



*Tecumseh*

# FIC•FRIO

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...CORREIOS...



**MASTERFLUX®**

**Health without borders**  
**DC Compressors**

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# TECHNOLOGY AND SUSTAINABILITY

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## MASTHEAD

The Fic Frio magazine is a regular publication by Tecumseh do Brasil.

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# A YEAR OF CHANGE

Yet another edition of Fic Frio and, with it, countless experiences related to our "new normal" and lots of learning in our life's baggage.

When we were in 2019, we ended up placing a lot of expectations for 2020. We thought it would be "the year". And it happens to be so! Despite the pandemic caused by Covid-19, which put the world in a standstill, we are able to reinvent ourselves.

And speaking of reinvention, in this edition we show the strength of women, who are increasingly integrated on the refrigeration market. In addition, data also point out that companies that invest more in female inclusion generate a 48% higher operating result and a 70% higher revenue growth on average. Therefore, Tecumseh makes a point of showing this victory for women, who often do not have the opportunity to show what they are up to professionally.

We will also present Tecumseh's foundry, which goes far beyond refrigeration and has supplied parts for the automotive and industrial markets since the 2000s.

Still about the Coronavirus pandemic, professionals from the most diverse areas had their jobs stalled, while the health sector came together to find a solution and stop the virus' spread. One is the vaccine, which must be kept at an adequate temperature and preserved until it reaches its final destination. Therefore, refrigerators available on the local and international market are the solution.

Masterflux products applied in (freezers, refrigerators, cooler boxes and containers) are practical and allow safe transport, preserving the medicine.

Fic Frio's no. 112, 113, 114 edition brings updated information, with products and services designed to preserve the environment, as well as ease people's lives.

On a side note, the Tecumseh Corporate University continues to host its students remotely, offering training, education and practical experiences necessary for professionals in the sector to improve their knowledge.

Stay on top of the latest on the refrigeration market.  
Have a good read!



# THE FEMALE STRENGTH

*That drives the growth in the refrigeration sector exponentially.*

**W**e have interviewed the President of ABRAVA'S WOMEN COMMITTEE Ms. Priscila Baioco and her VP Ms. Joana Canozzi, with the purpose of contributing to global and social development taking into account the plurality of people, cultures, genders and professions.

**What are the main actions taken by the women's committee, as well as its challenges and motivations?**

In this interview, we highlight the work carried out by ABRAVA's women committee and its actions. It aims to contribute to the market as a whole, both for women and for companies in the sector. In 2018 the Institute McKinsey released a

quantitative report on the positive financial impact that investing in diversity can generate for companies, which includes the issue of female presence. The data show that companies that invest more in female inclusion generate a 48% higher operating result and a 70% higher revenue growth on average.

We have the feeling that the female presence in the HVAC-R sector has changed a lot in recent years, we know that many of these women have joined through family influence. We need to get to know these women better in order to offer them what they are looking for, and to know what abilities the companies in the sector demand, with the objective of creating convergence and success for all in an inte-



grated way, concludes Joana Canozzi – VP at the ABRAVA'S WOMEN COMMITTEE.

"We are a group of women who seek to create and prepare a diverse environment for their inclusion. There were several meetings, analyzing global data on women's activities and researching strategies focused on gender equality. We started to plan actions that could, not just reinforce the female participation in the sector, but really include them. The ABRAVA'S WOMEN COMMITTEE aims at being an agent of transformation in the HVAC-R sector and for that we have the support of companies and professionals, men and women working together for this cause", said Priscila Baioco – President of the ABRAVA'S Women Committee.

**How have the actions carried out so far contributed to your professional development and, consequently, to the other women who benefit from this work?**

"With each training I offered them I noticed the gleam in their eyes, a feeling of gratitude and strength within them, something that always motivated me. Professionally, being part of the committee makes me more in line with the market reality and with a broader view of the issues that". Joana Canozzi, VP ABRAVA's Committee.

"We need to face to stand out and promote the female presence in the HVAC-R sector," said Joana Canozzi – VP



**Joana Canozzi, Vice Presidente**  
Comitê ABRAVA

at the ABRAVA'S WOMEN COMMITTEE.

On the ABRAVA website it is possible to obtain more information and log in to take part in the meetings and gatherings that take place in the committee. Any woman in the HVAC-R sector can participate, as they were created for women from associated and invited companies. Please find below the link to access the site: <https://abrava.com.br/a-abrava/comites/comite-de-mulheres-abrava>.

**ABRAVA's President, Eng. Arnaldo Basile, left a word of inspiration on this beautiful initiative:**

"The Brazilian HVAC-R sector follows the evolution of social and economic movements in all regions of the world and ABRAVA, as a legitimate and recognized national entity representing the sector, actively works to promote women's inclusion and equality in this sector, which is no longer exclusive to men. Based on these principles and commitments the ABRAVA's Women Committee was officially created on March 8, 2020, International Women's Day ".

# TECUMSEH DO BRASIL FOUNDRY

*Technology that goes beyond the refrigeration segment!*

**F**ounded in 1982, the Tecumseh do Brasil foundry began its activities with a focus on meeting internal demands, manufacturing castings for hermetic refrigeration compressors. Over time, new business opportunities and segments have boosted investments with the aim of expanding production capacity.

In the early 2000s, after countless efforts, a dedicated team and an opportunity to expand, the Tecumseh do Brasil foundry expanded its customer portfolio, and began to supply other parts for the market, both automotive and industrial. His customers at that time were Honda, Bosch and Contrail.

Shortly thereafter, it was possible to expand the segments served, as follows:

## AUTOMOTIVE LINE:



**Engines:** flywheel, pulleys, hubs.

**Brakes:** drums and brake discs, wheel cylinders and master cylinders.

**Chassis:** support.

**Transmission:** cylinders and pressure plates.

## AGRICULTURAL LINE:



Actuation plates and parts in ADI - austempered ductile iron.



## HOUSEHOLD APPLIANCES LINE:



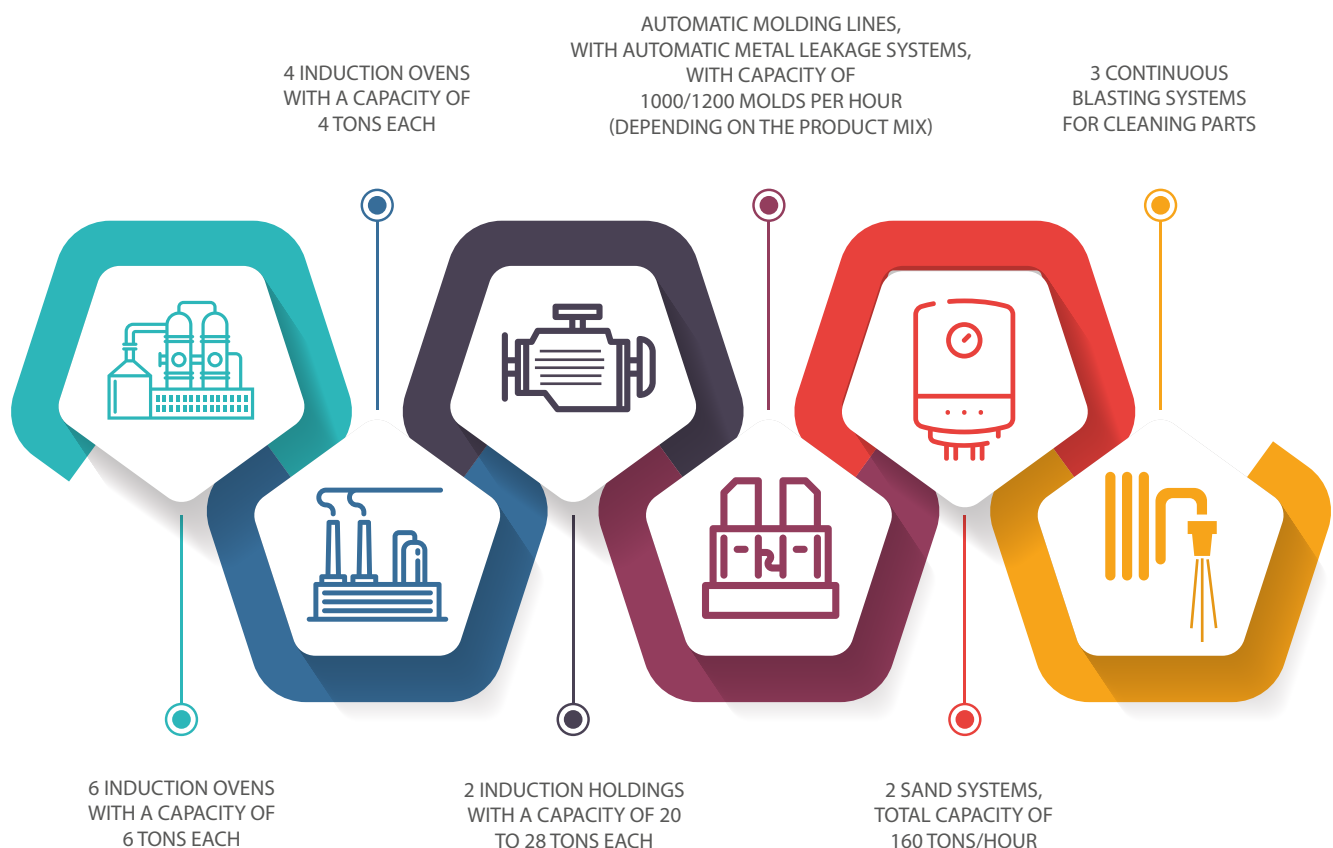
Crankcase, crankshafts, cylinder heads and bearings for hermetic compressors; bearings for washers.

## RAILWAY LINE:



Anchor bolts and supports.

## WITH ANNUAL PRODUCTION CAPACITY OF 45 TO 50 THOUSAND TONS, FOUNDRY IS MADE UP OF:



As for its structure, the foundry also has labs: a mechanical, a chemical and a metallographic one. These are equipped with a traction machine, two spectra, two durometers, LECO (carbon and sulfur), two ultrasound devices (manual and automatic), microscope for metallography, GCS testing machines – Green Compression Strength, RTU - resistance to traction in wet, permeability and friability of the sand.

The Tecumseh foundry team boasts process, projects and quality engineering teams. The teams are robust, engaged and highly motivated to meet the requirements of the domestic and foreign markets, as well as the legislation and segment specs. A history based on hard work, creativity and team spirit is set today to bring solutions to the present and future of the industry.





# CONTROLLED TEMPERATURE WINE CELLAR

*Tecumseh asked the leading wine cellar AC manufacturer in Europe to test its most advanced variable speed compressor solution with R-290 refrigerant. The single-body unit, similar to a window-type AC unit, is easy to install, cooling a wine cellar with up to 50m<sup>3</sup>.*

**T**he challenge of this kind of application lies in the fact that the result of a solution that has been widely tested on the market is compared,

however in this case, this experience occurred with the use of a fixed speed compressor. The original product in use was the Tecumseh THB4428Z compressor that used the R-449A refrigerant. The tests were carried out in the Tecumseh Europe lab in La Verpillière, France.

The main objective was the conversion of the current system R-449A to the natural fluid R-290, and also the technological conversion from fixed speed to variable speed (inverter). The inverter technology will provide greater energy efficiency and better temperature control of the cellar, there will be less oscillation of temperatures, which is desirable for an environment that preserves a spirit that often has no expiration date, as long as it is well maintained. Add to the challenge also the environmental concern, for this reason the refrigerant fluid R-290 was chosen, thus meeting the new regulatory requirements.

Finally, it was specified that the condensation, evaporation and overheating temperatures should be kept the same as the original.

The solution found by Tecumseh and suggested to the customer was to apply the various components that support Tecumseh's IntelliCOOL™ platform.

The choice of the best inverter solution to suit this new application was a fundamental step for the success of this project, since the key goal would be an optimal performance in this given application. The tests that ensued are indicated below:

1. Conducting comparative tests, performance benchmark of the original unit;
2. Optimization of the R-449A refrigerant charge and measurements;
3. The conversion of the original unit to the natural fluid in R-290;
4. Optimization of the converted unit, now at variable speed (inverter) with the VTCX410U compressor.



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The results obtained, see the comparative table below, brought benefits with a consumption reduction of up to 28% with the use of the IntelliCOOL™ technological platform, as follows:



System		Power consumption (kWh/24h)	Cooling Capacity (W)	Deviation from target (°C)	Test parameters
1	THB4428 + R-449A (310g)	5.57	205		Target Temp. 10°C with closed doors
2	VTCX410U (FS) + R-290 (90g)	4.02 (-28% vs. 1)	220		
3	VTCX410U (FS) + R-290 (90g)	5.72	220 @3.600 RPM		Target Temp. 10°C with open doors
4	VTCX410U (VS) + R-290 (90g)	5.44 (-4.9% vs. 3)			

- ☒ **28% reduction in electricity consumption:** obtained by replacing by the VTCX inverter compressor, it has a permanent magnet, synchronous motor, and this action complements the replacement of the R-290 refrigerant. The measurement was made in kWh/24h.
- ☒ **5% reduction in electricity consumption:** obtained by comparing the solution running at fixed speed x variable speed.
- ☒ **Better performance in temperature control +7% :** against R-449A, and better temperature stability (variation of 1.8°C inverter against the original 4.3°C with fixed speed compressor).



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## NEW PRODUCTS

### NATURAL REFRIGERANT – R-290



**VTC**  
HIGH  
EFFICIENCY



**AL**  
COMPRESSOR



**TC OPT**  
COMPRESSOR

### A2L REFRIGERANTS



**UNIQUE  
COMPRESSOR  
LINE**



**PAC3  
CONDENSING  
UNIT**



**DC COMPRESSORS**



### MASTERFLUX

# VARIABLE SPEED COMPRESSORS

*FROZEN FOOD ISLAND FREEZER*



In recent years, the reduction in electricity consumption has been one of the focal points for the segments that use refrigeration. According to the article "Energy Efficiency In Supermarkets – André Panesi, 2008", the electricity consumption in supermarkets, compared to the entire refrigeration segment, is equivalent to 25% of the total energy consumption. The management and culture of efficient energy use can bring superior conservation and cost savings to the respective segment.

The efficient use of electric energy includes the use of devices with higher technology level, higher efficiency, as well as taking preventive actions related to the facility infrastructure and controlling routine costs. These actions are increasingly important for maximum electric energy savings and added value with a quick ROI.

In the light commercial refrigeration segment, Tecumseh offers high efficiency and superior performance compressors, such as the VTC family. They are variable speed compressors (VSC), which use permanent magnet engines (PMSM) and flexibility regarding speed control.

This technology requires the use of dedicated frequency inverters that guarantee robustness to the electrical power supply system, certified protections of the inverter-compressor set, rapid temperature reduction, high efficiency,

among others.

In 2019, Tecumseh launched the TAL™ technology (Tecumseh Adaptive Logic), which provides an Inverter solution ready to be used in a system previously prepared with "on/off" thermostats, with conventional compressors. The TAL™ technology allows you to apply an inverter solution to a cabinet originally designed for use with a fixed speed compressor.

This state-of-the-art technology adapts the rotation of the Tecumseh variable speed compressor according to the thermal load requirement of the application, thus being robust and highly efficient.

This article presents the results of internal temperature and energy consumption, obtained in tests applied on a frozen food island freezer, in which compressors were used for comparison: VTC1424U-MD5C - variable speed in R-290 with TAL™ technology, (CSR) at fixed speed in R-404A, all of them highly efficient and developed with a focus on light commercial applications. Two tests were carried out for comparison analysis: a) temperature classification test, and b) energy consumption test according to the NBR ISO 23953 guidelines.

The classification test was carried out with the cabinet loaded and set at 25°C (Class 3, according to NBR ISO 23953), and shows that the compressor.




























VTC1424U-MD5C, which includes the TAL™ rotation variation logic, presented better rating during the defrost, and rapid temperature reduction.



The energy consumption test was carried out according to the manufacturer's load plan, and tested at room temperature of 25°C, with the TAL™ logic used with the variable speed compressor. Consumption was calculated in "kWh/24h", according to the applicable rules, and the period used for calculation was equal to the time between two defrost cycles. The application, developed with the VTC1424U-MD5C compressor and the 030F0228 inverter with the embedded TAL™ algorithm, provided the cabinet with a rapid temperature reduction of the thermal loads, a reduction in electricity consumption and better rating according to the applicable standards, in comparison to the baseline compressor at fixed speed. Thus, the application consumption registered with the variable set: VTC1424U-MD5C, 030F0228 and TAL™ was 31% smaller, when compared to the reference compressor tested under the same environment and configuration conditions.

Among the advantages and superior performance, the solution proved to be robust in terms of disturbances in the electrical network, lower noise level and easy installation. TAL™ guaranteed a superior performance in all the analyzed criteria in comparison to the baseline compressor, in the conditions tested, as shown in Table 1. In this way, the Inverter Tecumseh solution shows easy implementation in practice, uses low GWP fluid, promotes significant electricity savings in several application conditions, uses state-of-the-art technology in accordance with the principles of the culture of efficient use of electric energy in the light commercial refrigeration segment, thus providing more than 30% reduction in energy consumption.

**TABLE 1 - Applied case study.**

<b>Application - Frozen Food Island Freezer (Class 3)</b>					
 Superior  Lower  Equivalent	Ref.	Fixed speed R-404A	Fixed speed R-290	Variable speed R-290	
Compressor:		AE2430Z-GS3C		AE2430U-ES3C	 VTC1424U-MD5C 030F0228 / TAL™
Electronic controller:		Conventional On/Off		Conventional On/Off	 Conventional On/Off
Rotation control:		Does not have		Does not have	 Variable
Refrigerant:		R-404A		R-290	 R-290
<b>TEMPERATURE OF THERMAL LOADS</b>					
minimum / average / maximum [°C] <sup>3</sup>		-29.7 / -24.6 / -18.0		-29.2 / -25.0 / -18.4	 -28.6 / -24.3 / -18.5
<b>ELECTRICAL ENERGY CONSUMPTION</b>					
Energy consumption [kwh / day] <sup>1</sup>		8.411		7.770	 5.807
Consumption reduction		Reference		-7.6%	 -31%
<b>RATING</b>					
Cabinet rating <sup>2</sup>		L2		L2	 L1

<sup>1</sup> Data obtained between two thaws according to NBR ISO23953.

<sup>2</sup> Rating according to NBR ISO23953.

<sup>3</sup> Class 3 – 25°C, 60%, according to NBR ISO253953.

Bibliographic reference: André Panesi

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# MASTERFLUX APPLIED IN CONSERVATION OF VACCINES



**A**s we all know, the world was affected with the Coronavirus pandemic this year 2020. Initially in Asia, later spreading to Europe and Oceania and quickly reaching the Americas and Africa. We all had to adapt to a new reality. Social distancing, wearing a mask, washing hands constantly and of course bowing to quarantine. A scenario that brought challenges, doubts, uncertainties and mainly loss of lives.

It must be remembered that, on the other hand, many other lives were saved, thanks to the unrelenting work of health professionals and also as a result of people's cooperation and the support of technology.

We know that we need to follow our paths bringing the best that technology and science can offer us. Great distances, isolated regions suffer from the lack of equipment that can preserve medicines, vaccines, plasma or even organs for transplantation. There are technological solutions for the preservation of these vital elements, and that is what we are going to see below.

When we talk about mobility, we have to consider a DC power supply, like an ambulance. It is provided by a 12V or 24V DC battery in most cases.

Therefore, within such a vehicle, there is a need to refrigerate the existing drugs or plasma as mentioned above. Small refrigerators available on local and interna-

tional markets are the solution here. There is equipment from 30L up to 1500L that allow for greater storage.

In another situation, the famous last mile is served by small refrigerators in the shape of cooler boxes, see the image in the infographic below. They are practical and allow safe transport, preserving the medicine at the correct temperature until it can be used by the end user.



Image source: envato

Image of a cooler box.

Long distances, especially intercontinental ones, are traveled by air, specially refrigerated containers are used for such situations. This allows remote regions anywhere in the world to be served with properly preserved drugs and vaccines, while maintaining their original characteristics. Thus technology reduces the distances, once the quality is preserved (of a vaccine or medicine). This technology allows people, regardless of where they live, to have access to protection and treatment as

it does for anyone living in large urban areas.

Rotary and reciprocating hermetic compressors are a critical and vital part in the correct functioning of these mobile refrigeration systems, such as: freezers, refrigerator, cooler boxes and containers. Such equipment is in the field at that moment and is named Masterflux.

Masterflux products and their technological solutions encompass a series of models with different power options,



Image source: Tecumseh file

mainly DC, but there are also some AC solutions. The compressors are supplied with electronic controllers that allow the speed variation to bring better control in the lowering and maintenance of temperatures.

In the images above we present the main models, the already traditional and legendary CASCADE and SIERRA recently received two new members, the rotaries ATLAS and MESA. In particular, MESA compressors are an attraction in themselves, the small size allows them to be used even in individual cooling, refrigerated profes-

sional clothes, for example. These compressors and their controllers can be applied at low, medium or high evaporation temperature.

They are offered in various types of refrigerant fluids and with different supply voltages.



Source image: envato

Image: DC refrigerator



Source image: Tecumseh file

Image: DC refrigerated container



# SMALL SIZE AND HIGH EFFICIENCY



DEVELOPED WITH A ROBUST DESIGN, **THE INVERTER HERMETIC ROTARY ATLAS AND MESA ARE MICRO ROTARY COMPRESSORS** SUITED FOR REFRIGERATION OF INDEPENDENT DEVICES.

USING R-134a FLUID AND BLDC MOTOR, THEY PRESENT LOW VIBRATION AND NOISE, HIGH CAPACITY AND POSSIBILITY OF USING CLEAN AND RENEWABLE ENERGY.

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# WEBINARS



## INVERTER<sup>®</sup> TECHNOLOGY

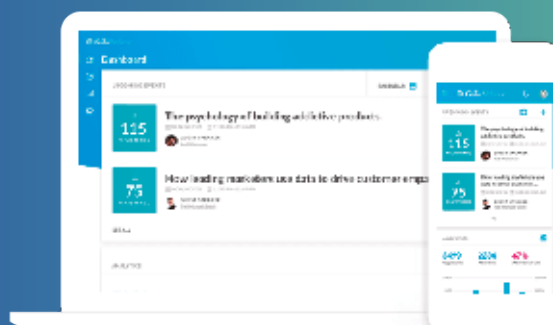
Find out more about Tecumseh's Inverter<sup>®</sup> technology in our webinars.  
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# OIL EQUALIZER TUBE

## Parallel Compressors

*What are they and what are they for?*



**C**ompressors mounted in parallel offer interesting advantages in commercial applications and we can highlight the following: variation of the refrigerating capacity to suit its demand, superior reliability when compared to single compressors in equivalent capacity, and also provides reductions in energy consumption.

Mounting the compressors in parallel does not change the basic requirements for an installation in the outdoor enclosure. Considering that there are some limitations of applications, notably in low back pressure, such issues depend on the type of compressor to be adopted. Another important point is the diameter of the suction line between the evaporator and the main line, there is an influence on the layout of the installation and it must be considered from the project, we refer here to the distance between the compressors and the evaporator(s), as well as if there is more than one suction line.

The speed of the refrigerant fluid must also be controlled regardless of whether one, two or more compressors are fitted. For an installation with the pipeline horizontal, the speed should be 4 to 6 m/s, when it is vertical, the recommended speed should be between 8 to 10 m/s.

Compressors for parallel installation must have the same cooling capacities, giving preference to the same models, for example the TFHD or TAGD family, which

are specially prepared for this type of installation.

It is not recommended to install more than 6 compressors in parallel, given their complexity, however they can be installed on the base or in racks using the appropriate shock absorbers recommended by the manufacturer.

Cooling lines must be designed to prevent existing vibrations from causing fatigue breaks. Therefore, we recommend that they have the greatest possible degree of freedom, for a recommended solution, see figure 1a.

The suction lines must be connected to a common tube between the compressors installed in parallel, equalization tube, see figure 2a.

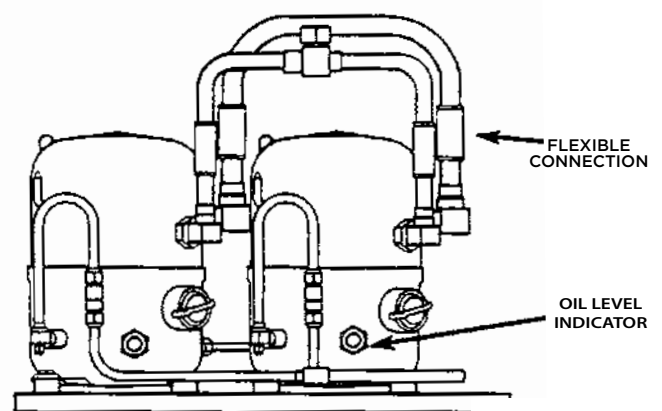


Figure 1a.

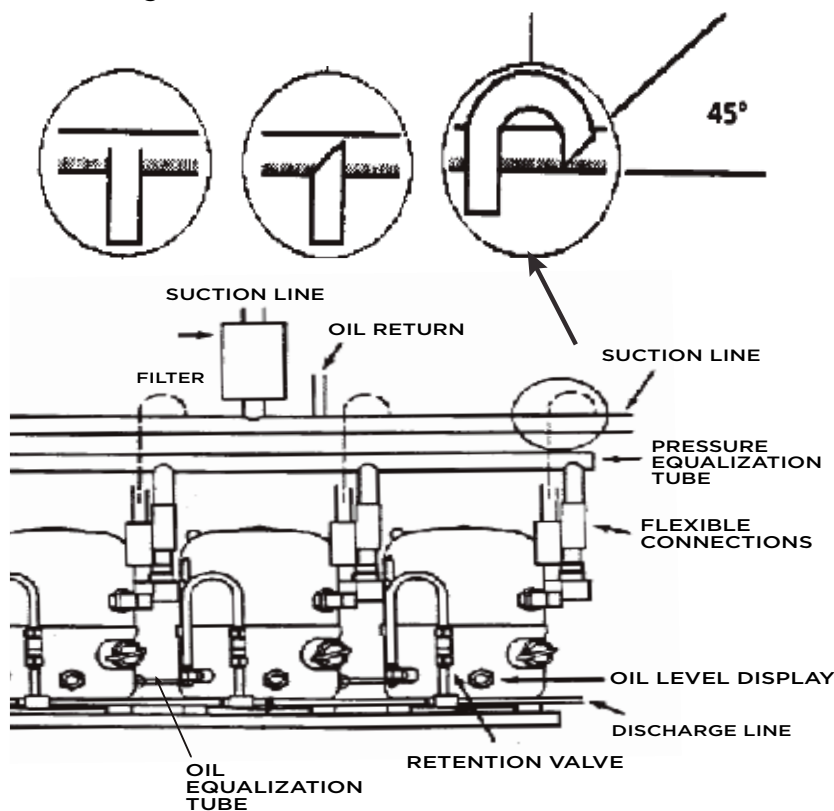


These connections must be equidistant from each other as well as having the same type of welded joint between the individual suction ducts and the common duct. An extension line in each suction of the compressors in parallel must be connected to the main suction duct, in which each compressor of the set under analysis will be connected respectively. It is important to remember that the welded junction of these tubes to the main suction duct has the same profile, in a chamfer, in radius with a 45° angle tip or even in the straight version. All must pass through the main suction duct respecting the same heights, above its internal wall, see figure 2b.

Figure 2b.



Figure 2a.



For orientation.

The discharge duct must have the same diameter along its length, with the discharge of each compressor having a check valve (against the return of the fluid) before its connection to the main discharge duct. This is repeated for each compressor in the compressor set in parallel. No less important are the oil level equalization tubes, they are mandatory and must be installed from compressor 1 to compressor 2 and so on. Figure 2a gives details of the positioning of the suction ducts to the main suction duct.

## STARTUP AND MAINTENANCE

Before starting, check the oil level of all compressors and supplement with original oil if necessary.

Check out all operating conditions if there is no refrigerant fluid in the compressors, due to the saturated vapors that return to the compressors in operation or to condensation in them when they are stopped. See the article on system balance in FICFRIO ED 83, page 12.

Check out the oil level of each compressor after a few days of operation and fill with original oil.

When replacing a failed compressor, change the oil in the entire system, as the failed compressor may have contaminated the other compressors with particles.




# GETTING TO KNOW A DOMESTIC REFRIGERATION SYSTEM

*Check what the requirements are*



**D**omestic refrigerators have requirements established by national and international standards, the most widely used standard is IEC62552.

This standard subdivides the types of refrigerators in several categories, the values described below are only valid for 3/4 star (  ) duplex frost-free tropical class refrigerators.

It is worth mentioning that, in addition to the requirements established in the IEC62552 standard, each manufacturer can choose additional or stricter requirements for its products.

The following topics will be covered here: definition of climate class, storage tests, cooling capacity, freezing, ice production, energy conservation, lowering (pull-down), temperature increase and condensation.

•Climatic class: when designing a cooler, the manufacturer does it according to the climate for which the product is intended. Refrigerators are divided by IEC into four categories: extended temperature climate (10°C - 32°C), temperate climate (16° C - 32°C), subtropical climate (16°C - 38°C) and tropical climate (16°C - 43°C). Specifically for the Brazilian market, manufacturers use the "tropical" classification.

•Storage test: according to its climatic class, the refrigerator must be able to maintain the internal temperature within defined values for each compartment.

In this way, a tropical class refrigerator is tested at 16°C and 43°C at room temperature. In this test, the freezer compartment is loaded with thermal loads monitored with temperature sensors, these loads must not reach temperatures above -18°C during the entire test.

The fresh food compartment, on the other hand, is tested empty and its interior is monitored by some sensors, in this com-

partment the measured temperatures should be between 0°C and 4°C during the entire test.

- Refrigeration capacity test: the purpose of this test is to measure the cooling capacity of the fresh food compartment, determining the time for a load of 4.5 kg and volume of 100L to be cooled from 25°C to 10°C when the refrigerator is exposed to a room temperature of 25°C.

- Freezing capacity test: this test aims to measure the freezing capacity of the freezer compartment. To reach the 3/4 star rating, a load of 3.5 kg and 100L of volume added to the freezer at +25°C, it must reach a temperature of -18°C in less than 24 hours. This test is also performed at a temperature of 25°C.

- Ice production capacity test: when the product has this functionality, this test aims to determine the amount of ice that is pro-

duced in kg/day when exposed to a room temperature of 25°C.

- Energy consumption test: this test determines the kWh/month value informed on the PROCEL/INMETRO labels. The product freezer is fully charged with thermal loads while the refrigerator compartment remains empty. The refrigerator is exposed to a room temperature of 32°C and its energy consumption is measured over a minimum period of 24 hours or a period that contains two consecutive defrosts. This test is performed twice. The first one with the temperature adjustment of the refrigerator allowing for the warmer monitored load to be below -18°C. In the second test, the adjustment is high so that the warmest load is above -18°C. The final consumption value is a weighted average between the two results obtained. Finally, the value obtained is converted to KWh/-





month according to the test duration.

- Pull Down Test: The purpose of this test is to measure the reserve capacity of a refrigeration appliance, especially for environments with a temperature rise. The thermostat and defrost must be disabled in order to provide uninterrupted operation of the cooling system. The empty product with open doors is positioned in a camera at room temperature of 43°C until it reaches thermal equilibrium. As soon as the balance is reached, the door is closed and the test starts.

In this test, the minimum time for both the freezer to reach -12°C and the refrigerator +8°C is recorded. The temperatures reached in the two compartments are recorded after thermal stabilization.

- Temperature rise test: This test aims to determine the time for frozen loads to rise from -18°C to -9°C. The refrigerator is

tested in a chamber at 43°C, and with its freezer fully loaded. With the product properly stabilized, the power is disconnected. The time counting starts as soon as the first load reaches -18°C and ends as soon as the first load reaches -9°C.

- Condensation test: The purpose of this test is to determine the extent of water condensation on the external surface of the refrigerator under environmental conditions specified. The refrigerator is exposed to a 24-hour test of normal operation with a room temperature of 32°C and a relative humidity of 75%. The test result is what kind of condensation occurred: mist, droplets, or water dripping and in which area of the external surface these situations occurred.



Imagem evato

# Refrigerator overview



Duplex refrigerator fresh food compartment loaded with three monitored loads for carrying out storage and pull-down tests.



The figures above belong to the freezer compartment of a fully loaded duplex refrigerator for carrying out storage, consumption and temperature rise tests.

**In Brazil, INMETRO coordinates the approval of new products and audits of existing ones through its accredited labs. In support of its customers, Tecumseh offers, at no cost, a complete structure with expert engineers and state-of-the-art labs to assist in the adjustment of the refrigeration system of products that use or intend to use Tecumseh compressors. In this way, customers guarantee that they are correctly applying Tecumseh products as well as avoiding undesirable failures during certification tests in labs accredited by INMETRO, which is the cause of release delays and higher costs.**

# CASE STUDY

## SILENSYS<sup>®</sup> ADVANCED



**T**he TECUMSEH SILENSYS ADVANCED unit and the manufacturers of A2L refrigerant fluids were invited by the important chain of organic stores BIOCOOP in France to present a quality solution.

In partnership with Le Froid Pecomark, a French distributor, and with Bourcet, a company of installers (from the professional kitchen and refrigeration segment), the Biocoop chain store in Lons-Le-Saunier (France, near Dijon) has chosen our products due to its greater durability thanks to the direct expansion cooling system equipped with the refrigerant fluid R-1234yf.

The SILENSYS ADVANCED refrige-

ration unit exceeds the performance limits required by the F-Gas 517/2014 directive and also by the Eco-Design 2015/1095. The refrigerant fluid R-1234yf has a global warming potential - GWP of 4 and therefore below the limit established by the F-Gas directive for stationary refrigeration systems, and zero potential impact on the ozone layer, from the English term Ozone Depletion Potential – ODP.

SILENSYS ADVANCED is a cooling unit that has a fairing, is silent and simple to install (Plug & Play). This new version has accesses, on the side for the installation of electrical components and at the front for the cooling compartment. It is designed to ensure safety for users in the cold chain, installers and refrigeration





system operators.

The temperature setting for the chamber is +2°C; with a 2K differential.

The components and subassemblies are installed in accordance with the rules defined by the EN378 standard. The refrigerant load is below the limit established for category III and with restricted access “c” of the EN378.

Regarding direct expansion, we can say that in the use of synthetic refrigerants, as in this case, it is technically recognized as a cost-effective solution, simple in its implementation, thus resulting in a lower total cost.

The SILENSYS ADVANCED side and front openings provide direct access to components in the event of maintenance. The equipment works very well and we are ready to repeat this experience again, said the manager of the installation company in charge of maintenance of the refrigeration systems.

About the companies participating in this project:

Created in 1986, Biocoop includes a network of 653 organic products stores (reference from 01/01/2020) with a common objective: the development of organic agricultural products with the spirit of equity and cooperation.

Le Froid Pecomark is a distributor of components for the refrigeration, air conditioning and renewable energy industries.

The company has 15 stores in France.

Headquartered in the Bourgogne-Franche-Comté region (France), the Bourcet et fils company has specialized for 25 years in the sale and installation of heating, air conditioning and refrigeration systems (commercial and industrial).



**Learn more about  
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## CAUSES AND TROUBLESHOOTING

### Compressors and Condensing Units

PROBLEMS	POSSIBLE CAUSES	SOLUTIONS
<b>Compressor doesn't start</b>	System components do not work correctly: 1. Controller / contactor stuck in the open position; 2. Controller disconnected due to location being cold; 3. Thermostat does not work properly.	Refer to the original equipment manufacturer (*OEM) service information
	Circuit breaker tripped or fuse open or removed.	FIRST: check for a ground fault.  SECOND: check the engine windings for proper continuity and resistance.  THIRD: check the electrical components of the compressor.
	The thermal protector is not working properly.	Check for continuity in the thermal protector. If there is no continuity, wait for the protector to cool down and close. This may take more than an hour. If there is no continuity, replace the protector when external.
	Inadequate or loose wiring.	Check the electrical diagram according to the electrical diagram and connect correctly.
<b>The compressor does not start • in operation it trips the thermal protector</b>	Inadequate wiring.	Check the electrical diagram and connect correctly.
	Low tension.	Shut down the system until the proper voltage is restored.
	System components, such as thermostat or controller/contactor are not working properly.	Refer to the OEM service information.
	Compressor electrical problems: 1. The compressor motor has an open or shorted winding; 2. The starting capacitor does not work; 3. Relay does not close.	FIRST: check for a ground fault. SECOND: check the motor windings for proper continuity and resistance. THIRD: check the electrical components of the compressor.
	Return of liquid in the compressor.	Add the crankcase heater and an accumulator to the suction line.
	Internal mechanical problem in the compressor.	To check for proper pumping, connect pressure gauges to the system. Then turn on the system power. If the system has an adequate refrigerant load, the compressor must maintain a pressure difference of at least 150 psig between suction and discharge. If the compressor does not pump properly, it must be replaced without further testing.

\*\*The above checks must be done with the product disconnected from the power supply.



# Tecumseh

PROBLEMS	POSSIBLE CAUSES	SOLUTIONS
<b>The compressor starts and runs, but short cycles with thermal protector trip</b>	High current passing through the thermal protector: 1. Extra current sources. 2. Compressor motor with shorted winding.	Check the electrical diagram. Check for extra sources of current passing through the thermal protector (such as fan motor, pumps). Refer to the *OEM service information.
	Compressor low voltage (single phase) or unbalanced voltage (three-phase).	Shut down the system until the proper voltage is restored.
	Electrical problems in the compressor, such as the thermal protector or the starting capacitor, do not work properly.	FIRST: check for a ground fault. SECOND: check the motor windings for proper continuity and resistance. THIRD: check the electrical components of the compressor.
	Discharge pressure too high.	Check system balance. Also, refer to the *OEM service information.
	Suction pressure too high.	Check system balance. Also, refer to the *OEM service information.
	Very hot return.	Check system balance. Also, refer to the *OEM service information.
<b>The unit works, but the execution cycle is shorter than normal</b>	System components, such as thermostat, control or contactor, do not work correctly.	Refer to the *OEM service information.
	Low pressure cut due to: 1. Leakage of the liquid line solenoid; 2. Refrigerant fluid load; 3. Restriction on the expansion device.	1. Repair or replace the solenoid valve. 2. Consult the *OEM service information. 3. Repair or replace the expansion device.
<b>Unit operates for a long time or continuously</b>	Incorrect refrigerant fluid load.	Check system balance. Also, refer to the *OEM service information.
	System components, such as a thermostat or contactor, do not work properly.	Refer to the *OEM service information.
	Frozen evaporator fins.	Refer to the *OEM service information.
	Cooling system restriction.	Refer to the *OEM service information.
	Dirty condenser.	Refer to the *OEM service information.
	Dirty filter.	Refer to the *OEM service information.
<b>Frozen suction line</b>	First measure the superheat. If it is within acceptable values, the possible problems are: 1. The expansion valve is passing excess refrigerant or is oversized; 2. The expansion valve is stuck in the open position; 3. Evaporator fan does not work; 4. Incorrect refrigerant load.	Refer to the *OEM service information.
<b>Frozen liquid line</b>	First measure the subcooling. If it is within acceptable values the possible problems are: 1. Restriction on the filter drier; 2. Valves partially closed.	Refer to the *OEM service information.
<b>The system vibrates during operation</b>	Loose parts or assemblies, pipe noise, unbalanced fan, worn fan engine bearings, etc..	Refer to the *OEM service information.

\* OEM = manufacturer. Note: Consult your product installation manual for more information.







# Online courses

Free online courses will be offered by the Tecumseh Corporate University. Check the schedule on our social networks, and don't miss our content!

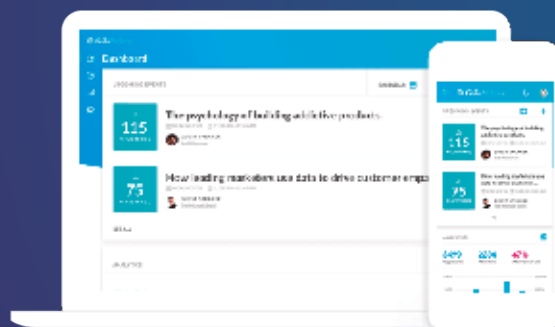
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