



TECHNICAL GUIDELINES OF THE EQUIPMENT

São Leopoldo - RS, September 2023



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1 INTRODUCTION

The construction of a ferris wheel is a challenging and complex undertaking that requires the utmost care and attention to ensure the safety, quality and efficiency of the attraction. In this context, it is essential to have high quality equipment in all stages of its manufacture, with first-line components and parts, providing complete information including assembly manual and fulfilling all the prerequisites that will be described during this Technical Specification.

The manufacturer must have the responsibility and a real commitment to the assembly of the equipment, with solid technical support and rigorous certifications, with 24-hour online service for prompt response in case of emergencies. In addition, the manufacturer's information plays a crucial role in the process of acquiring and installing the ferris wheel, ensuring its reputation in the market and its experience in similar projects. Thus serving as a determining factor for the choice of the manufacturer company.

Engineering and calculations also play a key role in ensuring the safety and stability of the structure, requiring the correct specification of each part and the realization of memorials of detailed calculations and technical drawings. The manufacturing company must also accurately estimate the assembly and delivery time of the Ferris wheel.

The manufacturer must also provide safety, quality and energy efficiency certifications, as well as strength, stability and functionality reports to ensure its structural integrity and the correct functioning of the systems.

In addition, the equipment supplier must follow all international standards and certificates for ferris wheel safety and performance, referenced in this Technical Specification, in addition to the performance standards of the country of manufacture.

By following all these requirements and guidelines, the ferris wheel project will be well grounded, ensuring the satisfaction of the contractor and offering an unforgettable and safe experience to visitors to Mato Grosso. The ferris wheel will become not only an iconic attraction, but also a symbol of quality and excellence in the scenery of Brazil's tourist attractions.

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2 REQUIRED CONTROLS AND SYSTEMS

In this topic will be presented the guidelines for the design of the control scheme and systems necessary to promote the safe and efficient operation of the ferris wheel.

2.1 Ferris wheel control system

The control system is responsible for monitoring and controlling the operation of the ferris wheel smoothly and efficiently, including the rotational movement, speed, stops, acceleration and deceleration. It plays a central and indispensable role in the operation, being responsible not only for monitoring, but also coordinating and optimizing a number of aspects to ensure the safety and comfort of passengers.

2.1.1 Speed control

The manufacturer must inform the exact speed for the usual rotation of the equipment. For emergencies and/or maintenance, the speed can be controlled by the cockpit operator with a rotary knob that allows the speed adjustment within the minimum and maximum safety parameters recommended for the equipment.

All these parameters must be clearly indicated by the manufacturer in the manual of use and assembly of the equipment.

2.1.2 Parameter monitoring

The control system continuously monitors several parameters that aim to allow the early detection of any abnormality or failure in the components of the equipment, enabling the taking of appropriate corrective measures.

The manufacturer shall at least submit systems identifying the following:

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- a) Cabin temperature: each cab must have an external display that demonstrates to the operator who is on the platform the internal temperature and must have a remote control for adjustments when necessary;
- b) Smoke detector: each cabin must contain a smoke detector for emergencies;
- c) Wind force: must be monitored throughout the operating time of the equipment via anemometer, with the indication of wind strength appearing on the control panel of the ferris wheel. The manufacturer must guide which is the most suitable place for its installation;
- d) Unbalance of the ferris wheel: the equipment must contain a display on the control panel, where it shows in real time the monitoring of any overload of the motors in the course of the rim rolling track. This eventual overload is the result of the effort that the engines make, related to the friction of the tires in relation to the rolling track;
- e) Engine failures: in case of failure of any of the engines a light signal indicating which engine it is must be indicated in the operating cabin;
- f) Brake failure: the operating cabin will also contain a specific light signal for the brakes and should indicate in case of failures.

This system must be detailed in the assembly manual and equipment use manual.

2.1.3 Operation Interface

The control system must be equipped with an intuitive operating interface, which allows operators to easily control and monitor the operation of the ferris wheel. This interface should provide clear information about the status of the ferris wheel, alarms, and other relevant information to facilitate efficient operation of the equipment.

The operations panel should feature buttons entitled: "Start", "Stop" (for usual stops during operation), "Forward/reverse" (to select the direction of emergency operation), "Brake" (used for emergency operation braking), "Emergency Stop" (for special emergency cases), "Reset" to reconnect emergency commands after a stop –

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this button can be arranged differently so that it has to be rotated to operate. The panel should also have buttons to trigger air conditioners and to turn on the scenic lighting.

The photo below demonstrates a control panel with the arrangement of buttons, which can be used as a parameter:

Reference image of a ferris wheel operations panel



The light panel shall display buttons and indicators with warning codes for cases of equipment problems, with lights indicating at least engine failure (one light per engine is indicated), brake failure, improper closing of the cabin doors, light indicating that the power is on and light indicating that the equipment is ready for operation.

As an instruction to the manufacturer, the following image below represents the lights indicating the engines. In the photo, each of the three cabinets has a light for each of the four engines. In the case of the Ferris Wheel of Mato Grosso should be four cabinets. This signal will also be alerted in the cockpit.

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Cabinets that signal the operation of the engines



Approximate photo of the indicator lights in the engine cabinet



The image below shows the light signal on the detection of brake failure. There should be a light signal on the brake panel. As there will be 16 brakes, there should be 16 light signals, as image:

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Luminous panel indicating the operation of each of the engine brakes



The control panel should also contain digital information about the wind speed that will be measured by an anemometer that must be provided by the manufacturer and must include in the design and in the installation manual the best place for its placement. It is important to point out that if the equipment suffers wind action during the operation of greater than 15m/s, it must be stopped.

The control panel must meet the following criteria of the ISA 101.01:2015 standard:

- a) As for the relationship between cognition and interface, prioritizing an efficient presentation with few units of information;
- b) Through color, using a grayscale for the interface and warm colors for emphasis such as alarms, failures, locks, inhibitions, SetPoints and interlocks;
- c) Representing the "quantity" by line length;
- d) Representing the hierarchy by the difference in object size;
- e) Representing grouping through outlines and fills around objects in the same group;

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- f) Providing accessibility, also changing the shape of the object to designate the change of status and not just the color, in addition to choosing to place side by side colors with a good luminous contrast;
- g) Avoid the use of movement on the screen, leaving only in case of alarms that require great attention;
- h) Presentation of objects by a flat positioning.

The presentation of the control panel system is requested demonstrating how the requirements from a) to h) mentioned in this topic were met. This document must be forwarded together with the projects, 30 days after the signing of the contract with MT PAR.

This system must be detailed in the assembly manual and equipment use manual.

2.1.4 Redundant systems

Redundant systems must be designed to offer a double guarantee of safety and operation of the ferris wheel. The systems that should have redundancy should be, at a minimum, the following:

- a) Engine brake: as mentioned in item 2.7 (Brake system), a manual brake is requested;
- b) Method of closing the door of the cabins: a double security closure is requested, with the automatic door and with the manual lever, as mentioned in item 2.15 (Type of door opening opening);
- c) Method of opening the door of the cabins: as redundancy in cases of failure of the automatic opening of the cabin, according to item 2.15 (Type of door opening opening), it must be possible to open it through a plug connected to the door;
- d) Power generator: if there is an interruption of the energy supply by the energy distributor, there must be the normal continuity of the operation of

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the equipment from the use of the diesel generator system according to item 2.8 (Monitoring and fault detection system);

- e) Emergency button: in addition to the emergency button present in the cockpit, it is necessary to have an external emergency button, positioned outside the cockpit. This allows the platform operator to trigger it in emergency situations, speeding up the detection of problems if the operator inside the cockpit has not yet identified it. Such activation will turn on the warning light in the cockpit, in accordance with item 2.9 (Alarm and evacuation system).

All these systems must be detailed in the assembly manual and equipment use manual.

2.2 Lighting system

The ferris wheel lighting system plays an essential role in creating a visually appealing experience for visitors to the attraction. The lighting system can be divided into two groups: Indoor lighting and Outdoor lighting. The entire lighting system should be detailed in the manuals of use and assembly.

The IEC 61347-1:2015 standard details the tests that need to be carried out by the manufacturer of the LEDs in order to ensure the constancy and conformity of their products. It also presents the type tests that must be carried out by the ferris wheel supplier to prove and ensure the safety of the electronic ballasts present in the lighting system.

As a complement, the NBR IEC 61347-2-13:2023 standard says that the requirements of IEC 61347-1, Section 5, apply when the number of specimens subjected to the tests is:

- a) One unit for the tests of Sections 6 to 12 and 15 to 20;
- b) A unit for Section 14 tests (additional unit or components, where required, may be required in consultation with the manufacturer).

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The supplier must forward the test reports for validation of compliance with IEC 61347-1 in compliance with IEC 61347-2:13.

In relation to LED Light sources, it is important that the materials chosen to compose the equipment, undergo tests of maintenance of luminous flux in LED Light sources. This process aims to evaluate the degradation of the luminous flux throughout its useful life. This normative is found in IESNA LM-80-08, but it can be replaced by a standard of the manufacturer country that defines the same method described above and also provided that it references the evaluation of durability, information for decision making, product reliability and support for standards and regulations.

For testing and measuring the distribution of light intensity, luminous efficacy, electric current, electrical power, junction temperature and other parameters that are very important for light sources, lamps and luminaires, detailing, as well as testing, should be conducted in the laboratory to obtain accurate and consistent measurements of the performance parameters of light sources. It is extremely important that these materials that will be used in the equipment have proof by IESNA LM-79 or similar standard of the country of origin, which have been subjected to tests equivalent to the adverse conditions of the equipment over time.

2.2.1 Indoor lighting

Priority should be given to the visual comfort of the occupants of the attraction with energy-efficient RGBW LED equipment with brightness, lighting and color intensity adjustments. Visitors must have an internal control for the change of the color of the cabin during the tour.

2.2.2 External lighting

Known as scenic lighting, it is used to enhance the aesthetics and look of the attraction by prioritizing visibility and highlighting the ferris wheel in its installation location. High-performance LED systems should be used in your installation, with possible configuration of visual effects, through programming or synchronization of

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lighting. Stage lighting should be present around the rim and cables on both sides. In addition to scenic reflectors with color variation in the columns.

LEDs should be placed on both sides of the piling cables and the entire side of the lattice rims. The equipment must have RGB+W color characteristics where the white color does not depend on the union of red, green and blue colors.

2.3 Sound system

The sound system must prioritize sound quality with a balance between its power and efficiency. The choice of speakers should take into account the geometric shape of the cabins and their acoustics, so that all occupants can have a good experience regardless of their position within the equipment.

Your cabin needs to have a quality sound insulation so that there is no audio leakage between the other cabins of the equipment. It is suggested the installation of equipment of internationally recognized brands. All its electrical installation must be done certifying the safety of the occupants with protection against short circuits and electrical overloads.

For the connectivity of the user with the sound system is indicated the Bluetooth system in Portuguese (from Brazil), having easy connection with devices such as smartphone and tablets. The Bluetooth system must provide stable connection, adequate range to cover the entire cabin, easily accessible interface with its menu in the local language of installation and compatibility with the various possible operating systems. The entire sound system must be detailed in the assembly manual and in the manual of use of the equipment.

The cabins must also have an antenna for capturing FM radio signal and USB input.

In addition to playing the sound desired by the passenger during the tour, the speakers will also serve as communication for cases in which warnings directly from the cockpit will have to be transmitted to the cabins, in special cases and emergencies.

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2.4 Electrical system and communication with the cabins

The communication system of the cabins of a ferris wheel is essential to ensure the safety of passengers and allow efficient operation of the equipment. The communication system between the wheel operation team and the passengers must occur through a two-way intercommunication system, where it is possible for the central to pass information and warnings of the equipment and the user can answer their questions and report emergencies.

In this way, a clearly identified intercom must be arranged inside the cabin. It should be located in the column at the back of the cabin, above the Bluetooth connection and lighting system, for the reach of all passengers.

In the command and control sector, there must be the identification of the cabins so that when the user activates the communication system the operator already knows which cabin to be treated remotely even without the user's information.

The communication system must not present faults, deficiencies, noises or any other problem that may interfere with its full operation. Your connection needs to be stable, reliable and of quality. The details of the communication system with the cabins must be included in the assembly manual and in the manual of use of the equipment.

The electrical circuits for feeding the cabin air conditioners must be at least divided into three circuits. The activation of the air conditioning must be controlled by the operation team of the boarding platform by remote control.

Another electrical system that refers to cabins are obstacle lights for aviation. The ferris wheel should have 5 pieces in total, four of which should be installed at the top of the cabins and should be separated by 90 degrees along the ferris wheel. The fifth piece should be at the top of one of the main columns. Power supply to the airplane signal lights at night must be ensured.

2.5 Ferris wheel safety system

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Ferris wheel safety systems play a crucial role in ensuring the integrity of passengers and providing safe operation during operation. The details of the safety system must be included in the assembly manual and in the manual of use of the equipment. Among the main security systems are:

- a) Monitoring systems: there must be continuous monitoring through video monitoring of the interior of the cabins and the boarding platform, according to item 2.19 (Security camera system). The monitoring screens will be next to the cockpit.
- b) Emergency stop device: the equipment must have a button to determine its emergency stop.
- c) Door closing and opening system: the doors must be automatic with a redundant system of manual closing through a lever, according to item 2.15 (Door opening system). In addition, there must be a light sensor that will inform the operator of the platform, on the outside of the cab, and the operator of the control cabin, if it is not correctly closed, according to item 3.8 (Monitoring and fault detection system);
- d) Lighting system: electrical wiring must be insulated to avoid contact with passengers, in addition, the room where the generators, equipment and electrical power panels are located must be blocked to the public and signposted. The equipment must have an emergency lighting system, always keeping the cabin lights on and with light signaling indicating exit on the platform, in cases of emergency, according to item 2.6.3 (Emergency lighting system);
- e) Communication system: the interior of each cabin will have a speaker kit and an intercom, which can be used by the cabin operator and passengers for communication in warning and emergency situations, according to item 2.6.3 (Emergency Communication)
- f) Fire system: smoke detection sensors must be installed inside the cabins, according to item 2.6.2 (Fire protection system), and there must also be a fire extinguisher strategically positioned inside each cabin as well as on the boarding platform, according to item 2.6.2 (Fire protection system);

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- g) Warning systems for aircraft: the equipment will have five pieces of light signal that will serve as an obstacle for aviation, four of which will be installed on the Ferris wheel, next to the cabins, at an angle of 90 degrees away from each other, and the fifth will be installed on top of one of the main columns, according to item 2.4 (Electrical and communication system).

2.6 Emergency system

The emergency system is a set of procedures, devices and protocols designed to ensure the safety of passengers in unforeseen or risky situations. The equipment should not be stopped and inspected until all passengers have disembarked, so in an extreme emergency it is necessary to increase the speed of rotation so that the ferris wheel is evacuated as soon as possible.

The manufacturer's user manual should provide precise details about the essential elements of this system, such as:

2.6.1 Emergency lighting system

The emergency lighting system is designed to provide adequate lighting in situations of power outage. This means that if there is a lack of power supply by the concessionaire, the internal lights of the cabins should continue to work with the use of the diesel generator that will be automatically turned on.

On the boarding platform, there should be emergency lights strategically positioned in order to identify the safest exit for passengers and operation staff, in case of evacuation or other emergency situations.

It is indicated that there is a backup system of energy through a diesel generator, so that it is not only dependent on the power utility the operation of emergency lighting. This system should be detailed in the assembly manual and the Ferris wheel usage manual.

The ABNT NBR 10898:2013 standard establishes requirements and guidelines for emergency lighting systems used in buildings and installations in

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Brazil. In item 7 she addresses the power circuit for the recharge of the batteries in the emergency lighting system, where she identifies that:

- a) The preferred rated voltages in alternating currents are 127 V and/or 220 V; However, for the ferris wheel of Mato Grosso will be adopted the neutral phase-voltage (Volts) in 220V.
- b) The electrical circuits defined for the supply of the emergency supply system shall be unique and properly identified in the general distribution table. The identification must indicate that the circuit cannot be interrupted, remaining energized constantly, so as to recharge and keep the batteries at full charge;
- c) Thermomagnetic circuit breakers used in the supply circuit of emergency lighting systems shall bear an instruction identification to prevent their unauthorised shutdown;
- d) Circuit breakers should be the only means of voluntarily shutting down the power circuit of the battery recharging system.

Item 8 refers to the supply circuit of the luminaires of the centralized systems:

- a) The voltage of the supply circuit must be up to 30 Vdc (direct current voltage);
- b) The protection of the supply circuits must be provided for and can be done in the central or in the switchboard by means of fuses on the positive and negative track;
- c) The feed conductors must have the same sections in both polarities;
- d) The supply conductors of the light points must be dimensioned not to exceed a voltage drop of more than 8% at the most unfavorable point;
- e) The sections of the conductors may not be less than 1,5 mm².

When preparing this topic, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

The guidelines for this system and the operation process should be presented in the user manual. The validation will be done through the analysis of the

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electrical project that must be forwarded after 30 days of the signing of the contract with MT PAR.

2.6.2 Fire protection system

A well-designed fire protection system is essential to ensure the safety of passengers, employees and ferris wheel structure in case of emergency.

Each cabin shall contain a protection system which shall include smoke detection systems (sensor installed on the roof of the cabins), fire alarms, fire extinguishers (which shall be arranged near the bottom of the cabin seats, with easy viewing by the passenger), emergency beacons and smoke escape systems to ensure rapid and effective response in the event of a real emergency. This system must be included in the assembly manual and in the user manual of the equipment.

According to the ABNT NBR ISO 7240-2:2021 standard, in normal condition, any type of system information can be viewed. However, no indication can be given that could be confused with indications used in the following situations:

- a) Fire alarm condition;
- b) Fault warning condition;
- c) Disabled condition;
- d) Test condition;
- e) Supervisory signal condition.

The standard also refers to the importance of fault indications where it should include:

- a) An indication visible by means of a dedicated yellow light-emitting indicator (the general fault warning indicator);
- b) a visible indication for each recognized fault;
- c) An audible indication as specified in item 4.5.6 of the standard that is referenced to the system failure;

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The visible indication shall be made by means of dedicated yellow light-emitting indicators, where these may be the same as those used to indicate disabling and/or testing of the corresponding fire detection zones or functions.

When preparing this topic, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

Validation of compliance with the guidelines will be carried out through project analysis sent 30 days after signing the contract with MT PAR. The system must be detailed in the equipment manual. International standards similar to the Brazilian one may be used.

2.6.3 Emergency communication

The equipment must contain emergency communication systems to be used to keep the operation team informed and coordinate actions in case of emergency.

This should include intercoms arranged on the boarding platform and inside the cabins, with loudspeakers, so that the cockpit can pass the necessary directions.

2.7 Brake system

The brake system is responsible for controlling the speed and stopping the Ferris wheel safely. This system must be designed to ensure the precise and smooth stopping of the ferris wheel, even in emergency situations. It should have a smooth operation of shape and not occur sudden braking and instant locking, which could affect the structure of the equipment.

The brake of the motor driving the equipment must normally be closed with three-phase working voltage. The system must have redundancy and be equipped with a manually operated lever at the rear end of the engine to separate the two brake discs. When the brake cannot be released due to a failure problem, this emergency lever can be used to release the brakes and ensure the continuous operation of the engine.

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For safety purposes, before the equipment is started, the brake indicator shall illuminate a light signal. Otherwise, the brake power circuit breaker and the brake circuit breaker should be checked to see if they are closed. The emergency stop button and the brake button must be restarted, otherwise the equipment cannot be turned on as the brakes will not be released.

During normal operation the brake must be on and released. If the operation is unbalanced for any reason, the emergency stop button must be pressed to apply the brake.

The brake system must be detailed in the assembly manual and in the manual of use of the equipment.

For a reference on the subject, some standards can be cited to support safety and efficiency in machines, electric drive system of adjustable speed and prevention of unexpected starts.

The ISO 13849-2023 standard provides the necessary safety parameters and guidelines on the principles governing the design and integration of safety-related parts of control systems (SRP/CS), including software development.

As this is an area that is influenced by engines directly linked to the runway, it is important to reference the ISO 14118:2017 standard which is an international guideline that addresses the safety requirements related to physical barriers to prevent access to hazardous areas. These barriers should be considered in design, can be fixed or mobile, and are intended to protect operators and others from injury caused by accidental contact with hazardous areas.

2.8 Fault monitoring and detection system

The equipment must be designed including a fault monitoring and detection system. They are of utmost importance for the safe operation of the ferris wheel and must be detailed in the assembly manual and the ferris wheel use manual.

As provided for in ISO 12100:2013, the system shall monitor at least the following points:

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- a) Engines: the cockpit panel shall contain illuminated signals identifying each engine in the equipment. In case of failure, the light will come on indicating where a problem is occurring;
- b) Brakes: During the normal operation of the ferris wheel, the brakes must be on and released. For safety purposes, before the equipment starts working, a light will come on on the control panel indicating that everything is ok with the brakes to be released. In case of system failure, a red light should come on the panel. There should be the redundant option of the brake being released by a manual emergency lever next to the engines. There should also be an emergency stop button to apply the brake in case of imbalance in the operation of the ferris wheel;
- c) Air conditioners: each cabin must contain a thermostat in Celsius that will monitor the internal temperature and an external digital monitor that will indicate the temperature regulated for the internal air conditioner and also the actual temperature that is inside the cabin. They must be constantly monitored by the support team that will be on the boarding platform in order to detect faults. In addition, in the cockpit, on the panel of the air conditioners, there should be a signal indicating failure in the circuit when it is detected.
- d) Door closing: also on the upper outside of the cabin, a light signal should be placed that will indicate and light up if the door is not properly closed. This detection should be made visually by the operators of the boarding platform and, in case of activation of the light signal, the cabin should not be occupied until the correction of the problem;
- e) Electrical failures: the equipment must have a system that can identify the interruption in the supply of electricity in the main network. The system will operate together with an Supervision Unit Alternating Current (USCA), which will be responsible for collecting network information such as voltage and current. It must be configured with detection thresholds that, when crossed, indicate power outage and also with a timer for checking for persistent failures. In the event of a persistent power outage, the system must start the generator. Even with the generator activated, the system continues to monitor the main power grid. Once the electrical power is restored and stabilized, the system must reverse the process by gradually disabling the generator and returning to

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the grid supply. It is important that the manufacturer points out what is the power of the generator required for the operation of the wheel in case of power outages. In addition, the manufacturer must inform the information necessary for the execution of the QGBT, which is responsible for releasing the energy to the equipment.

When preparing this topic, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

The entire system must be detailed in the manual of use of the equipment, which will serve as a form of validation to meet the present item of this notebook.

2.9 Alarm and evacuation system

In addition to monitoring systems, the equipment must contain an alarm and evacuation system that can alert passengers and operating staff in the event of an emergency and guide safe evacuation procedures if necessary.

On the boarding platform there will be a button that the operator can press as a way to alert the cockpit that something is wrong.

Both in the cabins and on the boarding platform should be installed speakers so that the cockpit can pass the necessary guidelines in case of emergency. In addition, the system also contemplates the light signals on the boarding platform guiding the emergency exit.

As for emergency signaling, taking into account that the equipment will be installed in Brazil, this must meet ABNT NBR 16828:2022. The signposts need to follow Table A – Geometric shapes and dimensions of the signposts, which is attached to this notebook.

When preparing this topic, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

The equipment usage manual should explain the evacuation procedures established for different emergency scenarios, ensuring that passengers and the

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operation team know how to act in a safe and organized manner during an evacuation.

2.10 Cabin cleaning system

The ferris wheel has its continuous movement, so that boarding and disembarkation should take place without pauses. In the meantime, cleaning should be carried out after using new passengers.

For a quick cleaning, the materials used in the cabins must be easy to clean, such as floors and seats. It is important that the user manual of the equipment provided by the manufacturer specifies the best form and products that should be used for cleaning.

These products should be recommended by the manufacturer so that there are no aggressions in the properties of the acrylics of the cabins, in the pigmentations of the materials and so that the upholstery and rubberized materials of the cabins do not suffer damage with the use of unsuitable products.

2.11 Cabin air conditioning system

The air conditioning system of the cabins must ensure a pleasant indoor environment regardless of the external temperature and its climatic changes. There must be an internal temperature monitoring system from a thermostat and an air conditioner per cab, which is controlled by an operator in the ferris wheel command center. The external ambient temperature and the internal temperature will be informed on the external display of the cabin and checked by the boarding platform staff thus maintaining a cool and comfortable environment. The photo below brings a reference of how the external monitor will be:

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Monitor on the outside of the cabin showing the cabin temperature in degrees Celsius



The cabins need to be executed with a good thermal insulation system increasing the energy efficiency of the equipment and reducing its consumption. Appliances should contain air filters that trap dust particles, pollutants and allergens from the air, improving indoor air quality.

The connection of the air conditioners will be made by the operation team at the beginning of each daily operation.

The evaporator with the air vents must be arranged at the top of the cabins in its entire diameter, as shown below:

Evaporators for refrigerated air outlet



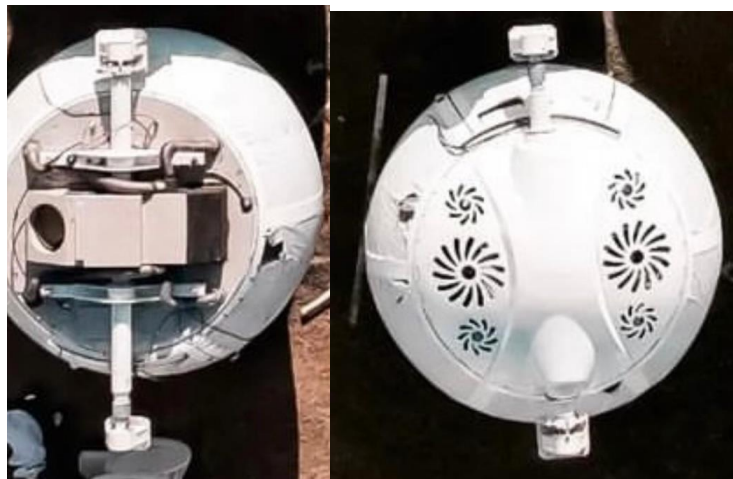
The condenser must be located at the top of the cabins under a coating in order to be hidden, as shown in the following image. It is noteworthy that this upper finish must be able to be removed for eventual maintenance in the air conditioning and in the electrical part of the cabin.

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Air conditioning condenser



The system should be designed to operate quietly, minimizing the emission of noise that may disturb the experience of passengers during the ride.

The air conditioning systems of the cabins must be detailed in the assembly manual and in the manual of use of the equipment.

Based on this item, we refer to the ABNT NBR 16401:2008 standard, which deals with the requirements for the design, installation and maintenance of air conditioning and ventilation systems in commercial, residential and industrial buildings. This standard establishes comprehensive guidelines to ensure thermal comfort, indoor air quality and energy efficiency in climate-controlled environments.

The standard addresses a variety of aspects, from the proper sizing of HVAC equipment to design criteria to ensure efficient air distribution and precise temperature control. It also deals with the characteristics of the materials used, filtration systems and hygiene standards for maintenance, in order to preserve indoor air quality and minimize health risks.

2.12 Cabin ventilation system

Cabins must be equipped with a ventilation system designed to provide adequate air circulation within the cabins, ensuring that fresh air enters and stale air

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is removed effectively. This helps to avoid the feeling of stuffiness and discomfort during the ride and helps the acrylic parts not to blur, which can disrupt the passenger's vision. In this way, mechanical exhaust fans should be arranged at the top (as illustrated in the photo below) and bottom of the cabin (the hoods should have a metallic finish, in the color of the cabin, to preserve their strength and durability).

Exhaust fans at the top of the cab



2.13 Access system for people with disabilities

The equipment must have an access system for people with disabilities in order to promote inclusion and ensure that everyone can enjoy this attraction. This system must be detailed in the manual of assembly and use of the equipment.

Among the indispensable details for accessibility are:

- a) Accessible boarding and disembarking platform: use of ramps with slopes compatible with Brazilian standards must be available for accessible boarding and disembarkation;
- b) Accessible cabins: cabins must have a minimum of 20% of accessible models, with their removable or folding tables to provide the necessary space for wheelchair mobility. In the case of booths without a table, they are considered affordable. The controls and panels must be at the height of 1.10m for all users of the equipment;

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- c) Safe operation: the manual of use of the equipment must provide instructions for safe operation, with stop of the equipment for the boarding and disembarkation of wheelchairs and people with reduced mobility.

The validation of this item will be done through the analysis of the project and manual of use of the equipment.

2.14 Cab bearing system, electrical connection brushes

The cab bearing system and the electrical connection brushes are important elements for the proper functioning of the ferris wheel and both perform different functions and should be detailed in the equipment assembly manual.

The bearing system is responsible for allowing the smooth and safe movement of the ferris wheel cabins. Each cab is mounted on a set of bearings that allows it to rotate around the central axis of the ferris wheel. These bearings are designed to support the weight of the cabin and passengers, providing a stable and frictionless rotation. For the bearing system the indication is first-line materials from renowned brands.

As we do not yet have access to the type, model and class of bearings that will be used in the cabins, the bearings must be presented by the manufacturer and they must have their permissible tolerances based on item 5 of ISO 199:2014 for thrust bearings and the tolerances of item 5 of ISO 492:2014 for radial bearings.

To prove compliance with the item mentioned, the manufacturer must send a report proving the guarantee of the permissible tolerances of those expressed in the standard according to the type of bearing used.

Electrical connecting brushes are devices that play a critical role in transmitting electrical energy from the fixed structure of the ferris wheel to the moving cabins. They are used in conjunction with collector rings, which are fixed to the structure, to create a continuous electrical connection with the moving cabins.

2.15 Type of door opening system

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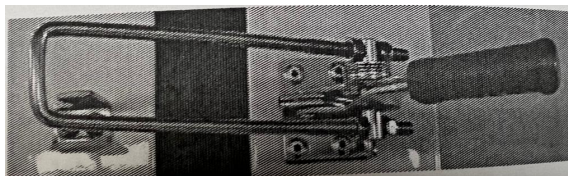


The system of opening and closing the door of the cabins must be electric, having a redundant system with manual locking that will be done by the operators who stay on the boarding platform. The lever arranged on the outside of the cab should be of the manual double safety type and should be similar to the image below:

Auto-open button reference for cab door



Manual opening lever reference for the cab door



It is important that there is a light signal outside and on the panel of the operations cabin that demonstrates that the cabin is in fact closed. The cabin should not have an option to open inside. In addition, if the cabin door presents a problem and does not close correctly, the cabin cannot be occupied by passengers until the problem is resolved.

For emergency situations or any problems related to the electronic door lock, the cabins must be equipped with a security system to allow the door to open. It is requested the installation of a 24V plug on the lower outside of the cabin, which will

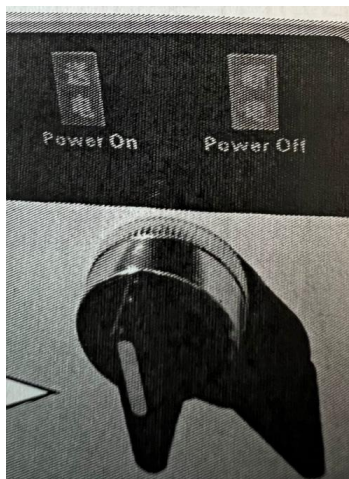
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allow a battery to be connected for the unlocking of the electronic lock. After being opened and evacuated, this food should be removed.

Reference for emergency open button the cab door



This entire system should be detailed in the manual of use and assembly of the equipment.

2.16 Air conditioning equipment drainage system

The drainage system is responsible for collecting and directing the water resulting from the operation of the air conditioning devices. It is important to specify the drain points in the cabins and their proper destination, ensuring efficient water removal and avoiding problems of accumulation or leaks in the cabins or in the ferris wheel structure. This process should be included in the description of the equipment and in its user manual.

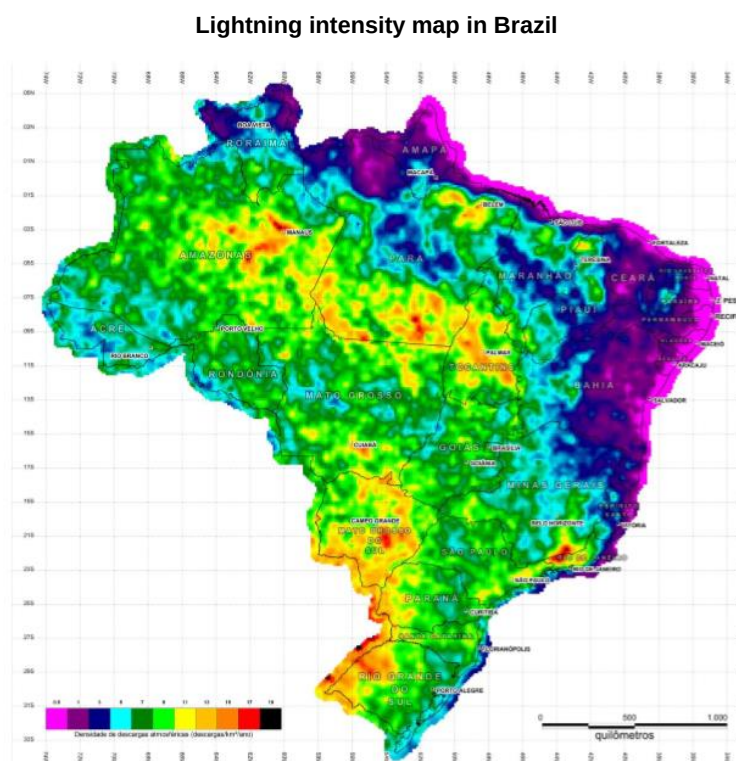
2.17 Lightning protection system

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The lightning protection system must be designed taking into account the density of atmospheric discharges in Brazil, as requested in NBR 5419-2:2015 and presented in the following image:



It asks the manufacturer to include a copper SPDA system. According to NBR 5419-1:2015 it consists of:

- a) an external lightning protection system;
- b) An internal lightning protection system.

In addition to the above requirement, the SPDA system must present a catchment subsystem, which must contain, according to NBR 5419-3:2015:

- a) Rods (including masts);
- b) Suspended drivers;

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c) Mesh conductors;

As mentioned earlier, the SPDA system must be designed in copper. NBR 5419:2015 presents some minimum measures for the components of the system.

a) Minimum thickness of sheet metal or metal pipes in collection systems:

- I. Prevents perforation: 5 mm;
- II. Only for plates that do not prevent perforation: 0.5 mm;

b) Material, configuration and minimum dimensions of grounding electrode:

Configuration	Minimum dimensions		Comments
	Spiked electrode (diameter)	Non-spiked electrode	
Stringed	-	50 mm ²	Diameter of each cord wire 3 mm
Solid rounded	-	50 mm ²	Diameter 8 mm
Solid tape	-	50 mm ²	Thickness 2 mm
Solid rounded	15 mm	-	
Tube	20 mm	-	Wall thickness 2 mm

c) Material, configuration and minimum section area of the pickup conductors, pickup rods and descent conductors:

Configuration	Minimum section area mm ²	Comments
Solid tape	35	Thickness 1.75 mm
Solid rounded	35	Diameter 6 mm
Stringed	35	Diameter of each cord wire 2.5 mm
Solid rounded	200	Diameter 16 mm

This system must be instructed by the manufacturer in the manual of use of the equipment.

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When preparing this topic, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

In the detailing of the assembly manual must present the design, installation instruction, inspection and maintenance and, finally, the tests that must be accurate to be efficient. The validation of compliance with the item will be carried out in the analysis of design and manuals.

2.18 Temperature control system in the control cabin

The Ferris wheel control cab must have a temperature control system to maintain a comfortable working environment for operators and, above all, to ensure an optimal working temperature of the electrical and electronic components of the ferris wheel.

The control cabin must have air conditioning and thermostat device that will control and maintain the appropriate temperature for the operation of the equipment, which can be adjusted by remote control. The manufacturer must indicate the ideal temperature in the user manual.

2.19 Security camera system

The security camera system is important for monitoring and controlling the attraction during its operation. Its monitoring must be carried out in real time by the security team or the operators, allowing the immediate detection of any suspicious or risky situation.

High-resolution cameras should be used inside the booths to capture clear and detailed images with the ability to identify faces and relevant details if it is necessary to review the images. The cameras must be equipped with night vision sensor allowing efficient surveillance even in low light conditions.

Among the main features for the proper functioning of the security camera system stands out:

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- a) Continuous recording: the system must be able to continuously record the images captured by the cameras. This is important to archive evidence of past events and facilitate further analysis if necessary.
- b) Secure storage of recordings: recordings should be stored securely and accessible only to authorized personnel. This is critical to ensuring passenger privacy and the protection of sensitive data.
- c) Data backup: it is important to have a data backup system to prevent the loss of important information in case of failure of the main system.
- d) Compliance with privacy regulations: the camera system must be designed and operated in accordance with the privacy and data protection regulations in force in the region where the ferris wheel is located.
- e) Operations monitoring: in addition to passenger safety, the camera system can also be used to monitor the attraction's operations, ensuring that everything is working as planned.

The user manual should contain the instructions for the operation training.

2.20 Power backup system

The equipment must have a power backup system through a diesel generator, so that in cases of interruption of the power supply by the concessionaire, the ferris wheel maintains its operation in normal operation so that the generator is turned on automatically. The system will also ensure emergency lighting in cases of emergency, ensuring the lights of the cabins accessed as well as maintaining light signals indicating the proper exit path from the platform.

The system must be able to identify the interruption in the power supply in the main grid by operating together with an Supervision Unit Alternating Current (USCA), which will be responsible for collecting the information from the network, such as voltage and current. It should come integrated with QTA, configured to detect power failures and, when necessary, drive the generator. The system should continue to monitor the main power grid and detect when it is restored, so that the generator is automatically turned off and the power supply through the grid returns.

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The power of the generator must be indicated by the manufacturer along with the bidding documents according to the demand of the equipment in order to maintain the continuous operation of the equipment.

In addition, the power backup system should be detailed in the assembly manual and the ferris wheel usage manual.

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3 TECHNICAL SUPPORT

In order to ensure proper operation, commitment to deadlines, delivery times and efficient maintenance of the ferris wheel, requirements will be established in relation to technical support. These demands are critical to ensuring effective operation, passenger safety and the continuous optimum performance of the equipment.

3.1 Parts supply

The company that manufactures the ferris wheel must undertake to supply parts for maintenance that the warranty does not cover, in cases of natural wear and tear on the components, so that the equipment can be configured and operated perfectly.

3.1.1 Spare parts

The manufacturer must have prompt delivery or indicate third-party companies that have or manufacture the Ferris wheel components with the same quality and origin.

To ensure compliance with this item, the contracting Party MT PAR must sign a contractual clause with the manufacturer ensuring the supply of parts not covered by the warranty.

3.1.2 Spare parts for emergency maintenance

The company that manufactures the ferris wheel must send, extra, along with the delivery of the equipment, the following items:

- a) 10% of each screw, nut and washer set (except inserts);
- b) 2 sets of insert, nut, counter nut and washer;
- c) 10 units of cables;

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- d) 2 units of tires;
- e) 2 complete premium model cabins;
- f) 5 units of the bluetooth system;
- g) 5 pairs of speakers;
- h) 2 complete air conditioning systems;
- i) Extra acrylic for assembling 2 cabins;
- j) 100 m² of rubber flooring;
- k) 4 complete sets of cabin bearings;
- l) 6 sets of internal lighting system;
- m) 1 unit of the aviation signaling component.

3.2 Assembly time

The manufacturer must provide approximate information about the estimated assembly time of the ferris wheel. This includes from the time required for the installation of the structural part such as columns, shaft and rim, to the assembly of the cabins, control systems and other components that make up the operation of the equipment.

The assembly manual is requested to define the types of cranes required and stipulate the assembly time.

3.3 Ferris wheel warranty

Generally, the warranty can be divided into different periods, such as full manufacturing warranty, extended warranty for specific parts, and separate warranties for different types of components.

The manufacturer must clearly state in the equipment's warranty and use manual the conditions under which the warranty is valid. This may include proper use of the ferris wheel, regular maintenance as per the manufacturer's recommendations, and other specific guidelines.

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3.4 Technical and maintenance support

The manufacturer must provide technical and maintenance support to ensure the safe, efficient and reliable operation of the ferris wheel. Some key points must be taken into consideration for a quality service.

There should be a line of communication with the ferris wheel manufacturer to get technical support, clarify doubts, and request expert assistance in case of more complex problems.

Maintenance procedures need to be detailed and up-to-date for each ferris wheel component in the user manual. These procedures should cover all items necessary for the safety and continuity of the Ferris wheel warranty.

To ensure compliance with this item, the MT PAR Contractor must sign a contractual clause with the manufacturer ensuring technical and maintenance support.

3.5 Preventive maintenance plan

The manufacturer shall submit a preventive maintenance plan that describes the recommended activities, periodicities and procedures to be adopted to maintain the performance and safety of the ferris wheel throughout its service life. This plan shall include regular inspections, lubrication, wear checks, system operation testing, replacement of components as required, among others, and shall be included in the equipment warranty manual provided by the manufacturer.

3.6 Ferris wheel lifetime

The service life of the equipment must be at least 30 years. In this way, it is important that the manufacturer also passes the information on the life expectancy of each part of the equipment, being at least the same time as the required warranty in respect of the following components:

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- a) Structural service life: at least 30 years;
- b) Lifetime of cables: at least 20 years;
- c) Cabin lifespan: at least 10 years;
- d) Lifetime of the cab axle system: 10 years;
- e) Lifetime of engine mechanisms: at least 10 years;
- f) Lifetime of electrical panels: at least 20 years;
- g) Lifetime of the stage lighting: at least 50 thousand hours of use/use for 10 hours a day.

The manufacturer must also provide what are the operating conditions and preventive maintenance so that the equipment meets the established service life deadlines. The service life should be included in the warranty manual along with its maintenance instructions.

3.7 Technical support from the manufacturer before, during and after the start of the equipment assembly

The manufacturer shall ensure continuous technical support during all phases of the project, from the prior preparation of the assembly to the completion of the installation. This includes providing technical information, assembly guidance, expert advice and clarification of doubts. In addition, it is relevant to specify the availability of technical support after assembly to assist in any necessary adjustments, troubleshooting, or improvements. The manufacturer should consider two technical visits, one during assembly and one after the completion of installation of the equipment.

MT Par requires the manufacturer to send a technical team to monitor the entire assembly of the ferris wheel. The contractor also requests a technical visit 6 months after completing the equipment installation.

Items to be fulfilled before, during and after assembly must be taken into account. Below we list essential items for good support:

- a) Clarification of doubts;
- b) Technical guidelines;

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- c) Support to the assembly team;
- d) Parts supply;
- e) Tests;
- f) Update and improvements;
- g) Warranty.

To ensure compliance with this item, the MT PAR contractor must sign a contractual clause with the manufacturer ensuring technical support.

3.8 24h online technical support

It is desirable for the manufacturer to make online technical support available 24 hours a day, offering communication channels for remote support, such as email or online chat. This continuous availability of technical support is essential to deal with any emergencies or operational problems that may arise during the assembly of the ferris wheel, ensuring a quick and efficient response by the manufacturer. The points below should be remedied by the manufacturer.

- a) Immediate assistance;
- b) Step-by-step guidance;
- c) Real-time problem resolutions;
- d) Verification of conformities;
- e) Progress monitoring.

3.9 Technical visit of the manufacturer during assembly

The manufacturer must commit to send a technician to the installation site of the ferris wheel during its assembly period giving preference to critical steps, such as mounting the rim, shaft and inclined columns, with the aim of providing direct support, technical guidance and resolving any issues that may arise during assembly.

The technical visit of the head of the manufacturer is an opportunity to be able to hold the conference between manufacturing and execution to ensure the quality and safety of the assembly of the ferris wheel.

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To ensure compliance with this item, the MT PAR contractor must sign a contractual clause with the manufacturer ensuring the manufacturer's technical visits.

3.10 Packing list before and after manufacture of conference wheel

The manufacturer must provide a detailed list of all the components, parts and materials that make up the ferris wheel before and after transportation. These packing lists should be made available for checking prior to shipment, allowing for full verification of items and ensuring that everything is in accordance with the agreed design and specifications. It is noteworthy that all parts must be included in the project enumerated (preferably, with QR Code), both in the project and in the equipment and that are easy to understand. The packing list must contain:

- a) Bill of materials;
- b) Technical specifications such as dimensions, weight, volume and thicknesses;
- c) Quantities of materials;
- d) Technical drawings and schematics;
- e) Manual of assembly, guarantees and use of the equipment;
- f) Technical documentation with all reports and warranty certificates.

The manufacturer must receive a technical team from Brazil 15 days before sending the equipment to check the components, quality and quantitative so that it can be released for transport.

For better visualization and conference of the packing list in China, the materials and equipment should be properly separated by equals, quantified in volumes, finally being packed and sent to Brazil in the same way. Below, we cite materials and forms of identification:

- a) The screws need to be separated into sets of screws, nuts and washers, according to model, dimensions, class, volume and weight;
- b) The cables need to be separated by thickness and length, and can be packed in sets of equals or individually, provided that each has an identification tag

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that is not easy to remove. The tag must contain the dimensions, size and identification number for conference in the manual;

- c) The sections of the columns must be identified individually, without repetition of numeration and according to the assembly sequence, (Example: column A section 1, column A section 2, column B section 1, column B section 2...). They also need to have length, diameter, and plate thickness information;
- d) Identification of the bearings, with clear and visible marking of the fixing tip on the shaft and column;
- e) The rim parts need to be well identified, with clear and visible marking of the assembly sequence, in addition to the specification of their dimensions and quantities;
- f) Engine support needs to contain information of the dimensions and clear and visible markings of the assembly sequence, as well as identification of the fixing side on the column;
- g) Identification of the dimensions of the column-concrete block fixing plates. The type of steel adopted must also be presented, as well as its characteristics for compatibility check with item 6.26 (Typology of steel required for the execution of the foundation discs) of this technical notebook. If equivalent steels are used, the manufacturer shall submit a document relating the two grades of steel;
- h) The inserts must be separated by set of insert, nut and washer, identified by tags with the dimensions of the items and the specifications of the steel used in each piece according to item 6.27 (section of inserts necessary for the connection with the foundations) of this technical notebook. If equivalent steels are used, the manufacturer shall submit a document relating the two grades of steel;
- i) Motors and electrical equipment in general with a very clear and visible identification tag containing the model, brand and dimensions. Also specify quantities.

3.11 Specifications of all tools for the assembly process

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The manufacturer must provide a detailed specification of all the tools required for the Ferris wheel assembly process. This includes hand tools, auxiliary equipment, lifting devices and any other technical resources required. At least the following items are specified:

- a) Mouth wrench;
- b) Screwdriver;
- c) Key philips;
- d) Allen wrench;
- e) Torx wrench;
- f) Turnstile key;
- g) Wrench;
- h) Hydraulic jack;
- i) Welding machines;
- j) Blowtorch;
- k) Electrodes;
- l) Capacity and types of cranes (with or without track, telescopic, road etc.)
- m) Screwdriver;
- n) Drill;
- o) Electric sander;
- p) Cutting machine and disc types;
- q) Grinder;
- r) Specific tools for torque of the cables;
- s) Digital hook scale (dynamometer) - Capacity;
- t) Load cell - Capacity;
- u) Block of pulleys and cables;
- v) Drag winch;
- w) Key for tightening the cables (specific by wheel model);
- x) Shackle (load, size, thickness ... etc.).

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4 CERTIFICATIONS, TESTS AND REPORTS

As for certifications, tests and reports, supporting documents will be required that attest to the quality and safety of the equipment. The manufacturer shall submit certifications proving the conformity of the product with the applicable technical standards and regulations.

All materials that will be applied to the equipment must have their quality certificate, regardless of whether they are produced in the factory or outsourced. These documents must be presented to the technicians in Brazil at the time of the packing list conference before sending the equipment.

ISO/IEC 17025:2017 establishes the requirements of competence, impartiality and operation for testing and calibration laboratories. It has a global recognition to evaluate the technical capacity and quality of laboratories that perform tests and calibrations.

The ISO/IEC 17025:2017 standard, in item 6.4.5 and item 6.4.6 shows that laboratories must have their certifications assured about calibration and that they must be able to achieve measurement accuracy.

All required reports must be issued by an independent laboratory accredited by INMETRO, if in Brazilian territory, or similar or renowned institution in the country of origin of the participating company. It is essential to emphasize that, if the products have approvals according to the standards of the country of manufacture, such standards must be presented. This will allow a more comprehensive and accurate evaluation of the characteristics of the products, ensuring their suitability to the quality and safety standards applicable in the specific context.

4.1 Safety certification

The manufacturer must present along with the documentation sent with the packing list certifications ensuring that the equipment meets all the safety requirements established by the applicable standards and regulations, thus ensuring its structural integrity, stability and safe operation of the ferris wheel.

Certifications should be at least in the following respects:

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- a) Steel of the plate connecting the foundations with the equipment;
- b) Steel of the inserts of the foundations;
- c) Cables;
- d) Acrylic;
- e) Engines;
- f) Screws;
- g) Air conditioning panel;
- h) Electrical panel.

These certifications should be issued by regulatory bodies and specialized entities according to the material to be certified.

4.2 Quality certification

In addition to the safety certification, it is essential that the company presents the quality certification that proves that the ferris wheel was designed and manufactured according to strict quality standards. This certification ensures that the materials used, the manufacturing processes meet criteria of excellence, ensuring reliable and durable performance.

Quality certifications shall be at least of the following:

- a) Quality certification of welds;
- b) Cable quality certification;
- c) Quality certification of the engines;
- d) Quality certification of the screws;
- e) Quality certification that all steel material has been subjected to the shot blasting process;
- f) Certification of quality of the painting, highlighting material and thickness of the covering;

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Compliance with standards and standards, testing and inspections, certifications by recognized entities, and technical reporting and documentation must be presented.

4.3 Energy and efficiency measures

The equipment manufacturer must present what actions and measures it will implement in the project to promote the reduction of energy consumption and improve the energy efficiency of the equipment. The actions and measures can involve both the performance of its components, because they have certifications and seals that guarantee reduced energy consumption, as well as by guidelines for use with the manuals sent by the manufacturer, guiding regular maintenance to ensure that the entire system operates with maximum efficiency.

The information on the energy efficiency of the equipment is of paramount importance to have reference of the monthly energy expenditure. These energy and efficiency measurements should involve energy consumption measurements, design analysis, and computer simulations.

4.4 Tests and report of resistance of the structure

The structure of the cable-stayed ferris wheel of 108 meters in height must be submitted to some reports of resistance of the materials applied in the equipment, for the fact that it must attest to the resistance of the materials such as thickness of the plates, resistance of the bearings, resistance of the cables referring to the action of the wind and weather suffered. Below are some of the main tests to perform to confirm the resistance of the Ferris wheel.

- a) Static load test;
- b) Dynamic load test;
- c) Extreme wind tests;
- d) Overload tests;
- e) Structure fatigue test.
- f) Impact testing.

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The tests should be done by software in the structural projection of the equipment and the results of the tests should be reported.

4.5 Tests and report of resistance of the cabins

Ferris wheel cabins must pass strength tests to ensure their structural integrity, carrying capacity and passenger comfort. The result should be lauded. These tests include static and dynamic analyses, considering different load and vibration scenarios. Among this, the manufacturer must attest to reports that both the structural part of the cabins and the resistance of the acrylics are in accordance with the requests considered thus avoiding dryness of the material, premature wear, which may interfere with the user experience.

4.6 Tests and stability report of the ferris wheel

Stability tests should be performed to verify the behavior of the equipment in adverse situations, such as strong winds and seismic events according to the study of the installation region. These tests ensure that the ferris wheel remains stable and safe in all circumstances, minimizing the risk of accidents.

Among the necessary tests to be performed, we highlight those mentioned in the item of structure resistance, such as static load tests, dynamic load tests, extreme wind tests and overload tests. The tests must be done through the use of specific software and must be reported.

4.7 Tests and vibration report of the ferris wheel

In vibration testing of a ferris wheel, it is important to evaluate how the structure, components and cabins respond to vibrations generated during operation. Vibration analysis is crucial to ensure the safety and comfort of passengers, as well as identifying possible malfunctions or flaws in the structure.

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It is noteworthy that the tests can be of the computational type, through structural modeling. They should be lauded. Among the main analyses to be observed are:

- a) Frequency of vibration with the measurement of the natural and working frequency allowing the identification of resonances at certain frequencies;
- b) Vibration amplitude by measuring the amplitude of the vibrations generated during normal operation of the ferris wheel. Excessive amplitude may indicate problems in the structure or components;
- c) Vibration at different points of the ferris wheel including columns, axle, trusses and cabins.

4.8 Wind tests and report

Wind testing for a ferris wheel is an essential procedure for evaluating the stability and safety of the structure during extreme wind conditions. Performing this test is important to ensure that the ferris wheel can withstand high-intensity winds, which can occur during adverse weather events such as storms or hurricanes.

As mentioned earlier, calculations for wind actions on the structure can be referenced by the ABNT NBR 6123 standard or the similar international standard, which provides methods for calculating wind actions on structures by analyzing factors such as wind speed, structure height, and surface aerodynamic characteristics. The dynamic effects of wind can cause vibrations and oscillations in the structure, so they need to be lauded and certified in the metal structure, cabins and cables of the ferris wheel.

When preparing this item, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

Because it is a large element, the test can be of the computational type, through structural modeling or wind tunnel tests with element on a reduced scale. The test must be awarded.

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4.9 Tests and reports of lighting and internal LED lights per cabin

Ferris wheel lighting systems must be tested to verify their proper functioning, including lighting uniformity, energy efficiency and compliance with safety standards. The results of at least the following tests must be submitted and must be accompanied by their appropriate reports. They are:

- a) Functional test;
- b) Light intensity test;
- c) Color test;
- d) Visual effects testing;
- e) Power consumption test.

All of these tests must be carried out by a professional/company approved by an authorized entity in the country of origin of the LED manufacturer.

The testing methodology must include observation of the uniformity of light distribution and functionality of intensity controls, color selection and visual effects; use of a lux meter or photometer to measure light intensity; use of a color temperature meter (calorimeter) to measure the color temperature in Kelvin for each selected color; and energy consumption tests using a meter connected to the lighting, establishing an average consumption.

To prevent any cabin from arriving in Brazil with a damaged internal lighting system, the ferris wheel supplier is asked to carry out functional tests on each cabin.

Tests must be recorded on video and carried out as follows:

- a) On and off test: record the operation of the switch to turn the lighting system on and off;
- b) Color test: change the lighting showing all the system colors;
- c) Intensity test: test the change in lighting intensity in all colors;
- d) Effect test: test the functioning of all the effects that the system presents, such as pulsing, alternating colors without user intervention and the like.

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4.10 Tests and sound reports of each cabin

To ensure the optimal performance of the speaker set and to avoid any possibility of equipment arriving with inadequate or defective installations, it is necessary for the manufacturer to provide a technical certificate that ensures the correct functioning of the sound system in each of the 42 cabins.

The attestations must be accompanied by internal footage of all cabins demonstrating the correct functioning of the speaker system. These footages will serve as evidence of the proper performance of the equipment, allowing for further verification.

4.11 Tests and safety report

Test results covering safety equipment and components shall be submitted to verify the correct functioning of the control systems, brakes, emergency evacuation system, safety systems and any other mechanisms that ensure the safety of passengers in the event of an emergency. Each one must be accompanied by its respective report.

It must be presented the certifications of the tests of welds of the flanges of the joints of the columns, welds of the execution of the shaft, bearings of both the shaft and of the cabs, support of the cabs, main structure of the engines and in the making of the lattice rim.

The tests that must be done and reported for these services described above are:

- a) Visual test inspection which is one of the types of basic non-destructive welding inspection. It can be performed in sight, with a magnifying glass or with devices and instruments for remote inspection;
- b) Penetrating liquid inspection: when a colored liquid is applied to the surface of the material being tested. The liquid is attracted to the defective areas on the surface of the material through capillary action and then withdrawn to reveal itself to detection using UV lights or other methods, depending on the type of penetrating dye and dye used;

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- c) Radiographic and ultrasonic weld inspection: it is a non-destructive test, normally used to examine the internal structure of the welds, so as to establish the integrity of the weld without destroying the welded component. The X-ray assay is produced by a radioactive isotope. The ultrasound test is based on reflection of acoustic waves, when they encounter obstacles to their propagation in the material, where it is reflected and returns to its generating source, if the obstacle is in a normal position (perpendicular) in relation to the sonic beam.

On the stairs can be used only visual and penetrating liquid test.

4.12 Emergency evacuation tests

The manufacturer shall provide in the equipment user manual guidelines and guidelines for emergency evacuation measures already tested for the equipment. Emergency evacuation procedures should be tested and evaluated to ensure that all passengers can be safely evacuated in cases of emergency or equipment failures.

It is important that it is determined by the manufacturer a maximum time of individual evacuation and of all the cabins of the ferris wheel in different emergency situations seeking the optimization of the process, considering that, in cases of emergency, the equipment must operate with the maximum speed allowed and reported by the manufacturer.

Consideration should be given to ensuring evacuation for accessibility, with targeted procedure to meet the needs of people with reduced mobility and other special needs.

4.13 Brake and control system tests

The brakes and the ferris wheel control system must be subjected to tests to ensure their proper operation, reliability and safety during operation. The manufacturer must attest to the accuracy and correct functionality of the brakes and control systems.

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An effective way to test the brakes and control systems before the equipment is in operation is through computer simulations. In this way, the manufacturer must present tests with simulations in different scenarios for the purpose of optimizing its operation before the physical test and give guidelines in the manual of use of the Ferris wheel.

Among the items to be analyzed in the brake test are:

- a) Testing procedures;
- b) Response time;
- c) Total downtime;
- d) Stability;
- e) Emergency testing;
- f) Procedures for maintenance;
- g) Test records.

4.14 Tests and reports of operation of air conditioning equipment by cabin

Cabin air conditioning units must be tested and evaluated to ensure their correct operation, energy efficiency, uniform temperature distribution and air quality.

The tests shall certify that the internal temperature regulated for the air conditioning of each cabin must be in equilibrium and be equal to that indicated by the thermostat on the external display. Individual reports must be made for each cabin with documentation signed by an authorized technical responsible in the country of manufacture.

The equipment manual should indicate a plan of periodic inspections and maintenance with specification of performing cleanings, filter changes, electrical and mechanical components.

4.15 Bluetooth operating reports per cabin

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Cabin Bluetooth connectivity systems should be individually tested and evaluated to verify their proper functioning, signal range, stability, and device compatibility. Some aspects are essential for the presentation of the operating report, which should first include information about the system, such as which version is used, the range capacity, the maximum number of devices connected simultaneously and other relevant specifications;

Below are specified some requirements that the tests should measure:

- a) Connectivity test: verify that bluetooth is able to establish proper connections with passengers' devices, such as smartphones or tablets;
- b) Latency test: check the response time between device actions;
- c) Range testing: involves positioning the devices at a distance from each other and measuring signal quality and communication capacity;
- d) Interference testing: assess how connectivity is affected when other wireless devices are connected in the environment;
- e) Stability and reliability: test the stability and reliability of bluetooth throughout the operation of the ferris wheel, ensuring that connections do not fall or fail;
- f) Security: evaluate the security measures implemented in the Bluetooth system to prevent possible violations or unauthorized access to passengers' devices.

Bluetooth operation tests can be performed by the manufacturer through a combination of methods, including software tools, measuring equipment, and manual procedures. The software can automate many tests and provides detailed reports. The equipment manufacturer must submit one test report per cabin.

4.16 Painting warranty

The manufacturer shall provide guarantees on the quality and durability of the paints and primer applied to the equipment. In addition, the type of paint used

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should be specified, respecting safety standards and providing effective protection against corrosion and environmental effects.

Paint tests for metal structures are carried out to ensure the adhesion, durability and protection of the painted surface from corrosion and other damage. Therefore, the manufacturer must present tests and reports according to the following items:

- a) Adhesion test: evaluates the strength of adhesion of the paint to the metal surface. It may involve making cuts in specific patterns in the paint and then applying duct tape to check adhesion;
- b) Layer thickness test: measures the thickness of the paint layer applied to the metal surface, being important to ensure that the paint layer has the proper thickness to provide protection against corrosion and other damage;
- c) Corrosion resistance test: can be evaluated by subjecting the painted surface to corrosive environments, such as salinity, humidity or salt mist, and observing any corrosion formation;
- d) Chemical resistance test: evaluates how the paint responds to specific chemicals that may come into contact with the metal structure;
- e) Impact test: simulates impacts or light collisions to check how the paint reacts and whether it remains intact;
- f) Accelerated aging test: evaluate how the paint resists premature aging when exposed to extreme environmental conditions such as high temperatures, intense UV light, and humidity.

The Chinese standard GB 8408-2018, references in item 7.6 painting processes and care with the application of anticorrosive. It is important that the surface of all metal parts are free of rust, grease, dust and any and all residue from storage, transport and sanding before painting. The painting should receive after treatment two coats of marine paint on all its metallic components

The manufacturer must send a photographic report containing all the painting processes of the equipment throughout the manufacture of the equipment and must issue a technical disclaimer on all the painting processes.

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The equipment must leave the factory painted and with protective insulation to avoid breakdowns during transport. This is an important concern to ensure the durability and appearance of it over time. The manufacturer must send a sample of the paint along with the equipment.

4.17 Drilling test and inspection report of the parts

The manufacturer shall perform tests on all parts of the equipment that contain holes, such as columns, rim, shaft, engine structure and cab support with the cab flange.

He must perform a pre-assembly of these parts of the ferris wheel with the proper screws, nuts and washers, and must record everything by images and certify in tests and reports on the accuracy of the parts that will be delivered, avoiding problems in the future assembly of the equipment in loco.

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5 MATERIALS USED

Regarding the materials used in the construction of the ferris wheel, it is crucial that the manufacturer provides detailed information about its quality, provenance and strength. Data on the types of steel, aluminum or other materials used, as well as their technical specifications and mechanical properties, will be required.

The use of high quality and resistant materials is fundamental to ensure the safety and durability of the ferris wheel, especially considering the constant exposure to weather conditions and operational loads. Therefore, it is essential that the manufacturer provides resistance reports, certifications and proof that the materials meet the applicable technical standards and norms. In addition, warranties for all materials must be included in the warranty manual.

5.1 Brands of electrical components

Specify the marks of the electrical components used in the ferris wheel, such as elements of the control panels, safety devices, lighting systems and other equipment related to the electrical part.

Some points that should be considered for the definition of the equipment used:

- a) Brand reputation;
- b) Certifications and compliances;
- c) Technical specifications;
- d) Product life cycles;
- e) Technical support.

5.2 Type of engines and brands

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The 16 drive motors of the equipment must all be equipped with brakes to minimize the risk of operating failures, as well as having a redundancy in relation to the engine brake containing a manual lever for emergencies.

Each motor contains a current relay. If the brake coils burn or other failures occur, the current relay sends a failure signal to the equipment, which should be alerted on the cockpit panel. At this time, if there are passengers, the electrical circuit of the fault brake must be disconnected and the manual lever must be used to release the brake and evacuate the passengers.

The engines must be designed so that in cases of emergency, even if two engines fail, the wheel remains operative to carry out a safe evacuation.

Information on the detailed assembly of the motor attachment should be included in the assembly manual in order to facilitate the correct and safe assembly, reducing possible installation errors. Just as warranties should be in the warranty manual.

5.3 Necessary equipment

The manufacturer must send the following tools for the assembly of the equipment:

- a) Two (2) torque machine units for the foundation inserts;
- b) Two (2) torque machine units for the column screws;
- c) Two (2) torque machine units for the screws of the temporary supports;
- d) Two (2) torque machine units for fixing the rim sessions;
- e) Two (2) torque machine units for the cab supports;
- f) Two (2) pin bag units for the removal of temporary supports;
- g) Two (2) torque machine units for the stake cables;
- h) Three (3) load cell units to measure the stresses of the piles;
- i) Two (2) units of mechanical elements to torque the cables;
- j) Two (2) torque meter units for fixing the stilts next to the shaft.

In addition, the manufacturer shall clearly specify in the assembly manual which types of cranes are to be used during assembly.

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5.4 Isolation of equipment for maritime transport

Because these are elements that will be transported by sea, it is important to detail the insulation used to ensure adequate protection of all equipment. This includes information on the type of insulation, materials used and procedures adopted to prevent damage caused by vibration, humidity, shocks and other adverse elements.

In cabins, you must have a metal support with rubberized insulation at the points of contact between the support itself and the cabins so that there are no breakdowns. These supports have the function of the cabins not facing contact with the ground.

Each cabin must have a protective film on the acrylics that will serve as protection against knocks, scratches and shock during transport. The cabins must be transported individually in maritime transport, because they have excess dimensions of container measurements. Special attention is recommended when choosing the protection used in the acrylics of the cabins, because due to direct sun incidence, the glue can have intensified adhesion, making it difficult to remove and causing damage to the equipment.

The columns should be insulated with mechanical protection along the tube, with circular protection spacers along the section, which serve as limiters to avoid as many collisions as possible in transport. The transportation of the sections of the columns should be done in 40-foot containers, closed to avoid corrosion risks throughout the maritime transport.

The rim sections should be insulated with mechanical protection throughout their exposed steel area. All sections must be carried in containers that do not have a roof on their top.

The shaft must receive mechanical protection throughout its area in order to prevent dryness and corrosion in the parts where it has gears and bearings. If the dimensions allow, it is recommended that the maritime transport of the shaft be done inside a container.

Electrical components and materials must be transported in unique containers. All items in the container must be with a mechanical protection in bubble

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wrap, and electrical wiring and other smaller components can be grouped, since pantographs and cabinets of the operation that will compose the cockpit must be packed completely and unitarily.

The cables must be accommodated inside a closed container, with mechanical protection throughout its length.

The temporary supports must come in open frame containers, that is, only the skeleton of the structure. As they are steels that will not be permanent in the equipment, they do not need to come in closed containers.

Open frame container



The screws should be separated by typology, the nuts should be by typology and the washers should be separated by typology. This material must be inside a closed container and identified each separate box. Still, this material should be wrapped in plastics with descriptions of each type.

The torquing tools of the cables, the appropriate torqueadions for each type of screws and nuts, should also come with the equipment, but they should be in wooden boxes of marine plywood to avoid problems of non-operation and bad weather.

The plates connecting with the foundation and the inserts should come in the first wave of the material, which occurs after the 120 days of contracting. This material must come with the tool to torque the foundation screws and nuts. They

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must be insulated with mechanical protection and be inside a container without being affected by the weather during transport.

Extra care must be taken for glued protective materials that can melt with the acrylic of the cabins due to the effect of direct solar incidence, causing difficulty of removal at the final destination and consequently damage to the equipment.

5.5 Stage light, specifications, typology, warranty and testing

The LEDs should be considered on both sides of the equipment and should be designed and supplied being 8 LEDs per meter and the colors should be complete with high grayscale, high refresh frequency and no flicker. The color series should consist of specially designed colored chip LED pixel lights for outdoor landscape lighting having as characteristic extruded aluminum alloy housing. One must have on-off clip style connection and anti-pull connection.

The transformer must be of high thermal conductivity, fully sealed by European glue of the highest quality, ensuring that there is no ingress of water in any way. The materials used must provide total insulation to ensure protection against water and dust and lightning.

The ABNT NBR IEC 60529 is relevant in several areas of industry, especially in the manufacture of electrical and electronic equipment, where protection against the ingress of dust and water is important to ensure the safety and proper performance of devices in different environments and conditions. Therefore, by following this standard, it is ensured that the products meet the specified protection requirements and comply with the relevant regulations.

The IESNA LM-80-08 standard is a technical standard developed by the Illuminating Engineering Society of North America (IESNA), which provides guidelines and procedures for measuring the maintenance of luminous flux from solid-state light sources such as LEDs.

IESNA LM-80-08 establishes standardized methods for conducting long-term testing on LEDs in order to assess how the luminous flux of devices degrades over time. The standard specifies the test conditions, including the temperature and operating current of the LEDs, as well as the measurement intervals.

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This standard is relevant in the lighting industry as it allows lighting manufacturers and designers to obtain reliable information about the degradation of the luminous flux of LEDs over time. This is crucial for predicting the service life and performance of solid-state lighting systems, aiding in design and product selection decision making.

By following IESNA LM-80-08, manufacturers can provide consistent data on the luminous flux maintenance of their products, assisting lighting professionals in choosing the most suitable devices for their applications and ensuring quality lighting and durability over time.

The IES LM-79 standard is a technical standard developed by the Illuminating Engineering Society of North America (IESNA) that establishes procedures and requirements for conducting photometric performance measurement tests of light sources such as luminaires and lamps. This standard aims to provide standardized guidelines for evaluating the lighting characteristics of lighting products, ensuring reliable and comparable results.

The IES LM-79 addresses aspects such as luminous flux emitted by a light source that serves to evaluate the total amount of light that the source emits. The spatial distribution of light, including luminous intensity in different directions, the luminous efficiency, which allows to calculate the luminous flux emitted and the electrical power consumed. It also addresses the color temperature that provides the methods for measuring the color temperature of the light source and the color yield index (CRI).

The standard evaluates the following items that must be verified, tested and reported by the manufacturer by a certified company in the industry and demonstrating its evaluation parameters:

- a) Luminous Flux (lm)
- b) Luminous Efficacy (lm/W)
- c) Luminous Intensity (cd)
- d) Related Color Temperature
- e) Color Reproduction Index
- f) Luminous Intensity Distribution Curve
- g) Power

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- h) Current
- i) Frequency
- j) Power Factor

It is noteworthy that, if the manufacturer refers to the regulations in force in the country of origin, its basis in the calculations, protection, potency, warranty and resistance of the product must be demonstrated. All required reports must be issued by an independent laboratory accredited by INMETRO, if national territory, or similar or renowned institution in the country of origin of the participating company or place of manufacture of the products, in the case of foreign companies.

When preparing the item, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

It should be noted that, if the manufacturer references the standards in force in the country of origin, their basis in the calculations, protection, power, guarantee and resistance of the product must be demonstrated. All required reports must be issued by an independent laboratory accredited by INMETRO, if national territory, or a similar or renowned institution in the country of origin of the participating company or place of manufacturing of the products, in the case of foreign companies.

5.6 Pantograph model

The pantograph is the element that contributes to the overall energy efficiency of the Ferris wheel. Therefore, the pantograph model to be chosen by the manufacturer is of extreme importance both regarding the continuous electrical contact between the central part of the Ferris wheel with the cabins, and for the due importance of the quality of the electrical components applied in its composition.

The pantograph if it is fixed in the structure of the shaft, must be structured with rods, containing spacers that will serve as separation of the copper tracks so that they do not have contact with each other.

These copper tracks will receive the brushes that will slide over the tracks and make the electrical distribution to the equipment. The equipment must have three

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copper tracks to power the three-phase system of the Ferris wheel. In addition, it should have one trail per air conditioning system, three trails for the lighting system, and two trails for the neutral and two for the ground (the housing and the protection of the equipment).

Pantograph axis images



The pantograph must be structured so that it does not have contact with water, rain, dust in order to have a complete service life.

In addition, the manufacturer must mention the care necessary for the maintenance of the pantograph, as well as the reputation of the manufacturer. The description of the warranty process offered by the manufacturer is also important to demonstrate the commitment to customer satisfaction and equipment safety.

5.7 Pantograph mounting

The equipment assembly manual should provide a breakdown of the pantograph assembly procedure for the ferris wheel. This detailing should include all the steps involved in the assembly, the specific alignment requirements and the techniques employed to ensure the necessary accuracy, from the preparation of the parts to the final fitting of the pantograph.

If the pantograph is not delivered assembled and has to be assembled on site, the manufacturer shall inform the distribution of the rods for the placement of the

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spacers of the copper tracks and shall inform the details of the brush attachment and the post-assembly pantograph sealing when the shaft is placed at its design site.

Details such as the assembly sequence, the tools and equipment required, and the specific care to be taken should be enumerated clearly and concisely. Because it is an equipment that is exposed to the weather it is essential to address the necessary care with the insulation of weather, ensuring that the pantograph is protected against the action of climatic factors that may affect its operation and durability. The details of the mounting of the protection next to the pantograph axis must also be presented.

5.8 Pantograph equipment brand

The manufacturer shall provide information on the brand of equipment used in the pantograph, as well as in the drive system and other relevant components. The manufacturer must opt for renowned and reliable brands to ensure quality and performance of the pantograph throughout its operation. We suggest the use of established brands in the sector, which have a proven track record of excellence in similar projects. The equipment must be accompanied by its quality and warranty certificates.

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6 ENGINEERING AND CALCULATIONS

In the context of engineering and calculations, a comprehensive set of guidelines for ferris wheel design should be presented. The assembly manual will contain essential details, including memorials of calculations that prove the safety and efficiency of the equipment.

The total and individual loads of each element should be specified, focusing on the precision and accuracy of the calculations. Clear definitions on the types of welds and screws used will ensure the integrity and strength of the structure. All this aims to ensure the safe and reliable operation of the ferris wheel, meeting the highest standards of quality and satisfaction of the contractor.

All required reports must be issued by an independent laboratory accredited by INMETRO, if national territory, or similar or renowned institution in the country of origin of the participating company or place of manufacture of the products, in the case of foreign companies.

6.1 Need for gantry execution and maximum tensile load that it must withstand

The gantry is an essential structure for the ferris wheel assembly process and this must be designed to withstand the maximum tensile loads applied during the rim assembly phase. It is essential that the gantry is part of the first batch of delivery by the manufacturer, together with the plates and inserts.

The gantry needs to be made of structural steel beam I, meeting the recommendations of NBR 7007 and referenced in the table below:

Table of mechanical properties of steel

Steel grade	Minimum yield strength (MPa)	Tensile strength (MPa)	Minimum elongation after rupture % Lo= 200 mm
BR 190	190	Min. 330	22,0
MR 250	250	400 – 550	20,0
AR 350	345	Min. 450	18,0
AIR 350 COLOR	345	Min. 485	18,0
AR 415	415	Min. 520	16,0

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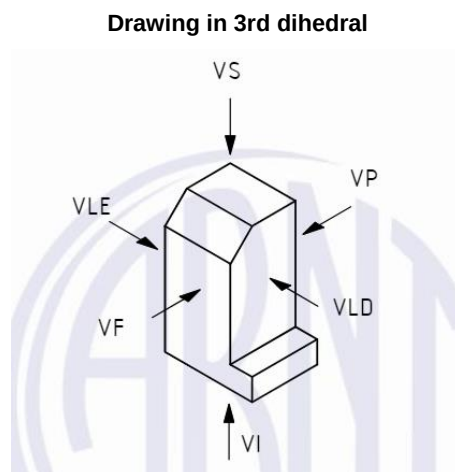
Steels of other standards are allowed, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities. If equivalent steel is used, the supplier must prove this equivalence.

Information on the maximum traction of the assembly, center of gravity of the rim and finite elements is also requested. The maximum deadline for the manufacturer to send this information about load and gantry design is within 30 days after signing the contract.

6.2 Project detailing

To ensure the safety and success of the ferris wheel project, it is necessary to provide complete details of all aspects involved in its construction. This includes technical drawings with dimensional specifications, including degrees of tolerance for clearance and of materials used in all parts, as well as the weight of each component.

Projects must be submitted in accordance with NBR 17006:2021, meeting its guidelines for orthographic representations, using the visualization of the parts and components in the third dihedral as shown in the figure below:



The manufacturer is asked to send the design detail in at least three views, which are VF, VS and VLD or VLE and also a 3D projection. To specify the part in

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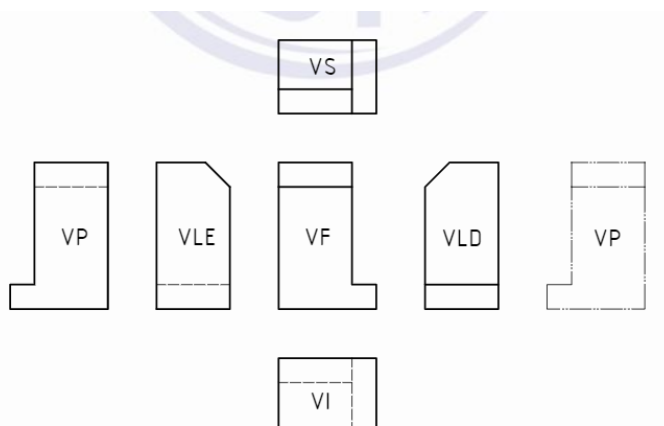
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greater detail, the supplier can forward as many more views as he deems necessary. Here is an explanatory table about the views and acronyms of the drawing and an image representing the views in planes:

Name of views

Direction of observation		Domination of the view
Assignment	View	
VF	Facing	Frontal
VS	From above	Superior
ELV	From the left	Left back
VLD	From the right	Right side
SAW	From below	Inferior
VP	From behind	Posterior

Visual representation of views



It is a requirement to inform the quantity of screws, connections and complete detailing of the connections between the parts. In addition, it is requested that all parts be enumerated relating the project to its physical version. It is recommended to draw up a list with all the pieces and their respective numbering.

NBR 6122:2019 deals with the design and execution of foundations, where in item 5.1 are described the actions coming from the superstructure, in this case the Ferris wheel, which act directly on the foundations. Meeting the guidelines of the

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standard, the supplier is asked to inform: the set of efforts to verify the ultimate limit states (ELU); the set of efforts to verify service limit states (ELS). It also asks for the moments generated by these loads in each column and the support point of the structure.

The technical details of each step of the electrical part should also be informed, including a list with quantitative materials and installation instructions.

6.3 Detailing of the assembly manual

The manual for assembling a ferris wheel is a comprehensive and essential document that provides all the necessary information for the correct assembly, operation, maintenance and safety of the attraction. It is a vital tool for those responsible for construction, operation and maintenance staff, ensuring that all procedures are carried out properly and safely.

Some of the items that should be in the manual of a ferris wheel include:

6.3.1 Introduction and general information

An introduction to the manual, with an overview of the ferris wheel, information about the responsible company, parts delivery schedule, assembly schedule and other relevant information.

6.3.2 Technical specifications

The supplier shall provide at least the following technical details:

- a) Dimensions;
- b) Total weight;
- c) Load capacity;
- d) Speed;
- e) Number of cabins;
- f) Cabin dimensions;
- g) Weight of cabins;
- h) Rim radius;

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- i) Rim weight;
- j) Rim dimensions;
- k) Number of columns;
- l) Dimensions of the columns with the thickness of the plate;
- m) Height of the anchorage of the shaft;
- n) Axle weight;
- o) Unit dimensions per piece;
- p) Unit weight per piece;
- q) Loads requesting the structure transferred to the ground;

6.3.3 Projects and drawings

The manufacturer must provide technical drawings, detailed designs, calculation memorials of each component of the ferris wheel, such as:

- a) Base plates;
- b) Columns;
- c) Cabins;
- d) Central axis;
- e) Rim;
- f) Engine support;
- g) Temporary supports;
- h) Drive system;
- i) Electric;
- j) Lighting Technician;
- k) Gantry for rim mounting;

6.3.4 Assembly Instructions

Step by step for the assembly of the Ferris wheel, which should contain:

- a) Assembly order;
- b) Lifting plan;

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- c) The sequence of removal of temporary support;
- d) Detailing for fixation of scenic light.

6.3.5 Materials and specifications

The assembly manual should offer information on all the materials used in the construction of the ferris wheel, such as:

- a) Type of steel used per component and/or part;
- b) Mechanical specification of the steel used;
- c) Dimensions, type of steel, mechanical protection (coating) of the cables;
- d) Material, thickness, mechanical and UV protection, transparency and mechanical strength of the acrylics of the cabins;
- e) Make, model, power, connection scheme and quantity of engines;
- f) Brand, model, power, luminous flux and other descriptive characteristics of the leds;
- g) Full description of the shaft encompassing all the materials used, including the bearings;
- h) Description of all internal and external components of the cabins, such as upholstery and floor, wall and ceiling coverings;
- i) Brand, model, power and BTUs of the air conditioner;
- j) Brand, model, power, version of the bluetooth system, size of the speaker and other descriptions pertinent to the sound system;
- k) Intercom details.

6.3.6 Fastenings and connections

Detailed instructions on the fastenings and connections between the components of the ferris wheel, which are:

- a) Type of weld per piece;
- b) Electrode used by welding;

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- c) Dimensions, class, type and material of the screws;
- d) Quantitative screws;
- e) Dimensions, class, type and material of nuts and washers;
- f) Quantity of nuts and washers;
- g) Identification of the degree of tolerance for clearance in screwed and pinned connections;

6.3.7 Necessary equipment

List of the necessary equipment and tools, with quantitative and description of use, dimensions, weights and specifications that are relevant to distinguish their type and/or model. The equipment to be described includes:

- a) Cranes;
- b) Shackles;
- c) Pulley block;
- d) Carvings;
- e) Hydraulic jacks;
- f) Hand tools;
- g) Power tools;
- h) Welding equipment;
- i) Specific tools;
- j) Cables.

6.4 Warranty manual breakdown

The ferris wheel warranty manual is another mandatory document to be provided by the manufacturer in order to ensure the safety, stability, functionality and durability of the equipment. It is important that each part and component of items manufactured by the manufacturer or by third-party companies are included in this manual, with its details, specifications and deadlines.

Some of the items that should be included in the warranty manual are:

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6.4.1 Tests and reports

Test reports carried out to ensure the quality and safety of the ferris wheel, including reports of operation, strength and durability.

6.4.2 Warranties and technical assistance

This item is intended to describe information about the warranties offered by manufacturers and suppliers, as well as details of available technical assistance.

For the warranties to be applicable, it is important that the manufacturer's warranty manual gives all maintenance guidelines and guidelines in a detailed manner, for the durability of the equipment and its components. The manufacturer must detail the service life of each component in its manual.

6.4.3 Responsibilities and contacts

Information about the companies involved in the design and construction of the Ferris wheel, as well as contacts for technical support and customer service.

6.5 Detailing of the user manual

Another manual that should be sent to the contractor is the user manual. It should encompass all the procedures and instructions to be adopted for the good performance, durability, safety and efficiency of the ferris wheel.

This manual aims to provide comprehensive instructions for the safe operation of the ferris wheel after its assembly, with a special focus on safety procedures and emergency measures. The operation of a ferris wheel involves several aspects that must be carefully considered to ensure the safety of passengers and operators.

Before commencing operation, it is essential that operators are properly trained and familiar with safety controls, systems and procedures. The manual details

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the steps required to turn the ferris wheel on and off, control the speed, ensure a safe boarding and disembarking of passengers, and monitor operation effectively.

A crucial section of this manual covers emergency procedures for dealing with unforeseen situations. This includes instructions on how to proceed in the event of power outages, unexpected outages, adverse weather conditions, and other situations that may require a quick and efficient response.

Passenger safety is a top priority. The manual details evacuation procedures in case of an emergency, providing clear guidance on how to disembark passengers safely and effectively. This includes the correct use of safety equipment such as belts and harnesses, as well as coordination with rescue teams if necessary.

In addition to the operational aspects, the manual also addresses the importance of regular maintenance and meticulous inspections of equipment. These measures are essential to identify any wear and tear, failure, or potential problem before they become a security threat. The manual provides guidance on scheduling.

The user manual must contain in detail the preventive measures to be adopted by the contractor. Among them:

6.5.1 Instructions for use

Instructions for the safe operation of the ferris wheel after assembly, including emergency and evacuation procedures.

6.5.2 Preventive and corrective maintenance

Instructions for periodic maintenance and corrective actions in case of failures or problems. Including instructions on checking the staples, plumbing and measurement measurements.

6.5.3 Cleaning

The manufacturer must provide in the user manual a section intended for cleaning instructions detailing procedures and products that can be used on the

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elements of the ferris wheel in order to preserve its useful life, such as: cleaning of the acrylic of the cabins, the floors of the cabins, the upholstery of the cabins, the air conditioners, cleaning of the pantograph, the engines, the brakes, the control panel, the power cabinets and the steel structure of the ferris wheel.

6.5.4 Safety standards

The equipment user manual shall be provided by the manufacturer providing the safety guidelines for operation and use of the ferris wheel, including emergency evacuation procedures.

Among the necessary safety procedures, at least the following should be detailed in the user manual:

- a) Guide detailing the daily safety instructions that the cockpit operator must take before beginning daily operation;
- b) Instruction guide and table detailing the required daily/weekly/monthly inspections and/or maintenance;
- c) Guide and evacuation instructions in cases of emergency, considering different scenarios such as fires, storms, wind incidence and lightning;
- d) Guide and guidelines for operation and / or evacuation for cases of electrical or mechanical breakdown;
- e) Guide to emergency rescue plans.

In addition, the manufacturer shall provide in the user manual other guidelines that it considers pertinent for the safe operation of the equipment.

6.5.5 Care and restrictions

The user manual should give guidance on specific care for preservation of the ferris wheel over time and restrictions on use such as adverse weather conditions.

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6.6 Loads of each part

To ensure the safety and success of the assembly of the ferris wheel, it is essential that all the parts that make up the equipment have the actual loads detailed in the manual. It is imperative that this information is accurate and not approximate, in order to avoid any problems during the equipment assembly process, and contributing to the choice of cranes and machinery defined for the job correctly.

The international system (SI) should be used as a reference for the presentation of units, bringing its fundamental mass quantity in kilograms (kg).

6.7 Full load

The total load of the ferris wheel will be obtained by the sum of all loads coming from its parts and components, including columns, axle, temporary supports, rim sections, cabins, bearings, piles and engine structure. These data are fundamental to perform the calculations necessary for the sizing of the foundations.

In order to ensure the correct planning and execution of the project, it is necessary that all this information is provided up to 30 days after the signing of the contract with the Government of Mato Grosso. This practice allows a complete analysis of the loads involved and enables the adoption of appropriate measures for the safety and stability of the ferris wheel.

The international system (SI) should be used as a reference for the presentation of units, bringing its fundamental mass quantity in kilograms (kg).

6.8 Wind calculation memorial

In the assembly manual, the detailed calculation memorial of the entire structure of the ferris wheel should be included. This memorial will cover thorough analysis of structural, total, static and dynamic wind loads, in accordance with applicable technical standards and regulations.

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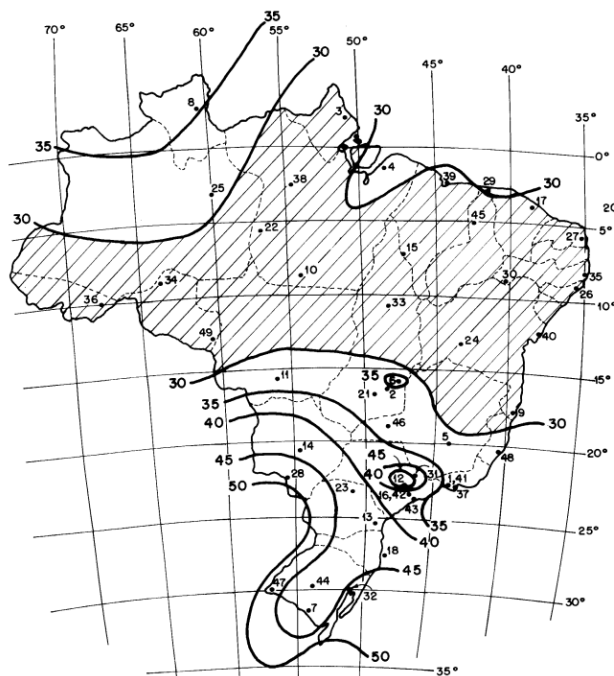
Detailed analyses of wind loads allow you to properly size all components of the structure, ensuring that it is able to withstand external forces in different weather situations.

This calculation memorial will be delivered along with the assembly manual up to 30 days after the signing of the contract with the Government of Mato Grosso. Meeting this established deadline is essential to allow a complete and accurate analysis of the structure, making it possible to make appropriate technical decisions to ensure the safety and reliability of the ferris wheel.

ABNT NBR 6123:1988, or equivalent international standard considering the conditions of the city of Cuiabá, in the State of Mato Grosso, as a reference for its calculations, and the basic wind speed isopleth described in figure 1 of the standard that takes as a reference its speed in m/s, should be used for wind calculations.

As already referenced in this manual, the Mato Grosso wind history of 35m/s should be considered. In addition, the equipment must withstand that operations occur normally with winds of up to 15m/s.

Figure 1 of NBR 6123



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When preparing the item, Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

6.9 Ferris wheel calculation memorial

The ferris wheel calculation memorial will cover all the structural analyses crucial to the operation and support of traction. The manufacturer shall provide the following calculations of the equipment:

- a) Moments of wind-related equipment. This will serve to size the foundations of the Ferris wheel;
- b) Structural calculation of the equipment for structural dimensioning;
- c) Calculation to size the inserts and foundation covers;
- d) Calculation of the supports of the cabins;
- e) Calculation of engines;
- f) Cabin resistance calculations;
- g) Sizing calculations of temporary supports;
- h) Calculation of pantograph sizing;
- i) Finite element calculus;
- j) Calculation of traction sizing of the assembly of the equipment related to traction. Calculation that supports the sizing of the gantry for mounting the rim;
- k) Calculation of the sizing of the mechanical traction cables for the assembly of the rim;
- l) Calculation of the brake to lock the rim at its end of assembly;
- m) Calculation of sizing of scenic light;
- n) Calculation of electrical voltage of the equipment;
- o) Calculation of SPDA sizing;
- p) Dimensioning of electrical panels;
- q) Sizing of electrical wiring.

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All these calculation memorials will provide confidence during assembly and after operation of the equipment. It must also be with the assembly manual, sent up to 30 days after signing the contract.

6.10 Traction calculation memorial for rim mounting

The manufacturer must provide the traction calculation memorial for the rim assembly. This memorial must contain the finite elements of the rim and temporary supports, point-to-point center of gravity data, and heat map of the temporary supports.

This information is part of the assembly manual, which must be delivered within 30 days after signing the contract with the Government of Mato Grosso.

6.11 Tolerance of each piece

To ensure the proper functioning of the ferris wheel it is necessary that all the parts fit perfectly. Annex B of NBR 16683 deals with the dimensional tolerances of the bars that make up the metal structure of the wheel components.

Below are the tables for each type of bar.

a) Flat bar

Tolerance in the width of flat bars

Bar width (mm)		Tolerance (mm)
From	Until	
-	40,00	± 0.75
40,1	80,00	± 1.00
80,01	-	± 1.50

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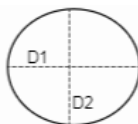


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Tolerance in the thickness of flat bars

Bar width (mm)		Tolerance (mm)
From	Until	
-	25,00	± 0.50
25,01	45,00	± 1.00
45,01	-	± 1.50

b) Round bar

Dimensions of the round bar

Ovalization = $|D1 - D2|$;

D1 = Diameter;

D2 = Diameter identified perpendicular to the previous one.

Tolerance for round bars

Nominal dimension (DN) (mm)		Tolerance (mm)	Ovalization (mm)
From	Until		
-	14,00	± 0.40	0,64
14,01	18,00	± 0.50	0,80
18,01	24,00	± 0.55	0,88
24,01	30,00	± 0.60	0,96
30,01	40,00	± 0.70	1,12
40,01	50,00	± 0.80	1,28
50,01	64,00	± 0.90	1,44
64,01	80,00	± 1.00	1,60
80,01	100,00	± 1.30	2,08
100,01	120,00	± 1.50	2,40
120,01	140,00	± 1.80	2,88
140,01	-	± 2.10	3,36

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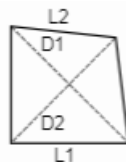
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c) Square bar

Square bar dimensions



Deformation between diagonals = $|D1 - D2|$;

D1= diagonal;

D2= diagonal identified perpendicular to the previous one.

Tolerance on the side of the square bars

Nominal dimension (DN) (mm)		Tolerance (mm)
From	Until	
-	14,00	± 0.40
14,01	18,00	± 0.50
18,01	24,00	± 0.55
24,01	30,00	± 0.60
30,01	40,00	± 0.70
40,01	50,00	± 0.80
50,01	64,00	± 0.90
64,01	80,00	± 1.00
80,01	100,00	± 2.00
100,01	120,00	± 2.20
120,01	-	± 3.00

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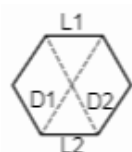
Tolerance on the side of the square bars

Nominal dimension (DN) (mm)		Maximum difference between diagonals (mm)
From	Until	
-	24,00	3,50
24,01	50,00	4,00
50,01	64,00	4,50
64,01	80,00	5,00
80,01	100,00	6,50
100,01	120,00	7,50
120,01	-	9,00

Tolerance in the corner radii of the square bars

Nominal dimension (DN) (mm)		Corner rays
From	Until	
-	18,00	Not specified
18,01	24,00	2 to 7
24,01	30,00	3 to 7
30,01	40,00	4 to 8
40,01	50,00	4 to 10
50,01	64,00	5 to 13
64,01	80,00	7 to 17
80,01	100,00	9 to 22
100,01	120,00	13 to 26
120,01	140,00	14 to 34
140,01	-	16 to 34

d) Hex bar

Hex bar dimensions

D1 = diagonal 1;

D2 = diagonal 2;

L1 = side;

L2 = side parallel to the previous one.

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Dimensions applicable to the tolerance of hexagonal bars

Nominal dimension (DN) (mm)		Tolerances
From	Until	
-	14,00	± 0.40
14,01	18,00	± 0.50
18,01	24,00	± 0.55
24,01	30,00	± 0.60
30,01	40,00	± 0.70

NBR 8261 deals with carbon steel pipes with circular section used for structural purposes. This standard specifies some parameters about the dimension tolerances of the column tubes, which can be checked below:

Dimensions applicable to the tolerance of carbon steel pipes with circular section

Specified external dimensions (mm)	External dimension variation for circular section pipes
$D \leq 65$	$\pm 0.5 \text{ mm}$
$65 < D \leq 90$	$\pm 0,75 \%$
$90 < D \leq 140$	$\pm 0,75 \%$
$D > 140$	$\pm 0,75 \%$

- Tolerances in wall thickness: a variation of $\pm 12,5 \%$ of the nominal thickness is allowed;
- Length tolerances should be $-0 \text{ mm} +100 \text{ mm}$. Other tolerances may be established by prior agreement.
- The dimensional data of the bars that make up the structure of the ferris wheel must be informed in the assembly manual.

Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

The verification of the conformity of this item will be made through the analysis of photographic and quality control reports issued by the supplier of each assembly test that is performed.

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6.12 Analysis of temporary brackets

Temporary brackets must be designed so that they are able to safely withstand the loads applied during the rim assembly step. To ensure structural integrity and capacity and to withstand the specific demands of the assembly, the steel used for the manufacture of the supports must be of the structural type. According to NBR 6648:2014, the mechanical properties of steel must be in accordance with the following table:

Mechanical properties of steel

Degree	LE min. Mpa	LR Min. Mpa	LE/LR Max.	Min. Stretching Lo = 50 mm	Min. Stretching Lo= 200 mm	Folding 180° / shim
CG210	210	340 to 490	0,93	27	23	1.0 and
CG250	250	400 to 550	0,93	23	20	2.0 and
CG280	280	450 to 600	0,93	22	19	2.5 and
e = thickness of the specimen max. 25 mm						

LE= Yield limit voltage;

LR= Rupture limit stress.

It also needs to meet item 4.5.2.2 of NBR 8800, which defines the maximum yield strength (LE) at 450 Mpa and LR/LE ratio of not less than 1.18.

Steels of other standards are allowed, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities.

The NBR 8800 in item 6.7.3.1 provides that the connections of the screwed parts can not be separated by any metals other than structural steels, and must be fully in contact when assembled. Therefore, the assembly of the temporary support must be done by a set of high strength screws, nuts and washers. All in compliance with the standard, which defines screws in ASTM A325 or ISO 4016, nuts in ASTM A194 and ASTM A563, and washers in ASTM F436 and ASTM F844;

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The weld must be designed aiming at the compatibility between metal-base and metal of the weld. The NBR 8800 has a table where it relates the two, below it can be verified.

Relationship between base metal and electrode, by type of weld

	Base metal	Compatible weld metal			
	ASTM	Electric arc with coated electrode (SMAW)	Submerged Arc (SAW)	Electric arc with gas protection (GMAW)	Electric arc with flow in the core (FCAW)
GROUP I	A36 (T ≤ 19mm) A500 Degree A A500 Degree B	AWS A5.1 - E60XX, E70XX AWS A5.5e - E70XX-X	ASW A5.17 - F6XX-EXXX, F6XX-ECXXX, F7XX-EXXX, F7XX-ECXXX AWS A5.23e - F7XX-EXXX-XX, F7XX-ECXXX-XX	AWS A5.18 - ER70S-X, E70C-XC, E70C-XM (except -GS) AWS A5.28e - ER70S-XXX, E70C-XXX	AWS A5.20 - E6XT-X, E6XT-XM, E7XT-X, E7XT-XM (except -2, -2M, -3, -10, -13, -14, and -GS and except -11 with thickness greater than 12mm) AWS A5.29e - E6XTX-X, E6XT-XM, E7XTX-X, E7XTX-XM
GROUP II	A36 (T > 19mm) A242 d ¹ A572 Grade 42 A572 Grade 50 A572 Grade 55 A992 A588 d ¹	AWS A5.1 - E7015, E7016, E7018, E7028 AWS A5.5e - E7015-X, E7016-X, E7018-X	AWS A5.17 - F7XX-EXXX, F7XX-ECXXX AWS A5.23e - F7XX-EXXX-XX, F7XX-ECXXX-XX	AWS A5.18 - ER70S-X, E70C-XC, E70C-XM (except -GS) AWS A5.28e - ER70S-XXX, E70C-XXX	AWS A5.20 - E7XT-X, E7XT-XM (except -2, -2M, -3, -10, -13, -14, and -GS and except -11 with thickness greater than 12mm) AWS A.29 e ¹ - E7XTX-X, E7XTX-XM
GROUP III	A572 Degree60 A572 Grade 65 A913c ¹	AWS A5.5e - E8015-X, E8016-X, E8018-X	AWS A5.23e - F8XX-EXXX-XX, F8XX-ECXXX-XX	AWS A5.28e - ER80S-XXX, E80C-XXX	AWS A5.29e - E8XTX-X, E8XTX-XM
a In joints consisting of base metals of different groups, weld metals compatible with the base metal of higher strength or lower resistance can be used, and low hydrogen electrodes should be used for the second option. Preheating should be based on the highest resistance group. b When stress relief is made on the welds, the weld metal cannot contain more than 0.05% vanadium. c AWS D1.1 limitations on heat input do not apply to ASTM A913, grade 60 and 65. d Special welding processes and materials (e.g., E80XX-X low-alloy electrodes may be required to meet the atmospheric corrosion resistance and shock resistance characteristics of the base metal - see AWS D1.1					

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and Welding metals of groups B3, B3L, B4, B4L, B5, B5L, B6, B6L, B7, B7L, B8, B8L, B9, or any BXH grade, in AWS A5.5, A5.23, A5.28, and A5.29, are not pre-qualified.

It is reinforced that in the metal-base item steels of other standards are admitted, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities.

In addition, it is the manufacturer's obligation to provide:

- a) New temporary supports;
- b) Exact measurements contained in the project;
- c) Detailing of the fixation to the shaft;
- d) Detailing of the attachment to the rim;
- e) Detailing of links between support sessions;
- f) Detailing of the dimensions of screws, nuts and washers. The dimensions must comply with NBR 8800, where the length of the screw must be such that, after installation, its end coincides with or exceeds the outer face of the nut.
- g) Detailing of torque of the screws;
- h) Detailing of the assembly of the supports;
- i) Welding detailing where you should show the type of electrode and the amount of weld beads at different points of the support;
- j) Visual test and magnetic powder;
- k) Specification of thickness and diameter of the pipes that are used in the structure;
- l) Numbering of the parts in the project and structure;
- m) Finite elements with the heat map in all situations of traction and compression in the rim assembly. This data must be informed from the fixation of the first pair of supports to the closing of the rim.
- n) Detailing guiding the order of withdrawal of the temporary supports after closing the rim.

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Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

To check compliance with this item, an analysis of the project will be carried out.

6.13 Cabin bearing detailing

Cabin bearings should be designed to ensure smooth and safe movement along the ferris wheel. Taking this into consideration, the manufacturer is requested to use a model with the grease embedded in the part and easily accessible for maintenance.

As for the detailing, this should include technical specifications on the type of bearings used, such as load capacity, coefficient of friction, material and other relevant parameters as well as information about bearings and other parts that compose it. The housing assembly process needs to be detailed in the equipment assembly manual.

6.14 Detailing of engine mounts

The motor mounts responsible for propelling the ferris wheel must be designed to withstand the loads and torque moments generated during operation. The details of these supports shall include, at a minimum, the following information:

- a) Technical drawing;
- b) Detailing of all the parts that make up the engine supports;
- c) Marked and enumerated parts and details side A and side B of the equipment;
- d) Welding detailing and the type of electrode that should be applied to the joints of the tube sections of the platform of the motors with the main columns;
- e) Exact measurements of the height of the supports in relation to the rim;

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- f) Acceptable adjustment tolerances for the positioning of the engines in relation to the rolling track.

The supports and other parts that are part of its set will be made of structural steel according to the mechanical properties of the steel present in NBR 6648:2014, referenced in the table below:

Mechanical properties of steel

Degree	LE min. Mpa	LR Min. Mpa	LE/LR Max.	Min. Stretching Lo = 50 mm	Min. Stretching Lo= 200 mm	Folding 180° / shim
CG210	210	340 to 490	0,93	27	23	1.0 and
CG250	250	400 to 550	0,93	23	20	2.0 and
CG280	280	450 to 600	0,93	22	19	2.5 and

e = thickness of the specimen max. 25 mm

LE= Yield limit voltage;

LR= Rupture limit stress.

In addition to meeting item 4.5.2.2 of NBR 8800, which defines the maximum yield resistance (LE) at 450 Mpa and LR/LE ratio of not less than 1.18.

Steels of other standards are allowed, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities.

The connection between the motor supports and the columns must be established using both screws and welding. Therefore, it is necessary for the manufacturer to provide the flanges of the supports already welded to the tubes of the structure of the platforms. The NBR 8800 lists the electrode that should be used, based on the weld and metal-base used, which can be checked in the following table:

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Relationship between base metal and electrode, by type of weld

	Base metal	Compatible weld metal			
	ASTM	Electric arc with coated electrode (SMAW)	Submerged Arc (SAW)	Electric arc with gas protection (GMAW)	Electric arc with flow in the core (FCAW)
GROUP I	A36 (T ≤ 19mm) A500 Degree A A500 Degree B	AWS A5.1 - E60XX, E70XX AWS A5.5e - E70XX-X	ASW A5.17 - F6XX-EXXX, F6XX-ECXXX, F7XX-EXXX, F7XX-ECXXX AWS A5.23e - F7XX-EXXX-XX, F7XX-ECXXX-XX	AWS A5.18 - ER70S-X, E70C-XC, E70C-XM (except -GS) AWS A5.28e - ER70S-XXX, E70C-XXX	AWS A5.20 - E6XT-X, E6XT-XM, E7XT-X, E7XT-XM (except -2, -2M, -3, -10, -13, -14, and -GS and except -11 with thickness greater than 12mm) AWS A5.29e - E6XTX-X, E6XT-XM, E7XTX-X, E7XTX-XM
GROUP II	A36 (T > 19mm) A242 d) A572 Grade 42 A572 Grade 50 A572 Grade 55 A992 A588 d)	AWS A5.1 - E7015, E7016, E7018, E7028 AWS A5.5e - E7015-X, E7016-X, E7018-X	AWS A5.17- F7XX-EXXX, F7XX-ECXXX AWS A5.23e - F7XX-EXXX-XX, F7XX-ECXXX-XX	AWS A5.18 - ER70S-X, E70C-XC, E70C-XM (except -GS) AWS A5.28e- ER70S-XXX, E70C-XXX	AWS A5.20 - E7XT-X, E7XT-XM (except -2, -2M, -3, -10, -13, -14, and -GS and except -11 with thickness greater than 12mm) AWS A.29 e) - E7XTX-X, E7XTX-XM
GROUP III	A572 Degree60 A572 Grade 65 A913c)	AWS A5.5e - E8015-X, E8016-X, E8018-X	AWS A5.23e - F8XX-EXXX-XX, F8XX-ECXXX-XX	AWS A5.28e ER80S-XXX, E80C-XXX	AWS A5.29e - E8XTX-X, E8XTX-XM
a In joints consisting of base metals of different groups, weld metals compatible with the base metal of higher strength or lower resistance can be used, and low hydrogen electrodes should be used for the second option. Preheating should be based on the highest resistance group. b When stress relief is made on the welds, the weld metal cannot contain more than 0.05% vanadium. c AWS D1.1 limitations on heat input do not apply to ASTM A913, grade 60 and 65. d Special welding processes and materials (e.g., E80XX-X low-alloy electrodes may be required to meet the atmospheric corrosion resistance and shock resistance characteristics of the base metal - see AWS D1.1 and Welding metals of groups B3, B3L, B4, B4L, B5, B5L, B6, B6L, B7, B7L, B8, B8L, B9, or any BXH grade, in AWS A5.5, A5.23, A5.28, and A5.29, are not pre-qualified.					

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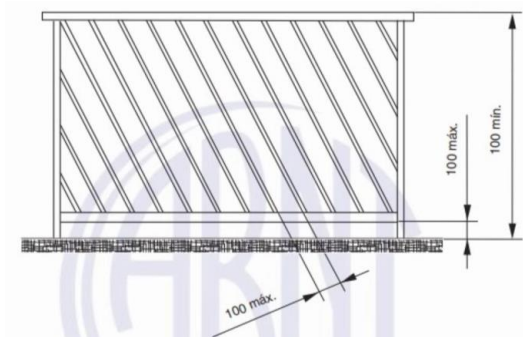
It is reinforced that in the metal-base item steels of other standards are admitted, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities.

For the bolted connections will be considered screws, nuts and washers of high resistance. As requested in NBR 8800, the parts must meet the following specification: screws in ASTM A325 or ISO 4016; nuts in ASTM A194 and ASTM A563; and washers in ASTM F436 and ASTM F844.

Another important aspect is the protection that the engine platform must have with respect to public access, since the area of engine support is close to the passenger runway. Thus, the manufacturer must design next to the equipment the guardrails of the engine platforms, which must be sent with the equipment.

These guardrails should not have sharp or pointed corners. They must be executed with tubular iron with transverse closures to avoid accidents in operation. As an example below, referenced in standard ABNT15926-2:2023 or similar international standard.

Engine support bodyguard



Another reference of grating type guardrails that should be used, is in figure 2 of NBR 14718:2019 (or similar international standard), where the distance between the profiles can not be more than 110mm.

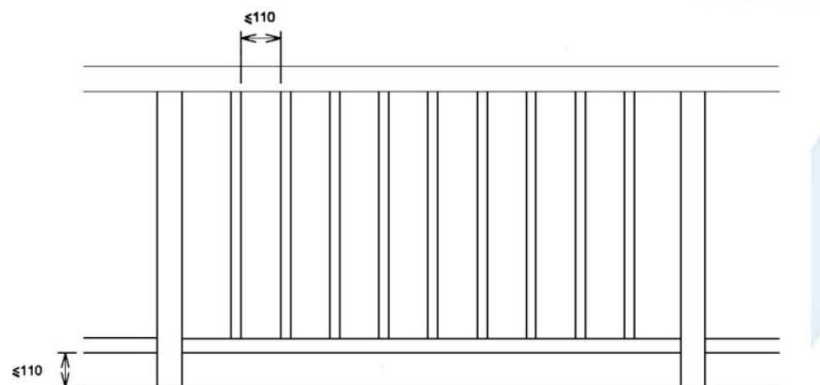
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Engine support bodyguard - Minimum distance between railings



6.15 Detailing of the fittings of the parts

Fitting detailing of parts is essential to ensure accurate and safe connections, resulting in efficient and fault-free assembly. This detailing should be clear and comprehensive for all parts that have connections, either by welding or screws and should be detailed in the equipment assembly manual.

The manufacturer shall provide the following information specified in the design:

a) Welded links:

- i. Technical drawing;
- ii. Welding detailing;
- iii. Dimensioning of welding beads;
- iv. Types of electrodes based on the NBR 8800 table, previously mentioned;
- v. Inspection tests;
- vi. What are the permitted tolerances of the union of two sections of the equipment.

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It should also include the amount of weld beads required, as well as the specification of the dimensions and the exact points where welding should take place. This ensures that the structural connections are robust and reliable, supporting the loads properly.

b) Screwed connections:

- i. Technical drawing;
- ii. Specification of screws (dimensions, steel, type... among others);
- iii. Strength and class of screws;
- iv. Specification of nuts and counternuts (dimensions, steel, type... among others);
- v. Specification of washers;
- vi. Tolerances of clearances between holes and screws;
- vii. Detailing of the flanges between the union of the pieces.

The screws, nuts and washers will be of high resistance, so it is necessary that they meet the NBR 8800 as to their material. The standard provides that: Screws in ASTM A325 or ISO 4016; nuts in ASTM A194 and ASTM A563; and washers in ASTM F436 and ASTM F844.

Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

6.16 Crane grip point on main columns

The grip points for the crane on the main columns shall be carefully designed, manufactured and clearly indicated in the technical drawings. When designing the grip points, factors such as the load capacity of the crane and the proper distribution of efforts will be considered.

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All columns, shaft and rim sections must have lifting points integrated into the parts, consisting of welded parts or holes properly sized to support the loads of the own weight of each piece with a safety coefficient of 1.5.

It will be up to the manufacturer to determine the design lifting points of the parts, which must be duly detailed in the design of the ferris wheel and in the assembly manual of the equipment, with dimensions, materials, details, cuts and technical notes that allow the full comprehension of the procedures to be performed during the lifting of the parts.

In addition, it is necessary for the supplier to send the plan for the lifting of the parts, which must contain, at a minimum, the following information:

- a) Detail the information in technical drawing;
- b) Detail the strength calculation, using the Poisson coefficient (ν) to see the deformation of the parts;
- c) Calculation of tearing of the parts if you get only holes;
- d) If the handles are welded, the details of the welds and their resistances must be presented.

6.17 Handle point for the cables in the wheel mount

The handle points for the cables should be properly considered during the manufacture of the equipment, providing ease in mounting the rim. These grip points will be specified clearly and in detail in the assembly manual, allowing for safe and precise traction during the assembly of the rim sessions.

When designing them, the proper distribution of tensile forces must be taken into account, ensuring that the assembly is conducted efficiently and safely. These strategically located points on the equipment will allow the cables to be properly fixed, ensuring the structural integrity of the rim. The presence of detailed specifications in the assembly manual will provide accurate guidance to the assembly team.

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6.18 Cable type and regulatory resistance

To ensure the safety and reliability of the ferris wheel, high-strength cables capable of withstanding the loads and stresses involved during traction operation will be used.

The manufacturer is responsible for defining the type and thickness of the cable used, however, this must meet the minimum breaking load requirements by cable category, which are presented in NBR ISO 2408 for the chosen model.

For the cable to be validated, as soon as the model is defined, the manufacturer must immediately pass the technical specifications to the contractor, thus being made the conference for the fulfillment of NBR ISO 2408.

The manufacturer shall provide at least the following prerequisites and information on the cables:

- a) 20-year warranty on stage cables;
- b) Mechanical protection in white cables;
- c) Resistance of cables;
- d) Pretensions;
- e) Final voltage of the cable;
- f) Origin;
- g) Manufacturer's report with resistance tests of the material;
- h) Total rupture tension.

Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

Conference report of the total length of the cables, where it will point out that the cables must be with the exact measurement so that there are no voltage errors.

6.19 Equipment calculation warranties (engineering calculations)

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All engineering calculations performed to size the equipment, parts and components will be properly documented and accompanied by safety and reliability analyses. Engineering calculations and part loads will be performed accurately, ensuring that each element is sized correctly and safely. This thorough approach is essential for the rigging plan to be assertive and able to handle all operational demands.

For the rigging plan to be assertive, the manufacturer must present the exact load of the axle for lifting with load detailing. This will serve for the choice and assembly plan that must be made. Along with these loads, they must contemplate the load of the bearings so that the load of the complete lifting is obtained.

These detailed calculations should be in the assembly manual. This documentation will be a valuable reference for the entire team involved in assembling and maintaining the ferris wheel, providing accurate information about the capabilities and limitations of each component.

It is possible to evidence the EN 1993-1-1 standard for structural engineering specifically in the design of metal structures. This standard establishes the principles and requirements for the design of steel structures, ensuring their safety, strength and durability. It is important to note that the equipment is calculated and designed by software, but after the extractions of these calculations it is necessary that the process follows clearly and safely.

6.20 Moments required for the execution of structural calculations referencing the standard, considering wind load actions

The moments necessary for the structural calculations should follow the current technical standards, considering the influence of the wind and other relevant factors to ensure the maximum stability of the ferris wheel. These precise and substantiated calculations will be presented in a complete and detailed way in the documentation that makes up the assembly manual.

By taking into account weather conditions, external loads and all relevant variables, structural calculations will ensure the robustness and reliability of the

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design. This approach ensures that the ferris wheel is able to withstand harsh conditions and operate safely in all situations.

Calculations related to wind action must follow the standards mentioned in item 6.8 of this file using information from the ABNT NBR 6123 standard, however, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

6.21 Markings between connections for mounting

Precise markings between the connections will play a key role in correctly aligning and positioning parts during assembly, ensuring the structural integrity of the ferris wheel. In addition, these markings will promote more efficient and clear communication between the project and the assembly.

These strategic markings will be presented in detail in the assembly manual, as well as printed directly on the manufactured parts, so that they cannot be removed. This approach ensures that the assembly team has an accurate reference during the process, reducing the possibility of errors and rework.

6.22 Type of fitting connections (welded and/or screwed)

The type of connection used in the assembly of the parts will be carefully specified in the design, providing precise details about the type of weld, the thickness of the welds and the tests that must be carried out at the end of the inspection. In addition, the screwed parts will be clearly identified and the strength report of the screws used will be made available.

This complete and detailed documentation will be duly included in the assembly manual, providing essential information to the team responsible for assembling the ferris wheel.

Below will be referenced the performance standards regarding types and characteristics of screws by the standard and details of welds that may have in the equipment.

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Integrity assessments of high-strength fasteners shall follow the guidelines of items 6, 7, 8 and 9 of ISO 898-1. This standard outlines the essential mechanical properties, such as elasticity limit and tensile strength, categorizing fasteners into resistance classes of 8.8, 9.8, 10.9 and 12.9. In addition, ISO 898-1 prescribes strict guidelines for dimensions, tolerances and markings, ensuring geometric compatibility and accurate identification of these vital elements.

In the context of a report, the reference to ISO 898-1 represents a seal of quality and safety. The compliance of high-strength fasteners with this standard attests to their ability to withstand specific loads and stresses, corresponding to the expectations of performance and durability. The meticulous definition of mechanical properties, dimensions and markings, as set out in ISO 898-1, demonstrates the commitment to internationally recognized standards, ensuring the structural integrity and safety of the buildings where these fasteners are employed.

The ISO 4014, ISO 4016, ISO 4017 and ISO 4018 standards in their tables 1 to 3 present the minimum essential dimensions of hexagonal head screws with classes A, B and C. The manufacturer must issue a report proving that his screws follow the guidelines of the aforementioned standards ensuring accuracy in their body diameter, thread diameter, Measurements of hexagon, total length, head length, thread length, wheel pitch and their class and grade markings.

The ISO 4032 standard in its tables from 1 to 3 present the minimum essential dimensions of hexagonal nuts with class A and B. The manufacturer must issue a report proving that its hexagonal nuts follow the guidelines of the cited standard ensuring accuracy in its total length, hexagonal measurement, thread measurement, thread diameter and its class and grade markings.

The ISO 7090 standard in its tables from 1 to 3 present the minimum essential dimensions of washers with class A. The manufacturer must issue a report that proves that his washers follow the guidelines of the cited standard, ensuring accuracy in their external diameter, inner diameter, thickness, chamfers and their class and grade markings.

The ISO 5817 standard defines weld quality by providing detailed criteria for categorizing imperfections in welded joints. When establishing various quality categories, the standard sets parameters for acceptance and repair of imperfections, taking into account factors such as size, shape and location. It offers clear guidance

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on non-destructive inspections and test methods and is an essential tool for ensuring weld integrity and compliance in a variety of applications.

Item 1 of table 1 of ISO 5817 presents the limits of imperfection in surface structures, item 2 of the table presents the acceptable limits in internally welded structures, item 3 specifies the acceptable limits of imperfection in the points of connection joint by end, item 4 presents the permissible limits in cases of multiple imperfections of welded elements. The manufacturer must send a report proving that its welds performed follow the guidelines in full of table 1 of ISO 5817.

For references of tests and non-destructive tests of ultrasound, radiography, particularly magnetic and penetrating liquid, refers to ISO 17635:2016. Figure B.2 of the standard presents guidelines for radiographic tests, figure B.3 guidelines for ultrasonic tests, penetrating liquid tests should be followed according to the guidelines of item 8 of ISO 3452-1:2021. In relation to visual tests should follow the guidelines of item 6 of ISO 17637 and their tests presented as item 7 of the same. For magnetic particle testing, the techniques presented in item 5 of ISO 17638 must be followed.

The required reports must be issued by an independent laboratory accredited by INMETRO, if national territory, or a similar or renowned institution in the country of origin of the participating company or place of manufacture of the products, in the case of foreign companies.

6.23 Specifications of the connection of the foundation with the equipment

The connection of the foundation with the equipment will be made through welding and reinforced with fins around the columns. The first section of the columns should be chamfered on the contact surface with the base plate.

The sides of the reinforcing fins, which will be in contact with the base plate and the column, must also have a bevel. The number of fins and their dimensions need to be detailed in design, as well as the amount of welds used in the column-base and fin-column-base connection. This detailing must be presented in the assembly manual in conjunction with the visual welding and magnetic powder (penetrating liquid) tests.

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The weld must be designed aiming at the compatibility between metal-base and metal of the weld. The NBR 8800 has a table where it relates the two, below it can be verified.

Relationship between base metal and electrode, by type of weld

	Base metal	Compatible weld metal			
	ASTM	Electric arc with coated electrode (SMAW)	Submerged Arc (SAW)	Electric arc with gas protection (GMAW)	Electric arc with flow in the core (FCAW)
GROUP I	A36 (T ≤ 19mm) A500 Degree A A500 Degree B	AWS A5.1 - E60XX, E70XX AWS A5.5e - E70XX-X	ASW A5.17 - F6XX-EXXX, F6XX-ECXXX, F7XX-EXXX, F7XX-ECXXX AWS A5.23e - F7XX-EXXX-XX, F7XX-ECXXX-XX	AWS A5.18 - ER70S-X, E70C-XC, E70C-XM (except -GS) AWS A5.28e - ER70S-XXX, E70C-XXX	AWS A5.20 - E6XT-X, E6XT-XM, E7XT-X, E7XT-XM (except -2, -2M, -3, -10, -13, -14, and -GS and except -11 with thickness greater than 12mm) AWS A5.29e - E6XTX-X, E6XT-XM, E7XTX-X, E7XTX-XM
GROUP II	A36 (t > 19mm) A242 d) A572 Grade 42 A572 Grade 50 A572 Grade 55 A992 A588 d)	AWS A5.1 - E7015, E7016, E7018, E7028 AWS A5.5e - E7015-X, E7016-X, E7018-X	AWS A5.17 - F7XX-EXXX, F7XX-ECXXX AWS A5.23e - F7XX-EXXX-XX, F7XX-ECXXX-XX	AWS A5.18 - ER70S-X, E70C-XC, E70C-XM (except -GS) AWS A5.28e - ER70S-XXX, E70C-XXX	AWS A5.20 - E7XT-X, E7XT-XM (except -2, -2M, -3, -10, -13, -14, and -GS and except -11 with thickness greater than 12mm) AWS A.29 e) - E7XTX-X, E7XTX-XM
GROUP III	A572 Degree60 A572 Grade 65 A913c)	AWS A5.5e - E8015-X, E8016-X, E8018-X	AWS A5.23e - F8XX-EXXX-XX, F8XX-ECXXX-XX	AWS A5.28e - ER80S-XXX, E80C-XXX	AWS A5.29e - E8XTX-X, E8XTX-XM
a In joints consisting of base metals of different groups, weld metals compatible with the base metal of higher strength or lower resistance can be used, and low hydrogen electrodes should be used for the second option. Preheating should be based on the highest resistance group. b When stress relief is made on the welds, the weld metal cannot contain more than 0.05% vanadium. c AWS D1.1 limitations on heat input do not apply to ASTM A913, grade 60 and 65. d Special welding processes and materials may be required (e.g., E80XX-X low-alloy electrodes to meet the atmospheric corrosion resistance and shock resistance characteristics of the base metal - see AWS D1.1					

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and Welding metals of groups B3, B3L, B4, B4L, B5, B5L, B6, B6L, B7, B7L, B8, B8L, B9, or any BXH grade, in AWS A5.5, A5.23, A5.28, and A5.29, are not pre-qualified.

In the metal-base item, steels of other standards are admitted, provided that they meet the minimum requirements mentioned in the table below, that is, steels of equivalent qualities.

The mechanical properties of steel must be in accordance with item 5.2 Mechanical properties of NBR 6648:2014, presented in the table below:

Mechanical properties of steel

Degree	LE min. Mpa	LR Min. Mpa	LE/LR Max.	Min. Stretch Lo = 50 mm	Min. Stretch Lo= 200 mm	Folding 180° / shim
CG210	210	340 to 490	0,93	27	23	1.0 and
CG250	250	400 to 550	0,93	23	20	2.0 and
CG280	280	450 to 600	0,93	22	19	2.5 and

e = thickness of the specimen max. 25 mm

LE= Yield limit voltage;

LR= Rupture limit stress.

It also needs to meet item 4.5.2.2 of NBR 8800, which defines the maximum yield resistance (LE) at 450 Mpa and LR/LE ratio of not less than 1.18.

Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

The required reports must be issued by an independent laboratory accredited by INMETRO, if national territory, or a similar or renowned institution in the country of origin of the participating company or place of manufacture of the products, in the case of foreign companies.

6.24 Detailing the connection of inserts and discs with the foundation

The connection details of the inserts and discs with the foundations will be designed to ensure an efficient and safe load transfer. In addition to the hole of the inserts, the plates must contain a hole for venting the concrete.

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The NBR 8800 in item 6.7.3.1 provides that the connections of the screwed parts can not be separated by any metals other than structural steels, and must be fully in contact when assembled. The holes can be punched, subpunched, widened or drilled and must be free of lamination scales, burrs or dirt that prevent any direct contact between the plate and the insert.

Brazilian standards were mentioned as the main reference. However, international standards are also accepted, as long as they are equivalent in terms of requirements and standards.

6.25 Steel thickness of the structure

The thickness of the steel used in the ferris wheel structure will be defined by the manufacturer based on detailed structural analyses and the necessary strength requirements.

The mechanical properties of steel must be in accordance with item 5.2 Mechanical properties of NBR 6648:2014, presented in the table below:

Mechanical properties of steel

Degree	LE min. Mpa	LR Min. Mpa	LE/LR Max.	Min. Stretch Lo = 50 mm	Min. Stretch Lo= 200 mm	Folding 180° / shim
CG210	210	340 to 490	0,93	27	23	1.0 and
CG250	250	400 to 550	0,93	23	20	2.0 and
CG280	280	450 to 600	0,93	22	19	2.5 and
e = thickness of the specimen max. 25 mm						

LE= Yield limit voltage;

LR= Rupture limit stress;

It also needs to meet item 4.5.2.2 of NBR 8800, which defines the maximum yield resistance (LE) at 450 Mpa and LR/LE ratio of not less than 1.18.

Steels of other standards are allowed, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities.

The reports of resistance of this material will be duly presented in the complementary documentation along with the warranty manual, at the time of the

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packing list. The required reports must be issued by an independent laboratory accredited by INMETRO, if national territory, or a similar or renowned institution in the country of origin of the participating company or place of manufacture of the products, in the case of foreign companies.

6.26 Typology of steel required for the execution of the foundation discs

The type of steel chosen for the foundation discs will be selected based on their strength and durability characteristics. The mechanical properties of steel must be in accordance with item 5.2 Mechanical properties of NBR 6648:2014, presented in the table below:

Mechanical properties of steel

Degree	LE min. Mpa	LR Min. Mpa	LE/LR Max.	Min. Stretch Lo = 50 mm	Min. Stretch Lo= 200 mm	Folding 180° / shim
CG210	210	340 to 490	0,93	27	23	1.0 and
CG250	250	400 to 550	0,93	23	20	2.0 and
CG280	280	450 to 600	0,93	22	19	2.5 and
e = thickness of the specimen max. 25 mm						

LE= Yield limit voltage;

LR= Rupture limit stress;

It also needs to meet item 4.5.2.2 of NBR 8800, which defines the maximum yield resistance (LE) at 450 Mpa and LR/LE ratio of not less than 1.18.

Steels of other standards are allowed, provided that they meet the minimum requirements mentioned in the table above, that is, steels of equivalent qualities.

The contracted company must present the characteristics, dimensions and details of the project within 30 days after signing the contract with the Government of Mato Grosso.

6.27 Section of inserts required for connection with foundations

The inserts used in the connection with the foundations will be designed taking into account the expected loads and the safety requirements of the equipment.

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According to item 6.7.2.2 of NBR 8800 the length of the screw must be such that, after installation, its end coincides with or exceeds the outer face of the nut.

These should contain threads only at the tips, in order not to decrease the mechanical strength, the tip that will be inserted in the foundation block should be in umbrella design. The complete insert kit has nuts, against nuts and washers.

According to item 4.5.2.4 of NBR 8800, high-strength screws must comply with ASTM A325 or ISO 4016 Class 8.8.

Nuts and washers must meet the compatible specifications mentioned in ANSI/AISC 360, which are for ASTM A194 and ASTM A563 nuts, and ASTM F436 and ASTM F844 washers.

Steels of other standards are allowed, provided that they meet the minimum strength present in the respective ASTM standard, that is, equivalent steels.

The characteristics of the project and galvanizing process adopted, fire or electrolytic, must also be included in the documentation sent up to 30 days after the signing of the contract.

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Code	Symbol	Meaning	Shape and color	Application
P1		No smoking	Symbol: Circular Background: White Pictogram: Black Circular band and diametrical bar: Red	Any area where smoking is allowed may increase the risk of fire.
P2		No open flame		Any area where the use of open flame may increase the risk of fire.
P3		Do not use water to extinguish the fire		Every situation where the use of water is improper to extinguish the fire
P5		No obstruction allowed		In areas subject to merchandise storage where obstruction may pose a danger to access emergency exits, escape routes, firefighting equipment, etc.
Code	Symbol	Meaning	Shape and color	Application
A1		General alert	Symbol: Triangular Background: Black Pictogram: Black Triangular band: Black	Whenever there is no specific alert symbol, it must always be accompanied by a specific written message.
A2		Caution, fire hazard		Near areas with highly flammable materials present.
A3		Caution, risk of explosion		Near areas with the presence of materials or gases that pose an explosion risk.



A5		Caution, risk of electric shock		Near electrical installations that pose a risk of electric shock.
Code	Symbol	Meaning	Shape and color	Application
S1		Emergency staircase	Symbol: Rectangular Background: Green Pictogram: Photoluminescent	Indication of the direction (left or right) of an emergency exit, especially for mounting on columns. Minimum dimensions: L= 1.5 H.
S2				Indication of the direction (left or right) of an emergency exit. Minimum dimensions: L= 2.0 H.
S3				Emergency exit sign to be affixed above the door to indicate access.
S4				a) Indication of the direction to access an exit that is not apparent: b) Indication of the direction of an exit via ramps: c) Indication of the direction of the exit in the vertical direction (going up or down). Note - The directional arrow should be positioned according to the direction to be indicated.
S5				
S6				
S7				
S8				



S9				► Indication of the escape direction inside staircases. ► Indicates right or left, going down or up. ► The directional symbol should be positioned according to the direction to be indicated.
S10				
S11				
Code	Symbol	Meaning	Shape and color	Application
S12		Emergency exit	Symbol: Rectangular Background: Green Message: "SAÍDA" (or "SAÍDA") with photoluminescent pictogram and/or directional arrow, with letter height always greater than or equal to 50mm.	Emergency exit sign with or without additional photoluminescent pictogram (arrow or image or both).
S13				
S14				
S15			Symbol: Rectangular Background: Green Message: "SAÍDA" photoluminescent, with letter height always greater than or equal to 50mm.	Indication of emergency exit with ramps for disabled, used as a complement to the photoluminescent pictogram (arrow or image or both).
S16				
Code	Symbol	Meaning	Shape and color	Application
E1		Audible alarm		



E2		Manual alarm command or fire pump.	Symbol: Square Background: Red Pictogram: Photoluminescent	It should be at a height of 1.80 meters and immediately above the indicated equipment.
E3				
E4		Emergency telephone or intercom.		
E5		Fire extinguisher		

