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Detailed Installation Instructions  
translated from the original notice

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**Please read this notice in full.**

The implementation, operation, maintenance and end-of-life management of products involves following strict rules in accordance with existing standards and best practices. Current standards and legislation should be respected in the country where the compressor is installed, and the rules of good refrigeration and electrical installation practice should be applied.

These instructions cover the main points of the ISO Standards. The EN guidelines and standards described below prevail in the European Union.

**1. Statements of compliance and incorporation**

These refrigeration compressors are designed to be incorporated into machines in accordance with the Machinery Directive 2006/42/EC. They comply with the Low voltage Directive 2014/35/EU and the PED Directive 2014/68/EU. Their commissioning is only permitted if they have been assembled in accordance with the following instructions, and if the machines comply with existing regulations.

In case of the use of A2L-classified refrigerants following ISO 817, follow the safety rules specific to flammable fluids. The compressors will be installed, maintained in accordance with ISO 5149 or EN 378 or EN60335-2 safety standards. FH2 compressors with A2L refrigerants requiring above compliance are with designation FH\*\*\*\*N for R1234yf, FH\*\*\*\* P for R454C and R455A.

**2. Safety and risks associated with the implementation and use of flammable refrigerants, classified as Category A2L**

**2.1. Flammable refrigerants:**

R1234yf is a pure hydrofluoro olefin (HFO) fluid.

R455A is a non-azeotropic mixture of hydrofluoro olefin (HFO), hydrofluorocarbon (HFC) and natural fluid composed of R1234yf (75.5%), R32 (21.5%) and R744 (3%)

R454C is a non-azeotropic mixture of hydrofluoro olefin (HFO) and hydrofluorocarbon (HFC) composed of R1234yf (78.5%) and R32 (21.5%)

R1234yf, R455A, and R454C fluids are heavier than air so they will naturally accumulate at the floor or bottom of the installation in the absence of ventilation .

Their main features are:

Refrigerant	R1234yf	R455A	R454C
Security class	A2L	A2L	A2L
Lower flammability limit under normal conditions in volume/volume according to ISO 817	6.2%	11.8%	6.2%
Lower flammability limit under normal conditions	0.289 kg/m <sup>3</sup>	0.431 kg/m <sup>3</sup>	0.293 kg/m <sup>3</sup>
Practical limit 20% LFL	57.8 g/m <sup>3</sup>	86 g/m <sup>3</sup>	59 g/m <sup>3</sup>
Self-ignition temperature (following ISO 817)	405°C	ND (473°C supplier data)	ND (> 400°C supplier data)



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Caution : Never use the product without referring to the Safety Data Sheet (S.D.S.) provided by refrigerant supplier/manufacturer.

2.2. Scope of application of standards for refrigeration systems using flammable fluids

Where authorised by local regulations and provided that the location is suitable, the maximum Refrigerant charge quantity for hermetically sealed compressors running on R1234yf, R455A, R454C are defined in the table below:

Refrigerant	following EN 60335-2 series standards (except EN 60335-2-40)	following CEI 60335-2-89 standards	following EN 378-1: 2017*
<b>R1234yf</b>	150g	1200g	<b>1700g</b>
<b>R455A</b>	150g	1200g	<b>2500g</b>
<b>R454C</b>	150g	1200g	<b>1600g</b>

\*For higher refrigerant charge Quantities, please refer to the requirements of Standard EN 378-1

2.3. Preventing the formation of potentially explosive zones

The use of flammable fluids may present a risk of ignition in the event of a leak. It is therefore important to ensure that the refrigeration system design and adequate compressor ventilation to avoid risk of formation of an explosive zone.

2.4. Staff Qualification

It is essential that Standard EN 378-3 is observed during installation and Standard EN 378-4 during maintenance works. To maintain and repair the installations, staff must be authorised to handle refrigerants and correctly trained in the handling of flammable refrigerants in order to avoid the risk of the formation of an explosive atmosphere.

Consequently, staff must know the tools, the transportation procedure for the compressor and refrigerant, and the safety precautions and regulations that apply to maintenance and repair work. Do-not use ignition sources while handling flammable refrigerants.

2.5. Protection of the compressor's electric terminal

The disintegration of the insulation (glass bead) on a compressor electrical terminal due to physical shock or over heating can result in terminal venting . Oil and refrigerant can spray out of the compressor if one of the terminal pins is ejected from the hermetic terminal, this mixture can be ignited by electricity/ spark and produce flames that can lead to serious burns or death. Any accidental damage to the electrical terminal during compressor's installation or operation must be scrapped.

To reduce the risk of electrocution or serious burns or death from terminal venting with ignition never energize the system unless the compressor's protective terminal cover is securely fastened and the compressor is properly connected to ground.

Also, especially when using flammable refrigerants, Tecumseh advocates the use of a security system to protect users, installers and installation. The system will be able to detect a spike in intensity that could melt the insulation (the phenomenon of "terminal venting"), and will thereby cut off the compressor's power supply.

Since the compressor is not equipped with protection in the case of an external fire, it is appropriate for the equipment manufacturer to secure the installation to prevent a fire. Adequate means of purging and protection against exceeding permissible limits (see conditions on the PED label) must be provided. Compressors should not be installed in a corrosive or dusty environment.



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3. **Specifications - Marking compressors in the FH² range**

3.1. **Identification label and designation:**

FH\*\*\*\*N, FH\*\*\*\*P compressors are CATEGORY II certified under the 2014/68/EU PED Pressure Equipment Directive.

(Reference free internal volume: 6.16L)

(\*) : additional information for products under PED

Labels contain the following information:

<p>Information in agreement with EN 378-2:</p> <p>Ref. Designation</p> <p>a Voltage</p> <p>b Frequency</p> <p>c Number of phases</p> <p>d Bill of Material</p> <p>e Refrigerant</p> <p>f Model Number</p> <p>g Serial number</p> <p>h Maximum allowable pressure (*)</p> <p>i Min/max temperature (*)</p> <p>j 1.1 * PS (*)</p> <p>k Registration number of the notified body (*)</p> <p>l Manufacturing and testing date (*)</p> <p>m Free volume</p>	
<p>FH****P compressors are qualified for R455A and R454C          FH **** N compressors are qualified for R134a and R1234yf.</p> <p>The Identification label of these compressors has a yellow Flammable warning logo as shown opposite:</p>	

In the case of multi-fluid compressors, the Printed PS pressure = at the pressure of the fluid + binding to TS maxi

Fluids	PS (b)	PED category
R-404A	20.1	I
R-452A	21	I
R-449A	20.4	I
R-448A	20.4	I
R-455A	21.5	II
R-454C	18.4	II
R-1234yf	10.8	II
R-513A	11.5	I
R-134a	10.9	I

PS : relative pressure at bubble point



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### 3.2. Specifications

The housing of the compressors in the 'FH<sup>2</sup>' family is subject to the low pressure of the refrigeration system.

In line with the PED and in order to ensure the best level of quality of its products at all times, Tecumseh tests each compressor on an assembly line at a pneumatic pressure which is greater than or equal to the requirement 1.1 x PS as per Annex C 1.3.2 of standard NF EN 14276-1, irrespective of the refrigerant indicated on the identification label and based on the calculation of the most Critical refrigerant,

For information: 1.1 \* PS (46°C sat) = 24 bar rel for R455A.

Additional burst tests are also performed periodically.

### 4. Transport - handling:

The compressor is charged with oil and nitrogen (0.3 to 0.5 bar) at the final stage of assembly inside the factory: The compressors are delivered without refrigerant charged .

For information about compressor delivery, refer to your terms of sale. Check the condition of the equipment compressor at its reception. (Good exterior appearance, no shock or deformation) especially on the connection terminal.

Do not hold or lift the compressor by the tubes, use its lifting ring intended for this purpose. Refer to our technical documentation to find out which storage and transport positions are allowed.

The recommendations for transporting refrigeration systems/ appliances loaded with refrigerants are the responsibility of the respective manufacturer of these refrigeration systems / appliances.

### 5. Recommendations related to the use and assembly of the compressor in a refrigeration system:

In the case of operating with flammable refrigerants, installation must be designed on the basis of a risk analysis to avoid refrigerant accumulation in the event of leakage in areas that are potential ignition sources.

- It is recommended to provide a device capable of detecting current taken by compressor in order to prevent sudden surge in currents that could melt the insulation ("pin venting" phenomenon) on electrical terminal pin of the compressor.
- Provide appropriate protections in line with local regulations to prevent the public, user or anyone with access to the application from degrading the product.
- Also provide adequate signage for flammable refrigerants on the complete installation, so that the user or anyone with access to the application is aware of the risks associated with their presence (putting in place standard pictograms preventing the risk of flammability).
- Establish an appropriate way to alert the user that they need to call on a professional to manipulate the application.

#### 5.1. Maximum allowable pressure

Tecumseh compressors are designed to operate at a maximum ambient temperature of +46°C. Observe and comply with the specific regulations to optimise the quantity of refrigerant in the installation and never exceed the maximum discharge pressure corresponding to the maximum condensation temperature of the compressor's operation. The compressor housing should not be subjected to a temperature below -35°C; the materials used would not guarantee sufficient mechanical characteristics.



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## 5.2. Expansion element

Tecumseh recommends the use of thermostatic expansion valves.

## 5.3. Installation for the first commissioning

Tecumseh cannot be held responsible if the installation and maintenance do not comply with the instructions provided in this manual. Current guidelines and regulations in force in the country where the compressor is installed, and the rules of the art for refrigeration and electrical connections, must be complied with.

## 5.4. Location of the compressor and definition of refrigerant charge

### 5.4.1. Defining the refrigerant charge

The refrigerant charge should not exceed the amount that can be stored under high pressure. To prevent migration of refrigerant in to the compressor housing during the compressor's off period/ thermal cycling, or when the refrigerant charge quantity is greater than 1.5 Kg, Tecumseh recommends the use of a **crank case Heater** and/or an non-return valve (NRV) on the discharge pipe line connected to condenser inlet( Scope of supply of NRV lies with the Refrigeration system/ appliance manufacturer) .

The return of liquid during transitional periods will be prevented by Accumulator.

The maximum charge quantity of flammable refrigerants is defined in Annex C of EN 378-1 based on the volume in which the refrigeration system is installed, its location and its type of occupancy (non-exhaustive).

### 5.4.2. Location of electrical components that create sparks in the case of the use of A2L flammable fluids

They must be located in a non flammable area. Tecumseh recommends installing them high up, and in a adequately ventilated area.

### 5.4.3. Compressor location

Ensure that the compressor should not block the movement of people or opening of doors and shutters.  
Ensure that the compressor is mounted on a base or structure that has enough strength to support it's safe operation. Check that the compressor level is horizontal and ensure silent blocks are assembled to the mounting leg . Be careful not to block the flow of air around the electrical components and compressor, to ensure its cooling.

## 5.5. Brazing, refrigeration connections

As a reminder, Brazing can only be carried out on installations not loaded with refrigerants.

To keep the installation running smoothly, it is advisable to:

- Braze using dry nitrogen and keep any flames away from electrical equipment.
- Insulate the suction line up to the compressor entrance, to avoid condensation.

Cut and shape the tubes carefully, to prevent dust and metal particles from entering the system. Never use a saw. Use a bending tool adapted to the diameter of the tube to avoid excessive restrictions.

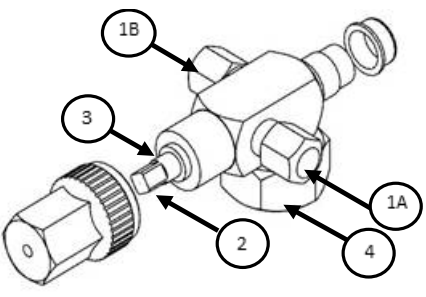
Tecumseh recommends brazed connections instead of Flare and Nut fittings to limit the likelihood of leakage over time. Screwed fittings on a flat surface using a gasket are acceptable. A leakage check is mandatory before commissioning.



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#### 5.6. Suction and Discharge valve tightening torques

<p>1- SAE tips 1/4": 7 to 11 Nm A – Process connection B – Pressure gauge connection</p> <p>2- setting needle square 1/4" : 6 à 13 Nm setting needle square 5/16" : 30 à 34,5 Nm</p> <p>3- packing gland nut: 5 à 13 Nm</p> <p>4- Rotalock connection 1"1/4- 12UNF : 114 Nm à 126 Nm. Rotalock connection 1"-14 UNS : 70 Nm à 85 Nm</p> <p>Unlock the packing nut before handling the float valve. Then tighten the packing nut.</p>	
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#### 5.7. Suspensions

An external suspension set including Silent blocks (Grommets) and spacers (sleeves) come as standard with all Tecumseh compressors. The role of these silent blocks is to reduce the transmission of vibrations generated by the compressor to the base on which it is mounted. In order to ensure this function properly, silent blocks should not be constrained. For this, the washer pressing on the spacer must leave a clearance of 1 to 4 mm from the top of the silent block. In order to not distort the spacer, apply a tightening torque of between 8 to 13 Nm for the M8 screws.

#### 5.8. Electrical connections

Electrical connections will be made before the refrigeration system is charged with refrigerant.

To preserve the quality of the Tecumseh compressor and the safety of the installation and ensure their proper operation, it is imperative to:

- Always wire the compressor when it is switched off.
- Validate the compatibility of the installation's power voltage with that of the compressor (see the nameplate).
- Validate the compatibility of the compressor's electrical drawing with that of the installation.
- Size the connecting cables (power, control) according to the characteristics of the installed compressor (see nameplate).
- Protect the power line and install a grounding line.
- Make electrical connections in accordance with the country's current regulations.
- Use the electrical components that come with the compressor, even if others seem acceptable.

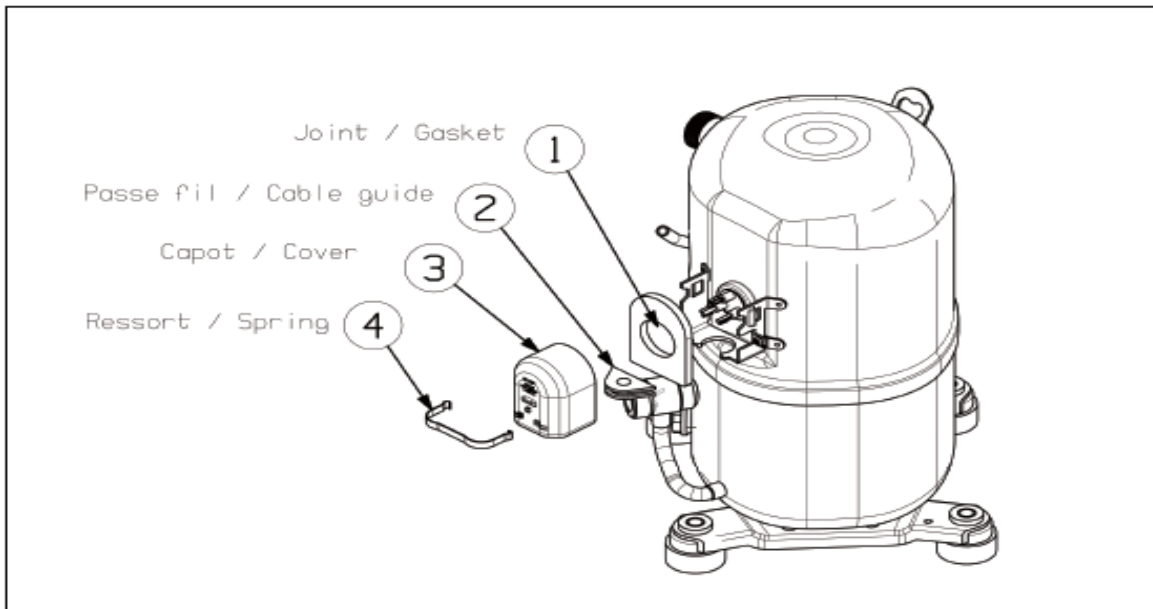
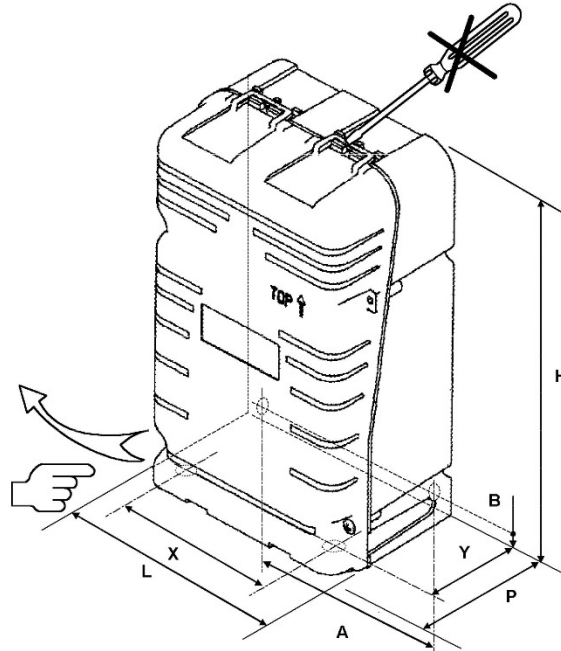


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The electric box must always be fixed vertically.

Dimensions	JUNIOR box	SENIOR box
L	125	180
H	206	232
P	82	90
X	91	130
Y	60	65
A	91	154
B	12	12



Assembly drawing for Protective cover for FH<sup>2</sup> Compressors

5.9. Circuit sealing

Before Charging with refrigerant, systematically search for leaks on all fittings, and seal them if necessary.

5.10. Evacuation





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Evacuate the installation to reach a residual pressure of about 200 micrometres of mercury (0.27 mbar), guaranteeing a good quality of vacuum. It is advisable to drain the HP and BP circuits simultaneously in order to reduce the operation time and ensure an identical level of vacuum throughout the circuit.

#### **6. Refrigerant charge, powering up and maintenance:**

If the following manipulations are performed in potentially explosive atmospheres, Tecumseh recommends referring to Standard EN 378. Part 4 prescribes the general safety guidelines, Annex E provides guidelines for interventions in equipment using flammable refrigerants.

General recommendations:

The electrical boxes will be properly installed and closed before charging the refrigerant and switching on installation.

HFO levels in the air will be monitored throughout the whole refrigerant charge and maintenance period.

Leak detection equipment will be calibrated to 20% of the LFL of the refrigerant in accordance with the EN 378-4 standard.

The work area will be ventilated throughout the procedure.

##### 6.1. Coolant charge

The provisions in Parts 2, 3 and 4 of EN 378 must apply to prevent the risk of refrigerant emission during refrigeration system filling and emptying operations.

Limit the refrigerant load so that the pressures are in the operating window defined by Tecumseh.

Never start the compressor if the vacuum is not broken in HP and BP.

The components will be grounded before starting the refrigerant charge.

Load the installation only with the refrigerant or one of the refrigerants for which the compressor was designed (see nameplate).

The refrigerant charge will always be in liquid form, to keep the mixture in the right place.

- Do not add any additives or dyes.

##### 6.2. Risk of refrigerant Over Charge

If the main parts of the compressor are submerged due to excess refrigerant charge, this can cause the compressor housing to burst. Immersion of the crank case, connecting rod, piston and cylinder in the liquid creates a hydraulic blockage preventing the compressor from starting: this is therefore a blocked rotor situation. If, for some reason, the compressor protector does not intervene quickly enough, a high current in the motor winding will create a rapid rise in temperature. This will cause the liquid to vaporise and the pressure in the compressor housing to increase rapidly.

As an example of what not to do when charging a system with refrigerant, never leave the charging cylinder connected to the system, even if the valve of the cylinder or that of the "manifold" is closed. If one of these valves leaks slightly, the system will be Over Charged with the risks mentioned above.

##### 6.3. Checks when commissioning

- Calibrate electrical protective devices, adjust the set/cut points of the regulatory and safety devices.

- Fully open the service valves.

- Check the operation of the oil heater, if present.

Tecumseh compressors are protected by an external or internal over load protector, the principle of which is based on a temperature/current combination. Like any protective device, it is normal for the compressor to trip on overload protector when it is operating outside the Tecumseh's recommended application window.



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When operating conditions are stabilised, do the following checks:

- Tension(Voltage) and intensity ( Current) absorbed by the compressor;
- HP and BP pressures from the installation;
- Overheating, undercooling, return gas temperature, discharge temperature;
- Search for leaks;
- Carry out a general inspection of the installation (cleanliness of installation, abnormal noise, etc.). Visually inspect the refrigeration system (for example, according to the list listed in Annex G of EN378-2).

For installations operating with a flammable refrigerant, check if the leak detection equipment is working properly.

Do not add oil unless the pipes exceed 20 m; in this case, use the oil recommended by Tecumseh.

#### 6.4. Maintenance

Tecumseh recommends securing the maintenance area in accordance with EN 378 Part 4

Below is a non-exhaustive list of recommendations:

- Obtain a permit for high-temperature work (if necessary);
- Ensure that no flammable material is stored in the work area and that there are no sparks in the work area;
- Switch off electrical appliances;
- Keep heat sources away to avoid explosions;
- If a heat source is present in the workplace, make sure a fire extinguisher is available;
- Ensure that the work area is properly ventilated, before intervening on the refrigeration system or before welding or tender brazing work;
- Mark the work area to prevent entry of unqualified people;
- Ensure that the leak detection system used is spark-proof, secured appropriately or inherently safe
- Ensure that all maintenance personnel have been trained.

Wherever possible, the refrigeration system operating with a refrigerant classified as an A2L category will be transported to a workshop authorized and compliant to do its maintenance.

Check that the pressure of the refrigeration system will not be a danger factor during the intervention (projection of parts, refrigerant etc.). The compressor can reach temperatures above 120°C in operation. Do not intervene in the compressor without protection.

**IMPORTANT : If the detection system preventing sudden surge in current that could melt the insulation (pin venting) has tripped, do not reset it. Replace the compressor following installation and commissioning recommendations (see Section 5).**

##### 6.4.1. Recovery of flammable refrigerants

- Use a recovery plant suitable for flammable refrigerants
- Identify the refrigerant in the cylinder and affix the flammability logo
- Do not mix refrigerants together.

##### 6.4.2. Inerting the refrigeration system and precautions before soldering

- Ensure that a fire extinguisher is present nearby,
- Inert the system with nitrogen without oxygen (or air),
- The flow will be ventilated preferably outdoors.

##### 6.4.3. Opening of the refrigeration system and replacement of components

**IMPORTANT : Soldering operation is prohibited on installations / refrigeration system charged with a flammable refrigerant . More generally, it is imperative to prohibit any source of ignition (sparks, flames, hot springs) near the circuit.**



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After replacing components, crimped connections are an alternative to soldering.

#### 6.4.4. Evacuation

For flammable refrigerants, check that the vacuum pump contactor is the only source of ignition. Make sure the vacuum pump does not blow near an ignition source (empty pump switch, etc.). An evacuation outside is recommended.

#### 6.4.5. Replacing electrical components

- The electrical cabinets will be properly closed before refrigerant charging and restarting installation.
- Replace defective electrical components with the same parts as recommended by the manufacturer to ensure continuity of installation safety. For electrical components of compressors please use Tecumseh's original spare parts.
- Do not move electrical components.

#### Check regularly

- security and regulatory bodies;
- the states of the electrical and refrigeration connections (retightening, oxidation, etc.);
- the operating conditions;
- the compressor attachments on its support;
- how the oil heater works.

Look for leaks once a year, or according to local regulations.

#### Signage

The refrigerant used and its mass must be labelled, whatever they may be. In the case of a fluid classified A2L, the flammability logo will be visible and readable.

#### 6.5. End of life of the product

Fluorinated refrigerants will be recovered as imposed by the F-Gas regulation in the European Union. Tecumseh also advises recycling the compressor oil and the compressor itself.

#### 7. Warranty

For information on the compressor warranty, refer to the terms and conditions of sale.

In order to be able to continuously improve these products, Tecumseh reserves the right to modify these instructions without notice.