ENGINEERING
TOMORROW

Application guidelines

Danfoss scroll for refrigeration
LLZ Evolution C (with POE oil)
Low temperature

50-60 Hz: R404A-R507-R452A-R448A-R449A-R454C-R455A-R454A

http://cc.danfoss.com

Danfoss scroll compressors are designed and manufactured according to the state of the art and to valid European and US regulations. Particular emphasis has been placed on safety and reliability. Related instructions are highlighted with the following icons:

This icon indicates instructions to avoid reliability risk.


This icon indicates instructions to avoid safety risk.

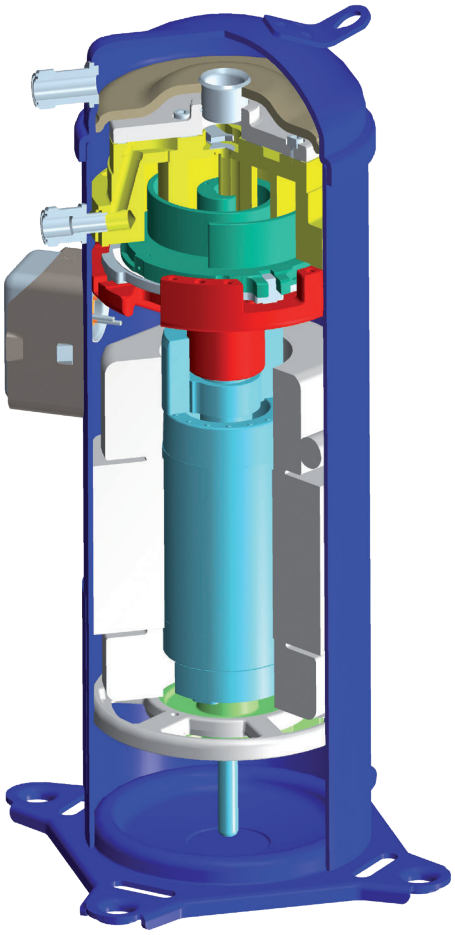
You are strongly advised to follow these instructions. For any deviation from the guidelines, please contact Danfoss Technical Support.

In any case, Danfoss accepts no liability as a result of the improper integration of the compressor into the unit by the system manufacturer.

Overview

Danfoss scroll compressor for refrigeration, LLZ, with its unique scroll design and manufacturing process flexibility, offers a highly efficient solution for demanding refrigeration applications.

LLZ refrigeration scroll compressors includes 5 sizes of low temperature scroll compressors designed for commercial refrigeration applications. These compressors are engineered for refrigeration and offer cooling capacity from 5 to 12 kW (4 to 10 HP) at common voltages and frequencies as well as any of the common refrigerants (R404A/R507/R452A/R448A/R449A/R454C/R455A/R454A).



Compressor model designation

Danfoss scroll compressor LLZ for R404A, R507 R452A, R448A, R449A, R454C, R455A, R454A is available as single compressor.

The example below presents the compressor nomenclature which equals the technical reference as shown on the compressor nameplate. Code numbers for ordering are listed section "Ordering information and packaging".

Nomenclature

Type	Size	Motor		Features		Evolution
LLZ	013	T	2	L	Q	9	C

Application
L: low temperature refrigeration

Family, Refrigerant
LZ(C): R404A, R507, R452A, R448A, R449A, R454C, R455A, R454A

Nominal capacity
In thousand Btu/h at 60 Hz, ARI, LBP conditions of R404A

Model variation
T: design optimised for refrigeration

Motor voltage code
2: 200-220V/3~/50Hz & 208-230V/3~/60Hz

Motor protection
L: internal motor protection

Tubing and electrical connections
Q: rotolock connections, screw terminals

Other features

	Oil sight glass	Oil equalisation	Oil drain	LP gauge port	Gas equalisation port
9	Threaded	None	Schrader	None	None

- with PVE Oil
A with POE Oil, C with POE oil and UL marked only

Label

50-60 Hz data
Model with Liquid injection line only

Models Refrigerant		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displacement ①	Oil charge	Net weight ②
		TR	W	Btu/h	W	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50 Hz R448A/ R449A*	LLZ013	4	2048	6990	2106	0.97	3.32	67.4	11.7	1.62	42
	LLZ015	5	2605	8890	2642	0.99	3.37	83.5	14.5	1.62	42
	LLZ018	6	3084	10525	2964	1.04	3.55	97.6	17	1.62	43
	LLZ024	8	3846	13126	3542	1.09	3.71	120.2	20.9	2.51	46
	LLZ034	10	5480	18704	4684	1.17	3.99	168.7	29.4	2.51	51
60 Hz R448A/ R449A*	LLZ013	4	3314	11310	2737	1.21	4.13	67.4	14.2	1.62	42
	LLZ015	5	4097	13983	3416	1.20	4.09	83.5	17.5	1.62	42
	LLZ018	6	4900	16723	3815	1.28	4.38	97.6	20.5	1.62	43
	LLZ024	8	6046	20636	4580	1.32	4.51	120.2	25.3	2.51	46
	LLZ034	10	8531	29116	5928	1.44	4.91	168.7	35.4	2.51	51

① Displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60 Hz
② Net weight with oil charge

TR: Ton of Refrigeration, Refrigerant: R448A*
EER: Energy Efficiency Ratio
COP: Coefficient Of Performance

Rating condition:
50Hz data: EN12900 LT, Evaporating temperature -35°C, Condensing temperature 40°C, Super Heat 10K, Subcooling 5K.
60Hz data: ARI 540 LT, Evaporating temperature -31.5°C, Condensing temperature 40.5°C, Return Gas Temperature 4.5°C, Subcooling 5K.

All of the compressor performance test after run-in 72h
*R449A performance data are nearly identical to R448A performance data
Subject to modification without prior notification.
Data given for motor code 2 compressor

Model without injection

Models Refrigerant		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displacement ①	Oil charge	Net weight ②
		TR	W	Btu/h	W	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50 Hz R404A/R507*	LLZ013	4	2417	8249	2366	1.02	3.48	67.4	11.7	1.62	42
	LLZ015	5	2937	10024	2776	1.06	3.62	83.5	14.5	1.62	42
	LLZ018	6	3453	11785	3150	1.10	3.75	97.6	17	1.62	43
	LLZ024	8	4411	15055	3957	1.11	3.79	120.2	20.9	2.51	46
	LLZ034	10	6051	20652	5458	1.11	3.79	168.7	29.4	2.51	51
60 Hz R404A/R507*	LLZ013	4	2896	9884	2774	1.04	3.55	67.4	14.2	1.62	42
	LLZ015	5	3552	12123	3307	1.07	3.65	83.5	17.5	1.62	42
	LLZ018	6	4228	14430	3799	1.11	3.79	97.6	20.5	1.62	43
	LLZ024	8	5278	18014	4611	1.14	3.89	120.2	25.3	2.51	46
	LLZ034	10	7404	25270	6157	1.20	4.10	168.7	35.4	2.51	51

① Displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60 Hz
② Net weight with oil charge

TR: Ton of Refrigeration, Standard rating conditions: EN12900 Evaporating temperature: -35 °C Superheat: 10 K
EER: Energy Efficiency Ratio Refrigerant: R404A* Condensing temperature: 40 °C Subcooling: 0 K
COP: Coefficient Of Performance
All of the compressor performance test after run-in 72h
*R507 performance data are nearly identical to R404A performance data
Subject to modification without prior notification.
Data given for motor code 2 compressor

50-60 Hz data
Model without injection

Models Refrigerant		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	W	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50 Hz R448A/ R449A*	LLZ013	4	2048	6990	2106	0.97	3.32	67.4	11.7	1.62	42
	LLZ015	5	2605	8890	2642	0.99	3.37	83.5	14.5	1.62	42
	LLZ018	6	3084	10525	2964	1.04	3.55	97.6	17	1.62	43
	LLZ024	8	3846	13126	3542	1.09	3.71	120.2	20.9	2.51	46
	LLZ034	10	5480	18704	4684	1.17	3.99	168.7	29.4	2.51	51
60 Hz R448A/ R449A*	LLZ013	4	3314	11310	2737	1.21	4.13	67.4	14.2	1.62	42
	LLZ015	5	4097	13983	3416	1.20	4.09	83.5	17.5	1.62	42
	LLZ018	6	4900	16723	3815	1.28	4.38	97.6	20.5	1.62	43
	LLZ024	8	6046	20636	4580	1.32	4.51	120.2	25.3	2.51	46
	LLZ034	10	8531	29116	5928	1.44	4.91	168.7	35.4	2.51	51

① Displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60 Hz
② Net weight with oil charge

TR: Ton of Refrigeration,
EER: Energy Efficiency Ratio
COP: Coefficient Of Performance
Refrigerant: R448A*

Rating condition:
50Hz data: EN12900 LT, Evaporating temperature -35°C, Condensing temperature 40°C, Super Heat 10K, Subcooling 5K.
60Hz data: ARI 540 LT, Evaporating temperature -31.5°C, Condensing temperature 40.5°C, Return Gas Temperature 4.5°C, Subcooling 5K.

All of the compressor performance test after run-in 72h
*R449A performance data are nearly identical to R448A performance data
Subject to modification without prior notification.
Data given for motor code 2 compressor

Model without injection

Models Refrigerant		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	W	W/W	Btu/h/W	cm^3/rev	m^3/h	dm^3	kg
50 Hz R404A	LLZ013	4	3213	10966	2507	1.28	4.37	67.4	11.7	1.62	42
	LLZ015	5	3898	13304	2949	1.32	4.51	83.5	14.5	1.62	42
	LLZ018	6	4583	15642	3346	1.37	4.68	97.6	17	1.62	43
	LLZ024	8	5854	19980	4204	1.39	4.74	120.2	20.9	2.51	46
	LLZ034	10	7991	27273	5772	1.38	4.71	168.7	29.4	2.51	51
60 Hz R404A	LLZ013	4	3857	13164	2938	1.31	4.47	67.4	14.2	1.62	42
	LLZ015	5	4718	16102	3507	1.35	4.61	83.5	17.5	1.62	42
	LLZ018	6	5616	19167	4028	1.39	4.74	97.6	20.5	1.62	43
	LLZ024	8	7011	23928	4889	1.43	4.88	120.2	25.3	2.51	46
	LLZ034	10	9791	33416	6616	1.48	5.05	168.7	35.4	2.51	51

① Displacement at nominal speed: 2900 rpm at 50 Hz, 3500 rpm at 60 Hz
② Net weight with oil charge

TR: Ton of Refrigeration,
EER: Energy Efficiency Ratio
COP: Coefficient Of Performance
Standard rating conditions: ARI
Refrigerant: R404A*
Evaporating temperature: -31.7 °C
Condensing temperature: 40.6 °C
Superheat: 50 K
Subcooling: 0 K
All of the compressor performance test after run-in 72h
*R507 performance data are nearly identical to R404A performance data
Subject to modification without prior notification.
Data given for motor code 2 compressor

50 Hz data
Model without injection

Models Refrigerant		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	W	W/W	Btu/h/W	cm³/rev	m³/h	dm³	kg
50 Hz R452A	LLZ013	4	2189	7469	1990	1.10	3.75	67.4	11.7	1.62	42
	LLZ015	5	2718	9274	2514	1.08	3.69	83.5	14.5	1.62	42
	LLZ018	6	3223	10997	2960	1.09	3.72	97.6	17	1.62	43
	LLZ024	8	4000	13648	3609	1.11	3.78	120.2	20.9	2.51	46
	LLZ034	10	5865	20011	5082	1.15	3.94	168.7	29.4	2.51	51

① Displacement at nominal speed: 2900 rpm at 50 Hz
② Net weight with oil charge

TR: Ton of Refrigeration,
EER: Energy Efficiency Ratio
COP: Coefficient Of Performance
Standard rating conditions: EN12900
Refrigerant: R452A
Evaporating temperature: -35 °C
Condensing temperature: 40 °C
Superheat: 10 K
Subcooling: 0 K
All of the compressor performance test after run-in 72h
Subject to modification without prior notification.
Data given for motor code 2 compressor

60 Hz data
Model without injection

Models Refrigerant		Nominal tons 60 Hz	Nominal cooling capacity		Power input	COP	E.E.R.	Swept volume	Displace-ment ①	Oil charge	Net weight ②
		TR	W	Btu/h	W	W/W	Btu/h/W	cm³/rev	m³/h	dm³	kg
60 Hz R452A	LLZ013	4	3335	11383	2886	1.16	3.94	67.4	14.2	1.62	42
	LLZ015	5	4187	14289	3476	1.20	4.11	83.5	17.5	1.62	42
	LLZ018	6	4919	16788	3952	1.24	4.25	97.6	20.5	1.62	43
	LLZ024	8	6137	20945	4829	1.27	4.34	120.2	25.3	2.51	46
	LLZ034	10	8516	29065	6595	1.29	4.41	168.7	35.4	2.51	51

① Displacement at nominal speed: 3500 rpm at 60 Hz
② Net weight with oil charge

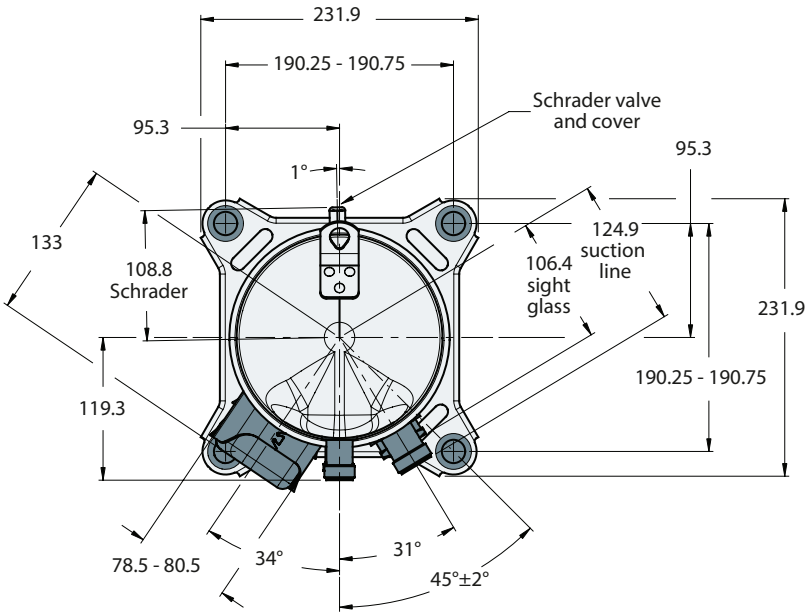
TR: Ton of Refrigeration,
EER: Energy Efficiency Ratio
COP: Coefficient Of Performance
Standard rating conditions: ARI 540 LT standard
Refrigerant: R452A
Evaporating temperature: -31.5 °C
Condensing temperature: 40.5 °C
Return Gas Temperature: 4.5 °C
Subcooling: 0 K
All of the compressor performance test after run-in 72h
Subject to modification without prior notification.
Data given for motor code 2 compressor

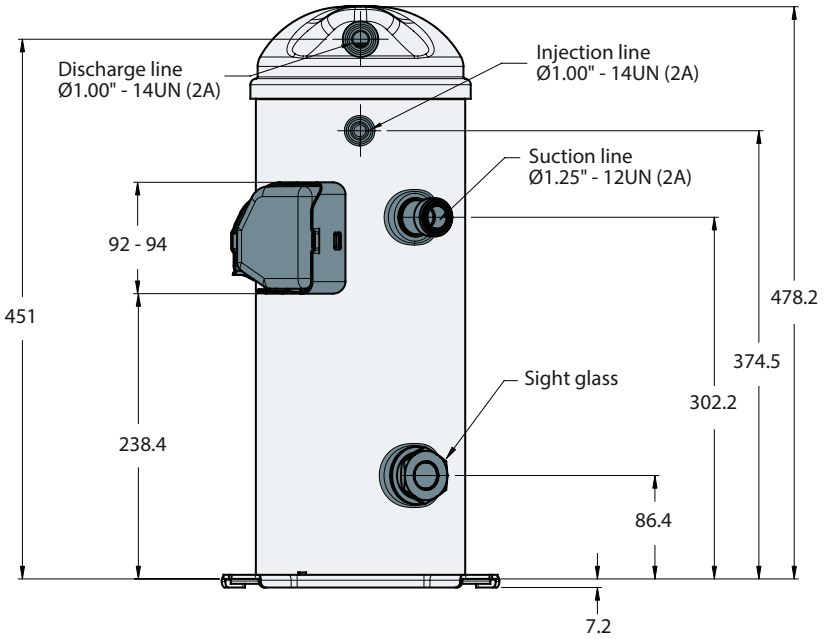
Performance table

Refrigerant	Model	motor code	-35/40/ SH10K/5 @50Hz			-31.5/40.5/ RGT4.5/5 @60Hz		
			Cooling [W]	Power [W]	EER [Btu/h/W]	Cooling [W]	Power [W]	EER [Btu/h/W]
R454C	LLZ013	Code 2	1873	1837	3.48	2961	2302	4.39
	LLZ015	Code 2	2286	2236	3.49	3627	2784	4.45
	LLZ018	Code 2	2836	2568	3.77	4409	3165	4.75
	LLZ024	Code 2	3453	3131	3.76	5322	3849	4.72
	LLZ034	Code 2	4859	4363	3.8	7587	5275	4.91
R455A	LLZ013	Code 2	1980	1979	3.41	3169	2477	4.37
	LLZ015	Code 2	2487	2379	3.57	3944	2961	4.54
	LLZ018	Code 2	3067	2739	3.82	4712	3393	4.74
	LLZ024	Code 2	3755	3330	3.85	5785	4097	4.82
	LLZ034	Code 2	5285	4645	3.88	8247	5611	5.01
R454A	LLZ013	Code 2	2154	2273	3.23	3441	2812	4.17
	LLZ015	Code 2	2711	2893	3.2	4306	3373	4.36
	LLZ018	Code 2	3211	3427	3.2	5098	3914	4.44
	LLZ024	Code 2	4073	4152	3.35	6453	4769	4.62
	LLZ034	Code 2	5455	5699	3.27	8939	6403	4.76

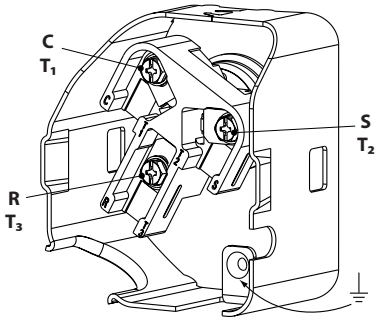
Note: All compressor performance tests are conducted after a 72-hour run-in period. Specifications are subject to change without prior notice.

Single compressors
LLZ013-015-018



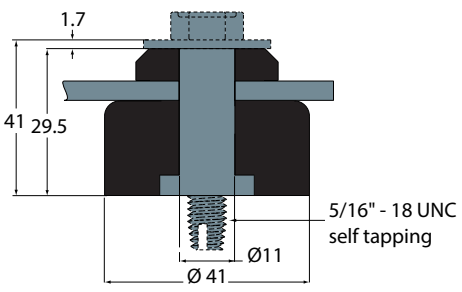


Terminal box



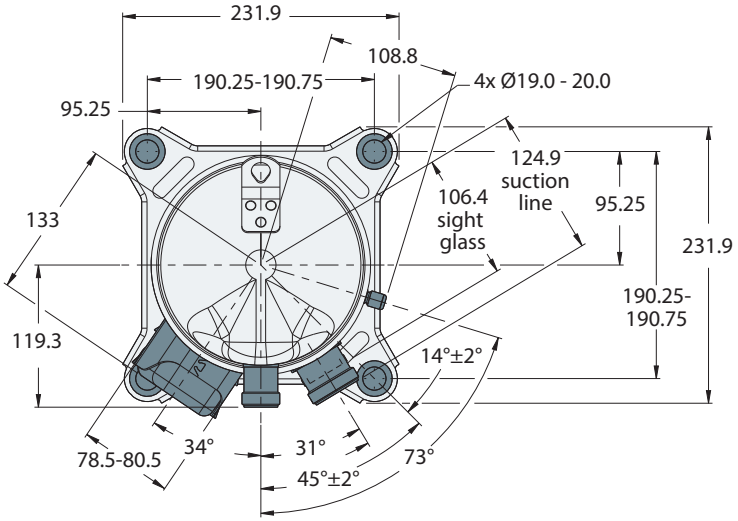
Ring connect screw terminals
C terminal box type

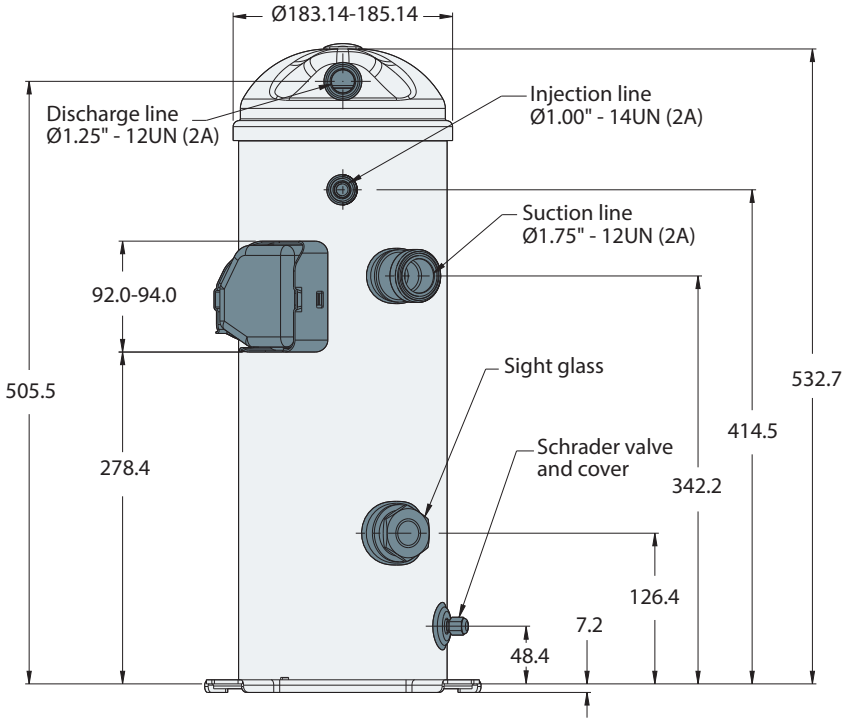
Mounting grommet



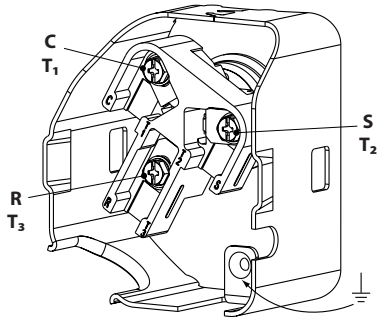
Recommended torque for
mounting bolts: 11 Nm (±1 Nm)

Single compressors
LLZ024



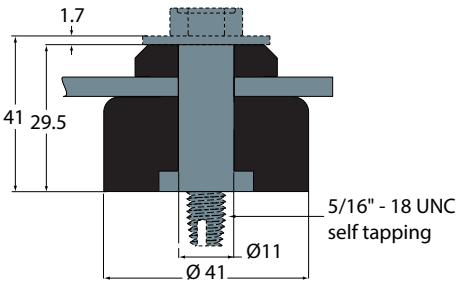


Terminal box



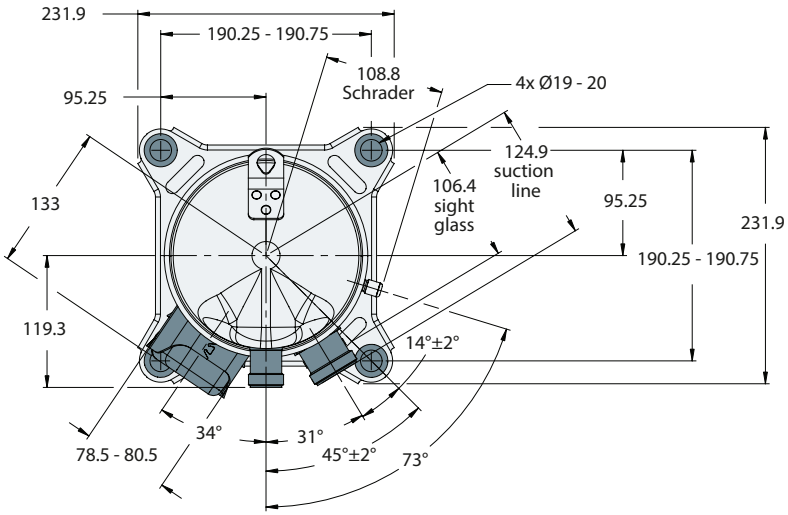
Ring connect screw terminals
C terminal box type

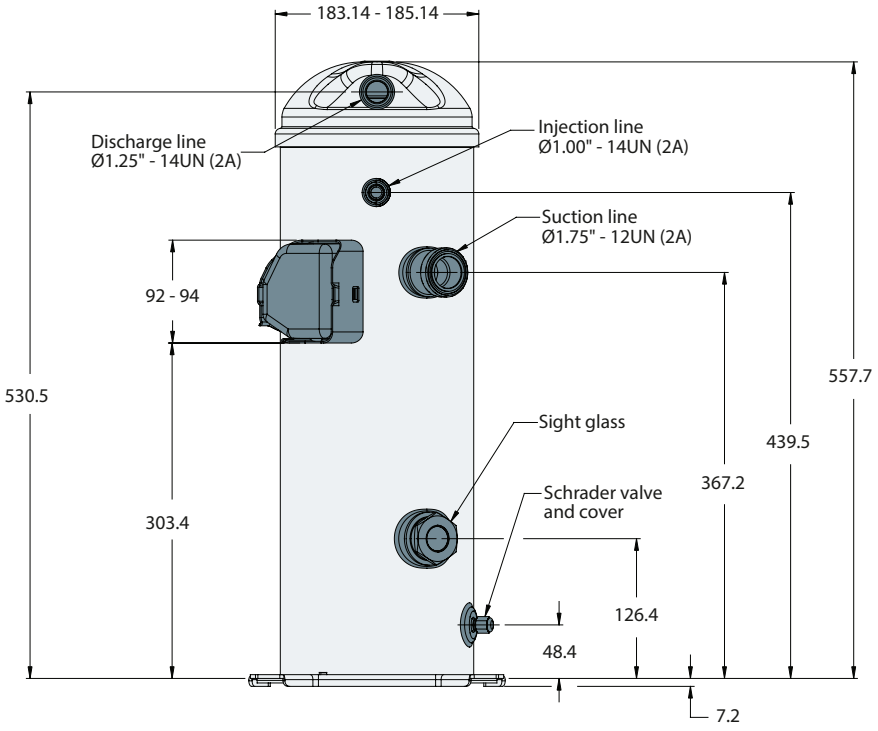
Mounting grommet



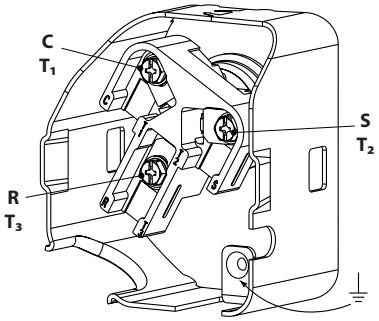
Recommended torque for
mounting bolts: 11 Nm (±1 Nm)

Single compressors
LLZ034



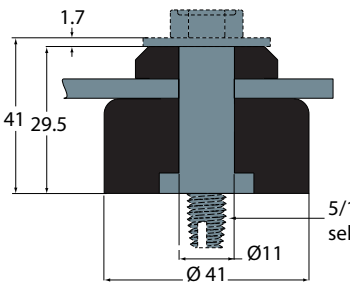


Terminal box



Ring connect screw terminals
C terminal box type

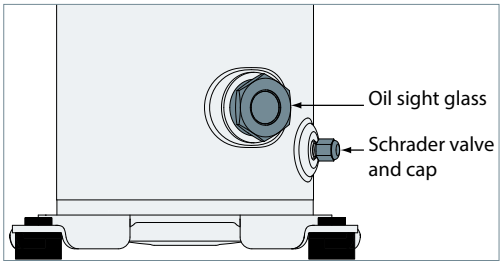
Mounting grommet



Recommended torque for
mounting bolts: 11 Nm (±1 Nm)

Oil sight glass

LLZ scroll compressors come equipped with a threaded oil sight glass with 1"1/8 - 18 UNEF connection. It can be used for a visual check of the oil amount and condition or it may be replaced by an accessory oil management device. The oil level must be visible in the sight glass during operation.



Schrader

The oil fill and drain connection and gauge port is a 1/4" male flare connector incorporating a schrader valve.

Suction and discharge connections

LLZ scroll compressors are factory delivered with rotolock connections only.

Compressor Models	Rotolock Sizes		
	Suction Fitting (in)	Discharge Fitting (in)	Injection Fitting (in)
LZL013	1"1/4	1"	1"
LLZ015	1"1/4	1"	1"
LLZ018	1"1/4	1"	1"
LLZ024	1"3/4	1"1/4	1"
LLZ034	1"3/4	1"1/4	1"

Motor voltage

Danfoss scroll compressors LLZ are available in motor voltage as listed below.

Motor voltage code		Code 2
50 Hz	Nominal voltage	200-220V - 3ph
	Voltage range	180-242V
60 Hz	Nominal voltage	208-230V - 3ph
	Voltage range	187-253V

The maximum allowable voltage imbalance is 2%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible motor damage. Voltage imbalance is given by the formula:

$$\text{\% voltage imbalance} = \frac{|Vavg - V1\text{-}2| + |Vavg - V1\text{-}3| + |Vavg - V2\text{-}3|}{2 \times Vavg} \times 100$$

Vavg = Mean voltage of phases 1, 2, 3.

V1-2 = Voltage between phases 1 and 2.

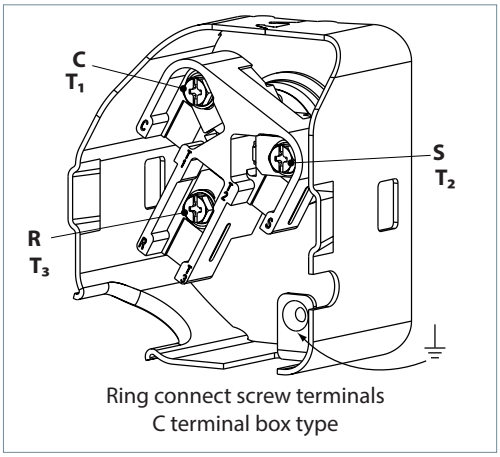
V1-3 = Voltage between phases 1 and 3.

V2-3 = Voltage between phases 2 and 3.

Wiring connections

R Danfoss scroll compressors LLZ will only compress gas while rotating counter-clockwise (when viewed from the compressor top). Three-phase motors will start and run in either direction, depending on the phase angles of the supplied power. Care must be taken during installation to ensure that the compressor operates in the correct direction (see “Phase sequence and reverse rotation protection”).

The drawings hereafter show electrical terminal labelling and should be used as a reference when wiring the compressor. For three phase applications, the terminals are labelled T1, T2, and T3. . For single-phase applications the terminals are labelled C (common), S (start), and R (run).

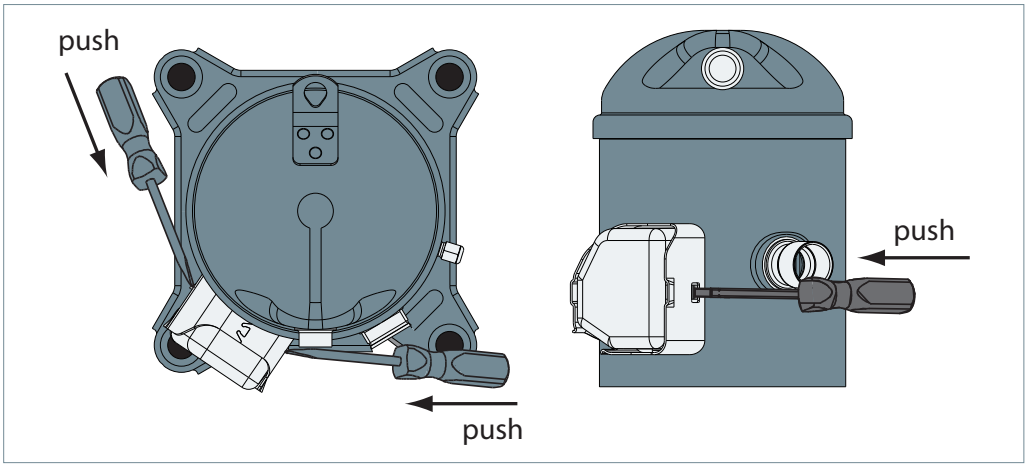


Ring connect screw terminals
C terminal box type

Terminal cover mounting

The terminal cover and gasket should be installed prior to operation of the compressor. Respect the "up" marking on gasket and cover and ensure that the two outside tabs of the cover engage the terminal box.

Terminal cover removal



IP rating

The compressor terminal box IP rating according to IEC 529 is IP22 for all models. IP ratings is only valid when correctly sized cable glands of the IP rating is applied.
First numeral, level of protection against contact and foreign objects
2 - Protection against object size over 12.5 mm (fingers of similar)
Second numeral, level of protection against water
2 - Protection against dripping water when tilted up to 15°
The IP rating can be upgraded to IP54 with an accessory kit (see section "Accessories").

Three phase electrical characteristics

Compressor model		LRA	MCC	Max. operating current	Max. operating current with economizer	Winding resistance
		A	A	A	A	Ω
Motor voltage code 2 200-220 V / 3 / 50Hz 208-230 V / 3 / 60Hz	LLZ013	123.0	25.0	16.4	20.0	0.60
	LLZ015	180.0	29.0	18.9	23.0	0.50
	LLZ018	184.0	31.0	24.1	29.4	0.43
	LLZ024	190.0	40.0	28.4	34.7	0.37
	LLZ034	250.0	50.0	42.4	44.7	0.29

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher average current as measured on mechanically blocked compressor tested under nominal voltage. The LRA value can be used as rough estimation for the starting current. However in most cases, the real starting current will be lower. A soft starter can be applied to reduce starting current.

MCC (Maximum Continuous Current)

The MCC is the current at which the motor protection trips under maximum load and low voltage conditions. This MCC value is the maximum at which the compressor can be operated in transient conditions and out of the application envelope. Above this value, the overload or external electronic module will cut-out the compressor to protect the motor.

Max. operating Current

The max. operating current is the current when the compressors operate at maximum load conditions and 10% below nominal voltage. Max Oper. A can be used to select cables and contactors. In normal operation, the compressor current consumption is always less than the Max Oper. A. value.

When using the Max Operating Current to define cables and contactors, a tolerance of 5% need to be taken into account.

Winding resistance

Winding resistance is the resistance between phases at 25°C (resistance value +/- 7%). Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a "4 wires" method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature. If the compressor is stabilised at a different value than 25°C, the measured resistance must be corrected using the following formula:

$$R_{tamb} = R_{25°C} \frac{a + t_{amb}}{a + t_{25°C}}$$

$t_{25°C}$: reference temperature = 25°C
t_{amb}: temperature during measurement (°C)
$R_{25°C}$: winding resistance at 25°C
R_{amb}: winding resistance at tamb
Coefficient a = 234.5

Motor protection

Danfoss scroll compressors LLZ are equipped with an internal line break protector mounted on the motor windings. The protector is an automatic reset device, containing a snap action bimetal switch.

Internal protectors respond to over-current and overheating. They are designed to interrupt Motor current under a variety of fault conditions, such as failure to start, running overload, and fan failure.

If the internal overload protector trips out, it must cool down to about 60°C to reset. Depending on ambient temperature, this may take up to several hours.

Phase sequence and reverse rotation protection

The compressor will only operate properly in a single direction. Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. For three-phase compressors, the motor will run equally well in both directions. Reverse rotation results in excessive noise; no pressure differential between suction and discharge; and suction line warming rather than immediate cooling. A service technician should be present at initial start-up to verify that supply power is properly phased and that compressor and auxiliaries are rotating in the correct direction.

Phase monitors are required for LLZ compressors. The selected phase monitor should lock out the compressor from operation in reverse.

Approval and certificates

LLZ scroll compressors comply with the following approvals and certificates.

Certificates are listed on the product datasheets: http://www.danfoss.com/odsg

UL (Underwriters Laboratories)	All LLZ models
Other approvals / certificates	Contact Danfoss

Internal free volume

Products	Internal free volume at LP side without oil (litre)
LLZ013-015-018	4.74
LLZ024-034	5.95

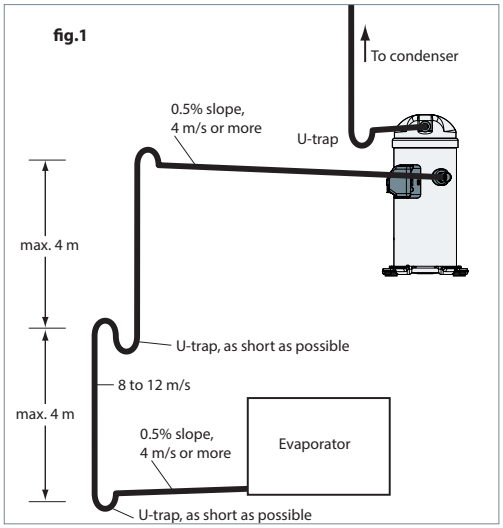
General requirements

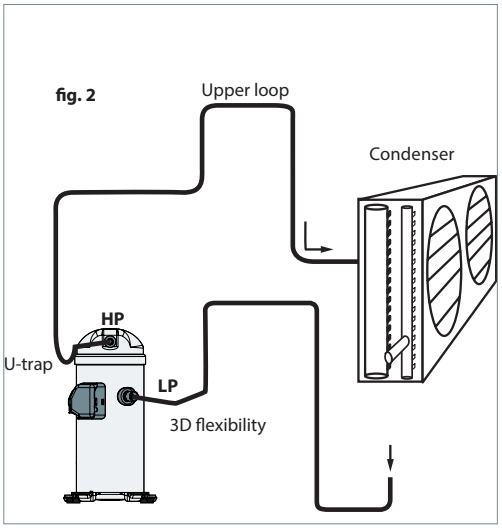
Proper piping practices should be employed to:

1. Ensure adequate oil return, even under minimum load conditions (refrigerant speed, piping slopes…). For validation tests see section "Manage oil in the circuit".

2. Avoid condensed liquid refrigerant from draining back to the compressor when stopped (discharge piping upper loop). For validation tests see section "Manage off cycle migration".

General recommendations are described in the figures below:





3. Piping should be designed with adequate three-dimensional flexibility to avoid excess vibration. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. For more information on noise and vibration, see section on: "Sound and vibration management".

General requirements

Compressors used in single application must be mounted with flexible grommets

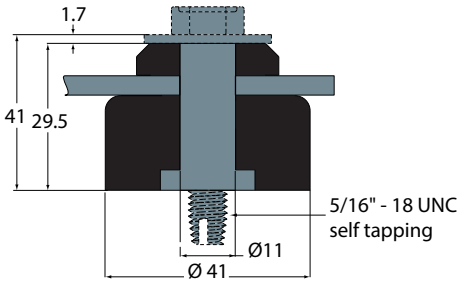
Compressors used in parallel application must be mounted with rigid mounting spacers onto rails and the manifold assembly must be mounted with flexible grommets onto frame.

During operation, maximum inclination from the vertical plane must not exceed 3 degrees.

Single compressor requirements

LLZ compressors are delivered with flexible grommets, accessory mounting kit.

Mounting grommet



Recommended torque for mounting bolts: 11 Nm (±1 Nm)

The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The required bolt size for the LLZ013-034 compressors is M8*45mm. This bolt must be tightened to a torque of 11 Nm.

Typical sounds and vibrations in systems can be broken down into the following three categories:
- Sound radiation (through air)
- Mechanical vibrations (through parts and structure)
- Gas pulsation (through refrigerant)

The following sections 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 air and the sound waves are travelling directly from the machine in all directions.

Sound levels are as follows:
- For compressors running alone:

Compressor model	50 Hz		60 Hz		Acoustic hood code number
	Sound power dB(A)	Attenuation dBA ①	Sound power dB(A)	Attenuation dBA ①	
LLZ013	78	8	80	8	120Z5052
LLZ015	80	8	83	8	120Z5052
LLZ018	83	10	84	10	120Z5052
LLZ024	85	10	86	10	120Z5053
LLZ034	85	8	86	8	120Z5055

Sound power and attenuation are given at ARI LBP conditions, measured in free space
① Attenuation given with acoustic hood

Maximum sound is +5dBA

LLZ scroll compressors have a unique discharge valve design that minimizes stopping noise. This results in very low shutdown sound.
Note: During compressor shut down, a short reverse rotation sound is generated. The duration of this sound depends on pressure difference at shut down and should be less than 3 seconds. This phenomenon has no impact on compressor reliability.

Mitigations methods:
We can consider two means to reduce compressors sound radiations:
1. Acoustic hoods are quick and easy to install and do not increase the overall size of the compressors to a great extent. Acoustic hoods are available from Danfoss as accessories. Refer to table above for sound levels, attenuation and code numbers.
2. Use of sound-insulation materials on the inside of unit panels is also an effective means to reduce radiation.

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. LLZ scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Rubber grommets are supplied with all LLZ scroll compressors.

Once the supplied rubber grommets have been properly mounted, vibration transmitted from the compressor base plate to the unit are held to a strict minimum. In addition, it is extremely important that the frame supporting the mounted compressor be of sufficient mass and stiffness to help dampen any residual vibration potentially transmitted to the frame. 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".

Gas pulsation

The LLZ scroll compressors have been designed and tested to ensure that gas pulsation has been minimized for the most commonly encountered refrigeration pressure ratio. On 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.

Mitigations methods:
If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass can be installed.

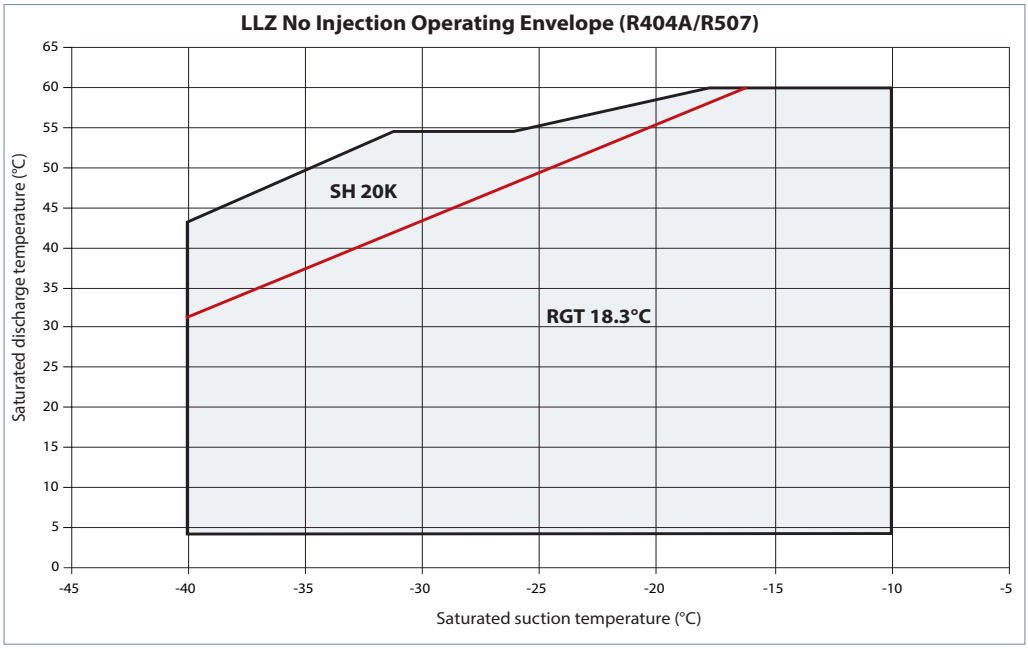
Requirement

R The operating envelope for LLZ scroll compressors is given in the figures below and guarantees reliable operations of the compressor for steady-state.

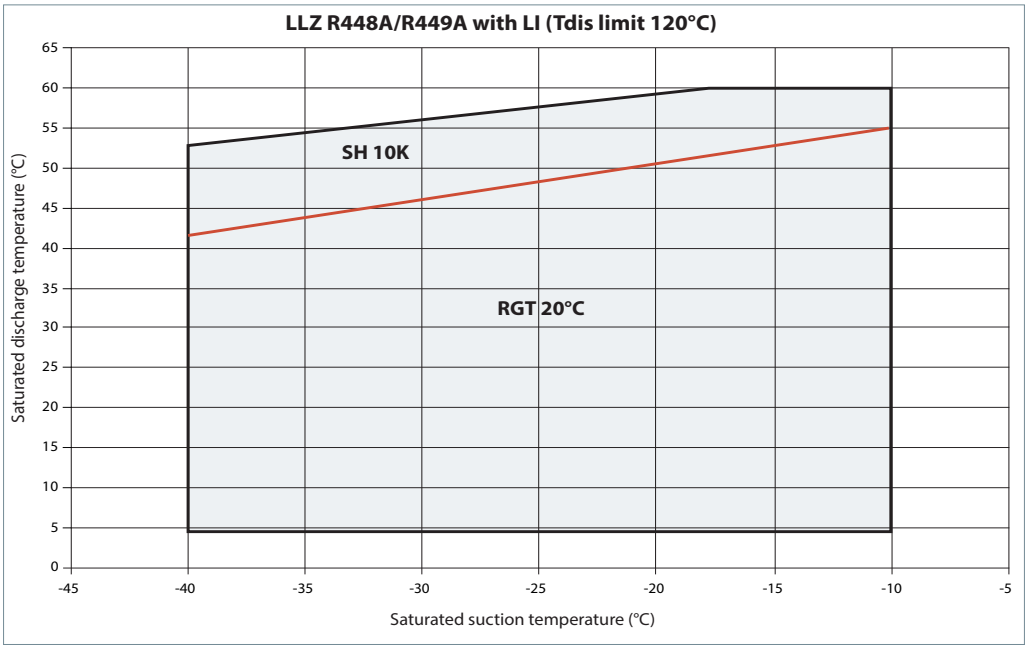
Steady-state operation envelope is valid for a suction superheat high than 5K

LLZ compressor operating envelops are different with refrigerant and with/with out injection. The details are as following.

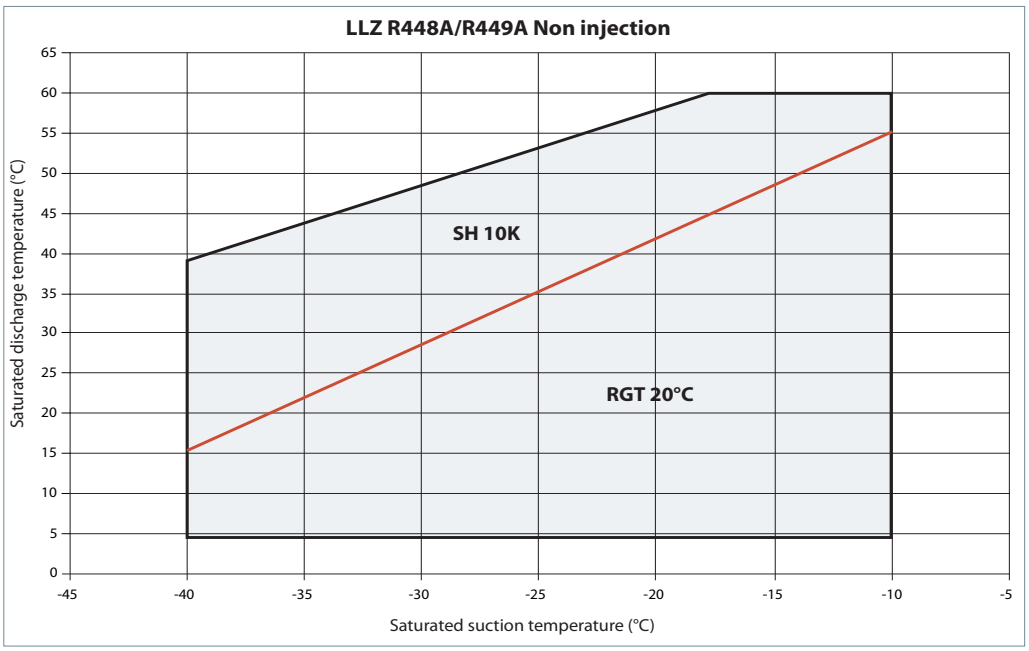
LLZ Compressor with R404A/R507, Non Injection



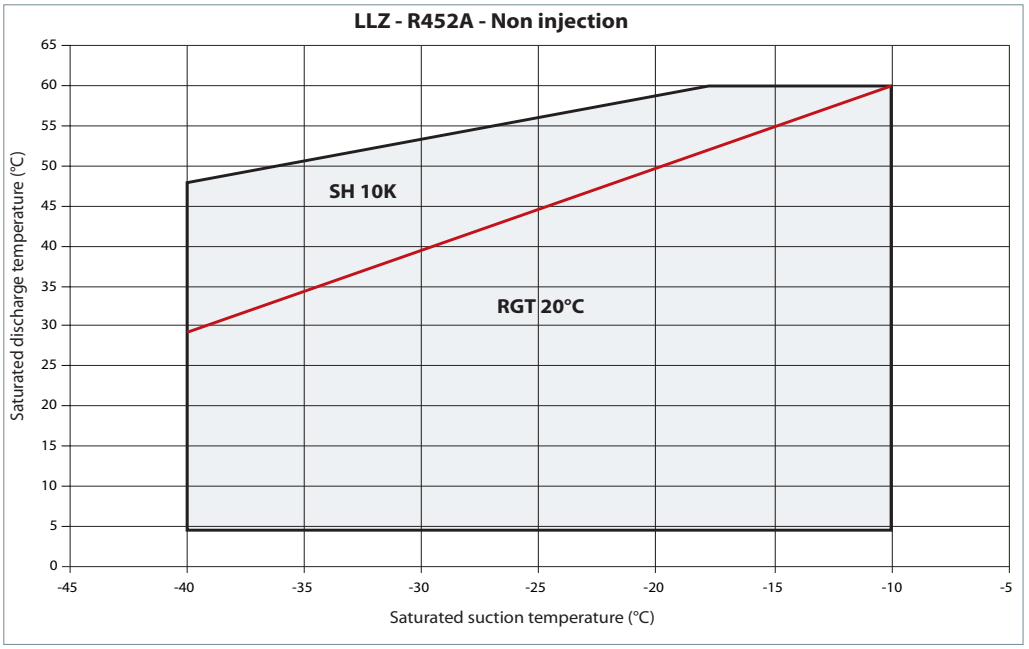
LLZ Compressor with R448A/R449A with LI



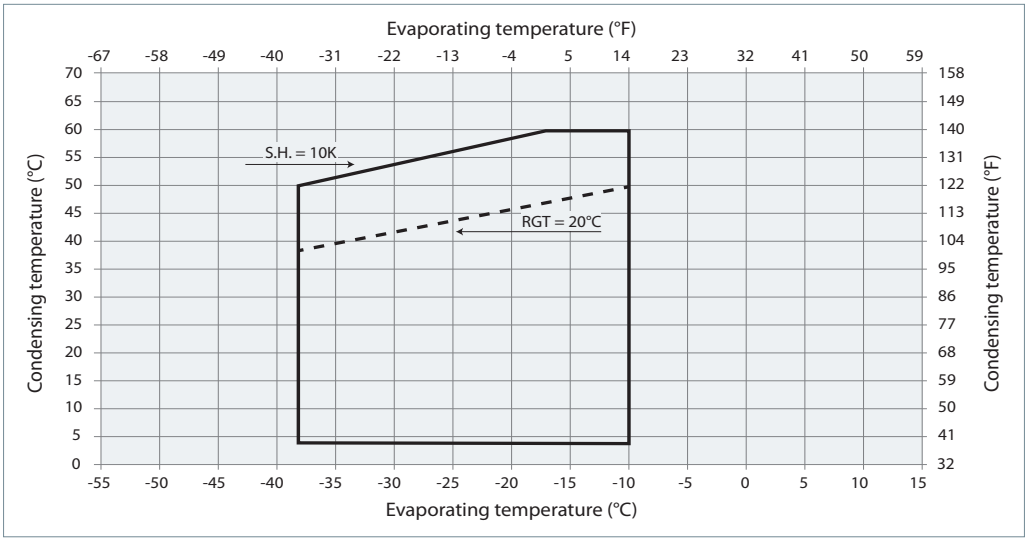
LLZ Compressor with R448A/R449A Non injection



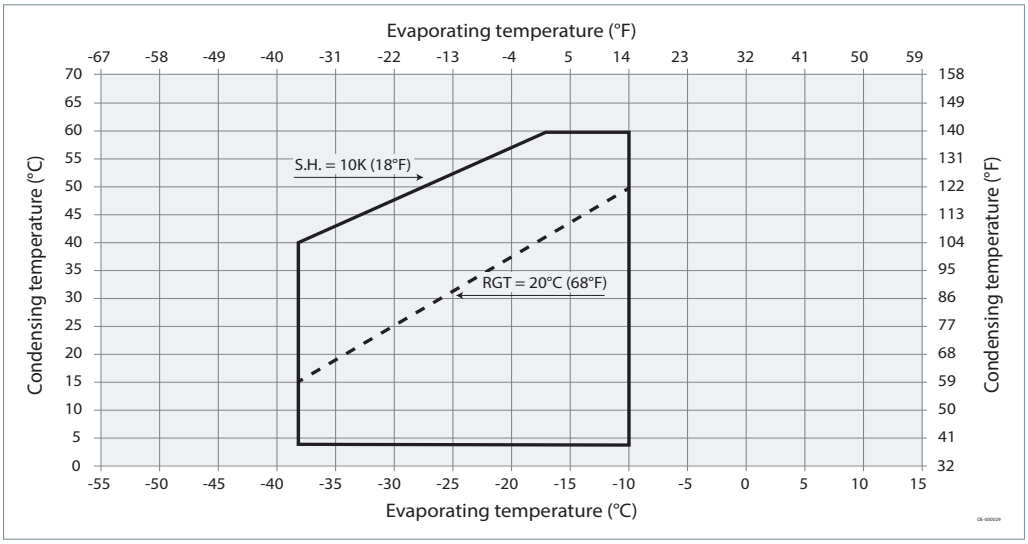
LLZ Compressor with R452A, Non injection



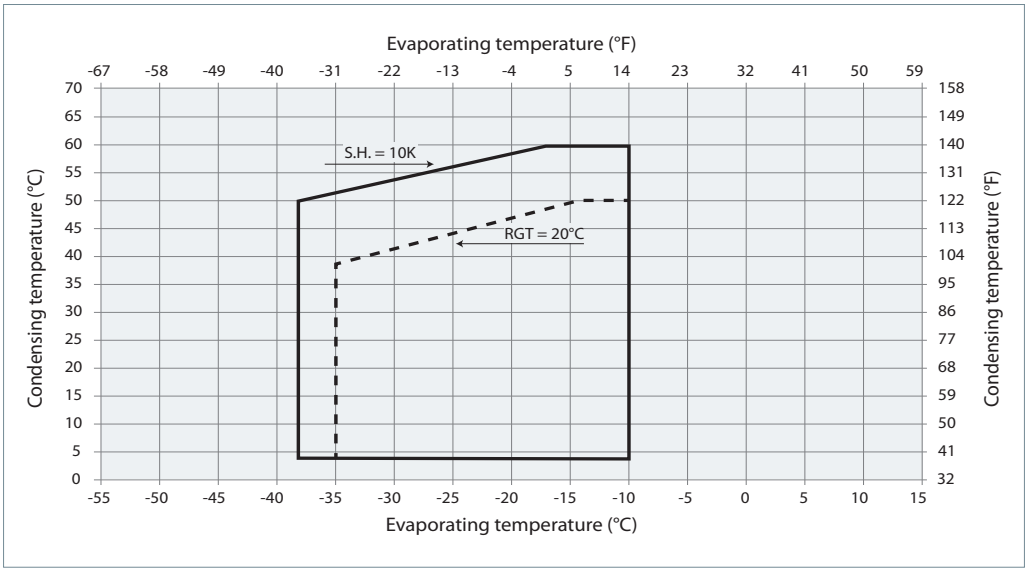
R454C - LLZ with injection



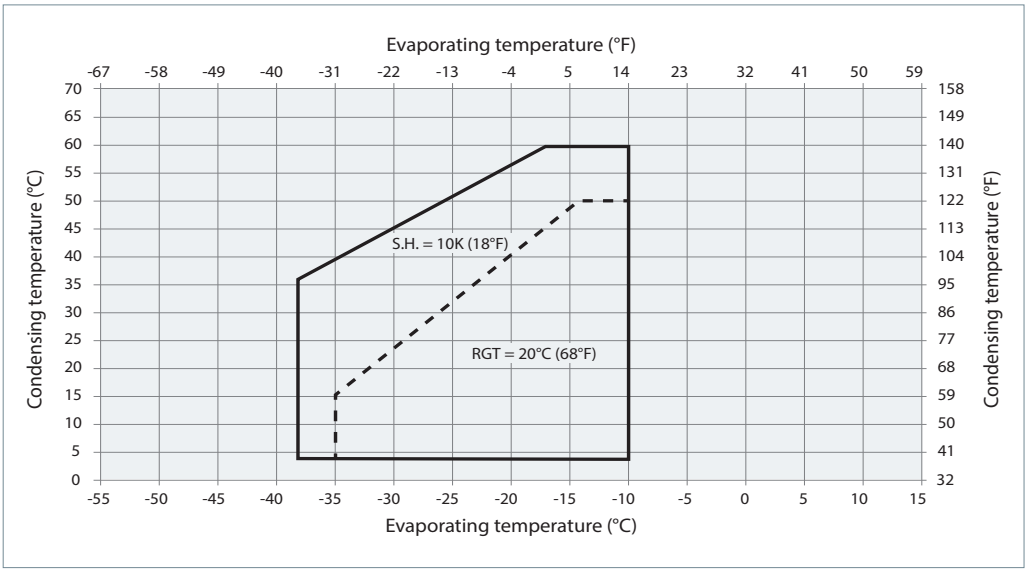
R454C - LLZ with non injection



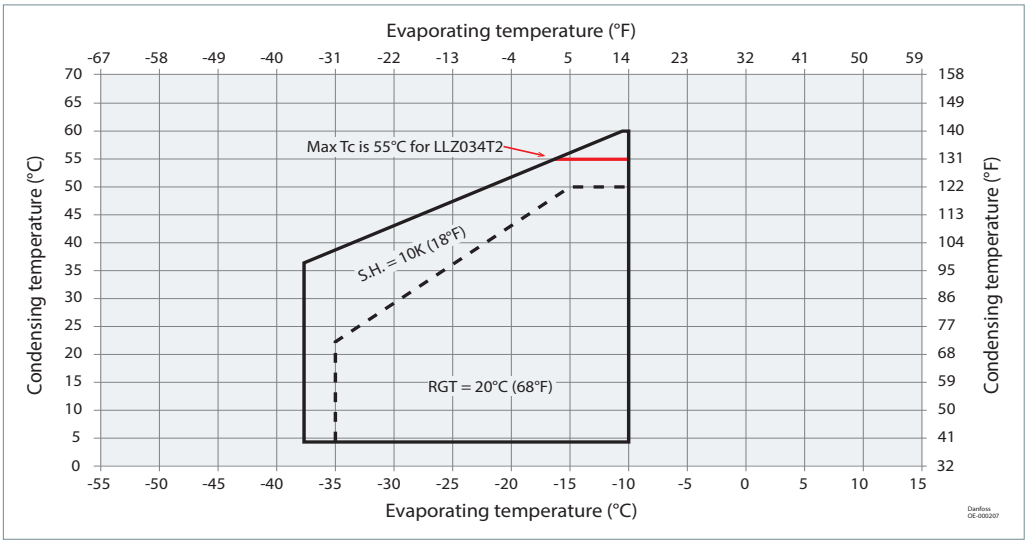
R455A - LLZ with injection



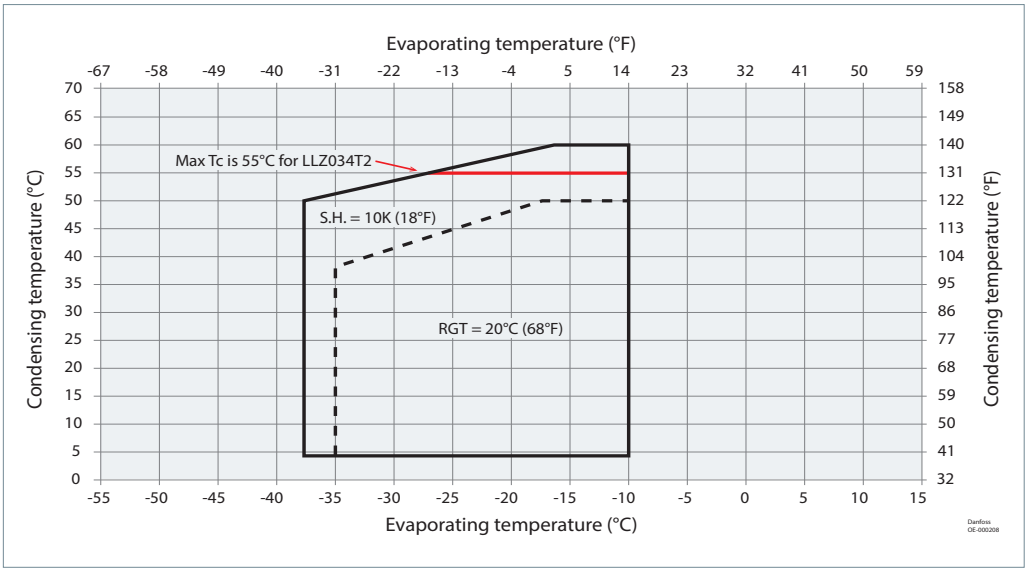
R455A - LLZ with non injection



R454A - LLZ with non injection



R454A - LLZ with injection



Manage operating envelope

Pressure settings		R454C	R455A	R404A/R507	R448A/ R449A	R452A	R454A
Working range high side	bar(g)	4.2 - 22.3	4.5 - 24.3	5.9 - 27.7	4.9 - 26.0	5.5 - 27.3	5.3 - 26.9
Working range low side	bar(g)	0.0 - 2.2	0.1 - 2.4	0.3 - 3.3	0.0 - 2.6	0.2 - 3.0	0.2 - 2.9
Maximum high pressure safety switch setting	bar(g)	25.0	27.0	29.7	28	29.3	28.9
Minimum low pressure safety switch setting	bar(g)	0.0	0.0	0.2	0.0	0.1	0.1
Minimum low pressure pump-down switch setting	bar(g)	0.0	0.0	0.4	0.0	0.3	0.4
Recommended pump-down switch settings	bar(g)	1.5 bar below nominal evaporating pressure					

R LP and HP safety switches must never be bypassed nor delayed and must stop all the compressors.

HP safety switch must be manual reset

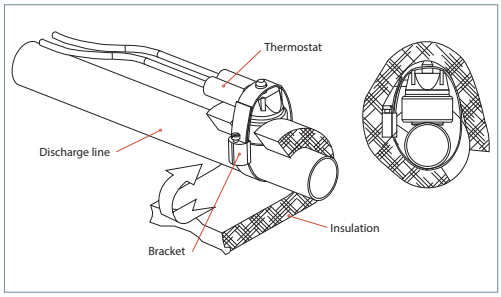
Depending on application operating envelope, you must define HP and LP limits within operating envelope and pressure setting table above.

For LLZ compressors, the external Discharge Gas Temperature protection (DGT) is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope.

The discharge gas thermostat accessory kit (code 7750009) includes all components required for installation as shown on the right. DGT installation must respect below requirements:

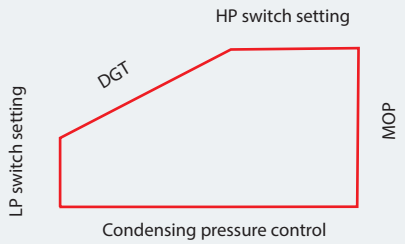
When LP safety switch worked, limit the number of auto-restart to maximum 5 times within 12 hours.

- The thermostat must be attached to the discharge line within 150 mm from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.
- The DGT should be set to open at a discharge gas temperature of 135°C.



Evaluate the risk

We consider two types of operating envelope management:

Basic: • HP and LP switch • MOP (Max Operating Pressure) ensured by expansion device • Condensing pressure control • DGT	Advanced: • HP and LP sensor • Operating envelope limits (permanent and transient) integrated into control logic • DGT
	No additional test are required

Theory of Liquid injection cycle

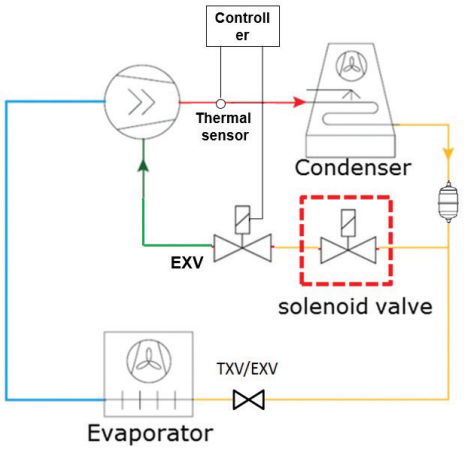
The below schematic shows a system configuration with a liquid injection cycle (1234561). The liquid refrigerant is injected into scroll pocket, the injected liquid will flash and absorb heat from compressed gas and scroll set. Then the liquid will cool the discharge gas, keep discharge gas temperature within safe limits.

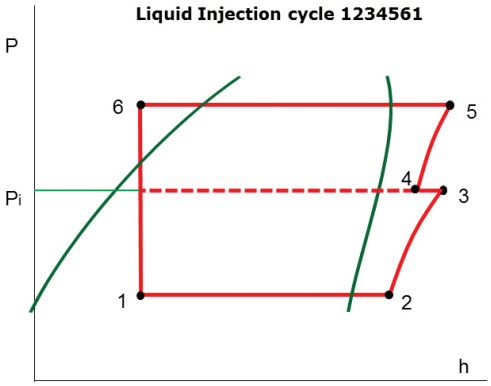
Liquid injection is achieved by an expansion valve. The valve can regulate the injection mass flow according to discharge temperature.

An additional solenoid valve has to be installed, it should close when compressor stops to prevent from liquid slug.

To prevent a partial or full blockage at the injection port caused through shavings, foreign bodies etc. , a filter dryer should be installed in the liquid line prior to the injection valve inlet.

Injection is disabled during defrost cycle or unit startup period.





During normal operation, refrigerant enters the compressor as a superheated vapor. Liquid flood back occurs when a part of the refrigerant entering the compressor is still in liquid state.

Liquid flood back can cause oil dilution and, in extreme situations lead to liquid slugging that can damage compression parts.

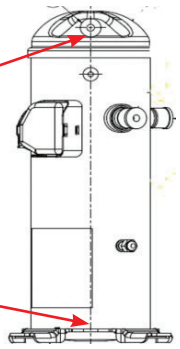
Requirement

In steady state conditions,
- Suction superheat must be higher than 5K
- Discharge superheat must be higher than 15K
- Oil superheat must be higher than 10K

In transient conditions,
- Discharge superheat must be higher than 5K
- Oil superheat must be higher than 10K

Discharge temperature sensor must be placed onto the discharge fitting and be insulated.

Oil temperature sensor must be placed between oil sight glass and compressor baseplate and be insulated.



Evaluate the risk

Use the tables below in relation with the system charge and the application to quickly evaluate the risk and potential tests to perform.

	BELOW charge limit	ABOVE charge limit
	No test or additional safeties required	Liquid flood back test

Charge limit is defined in table below:

	Models	Refrigerant charge limit (kg)
Single	LLZ013-015-018	4.54
	LLZ024-034	7.26

Test, criteria and solutions

Test	Purpose	Test condition	Pass criteria	Solutions
Liquid flood back test	Steady-state	Liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load (A). 	Oil superheat>10K Steady-state discharge superheat>15K	1. Check expansion valve selection and setting 2. Add a suction accumulator*
	Transient	Tests must be carried out with most unfavorable conditions : • fan staging, • compressor staging • …	Oil superheat>10K Transient discharge superheat >5K	1. Check expansion valve selection and setting. -For Thermostatic expansion valve (TXV) check bulb position... -For Electronic expansion valve (EXV) check measurement chain and PID.... 2. Add a suction accumulator*
Defrost test	Check liquid floodback during defrost cycle	Defrost test must be carried out in the most unfavorable condition (at 0°C evaporating temperature)	Oil superheat>10K Transient discharge superheat >5K	In refrigeration system, there are different defrost method, such as electric method. (for more details see “Control Logic”).

*Suction accumulator offers protection by trapping the liquid refrigerant upstream from the compressor. The accumulator should be sized at least 50 % of the total system charge. Suction accumulator dimensions can impact oil return (gas velocity, oil return hole size…), therefore oil return has to be checked according to section “Manage oil in the circuit”.

Manage off cycle migration

R Off -cycle refrigerant migration happens:
• when the compressor is located at the coldest part of the installation, refrigerant vapor condenses in the compressor.
• or directly in liquid-phase by gravity.

When the compressor starts running again, the refrigerant diluted in the oil generates poor lubrication conditions. In extreme situations, this leads to liquid slugging that can damage compression parts.

Requirement

Amount of liquid refrigerant in the compressors must not overpass the charge limit (refer to charge limit table in section "Manage superheat")

Evaluate the risk

Use the table below in relation with the system charge (refer to charge limit table in section "Manage superheat") and the application to quickly define necessary safeties to implement and test to perform:

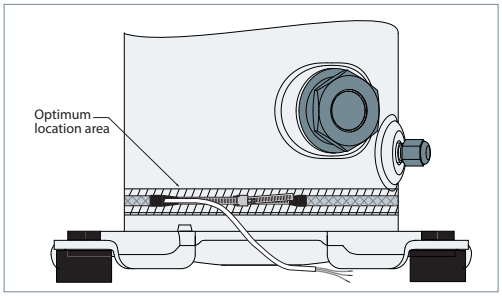
	BELOW CHARGE LIMIT	ABOVE CHARGE LIMIT
Non split	No test or additional safeties required	• Belt type crankcase heater * • Migration test • (External Non-Return Valve)
Split	Since each installation is unique, no test can fully evaluate off-cycle migration, therefore the following safeties are required: • Belt type crankcase heater * • Liquid Line Solenoid Valve**+ pump-down cycle***	

Test, criteria and solutions

Test N°	Purpose	Test condition	Pass criteria	Solutions
Migration test	Check that there is no migration of refrigerant into the compressor (either liquid or vapour condensating)	Energize CCH*. Stabilize the non-running system at a pressure equivalent to 5°C . Raise the system pressure equivalent to 20°C. When saturated condensing temperature reaches 20°C then start the unit.	When all compressors are idle: • Check in liquid line sight glass that there is no liquid refrigerant transfer • Oil superheat must be >10K during off-cycle After compressors has started: • Oil superheat must remain >10K	1. Check bulb position, tightness of expansion device, 2. add LLSV** 3. add pump down cycle*** 4. Check crankcase heater efficiency

Oil temperature sensor must be placed between oil sight glass and compressor baseplate and be insulated.

*Crankcase heater (CCH)
The blet type sump heaters are designed to protect the compressor against off-cycle migration of refrigerant.
Additional heater power or thermal insulation might be needed in case of ambient temperature below -5°C and a wind speed above 5m/second.
The heater must be energized whenever all the compressors are off.
Crankcase heater accessories are available from Danfoss (see section "Accessories").



It is recommended that the heater be turned on for a minimum of 8 hours prior to starting the compressor.

**Liquid line solenoid valve (LLSV)
A LLSV is used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer to the compressor during off -cycles. The quantity of refrigerant on the low-pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.

***Pump-down cycle
By decreasing pressure in the sump, pump down:
• evacuates refrigerant from oil
• set the sump saturating pressure much lower than ambiance temperature and due to that, avoid refrigerant condensation in the compressor.
Pump-down must be set higher than minimum pressure switch setting for pump-down (see section "manage operation envelop").

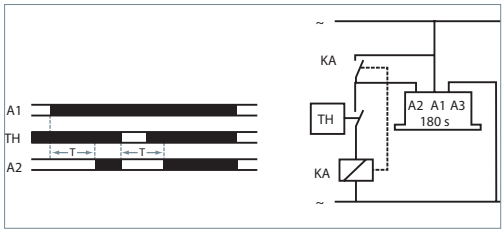
For more details on pump-down cycle see section "Control Logic".

Safety control logic requirements

	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP switch	See Pressure settings table from section "Manage operating envelope"	Immediate, no delay. No by- pass	Conditions back to normal. Switch closed again	Manual reset
LP safety switch				Maximum 5 auto reset during a period of 12 hours, then manual reset.
Electronic module (Motor protection, DGT)	Contact M1-M2 opened			Maximum 5 auto reset during a period of 12 hours, then manual reset.

Cycle rate limit requirements

Danfoss requires a minimum compressor running time of 2 minutes to ensure proper oil return and sufficient motor cooling.
Additionally, compressor service life is based on a maximum of 12 starts per hour.



Therefore, to guarantee these 2 requirements, a three-minute (180- sec) time out is recommended.

Oil management logic recommendations

In some cases, oil management can be enhanced by control logic:

- If oil return test failed, a function can be integrated in control to run all compressors simultaneously during one minute every hour in order to boost oil return. Time and delay can be fine-tuned by oil return test N°1 in section "Manage oil in the circuit". During oil boost, pay special attention to superheat management to avoid liquid flood back and foaming.
- If after running long time in full load, oil unbalance appears, then a function can be in control to stop all compressors during one minute every two hours in order to balance oil between compressors. Time and delay can be fine-tuned by Oil balancing test N°2 in section "Manage oil in the circuit".

Defrost logic recommendations

In refrigeration system applications, there are different defrost methods, such as electric heating defrost, hot gas bypass defrost, reversible defrost etc. For the systems which use hot gas bypass or reversible defrost method, suction accumulator is necessary as a result of the possibility of a substantial quantity of liquid refrigerant remaining in the evaporator.

This liquid refrigerant can then return to the compressor, either flooding the sump or as a dynamic liquid slug when the cycle switch back to normal cooling operations. Sustained and repeated liquid slugging and flooding can seriously impair the oil's ability to lubricate the compressor bearings. In such cases a suction accumulator is a must.

Pump-down logic recommendations

Pump-down cycle: Once the system has reached its set point and is about to shut off, the LLSV on the liquid line closes. The compressor then pumps the majority of the refrigerant charge into the high pressure side before the system stops on the low pressure pump-down switch. This step reduces the amount of charge on the low side in order to prevent off-cycle migration.
A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of refrigerant; however it is only convenient to apply on application with thermostatic control.
Rack application with pressostatic control can use timer delay to empty the evaporators before the stop. Time should be carefully set to not interfere with the low safety pressure switch.
For low pressure pump-down switch settings, refer to section "High and low pressure protection". For suggested wiring diagrams, please see section "Wiring diagram".
Under certain conditions, the internal valve may not completely seal, and due to the refrigerant back flow the compressor might restart during pump-down applications. Repeated short cycling can result in a compressor breakdown. It is recommended to install an external magnetic check valve (such as Danfoss Part No. 120Z5046) close to the compressor's discharge connector so the discharge volume is minimized.
A magnetic check valve is recommended for this as it offers the best solution regarding minimal required and maximal pressure drop over the wide application envelope of the LLZ scroll compressors. If a Danfoss NRV check valve is applied it has to be carefully selected for the specific operation conditions of the individual system.

Tests for pump down cycle approval:
- As the pump-down switch setting is inside the application envelope, tests should be carried out to check unexpected cut-out during transient conditions (i.e. defrost - cold starting). When unwanted cut-outs occur, the low pressure pump-down switch can be delayed. In this case a low pressure safety switch without any delay timer is mandatory.
- While the thermostat is off, the number of pressure switch resets should be limited to avoid short cycling of the compressor. Use dedicated wiring and an additional relay which allows for one shot pump-down.

Wiring information

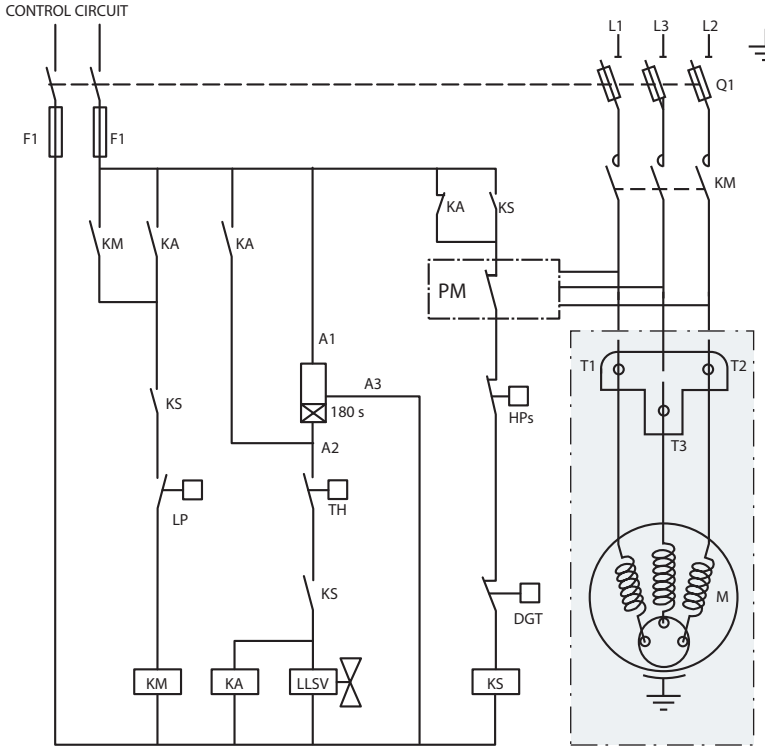
Requirements:

- An additional external overload protection is still advisable for either alarm or manual reset. For overload setting, take the max current you can face on the application and add 10%. Setting must always be lower than Max Operating Current (see table…)
- HP safety switch and DGT must be wired in the safety chain. Other safety devices such as LP can be either hardware or software managed.
- Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (e.g. seasonal shutdown).

The wiring diagrams below are examples for a safe and reliable compressor wiring:

The wiring diagrams below are examples for a safe and reliable compressor wiring:

Compressor model LLZ 013 - 015 - 018 - 024 - 034



Wiring diagram with pump-down cycle

Control device.....TH
Optional short cycle timer (3 mins) .180 s
Control relay.....KA
Liquid Line Solenoid valve.....LLSV
Compressor contactor.....KM
Phase monitor.....PM
Safety lock out relay.....KS
Pump-down control low pressure switch.....LP
High pressure safety switch.....HPs
Fused disconnect.....Q1
Fuses.....F1
Compressor motor.....M
Discharge gas thermostat.....DGT

Note:
For LLZ phase monitors are mandatory. The selected phase monitor should lock out the compressor from operation in reverse.

	Excessive air and moisture • can increase condensing pressure and cause excessively high discharge temperatures. • can create acid giving rise to copper platting. • can destroy the lubricating properties of the oil.	All these phenomena can reduce service life and cause mechanical and electrical compressor failure.
Requirements	LLZ compressors are delivered with < 100 ppm moisture level.	At the time of commissioning, system moisture content may be up to 100 ppm. During operation, the filter drier must reduce this to a level between 20 and 50 ppm.
Solutions	To achieve this requirement, a properly sized and type of drier is required. Important selection criteria's include: • driers water content capacity, • system refrigeration capacity, • system refrigerant charge.	For new installations with LLZ compressors with polyolester oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier.

Compressor storage

Store the compressor not exposed to rain, corrosive or flammable atmosphere between -35°C and 70°C when charged with nitrogen.

Compressor holding charge

Each compressor is shipped with a nominal dry nitrogen holding charge between 0.4 and 0.7 bar and is sealed with elastomer plugs.

R Respect the following sequence:

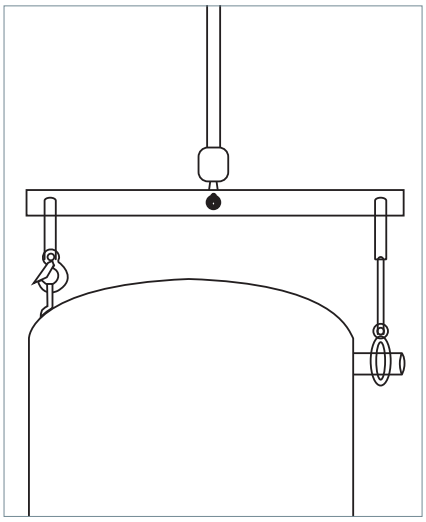
- Remove the nitrogen holding charge via the suction schrader valve to avoid an oil mist blow out.
- Remove the suction plug first and the discharge plug afterwards to avoid discharge check valve gets stuck in open position.

An opened compressor must not be exposed to air for more than 20 minutes to avoid moisture is captured by the POE oil.

Handling

R Compressor handling

LLZ Compressors are provided with a lifting lug. This lug should always be used to lift the compressor.
Once the compressor is installed, the lifting lug should never be used to lift the complete installation. The compressor must be handled with caution in the vertical position, with a maximum inclination of 15° from vertical.



Piping assembly

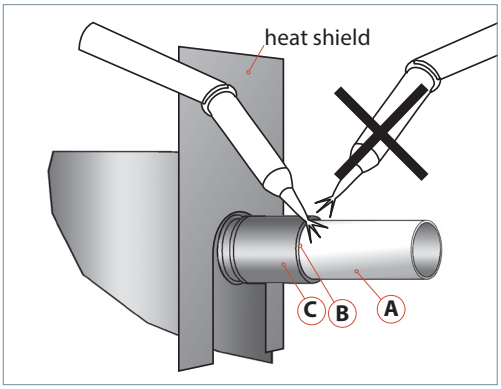
Good practices for piping assembly is a pre-requisite to ensure compressor service life.

System cleanliness

Circuit contamination possible cause:	Requirement:
Brazing and welding oxides	During brazing, flow nitrogen through the system
Filings and particles from the removal of burrs in pipe-work	Remove any particles and burrs generated by tube cutting and hole drilling
Moisture and air	Use only clean and dehydrated refrigeration grade copper tubing Opened compressor must not be exposed to air more than 20 minutes to avoid moisture captured by POE oil

Brazing procedure:

- Brazing operations must be performed by qualified personnel.
- Make sure that no electrical wiring is connected to the compressor.
- To prevent compressor shell and electrical box overheating, use a heat shield and/or a heat-absorbent compound.
- Clean up connections with degreasing agent
- Flow nitrogen through the compressor.
- Use flux in paste or flux coated brazing rod.
- Use brazing rod with a minimum of 5% silver content.
- It is recommended to use double-tipped torch using acetylene to ensure a uniform heating of connection.
- For discharge connections brazing time should be less than 2 minutes to avoid NRVI damages if any.
- To enhance the resistance to rust, a varnish on the connection is recommended.



R Before eventual un-brazing of the compressor or any system component, the refrigerant charge must be removed.

System pressure test and leak detection

! The compressor has been strength tested and leak proof tested (<3g/year) at the factory.
For system tests:

- Always use an inert gas such as Nitrogen or Helium.
- Pressurize the system on HP side first then LP side.
- Do not exceed the following pressures:

Maximum compressor test pressures	
Maximum compressor test pressure high side (HP)	31.1 bar (g)
Maximum compressor test pressure low side (LP)	31.1 bar (g)

Vacuum evacuation and moisture removal

Requirements:
- Never use the compressor to evacuate the system.
- Connect a vacuum pump to both the LP and HP sides.
- Evacuate the system to a pressure of 500 µm Hg (0.67 mbar) absolute.

Recommendations:
- Energized heaters improve moisture removal.
- Alternate vacuum phases and break vacuum. with Nitrogen to improve moisture removal.

For more detailed information see "Vacuum pump-down and dehydration procedure" TI-026-0302.

Refrigerant charging

R

Initial charge:
- For the initial charge, the compressor must not run.
- Charge refrigerant as close as possible to the nominal system charge.
- This initial charging operation must be done in liquid phase between the condenser outlet and the filter drier.

If needed, a complement of charge can be done:
- In liquid phase while compressor is running by slowly throttling liquid in.
- On the low pressure side, as far away as possible from the compressor suction connection.
- Never bypass safety low pressure switch.

For more detailed information see "Recommended refrigerant system charging practice" FRCC.EN.050.

Dielectric strength and insulation resistance tests

The tests are performed on each compressor at the factory between each phase and ground.

- Dielectric strength test is done with a high potential voltage (hi-pot) of 2Un +1000V AC at least, and leakage current must be less than 5 mA. Additional tests of this type are not recommended as it may reduce motor lifetime. Nevertheless, if such a test is necessary, it must be performed at a lower voltage.

R Do not use a megohm meter nor apply power to the compressor while it is under vacuum as this may cause internal damage.

- Insulation resistance is measured with a 500 V DC megohm tester and must be higher than 1 megohm.
- The presence of refrigerant around the motor windings will result in lower resistance values to ground and higher leakage current readings. Such readings do not indicate a faulty compressor. To prevent this, the system can be first operated briefly to distribute refrigerant.

Preliminary check

⚠ Check electrical power supply:
- Phase order: For LLZ compressors equipped with an electronic module, reverse rotation will be automatically detected. For more details refer to section "Motor protection".
- Voltage and voltage unbalance within tolerance: For more details refer to section "Motor voltage".

Initial start-up

- Surface sump heaters must be energized at least 8 hours in advance to remove refrigerant.
- A quicker start-up is possible by "jogging" the compressor to evacuate refrigerant. Start the compressor for 1 second, then wait for 1 to 2 minutes. After 3 or 4 jogs the compressor can be started. This operation must be repeated for each compressor individually.

System monitoring

The system must be monitored after initial startup for a minimum of 60 minutes to ensure proper operating characteristics such as:
- Correct superheat and subcooling.
- Current draw of individual compressors within acceptable values (max operating current).
- No abnormal vibrations and noise.
- Correct oil level.

If Oil Top-up is needed, it must be done while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line. Always use original Danfoss POE oil 160SZ from new cans.
For more detailed information see "Lubricants filling in instructions for Danfoss Commercial Compressors" TI 2-025-0402.

Danfoss recommends that compressors and compressor oil should be recycled by a suitable company at its site.

Single pack

Compressors are packed individually in a cardboard box. They can be ordered in any quantity. Minimum ordering quantity = 1.

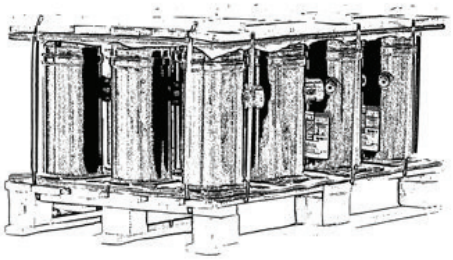
As far as possible, Danfoss will ship the boxes on full pallets of 9 compressors according below table.

Compressor model	Length (mm)	Width (mm)	Height (mm)	Gross weight (kg)
LLZ013	1169	965	730	460
LLZ015	1169	965	730	460
LLZ018	1169	965	730	468
LLZ024	1169	965	775	495
LLZ034	1169	965	817	544

Note : Here including 9 single pack compressors

Industrial pack

Compressors are not packed individually but are shipped all together on one pallet. They can be ordered in quantities of full pallets only, multiples of 12 compressors, according below table.



Compressor model	Nbr*	Length (mm)	Width (mm)	Height (mm)	Gross weight (kg)	Static stacking pallets
LLZ013	12	1170	815	665	538	3
LLZ015	12	1170	815	665	538	3
LLZ018	12	1170	815	665	550	3
LLZ024	12	1170	815	720	586	3
LLZ034	12	1170	815	817	651	3

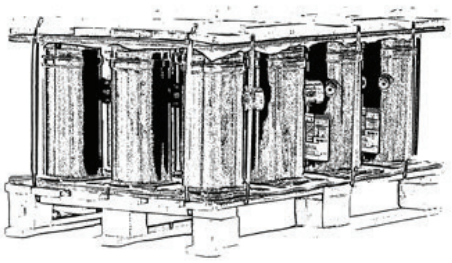
Compressor code numbers

Danfoss scroll compressors LLZ can be ordered in either industrial packs or in single packs. Please use the code numbers from below tables for ordering.

Single pack

Compressors	Model variation	Connections	Features	Evolution	Voltage code2
LLZ013	T	Q	9	C	121L9053
LLZ015	T	Q	9	C	121L9055
LLZ018	T	Q	9	C	121L9057
LLZ024	T	Q	9	C	121L9059
LLZ034	T	Q	9	C	121L9061

Industrial pack



Compressors	Model variation	Connections	Features	Evolution	Voltage code2
LLZ013	T	Q	9	C	121L9054
LLZ015	T	Q	9	C	121L9056
LLZ018	T	Q	9	C	121L9058
LLZ024	T	Q	9	C	121L9060
LLZ034	T	Q	9	C	121L9062

Crankcase heater

Type	Code No	Description	Application	Packaging	Pack Size
	120Z5040	Belt type crankcase heater, 70 W, 240 V, UL, CE mark	All models	Multipack	4
	120Z0059	Belt type crankcase heater, 65 W, 230 V, UL, CE mark		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

Lubricant

Type	Code No	Description	Application	Packaging	Pack Size
	120Z0648	POE lubricant, 215PZ(RL46HB),1 litre can	All models	Multipack	12

Mounting kit

Type	Code No	Description	Application	Packaging	Pack Size
	120Z0662	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge and economizer fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves.	LLZ013/015/018	single	1
	120Z0663	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers, rotolock connection kit for suction, discharge and economizer fitting for 1 scroll compressor including 3 Teflon seals, 2 nuts, 3 sleeves.	LLZ024/034	single	1

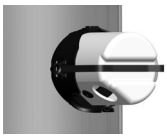
Acoustic hood

Type	Code No	Description	Application	Packaging	Pack Size
	120Z5052	Acoustic hood for scroll compressor	LLZ013-015-018	Single pack	1
	120Z5053	Acoustic hood for scroll compressor	LLZ024-034	Single pack	1

Terminal box

Type	Code No	Description	Application	Packaging	Pack Size
	120Z5018	Square terminal box (C & Q version)	C and Q version	Multipack	10

IP54 upgrade kit



Type	Code No	Description	Application	Packaging	Pack Size
	118U0057	IP54 upgrade kit	All models	Multipack	6

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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 spanning across three continents.

Danfoss Turbocor Compressors

Danfoss Inverter Scrolls

Danfoss Scrolls

Danfoss Maneurop Reciprocating Compressors

Danfoss Optyma Condensing Units

Danfoss Light Commercial Refrigeration Compressors

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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