

ANNEX I/ANEXO I

**TECHNICAL SPECIFICATION FOR THE SUPPLY,
INSTALLATION & START UP OF A BIOMASS
PRETREATMENT REACTOR SYSTEM TO BE INSTALLED IN
THE BIOCHEMICAL MODULE OF THE 2ND GENERATION
BIOFUELS ICTS IN THE INDUSTRIAL ZONE OF AOIZ
(NAVARRA).**

**ESPECIFICACIÓN TÉCNICA PARA EL SUMINISTRO,
INSTALACIÓN Y PUESTA EN FUNCIONAMIENTO DE UN
SISTEMA DE PRETRATAMIENTO DE BIOMASA A INSTALAR
EN EL MÓDULO BIOQUÍMICO DEL ICTS DE
BIOCOMBUSTIBLES DE 2ª GENERACIÓN EN EL POLÍGONO
INDUSTRIAL DE AOIZ (NAVARRA.)**

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Appendix I. Technical Specification for Industrial Painting

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1. OBJECTIVE

The aim of this technical specification is to define the minimum requirements that must be achieved in the design, manufacturing, material supply, inspections and testing of a Biomass Pretreatment Reactor System to be Installed at CENER's 2nd generation Biofuels ICTS in Aoiz (Navarre).

The system will be composed, as described in more detail in the following sections, by a biomass feeding and conditioning system, steam generator (if required) a pressurized reactor, and a discharge system of the product.

It is also included within the scope of this supply the control system for the whole unit, that is to say, it should be included an electrical and control panel, and it should be provided a list of electronic signals which must be connected to the central PLC of the Property.

This technical specification does not replace the reference Codes and Standards listed below. It only complements them with special conditions for this project.

Any alteration or deviation given by the Supplier shall be communicated to CENER (from now on the **Property**), who must approve in writing.

2. REGULATIONS, CODES AND REFERENCE STANDARDS

In addition to the requirements contained in this technical specification, the Regulations, Codes and Standards indicated below must be considered, always according to their latest edition:

Spanish Regulations

- Royal Decree 769/1999 of May 7, laying down provisions for implementing the Directive of the European Parliament and Council 97/23/EC on pressure equipment, and amending the Royal Decree 1244 / 1979 of 4 April, which approved the Regulation of pressure vessels.
- Royal Decree 1644/2008 of October 10, laying down the rules for marketing and commissioning of the machines.
- Royal Decree 1215/1997 of July 18 laying down minimum safety and health for workers' use of work equipment and subsequent amendments.
- Harmonised standards of reference in force.
- Any other rule or statutory provision applicable at national, regional or municipal level.

International recognized codes and standards of solvency

- ANSI American National Standards Institute
- IEC International Electrotechnical Commission
- ASTM American Society for Testing and Materials
- ASME American Society of Mechanical Engineers
- ISO International Organisation for Standardisation
- NEC National Electric Code
- NEMA National Electric Manufacturers Association
- DIN Deutsches Institut für Normung
- ATEX
- Directive 2004/108/EC relating to electromagnetic compatibility.

Electric motors will agree with the following codes and standards:

- Low Voltage Electrotechnical Regulations.
- UNE.
- International Electrotechnical Commission (IEC).
- Any other internationally recognized standard provided that it is basically in agreement with the IEC.

Use of this technical specification is not exempted from the application of any other rule that is not indicated and required by law or common practice applicable.

If there are discrepancies between the indicated rules and regulations and those required by the technical specifications, it shall be informed to the Property, which will act as it sees fit.

The Biomass Pretreatment Reactor System supplier shall submit to CENER the equipment's technical file (which will justify compliance with essential safety requirements, and have the content module based on conformity assessment required in each case), CE Declaration of Conformity should be highly valued (in case of not being possible, the supplier should provide the property with all the necessary information to obtain it), and other Certificates of Conformity issued by the Notified Body if necessary.

3. SCOPE OF SUPPLY

The scope of supply of this technical specification will be:

- Design, calculation, manufacture and supply of all components that form the System package, including all equipment, accessories and auxiliary support structure, according to Section 4 of this technical specification. This will include:
 - One feed hopper with feed screw or equivalent feeding system (conditioning systems for weighing and adjusting moisture content will be also valued)
 - One screw feeder or equivalent pressurization system
 - One pressurized reactor
 - One discharge system with lock hopper or equivalent
 - One flash tank or equivalent
 - Steam generator (if required)
 - All electric motors and reducers including VFD's (variable frequency drivers)
 - 304 SS Support frame with casters
 - Field Instruments and Controls connected to Control Panel with a micro PLC.
- Spare parts for two years of operation
- Documentation should be delivered as indicated in Section 6 of this Technical Specification and include all the documents listed in the Table
- The Supplier shall submit with the quotation, technical data sheets of different equipment, tools and accessories that form the Biomass Pretreatment Reactor System.
- Security system installation, such as safety valves or vacuum break valve.
- Painting of non- inox components (according to Appendix I)
- Cleaning and conditioning equipment and accessories for transport.
- Packing and shipment to CENER's facilities in Aoiz (Navarre) (DAP "Delivery at Place" ICC Incoterms 2010)
- Inspection and testing.
- Support services for the mechanical assembly (see below), commissioning and start-up of the Biomass Pretreatment Reactor System.
- Training for Operation, Troubleshooting and Maintenance.

The mechanical assembly of the Biomass Pretreatment Reactor System should be valued as an optional in the Offer. In case the supplier does not perform these works, should be present and will give the instructions and make the

recommendations so that it can be successfully performed by others. The internal interconnection of the different elements within the package will be within the scope of the supplier.

The Supplier shall submit a final document which should include the list of equipment, materials and services provided. In Section 4 of this technical specification indicates the minimum equipment and instrumentation to be included in the Biomass Pretreatment Reactor System.

The Biomass Pretreatment Reactor System's components must incorporate the required fixed plates (made of anticorrosive material) showing the following information:

Pumps:

- Service
- Number of buyer's purchase order
- Name of Manufacturer
- Construction year
- Equipment Serial Number
- Design Code
- Tag number in plant
- Nominal flow rate (m^3 / h)
- Differential head (m)
- Specific Gravity
- Rotation speed (rpm)
- Efficiency (%)
- Installed power (kW)
- Shaft power (kW)
- Pressure and maximum allowable operating temperature (kg / cm^2)
- Hydrostatic pressure of the casing (kg / cm^2)

Also, pumps incorporate another plate of the same material in which are recorded the following data for the bearings which are mounted on the pump:

- Manufacturer
- Full Description
- Internal clearance and / or pre-charge
- Type and quantity (in liters) of lubricant

Heat exchangers:

- Service
- Number of buyer's purchase order
- Manufacturer's Name
- Construction year
- Equipment Serial Number
- Design Code
- Tag number in plant
- Design Pressure and Temperature

- Post weld heat treatment
- Initial and periodic pressure hydraulic test
- X-rayed
- Corrosion allowance
- Volume / empty weight
- Category S / RAP and ITC-MIE-AP6.

Vessels:

- Service
- Number of buyer's purchase order
- Name of Manufacturer
- Construction year
- Equipment Serial Number
- Design Code
- Tag number in plant
- Design Pressure and Temperature
- Post weld heat treatment
- Initial and periodic pressure hydraulic test
- X-rayed
- Corrosion allowance
- Volume / empty weight

Solids transport systems:

- Service
- Number of buyer's purchase order
- Name of Manufacturer
- Construction year
- Equipment Serial Number
- Design Code
- Tag number in plant
- Design flow.
- Speed.

In addition, the Supplier shall include in its supply all the elements it considers necessary for proper and safe operation of the unit subjected to this technical specification according to usual good practices.

The Supplier shall indicate in its offer ancillary services required for the proper functioning of the Unit Package, and their conditions (pressure, flow, temperature, etc.). Also, a list of tie-ins for the Unit Package must be attached to the offer.

4. DESIGN AND MANUFACTURING CONDITIONS

4.1 GENERAL INFORMATION

With the data presented in this section, the Supplier should confirm that the offered equipment work in safe, low maintenance and required reliable operating conditions.

The operating factor of the equipment to be supplied is 1000 hr / yr.

It must be possible to do basic maintenance tasks on the equipment whilst operating. For such tasks only performance of the Property's staff specialist should be required, but with minimal training in this field, so that required action by qualified personnel only shall be in accidental situations or in-depth reviews that require stopping the installation.

As reflected in the current legislation & standards regarding Health and Safety at work, all those elements that could cause personal damages must be equipped with the appropriate warning signs, guards and safety devices.

The equipment must be designed to operate continuously and correctly, within an industrial building, and environmental conditions where it will be located (Aoiz, Navarra).

The maximum permitted noise level must be less than 80 dB (A) at a distance of 1 meter from surface of the equipment and measured at a height of 1.5 meters above the floor or walking surface when operating in its own way normal operation. Any equipment with noise levels up to 85 dB (A) may be acceptable if there is no accumulation of noise sources and has been designed to ensure that overall levels do not exceed 85 dB (A) at 1 meter distance. The Supplier shall indicate in its offer the level of noise every piece of equipment that makes up the package unit.

All equipment and ancillary facilities will be easily accessible by plant operators, so as to facilitate the maintenance of the facility.

The Biomass Pretreatment Reactor System will include all instrumentation, accessories and other items to ensure proper and safe installation.

4.1.1 Biomass Pretreatment Bench Scale System

The standard feedstocks will be: milled wheat straw (particle size range 10-20 mm) and poplar chips (particle size range 10-20 mm; any other supplier specification should be positively considered) with the moisture levels specified by the supplier. In some occasions they may also contain concentrated sulfuric acid between 0.5-2.5% (w / w).

The Biomass Pretreatment Reactor System should be able to operate at a maximum temperature of 200° C (higher operating temperatures will be positively considered) with saturated steam injection and an acid concentration range of 0.5-2.5% (w / w).

The unit must have systems that keep the operating temperature below safety limits (stated by the supplier)

The design parameters for the unit will be:

- Biomass feedstocks: chopped wheat straw and poplar chips.
- Inlet particle size: between 10 and 20 cm (any other supplier specification should be positively considered)
- Inlet moisture: as specified by the supplier
- Operating pressure: according to operating temperature
- Máximum operating temperature: at least 200 ° C (higher values will be positively considered)
- Design pressure: as required considering design codes to achieve operating conditions
- Design temperature: as required considering design codes to achieve operating conditions
- Minimum Flow: 5 kg/h of dried biomass (higher values should be positively considered)

The conditions of the utilities available in the installation are:

- Fresh water at room temperature of 7-10 ° C and a maximum pressure of 5 barg.
- Instrument air: 5-6 barg.

The Biomass Pretreatment Reactor System will be not located in an ATEX classified area.

4.2 ELEMENTS OF THE BIOMASS PRETREATMENT REACTOR SYSTEM

The items that must be included in the scope of supply of the Biomass Pretreatment Bench Scale System are listed below:

- **Atmospheric feed hopper and feed screw (or equivalent feeding system)** to transport the biomass fed into the unit package. Conditioning systems to measure and increase moisture content will be valued.
- **Pressure screw feeder or equivalent pressurization system**, for feeding biomass to the pressurized reactor. Dewatering systems will be valued.
- **Pressurized pretreatment reactor**. At this point will be added the medium pressure steam and additives required for the reaction. Therefore, the reactor must guarantee mixing and thermal transfer between steam and biomass particles.
- **Discharge system with lock hopper or equivalent free-fall system**, where it will discharge the pretreated biomass. It must have a system to prevent caking of the biomass, thus facilitating the product discharge. This discharge is carried out by pressure to a depressurization tank, which must be carried out using two automatic valves on / off located in series and will allow the discharge in batch of small quantities of biomass.
- **Depressurization vessel – Flash tank or equivalent**
- **All electric motors and reducers including VFD's**
- **304 SS Support frame with casters**
- **Steam generator (if required for proper operation):**

All equipment must be mounted on a common support frame of AISI-304 stainless steel.

4.2.1 Instrumentation

All field instruments and controls should be connected to control panel with Micro PLC

The Biomass Pretreatment Reactor System should include, at least, the minimum instrumentation listed below (additional instruments and controls will be positively considered):

- Indicators and temperature transmitters along the pretreatment reactor.
- Pressure indicators and transmitters both in the pretreatment reactor and in the flash tank.
- Mass flow transmitters in the inlet lines to the unit pack for medium pressure steam.
- Automatic control valve located in the medium pressure steam inlet line, for regulating the pressure inside the chemical pretreatment reactor.
- Two automatic valves on / off for the pressure - discharge to the flash vessel.

Please note that all the instruments must be from leading brands and worldwide known.

4.2.2 Electricity

A single control and force panel shall be supplied including both the PLC control and switchgear for controlling electric motors, including variable frequency drives, contactors, thermal relays, breakers, etc...

A frequency inverted will be located in the outlet of all the equipments that require soft start, variable speed rotation or frequency inversion. All drives are connected to the PLC using Modbus fieldbus type.

4.2.3 Control System

The Supplier will include manufacturing, supply and installation of control system that shall consist of a PLC programmed with the following characteristics:

- Reserve at least 20% of PLC in Input / Output cards, as well as in the processing capacity of CPU, wired output terminals, and power provided in the panel. Besides, another 20% reserve space will be left for future expansion. This space will be split evenly slot for I / O cards, engine output, drives, and bornes for I / O.
- Automat able to be programmed and with the necessary cards to connect to an Ethernet network and another one for connection to the Fieldbus Modbus PLC type. The PLC software is made so as to allow the contractor the adequate control of the equipment provided. Data recording systems outlined in this document shall be made in the central control computer so that the PLC will send all process data to this PC.

The supply scope must include all necessary licenses to run the software and will included as optional all necessary software licenses to carry out modifications in the programming. For this option the name, version and scope of software offered will be detailed.

The pre-treatment Unit will be equipped with emergency buttons for its complete shutdown. From any point of the plant will be visible at least one emergency stop button. These buttons are wired to the main plant PLC which sends an emergency stop command to the PLC of the pre-treatment Unit, carrying out the emergency stop of the whole plant. The contractor should consider if appropriate or helpful to include emergency stop buttons for the equipments listed below:

- Operating modes: For maintenance work and after introduction of a security key, can booted and manipulate individual equipments, without interlocking. For the manual mode will remain the interlocks, but you can force the operation of equipment. It is important that this mode does not allow the plant to operate in a manner that endangers persons or installations. For automatical mode, the plant will operate in an autonomously mode, sending and receiving the

necessary information to central control system, according to the previously programmed instructions.

- Touch screen for handling local field type Modbus mode. This screen is installed in the field at the foot of the facility and allows manual use of the plant, both for maintenance and for manual mode operation.
- Start up of the system.

Upon completion of the work the following will be provided; a user manual (to be attached to the general manual of the installation), training course, an annotated list of the PLC program and a CD with a copy of the programs.

4.2.4 Engines

The scope of supply of the unit includes motors, gearboxes and frequency changers (the latter must be installed on all the unit engines).

The engines will be IP 55 minimum and according to the classification of areas of the zone where they are installed. It shall also indicate in an appropriate place the clockwise direction of rotation of the engine.

The minimum level of energy efficiency of the engine will be IE2.

The motors are to be preferably of the ABB brand. Since this is the brand mainly present in the rest of the plant, this fact will be positively assessed in order to minimize the cost of spare parts, maintenance and training.

In no case, the power of the drive motor will be less than the maximum power absorbed by the consumer.

The drive motors will be supplied by the Filter-Unit Supplier and its technical characteristics are indicated in the datasheets.

The electric power of the engines will be at 400V, 3 phases and 50 Hz.

The drive motors shall have a rating equal to the power absorbed by the consumer multiplied by the following factors:

Power absorbed by the consumer	Coefficient
25 hp and under	1,25
30 hp to 75 hp	1,15
100 hp and over	1,10

It must be avoided the use of multipliers or speed bumps, and where necessary their use must comply with the API-677.

4.2.5 Materials

All materials used in the manufacture of the equipment shall be subjected to the approval of the Property. They will be suitable to operating conditions of each item.

The materials are specified by ASTM standards. All parts of the process that may come into contact with the fluid will be supplied of ALLOY-835, except for the screw that works at atmospheric pressure and the flash vessel, which will be made AISI-316.

Inspection certificates are required based on "3.1.B" UNE-EN 10204 for chemical analysis and mechanical properties of all pressure parts, components in contact with the process fluid, shafts, bearing housings and flashlights.

Regulation ASME VIII Division 1 must be used to for determine the need for resistance testing.

Agitator parts made of stainless steel should be degreased, pickled and passivated, while the parts made of carbon steel should be painted according to technical specification for industrial painting attached to this document (Appendix I).

In case of any material component failure, before proceeding with the repair of any component of the Pre-treatment Unit, the repair schedule must be approved by the Property.

5. INSPECTION, TESTING, RECEPTION AND TRANSPORT

5.1 INSPECTION

Property reserves the right to inspect the equipment during manufacture and before shipment; therefore the supplier has the obligation to provide free access to its manufacturing workshops. Regardless of whether or not inspections are performed during manufacture, it must be the responsibility of the Supplier to assure the compliance of the warranty of the supplied materials included in this technical specification and the applicable rules and regulations, as well.

During manufacturing, the Supplier may carry out the test which he considers necessary for compliance of the standards and warranty of the product. The Property reserves the right to attend these trials. However, all workshop reports will be available for reading.

The equipment will carry the manufacturer's plaques and where appropriate, those required by the official agency with all the necessary data, including at least, those listed in section 3 of this document.

All containers should be subjected to inspections and tests before being put into service according to existing regulation, and application codes. The supplier is totally responsible for them and therefore includes in its offer, all media and accessories needed to perform them.

5.2 FACTORY ACCEPTANCE TEST

The Supplier shall carry out, in addition, all analysis, tests, inspections or activities which are considered necessary to ensure the proper design and manufacturing and thus achieve the operation requirements of the equipment.

In the Factory Acceptance Test phase, to which the Property reserves the right to attend, all the equipment's responsibilities fall on the Supplier. In no event, any part of equipment will be sent if they have not satisfactorily exceeded the trials.

The Supplier is in charge of all testing costs and the replacement, if damaged, of parts or materials damaged as a result thereof.

The equipment will be tested by the Supplier in its own testing facilities.

5.3 RECEPTION

The Supplier shall inform beforehand (with a period of at least 15 days) the Property about the shipment of equipment in a letter, remaining the responsibility of the Supplier all the matters that may happen during the shipment of its product. It will not be authorized the dispatch of any equipment that has not been approved by the Property.

The Supplier shall deliver to the Property, a final document which must include the list of equipment, materials and services provided.

Property reserves the right to reject any damaged parts not suitable for its purpose and / or accomplishes the technical specification. In this case, the necessary corrections shall be carried out by the supplier, as well as the costs resulting therefrom.

The equipment will be provisionally received once placed in work, having successfully passed all tests and requirements of this technical specification. The equipment's final reception will take place after warranty period finalisation.

The Supplier will execute the tests in the manufacturing workshop, according to codes or standards of solvency, to ensure the proper functioning of equipment and construction tolerances.

5.4 PACKAGING AND SHIPPING

Once it has exceeded the factory testing of the equipment supplied, they must be properly prepared and protected for storage until shipment, as well as for transport and subsequent storage on site.

Depending on the type of transportation, the supplier will indicate the appropriate kind of packages used for such transport.

All materials will be cleaned internally and externally to remove welding chips, splashes' electrodes, dust, etc.

All flanges are provided with metal lids, gaskets and screws, to prevent the entry of dirt and to protect the seat faces of flanges.

The shipping of spare parts should be executed in separate packages from parts that are intended for mounting and they must be accompanied by appropriate invoices. In these lots must be indicated that it is spare part, using the word "spares".

5.5 TRAINING AND SUPPORT SERVICES

The Supplier should be present and include all the support services necessary for the commissioning and start-up of the Bench Scale System.

A training course for Troubleshooting and Maintenance should be included as well (detailed description of the program in the offer should be included).

6. DOCUMENTS TO BE SUBMITTED

All documents listed below must be sent to the property in electronic format. Although English language would be accepted, **translation into Spanish (together with original English documents) shall be highly valued (Specially concerning Operation & Maintenance Manual).**

As a complement to electronic format, three (3) hard copies of the final documentation shall be delivered. In phase of offer and approval will be enough supplying two copies.

The documentation to be submitted is shown in the table below:

ITEM	DESCRIPTION	PHASE			
		OFFER	ORDER	FINAL	REVIEW
		APPLICABLE	APPLICABLE	APPLICABLE	
1.	List of references	Yes			
2.	List of codes and regulations applied in manufacturing and	Yes	Yes	Yes	Yes
3.	Datasheets of equipment and	Yes	Yes	Yes	Yes
4.	P&ID's, drawings of the assembly and detailed mechanical	Yes	Yes	Yes	Yes
5.	Manufacturer technical catalogs	Yes	Yes	Yes	Yes
6.	Load diagrams	Yes	Yes	Yes	Yes
7.	List of instruments and signals (both internal and external), and instrumentation wiring	Yes	Yes	Yes	Yes
8.	Inventory count sheet of materials and		Yes	Yes	Yes
9.	List of special tools for assembly and		Yes	Yes	
10.	CE Marking and Certificates of			Yes	Yes
11.	Manual of Installation, operation, control system and			Yes	Yes
12.	Manufacturing schedule , inspection		Yes	Yes	Yes
13.	Photostatic copy of the nameplate			Yes	
14.	Dossier of tests executed in factory			Yes	

NOTES:

Non-delivery of this documentation on time may be enough for not taking the offer into consideration, or annul the order.

1. If possible, CE declaration of conformity must be attached. In case of not being possible; the supplier must provide all the information necessary to obtain it.
2. To be provided to the Property in less than two weeks from acceptance of order, for comments and approval of the Property.

Revisions of plans and documents resulting from changes must be shown through numerical revisions.

The review and approval of the drawings or documents by the Property does not relieve the supplier of its responsibility for design failures or others that may appear later. Will be obligation of supplier to correct these mistakes and assume the costs resulting therefrom.

7. WARRANTIES

The Supplier has the last responsibility of providing a Biomass Pretreatment Reactor System whose design and construction is appropriate for the specified conditions and to ensure their safety in normal operation.

The Supplier shall guarantee their equipment against any defects in design, construction or operation for 24 months after final acceptance. Any warranty extension should be valued

This warranty covers all expenses for the replacement and repair of defective materials, including travel and subsistence expenses. All repairs made under warranty will have a new warranty period of 12 months, which must be revalidated for each acceptance.

The supplier, according to the characteristics described below, should ensure the proper operation of the Biomass Pretreatment Reactor System from a mechanical and electrical point of view through performing the following two (2) tests at CENER's facility in Aoiz (Navarre):

Test 1: Mechanical and electrical operation test using wheat straw as feedstock. The operation will be carried out during 2 hours after achieving steady state conditions

- Biomass: wheat straw
- Particle size range 10-20 mm (any other supplier specification will be considered)
- Feedstock moisture: as specified by the supplier
- Reaction temperature: 200 ° C.
- Sulfuric acid concentration: 1% (w / w).
- Minimum Feed flow: 5kg / h of dry biomass

Test 2: Mechanical and electrical operation test using poplar wood chips as feedstock. The operation will be carried out during 2 hours after achieving steady state conditions

- Biomass: poplar wood chips
- Particle size range 10-20 mm (any other supplier specification will be considered)
- Feedstock moisture: as specified by the supplier
- Reaction temperature: 200 ° C.
- Sulfuric acid concentration: 1% (w / w).
- Minimum Feed flow: 5kg / h of dry biomass

Both tests will be considered valid if there are not mechanical and/or electrical failures during the whole process (from biomass feedstock feeding to product discharge) and process conditions (temperature and pressure) keep stable during the time considered (2 hours).

APPENDIX I.

TECHNICAL SPECIFICATION FOR INDUSTRIAL PAINTING

TECHNICAL SPECIFICATION FOR INDUSTRIAL PAINTING

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ANNEX A1. Dew Point Temperatures

TECHNICAL SPECIFICATION FOR INDUSTRIAL PAINT

1. OBJECTIVE AND SCOPE

The objective of this specification is to define the criteria for choosing the most appropriate corrosion protection system for the operating / environmental conditions of the item or equipment being protected. It also defines the considerations to be taken into account in its implementation and quality control in CENER's Biofuel ICTS settled in Aoiz (Navarra).

This specification does not replace existing codes and reference standards listed below. It only complements them with special conditions for this project.

This specification provides the protection systems applicable to all new metal surfaces to be used in the workshop and during field work and also the most frequent repainting and maintenance tasks.

The preparation and eventual protection of metal surfaces in special cases (hard rubber, protective coatings, passive protection against fire, etc.) is out of the scope of this specification.

Any alteration or deviation proposed by the Supplier shall be communicated to CENER, who must approve in writing.

2. REFERENCE STANDARDS

The project's general standards are stated in the specification OXC-00-ESP-00-01002 (Specification of standards which should be obligatory complied)

In addition to the requirements contained in this specification, the Code and Standards indicated below must be applied, always according to their latest edition.

- UNE Standards, in particular:
 - UNE 48293, "Imprimación de silicito de etilo, rico en zinc."
 - UNE 48277, "Imprimación epoxi rico en zinc."
 - UNE 48295, "Pintura epoxi modificada con hierro micáceo."
 - UNE 48274, "Pintura de Poliuretano alifático de acabado brillante."

- UNE 48271, "Imprimación de epoxi anticorrosiva libre de plomo y cromatos."
 - UNE 48621, "Pintura epoxi modificada de aluminio y alto espesor."
 - UNE-EN-ISO 11126, "Preparación de substratos de acero Especificación de abrasivos no metálicos."
 - UNE-EN-ISO 12944, "Protección de estructuras de acero frente a la corrosión."
- ISO Standards, in particular:
 - ISO 8501
 - INTA Standards
 - MIL Standards
 - CLH Standards

All work carried out must always comply the requirements specified in the Law 31/1995 of November 8, Occupational Health and Safety, Royal Decree 1627/1997 of 24 October on the minimum health and safety Works in Construction, and Royal Decree 614/2001, of June 8, on minimum requirements for health protection and safety of workers against electrical hazards.

Finally, in case that the applicable standards or regulations are being modified during the course of the project, or in case that this current technical specification has not taken into account an obligatory standard, this technical specification does not exempt the supplier from the responsibility of applying the referred to standards and/or regulations.

3. SCOPE OF DELIVERY

Within the scope of this specification are included all the corrosion protection systems that must be applied to each metal surface (equipment, tank, stand, structure, piping, etc.), surface preparation procedures and their application in the workshop or work, the approval of the products used and the checks and inspections to be performed at various stages of implementing them.

The scope of work will include the supply, transportation, storage and preparation of materials and daily cleaning of work area. Be included in the same way, the contribution of all elements required for the completion of the work as scaffolding, equipment, etc.

3.1 GENERAL INFORMATION

New equipment such as valves, pumps, machinery, electric motors, electrical equipment, instruments, etc., will be printed and finished in the workshop in accordance with the standards of the manufacturer that supplies them.

Surfaces to be treated must be safely accessible and well lit and ventilated. In the absence of adequate ventilation, workers performing such work shall have self-contained breathing equipments.

All equipment manufactured in the workshop as structures, tanks, etc. except pipelines are to be painted on site, will be received at that place with the primer already applied in the workshop.

All damage to surfaces treated in the workshop due to transportation, loading, unloading, installation, etc. must be repaired before applying the next layer by the supplier of such items.

The layers of primer, intermediate and finished products must be compatible. It is the responsibility of the Supplier to comply with this requirement, having to proceed with the repair of damaged areas due to the incompatibility of these products.

The application of the primer will be held the same day you make the mechanical cleaning of the surface. In case of commercial blasting, this period will be reduced to the following 4-6 hours. If the type of blasting is a white metal, the primer should be done within the following hour to the application of such treatment.

The metal surfaces to be joined with high strength bolts will not be painted, except that ones which the specified primer is rich in zinc, in that case only this primer will be applied.

Pressurized piping and equipment will not be painted until the end of heat treatment, destructive testing, weld and leak inspection.

Diluents used will be exclusively recommended by the manufacturer.

The following areas should not be painted unless specifically stated otherwise:

- Steel and nonferrous metals.
- Brick and concrete.
- External finish of isolated pipes as aluminum, galvanized steel or stainless steel, except as indicated in this specification.
- Concrete and mortar fire retardant unless it will be placed in an area of aggressive chemicals.
- Machined surfaces and joint contact surfaces.
- All equipment purchased that have been primed and finished by the manufacturer (instruments, engines, etc.). Such equipment will not be painted unless it is required to repair paint damages or get a trim color determined.
- The rating plates or any special instructions included as part of the equipment.
- Valve Stems, moving parts of equipment, oil bodies, shafts for pumps and compressors and, in general, any surface or equipment that would normally be lubricated or have a very close working tolerances.

All steel surfaces to be thermally insulated shall bear the treated surface and / or print shop.

The temperature of the supports (tails, feet, cribs, etc.) shall not exceed 60 °C unless otherwise noted.

The painting of all valve leaflets should be included whether they are isolated or painted.

The dry film thickness of each layer of paint will be measured using a feeler gauge or micrometer. This measurement will be recorded in the corresponding control sheet.

3.2 PAINT RECEPTION

The Supplier will store the paintings on the designated site (where they could be properly filed and safeguarded in a way that meets the applicable law and CENER Security Standards).

When the Supplier requires the use of any type of solvent necessary, will seek approval of CENER, detailing details of reception, storage location and use.

In the event of noncompliance by CENER with the quality of the paintings, the Supplier shall act on his behalf for their replacement.

3.3 SURFACE CONDITIONING

Before the starting the work, CENER will be informed of any manufacturing defects detected on the surface being treated.

In summary, the actions to be taken before the blasting operation will consist of:

- Remove rust, pollutants, salts, grease, dirt, etc.
- Remove mill scale (calamine).
- Remove all projections and welding slags.
- Filling defects in construction and sharp edges, cracks, peels, irregular welding beads, etc.

In some cases, blasting may not be necessary but surface preparation with power tools (always in consultation with CENER).

The blasting operation should be performed when cleaning metal surfaces are subjected to at least 3°C above the dew point (see Annex I) and relative humidity not exceed 75%.

In the blast and when possible recovery, metal grit will be used to obtain appropriate particle size in most cases in the steel roughness Rugotest BN 10a No. 3.

Where it is not possible to use metal shot, you can use washed sand, clean and dry (according to UNE-EN-ISO 11126-3).

After the blast, remnants of dust and abrasive products will be removed from the surface, by means of preferably clean and dry compressed air.

When repainting of layers was needed, once exceeded the maximum overcoating time, there will be a blast cleaning to sweep, so as to make a general dive surfaces without depth, whereupon the layer or layers provided.

All matters relating to the type and surface preparation prior to paint application, shall be made as specified in the standard UNE-EN-ISO 12944 and the ones made therein refers, especially ISO 8501.

3.4 APPLICATION OF PROTECTIVE LAYERS

The application of protective layers, both in workshop or field, shall be made as specified in the standard UNE-EN-ISO 12944-7, instructions of the manufacturer of each product to apply sheet-specified characteristics, and this specification.

Do not start any application task or be interrupted if started, with no charge for CENER as listed in the following cases:

- When the ambient temperature is below 5 °C, with the exception of the paints to dry by evaporation of a solvent (these paintings that can be applied even at room temperature 2 °C). But the painting won't be applied in any case, if the expected ambient temperature will fall below 0 °C before the paint has dried completely.

- Do not apply paint on a steel surface whose temperature is 3 °C below dew point (see Annex I), or that is 2 °C below.

- Paint shall not be applied on steel, at a temperature above 60 °C, unless it is a specifically painting for this aim. Not apply any paint on steel that is at a temperature that causes bubbles or porosity and other phenomenon either detrimental to the life of the paint.

- When it rains, snow, in fog, with gusty winds with sand projections or when relative humidity is greater than 85%. When applied on damp or wet surfaces or surfaces with ice. The existence of water or ice on these surfaces must be adequately proven to prevent the painting in such conditions.

If paint is to be applied in wet weather or cold, will have to paint properly covering or protecting the surface to be painted.

Damaged areas by frost, excessive moisture, snow or condensation will be repaired by removing the paint, preparing and repainting the surface again with the same number of layers and similar to other surfaces.

As far as possible, apply layers of paint so that it is a continuous and uniform layer in thickness and free of pore, droplets or areas of misapplication.

In two-component paints to carry out partial mixing will not be allowed, mixing complete packages prepared by the manufacturer.

Each mixture preparation will be documented in a checklist that comprises at least the following information: date, item to be coated, paint type, batch number, time of completion, method and signature of the application.

All coating layers (primer, intermediate and finish) must have a different color, so you can appreciate the depth of each layer of paint.

Steel parts to be welded after painting, will be left with a margin of 50 mm at the edges of the welding zones. However, these areas must have a surface treatment and cleaning similar to the rest of the surface.

Marks or signs necessary for the prefabrication and installation will be performed on painted surfaces.

The paint used for this purpose will be compatible with the last coat and will not deteriorate the technical life.

Supplier is required to adequately cover the instruments, equipment, etc, that have not been painted, to prevent them from falling paint.

The products used will be received packaged from the manufacturer of paints, clearly identified with their corresponding dates of manufacture and expiry and batch number. Each different batch number will be provided with the certificates of quality issued by the manufacturer.

Paints and solvents will be stored covered in separate booth, properly ventilated.

The preparation of paints and other protective materials will be made according to the manufacturer's instructions.

Whenever possible by products to be used, the coating application will be done by spraying, leaving other methods, such as a brush for very specific cases such as areas of difficult access or small areas.

In the application of the coating, if necessary, solvents and thinners recommended by the paint manufacturer and in the amounts specified by him will be used.

All the elements used for paint application will be kept clean and in good working condition, to ensure the application of the coating with all the guarantees.

All coating, primers, intermediate and finishing layers, should be properly compatible to ensure the functioning of the system.

Special care should be taken where the coating system has to withstand temperature, being necessary in this case that all layers of the system can withstand temperatures above the operating temperature.

In cases in which the coating system is in contact with sulfur or sulfur gas concentrations, no system layer components have zinc components.

All instruments used in quality control, must be approved, weighed and in perfect condition for their use.

At the end of work, the Supplier shall attach the identification sheets of the applied products, their quality control and certification by the manufacturer.

4. DESCRIPTION OF SURFACE PROTECTION SYSTEMS

4.1 STRUCTURE OF STEEL

Type of structure	Surface preparation	Primer	Intermediate layer	Finish coating
Aerial structures in aggressive environments ⁽¹⁾	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 µm de pintura epoxi pigmentada rica en zinc según norma UNE-48277.	1 Capa de 100 µm de pintura epoxi poliámidada de alto espesor pigmentada con hierro micáceo según UNE-48295	2 Capas de 45 µm de pintura de poliuretano alifático, según UNE 48274
Aerial structures in non-aggressive environments ⁽¹⁾	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 µm de pintura epoxi pigmentada rica en zinc según norma UNE-48277.	1 Capa de 100 µm de pintura epoxi poliámidada de alto espesor pigmentada con hierro micáceo según UNE-48295	2 capas de 45µm de pintura acrílica modificada, según CLH-M-01-03
Fireproof structures	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 µm de pintura epoxi pigmentada rica en zinc según norma UNE-48277.	-	-
Concrete structures	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 µm de pintura epoxi pigmentada rica en zinc según norma UNE-48277.	-	-

NOTE:

⁽¹⁾ Aggressive environment are considered areas of high humidity (RH> 85%), coastal areas, chemical

4.2 PIPING AND NON-ISOLATED EQUIPMENTS

Type of piping or equipment	Surface preparation	Primer	Intermediate layer	Finish coating
Carbon steel or alloy. Maximum temperature $T < 120^{\circ}\text{C}$	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 μm de película seca de silicato inorgánico de zinc según norma UNE-48293.	1 Capa de 100 μm de pintura epoxi-poliámidada pigmentada con hierro micáceo que resista 120°C según UNE 48295	2 Capas de 45 μm de pintura de Poliuretano alifático según UNE 48274 que resista 120°C
Carbon steel or alloy. Temperature $120^{\circ}\text{C} < T < 400^{\circ}\text{C}$	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 μm de película seca de silicato inorgánico de zinc según norma UNE-48293.		2 Capas de 25 μm pintura a base de siliconas/aluminio que resista 400°C
Galvanized steel	Limpieza de grasas y aceites con detergente Eliminación de sales con agua dulce a presión	1 Capa en taller de 30 μm de pintura epoxi bicomponente para galvanizado según UNE 48271-2.	1 Capa de 125 μm de pintura epoxi bicomponente de alto espesor con aluminio según norma UNE-48261.	1 capa de 40 μm de pintura acrílica modificada, según CLH-M-01-03.
Inox steel ⁽¹⁾	Limpieza de grasas y aceites con detergente Limpieza mecánica manual según ISO 8501-1 Rugosidad BN9a de Rugotest nº 3	1 Capa en taller de 60 μm de pintura epoxi fosfato de zinc según norma UNE-48271-1.		1 capa de 40 μm de pintura acrílica modificada, según CLH-M-01-03

NOTE:

⁽¹⁾ Apply to equipment for identification / esthetic must be painted. In the case of pipes is always painted as the color strips identifying / RAL for each feature, located as shown by this specification. When the pipeline is susceptible to oxidation induced by chlorides be painted in its entirety.

4.3 PIPING AND ISOLATED EQUIPMENTS

Type of piping or equipment	Surface separation	Primer	Intermediate layer	Finish coating
Carbon steel or alloy Maximum Temperature $T < 120^{\circ}\text{C}$	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 μm de película seca de silicato inorgánico de zinc según norma UNE- 48293.	1 Capa de 100 μm de pintura epoxi-poliámidada pigmentada con hierro micáceo que resista 120°C según UNE 48295	
Carbon steel or alloy. Temperature 120°C $< T < 400^{\circ}\text{C}$	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 μm de película seca de silicato inorgánico de zinc según norma UNE- 48293.		2 Capas de 25 μm de pintura a base de siliconas/aluminio que resista 400°C

4.4 STORAGE TANKS

4.4.1 External surface of storage tanks

Type of tank	Surface preparation	Primer	Intermediate layer	Finish coating
Isolated tanks T < 180°C	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 µm de película seca de silicato inorgánico de zinc según norma UNE-48293.	1 Capa de 100 µm de pintura epoxi-poliámidada pigmentada con hierro micáceo que resista 180°C según UNE 48295	
Non-isolated tanks	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad BN10a de Rugotest nº3	1 Capa en taller de 75 µm de película seca de silicato inorgánico de zinc según norma UNE-48293.	2 Capas de 100 µm de pintura epoxi-poliámidada pigmentada con hierro micáceo que resista 180°C	2 Capas de 40 µm de poliuretano alifático según UNE 48274

4.4.2 Internal surface of storage tanks

Tank type	Surface preparation	Primer	Intermediate layer	Finish coating
Tanks with type 1 fluids	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad 75-100 µm	1 Capa de 25-40 µm de película seca de epoxi amina sin disolvente ⁽¹⁾	1 Capa de 100 µm de pintura epoxi fenólica sin disolvente y curado con amina ⁽²⁾	1 Capa de 350 µm de pintura epoxi fenólica, sin disolvente y curado con amina
Tanks with type 2 fluids	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad 75-100 µm	1 Capa de 100 µm de pintura epoxi fenólica bicomponente de capa gruesa y alto contenido en sólidos curada con aducto de amina ⁽³⁾	1 Capa de 100 µm de pintura epoxi fenólica bicomponente de capa gruesa y alto contenido en sólidos curada con aducto de amina ⁽³⁾	1 Capas de 100 µm de pintura epoxi fenólica bicomponente de capa gruesa y alto contenido en sólidos curada con aducto de amina ⁽³⁾
Tanks with type 3 fluids	Chorroado hasta grado SA 21/2, según norma ISO 8501-1 Rugosidad 75-100 µm	1 Capa de 25-40 µm de película seca de epoxi amina sin disolvente ⁽¹⁾	1 Capa de 100 µm de pintura epoxi sin disolvente y curado con amina ⁽¹⁾ ⁽⁴⁾	1 Capa de 350 µm de pintura epoxi sin disolventes y curado con amina ⁽⁴⁾

NOTE: (1) shall apply only to protect the blasting is not possible to have a controlled atmosphere through various mechanisms such as dehumidifiers and heaters.

(2) This layer is only applied at the junction perimeter and surrounding background, in sharp overlapping plates and welds, as well as in places of difficult access.

(3) shall apply an extra layer of reinforcement at the junction perimeter of the bottom and surround the pronounced overlapping plates and welds, as well as in places of difficult access.

(4) The paint shall comply with the Royal Decrees 2207/94 and 1752/98 the Ministry of Health.

Type 1	Type 2	Type 3
Condensate	Gasoline without lead	Drinking water
Water	Biodiesel	
Cooling water	Distilated water	
Fire water	Methanol	
Fuel-oil ≤70°C	Agressive solvents	
Gas-oil	Fuel-oil >70°C	
Keroseno	Oil >70°C	
Nafta		
Oil ≤70°C		
Slops		

For interior painting of storage tanks the following considerations will be taken into account:

- In the tanks of oil, slops, gasoline, naphtha and diesel the background, the roof (including legs or supports), the first ring and upper ring (top ring) will be painted.
- All other storage tanks shall be wholly painted.
- Between the blasting and application of the primer, there shall be not more than 4 hours.
- In preparing for touch surfaces and patching, when blasting is not necessary to properly prepare the surface, abrasive wheel is used. If during performing work spark explosion hazard exist, brush with a crown of barbed tires bronze, bronze spatulas, etc, will be used.
- Once fully completed the tank, outside the union stamp sheet steel (tank) - concrete (foundation ring) to avoid possible leaks of water or product to the bottom of the tank in contact with the ground. Fillers are used with good adhesion steel-concrete, very flexible, high chemical resistance to the products with which they can stay in touch and good weather resistance. Apply with a minimum overlap in the steel and concrete of 200 mm. All these products are applied prior to a thorough cleaning of the area to apply and preparation of the surface if necessary.

5. FINISHING AND COLOR SIGNAL

5.1. GENERAL CRITERIA

Lines and equipment non-insulated made of carbon steel and alloy, and the lines galvanized carbon steel as well, will be painted in full accordance with the relevant system and color / finish RAL considered below in this specification (as a group).

Stainless steel lines will be painted with stripes of color identifying / RAL finish which is considered below in this specification (as group).

Isolated lines strip in color / RAL for (as group) on the protection plate.

In order to differentiate between other lines belonging to the same group and therefore have the same RAL, all lines will be identified by their full name as described in this specification.

The identification band will be placed at the following locations:

- On either sides of a valve or bellows.
- On both sides of an elbow.
- On both sides of an expansion Lira.
- On both sides of a set of flanges.
- At the ends of a tee or graft.
- 30 cm of the surface when the line is buried or between / leave a channel open to visitors, culvert, etc.
- Every 50 m in straight without accessories. In the case of the distance between two bands above 50 100 m below me, was painted just a middle ground equidistant from the others.

The identification label of each service is placed at the following locations:

- Input and output racks and visited channels, culvert, etc., and in the air before the underground sections of pipelines.
- Within the limits of batteries for each of the Suppliers involved in the project.
- On the piping to and from the plant.
- In the drives of pumps, compressors, etc. For collectors will drive them.
- Every 50 m in straight sections.

Each of these labels with the names of each service must be accompanied by a corresponding flow direction arrow, depending on the features included in this specification.

This flow direction arrow is also placed at all entrances and exits of equipment and tanks, regardless of label bearing identification service.

On the outside of tanks and equipment, upon completion of the finishing work will take place the labeling of the same name, as established in this specification.

There will also be lettering with the brand image CENER cases it deems appropriate.

5.2 FINISHING COLORS

Color / RAL finishing of pipes, equipment and structures indicated in the tables below should be considered as an indication, the Supplier must obtain the approval of CENER in each case

5.2.1 Pipes

Group	Service	Color	
Water	Water Demineralised water Degasified water Cooling water Drinking water Effluent water	Green	RAL 6032
Fire water	Fire water	Red	RAL 3000
Inert gases	Instrument air Service air Carbon dioxide	Blue	RAL 5012
Steam and condensates	High pressure steam Medium pressure steam Low pressure steam Very low steam	Orange	RAL 2010

	Medium condensate Low condensate		
Fuel Gases	Natural Gas	Yellow	RAL 1021
Chemicals	Amonium hidroxide Drainage from chemical process Chemicals addition Gypsum Limestone solution	Violet	RAL 4001
Gases and oxidizing agents	Oxygen Combustion air Combustion gases Recicled combustion gases	White	RAL 9010
Solids	Coal Limestone Sand	Steel	RAL 9006

5.2.2 Equipments

Description	Color	
CO ₂ and Natural Gas tanks	White	RAL 9010
Rest of tanks	To be decided by INERCO	
Vessels, towers reactors	Steel	RAL 9006
Stoves, boilers, heaters	Steel	RAL 9006
Silos, hoppers	Steel	RAL 9006
Filtration equipment	Steel	RAL 9006
Equipment stands	Steel	RAL 9006
Railings (stanchions, handrails, intermediate and skirting), cat ladders (Pillars, step and cage)	Yellow	RAL 1028
Pumps	Green	RAL 6017
Compressors, blowers, fans	Green	RAL 6017
Electric engines	Blue	RAL 5014
Electric generators	Blue	RAL 5014
Transformers	Blue	RAL 5014
Valves	Steel	RAL 9006
Valve leaflets	Black	RAL 9017
Fire equipment	Red	RAL 3000
Lifters, hoists	Yellow	RAL 1028

5.2.3 Estructures

Description	Color	
General structure, racks, pipes and canal supports	Verde	RAL 6002
Railings (stanchions, handrails, intermediate and skirting), cat ladders (Pillars, step and cage)	Amarillo	RAL 1012

5.2.4 Sheet metal enclosures

The walls of structures and buildings belonging to the plant shall be painted as shown in the following table:

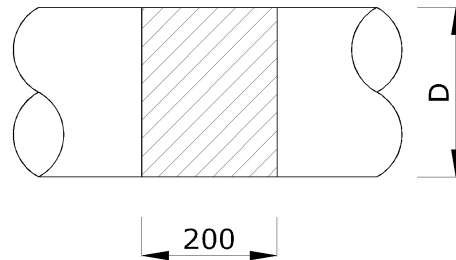
Descripción	Color	
Covered enclosure	Grey	RAL 7044
Lateral enclosure	Grey	RAL 7044
Perimeter shots	Grey	RAL 7044
Metal doors	Grey	RAL 7030

5.3 SIGNALING

5.3.1 Band / Pipe ID bands

Band and Pipe ID bands will have the corresponding finish or RAL color code as a group (see section 5.2.1).

The dimensions of the band will correspond to the following scheme

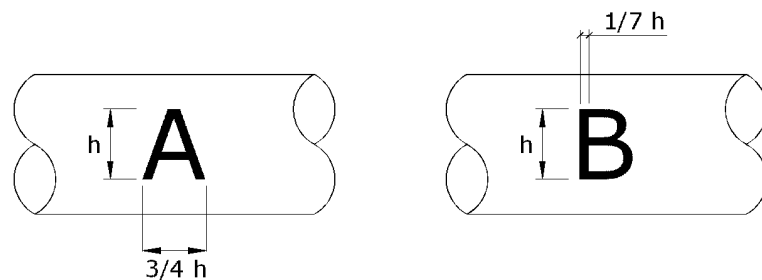


- Dimensions in mm.

- In the case of insulated pipelines, the diameter (D) will correspond to the outer diameter including insulation.

5.3.2 Identification name of product / service lines

The identification letters will be painted in black RAL 9017 for the following components: solids, oxidizing gases, combustible gases, steam and condensate. For the rest will be painted in white RAL 9010.



D	h
<1"	10
1" - 1 ½"	20
2" - 2 ½"	30
3"	40
4" - 6"	50
8"	70
10"	80
>10"	100

Dimensions in mm.

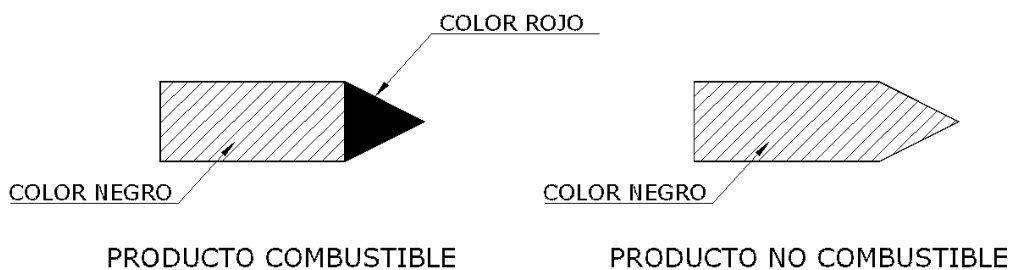
- In the case of insulated pipelines, the diameter (D) will correspond to the outer diameter including insulation.

5.3.3 Flow direction arrow pipe

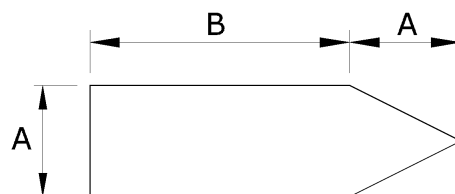
Arrows will be painted in black RAL 9017 for the following components: solids, and oxidizing gases, combustible gases and steam and condensate. For the rest will be painted in white RAL 9010.

To identify the flammability of products moving through the pipe, the ends shall be painted red RAL 3000.

The position of the tip of the arrow will indicate the direction of flow.



The flow direction arrows will have the following dimensions:

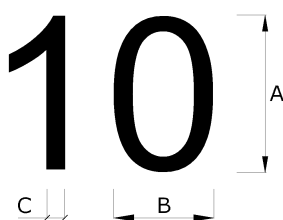


Pipe diameter	B	A
≤2"	40	10
3" - 6"	60	20
8" and higher	80	30

5.3.4 Labeling of the designation of tanks and equipment

The identification of tanks and equipment will be in black RAL 9017.

The font size and location depend on the capacity of the equipment according to the following scheme:



Capacity	A	B	C
≤100 m ³	200	150	30
100 - 500 m ³	300	225	40
≥500 m ³	400	300	60

- Dimensions in mm.

Equipment and tanks less than 500 m³ capacity will only be marked once half its total height.

The equipment and tanks of capacity greater than or equal to 500 m³ will be labeled twice half its total height.

5.3.5 Signs in pipes and vessels which contain or may contain dangerous substances and preparations

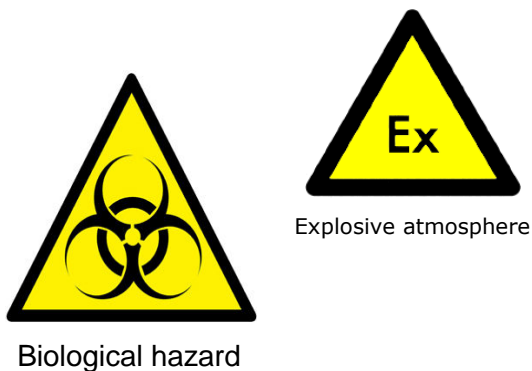
Containers and visible piping that contains or may contain dangerous substances or preparations must be labeled with appropriate warning signs. It may exempt the containers used for a short time and those whose content changes often, provided that they take appropriate alternative measures, primarily for training and information, to ensure an equivalent level of protection.

These signals will be glued, fixed or painted in conspicuous places in sufficient numbers and subject to points of special risk, such as valves or connections, in the area. And will be placed next to the labels identifying each service as indicated in paragraph 5.1 of this specification.

The intrinsic characteristics and conditions of use of signals to be used are:

- Signs will be of a material to resist the best possible impact, weather and environmental aggressions.
- The signals are preferably installed at a height and in a position appropriate to the visual angle, taking into account any obstacles in the immediate vicinity of the risk or object to be signaled or, in the case of a general risk, access the risk zone.
- The site for the signal should be well lit, accessible and easily visible. If general lighting is insufficient, additional lighting will be used or used fluorescent colors or fluorescent materials.
- In order to avoid decreasing the effectiveness of signaling signals are not used too close together.
- Signs must be removed when no longer exists the situation that warranted.

Depending on the nature of the hazardous substance or may contain pipes and containers, warning signs to be used is one of those shown below:



6. INSPECTIONS AND TESTS

The execution of the work must be supervised at all stages. Monitoring should be carried out by suitably qualified and experienced staff. The Supplier shall be responsible for carrying out this task by himself, as a guarantee that it is complying with the specification. It may also exist an additional oversight by CENER.

In cases where surface preparation and primer are performed in the workshop, and successive layers until the end of the system are made on site by a separate contract, the latter will conduct an inspection to determine if the state layer ensures shop primer applied successive layers of paint, or any repairs needed prior. In this case, CENER will be informed.

CENER may require the Supplier, at any stage of the scheme, the necessary tools, such as:

- Maximum and minimum thermometers.
- Hygrometer.
- Psychrometer.
- Roughness meter.
- Thickness gauge (wet and dry film).
- Checker adhesion.
- Products to verify cure.
- Detector of pores.
- Etc.

With the aim of checking and verifying the correct implementation of specification:

- The individual dry film thickness below 80% of nominal thickness are not acceptable. Individual values that are acceptable will be between 80% and 100% of nominal dry film thickness, provided that the overall average (mean) is equal to or greater than the nominal dry film thickness.
- Care should be taken in getting the nominal dry film thickness and avoid areas of excessive thickness. It is recommended a maximum dry film thickness of not more than twice the nominal thickness. For products and systems with a maximum dry film thickness critical (such as zinc silicate, which can cut up when given additional thickness) and other special cases should be consulted on the information sheet given by the manufacturer not being still valid prior acceptance criteria.
- CENER may request the Supplier samples of the system at any stage to perform the tests that may consider appropriate.
- CENER will ask for checks and tests it deems appropriate in accordance with the relevant articles of this specification, the Codes, Rules and Standards applied.
- CENER may require the Supplier during construction, official certificates of the

relevant materials proving their technical specifications of the materials offered. These certificates of compliance will join the Quality Assurance Documentation.

6.1 CERTIFICATES OF THE PAINT MANUFACTURER

All paintings must have been approved by an independent entity in order to certify their production according to the corresponding standard.

This certification will be valid for 5 (five) years, as long as no change in composition, manufacturing processes or the relevant standard, and all trials with these products, in previous works have had satisfactory results.

7. WARRANTIES

The Supplier shall guarantee for as long as CENER will state that the result of work carried out against any defect, and will compromise during that period in repairing or reproducing (free of charge) any deficiencies that may be observed and in the proper technical conditions.

CENER establishes that by operating and maintenance needs, the warranty period should not be less than 5 (five) years when surface preparation will be done by abrasive blasting and 3 (three) years when surface preparation will be manual.

For protection of tanks (exterior / interior) and equipments the warranty will be 10 (ten) years.

The following quality assurance requirements will be at least considered:

- Warranty for the permanence of the system that the finish coating may leave exposed more than 5% of the primer system.

- Warranty for the permanence of color, the color of the paint suffers a breakdown or marked change of tone as set out in standard UNE-EN-ISO 12944.

ANNEX AI.
DEW POINT TEMPERATURE

ANNEX AI. DEW POINT TEMPERATURE

Relative humidity%	Room temperature °C												
	0	5	10	12	14	16	18	20	22	24	26	28	30
100	0	5	10	12	14	16	18	20	22	24	26	28	30
99	-0,1	4,8	9,8	11,8	13,8	15,8	17,8	19,8	21,8	23,8	25,8	27,8	29,8
98	-0,3	4,7	9,7	11,7	13,7	15,7	17,7	19,7	21,7	23,7	25,6	27,6	29,6
97	-0,4	4,5	9,5	11,5	13,5	15,5	17,5	19,5	21,5	23,5	25,5	27,5	29,5
96	-0,6	4,4	9,4	11,4	13,3	15,3	17,3	19,3	21,3	23,3	25,3	27,3	29,3
95	-0,7	4,2	9,2	11,2	13,2	15,2	17,2	19,1	21,1	23,1	25,1	27,1	29,1
94	-0,9	4,1	9,1	11,0	13,0	15,0	17,0	19,0	21,0	22,9	24,9	26,9	28,9
93	-1,0	3,9	8,9	10,9	12,8	14,8	16,8	18,8	20,8	22,8	24,7	26,7	28,7
92	-1,2	3,8	8,7	10,7	12,7	14,6	16,6	18,6	20,6	22,6	24,6	26,5	28,5
91	-1,4	3,6	8,5	10,5	12,5	14,5	16,4	18,4	20,4	22,4	24,4	26,3	28,3
90	-1,5	3,4	8,4	10,3	12,3	14,3	16,3	18,2	20,2	22,2	24,2	26,1	28,1
89	-1,7	3,3	8,2	10,2	12,1	14,1	16,1	18,1	20,0	22,0	24,0	26,0	27,9
88	-1,8	3,1	8,0	10,0	12,0	13,9	15,9	17,9	19,8	21,8	23,8	25,8	27,7
87	-2,0	2,9	7,8	9,8	11,8	13,7	15,7	17,7	19,7	21,6	23,6	25,6	27,5
86	-2,2	2,7	7,7	9,6	11,6	13,6	15,5	17,5	19,5	21,4	23,4	25,4	27,3
85	-2,3	2,6	7,5	9,5	11,4	13,4	15,3	17,3	19,3	21,2	23,2	25,2	27,1
84	-2,5	2,4	7,3	9,3	11,2	13,2	15,1	17,1	19,1	21,0	23,0	24,9	26,9
83	-2,7	2,2	7,1	9,0	11,0	13,0	15,0	16,9	18,9	20,8	22,8	24,7	26,7
82	-2,9	2,0	6,9	8,9	10,8	12,8	14,8	16,7	18,7	20,6	22,6	24,5	26,5
81	-3,0	1,9	6,7	8,7	10,7	12,6	14,6	16,5	18,5	20,4	22,4	24,3	26,3
80	-3,2	1,7	6,6	8,5	10,5	12,4	14,4	16,3	18,3	20,2	22,2	24,1	26,1
79	-3,4	1,5	6,4	8,3	10,3	12,2	14,2	16,1	18,0	20,0	21,9	23,9	25,8
78	-3,6	1,3	6,2	8,1	10,1	12,0	13,9	15,9	17,8	19,8	21,7	23,7	25,6
77	-3,8	1,1	6,0	7,9	9,9	11,8	13,7	15,7	17,6	19,6	21,5	23,4	25,4
76	-3,9	0,9	5,8	7,7	9,7	11,6	13,5	15,5	17,4	19,3	21,3	23,2	25,2
75	-4,1	0,7	5,6	7,5	9,5	11,4	13,3	15,3	17,2	19,1	21,1	23,0	24,9
74	-4,3	0,5	5,4	7,3	9,2	11,2	13,1	15,0	17,0	18,9	20,8	22,8	24,7
73	-4,5	0,3	5,2	7,1	9,0	11,0	12,9	14,8	16,7	18,7	20,6	22,5	24,5
72	-4,7	0,1	5,0	6,9	8,8	10,7	12,7	14,6	16,5	18,4	20,4	22,3	24,2
71	-4,9	-0,1	4,7	6,7	8,6	10,5	12,4	14,4	16,3	18,2	20,1	22,1	24,0
70	-5,1	-0,3	4,5	6,5	8,4	10,3	12,2	14,1	16,1	18,0	19,9	21,8	23,7
69	-5,3	-0,5	4,3	6,2	8,1	10,1	12,0	13,9	15,8	17,7	19,7	21,6	23,5
68	-5,5	-0,7	4,1	6,0	7,9	9,8	11,8	13,7	15,6	17,5	19,4	21,3	23,2
67	-5,7	-0,9	3,9	5,8	7,7	9,6	11,5	13,4	15,3	17,3	19,2	21,1	23,0
66	-5,9	-1,1	3,7	5,6	7,5	9,4	11,3	13,2	15,1	17,0	18,9	20,8	22,8
65	-6,1	-1,4	3,4	5,3	7,2	9,1	11,0	13,0	14,9	16,8	18,7	20,6	22,5