



INDEPENDENT POWER TRANSMISSION OPERATOR S.A.  
TNPRD/ SUBSTATION SPECIFICATION & EQUIPMENT SECTION

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## **SPECIFICATION SS-20/6** **STEEL STRUCTURES FOR SUBSTATION AND SWITCHING** **STATION MATERIAL**

### **I. SCOPE**

This Specification covers the technical characteristics, the manufacturing and testing of steel structures used in outdoor Substation and Switching station switchyard

### **II KEYWORDS**

Steel structures, Lattice type structures, Steel structures for Substations and Switching stations.

### **III USE**

The steel structures shall be used in outdoor substations and switching stations to carry extra - high, high and medium voltage (400KV, 150KV, 66KV, 30KV, 20KV) equipment such as disconnecting switches, post insulators, Voltage transformers, Current transformers, Surge arresters, Coupling capacitors, etc.

### **IV STANDARDS**

1. Applicable standards for the steel structures
  - DIN 17100                      EN 10025
  - DIN 50115
  - DIN 50125
  - DIN 50111
  - EN 1461
2. Applicable standards for the assembling components
  1. Bolts DIN 7990, DIN 267, DIN 78
  2. Nuts DIN 934, DIN 267
  3. Washers DIN 7989 or DIN 434, DIN 267
  4. Lockwashers DIN 127, DIN 267

## **V TYPE OF STRUCTURES**

The steel structures shall be either of the lattice type or shall be made of prefabricated structural steel members.

## **VI. DESIGN CHARACTERISTICS**

The lattice steel structures shall be manufactured according to the relevant drawings which shall be provided each time with the inquiry and to be capable to withstand a wind pressure of  $180\text{kg/m}^2$  which corresponds to a wind speed of  $150\text{km/h}$  and with a coefficient of dynamic pressure of 1.5

The computed stresses shall be smaller than the critical stresses of the material referred to diagram No 3319 attached hereto.

## **VII. GENERAL TECHNICAL REQUIREMENTS FOR THE STEEL STRUCTURES**

1. All members of structures will be of structural steel St 37.2 and St 52.3 as shown in our drawings and in accordance with standards DIN 17100 or in accordance with standard EN 10025, S235JR and S355JR correspondingly.
2. All members of steel structures shall be hot dipped galvanized in accordance with standard EN 1461.
3. The boring, cutting and bending of all fabricated steel -work shall be carried out before galvanizing and shall be such as to prevent any possibility of irregularity occurring which might cause difficulty in the erection of the supports on the site.
4. All welding required for the fabrication of column beams and other steel work shall be carried out before the final galvanizing of these members.
5. All members shall be marked to facilitate erection. The marking shall be made before galvanizing and must indicate the type of structure and the number of the member or plate according to the corresponding drawings.
6. All members of steel structures and plates shall be carefully cut. Holes shall be accurately located so that when the members are in position the holes will be truly opposite to each other before being bolted up. Drifting of holes will not be allowed. All burrs shall be removed before galvanizing.
7. The manufacturers shall possess an EN 1090-1 conformance certificate, which will certify EXC3 execution class, following EN 1090-2, for the production works concerning the items mentioned in the inquiry.

During steel work industrialization, hole opening with drilling is compulsory only for the following members:

- Corner legs
- Holes which are near to the bending zone of the corner members and to the gusset plates.

- Other members with thickness not exceeding 10mm or 14mm, for S355 or S235 steel correspondingly, according to EN 10025.

## **VIII. ADDITIONAL REQUIREMENTS**

1. With the delivery of the steel structures the Suppliers should provide 3% additional auxiliary assembling components (bolts, nuts, washers, lockwashers etc.) besides those required for the erection of the steel structures.  
These additional auxiliary-assembling components shall be delivered in separate packets.
2. All steel structures shall bear the manufacturer's trade- mark or symbol.
3. The length of the screw thread of each anchoring rod shall be  $\geq 130\text{mm}$ .
4. With each anchoring rod shall be delivered three (3) nuts (screwed on the bolt), two (2) washers and one (1) lock washer
5. Anchoring rods shall be manufactured of hot dipped galvanized structural steel St 52.3, at their entire length, as shown in PPC's drawings.

## **IX. ASSEMBLING COMPONENTS**

### **1. BOLTS**

Metric thread bolts shall be used of class property 6.6 according to standard DIN 7990 having a diameter not smaller than 12mm.

When in position, all bolts or screwed rods shall not stand out from their corresponding nuts, as much as is allowed by DIN 78 but in any case not more than 10mm.

The length of the screwed parts shall be such that no screw thread part may form part of a sharing plane between parts, this shall be avoided with the use of washers.

For bolts of size M14 DIN 931 shall be applicable and with property of 8.8

### **2. Nuts**

Steel nuts shall be used of hardness 6 according to standard DIN 934

### **3. Washers**

Shall be used washers according to standard DIN 7989. For the parts of U-shaped profiles shall be used washers according to DIN 434.

### **4. Lockwashers**

Shall be used lockwashers of type B according to standard DIN 127.

All the bolts, nuts washers and lockwashers shall be galvanized according to standard DIN 267, part 10.

## **X. TESTS**

The following checks and tests shall be carried out in every for inspection quantity.

1. Check of certificates, which concern the chemical composition of the material.
2. Galvanizing  
Samples of all galvanized material shall be subjected to the galvanizing tests. Tests shall be carried out according to standard DIN 50976 and are referred to the coating thickness, the mass per unit area, the adhesion strength and also the homogeneity of the zinc coating.  
In the table 1 are shown the coating thickness and corresponding mass per unit area.

**Table 1**

Type of workpiece	Mean value Local coating thickness in $\mu\text{m}$	Mean value Corresponding mass per unit area in $\text{g/m}^2$	Minimum local coating thickness in $\mu\text{m}$
Steel parts less than 1mm thick	50	360	45
Steel parts 1mm to under 3mm thick	55	400	50
Steel parts 3mm to under 6mm thick	70	500	60
Steel parts 6mm and thicker	85	610	75

3. Dimensional check
  1. Verification of the main dimensions
  2. Verification of the cross sections
  3. Check of interchangeability between the steel structure parts.
4. Bending test  
Bending test ( $180^\circ$ ) shall be carried out according to standard DIN 50111 and DIN 17100 on samples selected from members of structures of each one steel - type and cross section used.

5. Impact test

Impact test shall be carried out according to standard DIN 50115 and DIN 17100 on samples selected from members of structures of each one steel type and cross section used.

6. Tensile

Tensile tests shall be carried out according to standard DIN 17100 or EN 10002 on samples selected from members of structures of each one steel - type and cross section used.

Dimensions of test pieces shall be in accordance with the standard DIN 50125. For the tensile test the ultimate breaking load, the yield point load and the elongation shall be measured in order to verify if they are within the permitted limits, which are referred in the table 2.

**Table 2**  
**TECHNICAL CHARACTERISTICS OF STEEL QUALITIES**  
**FOR STEEL STRUCTURES**

Tensile test	St 37.2	St 52.3
Ultimate breaking $\geq$	340~470 N/mm <sup>2</sup>	490-630 N/mm <sup>2</sup>
Yield point $\geq$	235 N/mm <sup>2</sup>	355 N/mm <sup>2</sup>
Breaking elongation	24%~26%	20%~22%

**XI. ASSEMBLING (ERECTION) OF STEEL STRUCTURES**

PPC maintains the right to ask from the suppliers to assemble (erect), in their own plant sites, any of the structures that sees fit in order to verify that they have been properly constructed.

**XII. PACKING**

All parts of the steel structures shall be delivered packed as follows and never steel structure loose inside a container and if they are delivered inside a container this must be in any case open from the upper part in order to facilitate the unloading.

- a. Parts longer than 2m (>2m) will be packed in packages which shall not exceed 2500kgr.
- b. Steel structures parts less than 2m (<2m) in length will be packed in packages which shall not exceed 800Kgr.
- c. The above packing (a and b) will be done with wrap wire of proper strength so as to withstand the weight of the package during lifting.
- d. All assembling (connecting) components such as bolts, nuts, washers and lockwashers shall be delivered inside robust wooden box of maximum weight of 50 kg and with the nuts to have been screwed on the bolt etc.