1/8"	80	174	35	105.1	121.2
			5 1/8"	75			130.5	146.5
			5"	75			127.5	146.5
		Steel	4"	80			115.6	134
			5"	75			141.3	154
RC2-830AVI	Discharge	Copper	3 1/8"	76	145	50	79.8	90
			3 5/8"				92.4	103
			4 1/8"				105.1	116
		Steel	3"				90.2	105
			3 1/2"				102.8	117
			4"				115.6	128
	Suction	Copper	4 1/8"	80	174	35	105.1	121.2
			5 1/8"	75			130.5	146.5
		Steel	5"	75			141.3	154
RC2-1020AVI	Discharge	Copper	3 1/8"	76	145	50	79.8	90
			3 5/8"				92.4	103
			4 1/8"				105.1	116
		Steel	3"				90.2	105
			3 1/2"				102.8	117
			4"				115.6	128
	Suction	Steel	6"	75	215	40	166.7	196
RC2-1270AVI	Discharge	Steel	5"	75	174	35	141.3	154
	Suction	Steel	8"		260	40	218	241

c. Suction and discharge stop valves

For maintenance and service of compressors, it is recommended to install suction and discharge stop valves. Please refer to the following detail of Hanbell stop valves.

Model	Stop Valve Size	
	Discharge	Suction
RC2-140AVI	1 1/2″	2″
RC2-260AVI	2″	3″
RC2-300AV	2″	3″
RC2-340AVI	2 1/2″	4″
RC2-410AVI	2 1/2″	4″
RC2-470AVI	2 1/2″	4″
RC2-550AVI	3″	4″
RC2-620AVI	3″	5″
RC2-830AVI	4″	5″
RC2-1020AVI	4″	6″
RC2-1270AVI	5″	8″

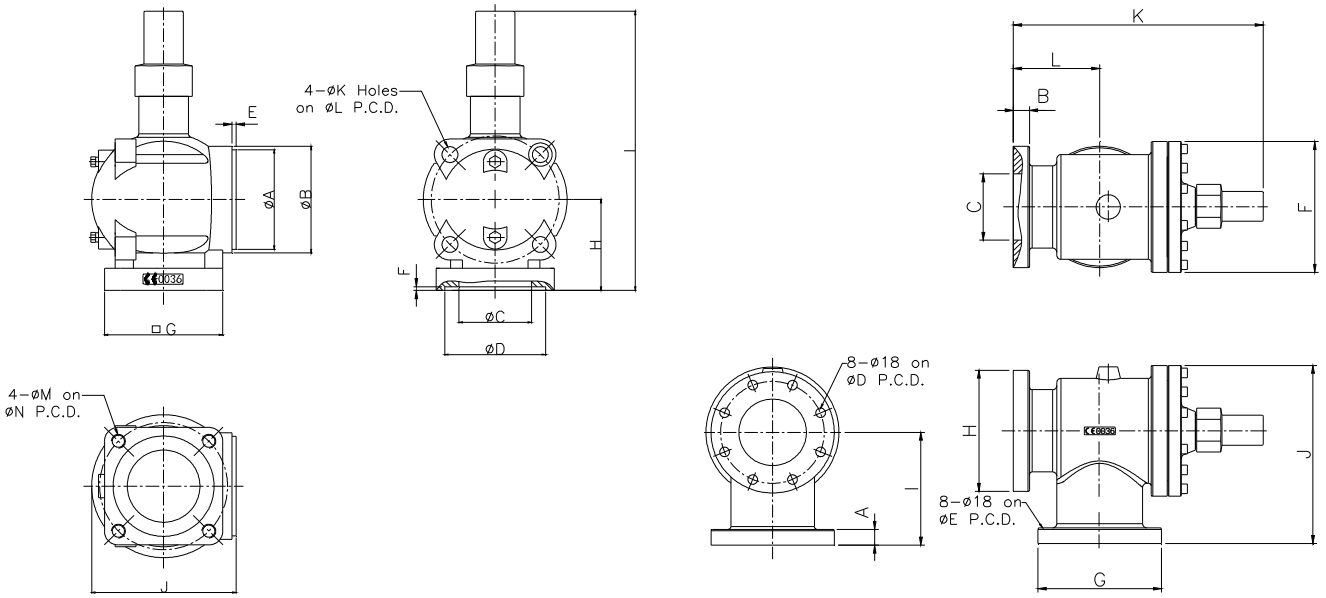


Figure 4.9: Dimensions of stop valve

Dia.	Dimensions unit: mm													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1 1/2"	75	82	40	75	6	5	106	79	262	90	18	105	M16x2	105
2"	90	100	60	91	6	5	122	86	291	131	18	120	M16x2	120
2 1/2"	110	120	67	111	6	5	137	96	297	152.5	18	140	M16x2	140
3"	120	135	80	121	6	5	154	107	349	185	22	160	M20x2.5	160
4"	145	155	105	146	6	5	171	132	406	209	23	185	M20x2.5	185

Dia.	Dimensions unit: mm											
	A	B	C	D	E	F	G	H	I	J	K	L
5"	30	30	126	194	194	248	230	230	214	338	466	161

* Specification of stop valve

Maximum working pressure	Hydrostatic pressure test	Refrigerant	Temperature range
21 kg / cm² g	32 kg / cm² g	HFC, HCFC	–40˚C~150˚C

d. INT69HBY diagnose motor protector and PTC temperature sensor

In order to protect compressors, each RC2-AVI series compressor has been installed three PTC temperature sensors (thermistors) inside motor coil and another one at the discharge port of the compressor. These sensors are connected to an INT69HBY diagnose protection module to monitor the motor coil temperature and the discharge temperature as well. If the temperature in one of the positions monitored exceeds the nominal response temperature of the respective PTC thermistors, the sensor resistance increases and the INT69HBY diagnose protection module output relay trips.

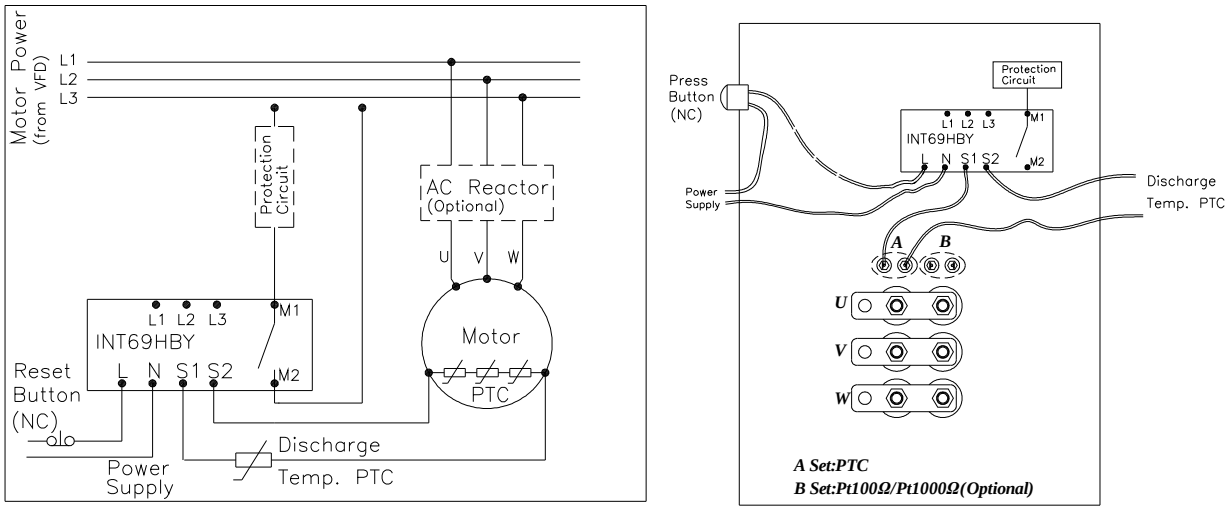


Figure 4.10: INT69HBY & PTC connection diagram

Other major functional descriptions are as follow:

1. The temperature monitoring in the motor winding is done according to the static evaluation process; the motor is switched off immediately if the nominal response temperature of the built-in AMS or PTC sensors is reached.
2. A short circuit at an AMS or PTC input also leads to a switch-off. A short cycling leads to a reset delay.
3. After cooldown or elimination of the error and a subsequent reset delay, the compressor can be restarted; restarting after locking only after reset.
4. For operation in the specified manner, the supply voltage has to be on permanently on the INT69 HBY Diagnose.
5. A dual LED (red, orange/ green) provides additional information about the motor protector and compressor status.

Technical data:

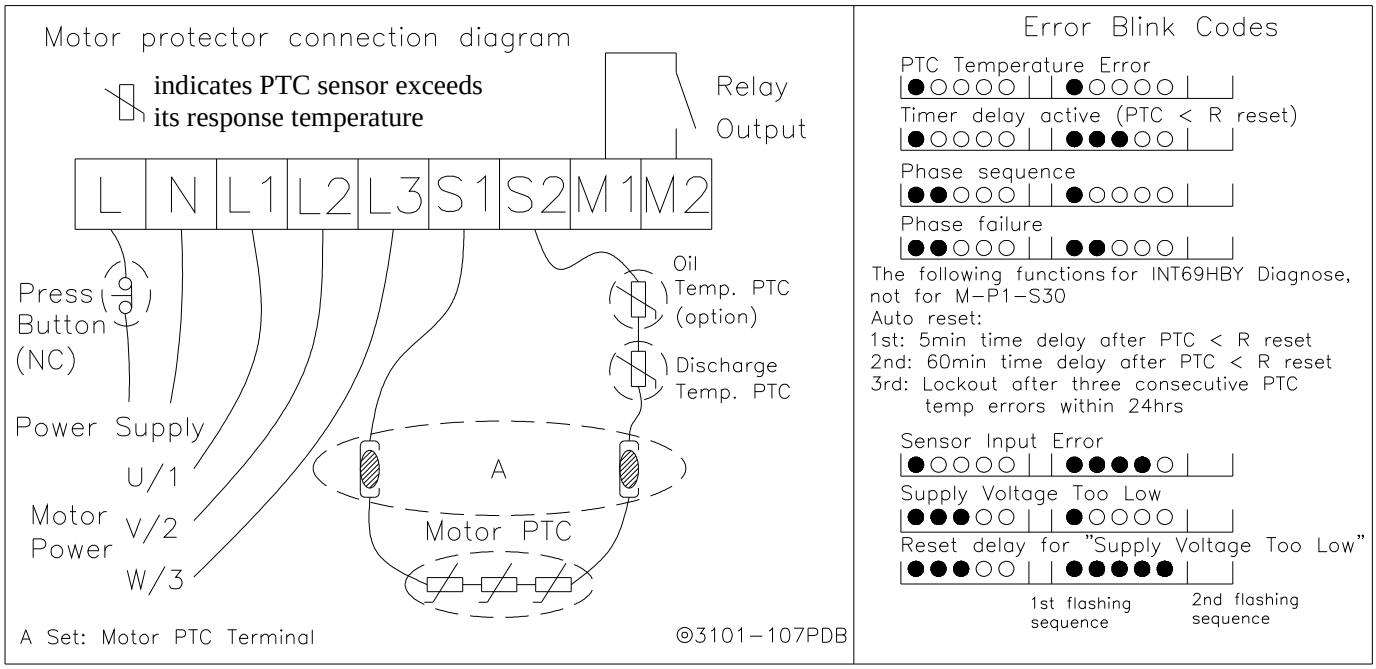
●Supply voltage
AC 50/60 Hz 115/240V-15 …+10% 3VA

●Relay output
max. AC 240V, max. 2.5A, C300

●Ambient temperature
-30 … +70 ℃

●Phase monitor
3 AC, 50/60Hz, 200 ~ 690 V ± 10%

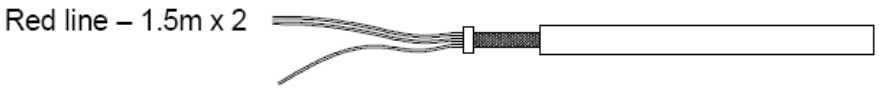
Blink codes display as shown right:



e. Oil heater

A UL approved 150W oil heater has been installed in every compressor as a standard accessory.

Before restart of compressor after shutdown for a long time, please turn on oil heater at least 8 hours to make the temperature inside compressor higher than system temperature and ambient temperature and then it can prevent condensation of refrigerant inside oil sump of compressors which may result in liquid compression in next start and poor lubrication due to too low viscosity of lubrication oil. In addition, Hanbell also offers 300W oil heater to keep adequate lubricant oil temperature for large external oil separator and applications in areas with low ambient temperature.



Green / Yellow line – 1.5m x 1 (Grounding)

Figure 4.11: Oil heater

Specification： 150W, 300W; 110V or 220V; IP 54; UL approval

Note: If the compressor is installed in low ambient temperature, it is recommended to insulate oil separator against cold ambience.

f. Oil level switch

There are 2 wires for the interlock to main control circuit or any micro controller's independent circuit. To prevent from oil level switch trip caused by oil foaming or surging in the sump, a time delay around 15 seconds is recommended before shut down the compressor.

Max. contact capacity = 50W/SPST
Surge current = 0.5A
Max. voltage = 200V DC/ 240V AC
Max. current = 1A

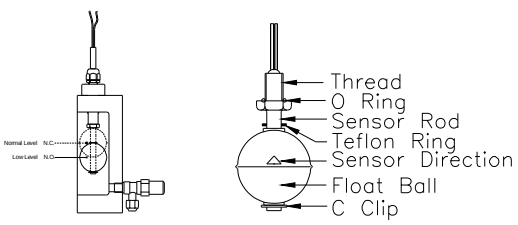


Figure 4.12: Oil level switch

Notes:

1. On the float ball there is a triangle mark indicate sensor direction. Therefore, before installing an oil level switch on a compressor or an external oil separator, please use the triangle mark as your reference. Please check this triangle mark and modify the oil level switch if needed.
2. The illustration below show you the outside appearance of oil level switch

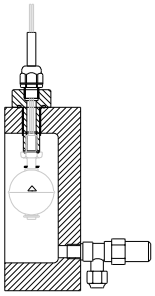


Figure 4.13: Oil level switch on a compressor

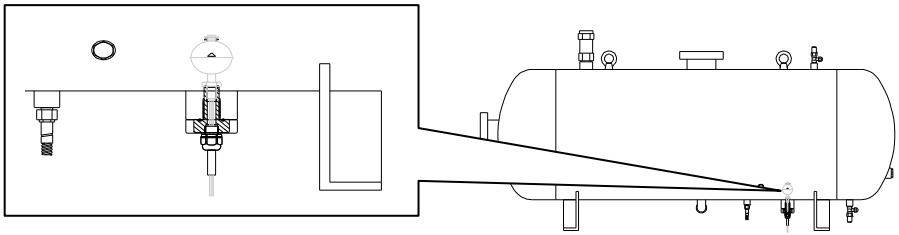


Figure 4.14: Oil level switch on an external oil separator

g. Oil drain valve

Oil drain valve is installed in a compressor to drain out oil for maintenance.

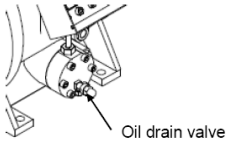


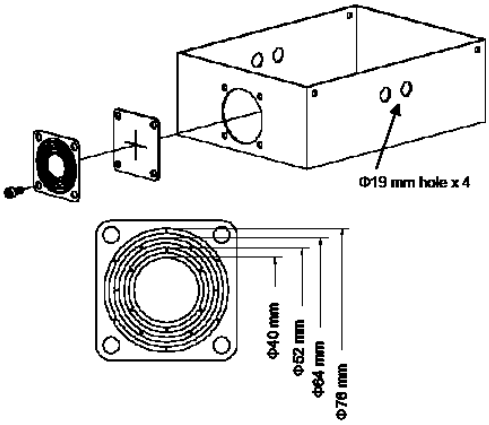
Figure 4.15: Oil drain valve

h.IP54 cable box

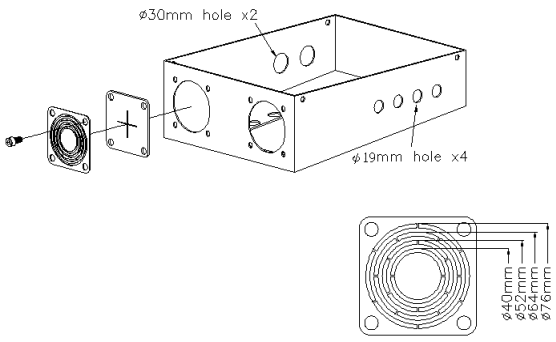
Hanbell designs and makes the cable box which meets IP54 specification.

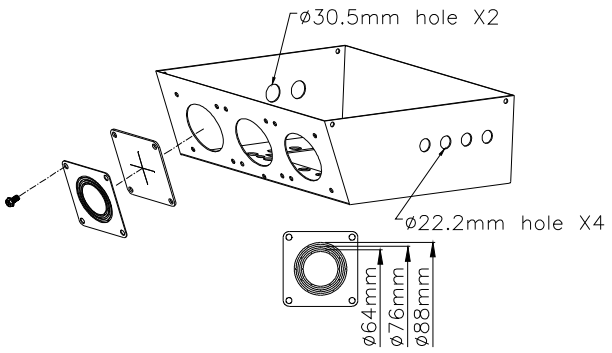
Dimensions of cable box and the size of opening in cable box (for motor power line and control power line) refer to the drawing below

- RC2-140AVI cable box



- RC2-260AVI, RC2-300AVI, RC2-340AVI, RC2-410AVI, RC2-470AVI, RC2-550AVI, RC2-620AVI, RC2-830AVI cable box





- RC2-1020AVI, RC2-1270AVI cable box

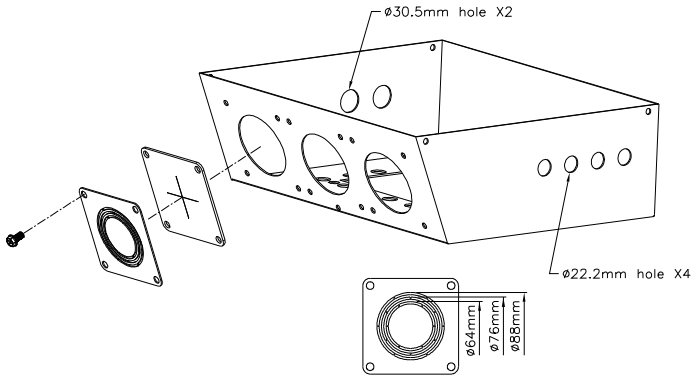


Figure 4.16: IP54 cable box

i. Liquid injection system (solenoid valve + expansion valve)

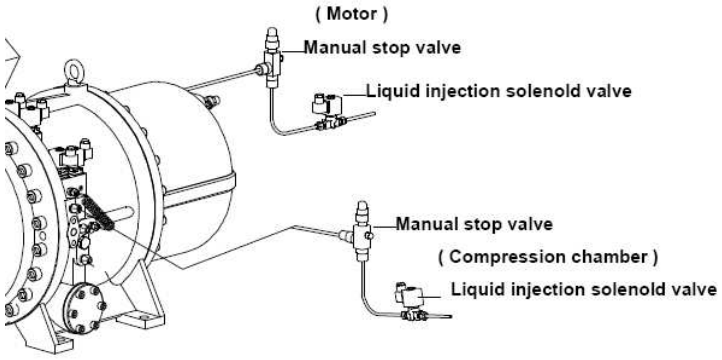
Liquid injection system is an auxiliary mechanism to cool motor coil. RC2-AVI series' motor is cooled by suction return gas. In high-condensing-temperature or low-evaporating-temperature applications, liquid injection system is recommended to cool motor coil auxiliary. In high-compression-ratio applications, liquid injection to compression chamber is also recommended to absorb high compression heat due to high compression ratio to maintain normal discharge temperature. Please refer to Chapter 7 for details of additional cooling.

Hanbell provides the following liquid injection expansion valves and solenoid valves for customers' options. Please refer to capacity recommended in Hanbell selection software to choose appropriate liquid injection expansion valves.

Brand	Model	Low Temp. Type	High Temp. Type
SPORLAN	Y1037-FV-3-180,3/8"SAE		○
	Y1037-FV-5-180,3/8"SAE		○
ALCO	TCLE-3HW-6A	○	
	TCLE-5HW-6A	○	
	TCLE-10HW-6A	○	
FUJIKOKI	JBE-E60HFKT-1		○

j. Liquid injection system (solenoid valve + stop valve)

This simple liquid injection system adjusts amount of liquid injection by stop valve, suitable for application with level load and ambient temperature but it's not recommended. Opening ratio of stop valve could not vary with system loading and change of temperatures. Therefore, frequent check of discharge temperature can prevent damage of compressor due to over cooling or insufficient cooling.



k. External oil separator

For improvement of oil return in flooded-type, low-temperature and parallel systems, system with long piping, Hanbell specially designs a complete series of external oil separators – OS series with characteristics of high separation efficiency and low pressure drop. The following table shows details of OS series:

Note: It is recommended to install a muffler before the external oil separator to avoid noise and vibration caused by resonance.

(I) Technical data：

Model	Type	Oil Volume (Liter)		Range of application based on Displacement (m^3/hr) (Recommended)	Shell Diameter
		High level	Low level		
OS40	Vertical	17	9	205	14”
OS50	Vertical	22	12	206~270	16”
OS65	Vertical	31	18	271~440	18”
OS80	Horizontal	33	20	441~705	20”
OS100	Horizontal	40	27	706~1120	20”

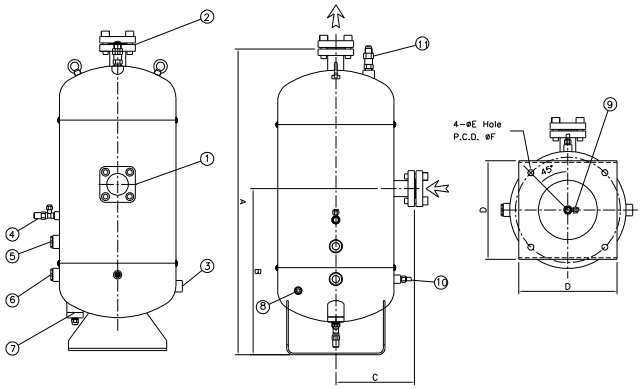
(Ⅱ) Accessories：

No.	Description	OS40	OS50	OS65	OS80	OS100	OS125	OS150
1	Refrigerant inlet	1 1/2”	2”	2 1/2”	3”	4”	5”	6”
2	Refrigerant outlet	1 1/2”	2”	2 1/2”	3”	4”	5”	6”
3	Oil outlet	5/8” Flare	5/8” Flare	5/8” Flare	1” PF	1” PF	1 1/4” PF	1 1/4” PF
4	Oil charge valve	1/4” Flare						
5	High oil S.G.	1 PCS						
6	Low oil S.G.	1 PCS						
7	Oil level switch	1 PCS						
8	Oil heater	150W	150W	150W	150W	150W	300W	300W
9	Oil drain valve	1/4” Flare						
10	Oil temp. protection (option)	1/8” NPTF						
11	Safety valve (option)	1/2”	1/2”	1/2”	1”	1”	1 1/2”	1 1/2”

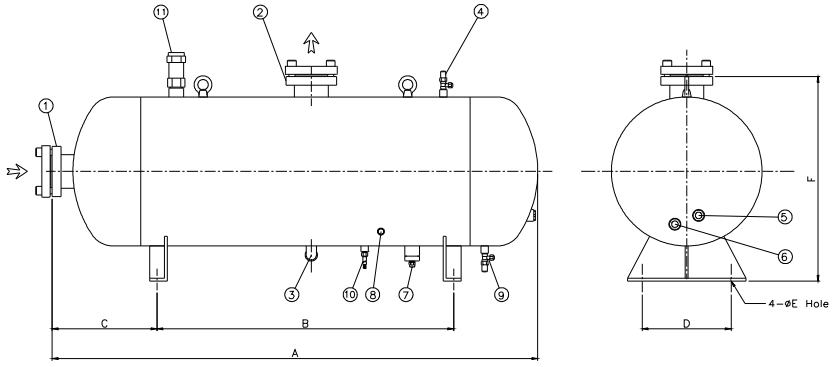
(Ⅲ) Dimensions：

No.	OS40	OS50	OS65	OS80	OS100	OS125	OS150
A	930	1050	1110	1227	1637	1829	2229
B	505	585	595	650	1000	1080	1480
C	240	275	300	568	354	409	409
D	300	350	350	300	300	400	400
E	18	22	22	23	23	23	23
F	320	360	360	688	698	830	830

(Ⅳ) Drawing：



Vertical - OS40, OS50, OS65



Horizontal -OS80, OS100, OS125, OS150

Figure 4.17: OS series external oil separator

l. External oil filter

External oil filter is an optional accessory of external oil separator. It is suggested to install an external oil filter in oil return line before the suction port of compressor for safe running of compressors.

*Flow Rate: max 50 (l/m)	*Weight:1.4KG/Set
*Working Pressure: 40 bar	(the weight is not including element)
*Material: Aluminum alloy	*Operating Temp.: from -25℃to 110℃
*Seal: VITON	

Compressor Model	Material Code	Inlet Size	Outlet Size
RC2-140/260/300/340 /410/430/470	3130-3240AA	5/8”	5/8”
RC2-550/620/830/10201270/	3131-3240AA	3/4”	3/4”

m. Oil flow switch

Oil flow switch operates in oil return line between external oil separator and compressor to prevent deficient oil return. Specification and installation of oil flow switch are shown as below:

Specification:

Part No.	Size	Switch value [l/min] H_20 Selectable range for fixed switch	Q Max. flow rate [l/min] H_20	Dimensions [mm]				Weight [kg]
				L	H	SW	X	
4414-FF015	G 1/2”	0.4 - 12	20	68	79	29	13	0.6
4414-FF020	G 3/4”	0.6 - 25	40	73	79	32	11	0.7
4414-FF025	G 1”	1.5 - 40	60	87	90	41	14	1.0

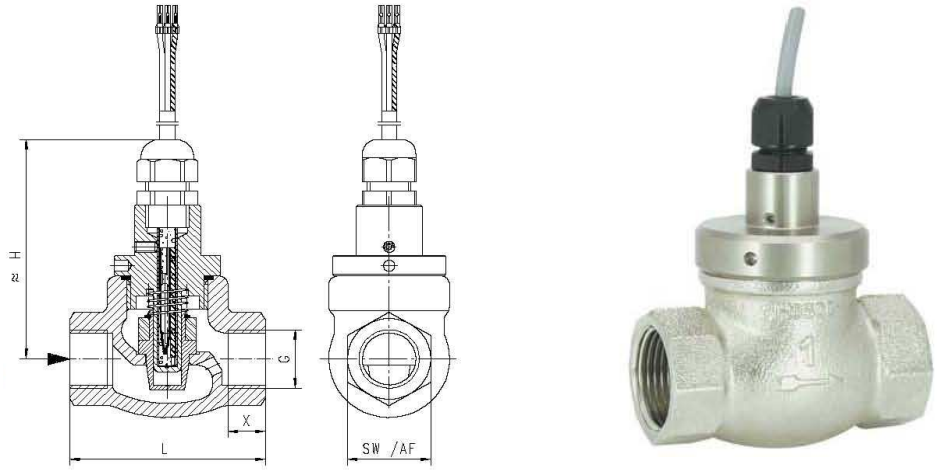


Figure 4.19: Oil flow switch

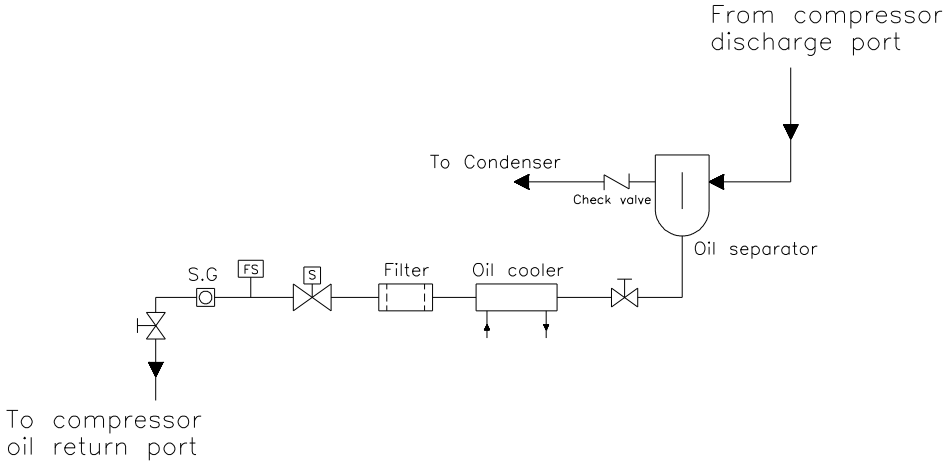


Figure 4.20: Installation of oil flow switch

n. Mounting pad

To avoid extra vibration and noise resulted from direct contact between compressor footings and the base on which the compressor is mounted, it is recommended to add mounting pads in between as the drawing below shown.

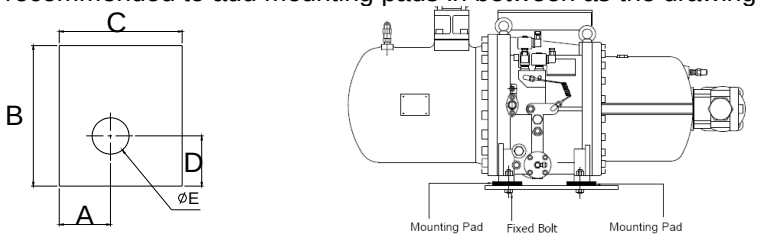


Figure 4.21: Compressor mounting pad (optional)

Model	Part No.	A	B	C	D	E	Thickness	Req. Q'ty
RC2-140AVI, RC2-260AVI, RC2-300AVI	3131-9815B	20	55	50	20	22	20 mm	4
RC2-340AVI, RC2-410AVI, RC2-470AVI, RC2-550AVI	3136-9815B	26	100	70	25	22	20 mm	4
RC2-620AVI, RC2-830AVI	3139-9815B	25	100	80	25	22	20mm	4
RC2-1020AVI, RC2-1270AVI	3142-9815B	40	100	80	40	22	20mm	4

o. Temperature sensors Pt100 or Pt1000

To effectively detect temperature of motor coil, Hanbell specially mounts Pt100 or Pt1000 sensor on motor coil as optional accessory for customers. This temperature sensor along with controller of the system monitor motor coil temperature and then control on/off of liquid injection valve accordingly to provide suitable liquid injection as shown in the diagram below.

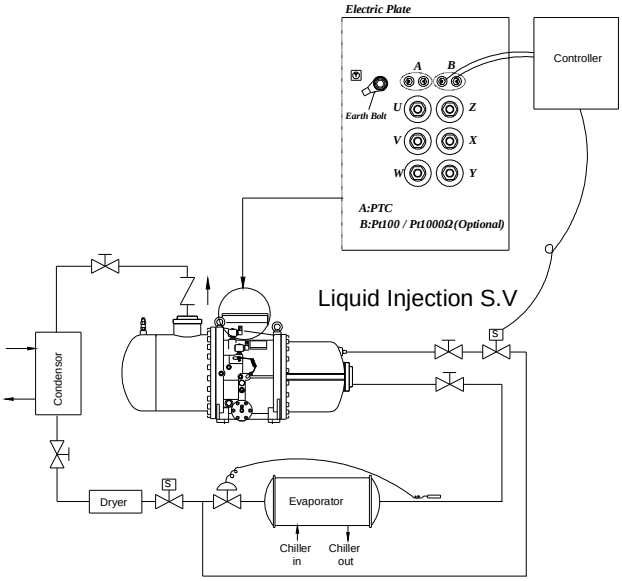
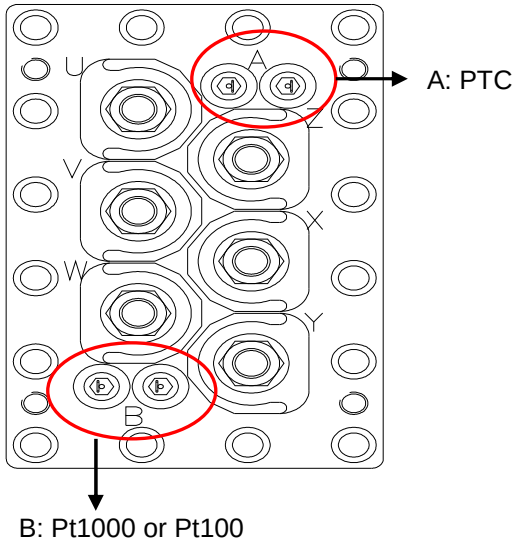


Figure 4.22: Liquid injection connection diagram



Note:

1. Liquid injection solenoid valve is controlled by the controller according to temperatures measured by Pt100/Pt1000 sensor.
2. Liquid injection sub solenoid valve is for auxiliary use. Its control logic is the same with that of aforementioned liquid injection valve.
3. Hanbell suggests to control temperature of motor coil at 60℃ (not higher than 60℃)

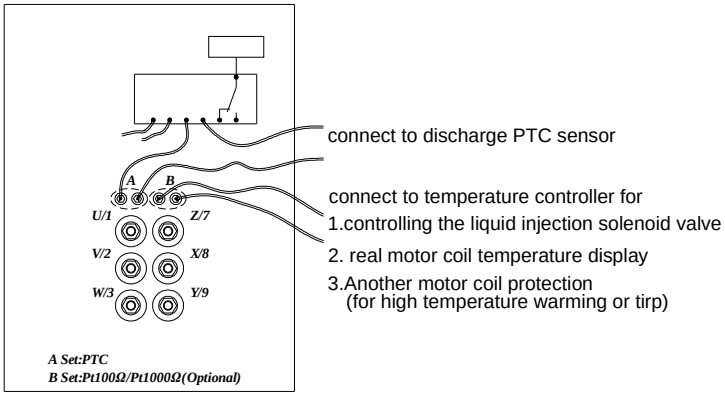


Figure 4.23: Connection diagram of Pt100/Pt1000 sensor

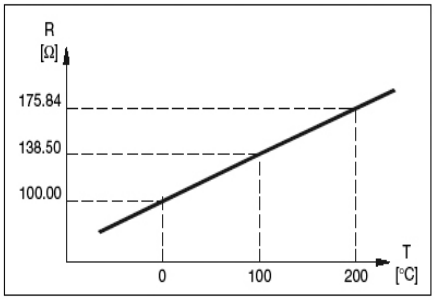


Figure 4.24: Pt100 sensor

Specification : Pt100 sensor

- Recommended max. meas. Current for heat coefficient <0.1K - DC 1 ~ 3 mA
- Heating coefficient - 10mΩ/K

- Sensor resistance at 0℃ - 100Ω±0.12Ω
- Change of resistance 0 ~ 100℃ - 0.385Ω/K
- Insulation test voltage U is – AC 1.5kV

Specification : Pt1000 sensor

- Recommended max. meas. Current for heat coefficient < 0.1K – DC0.2 ~ 2mA
- Sensor resistance at 0℃ - 1000Ω±1.20Ω
- Change of resistance 0 ~ 100℃ - 3.85Ω/K
- Insulation test voltage U is – AC 1.5kV

Please specify Pt100 or Pt1000 sensor when placing orders to Hanbell. Compressors can also be equipped with Pt100 or Pt1000 sensor to adjust liquid injection to precisely control motor coil while running.

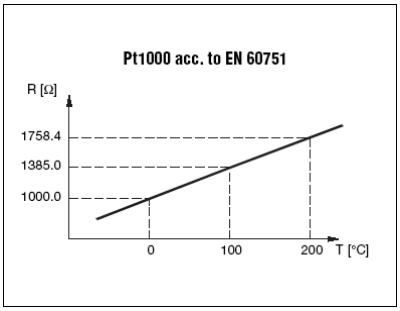


Figure 4.25: Pt1000 sensor

p. Minimum pressure valve(MPV)

Minimum pressure valve is useful in cold start condition. During the cold start period, because the system's condensing temperature is still low, the discharge pressure will stay at a quite low level which means the pressure differential between discharge and suction side will not be enough for compressor to act normally. Under such working condition, compressor might have difficulties to load itself. Oil supply to bearings and internal cooling might be not enough which will cause severe damage to those moving parts in the end. With minimum pressure valve, the pressure differential can be built shortly after the start up, so the capacity control and oil supply to those moving parts won't be a problem. Therefore, the compressor protection can be achieved. In addition to protection function, it can also act as check valve to reduce the reverse running time after compressor's stopping.

Flange on minimum pressure valves are provided for the ease of installation. It can be installed on either compressor's discharge port or external oil separator's discharge port (F type compressor only). The installation and specification are shown as below:

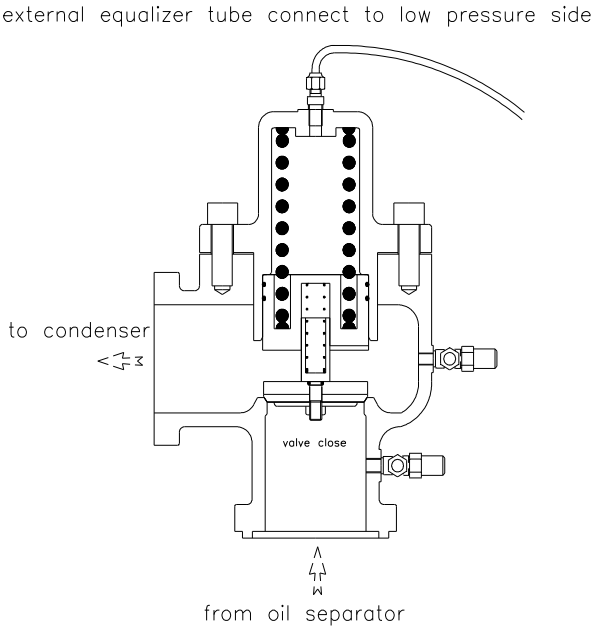


Figure 4.26 Installation of MPV

Model	Opening pressure	Max. pressure	Working temperature	Pressure drop
1 1/2"	3.6±0.3Bar	28Bar	<120℃	<0.1Bar
2"				
2 1/2 "				
3"				
4"				
5"				
6"				

Please consult Hanbell representatives for the detailed outline and application

5. Electrical data and design

5.1 Motor design

HANBELL RC2-AVI series screw compressors are equipped with Y-Δ motor for soft start with a frequency inverter, VFD. The motor winding is especially designed and its insulation is enhanced for a wide spectrum of rotation frequency. During start, before reaching the specified operating condition, the current is increased proportionally with time to the rated amp. Because the motor voltage is low during start, the starting current and starting torque is also low.

5.2 Electrical installation with VFD

The general connection diagram of inverter is shown in Figure 5.1. An AC reactor should be installed between the power supply and the inverter in order to prevent power system from serious breakdown.

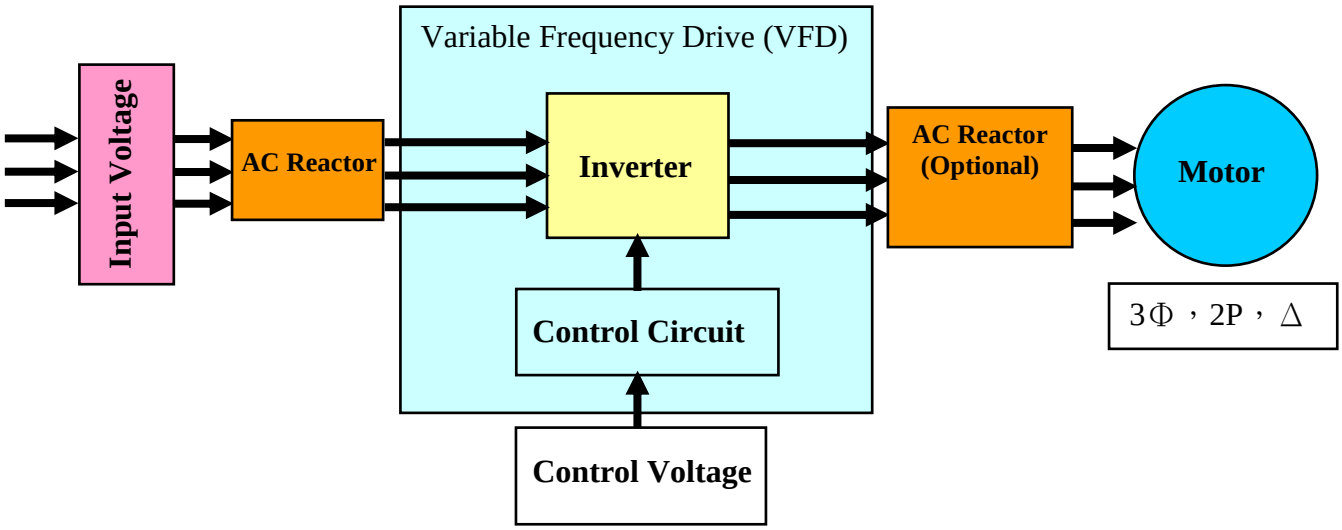


Figure 5.1: RC2-AVI compressor & VFD installation diagram

5.3 V-F diagram

The motor of RC2-AVI series compressor is designed for variable speed control. Its voltage vs. frequency characteristic diagram is as shown in Figure 5.2. When setting the inverter by its operation manual, please choose the same V/F characteristic as shown in Figure 5.2 in order to operate the compressor with proper settings.

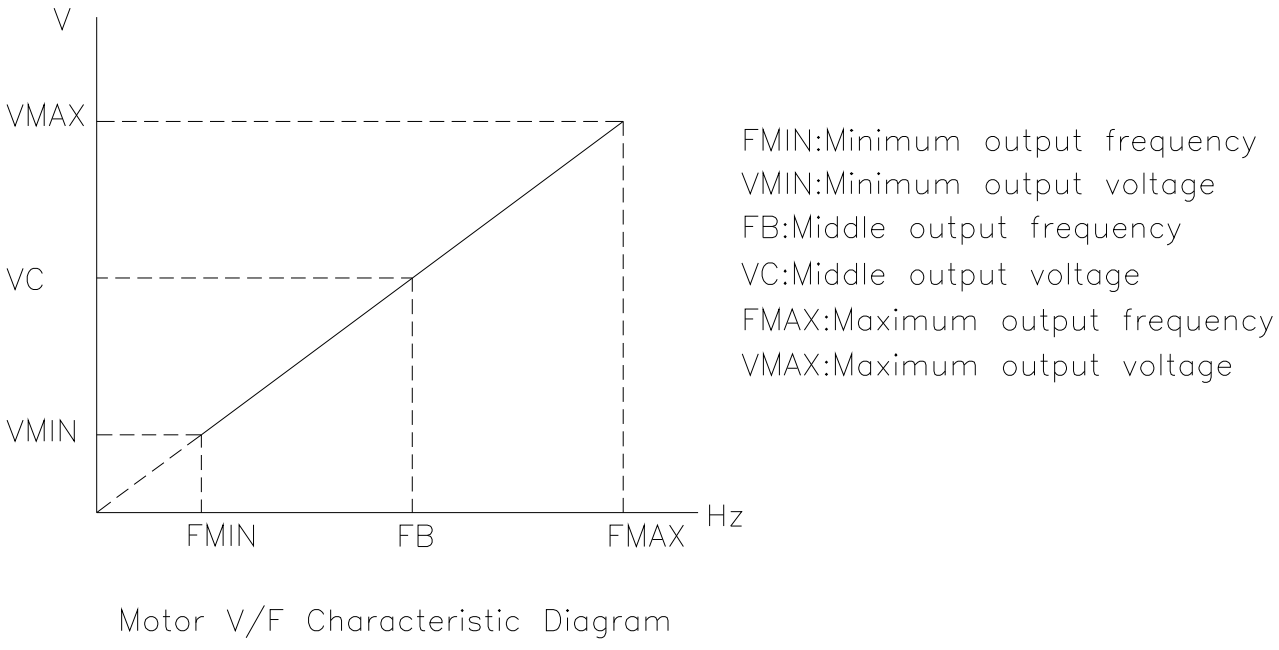


Figure 5.2: RC2-AVI motor V/F diagram

Notes:

1. VMAX / FMAX = Motor rated Voltage / Frequency.
2. FMIN or FB could be random. Make sure that VMIN / FMIN = VC / FB = VMAX / FMAX;
   FMAX > FB > FMIN; VMAX > VC > VMIN.
   For 400V, 80Hz Motor,
   VMAX is 400(V), and FMAX is 80(Hz)
   If FMIN is 20Hz, VMIN would be 400÷80×20 = 100 (V);
   If FB is 30Hz, VC would be 400÷80×30 = 150 (V)
3. For safety reason, the recommended way of checking V/F setting is to operate VFD without connecting motor. If the ratio of output voltage and frequency is always equal to VMAX / FMAX, V/F setting is finished.
4. Once VFD starts to drive motor, please check the output current is normal or not in the beginning. Incorrect V/F setting would result in an excessive current. If so, must shutdown VFD immediately, and recheck all the settings.

5.4 Protection devices

The table below shows the list of protection devices which are essential to protect the compressor and operate safely. Follow the protection devices listed in the table below to ensure the compressor's running under normal condition.

Protection device	**Set point**	Remark
Motor wiring temperature protector (PTC sensor)	Trip at 110℃	Standard
Discharge temperature protector (PTC sensor)	Trip at 110℃	Standard
Oil level switch		Optional
Oil filter pressure differential switch	Cutout 1.5kg/cm^{2}g	Optional
Oil flow switch		Optional
Pt100 or Pt1000 for liquid injection to motor chamber.	Depends on customer's application. Normally, Cut in 60℃, cut out 50℃	Optional

Motor thermistors and discharge thermistors are temperature sensors with quick response while the temperature approach to their set point; thermistors must be connected in series to a controller (INT69HBY) in cable box as a guardian to protect compressor. Alarm lamp for this protector is required to be embedded on control panel as indicator. Any intention to short controllers for starting of compressors is prohibited. It is beyond Hanbell's warranty of compressors if there is any action above mentioned found.

Note: when any protection device trips, please do troubleshooting and reset manually. Do not let the compressor reset automatically after abnormal trip.

5.5 Grounding

There's a grounding terminal inside cable box. Please accurately connect it to grounding of control panel for the system.

Suggestion:

a. The regular setting of electric leak protection should be greater than 50mA; for a humid location, 25mA is better.
b. Grounding voltage of casing should be no greater than 50V; for a humid location, the limit is 25V.
c. Grounding resistance should be no greater than 500 Ohm.
d. Air cut board (ACB) is regularly equipped with electric leak protection. Please refer to related settings for its normal action.
e. If electric leak protection is active, please check if insulation of equipments is normal and if its wiring and setting are correct.

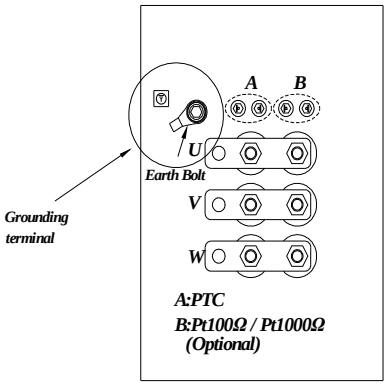


Figure 5.3: Grounding Terminal

Please make sure nothing is wrong before turning on the power. If there are any questions, please contact the supplier of equipments.

6. Operation and maintenance

6.1 Start-up

PRE-START CHECKING- The table below shows the required procedures and checkpoints before starting the compressor during commissioning or initial operation of the unit.

Items	Things to be checked	States or standard values
1. Accessories	1. Oil level 2. Oil heater 3. System valves status 4. Solenoid valves	1. Oil should be enough 2. Should be kept energized after the compressor's shutdown. 3. Opened 4. Fixed firmly.
2. Electrical system	1. Voltage of main power 2. Voltage of control circuit 3. Insulation resistance value of the motor between phase to phase and phase to ground. 4. Power terminals and wire cables' terminal connection. 5. Grounded 6. Capacity of electrical accessories 7. Settings of switches, sensors and controllers.	1. Voltage of power supply should be kept within 5% tolerance to the rated voltage, instant maximum voltage drop while starting should be less than 10% tolerance to the rated voltage. 2. Standard voltage is 220V. Maximum voltage is 230V. 3. Insulation resistance value should be above 5MΩ. 4. Power terminals are firmly fixed on terminal block and well insulated. Keep cables away from heat source and sharpened metal. 5. Regulated by the local electricity regulations. 6. Properly selected (or inquired by the system designer.) 7. Properly set (or inquired by the system designer.)
3. Piping system	1. Outer piping system 2. Leakage test 3. Bolts to fix the compressor.	1. Fixed firmly. 2. No leakage. 3. Fix the compressor tightly.
4. Safety devices	1. Motor coil temperature sensor (thermistor) 2. Discharge temperature sensor (thermistor) 3. Controller	1. Connected in series with discharge temperature sensor to INT69HBY. 2. Connected in series with motor temperature sensor to INT69HBY. 3. Close circuit (no reaction)
5. VFD setting	1. Connection with controller 2. V/F, motor rated current setting 3. Acceleration / deceleration time	1. Those functions as speed control, malfunction feedback, VFD reset should be workable. 2. Should follow the nameplate of compressor. 3. Acceleration: 50~60 sec from 0Hz to 50Hz; deceleration: vice versa.
6.Compressor motor	1. Motor temperature (from Pt100/1000)	1. Temperature meter should be correct.

In addition to the pre-start checking given in the above table, also consider the following:

a. It is necessary to pay more attention to the auxiliary facilities while the chiller is commissioning at the job-site and the periodic maintenance after the initial start-up.

b. In order to keep smooth lubrication under the low ambient temperature with the normal viscosity, oil heater should be kept energized after the compressor has been shut down for preparation of the next start-up.

c. Check that all the settings on each pressure switch are correct.

d. Check if all the stop valves in the system are already open.

e. Check the rotating direction of the compressor by starting the compressor for a transient period (approximate 0.5 or 1 sec.) and check the suction and discharge pressure gauges. When rotating in the correct direction, the suction pressure will drop immediately and the discharge pressure will go up as well.

f. Oil supply to compressor should be checked immediately after compressor starting. Oil flow switch is suggested to monitor oil flow rate automatically.

g. Oil foaming may occur during starting period, but it should disappear when the compressor is under stable operating conditions. Otherwise, this can indicate excessive liquid in the suction gas.

h. The running condition of the compressor after commissioning should be adjusted as - the discharge temperature will be at least 10K above the saturated condensing temperature and the suction vapor superheat should be within 10K to the saturated evaporating temperature.

i. The whole plant, especially the pipelines and capillary tubes must be checked for possible abnormal vibrations. Contact HANBELL or local distributors if any abnormal vibrations or noise found while the compressor is running.

j. Regularly check the plant according to national regulations and the following items also should be checked:

- ●Operating data of the machine
- ●Check the lubrication/ oil level
- ●All compressor protection devices

●Check electrical cable connections and tightness

Procedures for RC2-AVI series' operation

Start the compressor:
1. For loading and unloading the compressor with the inverter, it's recommended to increase or decrease its frequency by 1Hz at an interval of 1 to 2 seconds.
2. After starting the compressor, load the compressor to 30Hz.
3. During the period of loading to 30Hz, make sure the tendency of change in high/ low pressure is correct.
4. If there is any abnormal vibration or noise from the compressor during starting, please recheck inverter settings until the situation has been improved.
5. Check whether the compressor oil is sufficient or not through sight glasses.

Load/unload the compressor:
1. After running at 30Hz for 2~3 minutes, changing the frequency of inverter to load/unload the compressor.
2. When changing frequency, the expansion valve should be adjusted simultaneously to meet the new flow rate.

Stop the compressor:
1. Adjust the inverter to 20Hz, and then shut down the compressor after 30 seconds of operation.

6.2 Troubleshooting

The table below shows some problems that might happen in the jobsite during commissioning or operation of the compressor. This table will only serve as a guide for engineers to understand the situation when the problem occurs in the job site.

PROBLEMS	POSSIBLE CAUSES	REMEDY / CORRECTIVE ACTION
Sudden trip of motor thermistor / sensor	Low suction pressure cause low refrigerant flow rate	Install liquid injection to motor coil
	Refrigerant shortage	Charge refrigerant
	Suction filter clogged	Clean filter
	High suction temperature	Install liquid injection to motor coil
	High suction superheat	Adjust the superheat less than 10K
	Unstable electricity system or failure	Check electricity power supply
	Motor overload	
	Bad motor coil causing temperature rising rapidly	
Poor insulation of motor	Bad compressor motor coil.	Check the coil or change the motor stator
	Motor power terminal or bolt wet or frosty.	Check if the VFD settings are correct or not.
	Motor power terminal or bolt bad or dusty.	
	Bad insulation of magnetic contactors.	
	Acidified internal refrigeration system.	
	Motor coil running long time continuously under high temperature.	
	Compressor restart counts too many times.	
Compressor starting failure	Voltage incorrect.	Check the power supply
	Voltage drop too big when starting the compressor or magnetic contactor failure or phase failure.	Check the power supply and the contactor.
	Motor broken down	Change the motor
	Motor thermister trip.	See "sudden trip of motor sensor" above
	Incorrect supply power connection.	Check and re-connect
	Discharge or suction stop valve closed.	Open the stop valve
	Rotor locked	Check and repair
	Earth fault	Check and repair
	Protection device trip	Check
	Damaged bearings.	Change bearing.
Abnormal vibration and noise of compressor	Phenomenon of liquid compression.	Adjust proper suction superheat
	Friction between rotors or between rotor and compression chamber.	Change screw rotors or/and compression chamber.
	Insufficient lubrication oil.	Check the oil supply of the compressor is enough, add some oil if necessary.
	Loose internal parts.	Dismantle the compressor and change the damaged parts.
	System harmonic vibration caused by improper piping system.	Check the system piping and if possible improve it using copper pipe.
	External debris fallen into the compressor.	Dismantle the compressor and check the extent of the damage.
	Friction between slide valve and rotors.	Dismantle the compressor and change the damaged parts.
	Motor rotor rotates imbalance.	Check and repair.
	Motor line open	Check
Compressor does not run	Tripped overload	Check the electrical connection
	Screw rotors seized	Replace screw rotors, bearings etc….
	Motor broken	Change motor.
	Insufficient refrigerant.	Check for leaks. Charge additional refrigerant and adjust suction superheat less than 10K
High discharge temperature	Bad heat exchange in condenser	Check and clean condenser
	Refrigerant overcharge.	Reduce the refrigerant charge
	Air / moisture in the refrigerant system	Recover and purify refrigerant and vacuum system

PROBLEMS	POSSIBLE CAUSES	REMEDY / CORRECTIVE ACTION
	Improper expansion valve.	Check and adjust proper suction super heat
	Insufficient lubrication oil.	Check the oil level and add oil.
	Damaged bearings.	Stop the compressor and change the bearings and other damaged parts.
	Improper Vi value.	Change the slide valve.
	No system additional cooling (Liquid injection or oil cooler)	Install additional system cooling (liquid injection or oil cooling or both base on working condition limitation)
	Lack of refrigerant	Check for leaks. Charge additional refrigerant.
Compressor losses oil	Improper system piping	Check and correct the piping or install an external oil separator
	Liquid fills back	Maintain suitable suction superheat at compressor
	Lack of refrigerant	Check for leaks. Charge additional refrigerant.
Low suction pressure	Evaporator dirty or iced	Defrost or clean coil
	Clogged liquid line filter drier	Replace the cartridge
	Clogged suction line or compressor suction strainer	Clean or change suction strainer
	Expansion valve malfunctioning	Check and reset for proper superheat
	Condensing temperature too low	Check means for regulating condensing temperature

Note: The replacement of compressor parts should be performed only by a qualified / certified serviceman with full knowledge of HANBELL screw compressors or HANBELL service engineers.

7. Applications

7.1 Additional cooling

When compressors operate in the following application conditions, installation of an additional auxiliary cooling apparatus is recommended to lower discharge temperature, maintain proper temperature of lubricant and additional cooling for motor coil to ensure safe running of compressors.

- Air-cooled system
- High compression ratio system such as heat pump, low temperature and refrigeration system
- High discharge temperature system such as heat recovery system
- Any other heavy duty application

There are two types of additional cooling of compressor that described separately as below:

a. Liquid injection applications

In areas with high condensing temperature and/or low evaporating temperature as in the limitation diagram, additional cooling is required in order for the compressor to work properly. A relatively simple method of additional cooling is direct refrigerant injection in the compressor either in the motor side or compression chamber side.

The purpose of installing a liquid injection system is to prevent the compressor from overheat. The system installed a liquid injection expansion valve between the liquid line and compressor for cooling down the compression chamber and motor to ensure the continuous and safe running of the compressor. The suction superheat should be controlled between 5K~10K for the application of air-cooled and heat pump chillers by means of expansion valve devices. These devices can be adjusted by the stem of the expansion valve to control the suction superheat by means of refrigerant flow rate. When the initial startup, the loading of the chiller is heavy due to the high temperature of chilled water, so the liquid injection devices capacity should be selected or calculated enough to reduce the overheat of the compressor.

Calculating the cooling capacity of liquid injection devices

Liquid injection devices can be calculated with the **HANBELL selection software** or manually. For manual calculation, consider the most extreme conditions to be expected during actual operations i.e. minimum evaporating temperature, maximum suction gas super heat and condensing temperature.

Liquid injection applied with low temperature expansion valve

When the compressor applied in the low temperature system (E.T. $\leqq$ -10°C) the compression ratio is high at this condition, also the discharge temperature will be very high. The design of the liquid injection system for low temperature application is similar to the illustration shown in figure below. There are two connectors for the liquid injection in the compressor, one is in the motor side to cool down the motor temperature and reduce the discharge temperature. The other is in the compression chamber side and its function is to reduce the discharge temperature and increase the compression efficiency. However, when additional cooling in compression chamber like economizer operation, oil cooler application is used or when condensing temperature is low, discharge temperature be kept low and liquid injection may not be turned on, although motor load is severe and motor coil temperature is high. This may lead to motor failure. Therefore, in application mentioned above Pt100 or Pt1000 for liquid injection to motor is recommended instead.

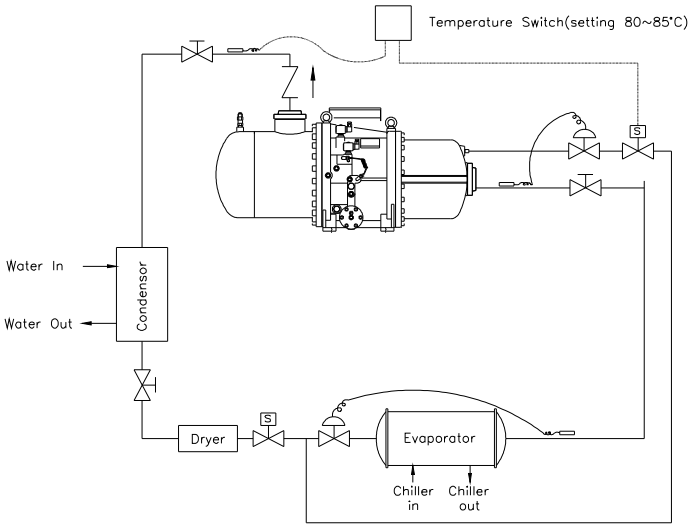


Figure 7.1: Liquid injection connected to motor

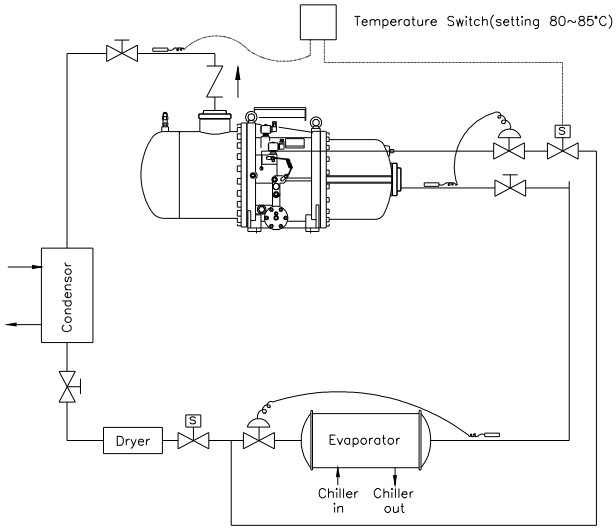


Figure 7.2: Liquid injection connected to compression chamber

Liquid injection applied with high temperature expansion valve

Select the high temperature expansion valve, which can sense the discharge temperature with its remote bulb. This can control the opening of expansion valve proportionally, and can reach the best cooling effect; it will control the compressor discharge temperature at an optimal situation of around 80°C.
It can also be installed with an additional solenoid valve or service valve in front of the high temperature expansion valve for the maintenance purposes. The solenoid valve will be opened while starting the compressor. The equilibrium tube of high temperature expansion valve should be connected to the high-pressure side to counter the internal pressure.
However, when additional cooling in compression chamber like economizer operation, oil cooler application is used, or when condensing temperature is low, discharge temperature may be kept low and liquid injection may not be turned on, although motor load is severe and motor coil temperature is high. This may lead to motor failure. Therefore, in applications mentioned above, Pt100 or Pt1000 for liquid injection to motor is recommended instead.

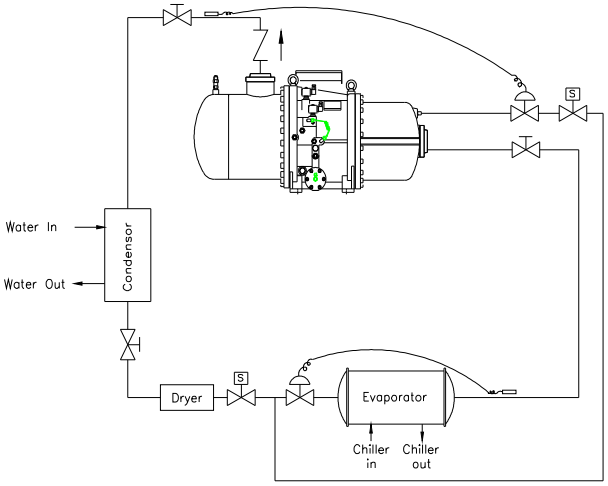


Figure 7.3: Liquid injection (high temperature type) connected to motor

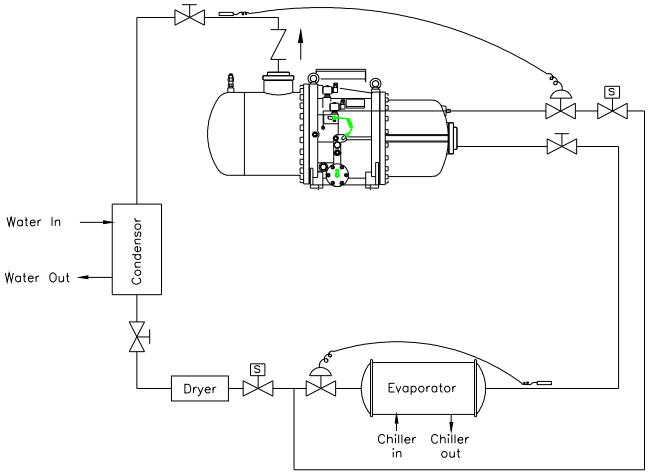


Figure 7.4: Liquid injection (high temperature type) to compression chamber

b. Oil cooler applications
Compared to liquid injection applications, external oil cooler application reduces the discharge temperature and at the same time gives better efficiency. Oil cooler application can be classified into 3 types: cooling by refrigerant, cooling by ambient air, cooling by cooling water. Oil cooler capacity can be calculated manually or using HANBELL selection software. When calculating manually, worst case operating conditions must be considered: minimum evaporating temperature, maximum suction gas superheat, maximum condensing temperature and the operation mode.

Cooling by refrigerant
The cooler uses refrigerant as the cooling medium. A basic refrigerant-cooled oil cooling system is shown in Figure 7.5.

In the oil cooler, solenoid valve for refrigerant circuit is controlled by oil temperature of the oil outlet of compressor.

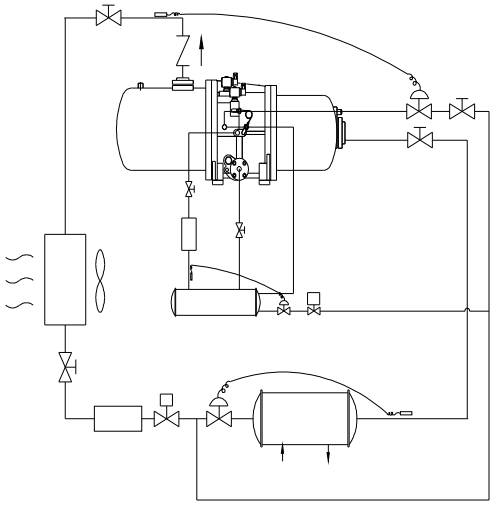


Figure 7.5: Oil cooling by refrigerant

Air-cooled oil cooling (cooling by ambient air)

The basic air-cooled oil cooling system is shown in Figure 7.6. This method of cooling is indirect cooling which uses ambient air to cool down the oil, which circulates in the oil cooler.

In the oil cooler, fan is controlled by oil temperature of the oil outlet of compressor.

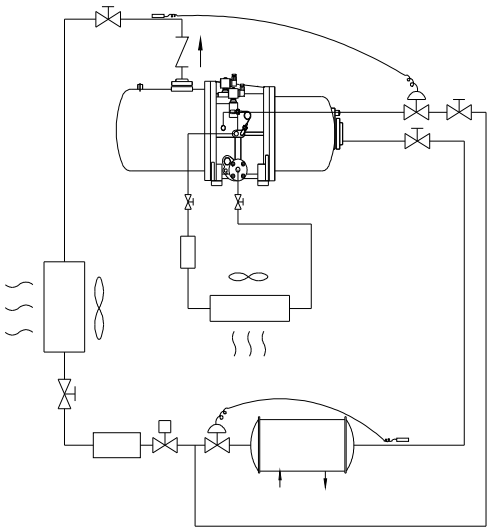


Figure 7.6: Oil cooling by ambient air

Water-cooled oil cooling (cooling by water)

This cooling method utilizes a shell and tube heat exchanger and a source of cooled liquid from an external cooling tower or closed loop evaporative cooler. Once-through water can be used but results in high water usage. An indirect cooling system uses a pump to circulate the cooling medium and a cooling tower or evaporative cooler to reject heat from the cooling medium. The basic water-cooled oil cooling system is shown in Figure 7.7.

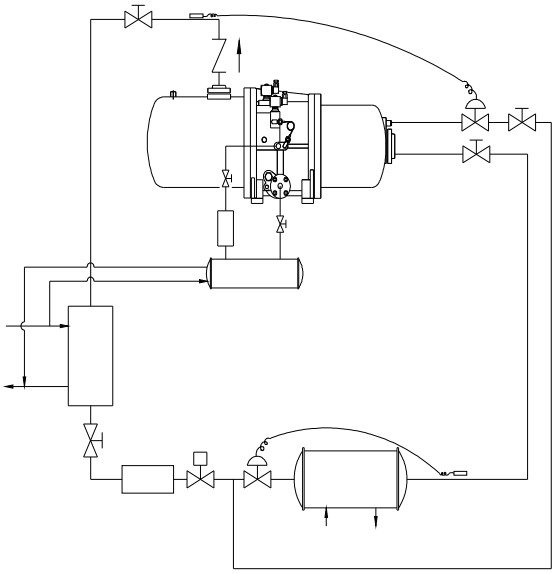


Figure 7.7: Oil cooling by water

Note:

1. Please decide appropriate oil cooler capacity by referring to HANBELL selection software.
2. The maximum pressure drop allowed in external oil cooler is 1.5 kg/cm^2.
3. When applying an oil cooler with a compressor, please add appropriate refrigeration oil in accordance with the size of oil cooler as well as the length of piping.

7.2 Parallel system applications

In the rack or parallel system, it is possible to happen the unequal-distribution of returned oil from the evaporator that could cause low oil level in one or more of the compressors. Be sure to install the oil level switch inside each compressors and oil flow switch installed in each oil return line to ensure the returned oil in each compressor with normal oil level.
The basic design of the system is shown in Figure 7.8, twin compressor parallel system connections. The accessories installed are the basic and if there are more applications or protection required, contact HANBELL or local distributor/agent for more information or further confirmation.

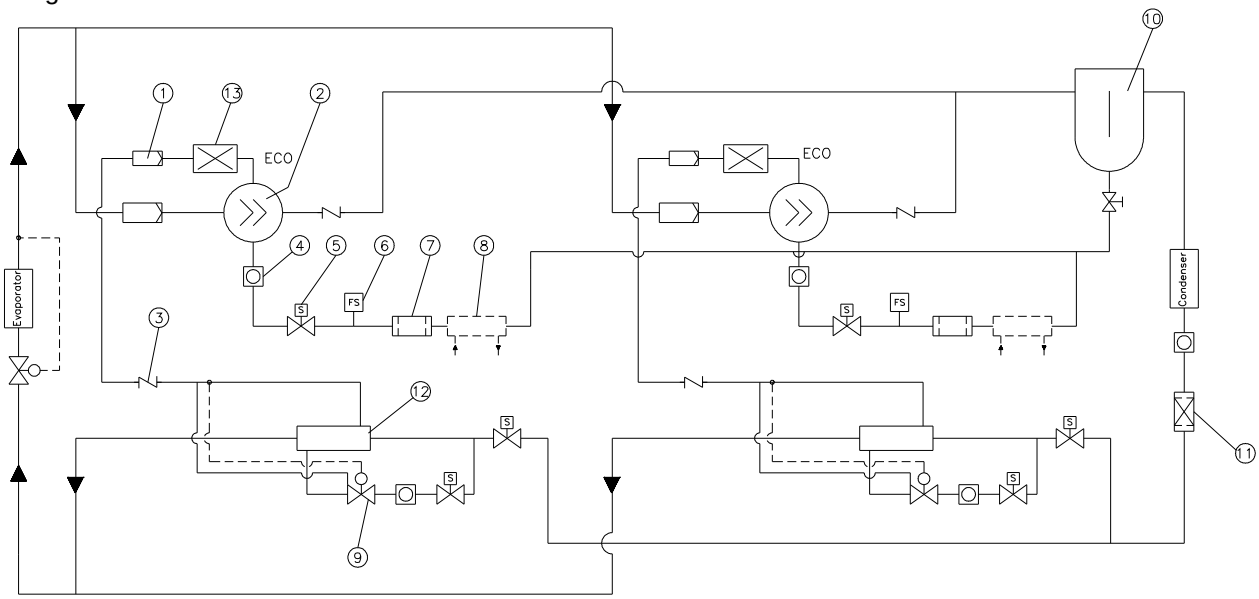


Figure 7.8 Parallel system with two compressors

Item	Description	Item	Description	Item	Description
1	Filter	6	Flow switch	11	Dryer
2	Compressor	7	Oil filter	12	Secondary cooler
3	Check valve	8	Oil cooler	13	Muffler
4	Sight glass	9	Expansion valve		
5	Solenoid valve	10	Oil separator		

7.3 Oil pump application

An additional oil pump is recommended to install to the system when the differential pressure of oil pressure and suction pressure is less than 4 bar (for example: water cooled flooder chiller). If compressor is operating at the mentioned condition, the failure of modulation and lubrication will be happened and will seriously damage the compressor. Besides the installation of additional oil pump, a high – low pressure differential switch is also recommended to install to this kind of system. Please contact Hanbell for more detailed information of oil pump.

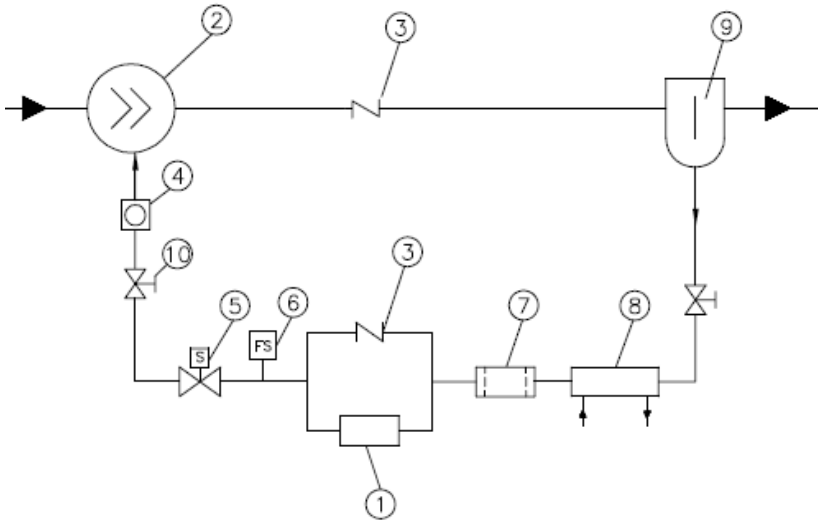


Figure 7.9 Additional oil pump

Item	Description	Item	Description	Item	Description
1	Oil pump	5	Solenoid valve	9	External oil separator
2	Compressor	6	Flow switch	10	Service valve
3	Check valve	7	Oil filter cartridge		
4	Sight glass	8	Oil cooler		

7.4 Inverter cooling

RC2-AVI can apply with a regular air-cooled or refrigerant-cooled inverter. In refrigerant-cooled inverter application, the refrigerant for cooling of inverter comes from liquid line after the condenser. The devices in inlet piping should include a solenoid valve, a regulation valve, and a sight glass as shown in the figure below. The solenoid valve should be of NC (normally closed) type, and opened/closed when the compressor starts/stops. The outlet piping, together with a service valve and a sight glass (optional), should be connected to the evaporator inlet. The regulation valve should be adjusted so that the temperature can be manually controlled under the lowest load of the system. In air-cooled inverter application, please keep good ventilation and make sure inverter temperature follows to the safety requirements.

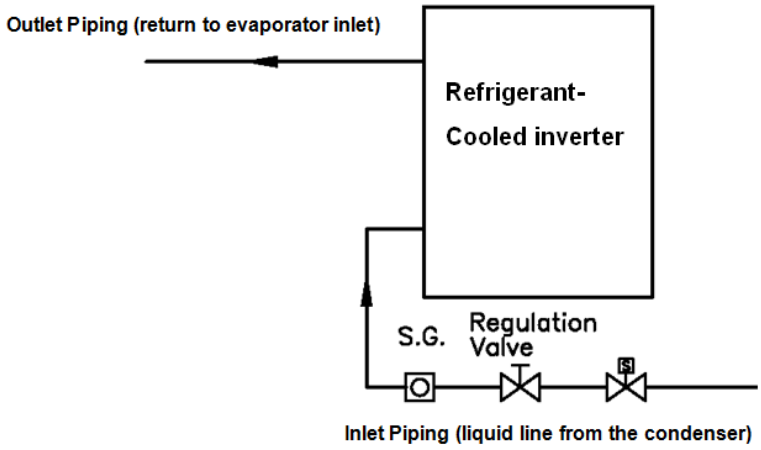


Figure 7.10 Refrigerant piping for inverter

Important Notes:

- All the piping connected to the inverter should be covered completely with thermal insulation, especially the segment after the regulation valve.
- If outlet piping needs to be connected to other ports of the compressor such as ECO port, please consult Hanbell for further information.

7.5 Important notes of applications

1. Pump down

DO NOT pump down the compressor on the chiller as a routine operation except only for temporary maintenance or a long term shut down. Because pump down will cause extremely high temperature in the compression chamber and overheat of the motor as well due to less amount of refrigerant in the suction side. When doing the pump down, be sure to take notice of the items listed below :

a. Pump down should be done once each time, as it may be dangerous to the compressor, compression chamber for pumping down repeatedly.

b. The minimum suction pressure when doing the pump down should be over 15 psig

c. Take notice of compressor running noise. If there is any abnormal noise happened, then emergently stop the pump down.

2. Long term partial load operation

If compressors have to run at partial load below 50% continuously, though maybe within operation limits under such operation condition and with temperature of motor below trip setting for overheating, insufficient dissipation of heat in motor will occur due to lower flow rate of suction gas at partial load. If compressors operate under high temperature for a long time, insulation of motor will deteriorate gradually at risk of serious motor damage finally. In such severe operation conditions, Hanbell strongly recommends installation of liquid injection system to cool motor coil and use of Pt100 or Pt1000 sensor as described in chapter 4.4-o, to effectively control temperature of motor while running. It is suggested to switch on liquid injection when temperature of motor coil is higher than 60℃ and turn off liquid injection when it's lower than 50℃.

3. Low pressure receiver

When a compressor operates in the following application conditions, installation of a low pressure receiver is recommended in order to prevent massive liquid refrigerant from returning to the compressor under momentary changes of operation condition.

●Heat pump ●Parallel system ●system with long piping

●operating in the low ambient temperature area ●system heating load varies extremely

8. Selection program

Selection program is available on Hanbell official website http://www.hanbell.com/index_eng.html

1. This program is suitable for the operating system of Windows 7 and above edition.

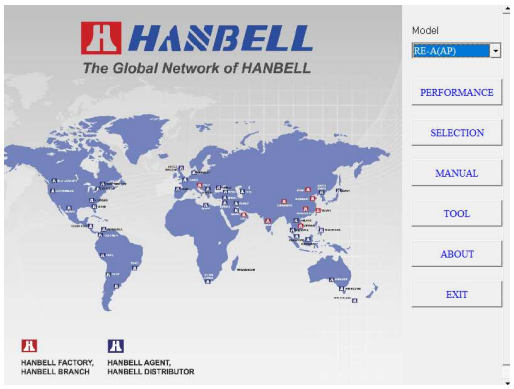
2. The monitor resolution shall be 1280 x720 or higher.

3. Double click the Hanbell Selection V5.0.4.exe file to start the setup.

4. Please follow the procedure and complete the installation.

Operating Procedure:

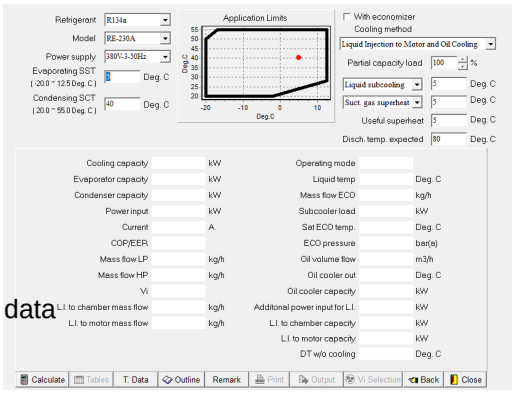
Step:
1. Before operating our selection software, please check any upgrade of selection software on Hanbell website.



2. There are 「RC2」, 「RE」, 「LT」 , 「RG」, 「LB」 , 「RT」 product on the menu

3. For example, selecting 「RE-A」 compressor, will bring user to next page of program. Then select Model and click 「*PERFORMANCE*」 button.

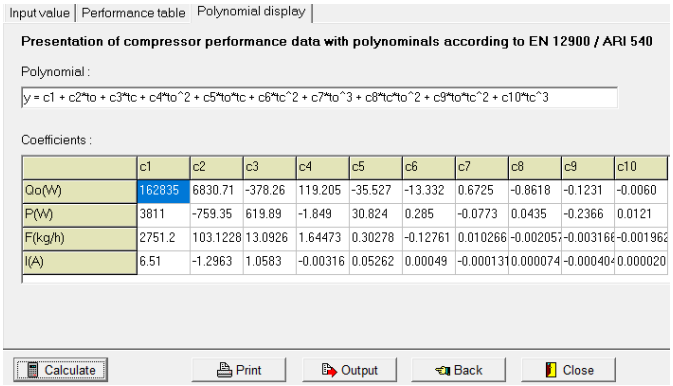
Following is a page to put into operation condition inputs, key-in the following condition and then click the 「**Calculate**」 button.
- Refrigerant type
- Compressor model
- Power supply (default is 380V 3 50Hz)
- Evaporating SST (default is 5 ˚C)
- Condensing SCT (default is 40 ˚C)
- Additional cooling method: oil cooler or liquid injection
- Partial load condition (%)



Click the 「**Calculate**」 button and it will show the performance data in the middle of the window.

There are additional functions available:
「**Tables**」： Calculate the polynomial coefficient
「**T.Data**」：The technical data is the same with function key of technical data
「**Outline**」: Pop-up the compressor outline selecting
「**Print**」： Print out the calculated performance data
「**Output**」： Save the calculated performance data as an file
「**Vi selection**」：Manually select Vi value

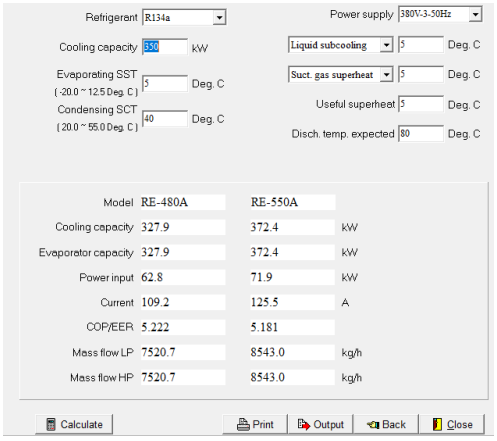
(3.2.1) Click 「**Tables**」 button and double check the input value to be calculated, then click calculate, coefficients will will display on polynomial display. User can output or print out the data.



In the 「RC2-AVI」 menu, we can select 「*SELECTION*」 to decide the most suitable compressor model.

Use will need to input the following operating conditions:

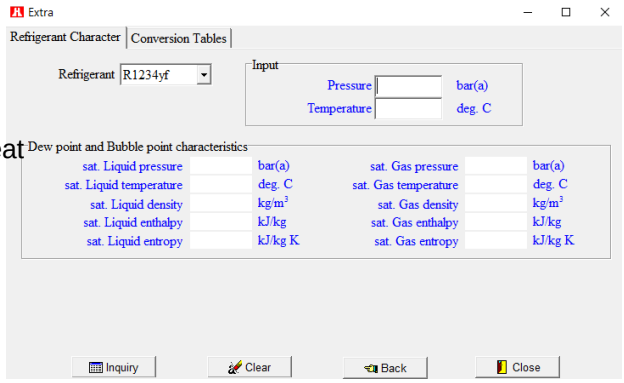
- Refrigerant type
- Cooling Capacity requirement (kW)
- Evaporating SST
- Condensing SCT
- Power supply



Then click 「Calculate」to have two most suitable compressor models suggested and their performance data

Click「*MANUAL*」button is a link to the technical manual on Hanbell website

Click「*TOOL*」**as an functional spreadsheet**, it has following two tools



「**Refrigerant Characteristic**」(R134a, R22, R407C)
「**Conversion Tables**」：
Temperature, length, area, volume, Mass
Pressure, Specific Volume, density, Velocity
Flow rate, power, Specific Enthalpy, Specific Entropy, specific heat

Click「**ABOUT**」to know the edition of this software.

Click「**EXIT**」Leave current window

9. Warranty

All HANBELL screw compressors pass strict quality and performance tests in our factory prior to delivery. The screw compressors are manufactured by quality materials and under warranty for: 1) One year after completion of installation and commissioning at jobsite. 2) 18 months from the original date sold by HANBELL/ designated sales agents, whichever expires earlier.

However, HANBELL will not honor warranty if the compressor fails due to the following reasons: 1) Damage caused during shipping or by war or force majeure incidents, etc... 2) Damage caused by improper installation, operation or maintenance that is not in accordance with HANBELL Technical Manual or instruction. 3) Damage caused by modification of any part on or connected to the compressor. 4) Damage caused by improper maintenance or repair by non-authorized technician. 5) HANBELL is not responsible for any accident which might happen to personnel while installing, setting up, operating, maintaining, and/or repairing the compressor.