

MAKING MODERN LIVING POSSIBLE



Application guidelines

# Danfoss scroll compressors SH- In parallel installation

50 Hz - 60 Hz - R410A





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**Benefits**

A parallel compressor installation refers to a system of interconnected compressors with a common suction line and common discharge line. The technique of mounting compressors in parallel, also called manifolding, has several benefits.

The main reason is reduced operating cost through greater control of capacity and power consumption. This is achieved by staggering compressor switch-on sequences that allow the parallel system to match its power with the capacity needed.

A second reason for manifolding is improved part load efficiency. In a parallel installation the

individual compressor(s) can be switched off while the other compressor(s) keep operating at 100% load. Therefore the part load efficiency is very near the full load efficiency. Conventional fixed speed compressor unloading methods impose a serious penalty for part load efficiency, mainly at low load operation.

Third, working with parallel systems allows for standardisation of compressors. As an example, the capacity range 10, 15, 20, 25 and 30 Tons can be covered with 5 individual compressors. But the same needs can be covered with only a 10 Tons and a 15 Tons model mounted in parallel, thus reducing the number of different compressor model to be stocked from 5 to 2.

**Scope**

These application guidelines describe the operating characteristics, design features and application requirements for the Danfoss SH scroll compressor in air conditioning and heat pump applications. The guidelines are not valid for refrigeration applications, which require dedicated compressors and more specific installations precautions.

To ensure proper parallel installation and running conditions, the following recommendations

must be followed: it is essential to respect all instructions given in these guidelines, the instruction leaflet delivered with each compressor and the Selection & Application Guidelines for single compressors.

For additional system components related to specific application requirements, the supplier recommendations must always be respected.

**Design challenge**

Parallel systems have to ensure correct compressor operation, oil management and reliability, which requires evaluation and testing.

**Oil equalisation**

Suction gas in a hermetic compressor flows via the oil sump which makes it more difficult to maintain equal pressure in the sumps of parallel compressors. Since oil equalisation usually depends on equal sump pressures this is a point of special attention. Danfoss Commercial

Compressors has developed specially adapted oil equalisation systems which ensure proper oil balancing between the compressors but it is always recommended to carry out some tests to validate it in the system (cf specific test recommendation).

**Interconnecting piping design**

This is an area where the manufacturer can use its research and testing capabilities to the users benefits. All factory designed parallel systems pass the critical 500 hours run test to qualify the piping configuration. This is not easily achieved with "field" erected systems which are often

affected by infancy problems such as pipe vibrations, noise or ultimately pipe ruptures.

Using factory designed and tested parallel systems guarantees predictable reliability.

**Compressor sequence**

The operating sequence should be arranged in such way that the running time of the compressors is equalised as much as possible.

<b>Cycling</b>	As a part of the design and development process at Danfoss Commercial Compressors it is verified that oil management and piping resistance meet engineering specifications at any cycling frequency.	The system must be designed in a way that guarantees a minimum compressor running time of 2 minutes to provide sufficient motor cooling after its start and a proper oil return. Note that the oil return may vary as it is a function of the system design.
<b>Cost effectiveness and serviceability</b>	In today's business climate, machine simplicity and low cost are main requirements. Danfoss SH scroll tandem and trio configurations are compact designs but they ensure easy	maintenance and service because refrigeration circuit connections, oil change, compressor wiring and compressor replacement are taken into account from the earliest design stage.
<b>Application envelope</b>	The domain of application, the types of refrigerant are evaluated to meet the	requirements of the intended applications.
<b>Oil return</b>	There is one last challenge which falls under the responsibility of the system designers and end users : proper oil return from the circuit.	Whatever the design of the parallel compressor system, good oil return from the circuit is prerequisite for the success of the equipment.

As mentioned before, one of the challenges of manifolding is oil management. To ensure

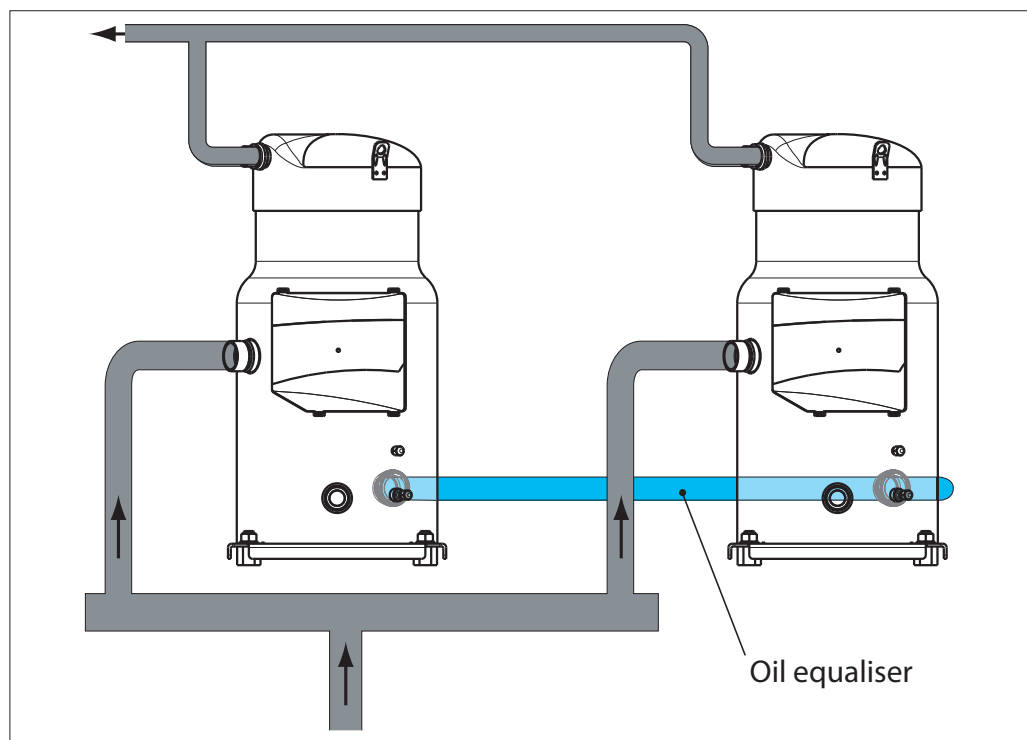
suitable oil distribution, the static system as described hereafter is used for SH compressors.

**Static systems**

This is one of the most simple and cheapest ways of manifolding compressors. Compressor sumps and low pressure shells are interconnected. An interconnecting pipe, on the lower part of the compressor (below the oil level), ensures oil balancing. The suction header design is critical, as it ensures a pressure drop balancing and equal distribution of oil returning from the system when all compressors are running.

The success of such a system relies very much on the sizing of the pipe work, small differences in sump pressure can result in significant oil level variations.

This system is limited to three compressors in parallel, and needs perfect suction tube balancing.



## Application Guidelines      Technical specifications

	Model	Nominal tons 60 Hz TR	Nominal cooling capacity		Power input kW	Max operating current <sup>Ⓞ</sup> A	Efficiency		Sound power dB(A)	Displacement <sup>Ⓞ</sup> m <sup>3</sup> /h	
			W	Btu/h			COP W/W	E.E.R. Btu/h /W			
50 Hz	Tandem	SH182	15	44600	152200	14.4	32.2	3.1	10.58	73.0	30.76
		SH195	16	49100	167600	15.7	35.6	3.14	10.72	73.8	33.39
		SH210	17.5	52300	178500	16.7	37.2	3.14	10.72	74.4	35.72
		SH212	17.5	53600	182900	17.0	39.1	3.17	10.82	74.5	36.02
		SH230	19	57000	194500	18.1	40.5	3.16	10.78	74.4	38.51
		SH242	20	59900	204400	18.9	42.3	3.17	10.82	75.5	40.68
		SH260	21.5	64700	220800	20.3	45.5	3.18	10.85	75.5	43.47
		SH281	23.5	68800	234800	21.6	47.8	3.18	10.85	76.0	46.74
		SH282	23.5	69400	236900	21.7	48.7	3.19	10.89	75.5	46.25
		SH301	25	73500	250900	23.0	51.0	3.19	10.89	76.0	49.52
		SH304	25.5	74600	254600	23.2	52.0	3.22	10.99	76.9	49.97
		SH322	27	77600	264800	24.3	53.3	3.19	10.89	76.5	52.79
		SH324	27	79400	271000	24.6	55.2	3.23	11.02	76.9	52.76
		SH345	29	83500	285000	25.9	57.5	3.23	11.02	77.3	56.03
		SH360	30	89000	303800	27.7	60.9	3.21	10.96	83.0	59.23
		SH368	30.5	89300	304800	27.5	61.7	3.25	11.09	78.0	59.26
		SH420	35	104200	355600	32.4	70.5	3.22	10.99	84.1	69.22
		SH475	39.5	117700	401700	36.4	79.7	3.24	11.06	84.1	77.67
		SH480	40	119700	408500	37.2	80.5	3.22	10.99	84.1	79.29
		SH482	40	119400	407500	37.0	80.1	3.23	11.02	85.0	79.20
		SH535	44.5	132900	453600	41.0	89.3	3.24	11.06	85.0	87.66
		SH540	45	134900	460400	41.8	90.1	3.22	10.99	85.0	89.28
		SH560	46.5	135000	460800	42.1	92.0	3.21	10.96	84.8	89.64
		SH590	49	146400	499700	45.0	98.6	3.25	11.09	85.0	96.12
		SH600	50	150300	513000	46.6	100.0	3.22	10.99	85.0	99.35
		SH620	51.5	150200	512600	46.7	101.6	3.22	10.99	85.5	99.63
	SH675	56.5	163700	558700	50.7	110.8	3.23	11.02	85.5	108.09	
	SH680	56.5	165600	565200	51.5	111.5	3.22	10.99	85.5	109.71	
	SH725	60	176000	600700	54.3	117.6	3.24	11.06	89.8	116.61	
	SH760	63.5	180900	617400	56.4	123.0	3.21	10.96	86.0	120.06	
	SH780	65	189500	646800	58.3	126.8	3.25	11.09	89.8	125.07	
	SH865	70	206800	705800	63.9	139.0	3.23	11.02	90.0	137.04	
	SH970	80	232600	793900	71.5	155.0	3.25	11.09	92.0	154.02	
	Trio	SH550	46	133500	455600	41.6	91.3	3.21	10.96	92.8	88.80
SH720		60	179100	611300	55.5	120.2	3.23	11.02	86.8	118.81	
SH885		74	219600	749500	67.5	148.9	3.25	11.09	86.8	144.18	
SH900		75	225500	769600	70.0	150.0	3.22	10.99	86.8	149.03	
SH1140		95	271400	926300	84.5	184.6	3.21	10.96	87.8	180.09	
SH1455	120	348900	1190800	107.2	232.5	3.25	11.09	93.8	231.04		
60 Hz	Tandem	SH182	15	54200	185000	17.1	33.6	3.16	10.78	75.0	37.13
		SH195	16	59200	202000	18.5	36.1	3.2	10.92	76.1	40.30
		SH210	17.5	63900	218100	19.8	38.2	3.22	10.99	76.8	43.11
		SH212	17.5	64200	219100	19.9	38.6	3.22	10.99	77.0	43.47
		SH230	19	69400	236900	21.5	41.3	3.23	11.02	77.5	46.47
		SH242	20	73500	250900	22.5	42.8	3.27	11.16	78.0	49.10
		SH260	21.5	79000	269600	24.2	45.9	3.27	11.16	78.5	52.46
		SH281	23.5	83900	286300	25.7	48.4	3.27	11.16	79.1	56.41
		SH282	23.5	84600	288700	25.9	49.0	3.27	11.16	79.0	55.82
		SH301	25	89400	305100	27.4	51.5	3.27	11.16	79.5	59.77
		SH304	25.5	90700	309600	27.7	52.8	3.28	11.19	79.8	60.31
		SH322	27	94300	321800	28.9	54.0	3.27	11.16	80.0	63.71
		SH324	27	96300	328700	29.4	55.9	3.28	11.19	80.1	63.67
		SH345	29	101100	345100	30.9	58.4	3.28	11.19	80.5	67.62
		SH360	30	108600	370600	33.2	60.4	3.27	11.16	88.0	71.48
		SH368	30.5	108000	368600	32.9	62.8	3.28	11.19	81.0	71.53
		SH420	35	126500	431700	38.7	71.1	3.27	11.16	88.5	83.54
		SH475	39.5	142800	487400	43.8	81.0	3.26	11.13	88.5	93.74
		SH480	40	145600	496900	44.8	81.8	3.25	11.09	88.5	95.70
		SH482	40	144400	492800	44.2	81.8	3.27	11.16	89.0	95.59
		SH535	44.5	160700	548500	49.3	91.7	3.26	11.13	89.0	105.80
		SH540	45	163500	558000	50.3	92.5	3.25	11.09	89.0	107.75
		SH560	46.5	163900	559400	50.6	93.3	3.24	11.06	89.1	108.19
		SH590	49	177000	604100	54.4	101.5	3.25	11.09	89.0	116.00
		SH600	50	182600	623200	56.4	103.2	3.24	11.06	89.0	119.91
		SH620	51.5	181800	620500	56.1	104.0	3.24	11.06	89.5	120.25
	SH675	56.5	198100	676100	61.2	113.9	3.24	11.06	89.5	130.45	
	SH680	56.5	200900	685700	62.2	114.7	3.23	11.02	89.5	132.41	
	SH725	60	212800	726300	65.4	121.5	3.25	11.09	92.2	140.74	
	SH760	63.5	219200	748100	68.0	126.2	3.22	10.99	90.0	144.90	
	SH780	65	229100	781900	70.5	131.4	3.25	11.09	92.2	150.95	
	SH865	70	250200	853900	77.3	143.7	3.24	11.06	92.5	165.40	
	SH970	80	281100	959400	86.6	161.3	3.25	11.09	94.0	185.89	
	Trio	SH550	46	162900	556000	49.8	90.6	3.27	11.16	89.8	107.10
SH720		60	216600	739200	66.3	122.7	3.27	11.16	90.8	143.39	
SH885		74	265500	906100	81.6	152.3	3.25	11.09	90.8	174.01	
SH900		75	273900	934800	84.6	154.8	3.24	11.06	90.8	179.87	
SH1140		95	328800	1122200	102.0	189.4	3.22	10.99	91.8	217.35	
SH1455	120	421700	1439200	129.8	241.9	3.25	11.09	95.8	278.84		

Ⓞ for +15°C evap. temp; +68°C cond. temp under nominal voltage 400V-3-50Hz / 460V-3-60 Hz

Ⓞ displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60 Hz

TR= Ton of Refrigeration

COP= Coefficient Of Performance

Frequency: 50 Hz / 60 Hz

Standard rating conditions: ARI standard

Rating conditions: SH compressors

Refrigerant: R410A

Sub-cooling: 8.3 K

Superheat: 11.1 K

Evaporating temperature: 7.2 °C

Condensing temperature: 54.4 °C

Subject to modification without prior notification. For full data details and capacity tables refer to Online Datasheet Generator <http://cc.danfoss.com>

The scroll compressor application range is influenced by several parameters which need to be monitored for a safe and reliable operation. These parameters and the main recommendations for good practice and safety devices are explained hereunder.

- Refrigerant and lubricants refer to FRCC. PC.007
- Motor supply
- Compressor ambient temperature
- Application envelope (evaporating temperature, condensing temperature, return gas temperature)

**Motor supply**

SH scroll compressors can be operated at nominal voltages as indicated below. Under-voltage and over-voltage operation is allowed

within the indicated voltage ranges. In case of risk of under-voltage operation, special attention must be paid to current draw.

		Motor voltage code 3	Motor voltage code 4	Motor voltage code 6	Motor voltage code 7	Motor voltage code 9
Nominal voltage	50 Hz	-	380-400 V - 3 ph 380-415 V - 3 ph *	230 V - 3 ph	500 V - 3 ph	-
Voltage range	50 Hz	-	340-440 V 340-457 V *	207 - 253 V	450 - 550 V	-
Nominal voltage	60 Hz	200-230 V - 3 ph	460 V - 3 ph	-	575 V - 3 ph	380 V - 3 ph
Voltage range	60 Hz	180 - 253 V	414 - 506 V	-	517 - 632 V	342 - 418 V

\* SH295 & 485

**Compressor ambient temperature**

SH compressors can be applied from -35°C to 55°C ambient temperature for SH090-105-120-140-161-184 and 51°C ambient temperature for SH180-240-295-300-380-485. The compressors

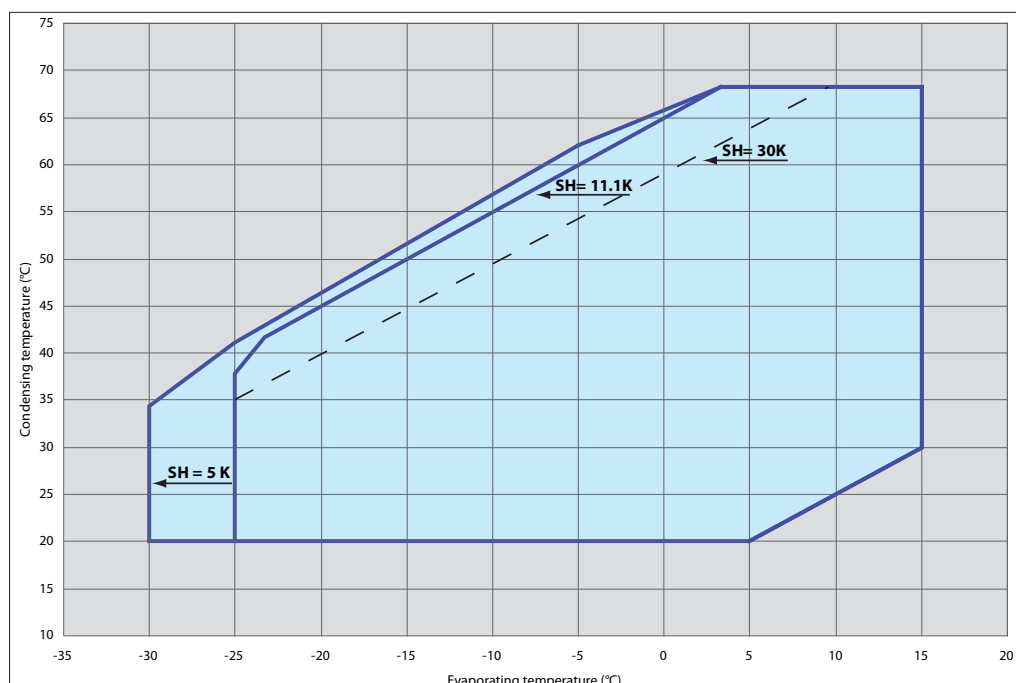
are designed as 100 % suction gas cooled without need for additional fan cooling. Ambient temperature has very little effect on the compressor performance.

**Operating envelope**

The parallel assemblies recommended design from Danfoss Commercial Compressors have been qualified to ensure there is no impact on the compressor operating envelopes. Consequently, the Danfoss scroll tandem and trio assemblies have the operating limits as shown below.

More details can be found in the Selection and Application Guidelines for Danfoss SH scroll compressors reference FRCC.PC.007.

**R410A - Tandem: SH182 to 970 - Trio: SH550 to 1455**





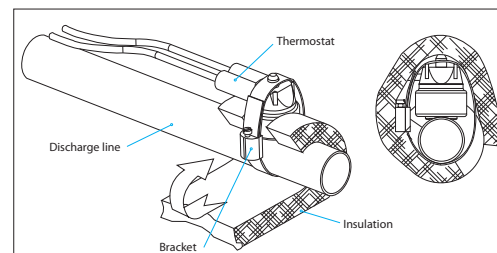
**Discharge temperature protection**

The discharge gas temperature of each compressor must not exceed 135°C.

When DGT protection is required (if the high and low pressure switch settings do not protect compressor against operation beyond its specific application envelope and on heat pumps) each compressor must be equipped with a discharge thermostat kit (available in sections "accessories").

SH485 includes a PTC sensor located in the fixed scroll, so this model doesn't need additional discharge temperature protection.

When a safety switch trips due to one of discharge gas thermostat, the compressor must stop immediately and must not restart until the discharge temperature is back to normal and the safety switch is closed again.


**High and low pressure protection**

The pump down pressure switch must have a set point slightly higher than the lowest compressor safety pressure switch set point. The compressor switch must never be bypassed and shall stop all the compressors. The high-pressure safety pressure switch shall stop all compressors. Please refer to Danfoss scroll compressors single application guidelines (FRCC.PC.007) for recommended settings.

Whenever possible (ie. PLC control) it is recommended to limit the possibilities of compressor auto-restart to less than 3 to 5 times during a period of 12 hours when caused low by LP safety switch settings.

**Cycle rate limit**

The system must be designed in a way that guarantees a minimum compressor running time of 2 minutes so as to provide for sufficient motor cooling after start-up along with proper oil return. Note that the oil return may vary since it depends upon system design.

There must be no more than 12 starts per hour (6 when a resistor soft-start accessory is introduced); a number higher than 12 reduces the service life of the motor-compressor unit. If necessary, place an anti-short-cycle timer in the control circuit, then connected as shown in the wiring diagram in the Danfoss scroll compressors application guidelines. A three-minute (180-sec) time-out is recommended.

Please refer to the Selection and Application Guidelines for Danfoss SH scroll compressors reference FRCC.PC.007. for general system design recommendations that are valid for single compressors as well as for parallel systems.

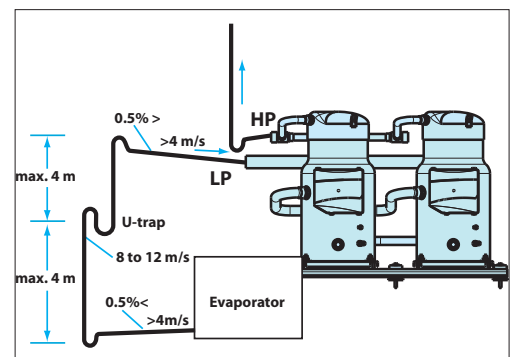
Typical system requirements and recommendations for parallel installations are listed below.

**Essential piping design considerations**

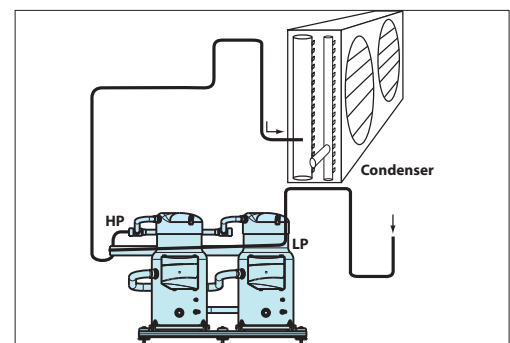
Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as to not trap oil and to prevent oil and refrigerant migration back to the compressor during off cycles. A double suction riser may be required for partial load operation if suction gas velocity is not sufficient to ensure proper oil return.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within that structure as well (for more information on noise and vibration, see section "Sound and vibration management").

If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle is omitted, the suction line should have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.



If the evaporator was situated below the compressors, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the thermal bulb location.



When the condenser is mounted at a higher position than the compressors, a suitably sized "U"-shaped trap close to the compressors is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressors during off cycle. The upper loop also helps avoid liquid refrigerant from draining back to the compressor when stopped.

**Expansion device**

When the parallel installation is serving a single evaporator system the dimensioning of the expansion device (thermostatic or electronic) becomes critical and must be made in relation to both minimum and maximum capacity. This will ensure correct superheat control in all situations, with the minimum of 5K superheat at the compressor suction. The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator. An oversized valve may result in erratic control. Proper selection could imply slightly under-sized expansion valve at full load. This consideration is especially important in manifolded units

where low load conditions may require the frequent cycling of compressors. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant superheat control under varying loads. The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. A minimum of 5K stable superheat is required. In addition, the refrigerant charge should be sufficient to ensure proper subcooling within the condenser so as to avoid the risk of flashing in the liquid line before the expansion device.

**Refrigerant charge limits**

Danfoss SH compressors can tolerate liquid refrigerant up to a certain extend without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited. In this respect, follow the guidelines given in the section: "Essential piping design recommendations" in priority.

Use the tables below to quickly evaluate the required compressor protection in relation with the system charge and the application.

Compressor models		Refrigerant charge limit (kg)
Tandem units	SH182	8.0
	SH195-210-230	8.5
	SH212-242-260-281-282-301-304-322-324-345-368	10.5
	SH360-420-475-480-482-535-540-590-600	17.5
	SH620-680-760	17.5
	SH725-780-865-970	22
Trio units	SH550-720-885-900	23
	SH1140 SH1455	24.5 29

	BELOW charge limit	ABOVE charge limit
Cooling only systems, Packaged units	<input checked="" type="checkbox"/> No test or additional safeties required	<b>REQ</b> Refrigerant migration & floodback test <b>REQ</b> Sump heater
Cooling only systems with remote condensor and split system units	<b>REC</b> Refrigerant migration & floodback test <b>REC</b> Crankcase heater, because full system charge is not definable (risk of overcharging)	<b>REQ</b> Refrigerant migration & floodback test <b>REQ</b> Sump heater <b>REC</b> Liquid receiver (in association with LLSV & pump down)
Reversible heat pump system		<b>REQ</b> Specific tests for repetitive floodback <b>REQ</b> Sump heater <b>REQ</b> Defrost test

**REC** Recommended      **REQ** Required       No test or additional safeties required  
 More detailed information can be found in the paragraphs system design recommendation of FRCC.PC.007.

**Sump heater**

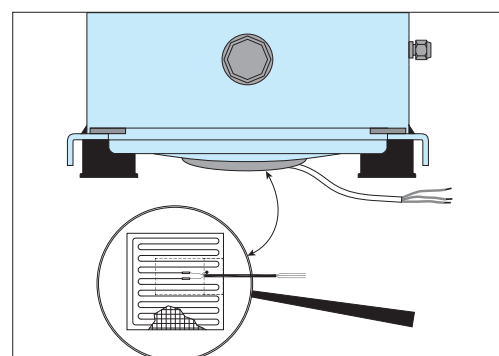
The surface sump heaters are designed to protect the compressor against off cycle migration of refrigerant. When the compressor is idle, the oil temperature in the sump of the compressor must be maintained at no lower than 10 K above the saturation temperature of the refrigerant on the low-pressure side. This requirement ensures that the liquid refrigerant is not accumulating in the sump. A sump heater is only effective if capable of sustaining this level of temperature difference.

service valves opened) and must be energized 15 minutes after all compressors have stopped and then whenever compressors are off. Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (eg. seasonal shutdown).

Since the total system charge may be undefined, a sump heater is recommended on all stand-alone compressors and split systems. In addition, any system containing a refrigerant charge in excess of the maximum recommended system charge for compressors requires a crankcase heater. A crankcase heater is also required on all reversible cycle applications.

Sump heater accessories are available from Danfoss (see section "Accessories").

The heater must be energized for a minimum of 6 hours before initial start-up (compressor



**External check valve**

Large SH (SH180-240 to 485) tandem and trio assemblies do not require the installation of an external check valve as each compressor comes equipped with a factory mounted internal check

valve, which prevents the compressor running backwards when stopped while others are in operation.

Application Guidelines	Specific application recommendations
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**Required tests**

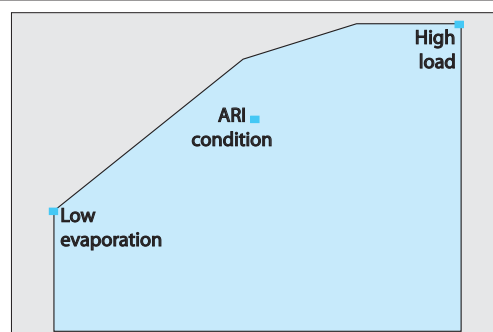
Specific application recommendations are fully described in Selection and Application Guideline (FRCC.PC.007). Please refer to this document.

Additionally the following tests should be done to validate effective operation and oil equalisation of compressors in parallel installation at any operating conditions of final application.

**Test conditions**

Tests shall be done at three points in final application envelope:

- ARI-based conditions
- Low evaporation (SH10K): low flow rate / pure oil/ low oil level
- High load (SH10K): high flow rate/ diluted oil/ high oil level



**Test sequences**

- Continuous for all compressors: 100% charge (all compressors continuous running)
- Continuous with partial charge: all partial charges configuration must be tested
- On/Off test: after 2 minutes shutdown of any compressor, the oil level has to retrieve a proper

- oil level within 1 minute when the compressor is switched back on.
- Transient 100% load: in transient condition such as end of defrost with temporary liquid flood back, check that oil return to normal level.

**Oil level criteria**

- The oil level of running compressors must be visible or full in the sight glass of running compressors at all operating conditions described before.
- The oil level of idle compressors may disappear in the oil sight glass.

- The oil level must retrieve a visible level in all compressors after the unit is stopped.
- Oil level top up might be necessary to retrieve a visible oil level in the sight glasses. Always use a Danfoss oil from new can (see section accessories).

**Running sound level**

The global sound level of “n” identical compressors is:

$$L_{GLOBAL} = Li + 10 \text{Log}_{10} n$$

Example for the trio

SH720 = 3 x SH240 (50Hz)

$$L_{SH240} = 82\text{dB(A)}$$

$$L_{SH720} = 82 + 10 \text{Log}_{10} 3 = 86.8\text{dB(A)}$$

The global sound level of “n” compressors with respectively  $L_i$  sound level is:

$$L_{GLOBAL} = 10 \text{Log}_{10} (\sum_{i=1}^{i=n} 10^{0.1 \cdot Li})$$

Example for the tandem

SH324 = SH140 + SH184 (50Hz)

$$L_{SH140} = 72.5\text{dB(A)}, L_{SH184} = 75\text{dB(A)}$$

$$L_{SH324} = 10 \text{Log}_{10} (10^{0.1 \times 72.5} + 10^{0.1 \times 75}) = 76.9\text{dB(A)}$$

	Model	50Hz	60Hz
Tandem	SH182	73.0	75.0
	SH195	73.8	76.1
	SH210	74.4	76.8
	SH212	74.5	77.0
	SH230	74.4	77.5
	SH242	75.5	78.0
	SH260	75.5	78.5
	SH281	76.0	79.1
	SH282	75.5	79.0
	SH301	76.0	79.5
	SH304	76.9	79.8
	SH322	76.5	80.0
	SH324	76.9	80.1
	SH345	77.3	80.5
	SH360	83.0	88.0
	SH368	78.0	81.0
	SH420	84.1	88.5
	SH475	84.1	88.5
	SH480	84.1	88.5
	SH482	85.0	89.0
	SH535	85.0	89.0
	SH540	85.0	89.0
	SH560	84.8	89.1
SH590	85.0	89.0	
SH600	85.0	89.0	
SH620	85.5	89.5	
SH675	85.5	89.5	
SH680	85.5	89.5	
SH725	89.8	92.2	
SH760	86.0	90.0	
SH780	89.8	92.2	
SH865	90.0	92.5	
SH970	92.0	94.0	
Trio	SH550	84.8	89.8
	SH720	86.8	90.8
	SH900	86.8	90.8
	SH1140	87.8	91.8
	SH1455	93.8	95.8

Sound power are given at rated ARI conditions measured in free space.

**Sound generation in a refrigeration or air conditioning system**

Typical sound and vibration in Refrigeration and Air-Conditioning systems encountered by design and service engineers may be broken down into the following three source categories.

**Sound radiation:** This generally takes an airborne path.

**Mechanical vibrations:** These generally extend along the parts of the unit and structure.

**Gas pulsation:** This tends to travel through the cooling medium, i.e. the refrigerant.

The following sections will focus on the causes and methods of mitigation for each of the above sources.

**Compressor sound radiation**

For sound radiating from the compressors, the emission path is airborne and the sound waves are travelling directly from the machine in all directions.

The Danfoss SH scroll compressor is designed to be quiet and the frequency of the sound generated is pushed into the higher ranges, which not only are easier to reduce but also do not generate the penetrating power of lower-frequency sound.

Use of sound-insulation materials on the inside of unit panels is an effective means of substantially reducing the sound being transmitted to the outside. Ensure that no components capable of transmitting sound / vibration within the unit

come into direct contact with any non-insulated parts on the walls of the unit.

Because of the scroll compressors models unique design of a full-suction gas-cooled motor, compressor body insulation across its entire operating range is possible. Acoustic hoods are available from Danfoss Commercial Compressors as accessories. They have been developed to meet specific extra low noise requirement. They incorporate sound proofing materials and offer excellent high and low frequency attenuation. These hoods are quick and easy to install and do not increase the overall size of the compressors to a great extent. Refer to section "Running sound level" for sound attenuation and code numbers.

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**Mechanical vibrations**

Vibration isolation constitutes the primary method for controlling structural vibration. Danfoss tandem and trio scroll compressors have been designed to produce minimal vibration during operations. To reduce transmission of vibrations, rubber mounting grommets are used, to mount the unit frame in the system. In addition, it is extremely important that the frame supporting the mounted compressors be of sufficient mass and stiffness to help dampen any residual vibration potentially transmitted to the frame. For further information on mounting requirements, please refer to the section on mounting assembly.

For tandem and trio SH180 to 485, depending on applications, it might be necessary to reach

higher natural frequencies. Then the standard rigid mounting should be replaced by accessory code number 120Z0495.

The tubing should be designed so as to both reduce the transmission of vibrations to other structures and withstand vibration without incurring any damage. Tubing should also be designed for three-dimensional flexibility. For more information on piping design, please see the section entitled "Essential piping design considerations".

A piping support can be added when necessary. For further information, please contact Danfoss, technical support.

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**Gas pulsation**

Manifolded compressors are equivalents to lagged sources of gas pulsation. Therefore pulse level can vary during time. On heat pump installations and other installations where the pressure ratio lies beyond the typical range, testing should be conducted under all expected conditions and operating configurations to

ensure that minimum gas pulsation is present. If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass should be installed. This information can be obtained from the component manufacturer.

**Ordering information**

To build a complete tandem, one must order the 2 compressors and the Tandem kit see codes "Tandem units" part.

To build a trio, one must order 3 compressors and the trio kit see codes "Trio units" part.

**For example : Tandem SH210**

- **Compressor 1** : SH090 Code number 120H0004 (Industrial pack)

- **Compressor 2** : SH120 Code number 120H0014 (Industrial pack)

- **Tandem kit** : SH210 Code number 7777043.

Danfoss SH scroll compressors can be ordered in either industrial packs or in single packs.

Please use the code numbers from below tables for ordering.

Refer of the FRCC.PC.007 for the packaging information.

Compressor model	Pack	Nbr	Connections	Motor protection	Code no.				
					3	4	6	7	9
					200-230/3/60	460/3/60 400/3/50	230/3/50	575/3/60 500/3/50	380/3/60
SH090	Industrial	8	Brazed	Internal	120H0002	120H0004	-	-	120H0010
	Single	1	Brazed	Internal	120H0001	120H0003	120H0005	120H0007	120H0009
SH105	Industrial	8	Brazed	Internal	120H0210	120H0212	-	-	120H0218
	Single	1	Brazed	Internal	120H0209	120H0211	120H0213	120H0215	120H0217
SH120	Industrial	8	Brazed	Internal	120H0012	120H0014	-	-	120H0020
	Single	1	Brazed	Internal	120H0011	120H0013	120H0015	120H0017	120H0019
SH140	Industrial	8	Brazed	Internal	120H0200	120H0202	-	-	120H0208
	Single	1	Brazed	Internal	120H0199	120H0201	120H0203	120H0205	120H0207
SH161	Industrial	8	Brazed	Internal	120H0022	120H0024	-	-	120H0030
	Single	1	Brazed	Internal	120H0021	120H0023	120H0025	120H0027	120H0029
SH180	Industrial	6	Brazed	M 24	120H0266	120H0268	-	-	120H0272
			Brazed	M 230	120H0274	120H0276	-	-	120H0280
	Single	1	Brazed	M 24	120H0265	120H0267	-	120H0269	120H0271
			Brazed	M 230	120H0273	120H0275	-	120H0277	120H0279
SH184	Industrial	6	Brazed	Internal	120H0360	120H0362	-	-	120H0368
	Single	1	Brazed	Internal	120H0359	120H0361	120H0363	120H0365	120H0367
SH240	Industrial	6	Brazed	M 24	120H0290	120H0292	-	-	120H0296
			Brazed	M 115 - 230	120H0298	120H0300	-	-	120H0304
	Single	1	Brazed	M 24	120H0289	120H0291	-	120H0293	120H0295
			Brazed	M 115 - 230	120H0297	120H0299	-	120H0301	120H0303
SH295	Industrial	6	Brazed	Module 24V	120H0852	120H0826	-	-	120H0842
			Brazed	M 115 - 230	120H0854	120H0828	-	-	120H0844
	Single	1	Brazed	Module 24V	120H0851	120H0825	-	120H0833	120H0841
			Brazed	M 115 - 230	120H0853	120H0827	-	120H0835	120H0843
SH300	Industrial	4	Brazed	M 24	120H0234	120H0238	-	-	120H0246
			Brazed	M 115 - 230	120H0236	120H0240	-	-	120H0248
	Single	1	Brazed	M 24	120H0233	120H0237	-	120H0241	120H0245
			Brazed	M 115 - 230	120H0235	120H0239	-	120H0243	120H0247
SH380	Industrial	4	Brazed	M 24	-	120H0254	-	-	120H0262
			Brazed	M 115 - 230	-	120H0256	-	-	120H0264
	Single	1	Brazed	M 24	-	120H0253	-	120H0257	120H0261
			Brazed	M 115 - 230	-	120H0255	-	120H0259	120H0263
SH485	Industrial	4	Brazed	M 24	-	120H1063	-	-	120H1073
			Brazed	M 115 - 230	-	120H1065	-	-	120H1075
	Single	1	Brazed	M 24	-	120H1062	-	-	120H1072
			Brazed	M 115 - 230	-	120H1064	-	-	120H1074

M24: Electronic motor protection, module located in terminal box 24 V,  
M230: Electronic motor protection, module located in terminal box 230 V,  
M115-230: Electronic motor protection, module located in terminal box 115/230 V,





## Application Guidelines Tandem units SH182 to SH970

### Operation principle

SH182 to SH760 tandems use the static system to balance the oil level between the compressors. Each of the compressors may run alone to provide proper capacity for part load operation. The system has been designed to ensure a

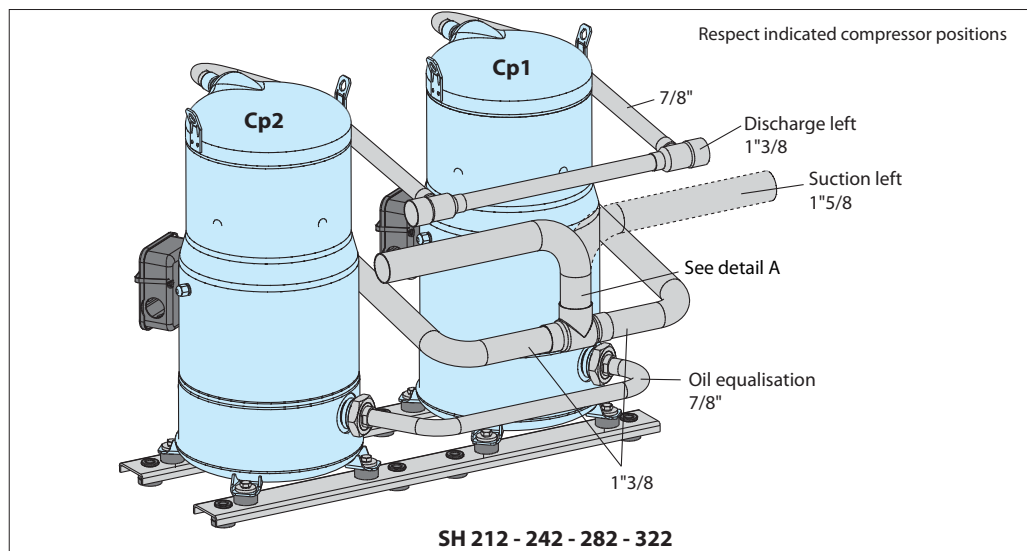
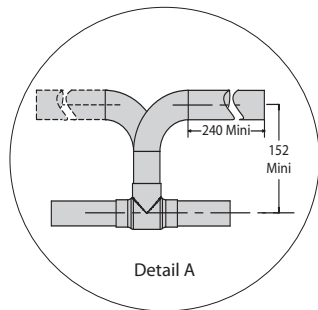
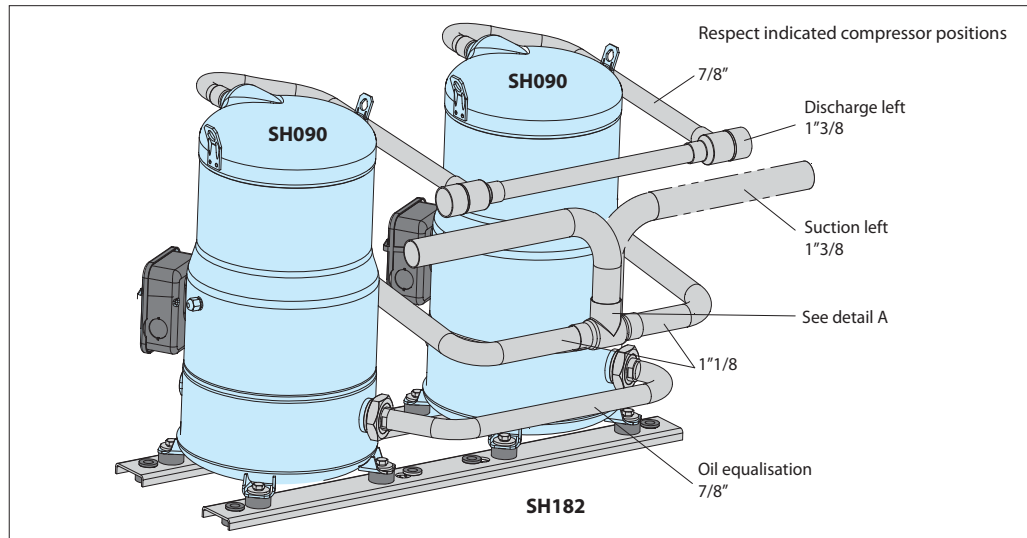
precise pressure balancing between the sumps, facilitating the oil equalisation by gravity. The discharge line is shown with two tees, to indicate that both left and right side discharge header are possible.

Tandem model	Composition	Suction	Discharge	Kit tandem Code No	Outline drawing number	
					Left suction connection	Right suction connection
SH182	SH090 + SH090	1"3/8	1"3/8	7777044	8556044P01	8556044P02
SH195	SH105 + SH090	1"5/8	1"3/8	7777043	8556045P05	8556045P06
SH210	SH120 + SH090	1"5/8	1"3/8	7777043	8556045P01	8556045P02
SH212	SH105 + SH105	1"5/8	1"3/8	7777044	8556044P07	8556044P08
SH230	SH090 + SH140	1"5/8	1"3/8	7777043	8556045P09	8556045P10
SH242	SH120 + SH120	1"5/8	1"3/8	7777044	8556044P03	8556044P04
SH260	SH140 + SH120	1"5/8	1"3/8	7777042	8556045P07	8556045P08
SH281	SH161 + SH120	1"5/8	1"3/8	7777042	8556045P03	8556045P04
SH282	SH140 + SH140	1"5/8	1"3/8	7777044	8556044P09	8556044P10
SH301	SH140 + SH161	1"5/8	1"3/8	7777042	8556045P11	8556045P12
SH304	SH120 + SH184	1"5/8	1"3/8	7777052	8556052P07	8556052P08
SH322	SH161 + SH161	1"5/8	1"3/8	7777044	8556044P05	8556044P06
SH324	SH140 + SH184	1"5/8	1"3/8	7777052	8556052P05	8556052P06
SH345	SH161 + SH184	1"5/8	1"3/8	7777052	8556052P03	8556052P04
SH360	SH180 + SH180	2"1/8	1"3/8	7777041	8556112	
SH368	SH184 + SH184	1"5/8	1"3/8	7777053	8556052P01	8556052P02
SH420	SH240 + SH180	2"1/8	1"3/8	7777037	8556112	
SH475	SH180 + SH295	2"1/8	1"3/8	7777038	8556112	
SH480	SH300 + SH180	2"1/8	1"3/8	7777038	8556113	
SH482	SH240 + SH240	2"1/8	1"3/8	7777041	8556112	
SH535	SH240 + SH295	2"1/8	1"3/8	7777037	8556112	
SH540	SH300 + SH240	2"1/8	1"3/8	7777037	8556113	
SH560	SH380 + SH180	2"1/8	1"3/8	7777038	8556115	
SH590	SH295 + SH295	2"1/8	1"3/8	7777041	8556112	
SH600	SH300 + SH300	2"1/8	1"3/8	7777041	8556114	
SH620	SH240 + SH380	2"1/8	1"3/8	7777048	8556115	
SH675	SH295 + SH380	2"1/8	1"3/8	7777037	8556115	
SH680	SH300 + SH380	2"1/8	1"3/8	7777037	8556116	
SH725	SH240 + SH485	2"1/8	1"5/8	7777038	8556134	
SH760	SH380 + SH380	2"1/8	1"3/8	7777041	8556117	
SH780	SH295 + SH485	2"1/8	1"5/8	120Z0551	8556141	
SH865	SH380 + SH485	2"5/8	1"5/8	120Z0550	8556136	
SH970	SH485 + SH485	2"5/8	1"5/8	7777041	8556137	

Composition of tandem

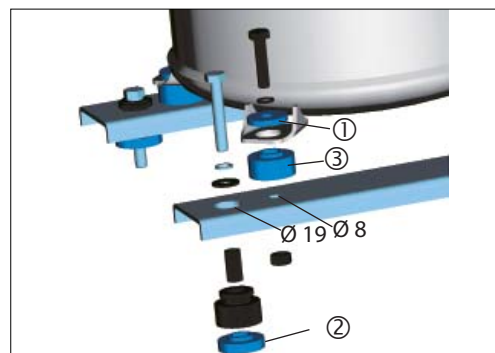
Tandem		SH182	SH212	SH242	SH282	SH322
Compressor 1	Model	SH090	SH105	SH120	SH140	SH161
	Code n° (1)	120H0004	120H0212	120H0014	120H0202	120H0024
Compressor 2	Model	SH090	SH105	SH120	SH140	SH161
	Code n° (1)	120H0004	120H0212	120H0014	120H0202	120H0024
Kit	Code n°	7777044				

(1): Example for the voltage code 4 (industrial pack). Refer to "code number information" part for other codes or single pack version



**Compressor mounting**

The tandem rail assembly is fixed on the unit frame using the flexible grommets supplied with the compressor. The compressors are fixed on the rails (not included) using the 4 mm flat washers ①, 14 mm rigid spacer ③, included in the «tandem kit» reference 7777044 (to be ordered with the compressors). An additional 7 mm rigid spacer ② must be placed under the rail grommets (see beside drawing).

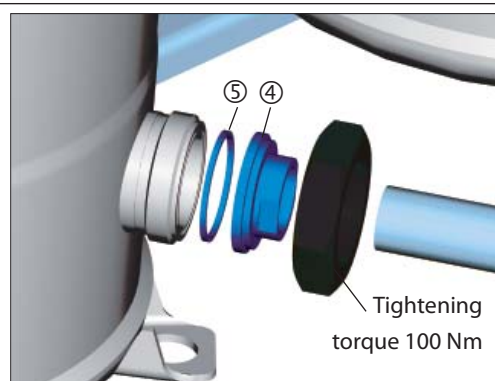


■ Supplied with the compressor  
■ Included in 7777044 kit  
■ Not supplied

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 7/8".

The kit 7777044 includes 1 3/4 - 7/8" adaptor sleeves ④ and new Teflon seals ⑤ to connect the 7/8" equalisation pipe on 1 3/4 oil connectors.


**Composition of the kit**

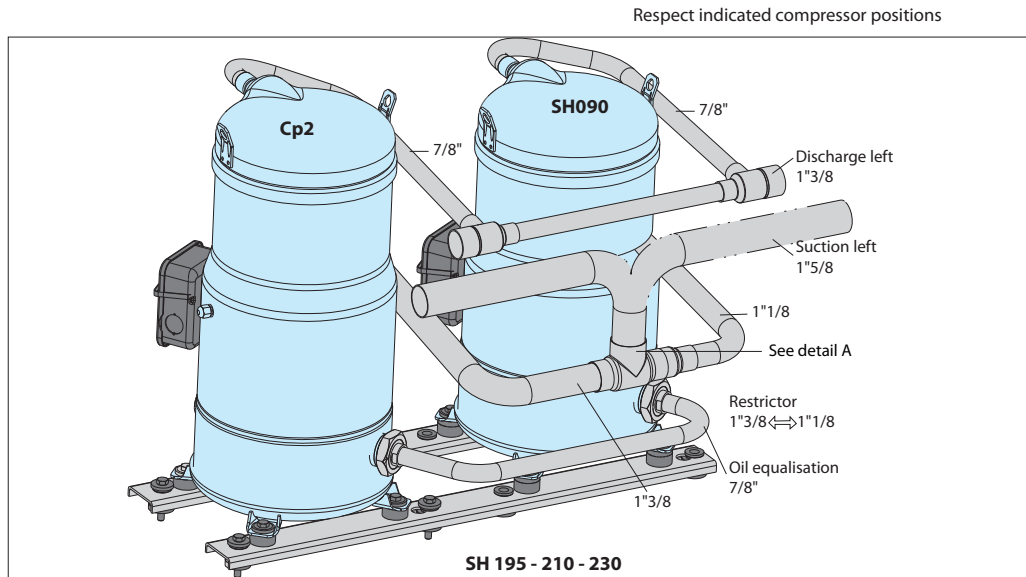
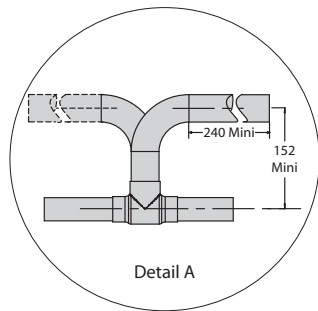
Kit code number 7777044

	Designation	Ref.	Qty.
①	Flat washer Thickness 4 mm	6301028P01	8
②	Rigid spacer Thickness 7 mm	5311629P01	8
③	Rigid spacer Thickness 14 mm	5311629P02	8
④	Equalisation sleeve 1" 3/4 Rotolock - 7/8" ODF	5311144P07	2
⑤	Teflon Seal	5607001P01	2

Composition of tandem

Tandem		SH195	SH210	SH230
Compressor 1	Model	SH090	SH090	SH090
	Code n° (1)	120H0004	120H0004	120H0004
Compressor 2	Model	SH105	SH120	SH140
	Code n° (1)	120H0212	120H0014	120H0202
Kit	Code n°	7777043		

(1): Example for the voltage code 4 (industrial pack). Refer to "code number information" part for other codes or single pack version

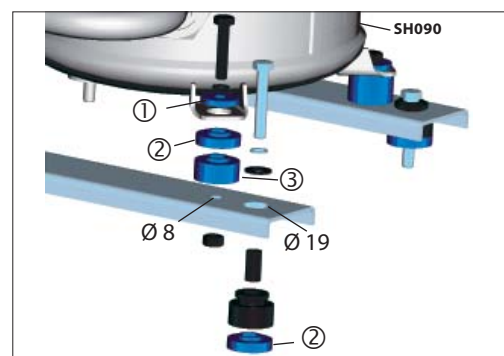
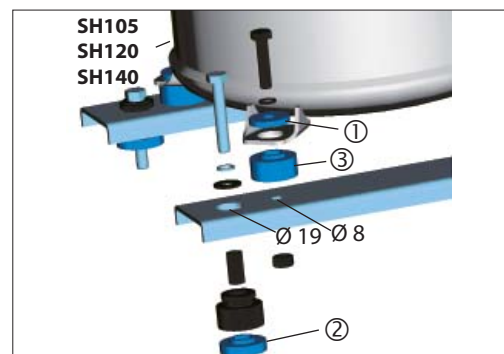


Compressor mounting

The tandem is fixed on the frame using the flexible grommets supplied with the compressor.

The compressors are fixed on the rails (not included) using the 4 mm flat washers ①, 14 mm rigid spacer ③, included in the "tandem kit" reference 7777043 (to be ordered with the compressors).

An additional 7 mm rigid spacer ② must be placed under the rail grommets (see beside drawing).



- Supplied with the compressor
- Included in 7777043 kit
- Not supplied

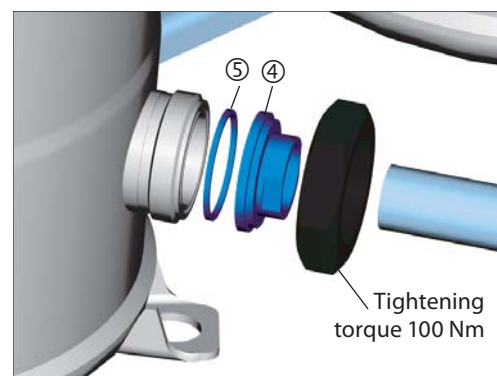
Because SH090 is 7 mm smaller than SH105, SH120, SH140 and in order to have the oil equalisation connection at the same level for

both compressors, an additional 7 mm rigid spacer ② must be added under the SH090 feet.

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 7/8".

The kit 7777043 includes 1 3/4 - 7/8" adaptor sleeves ④ & Teflon seals ⑤ to connect the 7/8" equalisation pipe on 1 3/4 oil connectors.


**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. But, this oil equalisation is also function of the configuration of the suction pipe.

**For tandem SH195:**

Suction from left or right: add restrictor ⑧ (copper colour) diameter 23 mm, at suction of the compressor SH105.

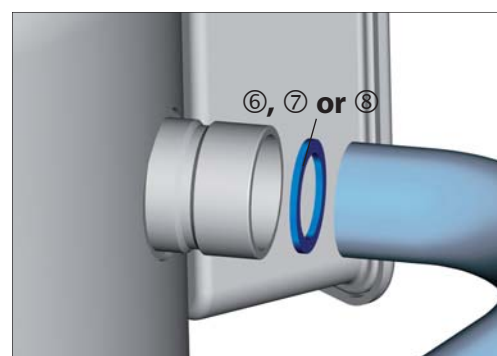
**For tandem SH210:**

Two profiles proposed:

- Suction from the left: add restrictor ⑥ (black colour) diameter 25 mm, at suction of the compressor SH120.
- Suction from the right: add restrictor ⑦ (black colour) diameter 24 mm, at suction of the compressor SH090.

**For tandem SH230:**

No restrictor is required.



- ⑥ on SH120 if main suction comes from the left **for SH210**
- or
- ⑦ on SH90 if main suction comes from the right **for SH210**
- or
- ⑧ on SH105 **for SH195**

**Composition of the kit**

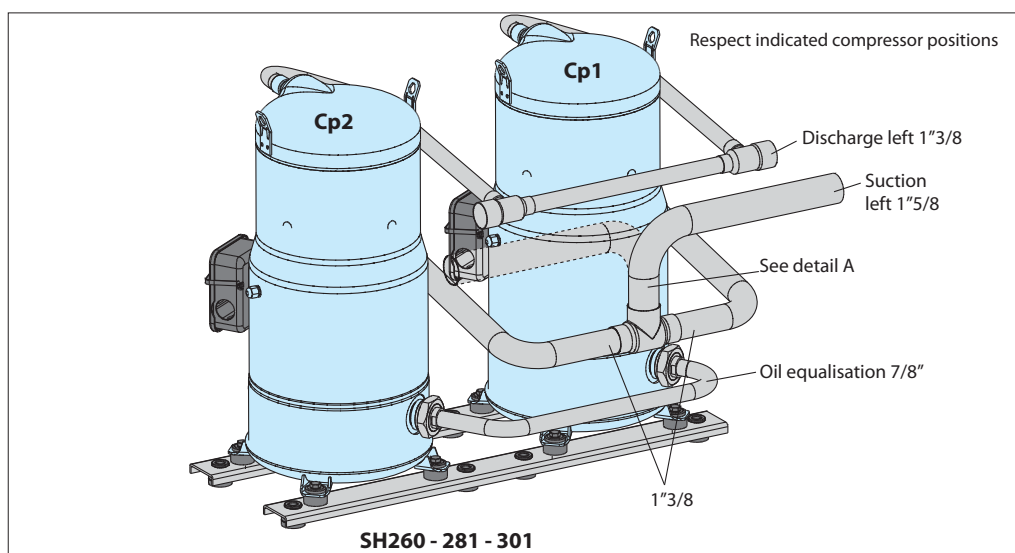
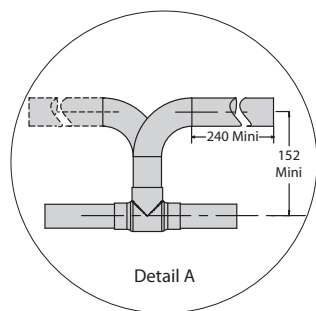
Kit code number 7777043

	Designation	Ref.	Qty.
①	Flat washer Thickness 4 mm	6301028P01	8
②	Rigid spacer Thickness 7 mm	5311629P01	12
③	Rigid spacer Thickness 14 mm	5311629P02	8
④	Equalisation sleeve 1 3/4 Rotolock - 7/8" ODF	5311144P07	2
⑤	Teflon Seal	5607001P01	2
⑥	Restrictor (black colour) Ø 25 mm int (Ø 35 mm ext)	5312497P01	1
⑦	Restrictor (black colour) Ø 24 mm int (Ø 28 mm ext)	5312497P02	1
⑧	Restrictor (copper colour) Ø 23 mm int (Ø 35 mm ext)	5312497P03	1

Composition of tandem

Tandem		SH260	SH281	SH301
Compressor 1	Model	SH120	SH120	SH140
	Code n° (1)	120H0014	120H0014	120H0202
Compressor 2	Model	SH140	SH161	SH161
	Code n° (1)	120H0202	120H0024	120H0024
Kit	Code n°	7777042		

(1): Example for the voltage code 4 (industrial pack). Refer to "code number information" part for other codes or single pack version

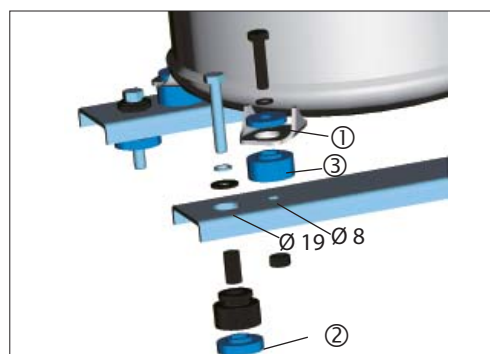


Compressor mounting

The tandem is fixed on the frame using the flexible grommets supplied with the compressor.

The compressors are fixed on the rails (not included) using the 4 mm flat washers ①, 14 mm rigid spacer ③, included in the "tandem kit" reference 7777042 (to be ordered with the compressors).

An additional 7 mm rigid spacer ② must be placed under the rail grommets (see beside drawing).

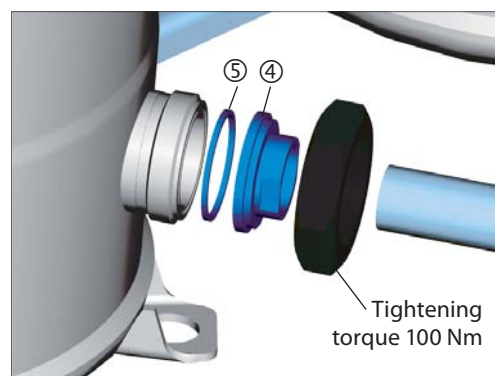


- Supplied with the compressor
- Included in 7777042 Kit
- Not supplied

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 7/8".

The kit 7777042 include 1"3/4 - 7/8" adaptor sleeves ④ & Teflon seals ⑤ to connect the 7/8" equalisation pipe on 1"3/4 oil connectors.


**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump.

**For tandem SH260:**

Two profiles proposed:

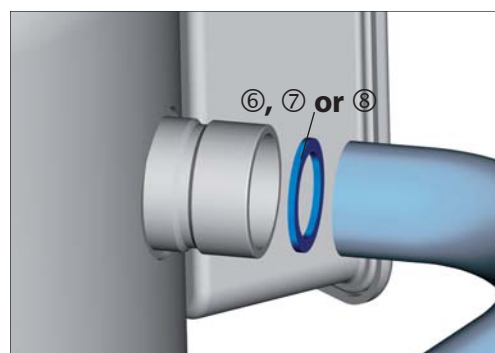
- Suction from the right: add a restrictor ⑥, at suction connection of the SH120.
- Suction from the left: no restrictor.

**For tandem SH281:**

- Suction from the left: add a restrictor ⑥, at suction connection of the SH120.
- Suction from the right: add a restrictor ⑦, at suction connection of the SH120.

**For tandem SH301:**

Suction from left or right: add restrictor ⑧ (white colour) diameter 26 mm, at suction of the compressor SH140.


**Composition of the kit**

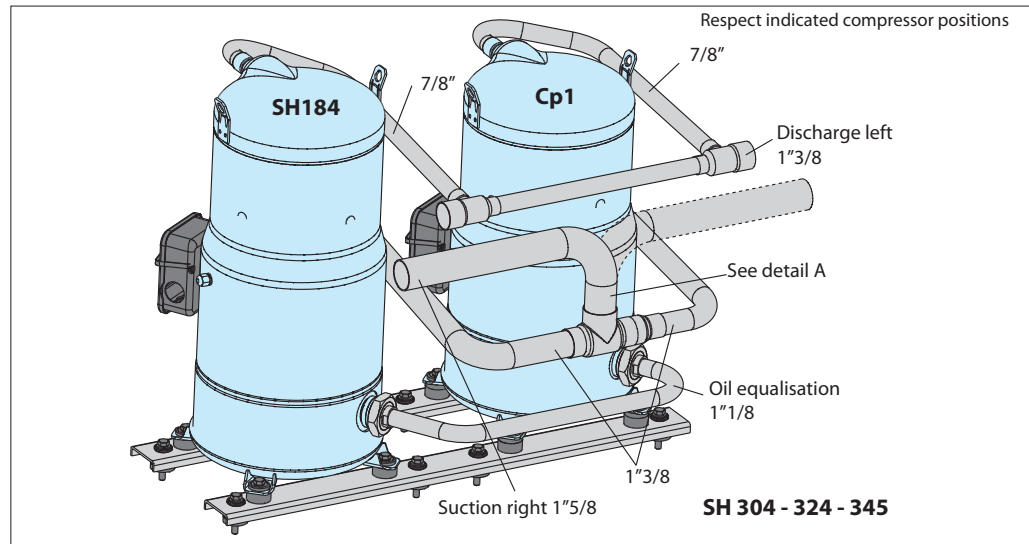
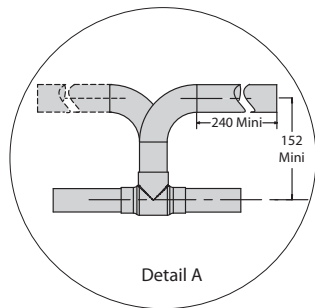
Kit code number 7777042

	Designation	Ref.	Qty.
①	Flat washer Thickness 4 mm	6301028P01	8
②	Rigid spacer Thickness 7 mm	5311629P01	8
③	Rigid spacer Thickness 14 mm	5311629P02	8
④	Equalisation sleeve 1"3/4 Rotolock - 7/8" ODF	5311144P07	2
⑤	Teflon Seal	5607001P01	2
⑥	Restrictor Ø 25 mm (black colour)	5312497P01	1
⑦	Restrictor Ø 23 mm (copper colour)	5312497P03	1
⑧	Restrictor Ø 26 mm (white colour)	5312497P05	1

Composition of tandem

Tandem		SH304	SH324	SH345
Compressor 1	Model	SH120	SH140	SH161
	Code n° (1)	120H0014	120H0202	120H0024
Compressor 2	Model	SH184	SH184	SH184
	Code n° (1)	120H0362	120H0362	120H0362
Kit	Code n°	7777052		

(1): Example for the voltage code 4 (industrial pack). Refer to "code number information" part for other codes or single pack version

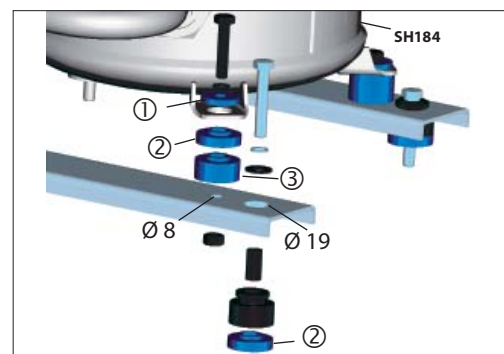
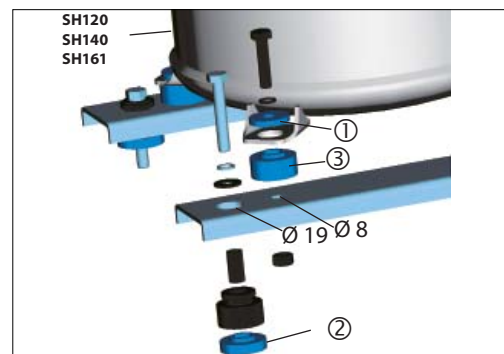


Compressor mounting

The tandem is fixed on the frame using the flexible grommets supplied with the compressor.

The compressors are fixed on the rails (not included) using the 4 mm flat washers ①, 14 mm rigid spacer ③, included in the "tandem kit" reference 7777052 (to be ordered with the compressors).

An additional 7 mm rigid spacer ② must be placed under the rail grommets (see beside drawing).



- Supplied with the compressor
- Included in 7777052 Kit
- Not supplied

Because SH120, 140 and 161 are 7 mm smaller than SH184 and in order to have the oil equalisation connection at the same level for

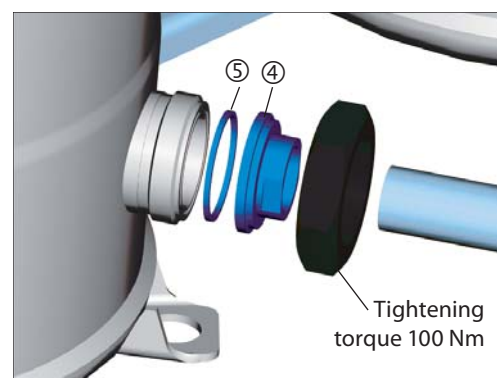
both compressors, an additional 7 mm rigid spacer ② must be added under the SH120, 140 or 161 feet.



**Oil equalisation connection**

The level of oil naturally balances by a pipe of 1"1/8.

The kit 7777052 includes 1"3/4 - 1"1/8 adaptor sleeves ④ & Teflon seals ⑤ to connect the 1"1/8 equalisation pipe on 1"3/4 oil connectors.


**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. But, this oil equalisation is also function of the configuration of the suction pipe.

**For tandem SH304:**

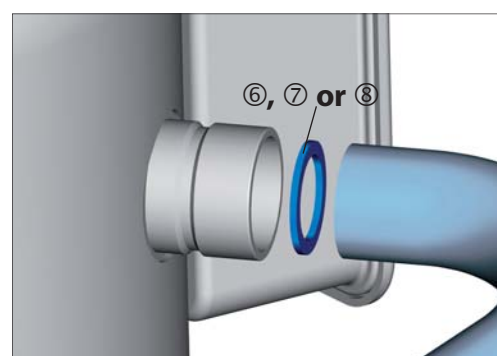
Suction from left or right, add a restrictor ⑧ (copper colour) diameter 23 mm at the suction of the compressor SH120.

**For tandem SH324:**

Suction from left or right, add a restrictor ⑦ (black colour) diameter 24 mm at the suction of the compressor SH140.

**For tandem SH345:**

Suction from left or right, add a restrictor ⑥ (white colour) diameter 26 mm at the suction of the compressor SH161.


**Composition of the kit**

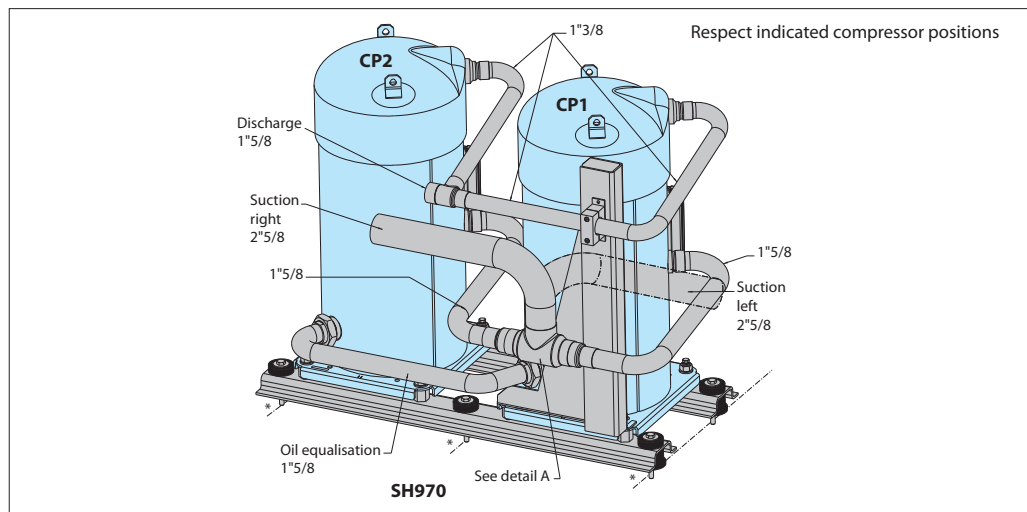
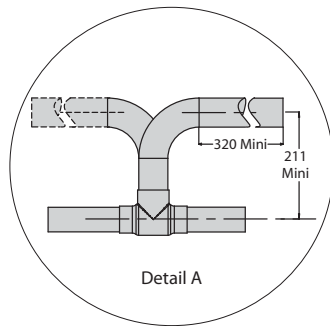
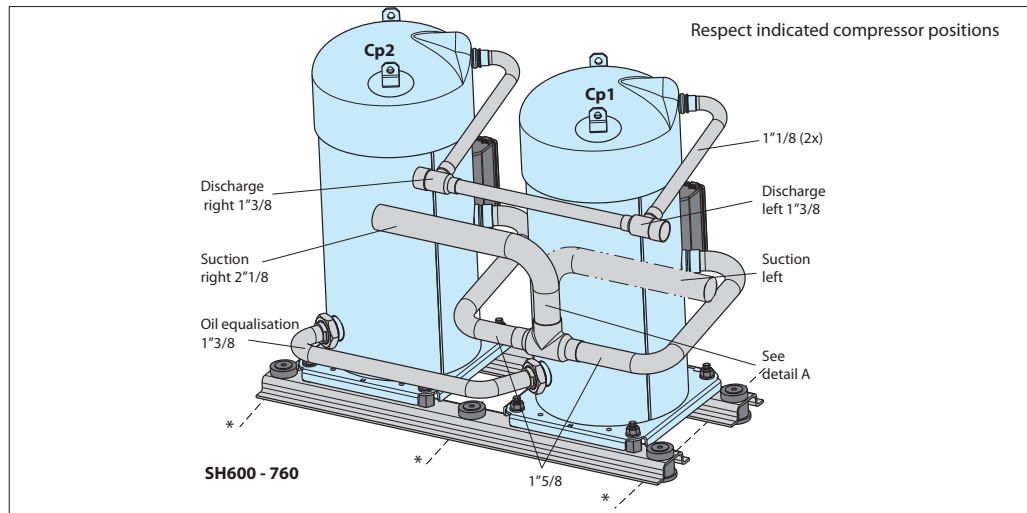
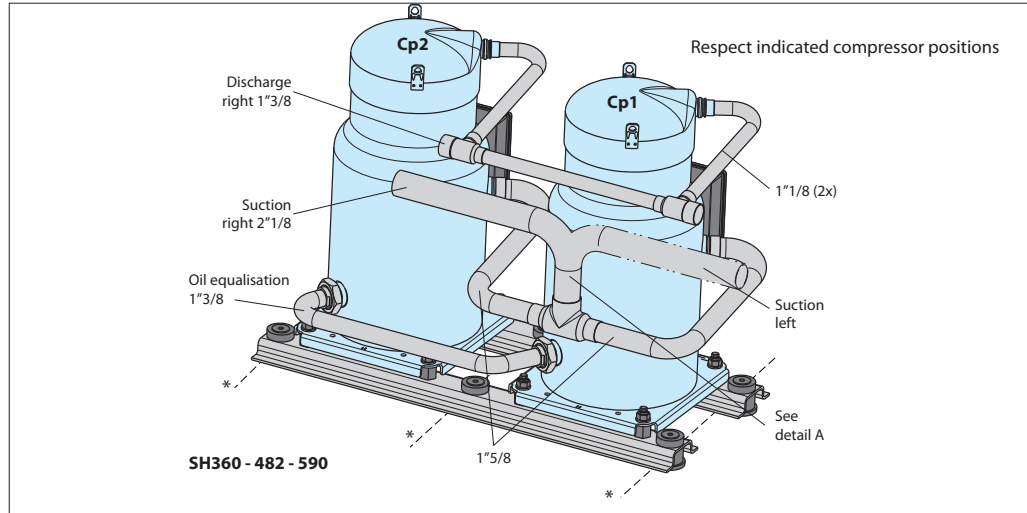
Kit code number 7777052

	Designation	Ref.	Qty.
①	Flat washer Thickness 4 mm	6301028P01	8
②	Rigid spacer Thickness 7 mm	5311629P01	12
③	Rigid spacer Thickness 14 mm	5311629P02	8
④	Equalisation sleeve 1"3/4 Rotolock - 1"1/8 ODF	5311139P02	2
⑤	Teflon Seal	5607001P01	2
⑥	Restrictor (white colour) Ø 26 mm int (Ø 35 mm ext)	5312497P05	1
⑦	Restrictor (black colour) Ø 24 mm int (Ø 35 mm ext)	5312497P06	1
⑧	Restrictor (copper colour) Ø 23 mm int (Ø 35 mm ext)	5312497P03	1

Composition of tandem

Tandem		SH360	SH482	SH590	SH600	SH760	SH970
Compressor 1	Model	SH180	SH240	SH295	SH300	SH380	SH485
	Code n° (1)	120H0276	120H0300	120H0828	120H0240	120H0256	120H1065
Compressor 2	Model	SH180	SH240	SH295	SH300	SH380	SH485
	Code n° (1)	120H0276	120H0300	120H0828	120H0240	120H0256	120H1065
Kit	Code n°	7777041					

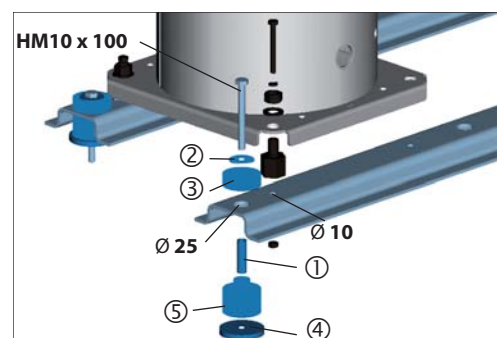
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



\*: The unit frame must include a sufficiently strong structure at these position to support tandem rails.

**Compressor mounting**

The tandem is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and the grommets ⑤, provided in the kit 7777041.



■ Supplied with the compressor or kit 120Z0495 \*

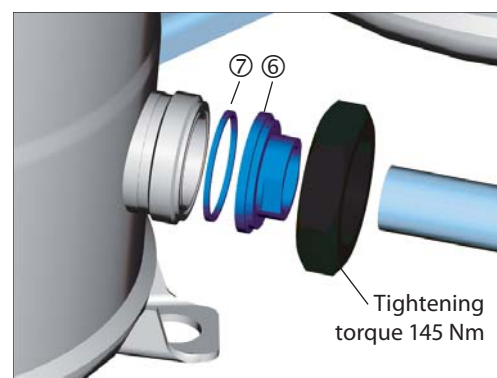
■ Included in 7777041 Kit

■ Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 1"3/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2"1/4 - 1"3/8 and Teflon seals ⑦, included in the kit 7777041 must be used.


**Composition of the kit**

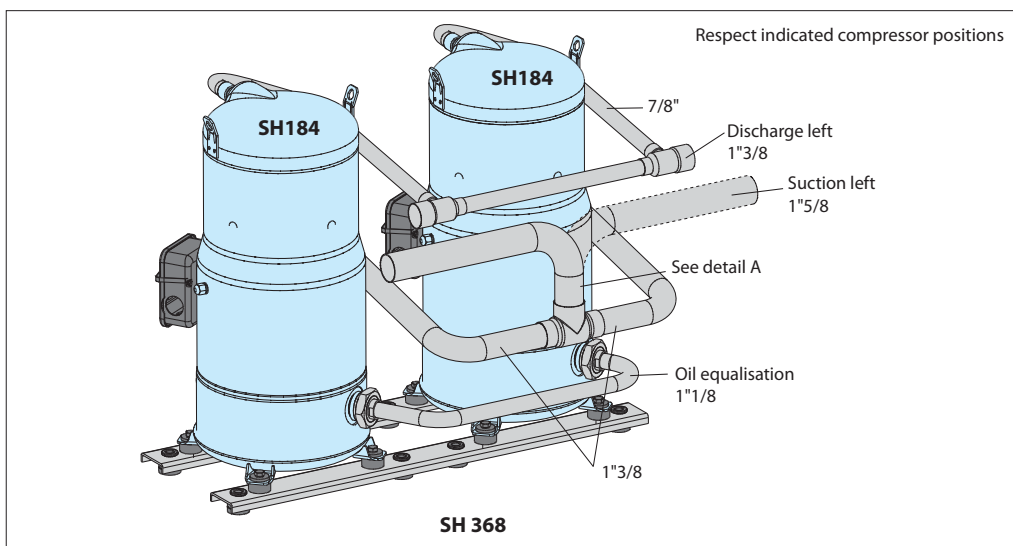
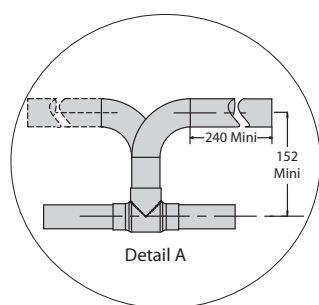
Kit code number 7777041 (Left and Right Suction)

	Designation	Ref	Qty
①	Grommet Sleeves M	X05090234P01	6
②	Flat Washers LL10Z	6301011	6
③	Washers	5603010P01	6
④	Washer for tandem / trio	5311860P01	6
⑤	Grommets	5603009P02	6
⑥	Sleeve 2"1/4 Rotolock - 1"3/8 ODF	5311145P08	2
⑦	Teflon Seal Ø 50,8 mm	5607001P04	2

Composition of tandem

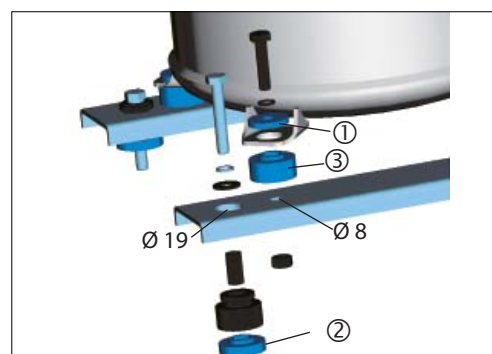
Tandem		SH368
Compressor 1	Model	SH184
	Code n° (1)	120H0362
Compressor 2	Model	SH184
	Code n° (1)	120H0362
Kit	Code n°	7777053

(1): Example for the voltage code 4 (industrial pack). Refer to "code number information" part for other codes or single pack version



Compressor mounting

The tandem rail assembly is fixed on the unit frame using the flexible grommets supplied with the compressor. The compressors are fixed on the rails (not included) using the 4 mm flat washers ①, 14 mm rigid spacer ③, included in the "tandem kit" reference 7777053 (to be ordered with the compressors). An additional 7 mm rigid spacer ② must be placed under the rail grommets (see beside drawing).

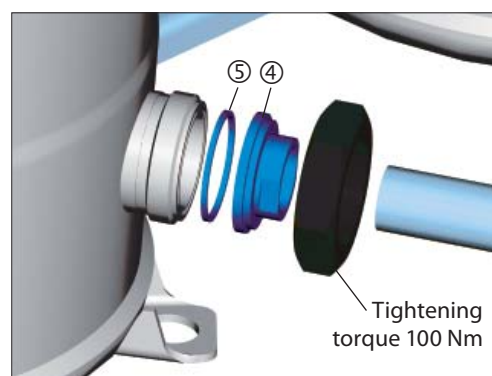


- Supplied with the compressor
- Included in 7777053 Kit
- Not supplied

Oil equalisation connection

The level of oil naturally balances by a pipe of 1"1/8.

The kit 7777053 includes 1"3/4 - 1"1/8 adaptor sleeves ④ and new Teflon seals ⑤ to connect the 1"1/8 equalisation pipe on 1"3/4 oil connectors.



**Composition of the kit**

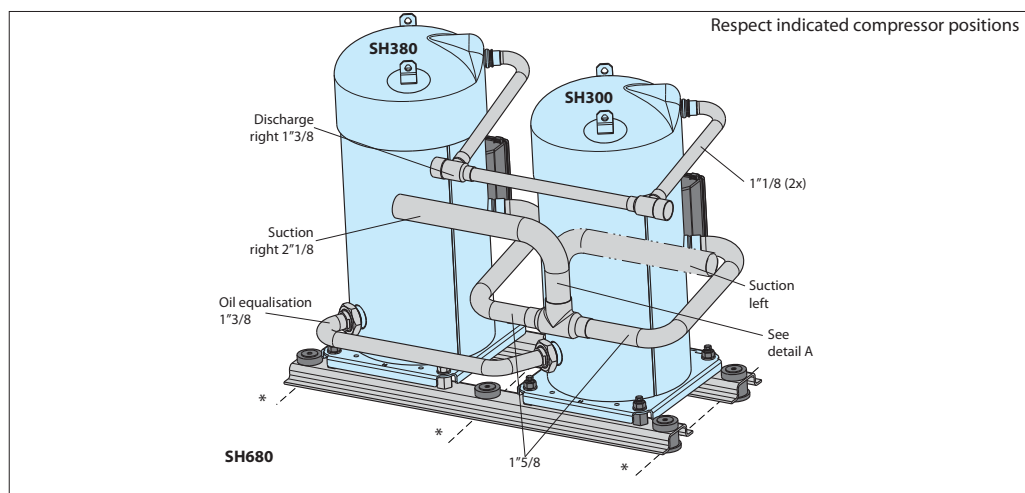
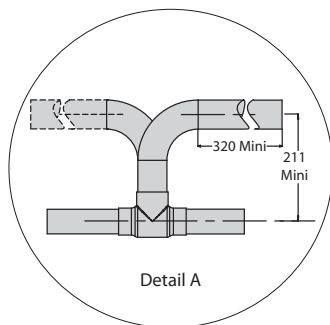
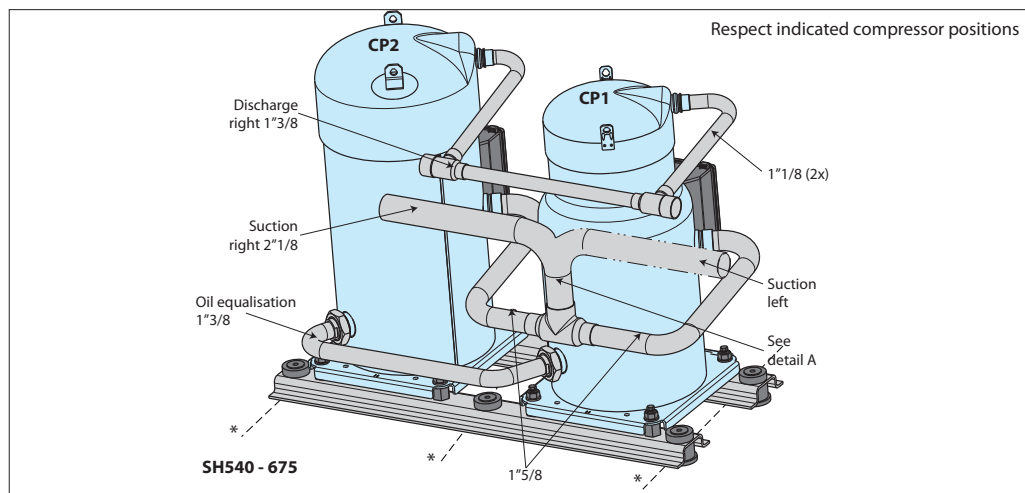
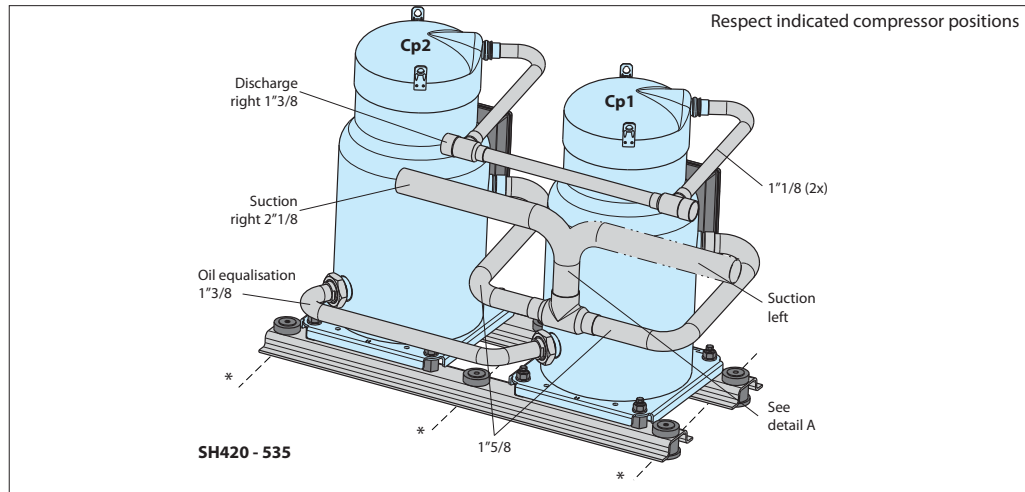
Kit code number 7777053

	Designation	Ref.	Qty.
①	Flat washer Thickness 4 mm	6301028P01	8
②	Rigid spacer Thickness 7 mm	5311629P01	8
③	Rigid spacer Thickness 14 mm	5311629P02	8
④	Equalisation sleeve 1" 3/4 Rotolock - 1"1/8 ODF	5311139P02	2
⑤	Teflon Seal	5607001P01	2

Composition of tandem

Tandem		SH420	SH535	SH540	SH675	SH680
Compressor 1	Model	SH180	SH240	SH240	SH295	SH300
	Code n° (1)	120H0276	120H0300	120H0300	120H0828	120H0240
Compressor 2	Model	SH240	SH295	SH300	SH380	SH380
	Code n° (1)	120H0300	120H0828	120H0240	120H0256	120H0256
Kit	Code n°	7777037				

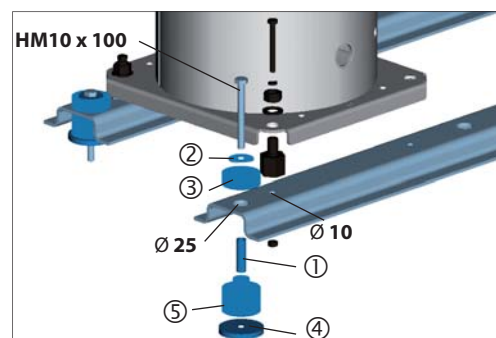
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



\*: The unit frame must include a sufficiently strong structure at these position to support tandem rails.

**Compressor mounting**

The tandem is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and the grommets ⑤, provided in the kit 7777037.



■ Supplied with the compressor or kit 120Z0495 \*

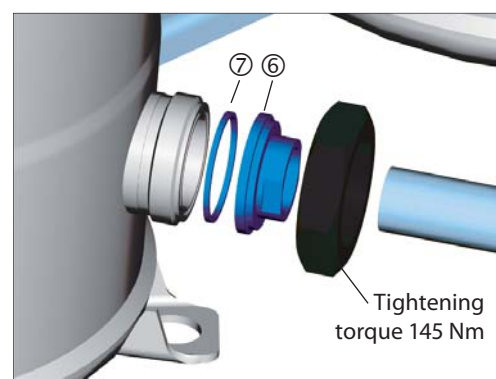
■ Included in 7777037 Kit

■ Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 1"3/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2"1/4 - 1"3/8 and Teflon seals ⑦, included in the kit 7777037 must be used.



Tightening torque 145 Nm

**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. Hence, a restrictor ⑧ must be added on suction connection of the smallest compressor:

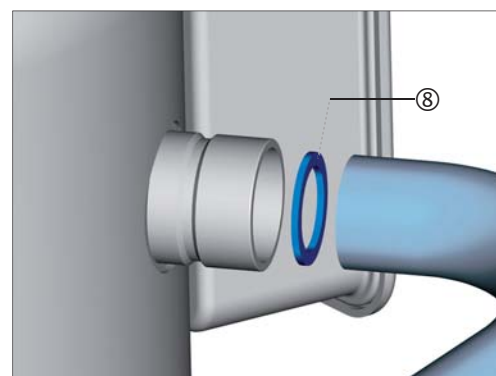
**For SH420 tandem:** on the suction of the compressor SH180.

**For SH535 tandem:** on the suction of the compressor SH240.

**For SH540 tandem:** on the suction of the compressor SH240.

**For SH675 tandem:** on the suction of the compressor SH295.

**For SH680 tandem:** on the suction of the compressor SH300.


**Composition of the kit**

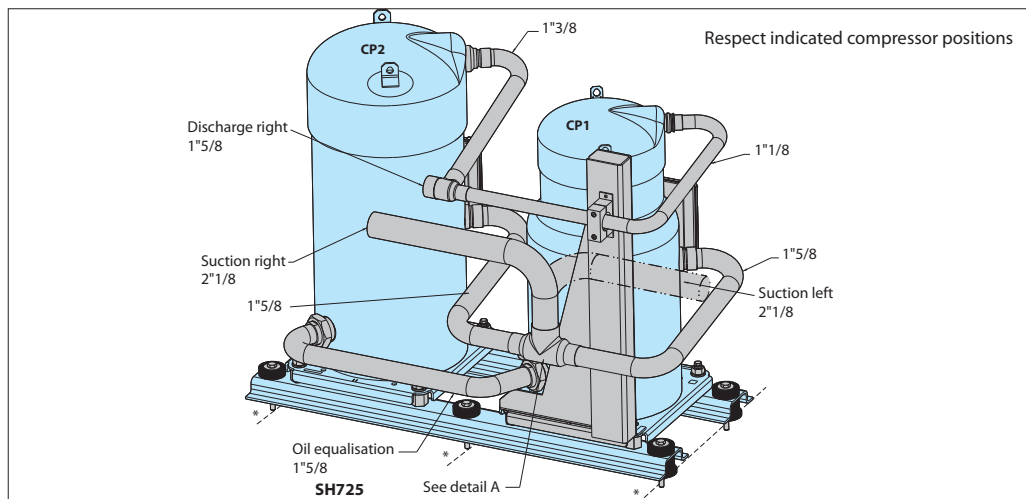
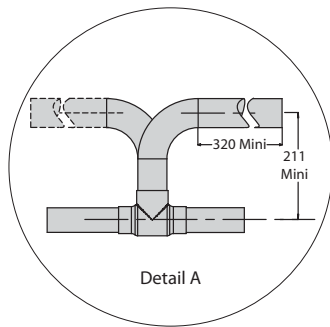
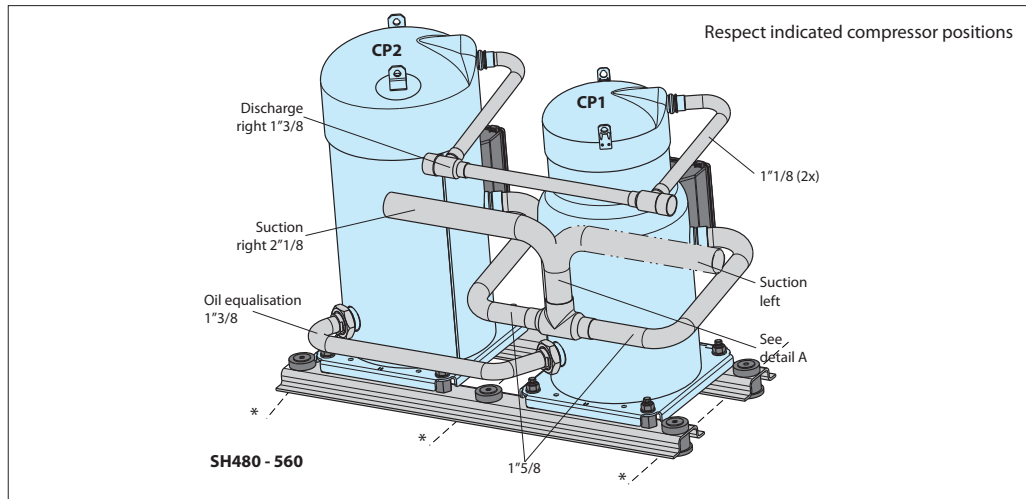
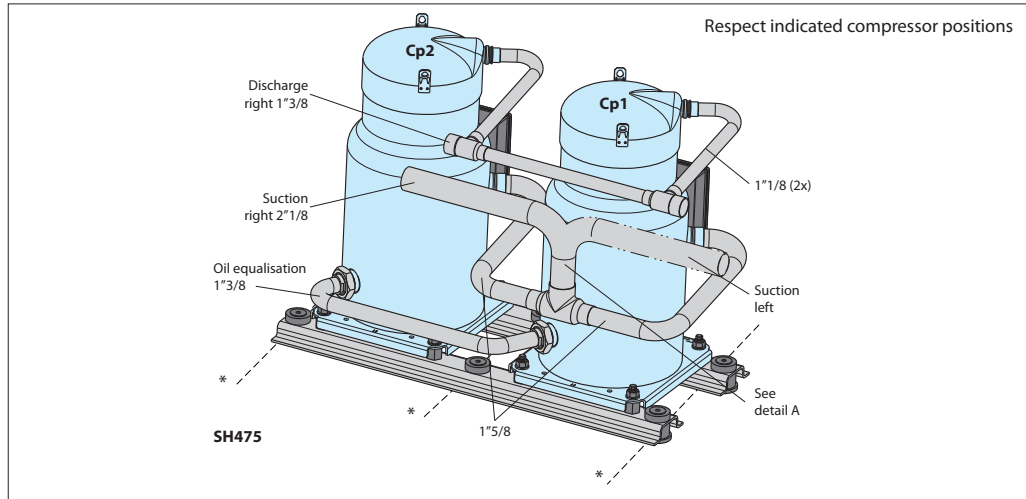
Kit code number 7777037 (Left and Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	6
②	Flat Washers LL10Z	6301011	6
③	Washers	5603010P01	6
④	Washer for tandem / trio	5311860P01	6
⑤	Grommets	5603009P02	6
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"3/8 ODF	5311145P08	2
⑦	Teflon Seals Ø 50.8 mm	5607001P04	2
⑧	Suction Restrictor Ø 31 mm	5311579P01	1

Composition of tandem

Tandem		SH475	SH480	SH560	SH725
Compressor 1	Model	SH180	SH180	SH180	SH240
	Code n° (1)	120H0276	120H0276	120H0276	120H0300
Compressor 2	Model	SH295	SH300	SH380	SH485
	Code n° (1)	120H0828	120H0240	120H0256	120H1065
Kit	Code n°	7777038			

(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version

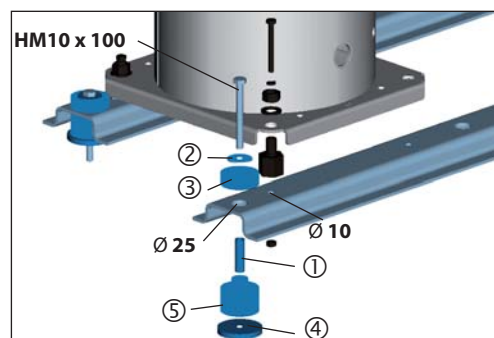


\*: The unit frame must include a sufficiently strong structure at these position to support tandem rails.



**Compressor mounting**

The tandem is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and the grommets ⑤, provided in the kit 7777038.

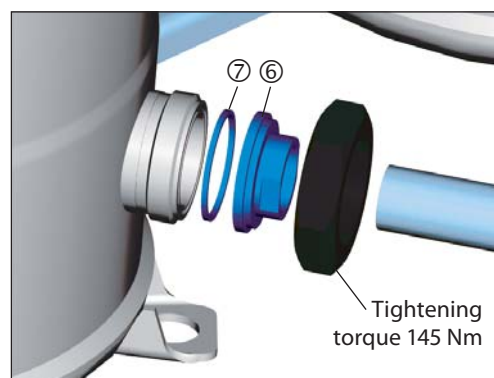


- Supplied with the compressor or kit 120Z0495 \*
- Included in 7777038 Kit
- Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

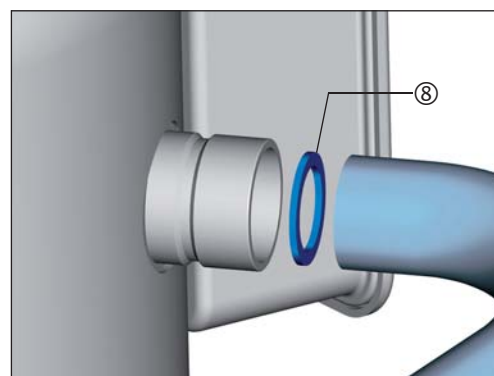
**Oil equalisation connection**

The level of oil naturally balances by a pipe of 1"3/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2"1/4 - 1"3/8 and Teflon seal ⑦, included in the kit 7777038 must be used.


**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. Hence, a restrictor ⑧ must be added on the suction of the smallest compressor:

- for tandem SH475-480-560: on the suction of the compressor SH180
- for tandem SH725: on the suction of the SH240.


**Composition of the kit**

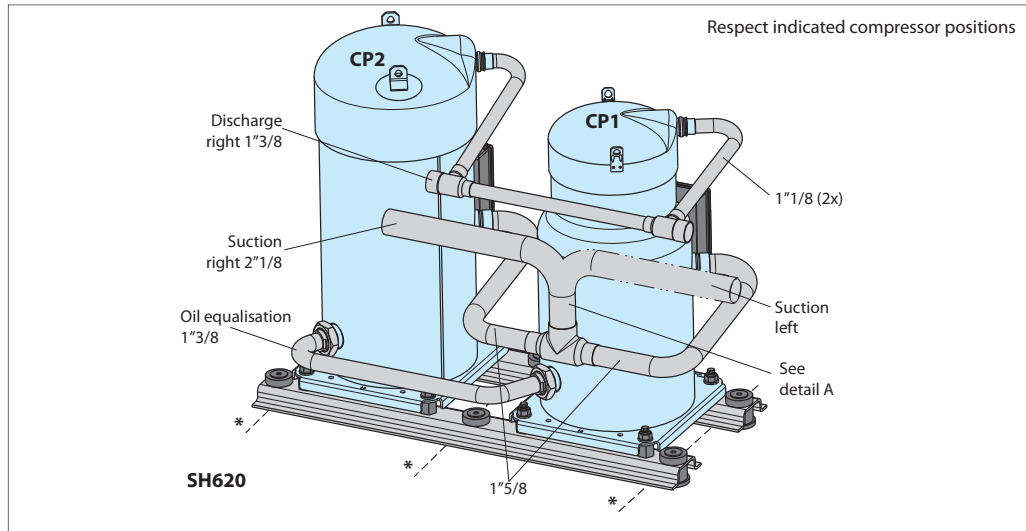
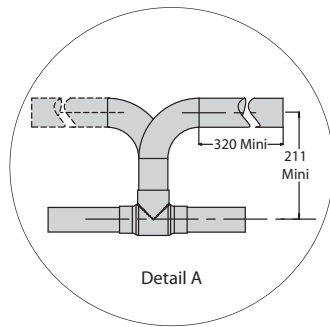
Kit code number 7777038 (Left and Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	6
②	Flat Washers LL10Z	6301011	6
③	Washers	5603010P01	6
④	Washer for tandem / trio	5311860P01	6
⑤	Grommets	5603009P02	6
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"3/8 ODF	5311145P08	2
⑦	Teflon Seals Ø 50.8 mm	5607001P04	2
⑧	Suction Restrictor Ø 26 mm	5311579P04	1

Composition of tandem

Tandem		SH620
Compressor 1	Model	SH240
	Code n° (1)	120H0300
Compressor 2	Model	SH380
	Code n° (1)	120H0256
Kit	Code n°	7777048

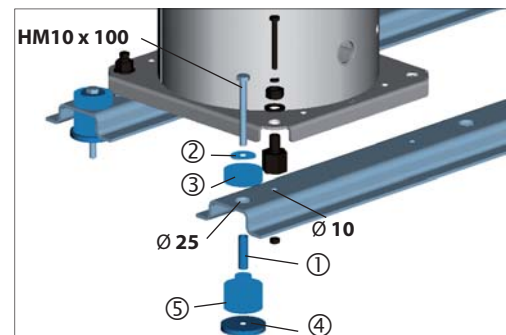
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



\* : The unit frame must include a sufficiently strong structure at these position to support tandem rails.

Compressor mounting

The tandem is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and the grommets ⑤, provided in the kit 7777048.



■ Supplied with the compressor or kit 120Z0495 \*

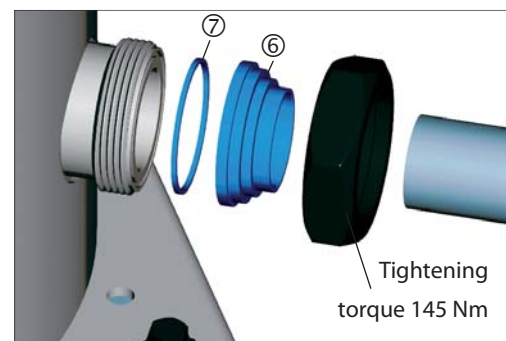
■ Included in 7777048 Kit

■ Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

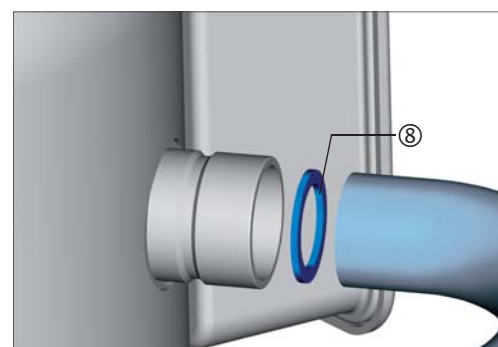
Oil equalisation connection

The level of oil naturally balances by a pipe of 1 3/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2 1/4 - 1 3/8 and Teflon seals ⑦, included in the kit 7777048 must be used.



**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. Hence, a restrictor ⑧ must be added on the suction of the compressor SH240.


**Composition of the kit**

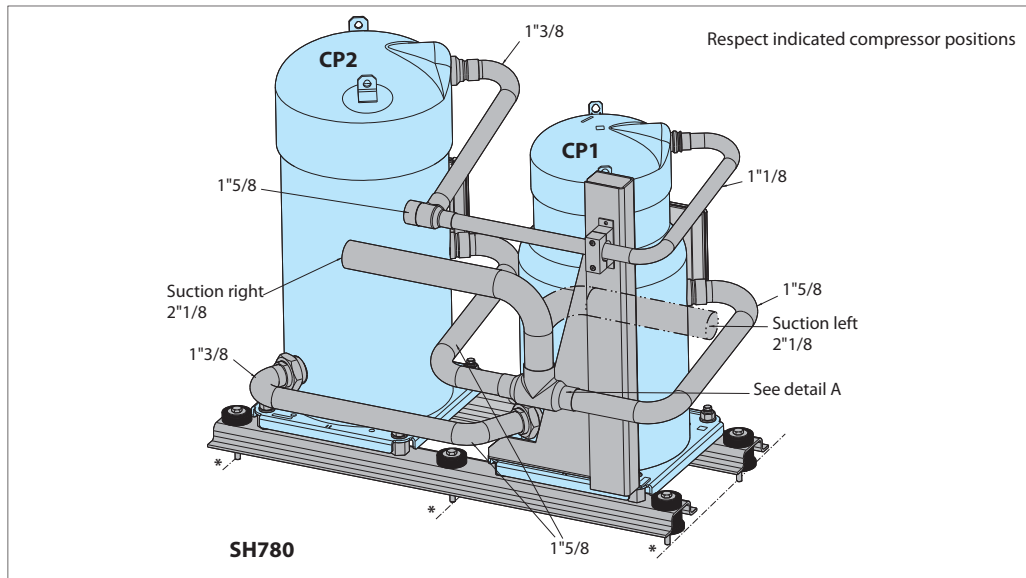
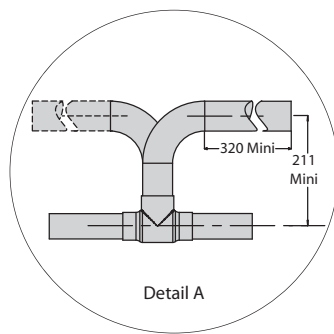
Kit code number 7777048 (Left and Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	6
②	Flat Washers LL10Z	6301011	6
③	Washers	5603010P01	6
④	Washer for tandem / trio	5311860P01	6
⑤	Grommets	5603009P02	6
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"3/8 ODF	5311145P08	2
⑦	Teflon Seals Ø 50.8 mm	5607001P04	2
⑧	Suction Restrictor Ø 29 mm	5311579P05	1

Composition of tandem

Tandem		SH780
Compressor 1	Model	SH295
	Code n° (1)	120H0828
Compressor 2	Model	SH485
	Code n° (1)	120H1065
Kit	Code n°	120Z0551

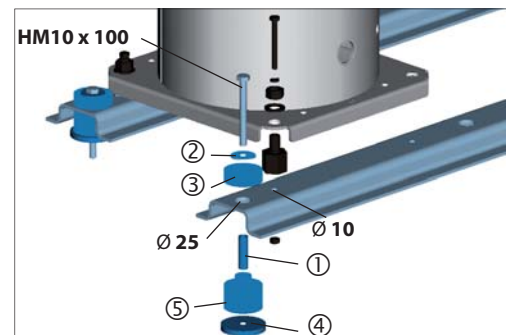
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



\*: The unit frame must include a sufficiently strong structure at these position to support tandem rails.

Compressor mounting

The tandem is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and the grommets ⑤, provided in the kit 120Z0551.



■ Supplied with the compressor or kit 120Z0495 \*

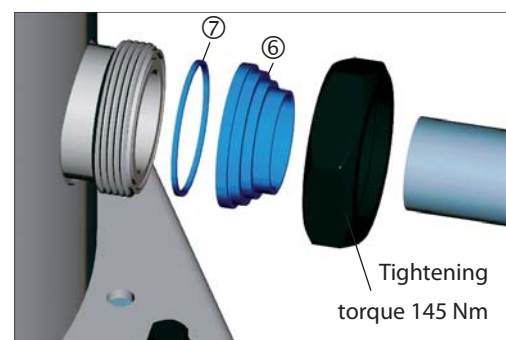
■ Included in 120Z0551 Kit

■ Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

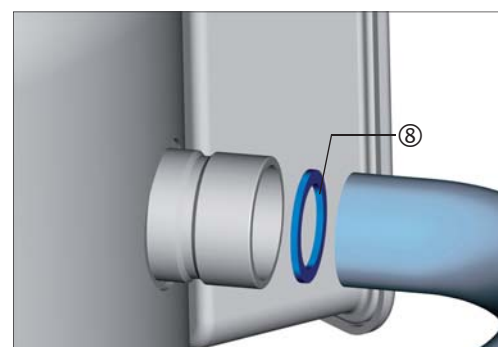
Oil equalisation connection

The level of oil naturally balances by a pipe of 1 3/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2 1/4 - 1 3/8 and Teflon seals ⑦, included in the kit 120Z0551 must be used.



**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. Hence, a restrictor ⑧ must be added on the suction of the compressor SH295.


**Composition of the kit**

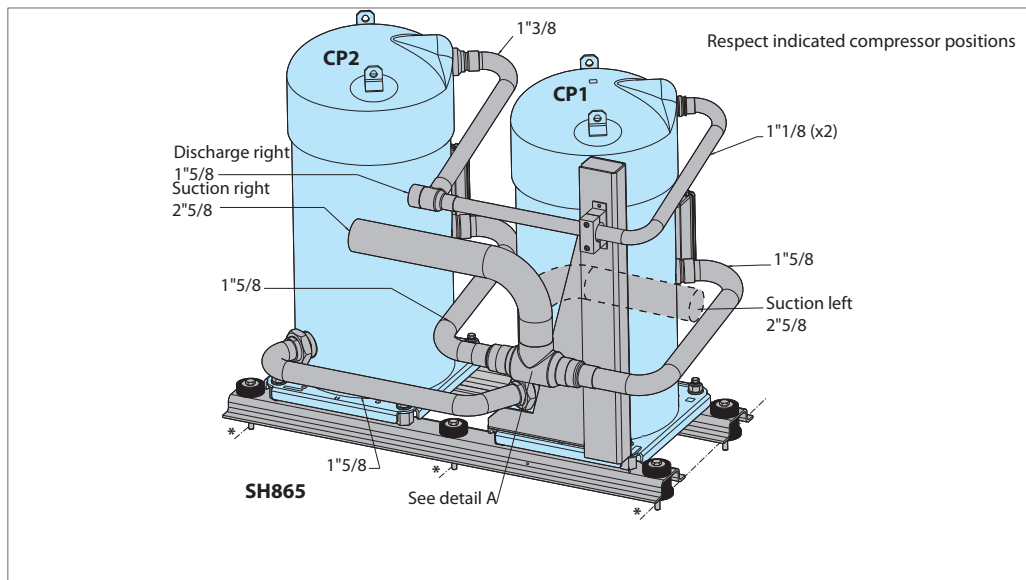
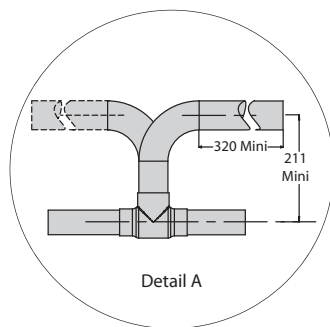
Kit code number 120Z0551 (Left and Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	6
②	Flat Washers LL10Z	6301011	6
③	Washers	5603010P01	6
④	Washer for tandem / trio	5311860P01	6
⑤	Grommets	5603009P02	6
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"3/8 ODF	5311145P08	2
⑦	Teflon Seals Ø 50.8 mm	5607001P04	2
⑧	Suction Restrictor Ø 27 mm	5311579P07	1

Composition of tandem

Tandem		SH865
Compressor 1	Model	SH380
	Code n° (1)	120H0256
Compressor 2	Model	SH485
	Code n° (1)	120H1065
Kit	Code n°	120Z0550

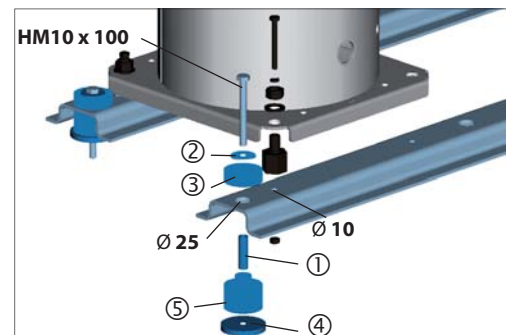
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



\*: The unit frame must include a sufficiently strong structure at these position to support tandem rails.

Compressor mounting

The tandem is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and the grommets ⑤, provided in the kit 120Z0550.

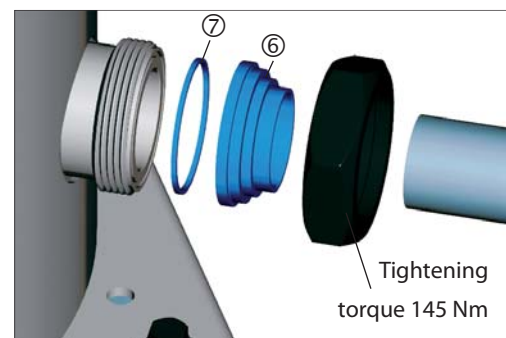


- Supplied with the compressor or kit 120Z0495 \*
- Included in 120Z0550 Kit
- Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

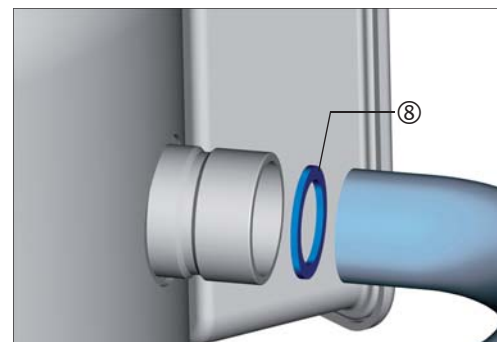
Oil equalisation connection

The level of oil naturally balances by a pipe of 1 3/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2 1/4 - 1 3/8 and Teflon seals ⑦, included in the kit 120Z0550 must be used.



**Suction washer**

Due to the difference of capacities of the compressors, it is essential to equalise the pressure of the sump. Hence, a restrictor ⑧ must be added on the suction of the compressor SH380


**Composition of the kit**

Kit code number 120Z0550 (Left and Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	6
②	Flat Washers LL10Z	6301011	6
③	Washers	5603010P01	6
④	Washer for tandem / trio	5311860P01	6
⑤	Grommets	5603009P02	6
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"3/8 ODF	5311145P08	2
⑦	Teflon Seals Ø 50.8 mm	5607001P04	2
⑧	Suction Restrictor Ø 30 mm	5311579P08	1

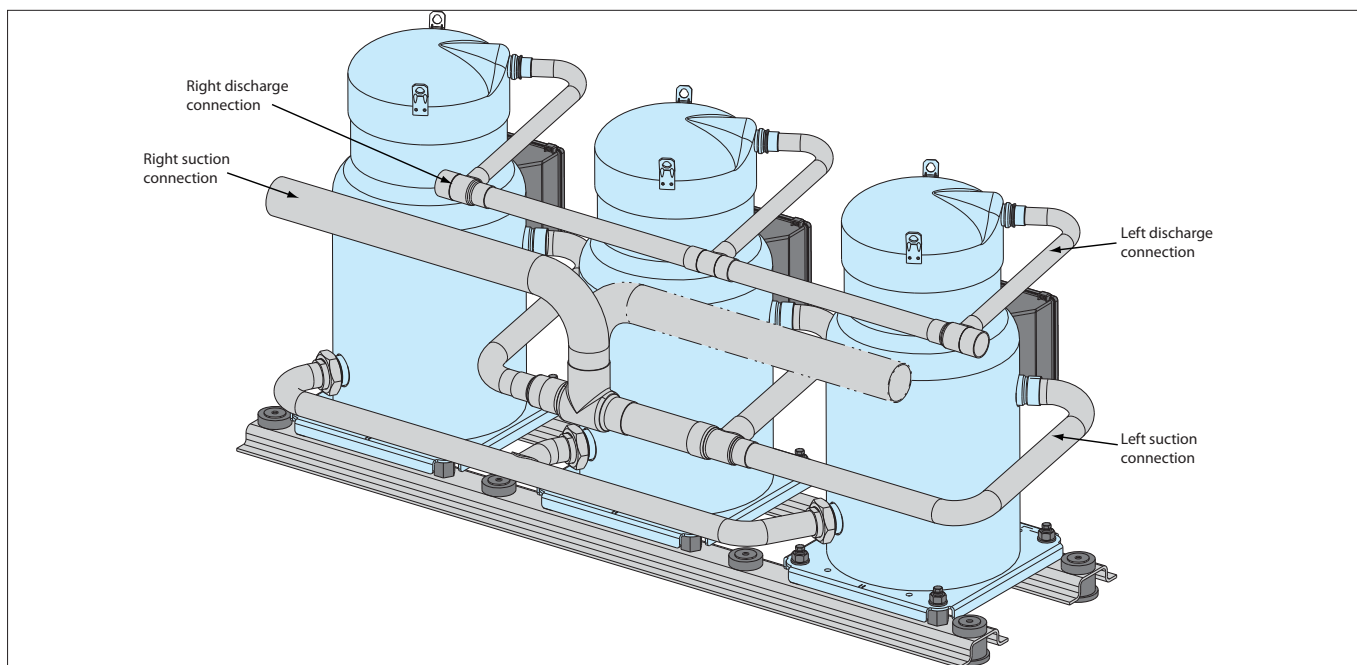




**Operation principle**

SH550 to SH1455 trio use the static system to balance the oil level between the compressors. Each of the compressors may run alone to provide proper capacity for part load operation. The system has been designed to ensure a

precise pressure balancing between the sumps, facilitating the oil equalisation by gravity. The discharge line is shown with three tees, to indicate that both left and right side discharge header are possible.



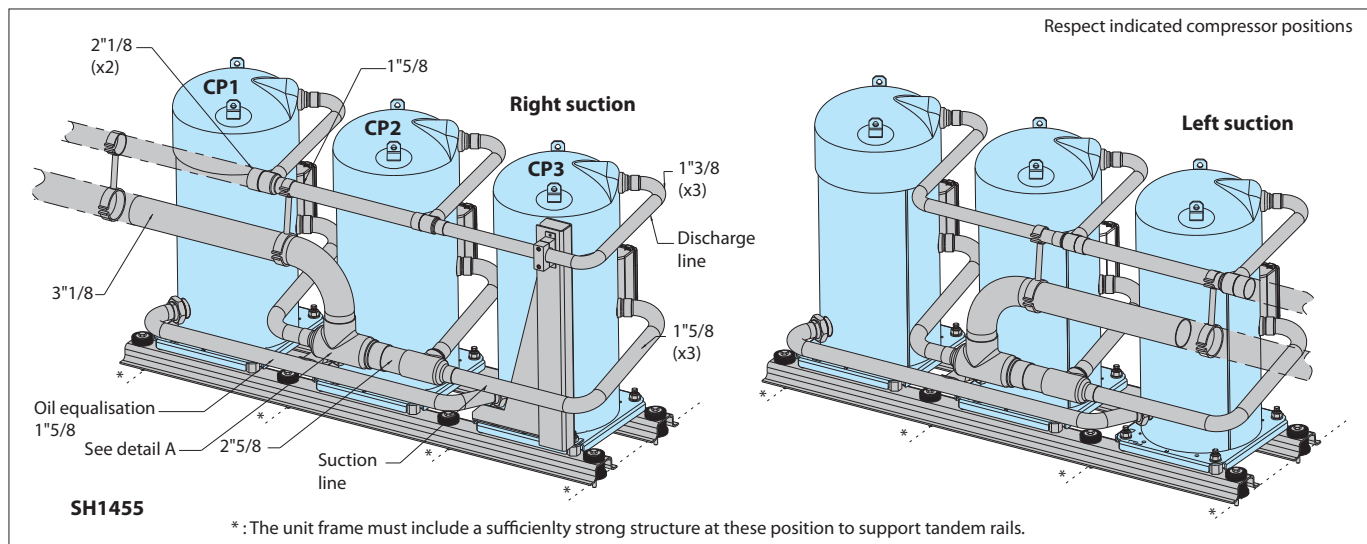
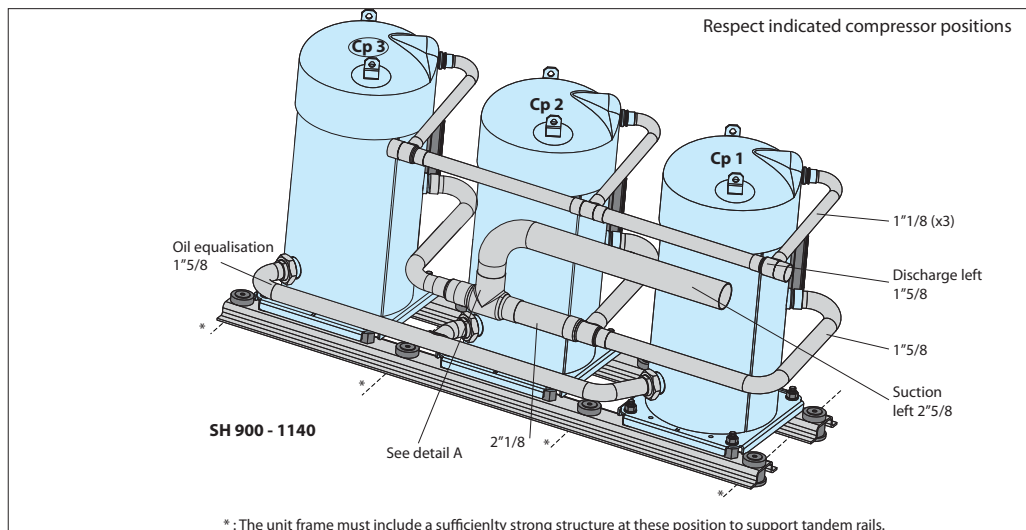
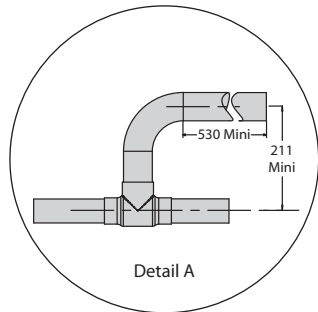
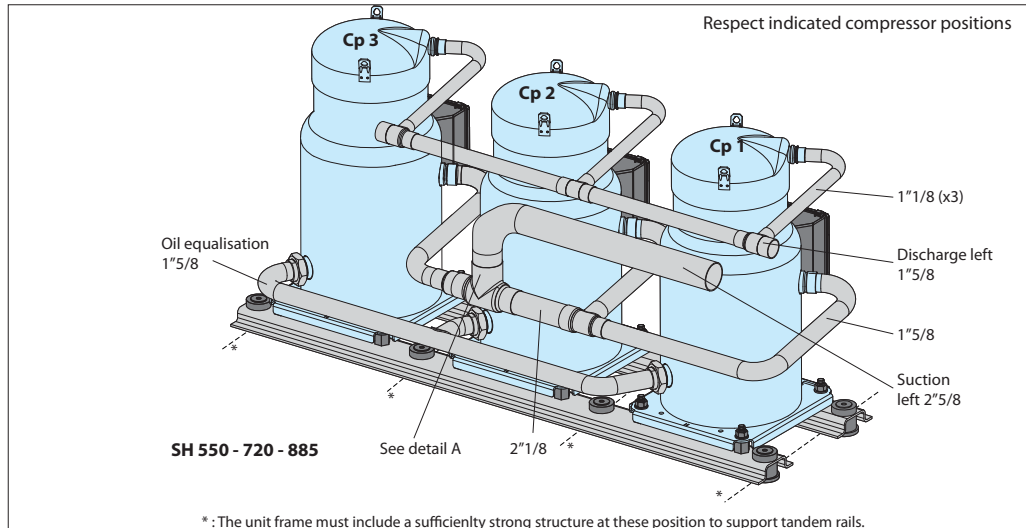
Trio model	Composition	Suction	Discharge	Kit Trio Code no	Trio drawing number
SH550	3 x SH180	2"5/8	1"5/8	7777040* 7777039**	8556118
SH720	3 x SH240	2"5/8	1"5/8	7777040* 7777039**	8556118
SH885	3 x SH295	2"5/8	1"5/8	7777040* 7777039**	8556118
SH900	3 x SH300	2"5/8	1"5/8	7777040* 7777039**	8556119
SH1140	3 x SH380	2"5/8	1"5/8	7777040* 7777049**	8556120
SH1455	3 x SH485	3"1/8	2"1/8	7777040	8556138

\* Left suction connection  
 \*\* Right suction connection

Composition of trio

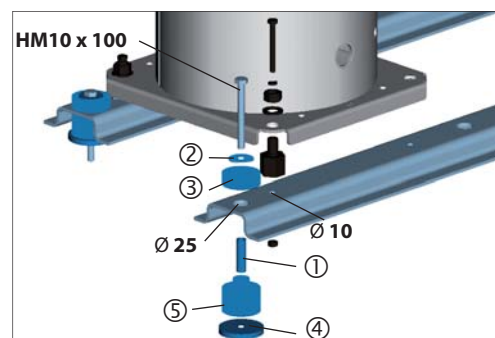
Trio		SH550	SH720	SH885	SH900	SH1140	SH1455
3 identical compressors	Model	SH180	SH240	SH295	SH300	SH380	SH485
	Code n° (1)	120H0276	120H0300	120H0828	120H0240	120H0256	120H1065
Kit	Code n°	7777040					

(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



**Compressor mounting**

The Trio is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and grommets ⑤, provided in the kit 7777040.

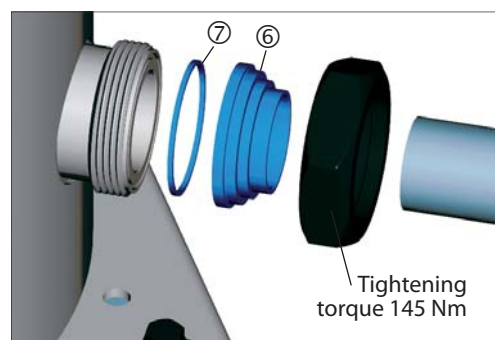


- Supplied with the compressor or kit 120Z0495 \*
- Included in 7777040 Kit
- Not supplied

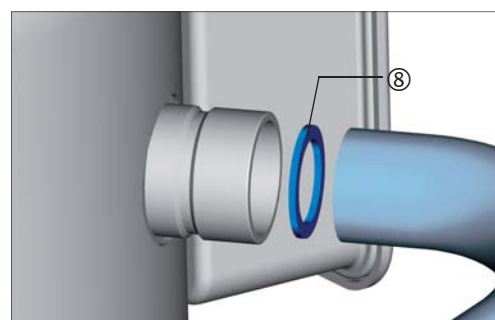
\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 1"5/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2"1/4 - 1"5/8 and Teflon seals ⑦, included in the kit 7777040 must be used.


**Suction washer**

One suction washer ⑧ must be placed in **compressors number 3** of trio SH550, 720, 885, 900 and 1140, **compressor number 2 and number 3** of trio 1455.


**Composition of the kit**

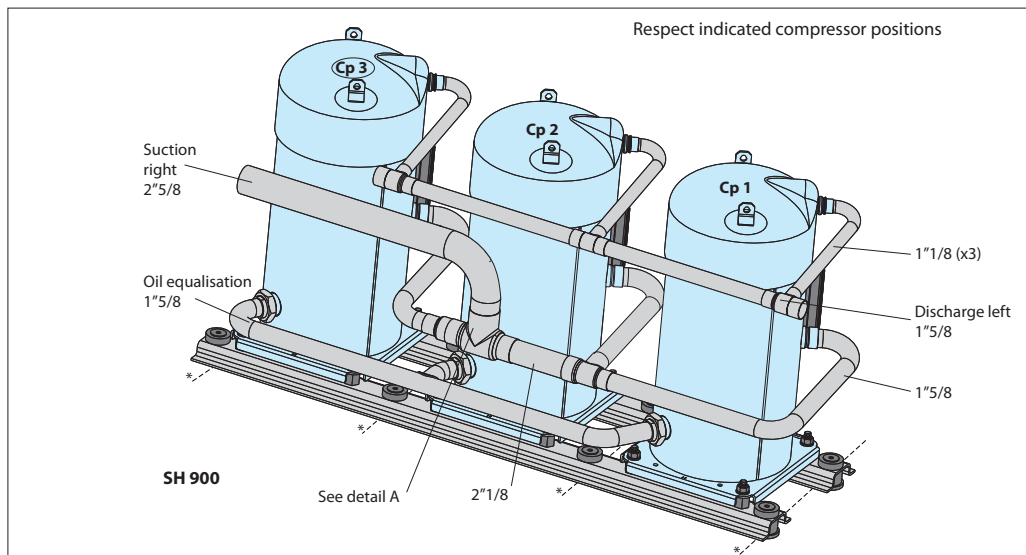
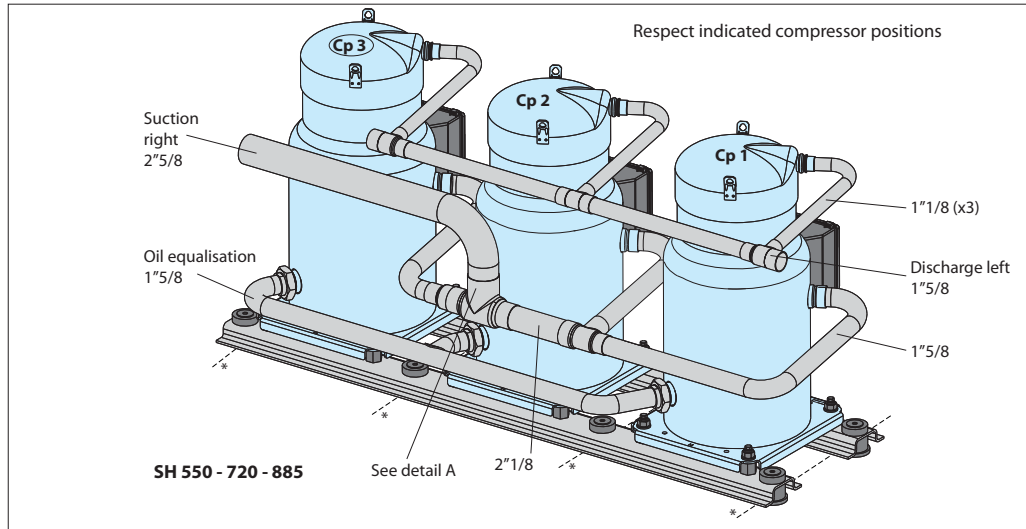
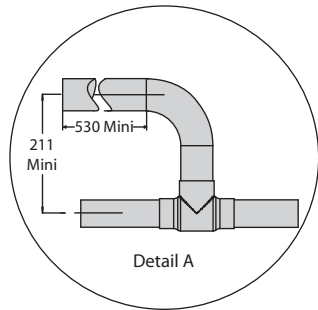
Kit code number 7777040 (Left Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	8
②	Flat Washers LL1 0Z	6301030P03	8
③	Washers	5603010P01	8
④	Washer for tandem / trio	5311860P01	8
⑤	Grommets	5603009P02	8
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"5/8 ODF	5311140P03	3
⑦	Teflon Seals Ø 50.8 mm	5607001P04	3
⑧	Suction Washer Ø 33 mm	5311579P02	2

Composition of trio

Trio		SH550	SH720	SH885	SH900
3 identical compressors	Model	SH180	SH240	SH295	SH300
	Code n° (1)	120H0276	120H0300	120H0828	120H0240
Kit	Code n°	7777039			

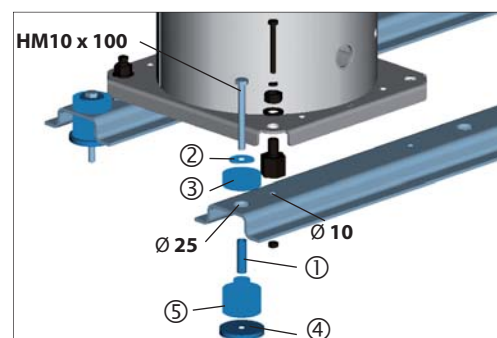
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180)). Refer to "code number information" part for other codes, other motor protection or single pack version



\*: The unit frame must include a sufficiently strong structure at these position to support tandem rails.

**Compressor mounting**

The Trio is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ & ④ and grommets ⑤, provided in the kit 7777039.

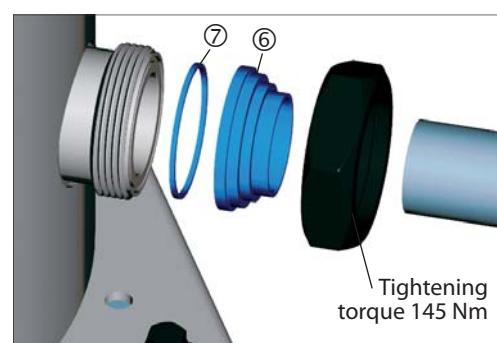


- Supplied with the compressor or kit 120Z0495 \*
- Included in 7777039 Kit
- Not supplied

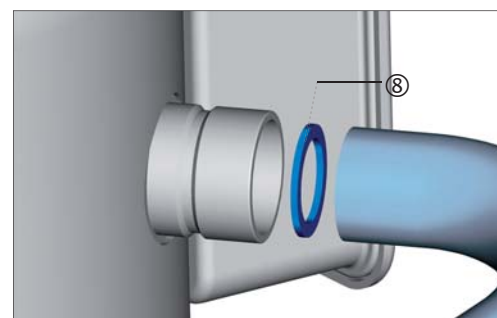
\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

**Oil equalisation connection**

The level of oil naturally balances by a pipe of 1"5/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2"1/4 - 1"5/8 and Teflon seals ⑦, included in the kit 7777039 must be used.


**Suction washer**

One suction washer ⑧ must be placed in **compressors number 1 and number 3** of trio SH550, 720, 885 and 900


**Composition of the kit**

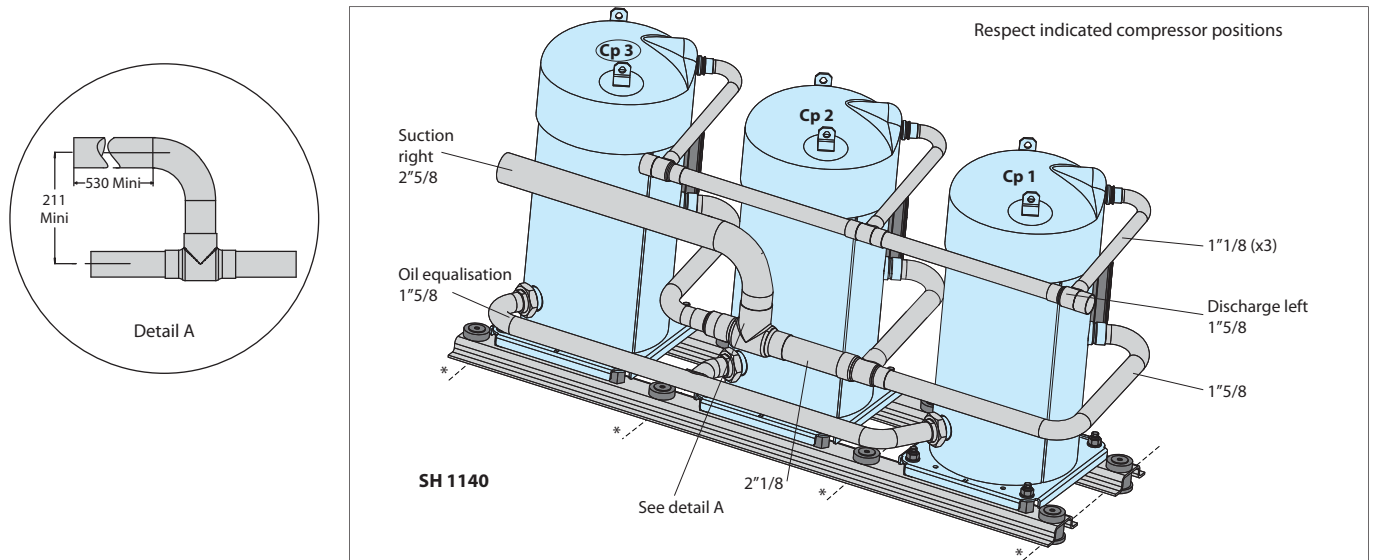
Kit code number 7777039 (Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	8
②	Flat Washers LL10Z	6301030P03	8
③	Washers	5603010P01	8
④	Washer for tandem / trio	5311860P01	8
⑤	Grommets	5603009P02	8
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"5/8 ODF	5311140P03	3
⑦	Teflon Seals Ø 50.8 mm	5607001P04	3
⑧	Suction Washer Ø 34.5 mm	5311579P03	2

Composition of trio

	Trio	SH1140
3 identical compressors	Model	SH380
	Code n° (1)	120H0256
Kit	Code n°	7777049

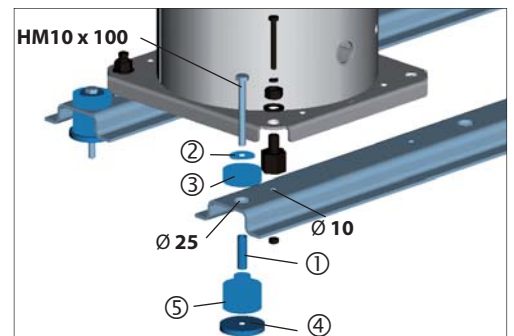
(1): Example for the voltage code 4 (Industrial pack and motor protection M115-230 (M230 for SH180). Refer to "code number information" part for other codes, other motor protection or single pack version



\* : The unit frame must include a sufficiently strong structure at these position to support tandem rails.

Compressor mounting

The trio is fixed on the frame by using grommet sleeves ①, flat washers ②, washers ③ and ④ and grommets ⑤, provided in the kit 7777049.

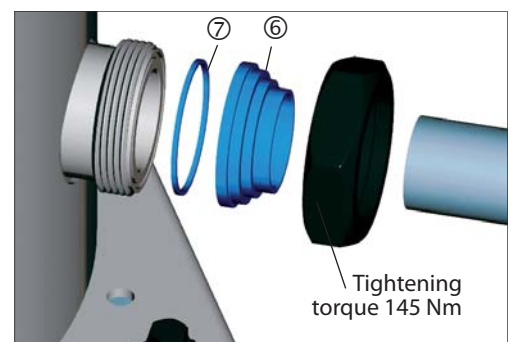


- Supplied with the compressor or kit 120Z0495 \*
- Included in 7777049 Kit
- Not supplied

\* for 60Hz applications, it is recommended to replace hexagonal rigid spacers delivered with compressor by triangle rigid spacers available in kit 120Z0495

Oil equalisation connection

The level of oil naturally balances by a pipe of 1"5/8. To fix this oil connection equalisation rotolock, the adaptor sleeves ⑥: 2"1/4 - 1"5/8 and Teflon seals ⑦, included in the kit 7777049 must be used.



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**Application Guidelines**      **Trio units SH1140 right suction**


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**Suction washer**                      No suction washer required for this trio.

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**Composition of the kit**                      Kit code number 7777049 (Right Suction)

	Designation	Ref.	Qty.
①	Grommet Sleeves M	X05090234P01	8
②	Flat Washers LL10Z	6301030P03	8
③	Washers	5603010P01	8
④	Washer for tandem / trio	5311860P01	8
⑤	Grommets	5603009P02	8
⑥	Adaptor Sleeves 2"1/4 Rotolock - 1"5/8 ODF	5311140P03	3
⑦	Teflon Seals Ø 50.8 mm	5607001P04	3

**Tandem models**

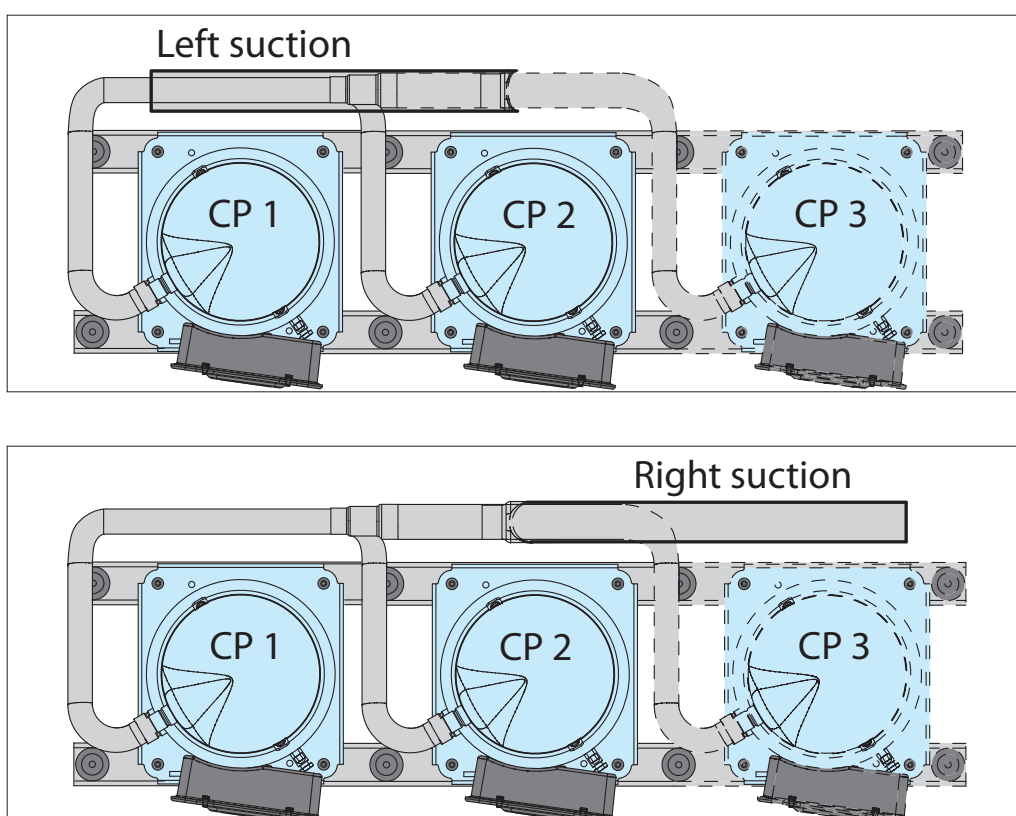
CP1		CP2		Tandem model	Suction from	Kit code n° to order	Washer reference	Washer Ø (mm)	Washer in suction of
SH090	+	SH090	=	SH182	Left Right	7777044		Not needed	
SH090	+	SH105	=	SH195	Left Right	7777043	5312497P03 5312497P03	23 23	CP2 CP2
SH090	+	SH120	=	SH210	Left Right	7777043	5312497P01 5312497P02	25 24	CP2 CP1
SH105	+	SH105	=	SH212	Left Right	7777044		Not needed	
SH090	+	SH140	=	SH230	Left Right	7777043		Not needed	
SH120	+	SH120	=	SH242	Left Right	7777044		Not needed	
SH120	+	SH140	=	SH260	Left Right	7777042		Not needed	
SH120	+	SH161	=	SH281	Left Right	7777042	5312497P01 5312497P03	25 23	CP1 CP1
SH140	+	SH140	=	SH282	Left Right	7777044		Not needed	
SH140	+	SH161	=	SH301	Left Right	7777042	5312497P05	26	CP1
SH120	+	SH184	=	SH304	Left Right	7777052	5312497P03	23	CP1
SH161	+	SH161	=	SH322	Left Right	7777044		Not needed	
SH140	+	SH184	=	SH324	Left Right	7777052	5312479P06	35	CP1
SH161	+	SH184	=	SH345	Left Right	7777052	5312479P05	26	CP1
SH180	+	SH180	=	SH360	Left Right	7777041		Not needed	
SH184	+	SH184	=	SH368	Left Right	7777053		Not needed	
SH180	+	SH240	=	SH420	Left Right	7777037	5311579P01 5311579P01	31 31	CP1 CP1
SH180	+	SH295	=	SH475	Left Right	7777038	5311579P04 5311579P04	26 26	CP1 CP1
SH180	+	SH300	=	SH480	Left Right	7777038	5311579P04 5311579P04	26 26	CP1 CP1
SH240	+	SH240	=	SH482	Left Right	7777041		Not needed	
SH240	+	SH295	=	SH535	Left Right	7777037	5311579P01 5311579P01	31 31	CP1 CP1
SH240	+	SH300	=	SH540	Left Right	7777037	5311579P01 5311579P01	31 31	CP1 CP1
SH180	+	SH380	=	SH560	Left Right	7777038	5311579P04 5311579P04	26 26	CP1 CP1
SH295	+	SH295	=	SH590	Left Right	7777041		Not needed	
SH300	+	SH300	=	SH600	Left Right	7777041		Not needed	
SH240	+	SH380	=	SH620	Left Right	7777048	5311579P05 5311579P05	29 29	CP1 CP1
SH295	+	SH380	=	SH675	Left Right	7777037	5311579P01 5311579P01	31 31	CP1 CP1
SH300	+	SH380	=	SH680	Left Right	7777037	5311579P01 5311579P01	31 31	CP1 CP1
SH240	+	SH485	=	SH725	Left Right	7777038	5311579P04	26	CP1
SH380	+	SH380	=	SH760	Left Right	7777041		Not needed	
SH295	+	SH485	=	SH780	Left Right	120Z0551	5311579P07	27	CP1
SH380	+	SH485	=	SH865	Left Right	120Z0550	5311579P08	30	CP1
SH485	+	SH485	=	SH970	Left Right	7777041		Not needed	



**Trio models**

CP1	CP2	CP3	Trio model	Suction from	Kit code n° to order	Washer reference	Washer Ø (mm)	Washer in suction of			
SH180	+	SH180	+	SH180	=	SH550	Left	7777040	5311579P02	33	CP3
								Right	7777039	5311579P03	34.5
SH240	+	SH240	+	SH240	=	SH720	Left	7777040	5311579P02	33	CP3
								Right	7777039	5311579P03	34.5
SH295	+	SH295	+	SH295	=	SH885	Left	7777040	5311579P02	33	CP3
								Right	7777039	5311579P03	34.5
SH300	+	SH300	+	SH300	=	SH900	Left	7777040	5311579P02	33	CP3
								Right	7777039	5311579P03	34.5
SH380	+	SH380	+	SH380	=	SH1140	Left	7777040	5311579P02	33	CP3
								Right	7777049		Not needed
SH485	+	SH485	+	SH485	=	SH1455	Left	7777040	5311579P02	33	CP2 & CP3

**Compressor position and suction header side**



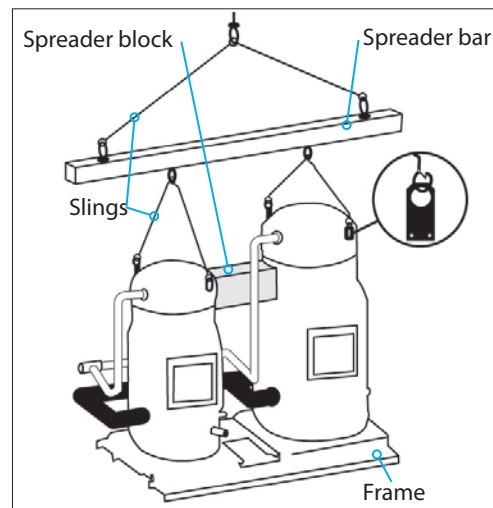
Installation and service procedures for a parallel system are similar to basic system installations. The selection of additional system components for parallel installations follows the basic system

common rules. Please refer to the Selection and Application Guidelines for Danfoss SH scroll compressors (FRCC.PC.007) for detailed installation and service procedures.

**Handling**

Danfoss Commercial Compressors recommends using the lift and handling devices, as shown in picture beside, and that the following procedure be used to prevent damage.

- Two lift rings are provided on each compressor. Use all four rings.
- Maximum loads authorized per sling and for the hoist hook must not be lower than the weight of the assembly.
- The minimum spreader bar length must be at least equal to the centre distance between the two compressors to prevent bending the frame.
- When lifting, use a spreader block between the compressors to prevent any unit frame damage.
- When the tandem unit is already mounted into an installation, never lift the complete installation by using the lift rings on the compressors.



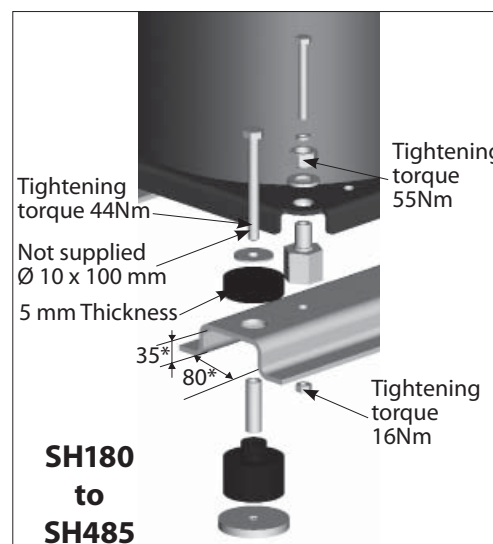
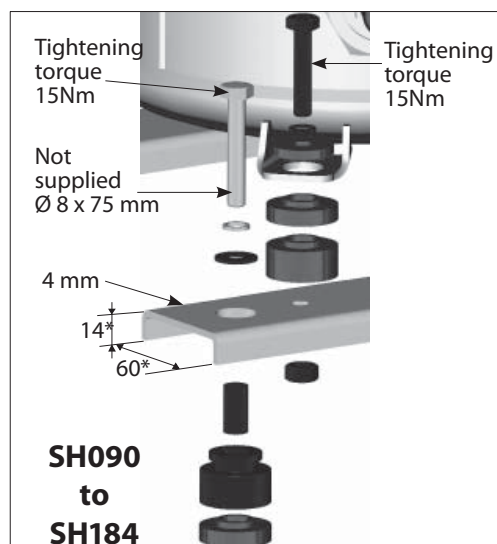
**Compressor mounting**

A common base frame, rigid enough to support the weight of the compressors, must be used for installation. The common frame must always be mounted on grommets to reduce transmission of vibration to the floor. It is recommended to install all control and safety devices on an independent frame. These devices should be connected to the common frame using flexible tubing.

Suction and discharge lines must have adequate three dimensional flexibility. For parallel systems the simplest means of acquiring this is by the use of vibration absorbers.

For details see compressors mounting for each tandem/trio arrangement.

**Tightening torques**



**Tandem and trio piping design**

For each tandem and trio configuration specific outline drawings are available as indicated on the previous pages. These drawings must always be respected. No changes shall be made to the indicated tubing diameter and fitting types.

The oil equalisation line shall be made of copper tube and assembled in such a way that it does not extend above the connection height and must be horizontal so as not to trap oil.

**Wiring and rotation direction**

All compressors in a tandem and trio unit must be electrically wired individually.

Compressors should run with the correct rotation direction. This can be achieved by having the correct phase sequence on each compressor motor terminal (L1-T1, L2-T2, L3-T3).

**Oil level**

The oil must be checked before commissioning (visible in the oil sight glass). Check the oil level again after a minimum of 2 hours operation at nominal conditions. In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 20 m or with many oil traps, additional oil may be required. Normally the quantity of oil added should be no more than 2% of the total refrigerant charge (this percentage does not take into account oil contained in accessories such as suction accumulators, liquid receiver, or oil traps). If this amount has already been added and the oil level in the compressors keeps decreasing, the oil

return in the installation is insufficient. A piping design checking is required.

During operation, the oil level in the sight glass of the compressors may fluctuate. The oil level can be checked directly after the system has stopped. In this case the level must be visible in the oil sight glass of all compressors.

On units working 100% load continuously, a compressor oil level might decrease. In order to avoid any loss of oil, regular unit stops might be needed to re equilibrate oils levels in the compressors.

**Failure analysis**

When one compressor in a parallel system fails, the chance of foreign particles entering other compressors is greatly increased. Therefore a

failure analysis must be done quickly to insure further proper running conditions for the overall installation (i.e. : oil analysis).

**Oil equalisation connection**

Danfoss Commercial Compressors has developed specially adapted oil equalisation systems which ensure proper oil balancing between the compressors.

Hence, Danfoss SH scroll compressors are equipped with rotolock connections:

- SH090 to 184: 1" 3/4 rotolock connection allowing use of 1" 3/4 - 7/8" or 1" 3/4 - 1" 1/8.

- SH180 to 485: 2" 1/4 rotolock connection allowing the use of 2" 1/4 - 1" 3/8 (tandem) or 2" 1/4 - 1" 5/8 sleeve (trio).

Oil equalisation fitting must not be heated during installation and servicing. This could damage to the compressor and impact oil equalisation balancing.

**Gaskets and gasket sets**


Type	Code n°	Description	Application	Packaging	Pack size
G07	8156132	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
G07	7956003	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Industry pack	50
G08	8156133	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Multipack	10
G08	7956004	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Industry pack	50
	8156013	Gasket set 1"1/4 - 1"3/4 - 2"1/4, OSG gaskets black & white	All Rotolock models	Multipack	10

**Solder sleeve**


Type	Code n°	Description	Application	Packaging	Pack size
P03	8153006	Solder sleeve P03 (2"1/4 Rotolock - 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10
P03	7953006	Solder sleeve P03 (2"1/4 Rotolock - 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Industry pack	50
P07	8153013	Solder sleeve P07 (1"3/4 Rotolock - 7/8" ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P07	7953010	Solder sleeve P07 (1"3/4 Rotolock - 7/8" ODF)	Models with 1"3/4 rotolock connection	Industry pack	50
P10	8153003	Solder sleeve P10 (1"3/4 Rotolock - 1"3/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10

**Rotolock nut**

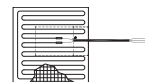

Type	Code n°	Description	Application	Packaging	Pack size
	8153124	Rotolock nut, 1"3/4	Models with 1-3/4" rotolock connection	Multipack	10
	7953003	Rotolock nut, 1"3/4	Models with 1-3/4" rotolock connection	Industry pack	50
	8153126	Rotolock nut, 2"1/4	Models with 2-1/4" rotolock connection	Multipack	10
	120Z0047	Rotolock nut, 2"1/4	Models with 2-1/4" rotolock connection	Industry pack	50

**3-phase soft start equipment**


Type	Code n°	Description	Application	Packaging	Pack size
MCI 15 C	7705006	Electronic soft start kit, MCI 15 C	SH090	Single pack	1
MCI 25 C	7705007	Electronic soft start kit, MCI 25 C	SH105-120-140-161-184	Single pack	1
MCI 50 CM	7705009	Electronic soft start kit, MCI 50 C	SH180-240-295-300-380	Single pack	1

**Motor protection modules and transformers**


Type	Code n°	Description	Application	Packaging	Pack size
	120Z0141	Electronic motor protection module, 24 V DC	SH180	Single pack	1
	8169020	Electronic motor protection module, 24 V AC		Single pack	1
	8169021	Electronic motor protection module, 230 V		Single pack	1
	120Z0140	Electronic motor protection module, 24 V DC	SH240-295-300-380-485	Single pack	1
	8169015	Electronic motor protection module, 24 V AC		Single pack	1
	8169016	Electronic motor protection module, 115/230 V		Single pack	1

**Surface sump heaters**


	Code no.	Accessory description	Application	Packaging	Pack size
	120Z0388	80W 24V surface sump heater CE & UL	SH090-105-120-140-161-184	Multipack	8
	120Z0389	80W 230V surface sump heater CE & UL		Multipack	8
	120Z0390	80W 400V surface sump heater CE & UL		Multipack	8
	120Z0391	80W 460V surface sump heater CE & UL		Multipack	8
	120Z0402	80W 575V surface sump heater CE & UL		Multipack	8
	120Z0360	56W 24V surface sump heater + inferior hood, CE & UL	SH180-240-295-300-380-485	Multipack	6
	120Z0376	56W 230V surface sump heater + inferior hood, CE & UL		Multipack	6
	120Z0377	56W 400V surface sump heater + inferior hood, CE & UL		Multipack	6
	120Z0378	56W 460V surface sump heater + inferior hood, CE & UL		Multipack	6
	120Z0379	56W 575V surface sump heater + inferior hood, CE & UL		Multipack	6

**Discharge temperature protection**


Type	Code No	Description	Application	Packaging	Pack Size
	7750009	Discharge thermostat kit	All models	Multipack	10
	7973008	Discharge thermostat kit	All models	Industry pack	50

**Mounting hardware**


Type	Code No	Description	Application	Packaging	Pack Size
	120Z0066	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	SH090-105-120-140-161-184	Single pack	1
	8156138	Mounting kit for scroll compressors. Grommets, sleeves, bolts, washers	SH180-240-295-300-380-485	Single pack	1
	7777045	Mounting kit for 1 scroll compressors including 4 rigid spacer, 4 sleeves, 4 bolts, 4 washers	SH180-240-295-300-380-485 in parallel installation	Single pack	1
	120Z0495	Mounting kit for 1 scroll compressor including 4 triangle rigid spacer	SH180-240-295-300-380-485 in parallel installation	Single pack	1

**Acoustic hoods**


Type	Code No	Description	Application	Packaging	Pack Size
	120Z0034	Acoustic hood for scroll compressor	SH090	Single pack	1
	120Z0035	Acoustic hood for scroll compressor	SH105-120-140-161 (except SH161 - 140 code 3)	Single pack	1
	120Z0135	Acoustic hood for scroll compressor	SH184-SH161 code 3 -SH140 code 3	Single pack	1
	120Z0022	Acoustic hood for scroll compressor	SH180-240-295-300-380-485	Single pack	1
	120Z0353	Inferior hood for scroll compressor	SH180-240-295-300-380-485	Single pack	1

**Terminal boxes, covers & T-block connectors**


Type	Code No	Description	Application	Packaging	Pack Size
	120Z0413	Terminal box cover	SH184-140 & 161 code 3	Single pack	1
	8156135	Service kit for terminal box 96 x 115 mm, including 1 cover, 1 clamp, 1 T block connector 52 x 57 mm	SH090-105-120-140-161 (except SH140-3 and SH161-3)	Multipack	10
	8173230	T block connector 52 x 57 mm	SH180-240-300-380 (except 240-3, 300-3, 380-3)	Multipack	10
	8173021	T block connector 60 x 75 mm	SH140-3,161-3,184-180-240-300-380 (except 240-3, 300-3, 380-3)	Multipack	10
	8173331	T block connector 80 x 80 mm	SH240-295-300 code 3-SH485	Multipack	10
	120Z0458	Terminal box 210 x 190 mm, incl. cover	SH180-240-295-300-380-485	Single pack	1
	120Z0462	Terminal box 210 x 190, incl. cover and module wiring for 258 x 208 and 186 x 198 terminal box replacement	SH180-240-300-380-485	Single pack	1

**Lubricant**


Type	Code No	Description	Application	Packaging	Pack Size
160SZ	7754023	POE lubricant, 1 litre can	All models	Single pack	1
160SZ	7754024	POE lubricant, 2 litre can	All models	Single pack	1

**Miscellaneous**


Type	Code No	Description	Application	Packaging	Pack Size
	8156019	Sight glass with gaskets (black & white)	All models	Multipack	4
	8156129	Gasket for oil sight glass, 1"1/8 (white teflon)	All models	Multipack	10
	7956005	Gasket for oil sight glass, 1"1/8 (white teflon)	All models	Multipack	50
	8154001	Danfoss Commercial Compressors blue spray paint	All models	Single pack	1

**Tandem kits including**


Type	Code n°	Description	Application	Packaging	Pack size
	7777044	Suction washer, rigid spacer, sleeve for oil connect	SH182.212.242.282.322	Single pack	1
	7777043	Suction washer, rigid spacer, sleeve for oil connect	SH195.210.230	Single pack	1
	7777042	Suction washer, rigid spacer, sleeve for oil connect	SH260.281.301	Single pack	1
	7777052	Suction washer, rigid spacer, sleeve for oil connect	SH304.324.345	Single pack	1
	7777041	Suction washer, grommets, sleeve for oil connect	SH360.482.590.600.760.970	Single pack	1
	7777053	Suction washer, rigid spacer, sleeve for oil connect	SH368	Single pack	1
	7777037	Suction washer, grommets, sleeve for oil connect	SH420.535.540.675.680	Single pack	1
	7777038	Suction washer, grommets, sleeve for oil connect	SH475.480.560.725	Single pack	1
	7777048	Suction washer, grommets, sleeve for oil connect	SH620	Single pack	1
	120Z0550	Suction washer, grommets, sleeve for oil connect	SH865	Single pack	1
	120Z0551	Suction washer, grommets, sleeve for oil connect	SH780	Single pack	1

**Trio kits**


Type	Code n°	Description	Application	Packaging	Pack size
	7777051	Suction washer, rigid spacer, sleeve for oil connect	SH483	Single pack	1
	7777039	Suction washer, grommets, sleeve for oil connect	SH550.720.885.900 (right suction)	Single pack	1
	7777040	Suction washer, grommets, sleeve for oil connect	SH550.720.885.900.1140 (left suction) 1455 (left and right suction)	Single pack	1
	7777049	Suction washer, grommets, sleeve for oil connect	SH1140 (right suction)	Single pack	1



Danfoss Commercial Compressors is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spread across three continents.



Danfoss Variable Speed scroll compressors



Danfoss Air Conditioning scroll compressors



Danfoss Heat Pump scroll compressors



Maneurop® Variable Speed reciprocating compressors



Danfoss Refrigeration scroll compressors



Maneurop® Reciprocating Compressors



Optyma™ & Optyma Plus™ Condensing Units



Refrigeration compressors (manufactured by Secop)

Our products can be found in a variety of applications such as rooftops, chillers, residential air conditioners, heatpumps, coldrooms, supermarkets, milk tank cooling and industrial cooling processes.

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