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CRANES

1 GENERAL TECHNICAL SPECIFICATIONS

1.1 Scope of Work

This specification covers the design, manufacture, factory test, transportation from factory to construction site, storage, complete installation, painting, site test, and commissioning of the following cranes, including the supply of tools, spare parts, and all auxiliary devices necessary for the installation, operation, and maintenance of overhead travelling bridge cranes and gantry cranes. All equipment shall be designed and manufactured to operate at ambient temperatures of -20 °C to +40 °C.

Even if not detailed in the specification, all other materials, equipment, and devices necessary for safe operation shall be supplied by the contractor.

1.2 General Requirements

- All equipment shall be designed to allow convenient installation, dismantling, and control. For ease of installation at the workplace, marking shall be carried out where necessary.
- All equipment shall be strong enough for long-term service and shall include auxiliary equipment required for such installations even if not specified in the specification.
- Materials selected for the crane shall be new, conforming to standards, and of the best available quality. First-class workmanship shall be required in the manufacture and installation of the crane.
- In the installation of the crane, particular attention shall be paid to operational safety, sufficient service life, easy maintenance and lubrication, and ease of replacement of wearing parts.
- Welds shall be free from all defects such as burrs and holes. Welding works shall be carried out in accordance with AWS standards or their equivalents.
- Induction motors shall be totally enclosed type and shall operate without failure at $\pm 10\%$ voltage variation at 50 Hz frequency. The crane supply shall be controlled by maximum and minimum current relays against $\pm 30\%$ voltage and $\pm 40\%$ frequency variation resulting from large voltage fluctuations in the plant.
- The manufacturer shall supply all bolts, nuts, and fittings necessary for the installation of crane rails.
- The manufacturer shall procure other parts and equipment not manufactured by itself but required for the crane from reliable firms. Such equipment shall be subject to the approval of the Administration.
- The manufacturer shall dispatch the crane to the site after workshop installation and control and shall carry out the assembly. All costs of transportation, materials, and workmanship for this work shall be borne by the contractor.
- All equipment necessary for installation shall be provided by the manufacturer.

- The connection of the crane to the main grounding network shall be made by the manufacturer.
- The manufacturer shall provide all control cables, electrical conduit pipes, and fittings necessary for the complete operation and control of the equipment.
- Attention shall be paid to the external form and aesthetics of the cranes.

1.3 Design and Workmanship

The design of the equipment shall conform to the best current engineering practice. Each part of the equipment shall be the contractor's standard design, provided it has been designed according to the overall equipment specification, and parts with proven quality before shall be used.

The design shall be based on strength, simplicity, and reliability to ensure long service time with most economical point of view and low maintenance cost.

All equipment, including accessories and auxiliary materials, shall be manufactured and assembled to allow quick internal and external access for inspection, cleaning, maintenance, and replacement. Similar parts shall be fully interchangeable with each other and with spare parts. Except in cases where special arrangements are required for functional reasons or special design, no part of the equipment shall require the removal of another permanently installed component for inspection, maintenance, or replacement.

Even after long service time under the most severe stresses, the design, dimensions, and materials of all parts shall not suffer any damage. Materials used in the manufacture of the equipment shall be of the highest quality and selected to provide the required service. The equipment shall be designed and manufactured to minimize corrosion. Water shall not be allowed to accumulate anywhere. The workmanship of the equipment as a whole shall be of the highest quality level. Surface protection shall prevent corrosion under all climatic conditions.

If the contractor wishes to request any exemption from any part of the specification, the contractor shall specifically state in his offer under the heading "Exemptions from Specification Provisions" the properties and reasons for such differences. Where the specification requires the approval of the Administration, such approval shall be obtained before commencement of the work.

1.4 Applicable Standards

Turkish Standards shall be used as long as they exist and are applicable. Unless otherwise specified, the design, installation, manufacture, and testing of the equipment shall be in accordance with the following standards :

• TS	Turkish Standards
• AMCA	Air Movement and Control Association
• ANSI	American National Standards Institute
• ARI	Air-Conditioning and Refrigeration Institute
• ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers

• ASA	American Standards Association
• ASME	American Society of Mechanical Engineers
• ASTM	American Society for Testing and Materials
• AWS	American Welding Society
• DIN	German Institute for Standardization
• IEC	International Electrotechnical Commission
• IEEE (AIEE)	Institute of Electrical and Electronics Engineers
• NFPA	National Fire Protection Association
• NIST	National Institute of Standards and Technology
• NEMA	National Electrical Manufacturers Association
• NEC	National Electrical Codes
• SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
• UL	Underwriters Laboratories

The latest revision or edition of the standard in force at the time of the work shall be valid.

If the Contractor, for any reason, does not wish to use the standards stated above, a written statement including a full list of the standards intended to be used, with explanations of the changes and justifications, shall be submitted to the Administration for approval. Without the written approval of the Administration, such request shall not be valid.

1.5 Units of Measurement

For all works described under this Contract, the International Metric System shall be used. Unless otherwise specified, all units of measurement shall be expressed in metric system units.

1.6 Tolerances

To limit the dimensions of any metal parts, tolerances and allowances shall conform to ISO "Systems for Limits and Fits" or VDE/DIN standards.

1.7 Stresses and Safety Factor

In the overall design, particularly for parts subject to variable stresses, vibration, impact, or shocks, adequate safety factors shall be used.

The contractor shall take full responsibility for a sufficient design and shall apply low stresses where required (as approved by recognized good engineering practices).

Upon request, the contractor shall provide the Administration with full information on the maximum unit stresses used in the equipment design.

1.8 Seismic Conditions

All equipment and devices shall be designed in accordance with the following earthquake

conditions.

In calculations:

- Peak horizontal acceleration (x and y directions)
- Peak vertical acceleration (z direction) shall be taken as 2/3 of the peak horizontal acceleration.

It shall be considered that earthquake loads are applied simultaneously in all three directions.

1.9 Nameplates and Marking

All equipment shall be provided with firmly fixed nameplates showing the manufacturer's name, model, serial number, year of manufacture, main characteristic data of the equipment, and any other information required by applicable standards or necessary for the proper identification of the equipment.

The Contractor shall also supply all nameplates and other labels for control panels, control desks, and other places required for operational, functional, and safety criteria. These nameplates shall be made of acrylic or resin and inscribed with black letters on a white background. Nameplates shall be in Turkish.

Details of the information to be shown on the nameplate, etc., shall be subject to the approval of the Administration.

1.10 Painting

1.10.1 General

Aluminum and galvanized surfaces shall not be painted. Other surfaces shall be subjected to the following procedures.

1.10.2 Cleaning

All surfaces shall be cleaned down to bare metal using sandpaper or quartz sand. Burrs, grease, dust, etc., shall be completely removed from the surface. Metallic sand composed of steel particles shall not be used for such cleaning.

1.10.3 Workshop Painting

As soon as possible, but not later than four hours after sandblasting and dust removal, surfaces shall be painted with two coats of primer and two coats of suitable finish paint. The paint, including color, to be used shall be subject to the approval of the Administration.

The total thickness of the paint shall not be less than the thickness approved by the Administration.

Damaged painted parts during installation or tests shall be repaired.

1.11 Equipment, Material, and Workmanship

All equipment shall be new and of the latest design, proven by experience to be suitable

for the purpose.

All materials within the equipment shall be new, first-class commercial quality, and flawless.

Workmanship shall be of first-class quality and in accordance with the best workshop practices suitable for high-class equipment manufacture.

Wherever possible, similar parts and spare parts shall be interchangeable.

1.12 Coordination with Other Manufacturers and Subcontractors

The Contractor shall provide full coordination with other contractors and manufacturers.

The Contractor may subcontract one or more parts of the work or equipment supply. Subcontractors shall be fully under the responsibility of the contractor and may only be used with the prior approval of the Administration.

The Contractor shall submit to the Administration, for approval, the names and references of the manufacturers of all equipment intended to be included in the scope of work, together with performance data and other relevant information on the proposed equipment.

1.13 Drawings and Information to be Provided by the Contractor

The manufacturer shall be responsible for the complete design of the crane to be supplied under this specification and related contract documents. Unless otherwise specified herein, the crane shall be designed in accordance with the “Rules for the Design of Hoisting Appliances” published by FEM.

The manufacturer shall submit the designs prepared in accordance with the specification requirements for review and approval to the Administration. The manufacturer shall clearly provide the characteristics of all equipment to be supplied, as well as any additional information necessary for the operation and maintenance of the equipment not previously included in the offer. Before commencing the designs, the manufacturer shall provide the Administration with a list including the serial numbers, titles, and estimated delivery dates of the designs to be prepared.

The designs shall be prepared in detail and shall include at least the following:

- Steel structure designs and manufacturing details,
- Installation designs and hook limits,
- Part numbers, dimensions, weights, material types, machining symbols and tolerances, welding and bolt details of all parts related to the equipment,
- Characteristics of the equipment,
- Circuit diagrams, busbar connection diagrams, triple-pole connection diagrams showing resistors, switches, motors, etc.,
- Seven (7) copies of the complete operation and maintenance manual.

This list shall be extended if required during the progress of the work.

Any matters not specified in this specification or in the FEM specification shall be in accordance with applicable international industrial standards.

The Contractor shall provide performance data and other appropriate information on all equipment intended to be included in the scope of work, together with the names and references of the manufacturers, for approval.

In accordance with the Contract requirements, instruction manuals and drawings necessary for the supervision, operation, and maintenance of the systems and equipment supplied, including all necessary definitions and data on the supplied equipment and accessories, shall be delivered. These instructions shall be provided in addition to the main plant instructions for all relays and instruments. Prior to delivery, these instruction manuals shall be approved by the Administration.

The Contractor shall provide the Administration with detailed calculations, manufacturer's documents, and data sheets before the manufacture or ordering of the equipment.

Design Calculations shall include at least the following:

- Foundation load; calculation of the loads transferred from the bridge to the concrete structure when the crane operates at permissible load, shall be prepared by the manufacturer and submitted to the Administration as a project note.
- Dimensions, weights, etc.; confirmation and, if necessary, correction of the approximate calculations, dimensions, weights, etc., shall be provided in the manufacturer's offer.
- Strength calculations; strength calculations for the main parts of the crane shall be submitted in seven (7) copies together with the designs for review by the Administration. These calculations shall include at least the bridge structure, wheels, bridge and trolley rails, drums, gears, shafts, ropes and hooks, and motor capacities.

Within two (2) months after signing the contract, the contractor shall provide the Administration for approval with a work schedule showing details of all stages of the work. The work program shall conform to the main work program established by the Administration.

Progress reports shall be submitted to the Administration every month.

1.14 Installation, Control and Tests

1.14.1 General

In cases deemed necessary by the Administration, all materials, components, devices, etc. related to the equipment shall be subjected to tests and inspections during manufacturing operations in the Contractor's (or the Contractor's subcontractor's) workshop in order to prove compliance with the contract conditions. All expenses related to workshop and site tests shall be borne by the contractor.

Upon application, the Contractor shall at all times provide the Administration with free access to the workshop. The contractor shall provide every facility for the unrestricted

supervision and monitoring of the installation operations and tests, and shall inform the Administration when required.

To facilitate the Administration's supervision and observation of the installation operations and tests, an information flow regarding the equipment manufacture and test schedules shall be provided to the Administration. At least fifteen (15) days before any inspection, test, etc., the Contractor shall notify the Administration in writing of the dates and places of the inspection, test, etc. At least five (5) days before the date of the inspection, test, etc., the Administration shall inform the Contractor of its intention to attend.

For the purpose of coordinating workshop inspections and tests, the Contractor shall prepare detailed manufacturing schedules for the principal elements of the equipment and submit them to the Administration. The schedule shall clearly show the estimated dates of the various phases of the work or operation (e.g., design, ordering of materials, receipt of materials, pre-assembly, machining, etc.) and the workshop inspections and tests. These schedules shall be updated by the Contractor every two months. The progress of the work shall be shown in the schedule.

If the Administration considers that the instruments and devices used by the manufacturer during inspections and tests require calibration, such instruments and devices shall be calibrated by an independent organization approved by the Administration, at the Contractor's expense.

Workshop assemblies shall be carried out to ensure the mutual fit of the various parts and to check the accuracy of dimensions, clearances, and tolerances. Parts assembled this way shall be marked so that they can be reassembled at the site.

The equipment shall be dispatched to the site pre-assembled to the greatest practicable size. All cabinets, control panels, etc. shall be completely assembled and wired in the manufacturer's workshop.

The Contractor shall provide all services, installation tools, facilities, etc. required for installation, and shall be responsible for the installation of the equipment supplied by itself. The Contractor shall supply all qualified and unskilled labor necessary for installation at the site, for testing, and for commissioning, at his own expense. Insofar as instructions and inspections are intended to ensure that the installation work is carried out properly, the workers shall operate under the instructions and control of the Contractor's installation supervisor.

The Contractor shall notify the Administration in writing three (3) months in advance of the planned date for the start of the equipment installation operations at the site. In this notice the Contractor shall also provide details such as the number and characteristics of the installation personnel it intends to employ at the site for the installation works.

Before commencing the installation works, the Contractor shall closely inspect all foundations, other structures, and the site where the parts of the equipment supplied under the contract will be installed, to verify their conformity with the foundation and connection drawings. The results of such inspections shall be submitted to the Administration sufficiently in advance of the start of the installation works to allow time for the correction of any errors.

Equipment installation operations shall be carried out properly in accordance with the manufacturer's installation instructions and the applicable specifications related to materials, use, welding works, etc.

The installation works shall cover the assembling and securing of all parts of the work in such a manner that they will not move from their positions during subsequent construction works. For this purpose, the Contractor shall supply all necessary equipment and struts.

The equipment shall be aligned as accurately as possible. The Contractor shall comply with the tolerances specified by the manufacturer and suppliers. Measurements shall be made with precision measuring instruments. All clearances and positions of the installations shall be recorded and copies of these records shall be submitted to the Administration.

After alignment, the parts shall be held firmly in position with dowel pins, fitted bolts, anchors, supports, etc.

Machines and bases shall be installed perfectly true and shall be grouted in situ. During installation the contractor shall comply with all safety regulations.

All parts of the equipment shall be protected against any kind of damage from the time of delivery until the time of commissioning. Parts damaged during installation or commissioning shall be repaired or replaced.

For glass parts or other parts that can be easily damaged, appropriate protective coverings shall be provided during installation.

Machined surfaces or surfaces to be left bright in service shall be protected during installation by a suitable corrosion-resistant film.

Assembly bases and scaffolds shall provide safe working conditions and shall be equipped with suitable decking and barriers.

Before carrying out any welding, oxy-cutting, or drilling operations on steel structures, the Contractor shall obtain written permission from the Administration. If installation or suspension attachments have been fixed to steel structures for installation operations, when no longer required the Contractor shall remove them, and excess weld metal and other attachments shall be ground off so that the steel structures are restored to their proper condition.

Unless specifically stated in writing by the Administration, tools and equipment supplied for the maintenance and repair of the equipment shall not be used for installation.

After installation, the final coat of paint shall be applied at the site in accordance with the painting specification, and any damaged paintwork shall be properly renewed.

The approval of materials and equipment, of the installation, of the tests and test methods, and the acceptance of the relevant test certificates, or the waiver of inspections and tests, shall in no way relieve the contractor from the responsibility of executing the works in accordance with the contract conditions, of ensuring that all supplied materials are undamaged, and of ensuring that they are fit for the intended purpose in every respect.

All tests, inspections, and the results arising therefrom shall be recorded and signed by the relevant parties. The reports shall demonstrate that the equipment complies with the contract

conditions. The inspections and tests shall include, but not be limited to, the tests described below.

1.14.2 Workshop Tests

1.14.2.1 Dimensional Controls and Visual Inspection

Dimensional controls shall be carried out for all main parts, components, and partial assemblies, particularly where precise tolerances and fits are involved (shaft tolerances, clearances between stationary and moving parts, connection dimensions with other parts for assembly, etc.). If the dimensional controls reveal measurement discrepancies that would affect the fit, assembly, or disassembly of the relevant part or component, such discrepancies shall be corrected.

However, such corrections shall in no case result in any compromise of operational efficiency and safety or of the interchangeability of components, and shall only be carried out after the written approval of the Administration has been obtained. If the above corrections and modifications are not made under the stated conditions, the relevant component shall be rejected. Defective machine parts or equipment shall not be dispatched to the site.

1.14.2.2 Function Tests

Function tests of partial assemblies and/or complete assemblies shall be carried out in the contractor's (or the Contractor's subcontractor's) workshop as far as possible. These tests shall be performed, as far as practicable, under the most critical operating conditions. Function tests shall be repeated until it is proven that the operation of the assembled equipment complies with the contract requirements.

1.14.3 Construction Site Tests

After installation at the construction site, the equipment shall be subjected to operational tests. These tests shall include, but not be limited to, the testing, inspection, and examination of all equipment installed, welded, and assembled at the site.

The Contractor shall provide, at his/her own expense, all qualified personnel, all equipment, materials, and services necessary for the proper and complete testing of all equipment and for commissioning. If the Administration is of the opinion that the designated personnel are not sufficiently qualified to carry out the necessary site tests, the Administration may request the Contractor to send additional personnel with sufficient qualifications to the site.

After the installation process and preparatory works for operation, and independently of the tests previously carried out in the workshops, the equipment shall be subjected to functional tests, performance tests, and reliability tests in order to prove compliance with the contract requirements. During these tests, the functional reliability, operational safety, and operating economy of the equipment shall be carefully checked. The duration of the reliability tests shall not be less than thirty (30) consecutive days. During the reliability tests, all equipment and accessories shall be brought to optimum operating conditions. During the reliability tests,

the equipment shall be operated by the Administration's personnel under the supervision of the Contractor's inspector and with their assistance and advice, however the Contractor may request any minor adjustments that may be necessary, provided that such adjustments do not interfere with proper function, safety, and economy in the operation of the equipment.

The Contractor shall notify the Administration in writing one (1) month in advance of the expected start date of any site test. In this notice, the Contractor shall also provide details regarding the test method, test duration, etc. Partial system tests shall commence only with the written approval of the Administration.

The approval of tests, the acceptance of test certificates, or the waiver of any site test shall not relieve the Contractor of the responsibility to fulfill the contract requirements.

1.15 Warranties

1.15.1 Period

The Contractor shall warrant all permanent equipment supplied under the contract against all defects in design, workmanship and material throughout the contract period and for a period of twelve (12) months after the provisional acceptance date.

1.15.2 Failure to Fulfill Warranties

During the performance of the work and within the warranty period after provisional acceptance, the Contractor shall promptly repair and/or dismantle and replace any work that the Administration declares to be not in compliance with the contract requirements, without imposing any cost on the Administration. The Contractor shall carry out all repairs of damages resulting from such repair, dismantling and replacement operations. If the Contractor refuses or persistently neglects to make the necessary corrections after being notified, the Administration may carry out the corrections at the Contractor's expense.

Unless otherwise specified in the contract, any equipment replaced or any part repaired shall be subject to a Warranty Period equal in characteristics and duration to the previous one, commencing from the date of completion of the replacement or repair.

1.16 Packaging and Transportation

All equipment shall be carefully packed to withstand all climatic conditions and long-term sea and land transportation.

Spare parts shall be packed and boxed to withstand long-term storage and shall be fully protected against rust.

Spare parts shall be packaged separately. Spare part packages shall bear clear markings indicating that the contents are spare parts, and storage instructions shall be included.

No material shall be dispatched without the written approval of the Administration.

1.17 Delivery

The materials to be delivered shall conform to the approved current work progress

schedule and shall be coordinated based on the site conditions. Anchor bolts and templates to be delivered shall be supplied well before the pouring of the structural concrete.

The materials to be delivered shall be intact, in the manufacturer's original packaging or boxes, and shall bear durable and legible identification labels. Where applicable, the date of manufacture and shelf life shall be indicated. UL labels shall also be present on the product.

The unloading of materials shall be carried out as specified or in accordance with the manufacturer's instructions. Material receipt records shall be maintained at the site. The materials shall be examined to ensure completeness and to check whether they have been damaged during shipment.

In order to prevent disruption of the work progress, the Contractor shall remove damaged materials from the site, expedite the delivery of undamaged new products, and procure the specified missing or lost materials as soon as possible.

1.18 Transportation, Storage and Protection

The materials shall be handled and stored so as to be protected from damage and in accordance with the manufacturer's written instructions on the material. During the period of storage and installation until acceptance for use, maintenance shall be carried out as recommended by the manufacturer.

Storage shall be arranged to allow easy access for inspection. Periodic inspections shall be carried out to ensure that stored materials are preserved under the specified conditions without damage or deterioration.

Finished goods ready for installation shall be stored in dry and well-ventilated areas. These materials shall not be exposed to variations in temperature and humidity.

Manufactured goods shall be stored on blocks or wedges to prevent contamination and soiling. Loose granular materials shall be stored on well-drained firm ground to prevent mixing with foreign matter. Perishable materials shall be covered with impermeable sheets, and adequate ventilation shall be provided to prevent condensation.

Hazardous materials shall be stored properly to prevent contamination of personnel, the storage building and the site. Material characteristics shall comply with applicable laws, the manufacturer's instructions, and the Contractor's site-specific Safety and Security Instructions.

1.19 Materials

All materials to be used in the manufacture of the equipment to be supplied shall be selected as the most suitable, considering flexibility, durability and other physical properties for their intended purpose. Materials shall be new, first-class commercial quality, and free from defects and faults.

All materials not manufactured by the Contractor shall be products of recognized manufacturers.

The Contractor shall be responsible for the coordination of the standardization of all

minor mechanical and electrical equipment, materials and items, and shall ensure interchangeability of parts and spares.

For such standardization purposes, the Contractor shall arrange and carry out the necessary coordination work with subcontractors.

Without being limited to the following, such materials, equipment, appliances and fittings shall include:

- Electric motors
- Valves
- Gauges
- Electrical instruments and meters
- Plug-in printed circuit boards
- Terminals and terminal blocks
- Primary and auxiliary relay devices
- Contactors, fuses, miniature circuit breakers and the like
- Control devices and control switches
- Lamps, bulbs, sockets, plugs, etc.
- Lubricants

1.20 Spare Parts and Accessories

1.20.1 Spare Parts

The Contractor shall provide a detailed list of various equipment and spare parts deemed necessary for a five (5) year operating period.

All spare parts shall be interchangeable with one another and manufactured with materials and workmanship specified in the contract.

All spare parts shall be shipped in boxes and suitably protected against possible damage.

1.20.2 Accessories, Tools and Instruments

The Contractor shall supply a complete set of keys, special tools or instruments that may be necessary or appropriate for the installation or dismantling of any part of the equipment.

The Contractor shall submit an itemized list of the special tools and equipment to be supplied. If the Administration considers that additional tools are required to meet the above needs, such tools shall be supplied without additional cost. The above-mentioned tools and equipment shall become the property of the Administration.

1.21 General Construction Site Arrangement

With respect to safety, cleanliness, and protection against fire and accidents, the provisions of the “General Technical Specification” shall be applied.

1.22 Bolts, Anchor Rods, Nuts, and Screws

All bolts, anchor rods, nuts and screws shall conform to metric thread standards.

All bolts, anchor rods, nuts and screws (including washers) shall be properly protected against corrosion according to local conditions. Nut and bolt heads shall be hexagonal and properly machined.

Nuts, bolts and screws liable to loosen during operation shall be locked in position by methods approved by the Administration.

1.23 Dowels

Dowel holes and dowels shall be provided at all stages of installation, at points where accuracy of site installation must be confirmed, and to facilitate disassembly of the installation.

1.24 Electrical Equipment

The supply circuit shall be 3-phase, 4-wire, 50 Hz, 380/220 V AC. The terminal voltage of auxiliary equipment shall be 380/220 V AC respectively. All equipment and devices powered from internal services shall withstand simultaneous voltage and frequency variations of $\pm 10\%$ and $\pm 5\%$.

The supply, installation and testing of all interconnections and operating cables between main system elements such as sub-distribution boards and control panels shall form part of the scope of work. All internal cabling (between cells, cubicles and panels, as well as between air fans, air heaters, motorized devices, control switches, control lamps, etc.) shall be included in the scope of work.

All cables leading to external connections shall be terminated at terminal blocks and marked with conductor and circuit identification.

Internal cables shall be laid efficiently from point to point and shall be bunched together wherever possible.

1.24.1 Electric Motors

Electric motors shall be three-phase, squirrel-cage type induction motors. All motors shall be totally enclosed, externally cooled (fan-cooled) type (IP44 according to IEC publication 34-5). All winding insulation shall be Class F.

Starting shall be direct-on-line. All motors shall be designed to successfully operate at 85% of the rated motor voltage during starting.

Motor starters shall be combined circuit breakers with overload protection on all ungrounded conductors.

All dimensions shall conform to IEC publications 72-1 and 72-22. Rated values shall conform to CENEL publication 28/64 for an ambient temperature of 45 °C.

All motors, including auxiliary and protective devices, shall have the capacity to operate

continuously under full load at 85% to 110% of rated motor voltage.

1.24.2 Electrical Works

Miscellaneous electrical works including wiring, conduits, connections, plugs, etc. shall comply with IEC regulations. All electrical wiring of a supplied equipment shall be complete. All control and minor wiring sections and conduits of each part shall be brought to junction boxes or cubicles.

Wiring shall be terminated at cast-type terminal blocks with terminal marking strips.

Terminal blocks shall be easily accessible and properly located. All terminals, connections and wiring shall be suitable for operation under 1.000 V in accordance with applicable IEC recommendations.

Conduits shall be rigid, galvanized, steel with threaded ends. Fittings shall be socket type with gaskets for tightness and shall be galvanized. Flexible conduits may be used where vibration or flexibility is required. They shall be tightened with suitable fittings.

After signing the Contract, the color coding of alternating current and direct current circuits shall be decided with the Administration.

Low-voltage power cables: dielectric constant shall be 3.000 V, stranded copper conductors shall be thermoplastic insulated, overall cable shall be thermoplastic enwrapped (maximum ambient temperature 45 °C).

Low-voltage control cables: dielectric constant shall be 2.000 V, copper conductors, shall be thermoplastic insulated, overall cable shall be thermoplastic enwrapped (maximum ambient temperature 45 °C).

The cross-section of control cables shall be minimum 1,5 mm².

1.25 Cable Color Codes

Alternating current cables shall be color coded as follows:

- Phase 1: yellow
- Phase 2: green
- Phase 3: purple
- Neutral: light blue
- Protective conductor yellow/green

Direct current source shall be color coded with red conductors for positive poles and blue conductors for negative poles.

1.26 Grounding

The Contractor shall connect the system to the bare copper ends left at the two nearest points of the plant grounding grid.

1.27 Current Relays

All current monitoring devices used throughout the work shall be equipped with contacts suitable for the 110 V direct current system and shall change position when the predetermined current value falls below the setpoint.

1.28 Limit Switches

Any limit switch shall be fully suitable for the specific application. Special attention shall be given to potentially harmful environmental conditions including water, oil, dust, dirt, temperature variations, and different expansions. Where switches are operated through linkages, measures shall be taken to eliminate faulty operation and adjustment changes caused by wear or tolerance. Operating voltage is 110 V direct current.

1.29 Coupling and Gear Guards

All couplings and gear systems shall be equipped with protective guards against accidents.

1.30 Welding

1.30.1 Preparation for Welding Work

Elements and parts to be welded together shall be cut to the correct shape and dimension either by mechanical means such as shearing, grinding, machining, or by gas or arc cutting. The design of welded joints and the selection of welding filler metal shall comply with DIN or other approved standards and shall ensure full penetration and sound fusion with the base metal. Edges of surfaces to be welded shall be of sound metal, free from visible defects, laminations or defects from cutting, and free from rust, oil, grease, and other foreign matter to a minimum of 50 mm behind from the edge to be welded.

1.30.2 Welding Procedures

All welding operations shall be performed by electric arc welding or other suitable methods in accordance with the Standard Welding Procedure Specifications (SWPS) of the American Welding Society or at least equal to the requirements of the latest issues of relevant DIN standards.

1.30.3 Qualification of Welders

The Contractor shall be responsible for the quality of the work performed by its welding crew. All welders and welding operators selected for this work shall have passed a welder performance test at least equivalent to those specified in the latest edition of the American Welding Society “Standard Qualification Procedure” or in DIN 8563. All costs related to welder qualification tests shall be borne by the Contractor.

Welder qualification certificates shall be submitted to the Administration upon request.

1.30.4 Welding Equipment

All welding machines, transformers, cables, electrodes, etc. required for welding work at the site shall be from recognized manufacturers and suitable for their intended purpose.

Consumables (electrodes, etc.) shall be included in the contract price. Permanent tools and equipment shall remain as the property of the Contractor.

2 POWER STATION TRAVELLING BRIDGE CRANE SPECIFICATIONS

2.1 Scope of Work

This specification covers the design, supply of materials, manufacturing, painting, transportation, installation, testing, and delivery in operating condition to the Administration of an electrically operated power plant bridge crane together with a monorail crane suspended under the bridge and all auxiliary equipment.

The bridge crane shall be used especially in the installation and maintenance works of turbine, generator, butterfly valve and electrical equipment.

In accordance with this specification, the manufacturer shall supply completely one (1) trolley, one (1) main hoisting unit, and one (1) monorail hoisting unit, equipped with the elements detailed below:

- Bridge and operator's cabin made of steel,
- 1 trolley,
- Monorail crane to be connected to the bridge girder, located so as to scan the maximum area, and to be controlled from the operator's cabin of the crane,
- Mechanisms providing forward-backward, cross travel, and hoisting-lowering movements,
 - Rails along the power plant for the bridge travel, anchors, connections, trolley rails, current supply bars and buffers,
 - Walkway on the bridge, guardrails, and equipment ensuring personnel safety,
 - All equipment necessary for first-class operation,
 - Auxiliary parts and spare parts specified in Sections 2.9 and 2.10,
 - Seaman's ladder providing access from the assembly area to the crane runway,
 - Connection of the crane to the power plant grounding grid,
 - All equipment necessary for the load test of the crane.
 - The crane shall be designed with the minimum possible overall dimensions (clearance).

2.2 Operation Specifications

The values not specified below shall be finalized according to the instructions of the Administration, the drawings and the nature of the work, and shall be guaranteed by the Contractor.

- Bridge span, from axis of rails m

- Bridge girder level (rail base)..... m
- Side clearance (rail to wall)..... m
- Main hook lower limit..... m
- Main hook upper limit..... m
- Monorail hook lower limit m
- Monorail hook upper limit m

Hook Approach Limits*

- Main hook (to tailrace side rail axis) 1,50 m
- Main hook (to penstock side rail axis)..... 1,50 m
- Monorail hook (to tailrace side rail axis)..... 2,00 m
- Monorail hook (to penstock side rail axis) 2,00 m

* These values shall be reduced as much as possible.

- Supply voltage.....380/220 V, 3 Phase, 50 Hz, 4-wire
- Crane rail.... ...DIN 536
- Main hook.....DIN 15402 Blatt 1

2.3 Performance and Hoisting Height

Capacity

- Main hook.....t
- Monorail hook.....t

Hoisting height

- Main hook.....m
- Monorail hook.....m

Speeds*

- Main hook..... 0–4 m/min
- Monorail hook..... 0–8 m/min
- Trolley speed..... 0–10 m/min
- Bridge speed..... 0–15 m/min
- Monorail travel speed..... 0–20 m/min

* Speed controls shall be provided with frequency converters.

Overloading shall be prevented by a protection device.

2.4 Requirements for Characteristics

- The hoisting equipment brake shall have the capacity to withstand 2,5 times the nominal capacity.

- Speed tolerances: At normal voltage and nominal capacity, the speed tolerances shall remain within the following limits.
 - o Hoisting +10% to –5% of nominal speed
 - o Lowering +25% to –5% of nominal speed
 - o Trolley and bridge speed +10% to –5% of nominal speed
- Slow movement tolerance:
 - o Vertical movements shall be smoothly controlled within two (2) mm for the main crane and within five (5) mm for the monorail crane.
 - o Bridge and trolley movements shall be controlled within ten (10) mm under any load.
- Girder deflection: Under 110 tons nominal load, with the trolley at mid-span of the bridge girder, the deflection shall not exceed 1/1.000 of the span.
- Dimensional tolerances:
 - o Shall comply with FEM standards.

In general, small dimensions between 50–100 mm on machined surfaces shall have $\pm 0,3$ mm accuracy, and larger dimensions up to 250 mm shall have $\pm 0,5$ mm accuracy. In steel structures, dimensions less than 1.000 mm shall have ± 3 mm accuracy, and dimensions over 1.000 mm shall have ± 5 mm accuracy.

2.5 Material Characteristics

2.5.1 Materials

All materials shall be new, of the best available in terms of suitability for use, durability, and strength, and shall comply with the latest editions of TSE, ASTM, and DIN standards or their equivalents specified in Clause 1.2.

If materials to be used for equipment are not specifically stated in the specification, materials to be used for the equipment shall generally be of good quality normally used for such equipment. The properties of the materials shall be considered in this selection.

2.5.2 Safety Factors

The safety factors shall be calculated using the following formulas.

$$\text{Steel structure safety factor : } \frac{\text{Breaking strength of the material (kg/mm}^2\text{)}}{\text{Design stress (kg/mm}^2\text{)}}$$

$$\text{Steel rope safety factor: } \frac{\text{Rope breaking load (ton)} \times \text{Number of ropes} \times \text{Efficiency of pulleys}}{\text{Normal load (ton)} + \text{Weight of hook block (ton)}}$$

- o For shafts and axles Not less than 5,0
- o For gears Not less than 5,0
- o For steel ropes Not less than 6,0
- o For other materials Not less than 3,0

Note: The maximum strength of the materials shall be taken as the minimum stress specified in the standards.

2.6 Loading and Stresses

2.6.1 General

The mechanical parts of the crane shall be designed with a safety factor of not less than five (5) under nominal load and based on the maximum strength of the material used.

2.6.2 Steel Structure

2.6.2.1 Bridge Girders

The crane bridge girders shall be of welded steel box sections. The trolley rails shall not be added to the upper flange stresses of the crane girders. The trolley rail shall coincide with the vertical neutral axis of the relevant girder section. The girder section sizes shall be selected to prevent deflection under vertical and lateral loads.

2.6.2.2 Trolley

The trolley frame shall be of welded steel construction. It shall be subjected to stress relieving after fabrication, and the surfaces where the mechanism rests shall be machined. The trolley shall be rigid structure, shall not cause harmful deflection, and shall ensure a uniform distribution of the load on the wheels.

2.6.3 Design Loads

2.6.3.1 Structural Parts

In Section 1 of the FEM Standards “Rules for the Design of Cranes,” the loads to be used in the design of steel materials (loads from movements, buffer effects, etc.) and the amplification factor are specified, taking into account the crane group and the place of service of the crane.

To obtain the safety factors in checking the stresses occurring in various elements of the crane under different loading conditions, the following three critical cases shall be considered.

- The yield limit of the material shall not be exceeded,
- The critical buckling or crumpling load shall not be exceeded,

- The operational strength shall not be exceeded.

The physical and chemical properties of the material and the welding quality shall be guaranteed by the manufacturer. The permissible stresses for the material to be used shall comply with the values specified in Sections 1.41–1.42–1.43 of the FEM Standards, referring to the critical stresses of the material.

These critical stresses correspond either to the yield limit (as a stress equivalent to the critical elongation limit), or to the critical stress for crumpling or buckling, or to the operational strength, or to stresses corresponding to 90% of the stresses obtained from long-life tests.

The stresses on each element of the supporting system shall be analyzed according to strength methods and loading conditions for the materials. For all compression members, gross cross-sections (i.e., without deduction of holes) shall be considered, and for all tension members, net cross-sections (i.e., with deduction of holes) shall be included in the calculations.

2.6.3.2 Mechanisms

Mechanism components shall be designed with sufficient safety to withstand breakage, buckling, service strength, and excessive wear. Other factors that may impair the operation of the mechanism, such as overheating and deformation, shall also be taken into account during design. The calculation principles of the hoisting components are given in the FEM Standards.

- Selection of bearings,
- Selection of ropes,
- Selection of trolley and drum,
- Wheel,
- Determination of suitable rail width, etc.

The calculation methods for gears shall be left to the manufacturer, but the loads to be used in the calculations shall be determined in accordance with the FEM Standards.

2.7 Manufacturing Requirements

2.7.1 Steel Structure

The bridge girders, trolley frame, and rail buffers shall be designed to prevent vibration and deformation during operation. In particular, to keep the bridge structure in its fabricated form under the influence of acceleration and deceleration, the main and auxiliary girders shall be securely reinforced at their corners with large gusset plates.

The bridge girder shall be rigidly installed to withstand vertical and lateral loads. On both sides of the bridge, a walkway of steel plate shall be provided, including guardrails made of 1 m high steel pipe, return guardrails, and a checkered plate walking path. Rails shall be provided on the bridge to allow for trolley movement. The bridge and trolley shall be manufactured as welded steel structures.

2.7.2 Control Cabin

It shall be closed type, providing clear visibility in all directions, and with sufficient space for control equipment. The operator shall be able to clearly observe the installation site. The cabin shall be suspended on the desired girder and side of the bridge as shown in the project. The cabin shall be designed for a floor load of 250 kg/m², excluding the weight of the equipment installed or fixed inside the cabin. The cabin shall be fabricated of profile steel and sheet, and its exterior shall provide a good appearance. All electrical equipment shall be properly enclosed for operator protection. The cabin floor shall be covered with 10 mm thick rubber flooring, and a rotating fixed operator's seat shall be provided. The cabin shall be equipped with an electric heater, a fan with a rotating head, a portable dry-type fire extinguisher, a lighting system, and a ladder for access to the bridge runway.

2.7.3 Hoisting Equipment

The hoisting equipment shall include monorail hoisting equipment suspended under the main and bridge girders mounted on the trolley. Both units shall be controlled from the operator's cabin. In addition, they shall be radio remote controlled. Special attention shall be paid to the design and manufacture to prevent oscillation during lifting and lowering of the load. The up and down movements of the hooks shall be in the vertical plane.

2.7.3.1 Drums

The hoisting drum shall be mounted so as to distribute the load equally to both girders. The drum shall be of cast steel or welded construction. The rope grooves shall be right and left helix. The drum shall be sized to accommodate the whole rope without overlapping, and when the hook is at the lower limit level, there shall remain at least two (2) full turns of rope on both ends of the drum. The pitch circle diameter of the drum shall be at least twenty (20) times the rope outside diameter. The groove depth shall conform to DIN 15061 standard. The drum gear shall be rigidly fixed to the drum in order to eliminate torsional stresses on the drum shaft.

2.7.3.2 Sheaves

Sheaves shall be of cast steel or welded construction and shall contain rope grooves with appropriate tolerance. The pitch circle diameter of the sheave groove in running pulleys shall be not less than twenty (20) times the rope outside diameter. However, the pitch circle diameter of the equalizer sheave shall not be less than ten (10) times the rope outside diameter. Sheave shafts shall be of heat-treated carbon or alloy steel. All rotating sheaves shall be equipped with roller or plain bearings and greased.

2.7.3.3 Brake

The hoisting mechanism shall be equipped with an electromagnetic and electro-hydraulic or eddy current brake. The electromagnetic brake shall be mounted on one side of the input shaft of the reducer and shall operate only when the electric current is cut off. The electro-hydraulic brake shall be mounted on the other side of the input shaft of the reducer and shall be used for adjusting hoisting and lowering speeds. The braking torque of the electro-hydraulic

brake shall vary with the speed of the drive motor. The brake shall operate with minimum shock and safely, and its operating time characteristic shall be adjustable. All brake shoes shall be fitted with brake linings rigidly secured to the frame in order to minimize changes in the coefficient of friction due to speed and temperature variations. Every part of the brake shall be designed to allow for easy adjustment, repair, and replacement. The brake shall be selected to hold at least 2,5 times the rated load.

2.7.3.4 Limit Switches

The travel limits of bridge, trolley, and hook motions shall be controlled by limit switches of adequate capacity for each switch circuit. Each limit switch shall stop the motion in its travel direction while allowing control in the opposite direction.

2.7.3.5 Hook Block

The hook block shall contain sheaves, suspension plates, shaft and thrust bearings, and hooks. The main hook shall be of the double-hook type, and the monorail hook shall be of the single-hook type. Both hooks shall rotate freely on roller bearings by hand under maximum load. Hooks shall be of solid forged, heat-treated alloy or carbon steel construction. Bearings shall be designed fully enclosed to be dustproof and grease-tight. All hooks shall conform to DIN 15401 and 15402. Hook blocks shall have stoppers to protect the ropes and prevent them from coming out of the sheaves.

2.7.4 Trolley Travel

The trolley drive unit shall be mounted on the trolley frame, and the motion of the drive motor shall be transmitted to the trolley wheels through a gear reducer. All wheels shall be double-flanged. The wheels shall be roller-bearing mounted, and the number of driven wheels on each rail shall not be less than 25% of the total number of wheels. On both sides of the gear reducer housing, a flexible, conical ring-bolt shrink-fit or flange type, or another type of coupling recommended by the manufacturer and approved by the Administration shall be provided. An electromagnetic or disc brake shall be installed between the motor and the reducer. The brake capacity shall not be less than 1,5 times the full-load torque of the drive motor.

At both ends of the trolley rails, there shall be rigid buffers not less than half the diameter of the driven wheel, or blocks matching the wheel radius. Buffers shall be fixed to the bridge girders, and blocks to the ends of the rails.

2.7.5 Bridge Travel

The driven wheels on both sides of the bridge shall receive motion through gears, shafts, and gear reducers. The manufacturer shall provide a separate motor-reducer system at each end of the bridge for bridge travel. The drive and control mechanism shall be designed so that the movement is smooth and free of vibration. The drive motor shall be equipped with an electromagnetic or double-shoe electro-hydraulic brake, which shall be effective when the

power is cut off. The wheels shall be double-flanged and made of cast steel.

In case of axle fracture, measures shall be taken to prevent the crane from moving more than 25 mm. Axles shall be of forged, heat-treated carbon or alloy steel, precisely machined, ground, and bearings polished. Shear bushings in wheel bearings shall conform to DIN standards. The number of driven wheels providing bridge travel shall not be less than half of the total number of wheels on that rail.

At both ends of the rails, there shall be buffers not less than half the diameter of the driven wheels. Buffers shall be designed to stop the crane when running unloaded at full speed and shall be anchored to the concrete, not the rails.

The crane shall be supported on reinforced concrete girders. The manufacturer shall supply base plates to distribute crane wheel loads onto the concrete girders within the permissible pressure stress of 60 kg/cm² of the concrete. Also, the bolts and nuts fixing these plates to the rails shall be provided by the manufacturer.

2.7.6 Monorail

A monorail crane shall be provided under one of the bridge girders of the overhead crane. The complete monorail crane, including hoisting and travel mechanisms, shall be suspended from the I-beam mounted under the bridge girder. All movements of the monorail crane shall be controlled from the cabin. Other provisions shall be the same as for the main crane.

2.7.7 Mechanical Parts

2.7.7.1 Gears

Gears shall be of worm, V (double helical), or spur type. V (double helical) gears shall be of the standard continuous-tooth type. Spur gears shall be of standard cut or of the herringbone type with 20° pressure angle at the tooth roots. Worms and pinions shall be made of machined carbon or alloy steel, treated to resist vibration. Spur gears shall be of one-piece cast or cast steel body with teeth, or fabricated by welding from steel bars and plates. All welded gears shall be stress-relieved. Worm gears shall be made of bronze with suitable characteristics. All gears shall be designed on the basis that the maximum service load at operating speeds shall be carried by one tooth. High-speed gears and pinions shall be mounted in gearboxes with oil bath lubrication. Gearboxes shall be designed to allow inspection and cleaning. Gearboxes shall be of cast steel or welded steel construction and provided with oil level indicator, filler/vent plug, and drain plug.

2.7.7.2 Shafts

All shafts shall be made of quality material and precisely machined. Gears shall be fixed on the shaft by key. Shafts shall be safely supported against bending. During the bearing installation, care shall be taken to ensure that the maximum shaft deflection is 0,8 mm per meter.

2.7.7.3 Undercarriage, Wheels and Axles

The bridge and end girders shall be of cast or welded box type steel construction with machined surfaces to ensure equal distribution of the load among the wheels and to provide for bolting of the wheels and other components. In case of axle fracture, safety blocks shall be provided to limit the drop to 25 mm, minimizing shock to the crane structure and operating parts. Each end carriage shall have dirt scrapers and safety blocks to prevent derailment.

All crane wheels shall be double-flanged, made of cast steel, forged steel, or rolled steel with wheel blanks. The wheels shall be absolutely machined or ground to be concentric with their bores. Sufficient tolerance shall be provided between the wheel flange and the rail head for machining clearance. The wheels shall be designed to carry the maximum load under normal conditions without wear.

Axles shall be of forged, heat-treated carbon or alloy steel and precisely machined. Driving wheels shall be fixed on the rotating shaft by a suitable method for power transmission.

2.7.7.4 Bearings

Bearings shall be cylindrical, roller, or plain type with bronze bushes. All bearings shall be designed to permit easy removal of shafts and to operate in oil bath or with pressure lubrication. Bridge/end carriage connection bearings shall be interchangeable. A shaft directly connected to the motor shall be supported on ball bearings. Shaft bearings shall be located as close as possible to the load point. All bearings shall be designed for easy removal, and their housings shall be of cast steel or welded steel.

2.7.7.5 Protective Covers

All gears and moving parts close to the walkway shall be covered with steel protective covers for dustproofing and safety purposes. Drip pans shall be placed where necessary to prevent oil and grease from dripping onto the floor and below.

2.7.7.6 Travel Rails

The crane travel rails shall comply with DIN 536 B1 A-100.

For the trolley travel rail, a square-section rolled product may be used if sufficient in terms of strength.

The supply shall also include all accessories required for installation, in particular all anchorages necessary for the installation of rails and the connections to the plant's main grounding grid. Nuts used on the rails shall be secured with safety locks to prevent loosening.

2.7.7.7 Lubrication

All high-speed gears and pinions shall operate in oil bath. Low-speed gears shall be lubricated with soft grease. Bearings shall be lubricated either in oil bath or with high-pressure grease, and industrial button fittings shall be used. Lubrication fittings of bearings and bushes

shall be easily accessible and, if necessary, properly connected to convenient points with large-diameter copper or brass pipes. Oil pans of suitable size shall be provided to collect oil and grease dripping from operating parts. Oil pans shall be located at accessible places for draining and cleaning.

2.7.7.8 Couplings and Keys

All couplings, driving wheels, and driving gears shall be connected to the shafts with standard rectangular cross-section keys. Key dimensions shall be determined according to safe seating and material shear strength.

All couplings shall be of cast or forged steel. All rigid couplings shall be shrink-fit type with safety flange or conical sleeve bolts. Couplings shall transmit the full load of the shaft and be keyed to the shaft. Flexible couplings shall be installed on stressed shafts due to bending and misalignment, and at loaded bearings where easy removal of motors, wheels, and reducers is required. The motor coupling shall be of flexible type.

2.7.7.9 Bolts and Nuts

All bolts and nuts for mechanical equipment shall be machined and hexagon-headed. Washers shall be placed under the seating surfaces of bolt heads and nuts for tightening. In castings, seating surfaces shall be on machined bosses or corrected small areas. Nuts exposed to vibration and fluctuating loads shall be secured with efficient lock nuts. Lock nuts shall be of standard thickness.

2.7.8 Wire Ropes

Wire ropes shall be of sufficient length to provide at least two (2) full turns on both ends of the drum, in addition to the hoisting height and the length required for fastening to the drum. All wire ropes shall be selected with a minimum safety factor of six (6), based on their normal breaking strength.

Wire ropes shall be selected in accordance with DIN 655 or its equivalent. The ropes shall be of non-rotating, single-fiber core, multi-strand, fully lubricated type. The breaking strength shall not be less than 180 kg/mm².

2.7.9 Electrical Equipment

Electrical equipment shall be selected to suit a 380/220 V $\pm 10\%$ voltage, 50 Hz, 3-phase system.

2.7.0.1 General Requirements

The material shall be protected against electricity without leakage current or weak insulation. Grounding connections and contacts shall be selected to withstand thermal and mechanical effects of maximum fault currents. Power and control circuits shall be protected

against overload and short-circuits with appropriate circuit breakers. Fuse protection shall not be accepted. The minimum breaking capacity for power circuits shall be 15 kA. Auxiliary contacts, control devices, and similar equipment shall be selected with proper protective devices to protect all electrical equipment against overload and short-circuit currents. Remote-controlled switches and contactors shall have a mechanical life not less than 10 million operations and a life of main and auxiliary contacts not less than 2 million operations.

All materials used in the manufacture of electrical devices shall be fire-resistant type. Arc contacts (breakers, contactors, switches, etc.) shall be of air-break type; oil-filled types shall not be accepted. Cables and wires shall have copper conductors with a minimum cross-section of 2,5 mm², self-extinguishing synthetic insulation, and plastic outer sheath. All cables shall be laid in grounded metallic covered ducts, and both ends of the cables shall be marked to indicate the circuits they belong to.

2.7.9.2 Insulation Levels

Insulation levels shall not be less than the following values:

- L.V. A. Apparatus: Test voltage 2.500 V A.C. for 1 minute
- L.V. D. Apparatus: Test voltage 2.000 V A.C. for 1 minute

2.7.9.3 Connection Fittings

Connection fittings shall be neatly arranged and fixed with sufficient intermediate supports. Cable colors shall be selected according to color codes.

2.7.9.4 L.V. Circuit Breakers and Contactors

They shall be of reliable manufacture, fast-acting, and of independent value. Necessary magnetic and thermal protections shall be provided in circuit breakers. This protection shall occur in the primary circuit and provide full selectivity.

Busbars for crane power supply shall be of enclosed type. Each motor on the trolley shall have separate contactors for power supply and control circuits; under no circumstances shall bridge contactors be used for more than one circuit. The manufacturer shall supply all bridge contactors, trolley collectors, isolators, and elbows.

The manufacturer shall equip the crane with an internal supply rail system of the enclosed type, with no moving parts on the outside of the protector, internally supported by traveling carriages with metal enclosures. The supply rail system shall include all items necessary for the complete system, with fully interchangeable standardized parts. The distance between rail hangers and elbows shall not exceed 1,5 m.

When the supply rail system is installed, it shall allow independent movement relative to steel protectors in case of uneven expansion due to temperature changes. All contactors shall be covered with customary protectors. All contactors shall be of hard-drawn copper, capable of carrying the rated current continuously in each pole without overheating. The trolley shall be

equipped with sealed ball-bearing wheels and silver-alloy contacts of adequate size to carry the full current continuously without overheating.

2.7.9.5 Auxiliary Contacts

Circuit breakers, contactors, etc. shall be equipped with sufficient auxiliary contacts for control, signaling, releasing, and interlocking.

2.7.9.6 Resistors

Resistors shall be metallic, naturally air-cooled, manufactured and mounted with large heat-dissipating surfaces to prevent overheating, and capable of carrying current for long periods.

2.7.9.7 Limit Switches

For the safety of the bridge, personnel, and equipment (including hoisting mechanism, trolley, and bridge), sufficient limit switches shall be provided.

All limit switches shall be fully enclosed, nut-travel or rotary-cam type, adjustable for opening and closing circuits and capable of operating at any hoisting position. Limit switches shall automatically return to their original positions.

2.7.9.8 Grounding

All parts of the electrical equipment, such as enclosures and supports, shall be grounded to the crane rails with braided copper conductors of at least 16 mm² (including connections). For each rail, arrangements shall be made to provide connections at both ends to the plant main grounding grid. The grounding system shall be carried out by the construction contractor, and the grounding cables shall be brought close to the grounding terminal of the equipment.

2.7.9.9 Collectors

Collectors required for bridge travel shall be of roller type or shoe type. Collectors shall be designed to maintain constant contact pressure with the busbars even if slight vibrations occur due to crane movement. Collectors, busbars, busbar insulators, and other necessary metallic connections shall be provided by the manufacturer. Busbars shall be made of solid copper bars of suitable cross-section or steel rails clad with copper of at least 2 mm thickness.

The manufacturer shall provide the complete flexible cable system connected to traveling hangers along the trolley runway. The supply cable shall be flexible, steel wire rope-reinforced, multi-core type with ethylene-propylene rubber insulation.

Bridge and trolley current-carrying busbars shall be of adequate capacity to carry the full current. The temperature rise of each busbar shall not exceed 30°C when the ambient temperature is 40°C.

2.7.9.10 Motors

The drive motors shall be totally enclosed, IP44 protected, slip-ring asynchronous type, suitable for 40% ED operation, and capable of meeting the required conditions. Motor bearings shall be of roller bearing type. Motors may also be offered as squirrel cage type if conditions permit. Starting of motors above 5,5 kW shall be selected so that the motor starting current does not exceed $2,5 I_n$.

The motor brake torque shall not be less than 275% of the full load torque at rated voltage and frequency. The motor circuit breaker shall not exceed 150% of the full load current. Each motor shall be mounted and insulated to withstand creep operation, shocks, and vibrations transmitted from operating machines.

2.7.9.11 Lighting of the Equipment

The crane lighting system shall be supplied from the 380/220 V general supply busbars via a circuit breaker connected to a dry-type transformer. The circuit breaker shall be equipped with thermal-magnetic protection devices in each phase. The circuit breaker shall have an effective breaking capacity of 15.000 A at rated voltage. The transformer shall be provided with a general-purpose enclosure.

The manufacturer shall provide two fluorescent lamps (220 V, 40 W) and their switch for the control cabin. Ladders, platforms, and walkways shall be equipped with industrial-type lighting fixtures.

To illuminate the area under the crane, four industrial-type, wide-angle mercury-vapor floodlights (220 V, 500 W) shall be placed at easily accessible points on the crane bridge. All lamps shall be controlled from the operator's cabin.

2.7.9.12 Sockets

The manufacturer shall install three-pole, 220 V, 20 A polarized and grounded sockets in the operator's cabin, on the crane trolley, and at both ends of the bridge walkways.

Sockets shall be installed at the following locations:

- One (1) socket in the operator's cabin,
- One socket on each side of the bridge,
- Two (2) sockets under the crane girder, one on each side,
- If access inside the bridge girder for inspection is possible, one socket shall be provided in each girder.
-

2.8 Auxiliary Parts and Materials

The following auxiliary parts and materials shall be provided:

- Nameplate (2 pieces),
- Connection parts with trolley and crane rails (1 set),
- One electric horn (push-button type) for the crane,
- Brake oil, grease, and lubricating oil in quantities twice the normal requirement,
- Special tools and equipment for crane assembly and disassembly, with toolbox,
- Hand-operated grease supply system, with pipes,
- One electric heater and one fan for the operator's cabin,
- Fluorescent and mercury-vapor lamps,
- One control lamp with 30 m cable,
- One 10 kg portable dry-type fire extinguisher for the operator's cabin,
- One swivel-type chair for the operator's cabin,
- One audible warning signal for crane travel,
- Ladder providing access to the bridge walkway.
-

2.9 Spare Parts

The manufacturer shall supply the following spare parts. In addition to the listed spare parts, the manufacturer shall include a priced list of recommended spare parts in the offer. All spare parts shall be identical in material and workmanship to the originals and fully interchangeable.

- | | |
|-----------------------------|---------------------------|
| • Brake lining | 1 set of each type, |
| • Carbon brush | 1 set of each type, |
| • Main contact | 1 set for each contactor, |
| • Contactor coil and relays | 1 piece of each type, |
| • Auxiliary contact | 2 blocks of each type, |
| • Signal lamp | 2 sets of each type, |
| • Other necessary parts. | |

2.10 Nameplate

A permanent nameplate indicating the manufacturer's name, address, serial number, date of manufacture, rated capacity, etc. shall be mounted on two visible places of the crane bridges.

2.11 Control and Tests

2.11.1 General

The manufacturer shall perform the following tests in accordance with the provisions of the specification, and all expenses shall be included in the contract price. The crane shall be inspected by Administration personnel during its manufacture and workshop installation. All devices, equipment, and measuring instruments required for workshop and construction site tests shall be provided by the manufacturer.

2.11.2 Workshop Inspection and Tests

Following the workshop installation of the crane, the following tests shall be carried out in the presence of the representative of the Administration and the authorized representatives of the manufacturer.

- Mechanical strength tests shall include but not be limited to the following,
 - Structural steels carrying high stress, tensile strength, yield point, elongation and bending test, and elasticity (Charpy) test,
 - Structural steels carrying low stress, tensile strength, yield point, elongation and bending test,
 - Hardness (Brinell) test for gears, pinions, drive wheel steels,
 - Drop test for rails.
- The manufacturer shall submit to the Administration the full list of mechanical strength tests proposed for the materials.
- Workmanship quality tests shall include but not be limited to the following,
 - X-ray test of all intersecting and critical welds,
 - Ultrasonic test of all welds,
 - Ultrasonic test of all materials carrying significant stress.
- The manufacturer shall provide the full list of workmanship quality tests offered.
- The crane shall be completely assembled by the manufacturer's proposal. Surface treatments shall be carried out before installation. Workshop installation shall allow for general inspection, checking of dimensions, no-load tests of the trolley and hooks, and control of the parallelism of the rails. Power shall be supplied for workshop tests of the hoisting mechanisms, trolley, and bridge travel, and for checking the operation of the gears,
 - Dimensional check and visual inspection,
 - Characteristic test of all motors,
 - Power tests of brakes, contactors, limit switches, and emergency devices,
 - Electrical tests for control panels, cable ducts, etc.,
 - Control of control circuit arrangement,
 - No-load operating tests shall include the following items,
 - Suitability of motors, gears, etc.,

- Voltages and currents of all motors in operation at both ends,
- Measurement of insulation resistance,
- Temperature rise in bearings,
- Noise and vibration.

2.12 Protective Paint

Before starting manufacture, all foreign substances such as oil, rust, and dust on all parts to be manufactured shall be removed by sandblasting and immediately primed. The manufacturer shall take all necessary measures to protect the equipment against corrosion and, before commencing painting works, shall submit to the Administration a painting plan including paint color and properties, painting duration, and method for approval. The final coat color shall be determined by the Administration. Primer paint shall be applied in two coats. Synthetic resin paint shall be used for the final coat on all exposed surfaces of the equipment. The final coat of paint shall be applied in two layers; the first coat shall be applied in the workshop, and the second coat shall be applied at the work site. All equipment and materials required for the cleaning of surfaces to be painted and for painting shall be provided by the manufacturer.

Electrical equipment (motors, panels, etc.) shall be spray-painted and delivered to the work site already painted. However, sufficient spare paint shall be kept on hand for repair purposes. The applied paints shall be guaranteed for five (5) years.

Painting shall not be allowed in the following cases,

- If the ambient temperature is below 5 °C,
- If the ambient temperature and humidity are too high,
- If there is a possibility of rain before the paint has completely dried,
- If there is a possibility of blistering of the paint due to sunlight.

On the inner surfaces of gearboxes in contact with oil, a primer coat of at least 200 microns thickness shall be applied with white epoxy polyamide or equivalent paint.

Unless otherwise specified, the final color of the crane shall be **RAL 1021** (cadmium yellow). The hook block, cabin, and end beam sections shall be painted with yellow and black stripes.

2.13 Operation Warranty

The manufacturer shall guarantee the mechanical quality and proper functioning of the equipment to be supplied and the following values,

- The capacity of the hoisting equipment,
- Under the most unfavorable conditions, the maximum deflection of the main girders

under nominal load shall not exceed 1/1.000 of the span,

- The power of the motors.

The manufacturer shall guarantee that the brakes and safety devices will operate properly and correctly under the most unfavorable test conditions.

3 PORTAL CRANE CHARACTERISTICS

3.1 Scope of Work

This specification covers the design, material supply, manufacturing, painting, shipment, installation, testing, and delivery in operating condition to the Administration of an outdoor type, low-speed portal crane together with all auxiliary equipment.

The portal crane shall be used for installation, maintenance, and operation of gates and other required equipment.

3.2 Summary of Equipment

According to this specification, the manufacturer shall supply in complete form the outdoor type, low-speed portal crane, equipped with one (1) trolley and one (1) hoisting mechanism, together with the elements detailed below:

- Bridge, legs, and operator's cabin made of steel,
- One (1) trolley,
- Mechanisms and electric motors for traveling forward–backward and hoisting–lowering movements,
- Rails, anchors, connections, trolley rails, electrical connections, and buffers required for portal travel,
- Ladders, walkways, guardrails, and all devices for personnel safety on the portal and access to the operator's cabin,
- All necessary equipment for first-class operation,
- Auxiliary parts and spare parts,
- All equipment necessary for load tests of the crane,
- Connection of the crane to the plant grounding grid,
- The crane shall be designed with the minimum possible clearance dimensions.

3.3 Operation Specifications

Among the values given below, those not specified shall be finalized in accordance with the instructions of the Administration, the drawings, and the nature of the work, and shall be guaranteed by the Contractor.

- Hoisting capacity: Ton
- Hoisting height: m

Speeds*

- Hoisting.....4.0 m/min
- Portal travel speed..... 20 m/min
- Trolley travel speed..... 10 m/min

* Speed controls shall be carried out by frequency converters.

3.4 Requirements for Manufacturing

Except where otherwise specified below, all provisions in other sections concerning service conditions, standards, units, supply circuits, electrical equipment, color codes, nameplates, general requirements, specification drawings, Contractor's drawings, design calculations, requirements for characteristics, material requirements, manufacturing requirements, auxiliary parts and materials, spare parts, tests, protective painting, and operational warranty shall be strictly complied with.

3.4.1 Loads

This portal crane shall be designed for the following load conditions:

- Condition 1..... Normal operation without wind
- Condition 2..... Operation with an average wind speed of 8 m/s
- Condition 3..... Out of service with a wind speed of 20 m/s
- Earthquake coefficient of 0,1 g in any horizontal direction

In the application of FEM rules, the crane structure shall at least comply with Service Class A and Load Conditions 1–2.

The Contractor shall evaluate the load condition of horizontal movements according to FEM rules. The classification groups of these mechanisms shall result from the combination of the evaluated load condition and the above-mentioned service class.

3.4.2 Trolley Travel

The mechanism providing trolley travel shall be mounted on the trolley frame, and the drive motor motion shall be transmitted to the trolley wheels via a reduction gear. The trolley drive motor shall be equipped with a brake of the automatic spring-applied, electro-hydraulic release, brake pad type, designed to allow rapid braking and release in both directions of movement, and to permit slow motion without undesirable shock or impact. The brake shall have a capacity of at least 1,5 times the maximum load torque of the trolley movement and shall be capable of holding stationary under wind speed of 20 m/s in both directions. A manually operated locking device shall be provided for the trolley.

The wheels shall be double-flanged and made of cast steel. The wheels shall be roller-bearing mounted, and the number of running wheels on each rail shall not be less than 25% of the total number of wheels. Flexible couplings of tapered ring bolted tension type or flanged type shall be fitted on both sides of the gear unit. An electromagnetic or disc-type brake shall be provided between the motor and reducer. The brake capacity shall not be less than the full

load torque of the drive motor.

The locking device shall be capable of preventing the trolley from moving under wind loads caused by 20 m/s wind in both directions. Each lock shall be equipped with a limit switch preventing motor operation when engaged.

At both ends of the trolley rails, rigid buffers of a height not less than half of the moving wheel diameter or stops appropriate to the wheel radius shall be provided. The buffers shall be fixed to the bridge girders and the stops to the rail ends.

3.4.3 Portal Travel

The moving wheels provided on both sides of the portal shall be driven by gears, shafts, and gear reducers. Portal travel motors shall operate simultaneously by a common control device. The drive and control system shall be designed to ensure stable and vibration-free movement. The drive motors shall be equipped with electromagnetic or disc-type brakes effective upon power failure. The brakes shall have a capacity of at least 1,5 times the maximum bridge travel torque under full load and shall be capable of holding the crane stationary against wind speeds of 20 m/s in both directions. The wheels shall be double-flanged and made of cast steel.

The portal travel mechanism shall be provided with a manually operated locking device. This device shall prevent portal movement under wind loads caused by 20 m/s wind in both directions. Each lock shall be equipped with a limit switch preventing motor operation when engaged.

Precautions shall be taken to prevent the crane from traveling more than 25 mm in case of axle breakage. The axles shall be made of heat-treated carbon or alloy steel, precisely turned, ground, and with polished bearings. Shear bushes conforming to DIN standards shall be used in wheel bearings. The number of driven wheels for bridge travel shall not be less than half of the total number of wheels on that rail.

At both ends of the rails, buffers of a height not less than half the moving wheel diameter shall be provided. The buffers shall be designed to stop the crane when running unloaded at full speed and shall be anchored to the concrete, not to the rails.

3.4.4 Housing

Each trolley shall be enclosed in an aluminum trapezoidal sheet housing. The housings shall provide sufficient space for easy maintenance of the equipment and shall be equipped with a lockable door, window, ventilation window, and 2 fluorescent lamps.

3.4.5 Steel Structure

The portal structure, bridge girders, trolley frame, and rail buffers shall be designed to prevent vibration and deformation during operation. In order to keep the bridge structure in its manufacturing form, especially during acceleration and deceleration, the main and auxiliary girders shall be securely reinforced with large gusset plates at the corners.

The bridge girder shall be rigidly mounted to withstand vertical and lateral loads. On

both sides of the bridge, a walkway of steel plate shall be provided, consisting of 1 m high steel pipe handrails, return guardrails, and a checkered plate walkway. Rails for trolley travel shall be placed on the bridge. The bridge and trolley shall be manufactured as welded steel construction.

3.4.6 Push Button Control System

The crane shall be operated from a push button control box at elevation 1380,80. The control box shall be impact-resistant, made of hard plastic or steel plate, outdoor type, and watertight. The cable between the push button control box and the bridge, through which all crane movements shall be controlled, shall be a flexible, steel wire-core, ethylene-propylene rubber-insulated cable, with sufficient cross-section to carry the required current and with adequate strength to support the weight of the box and suspensions. All push buttons for lighting and signaling devices shall be placed on the control box. The system shall not operate unless the safety key placed on the box is in position.

3.4.7 Portal Travel and Trolley Current Collectors

The portal power supply system shall consist of an automatic, motor-driven cable drum mechanism capable of winding the cable in both directions. The cable drum shall be of welded steel construction, mounted on ball bearings, and of sufficient diameter to wind the entire length of the travel cable.

The cable shall be 4-core, flexible, steel wire-core, ethylene-propylene rubber insulated, and as long as the portal travel path. The Contractor shall place a watertight terminal box with grounded neutral at the end of the travel path on the draft tube side, rated 380/220 V, 3-phase, 4-wire, 50 Hz. The manufacturer shall connect the portal crane power supply cable to this terminal box using cable clamps and anchor elements to prevent stress on the cable.

The manufacturer shall also provide a complete flexible cable system for each trolley, suspended from moving hangers along the trolley travel path. The supply cable shall be flexible, steel wire-core, multi-conductor, ethylene-propylene rubber insulated.

Portal and trolley current collectors shall have sufficient capacity to carry full current. The temperature rise of each collector shall not exceed 30°C when the ambient temperature is 40° C.

3.4.8 Lighting of Equipment

The crane lighting system shall be fed from a dry-type transformer connected by a circuit breaker to the 380/220 V main busbars. The circuit breaker shall be equipped with thermal-magnetic protection on each phase. The circuit breaker shall have an interrupting capacity of 15.000 A at rated voltage. The transformer shall be equipped with a general-purpose enclosure.

The manufacturer shall install suitable lighting fixtures in all work areas, stairs, walkways, platforms, and other locations where equipment is installed, as follows. All fixtures shall be watertight type.

- | | |
|--|---|
| • Fluorescent lamp (220 V, 40 W) | Two (2) units in the operator cabin
Two (2) units in the trolley housing |
| • Fluorescent lamp (220 V, 40 W) | One (1) unit in each panel |
| • Mercury vapor floodlight (220 V, 1000 W) | Two (2) units on each girder between legs, total of four (4) units |
| • Mercury vapor floodlight (220 V, 100 W) | Four (4) units for platforms, stairs, and walkways |
| • Normal lamp (220 V, 100 W) | Three (2) units for the access platform to the operator's cabin from ground level |
| • Normal red lamp (220 V, 100 W) | Four (4) units on the main girder of each leg for warning purposes |

Lighting fixtures on the access stairway and platform to the operator's cabin from ground level shall be controlled by a switch mounted on the leg where the exit stair is located. All other fixtures shall be controlled from the operator's cabin.

4 INSTALLATION WORKS

4.1 General

The manufacturer shall perform the installation works shown below. The installation works of the equipment to be supplied by the manufacturer shall be carried out by the manufacturer. This includes site tests and temporary labor.

4.1.1 Responsibilities and Duties

The manufacturing, assembly, and installation works required to ensure that the equipment operates under the best conditions shall be guaranteed to a very high degree. The manufacturer shall be responsible during installation for construction, inspection, maintenance, storage, and housing works.

4.1.2 Performance of Installation Works

The manufacturer shall complete the installation of the equipment properly in accordance with the specifications, instructions, and drawings. All works shall be carried out under the supervision of the Administration.

Installation instructions and a complete installation diagram showing the locations and quantities of all parts and providing other information to assist during installation shall be prepared and submitted to the Administration.

The manufacturer shall prepare reports related to the installation works and obtain necessary instructions from the Administration. The manufacturer shall take all necessary precautions against theft, fire, etc.

The manufacturer shall maintain close contact with the Contractors and report to the Administration on the implementation of the construction methods and work schedules of both works and shall inform the Administration of the decisions made during meetings. Disputes regarding these works shall be resolved between the manufacturer and the Contractor.

The approval of the Administration shall be obtained for the qualifications of the welders to be used in the installation works in Türkiye. Before employing these welders, the manufacturer shall submit documents stating their identities and experience to the Administration.

The manufacturer shall submit to the Administration, within ... months at the latest following the award of the contract, the projects and documents forming the anchor foundations of the portal crane rails.

The manufacturer shall also submit to the Administration, four (4) weeks before starting installation, the projects and documents covering the installation method and program.

4.1.3 Machines and Tools for Installation

All machines and tools necessary for installation shall be supplied and kept ready by the manufacturer.

4.1.4 Materials Required for Installation

The following materials shall be supplied by the manufacturer:

- Materials and steel fabrications required to keep rails and travel path current collector shoes in place during installation,
- Solvent cleaners and oils in sufficient quantities for cleaning the equipment and parts,
- Anchor hooks required for installation,
- Other parts and materials required for installation.

4.2 Installation

The Manufacturer shall package crane components separately to facilitate transportation (e.g., bridge girders, trolley, end girder, legs, operator's cabin, etc.) and shall assemble them at their actual locations on site.

The manufacturer shall install limit switches for electric motors and other electrical devices, completing all related cabling and piping works. The manufacturer shall properly place the travel rails on the concrete girders and install the current collector busbars on the side of the girder indicated in the drawings.

Concrete for the bridge travel rail bedding and plastering of anchor bolt holes shall be done by the Contractor.

The manufacturer shall connect all equipment to the grounding system. The grounding system shall be installed by the Contractor, and a grounding terminal shall be left near the rails

for grounding of the bridge rails.

4.3 Paint Application

4.3.1 General

- After completing the installation works, the manufacturer shall carry out painting works in accordance with the specification or as instructed by the Administration. Before starting painting works, the manufacturer shall submit a painting application plan for approval by the Administration.
- All tools and materials required for cleaning and painting of surfaces shall be supplied by the manufacturer.
- Paint shall be applied to surfaces cleaned of rust, dust, oil, moisture, and all other foreign substances.
- During the final coat application of the crane, necessary precautions such as masking shall be taken to prevent painting of equipment originally painted and installed.
- Unless otherwise specified, the final coat color of the crane, except for oven-painted and factory-painted equipment, shall be RAL 1021 cadmium yellow. Areas requiring special attention such as the hook block, end girders, and operator's cabin shall be painted with yellow-black stripes. For ready-made equipment such as panels, motors, monorail hoists, and cable trolleys, colors may differ subject to the approval of the Administration.
-

4.3.2 Painting Works

Unless otherwise specified, painting works shall be carried out in accordance with the specification. The manufacturer shall apply one coat of primer protective paint and one intermediate coat of paint in the workshop, and the final coat of paint shall be applied at the site. The dry film thickness of the paint obtained after the final coat shall not be less than **0,20 mm**.

The manufacturer shall also perform the repair/touch-up painting of parts painted in the workshop or equipment such as oven-painted panels, cabinets, etc., which may be damaged during transportation. For this purpose, the necessary quantities, colors and type of paint shall be kept available at the site.

4.4 Construction Site Tests

Following the assembly of the crane and completion of the final adjustments, the following tests shall be carried out in the presence of the Administration's representative and the Manufacturer's authorized personnel.

- Ultrasonic and X-ray tests: all site welds shall be controlled by ultrasonic testing, and suspicious areas shall be further examined by X-ray testing in cross directions.
- No-load operation test: visual inspection of the equipment and dimensional checks shall be performed.

- Normal load test: with the rated load on the hook, hoisting speed, trolley and bridge travel speed, motor current, girder deflection, etc. shall be measured. The hoisting mechanism shall be checked for hoisting, lowering and holding the load in any position. All brakes shall be tested for proper functioning and adjustment during these tests.
- Dynamic load test (120%): with the specified load suspended on the hook, all motions shall be performed consecutively and carefully without any speed measurement and without allowing the motors to overheat. The test shall be carried out continuously for half an hour.
- Static load test (140%): with the specified load suspended on the hook, the crane shall be subjected to a static test for one hour. After measuring the girder deflection, the load shall be gradually reduced and completely released, and it shall be checked whether any permanent deformation has occurred.
- Test of the operation of limit switches,
- Characteristic tests of motors,
- Insulation test (Megger),
- And other necessary tests.

For the dynamic and static tests, all loads shall be provided by the Administration, while the test bench and required slings and measuring devices, etc. shall be provided by the manufacturer. No permanent defect shall be observed after the tests. At the end of the tests, all hook dimensions shall be checked for deformation. The manufacturer shall submit the test reports to the Administration.

5 TECHNICAL INFORMATION AND DRAWINGS TO BE INCLUDED IN THE TENDER

The tenderer shall attach the following drawings and technical information to the tender.

- Drawings indicating the crane dimensions and hook travel limits
- Type of bridge girder,
- Crane span,
- Trolley span,
- Horizontal travel,
 - Main hook,
 - Monorail hook.
- Vertical travel,
 - Main hook,
 - Monorail hook.
- Rated capacity,

- Main hoisting mechanism,
 - Monorail hoisting mechanism.
- Operating speed,
 - Hoisting; main and monorail hook,
 - Bridge travel,
 - Trolley travel,
 - Monorail travel,
- Crane rails,
 - Type,
 - Weight per meter and total weight including accessories,
 - Rail length.
- Main and monorail hoisting mechanisms,
 - Rope diameter,
 - Number of strands in the rope,
 - Number of wires per strand,
 - Breaking strength,
 - Safety factor.
- Number of travel wheels and maximum load on one wheel,
- Guaranteed girder deflection at rated load and at 140% overload,
- Number and position of driving wheels,
- Motor characteristics (for each motor),
 - Rated power,
 - Brand,
 - Motor full-load speed,
 - Starting torque,
 - Full-load torque.
- Drawings of hooks,
- Electrical control diagram,
- Crane weight,
- Mode of transport, package dimensions and weight,
- Name and weight of the heaviest part of the crane during site installation,
- Instructions,
 - Control system,
 - Rail and trolley contactor system,

- Braking system,
 - Method of installation and assembly of the crane,
 - Pinions,
 - Drums,
 - Rope sheaves,
 - Hooks,
 - Wheels,
 - Rail (trolley travel),
 - Rail (bridge travel),
 - Rail (monorail travel).
 - Surface protection,
 - Name of products used,
 - Description,
 - Number of coats,
 - Protective strength of each coat,
 - Total paint thickness,
 - Colors of successive coats,
 - Application method,
 - Drying time between coats,
 - Curing time,
 - Protection period.
 - Main materials used for the principal parts and design stresses,
- Part name : Material : Yield strength : Design stress :**
- Main Structure (rolled steel)
 - Main Structure (steel plate)
 - Shafts
 - Gears
 - Pinions
 - Drums
 - Sheaves
 - Hooks
 - Wheels
 - Steel Wire Rope

- Installation schedule and method,
- Electrical power requirement for the work,

The tenderer shall clearly specify the performance warranties for the equipment offered and the conditions under which such warranties shall be valid.