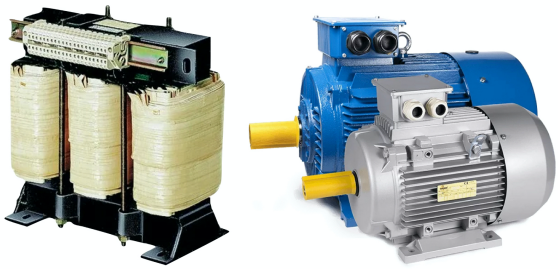
Are you buying a used ride in Europe and wish to operate it on the American continent? In many cases it is necessary to adapt the ride to the different type of alternating current available at the destination in order to avoid breakdowns. This article is a guideline of the necessary modifications.



380V 3ph 50Hz => 220V 3ph 60Hz

HOW TO ADAPT A EUROPEAN RIDE TO THE DIFFERENT POWER SUPPLY OF COUNTRIES ON THE AMERICAN CONTINENT WITH 220V-60HZ THREE-PHASE

by Enrico Fabbri

Many operators on the American continent wish to purchase used rides in Europe to operate them in their own country. Unfortunately, most countries on the American continent have an alternating current with a different voltage and frequency than in Europe. Consequently, the ride must be modified before being used to avoid malfunctions or major failures.

In Europe, alternating current has a voltage of 380 volts three-phase and a frequency of 50 Hertz, while most countries on the American continent have an alternating current of 220 volts three-phase and a frequency of 60 Hertz, to which the connection of the neutral and grounding must logically be added.

The modifications necessary to adapt the ride are always possible, the difficulty and costs to be faced depend on the type of ride and the characteristics of the components installed, such as, for example, the type of electric motors, hydraulic pumps and large compressors.

This article provides basic information and is intended for non-specialists who wish to learn more for educational purposes only. We recommend that you contact competent persons both for a detailed analysis of the ride that is to be modified and to carry out the necessary activities.

For the sake of simplicity, in this article we will evaluate the modifications to be made to a European ride that is to be operated in another geographical area with a 220 Volt three-phase 60 Hertz alternating current.

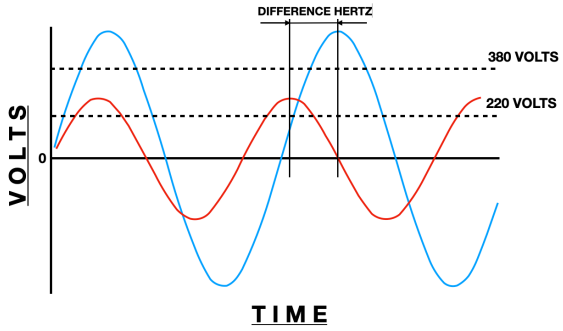
The alternating current

Throughout the world, the current supplied by governments is an alternating current (AC). The image below shows a graph of the course of the current over time; it is a wavy line that varies from a minimum to a maximum fifty or sixty times per second.

The height of the wavy curve represents the voltage measured in VOLT, e.g. the blue line relating to the 380 Volt voltage is much higher than the red line relating to the 220 Volt voltage.

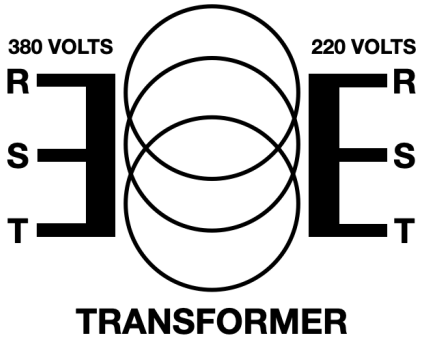
The number of waves per second represent the frequency measured in HERTZ, e.g. the blue-coloured line changes direction 50 times per second while the red-coloured line changes direction 60 times per second.

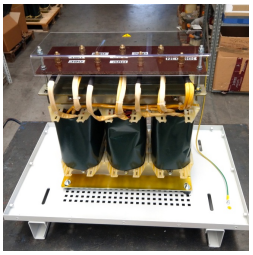
In order to operate the ride in the new area, both the voltage and the frequency must be adapted. We recommend that you continue reading this article to understand what solutions are generally applied.



CHANGING THE VOLTAGE

The first step is to adapt the ride to the different alternating current voltage, as we said in Europe the alternating current voltage is 380 volts three-phase while in the American continent the AC voltage is 220 volts three-phase.





To adapt the voltage, it is necessary to use an autotransformer, as shown in the image below. This is a fairly simple and inexpensive solution.

Since the ride operates with alternating current with three phases (R-S-T), obviously the transformer will also have to be three-phase and will therefore have three connections on the 220 Volt side and three connections on the 380 Volt side.

Based on our experience, we recommend an autotransformer with three different 210/220/230 Volt inputs and a single 380 Volt output.

CHANGING THE FREQUENCY

In order to adapt the ride to the different frequency (Hertz) of the alternating current, it is necessary to analyse the different components installed in the ride before deciding what to do. In some cases the modifications are very simple and in other cases it may be necessary to change components.

WARNING: the autotransformer only changes the voltage and not the frequency of the alternating current. Many electrical components subjected to a frequency other than the original one may fail.

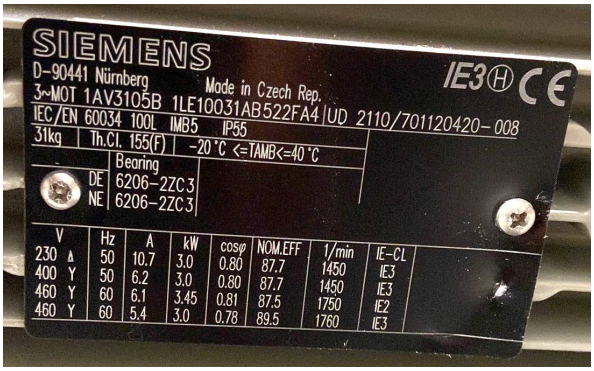
Let us proceed to analyse the possible components installed in the ride and the possible solutions applicable.

Electric motor connected to a oil pump required for ride setup

An electric motor built to run in Europe with alternating current at a frequency of 50 Hertz and operated with an alternating current at a frequency of 60 Hertz will turn 20% faster. Consequently, the oil pump connected to this electric motor will turn 20% faster and generate 20% less maximum pressure.

Most oil systems used in the assembly of the ride are dimensioned with an operating margin that allows the oil cylinders to function correctly in this condition. If you are unable to complete the assembly of the ride, it means that your oil system was designed without an operating margin: in this case you will have to install an electric motor with 20% more power.

We advise you to check that the electric motor manufacturer's label indicates that it can operate at either 50 Hertz or 60 Hertz.



Electric motor connected to a oil pump required to operate the ride

Some rides are set in motion by hydraulic motors with oil, thus involving a large oil power unit with a large electric motor. The rule explained above also applies here: the oil pump connected to this electric motor will turn 20% faster and generate 20% less maximum pressure.

In this case, the systems involve the use of special valves connected with electronic boards and it is therefore impossible to provide a generalised solution.

We recommend that you analyse the system with a competent person or contact the manufacturer of the ride. One possible solution is to connect an inverter to the electric motor and adjust it to the original frequency.

Electric motor connected to a water pump

Let us now analyse the case of an electric motor connected to a water pump used for moving water, such as in the case of FLUME-RIDE type rides. The pump connected to this electric motor will turn 20% faster and generate 20% less maximum pressure.

In this type of ride, lower pressure means that it will be more difficult to raise the water to the desired height. In this case you will have to install an electric motor with 20% more power, or add an inverter to power the electric motor with the same original frequency.

We advise you to contact the pump manufacturer before making any decisions, bearing in mind that these types of pumps are a single body with the electric motor with solutions to prevent water infiltration, they are in fact pumps that operate immersed in water.

We advise you to check that the electric motor manufacturer's label indicates that it can operate at either 50 Hertz or 60 Hertz.

Small size air compressor

Many rides use a small air compressor to provide the compressed air needed to operate disc brakes and passenger safety mechanisms.

An air compressor connected to the electric motor will turn 20 per cent faster and generate 20 per cent less maximum pressure.

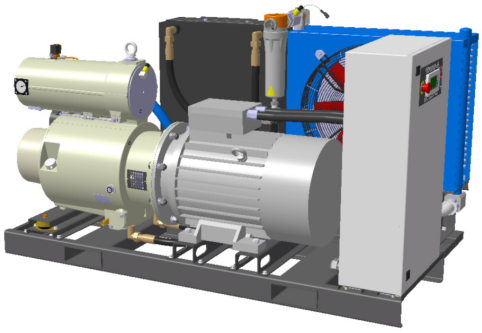
For a variety of reasons, these air compressors cannot withstand the increased stress and fail after only a few hours of use. We therefore suggest that you purchase a new compressor with the required characteristics.

Large air compressor

Some rides, such as the TAGADA, require a large air compressor to move pneumatic cylinders. The pneumatic system involves a compressed air tank and pneumatic valves.

The rule explained above also applies here: an air compressor connected to the electric motor will turn 20% faster and generate 20% less maximum pressure.

In many cases, the lower maximum pressure generated by the air compressor may prevent the ride from functioning properly. Any modification could be more complex because many manufacturers incorporate the electric motor into the compressor, making any modification more difficult.



If the air compressor is an older model with a star/delta starting system, then it will be necessary to install an electric motor with 20% more power, or to add an Inverter to power the electric motor with the same original frequency.

If the air compressor is a recent model with an automatic start-up system with integrated Inverter, then a modification may not be necessary.

We recommend that you contact the air compressor manufacturer for more information.

Device for controlling a direct current **motor or for controlling an** alternating current **motor**

Many rides operate with electric motors connected to gearboxes for the rotation systems. If the electric motor installed is of the "direct current" type, then a DC-DRIVE required to convert the alternating current into the direct current needed by the motor will be installed. If the electric motor is of the "alternating current" type, then an AC-DRIVE (INVERTER) will be installed to adjust the frequency of the alternating current required by the motor

Most rides manufactured up to the year 2000/2005 operate with electric motors running on direct current with a DC-DRIVE installed in the electric panel. If the DC-DRIVE is a non-digital type, then changing the frequency may be difficult or impossible, and we recommend replacing it with a state-of-the-art DC-DRIVE.

If the ride is operated with a DC-DRIVE, or an AC-DRIVE, of the digital type, then the change of frequency is possible with a manual adjustment or is automatically managed by the DRIVE itself.

We therefore recommend that you check the information on the DRIVE manufacturer's plate.

Other components in the electrical panel

Each electrical panel contains other components such as, for example, circuit breakers, relays and limit switches needed to control the ride. These components generally operate with a service voltage of 24 volts alternating current supplied by a small transformer. All these components can generally operate at both frequencies.

PLCs are programmable computers used in rides to manage many functions. Both the PLCs and the connected components operate with a 24-volt direct current generated by a power supply installed in the electrical panel, which generally accepts both frequencies.

The lighting systems commonly used in rides can operate correctly with both frequencies.

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