

## INDEPENDENT POWER TRANSMISSION OPERATOR S.A. TRANSMISSION NEW PROJECTS DEPARTMENT SECTION OF TRANSMISSION LINES SPECIFICATIONS

**TECHNICAL DESCRIPTION TD-201 STEEL LATTICE TOWERS**

**FOR 150 ΚV O.H.T.L.**

1. **Light – Single Circuit E**
2. **Heavy – Single Circuit B**
3. **Heavy – Double Circuit 2B**

**MAY 2018**

This specification covers the supply of steel lattice towers for 150 KV Transmission Lines.

## GENERAL DATA

* 1. There are four tower types for each one of the following three categories of lines.

|  |  |  |  |
| --- | --- | --- | --- |
| **Line category** | **E** | **B** | **2B** |
| **Tower type** | **Light-Single circuit** | **Heavy-Single circuit** | **Heavy-Double circuit** |
| **Straight line** | **S2** | **S3** | **S4** |
| **Small angle** | **R2** | **R3** | **R4** |
| **450 angle** | **T2** | **T3** | **T4** |
| **750 angle or Terminal Dead End** | **Z2** | **Z3** | **Z4** |

* 1. The general characteristics of the transmission lines of each category are :

## Single circuit Double circuit

(E and B Categories) (2B Category)

- Line Voltage 150 ΚV 150 ΚV

- Line Circuits One three phase circuit with single conductor per phase

- Circuit Arrangement The three phases are

arranged in a horizontal configuration

Two three phase circuits with single conductor per phase

The three phases of each circuit are arranged in an approximate vertical configuration at each side of the tower

- Shield Wires Arrangement

Each tower is equipped with two shield wires installed above the conductors symmetrically to the tower axis

Each tower is equipped with one shield wire installed at the tower's highest point on the tower axis

- Phase Conductor Data

1. For Light-single circuit line (E): ACSR LINNET 336400 CM. Overall diameter 18,3 mm, weight 0,7 kg/m.
2. For Heavy - single circuit line (B) and Heavy double circuit line (2B): ACSR GROSBEAK 636000 CM.

Overall diameter 25,2 mm, weight 1,3 kg/m.



1. The towers shall be manufactured from structural steel angle profiles, of Open Hearth (Siemens-Martin), Electric Furnace or LD process. Both mild and high tensile steel quality may be used. The tolerance of structural steel profiles and plates used shall be only positive and within the margin given in DIN 1612 or equivalent standards and the ratio between width and thickness shall be in accordance with DIN 4114 (and not greater than 17).

|  |  |
| --- | --- |
| - Shield wire data | Seven strand galvanized steel wire , overall diameter 9,5 mm, weight 0,44 kg/m. |
| - Insulators data | Disc type insulators of 10 IN diameter and 5 3/4 IN spacing of Normal type (or Fog type where needed). |

A minimum ungalvanized thickness of 5 mm material shall be used for members forming the shape of the tower and 3 mm for all other members.

Each member of the tower shall be marked before galvanizing, to facilitate erection. The marking must specify the tower type and the member number shown at the corresponding drawings.

The maximum allowable ratio of unsupported length to the radius of gyration shall be as follows; 150 for corner legs, 200 for diagonals and 250 for redundants.

1. Metric thread bolts from high tensile steel quality shall be used, having a diameter not smaller than 12 mm. Not more than 4 sizes of diameter of bolts shall be used for each tower type.

All bolts shall be of sufficient unthreaded part length, to secure that no shearing forces will be developed in the threaded part and shall be furnished with suitable washers and spring washers according to ISO 7089 (or DIN 126) and DIN 127B correspondingly. The mechanical properties of bolts and nuts shall be in accordance with ISO 898-1 and 898-2 correspondingly while their geometric properties shall be in accordance with DIN 7990 and DIN 934 respectively. Only bolts of proper class 6.6 or 6.8 shall be used. The tolerance between hole and bolt diameter shall be in accordance with the corresponding EN 1090-2 Standard.

The fabrication of towers shall be in accordance with EN 1090-1 and 1090-2 for execution class EXC3.

All holes have to be done by drilling or punching. Punching of holes on steel members must be made in accordance with EN 1090-2. The opening of holes by drilling is mandatory only regarding the following tower elements:

* + Corner legs
  + Main elements of cross arms (internal bracing not included)
  + Holes locate nearby the bending zone of corner members and gusset plates
  + Other elements the thickness of which exceeds 10mm and 14mm for S355 and S235 steel qualities respectively, according to EN-10025 Standard.

An extra three per cent (3%) of the necessary quantity of bolts, nuts, washers and spring washers must be delivered to IPTO.

The nuts must be delivered bolted on the corresponding bolts.

All tower members and connecting material shall be hot dip galvanized in accordance with EN ISO 1461 specification.

1. Each tower shall be provided with the necessary tower fittings i.e. shackles, hangers and U-bolts, required for the attachment of the line fittings to the tower. Tower fittings shall be made of high tensile steel and shall have an opening with ample radius of curvature in order to take without any friction the line fittings in general. Their axis of rotation on the tower shall be horizontal.

Cotter pins of all tower fittings shall be made of bras or phosphorus bronze.

Anti-climbing guards shall be furnished where needed, to prevent climbing in tower of unauthorized persons. Enameled danger plates shall be also furnished to be installed on every tower.

## TOWER CHARACTERISTICS

The height of the conductor attachment from theoretical ground level for a normal tower with normal legs is 19,95 m for tower types S and R and 19,00 m for tower types T and Z.

The towers are furnished with individual leg extensions for use on irregular ground and/or for increasing the height of the conductor attachment, from the ground level.

For all types of towers has been designed an extended body of +4,5 m. The following leg extensions have been designed:

1. Leg extensions -1,5 m (shorter than normal)
2. Normal (zero) leg extensions
3. Leg extensions +1,5 m (longer than normal)
4. Leg extensions +3,0 m (longer than normal)
5. Leg extensions +6,0 m (longer than normal)

For tower types S2 and R2 (both for extended and non-extended tower types), 1,0 m shorter than normal legs have also been designed. Also +4,5 m leg extensions have been designed for series 3 and 4 extended body (+4,5 m body extension) towers.

All legs of the same type and the same body extension are interchangeable and suitable for connection on the left or right side of the tower face.

Any horizontal section of the whole tower below waist is square and the webs of every tower face are symmetrically placed.

The use of tensioned web members has not been allowed.

All types to towers are equipped with horizontal panels located at :

* The lower surfaces of the crossarms
* The upper part of the leg extensions
* Any change in inclination of leg members

## CONNECTIONS

Generally welding is not allowed. The connections of members shall be detailed in such a manner, as to avoid eccentricities. Empty spaces at connections between members must be filled with suitable fillers.

All connections shall meet the following minimum requirements.

* 1. Splices between leg members Lap splices are not allowed

Butt splices between leg members have to be made with an inside splice angle having a thickness of at least the same with that of the thicker member and two outside straps having a thickness of at least 5 mm.

* 1. Connection at joints

When two or more members are jointed on another stronger member, the intersection of their bolt axes must lie within the limits of this other member. In case this cannot be effected, gusset plates should be used, having a thickness of at least 1 mm greater than that of the thicker of these jointed members.

When more than two members are jointed together through a gusset plate, this should have a thickness of at least 1 mm greater than of the thicker jointed member.

Generally the gusset plates shall have a thickness of at least 5 mm.

* 1. Quality of splice angles, straps and plates.

The quality (ultimate strength) of the splice angles, butt straps and gusset plates, shall be at least equal to the higher quality of the members involved in the connection.

* 1. Minimum distances from bolts

The following minimum distances from the center of the bolt hole, must be kept (d=nominal diameter of bolt):

* + - For all members and straps of splice connections :

Distance from sheared edge = 2,00 D

Distance from rolled edge = 1,35 D

Distance from the center of the nearest bolt = 3,50 D

* + - For all members and plates of connections at joints :

Distance from sheared edge = 1,50 D

Distance from rolled edge = 1,20 D

Distance from the center of the nearest bolt = 2,50 D

## FOUNDATIONS

Each tower will be based on four separate concrete footings.

The steel stubs shall be cast into concrete blocks, suitably reinforced if necessary.

Stub extensions of standard lengths are used on irregular ground. The quantities and the corresponding lengths of stub extensions shall be determined by IPTO.

The types of foundations that are mainly used are Rock Anchor, Auger and Pad and Chimney. For soils with low allowable bearing pressure Special Type foundations are used.

For each type of foundation a standard length of stubs is used.

Each footing shall be provided with one galvanized steel grounding rod of 2 cm diameter and 200 cm length. The grounding rod shall be attached with good electrical connection to the tower at the bottom of the footing, through a length of 10 mm diameter galvanized steel solid wire. For every tower 4 such grounding rods are required, one for each leg.

Counterpoise will be used for additional tower grounding, where needed, and shall be connected at the tower on an individual bolt of suitable diameter above ground, long enough to take this connection. For every tower 4 such bolts are required, one for each leg.

## REQUIREMENTS FOR BIDDER AND CONTRACTOR

* 1. Bidder has to submit with his offer the guaranteed characteristics of steel to be used, which must be in accordance with EN 10025 Standard.
  2. After the award of the contract the CONTRACTOR has to submit the following for approval.
     + Table of characteristics and dimensions of the steel sections to be used if there are changes in the construction drawings.
     + Construction drawings of any changes that may be required by IPTO (and CONTRACTOR is obliged to accept) and also the resultant difference of unit weight. These drawings are property of IPTO hereafter.
     + Detailed drawings of any proposed modifications to tower fittings. Any changes will be done under IPTO approval and without any extra charge of IPTO.

## ROUTINE TESTS AND SAMPLING

For each tower type, an assembly test of tower body and body extensions and (after IPTO'S representative request) assembly of leg extensions, will be made.

The following routine tests shall by made on every lot of tower elements for shipment, but in no way shall restrict the IPTO'S representative to request any other additional or supplementary tests.

|  |  |
| --- | --- |
| **1.** Material control : | Tension test, Elongation measurement Bending test, Shear test |
| **2.** Galvanizing tests : | Visual control, Adherence test, Uniformity of coating  test, Weight of coating test |
| **3.** Dimension control : | General dimensions control, Profile measurement,  Interchangeability control |

**4.** All tests required by EN 1090-1 and EN 1090-2 for execution class EXC3.

All the above tests shall be made on all qualities of steel and connecting material used in the manufacture of the lot to be delivered.

The number of test specimens will be sufficient to secure that the delivered lot is suitable for its intended use and is in conformity with the specifications.

## ATTACHMENTS

For bidder's information are attached

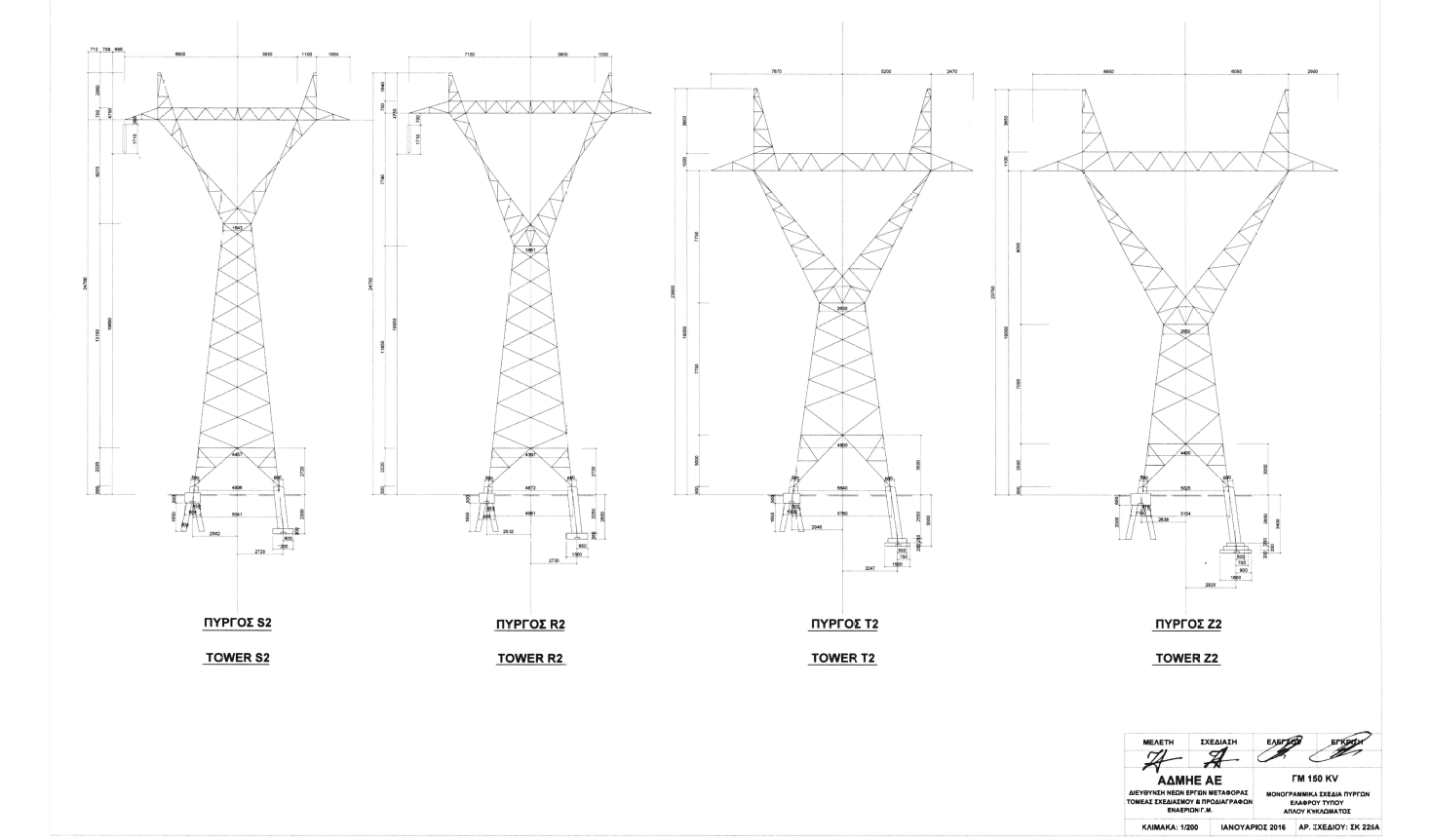
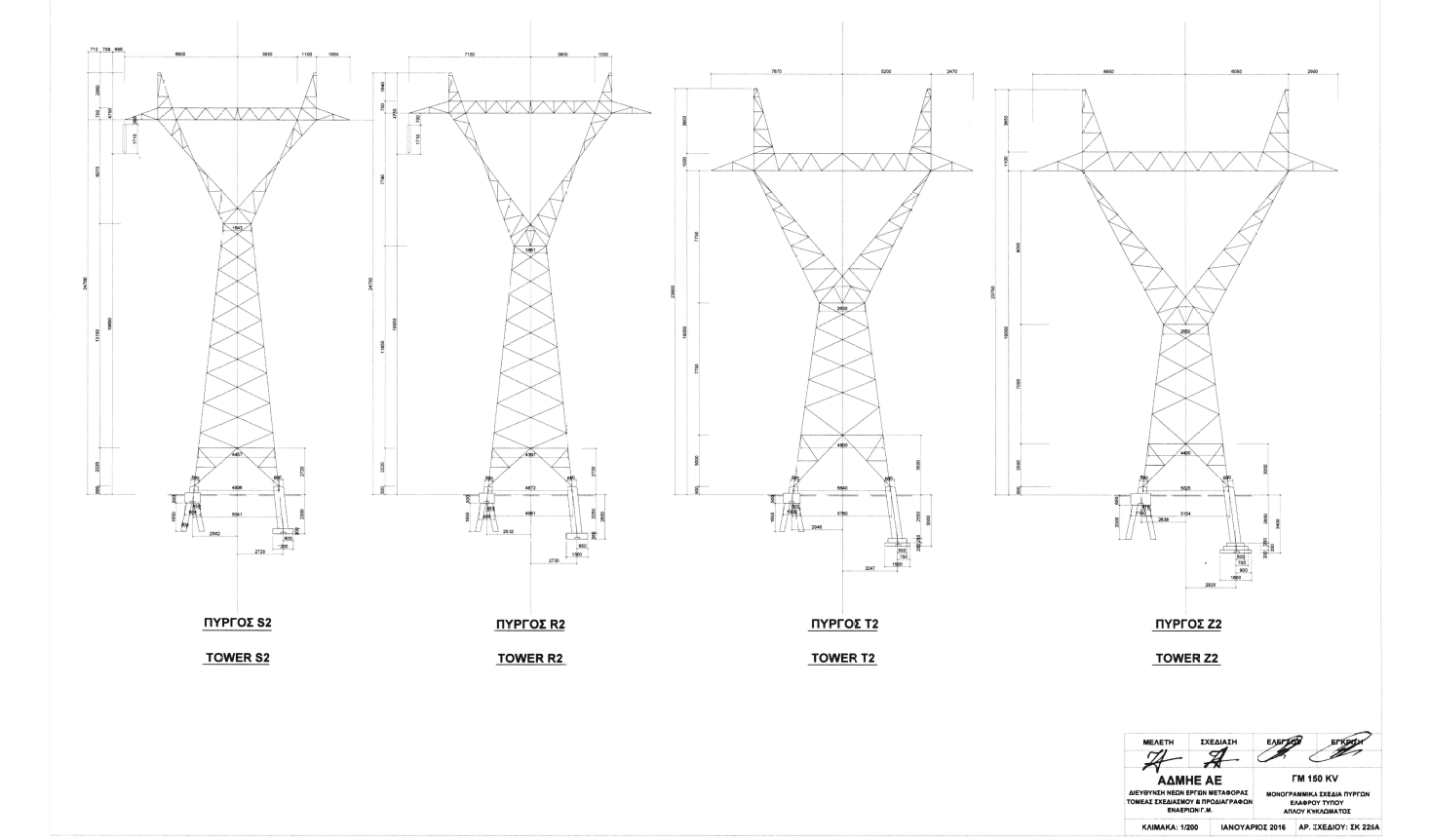
* 1. Table of unit weights of towers' parts (TΣΠΕΓM 681 Ε)
  2. Tower outlines of line categories 2, 3 and 4 (ΣΚ. 225A, ΣΚ. 251A, ΣΚ. 177A).
  3. Table of steel sections used and their geometrical characteristics (4 pages).
  4. Table of construction drawings that IPTO S.A. will give to CONTRACTOR after the award of the Contract (TΣΠΕΓM 682 Δ).

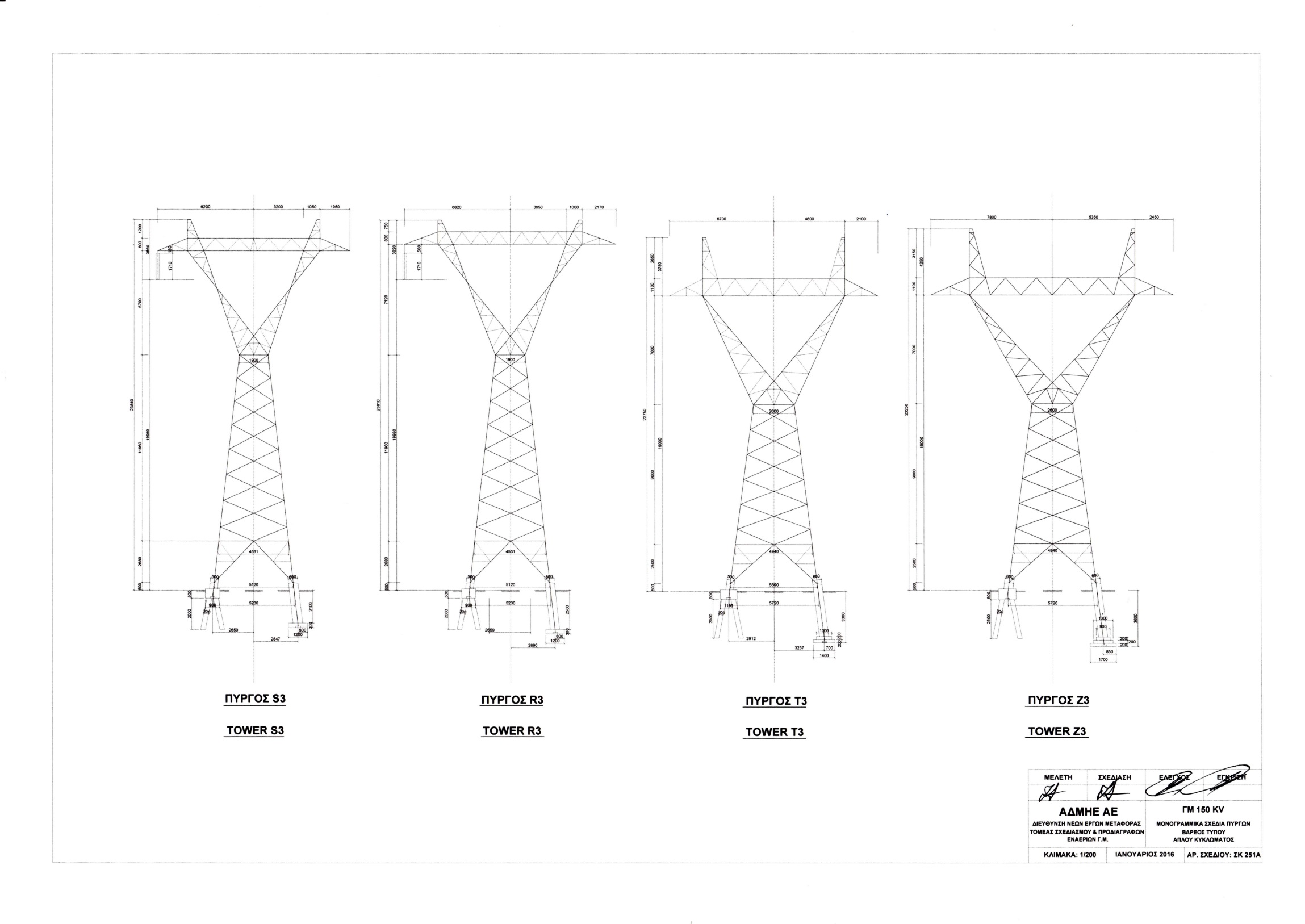


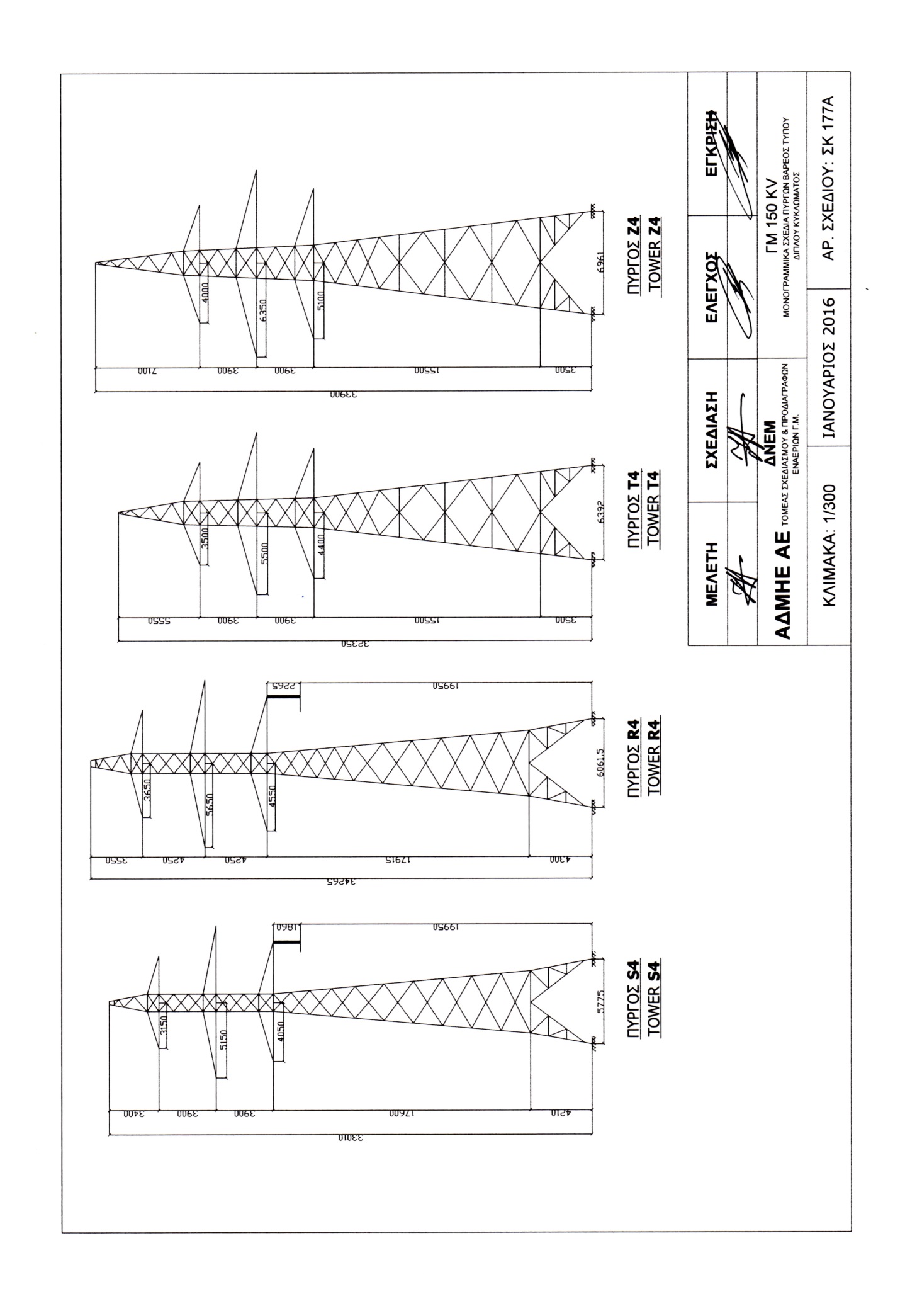
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| **IPTO S.A. / TNPD / OVERHEAD T.L. DESIGN & SPECIFICATIONS SECTION / JAN. 2016 TABLE OF WEIGHTS OF TOWER PARTS FOR 150 KV T.L.** | | | | | | | | | | | | |
| **LINE CATEGORY** | **LIGHT SINGLE CIRCUIT** | | | | **HEAVY SINGLE CIRCUIT** | | | | **HEAVY DOUBLE CIRCUIT** | | | |
| **TOWER TYPE** | **S2** | **R2** | **T2** | **Z2** | **S3** | **R3** | **T3** | **Z3** | **S4** | **R4** | **T4** | **Z4** |
| Tower body | 2277 | 2755 | 3590 | 4643 | 2675 | 3130 | 4036 | 5260 | 3234 | 4095 | 5257 | 7050 |
| Horiz. Panel for Normal Tower | 127 | 127 | 144 | 183 | 143 | 143 | 187 | 220 | 247 | 300 | 285 | 407 |
| Leg extension -1,5 for Normal Tower | 42 | 47 | 108 | 110 | 60 | 69 | 85 | 112 | 92 | 119 | 153 | 218 |
| Leg extension -1,0 for Normal Tower | 48 | 53 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Leg extension N for Normal Tower | 66 | 72 | 146 | 178 | 93 | 110 | 126 | 175 | 144 | 188 | 229 | 308 |
| Leg extension +1,5 for Normal Tower | 116 | 126 | 211 | 241 | 145 | 159 | 194 | 243 | 205 | 251 | 307 | 399 |
| Leg extension +3,0 for Normal Tower | 148 | 172 | 275 | 319 | 192 | 210 | 256 | 315 | 264 | 320 | 394 | 502 |
| Body extension +4,5 with horiz. panel | 610 | 654 | 1096 | 1222 | 797 | 900 | 1283 | 1462 | 972 | 1202 | 1613 | 2270 |
| Leg extension -1,5 for Extended Tower | 48 | 53 | 114 | 103 | 78 | 85 | 97 | 123 | 115 | 140 | 172 | 239 |
| Leg extension -1,0 for Extended Tower | 53 | 59 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Leg extension N for Extended Tower | 73 | 81 | 142 | 169 | 106 | 117 | 152 | 186 | 168 | 209 | 248 | 341 |
| Leg extension +1,5 for Extended Tower | 127 | 135 | 201 | 236 | 155 | 169 | 217 | 258 | 224 | 279 | 315 | 442 |
| Leg extension +3,0 for Extended Tower | 164 | 179 | 267 | 317 | 212 | 230 | 287 | 345 | 287 | 346 | 406 | 556 |
| Leg extension +4,5 for Extended Tower | 236 | 247 | 340 | 421 | 266 | 294 | 376 | 444 | 370 | 451 | 534 | 692 |
| Leg extension +6,0 for Extended Tower | 274 | 291 | 400 | 501 | 324 | 351 | 455 | 533 | 415 | 526 | 643 | 823 |
| Stub ext. for PAD foundation (P) | 19 | 27 | 51 | 77 | 25 | 36 | 63 | 105 | 44 | 70 | 102 | 158 |
| Stub ext. for Auger foundation (A1) | 10 | 13 | 23 | 38 | 13 | 14 | 28 | 54 | 22 | 30 | 52 | 79 |
| Stub ext. for Auger foundation (A2) | 13 | 17 | 30 | 52 | 17 | 20 | 36 | 71 | 28 | 39 | 71 | 104 |
| Stub ext. for Auger foundation (A3) | 17 | 22 | 37 | 67 | 22 | 26 | 44 | 88 | 34 | 47 | 89 | 129 |
| Stub ext. for Auger foundation (A4) | 20 | 26 | 44 | --- | 26 | 32 | 52 | --- | 39 | 56 | --- | --- |
| Stub ext. for Auger foundation (A5) | 24 | 30 | --- | --- | 30 | 38 | 59 | --- | 45 | 65 | --- | --- |

## Τ.Σ.Π.Ε.Γ.Μ 681 E

Rev. Jan. 2016

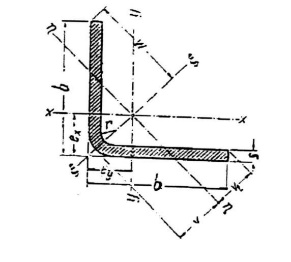






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| **PTO S.A. / TNPD / OVERHEAD T.L. DESIGN & SPECIFICATIONS SECTION**  **Sections 150 KV (Total : 4 pages)**  **L** ( EQUAL LEGS ) | | | | | | | | | | | | | | | | | | |
| Designation | Dimension | | | | Cross  section | weight | Distange of axes | | | for bending axis | | | | | | | | k |
| x-x = y-y | | | ξ-ξ | | n-n | | |
| **L** | b | d | r | r1 | F | G | e | w | v | Jx | Wx | ix | Jξ | iξ | Jn | Wn | in |
| (mm)x(mm)x(mm) | (mm) | (mm) | (mm) | (mm) | (cm2 ) | (kg/m) | (cm) | (cm) | (cm) | (cm4 ) | (cm3 ) | (cm) | (cm4 ) | (cm) | (cm4 ) | (cm3 ) | (cm) |
| 40x40x3 | 40 | 3 | 6 | 3 | 2,35 | 1,84 | 1,07 | 2,83 | 1,52 | 3,45 | 1,18 | 1,21 | 5,45 | 1,52 | 1,44 | 0,95 | 0,78 | 3,84 |
| 45x45x4 | 45 | 4 | 7 | 3,5 | 3,49 | 2,74 | 1,23 | 3,18 | 1,75 | 6,43 | 1,97 | 1,36 | 10,20 | 1,71 | 2,68 | 1,53 | 0,88 | 4,54 |
| 50x50x4 | 50 | 4 | 7 | 3,5 | 3,89 | 3,06 | 1,36 | 3,54 | 1,92 | 8,97 | 2,46 | 1,52 | 14,20 | 1,91 | 3,73 | 1,94 | 0,98 | 4,06 |
| 55x55x4 | 55 | 4 | 8 | 4 | 4,31 | 3,38 | 1,47 | 3,89 | 2,08 | 12,00 | 2,98 | 1,67 | 19,00 | 2,10 | 5,01 | 2,41 | 1,08 | 3,71 |
| 55x55x9 | 55 | 9 | 8 | 4 | 9,16 | 7,19 | 1,68 | 3,89 | 2,38 | 24,20 | 6,35 | 1,63 | 38,20 | 2,04 | 10,30 | 4,33 | 1,06 | 1,15 |
| 60x60x4 | 60 | 4 | 8 | 4 | 4,71 | 3,70 | 1,60 | 4,24 | 2,26 | 15,80 | 3,58 | 1,83 | 24,90 | 2,30 | 6,61 | 2,93 | 1,19 | 3,35 |
| 60x60x9 | 60 | 9 | 8 | 4 | 10,10 | 7,90 | 1,81 | 4,24 | 2,56 | 32,10 | 7,66 | 1,79 | 50,70 | 2,25 | 13,50 | 5,27 | 1,16 | 7,56 |
| 65x65x6 | 65 | 6 | 9 | 4,5 | 7,53 | 5,91 | 1,80 | 4,60 | 2,55 | 29,20 | 6,21 | 1,97 | 46,30 | 2,48 | 12,10 | 4,74 | 1,27 | 4,69 |
| 65x65x10 | 65 | 10 | 9 | 4,5 | 12,10 | 9,49 | 1,97 | 4,60 | 2,78 | 45,10 | 9,94 | 1,93 | 71,20 | 2,43 | 19,00 | 6,82 | 1,25 | 7,71 |
| 70x70x5 | 70 | 5 | 9 | 4,5 | 6,84 | 5,37 | 1,88 | 4,95 | 2,66 | 31,20 | 6,10 | 2,14 | 49,50 | 2,69 | 13,00 | 4,87 | 1,38 | 3,60 |
| 70x70x6 | 70 | 6 | 9 | 4,5 | 8,13 | 6,38 | 1,93 | 4,95 | 2,73 | 36,90 | 7,27 | 2,13 | 58,50 | 2,68 | 15,30 | 5,60 | 1,37 | 4,32 |
| 70x70x10 | 70 | 10 | 9 | 4,5 | 13,10 | 10,30 | 2,09 | 4,95 | 2.96 | 57,20 | 11,70 | 2,09 | 90,50 | 2,63 | 24,00 | 8,10 | 1,35 | 7,15 |
| 75x75x5 | 75 | 5 | 10 | 5 | 7,36 | 5,78 | 1,99 | 5,30 | 2,81 | 38,50 | 6,99 | 2,29 | 61,00 | 2,88 | 16,10 | 5,55 | 1,48 | 3,37 |
| 75x75x6 | 75 | 6 | 10 | 5 | 8,75 | 6,87 | 2,04 | 5,30 | 2,89 | 45,60 | 8,35 | 2,28 | 72,20 | 2,87 | 18,90 | 6,54 | 1,47 | 4,05 |
| 80x80x6 | 80 | 6 | 10 | 5 | 9,22 | 7,34 | 2,22 | 5,66 | 3,15 | 57,30 | 9,92 | 2,48 | 91,40 | 3,15 | 23,10 | 7,32 | 1,59 | 3,68 |
| 80x80x7 | 80 | 7 | 10 | 5 | 10,80 | 8,49 | 2,21 | 5,66 | 3,13 | 64,20 | 11,10 | 2,44 | 102,00 | 3,07 | 26,50 | 8,48 | 1,57 | 4,40 |
| 90x90x6 | 90 | 6 | 11 | 5,5 | 10,60 | 8,30 | 2,41 | 6,36 | 3,41 | 80,30 | 12,20 | 2,76 | 127,00 | 3,47 | 33,30 | 9,80 | 1,78 | 3,35 |
| 90x90x7 | 90 | 7 | 11 | 5,5 | 12,20 | 9,60 | 2,45 | 6,36 | 3,46 | 92,40 | 14,10 | 2,75 | 147,00 | 3,46 | 38,20 | 11,00 | 1,77 | 3,92 |
| 90x90x8 | 90 | 8 | 11 | 5,5 | 13,90 | 10.9 | 2,50 | 6,36 | 3,53 | 104,00 | 16,10 | 2,74 | 165,00 | 3,45 | 43,50 | 12,30 | 1,77 | 4,44 |
| 90x90x14 | 90 | 14 | 11 | 5,5 | 23,20 | 18,30 | 2,76 | 6,36 | 3,90 | 171,00 | 27,40 | 2,71 | 269,00 | 3,40 | 71,50 | 18,30 | 1,75 | 7,53 |
| 100x100x7 | 100 | 7 | 12 | 6 | 13,70 | 10,70 | 2,67 | 7,07 | 3,77 | 128,00 | 17,50 | 3,06 | 203,00 | 3,86 | 53,10 | 14,10 | 1,97 | 3,52 |
| 100x100x8 | 100 | 8 | 12 | 6 | 15,50 | 12,20 | 2,74 | 7,07 | 3,87 | 145,00 | 19,90 | 3,06 | 230,00 | 3,85 | 59,90 | 15,50 | 1,96 | 4,01 |
| 100x100x9 | 100 | 9 | 12 | 6 | 17,30 | 13,60 | 2,78 | 7,07 | 3,93 | 161,00 | 22,30 | 3,05 | 255,00 | 3,84 | 66,50 | 16,90 | 1,96 | 4,50 |
| 110x110x9 | 110 | 9 | 12 | 6 | 19,00 | 15,10 | 3,08 | 7,78 | 4,35 | 221,00 | 27,90 | 3,45 | 359,00 | 4,35 | 96,10 | 22,10 | 2,20 | 3,76 |
| 110x110x13 | 110 | 13 | 12 | 6 | 26,90 | 21,30 | 3,22 | 7,78 | 4,56 | 312,00 | 40,00 | 3,35 | 491,00 | 4,27 | 133,00 | 29,20 | 2,20 | 5,44 |
| 120x120x8 | 120 | 8 | 13 | 6,5 | 18,70 | 14,70 | 3,23 | 8,49 | 4,57 | 255,00 | 29,10 | 3,69 | 405,00 | 4,65 | 105,00 | 23,10 | 2,37 | 3,40 |
| 120x120x9 | 120 | 9 | 13 | 6,5 | 21,00 | 16,50 | 3,27 | 8,49 | 4,63 | 285,00 | 32,60 | 3,68 | 452,00 | 4,64 | 117,00 | 25,40 | 2,36 | 3,75 |
| 120x120x10 | 120 | 10 | 13 | 6,5 | 23,20 | 18,20 | 3,31 | 8,49 | 4,69 | 313,00 | 36,00 | 3,67 | 497,00 | 4,63 | 129,00 | 27,50 | 2,36 | 4,17 |
| 130x130x8 | 130 | 8 | 14 | 7 | 20,40 | 16,00 | 3,46 | 9,19 | 4,90 | 327,00 | 34,30 | 4,00 | 518,00 | 5,04 | 135,00 | 27,60 | 2,58 | 3,07 |
| 130x130x9 | 130 | 9 | 14 | 7 | 22,80 | 17,90 | 3,51 | 9,19 | 4,96 | 364,00 | 38,40 | 4,00 | 578,00 | 5,04 | 150,00 | 30,30 | 2,57 | 3,46 |
| 130x130x10 | 130 | 10 | 14 | 7 | 25,20 | 19,80 | 3,55 | 9,19 | 5,03 | 401,00 | 42,50 | 3,99 | 637,00 | 5,03 | 165,00 | 32,90 | 2,56 | 3,85 |
| 130x130x11 | 130 | 11 | 14 | 7 | 27,60 | 21,70 | 3,60 | 9,19 | 5,09 | 437,00 | 46,50 | 3,98 | 694,00 | 5,01 | 180,00 | 35,40 | 2,55 | 4,23 |
| 130x130x13 | 130 | 13 | 14 | 7 | 32,30 | 25,40 | 3,68 | 9,19 | 5,20 | 506,00 | 54,30 | 3,96 | 806,00 | 4,99 | 209,00 | 40,00 | 2,54 | 4,99 |
| 140x140x9 | 140 | 9 | 15 | 7,5 | 24,60 | 19,30 | 3,75 | 9,90 | 5,30 | 458,00 | 44,70 | 4,31 | 726,00 | 5,43 | 189,00 | 35,70 | 2,77 | 3,21 |
| 140x140x10 | 140 | 10 | 15 | 7,5 | 27,20 | 21,40 | 3,79 | 9,90 | 5,36 | 504,00 | 49,40 | 4,30 | 801,00 | 5,42 | 208,00 | 38,70 | 2,76 | 3,57 |
| 140x140x11 | 140 | 11 | 15 | 7,5 | 29,80 | 23,40 | 3,84 | 9,90 | 5,43 | 550,00 | 54,10 | 4,29 | 874,00 | 5,41 | 227,00 | 41,70 | 2,76 | 3,93 |
| 140x140x12 | 140 | 12 | 15 | 7,5 | 32,50 | 25,50 | 3,85 | 9,90 | 5,44 | 599,00 | 59,00 | 4,29 | 925,00 | 5,32 | 252,00 | 46,30 | 2,78 | 4,19 |

**Page 1 of 4**

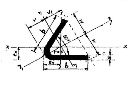


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| **IPTO S.A. / TNPD / OVERHEAD T.L. DESIGN & SPECIFICATIONS SECTION**  **KL** ( EQUAL LEGS ) | | | | | | | | | | | | | | | | | | | | |
| Designation | (mm) | Dimension | | | Cross  section | Weight | Distance of axes | | | | for the bending axis | | | | | | | | | |
| x-x | | | ξ-ξ | | | n-n | | | Jxy |
| KL | b | s | r | F | G | ex=ey | w | v | v1 | Jx | Wx (min) | ix | Jξ | Wξ (min) | iξ | Jn | Wn (min) | in |
| (mm)x(mm)x(mm) | (mm) | (mm) | (mm) | (cm2) | (kg/m) | (cm) | (cm) | (cm) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) |
| 35x35x3 | 65 | 35 | 3 | 3 | 1,95 | 1,53 | 1,01 | 2,48 | 1,18 | 1,25 | 2,32 | 0,93 | 1,09 | 3,77 | 1,52 | 1,39 | 0,85 | 0,68 | 0,66 | 1,53 |
| 38x38x3 | 70 | 38 | 3 | 3 | 2,10 | 1,65 | 1,07 | 2,65 | 1,27 | 1,34 | 2,87 | 1,07 | 1,17 | 4,66 | 1,76 | 1,49 | 1,07 | 0,80 | 0,71 | 1,83 |
| 40x40x3 | 75 | 40 | 3 | 3 | 2,26 | 1,77 | 1,14 | 2,83 | 1,36 | 1,43 | 3,51 | 1,23 | 1,25 | 5,69 | 2,01 | 1,59 | 1,31 | 0,92 | 0,76 | 2,20 |
| 43x43x3 | 80 | 43 | 3 | 3 | 2,40 | 1,88 | 1,20 | 3,00 | 1,45 | 1,52 | 4,24 | 1,39 | 1,33 | 6,88 | 2,29 | 1,69 | 1,60 | 1,05 | 0,82 | 2,64 |
| 45x45x3 | 85 | 45 | 3 | 3 | 2,55 | 2,00 | 1,26 | 3,18 | 1,54 | 1,61 | 5,07 | 1,57 | 1,41 | 8,22 | 2,58 | 1,80 | 1,91 | 1,19 | 0,87 | 3,15 |
| 48x48x3 | 90 | 48 | 3 | 3 | 2,70 | 2,12 | 1,32 | 3,36 | 1,62 | 1,70 | 6,00 | 1,75 | 1,49 | 9,72 | 2,90 | 1,90 | 2,27 | 1,34 | 0,92 | 3,72 |
| 50x50x3 | 95 | 50 | 3 | 3 | 2,85 | 2,24 | 1,39 | 3,53 | 1,71 | 1,78 | 7,03 | 1,95 | 1,57 | 11,40 | 3,22 | 2,00 | 2,67 | 1,50 | 0,97 | 4,36 |
| 53x53x3 | 100 | 53 | 3 | 3 | 3,00 | 2,36 | 1,45 | 3,71 | 1,80 | 1,87 | 8,18 | 2,16 | 1,65 | 13,20 | 3,57 | 2,10 | 3,12 | 1,67 | 1,02 | 5,06 |
| 55x55x3 | 105 | 55 | 3 | 3 | 3,15 | 2,47 | 1,51 | 3,89 | 1,89 | 1,96 | 9,45 | 2,37 | 1,73 | 15,30 | 3,93 | 2,20 | 3,61 | 1,84 | 1,07 | 5,84 |
| 58x58x3 | 110 | 58 | 3 | 3 | 3,30 | 2,59 | 1,57 | 4,06 | 1,98 | 2,05 | 10,80 | 2,60 | 1,81 | 17,50 | 4,31 | 2,31 | 4,15 | 2,03 | 1,12 | 6,69 |
| 60x60x3 | 115 | 60 | 3 | 3 | 3,45 | 2,71 | 1,64 | 4,24 | 2,07 | 2,14 | 12,40 | 2,84 | 1,89 | 20,00 | 4,72 | 2,41 | 4,75 | 2,22 | 1,17 | 7,62 |
|  | | | | | | | | | | | | | | | | | | | | |
| 36x36x4 | 65 | 36 | 4 | 4 | 2,60 | 2,04 | 1,08 | 2,53 | 1,19 | 1,29 | 3,15 | 1,26 | 1,10 | 5,15 | 2,03 | 1,41 | 1,16 | 0,90 | 0,67 | 1,99 |
| 38x38x4 | 70 | 38 | 4 | 4 | 2,80 | 2,20 | 1,14 | 2,71 | 1,28 | 1,38 | 3,90 | 1,45 | 1,18 | 6,38 | 2,36 | 1,51 | 1,44 | 1,05 | 0,75 | 2,47 |
| 41x41x4 | 75 | 41 | 4 | 4 | 3,00 | 2,36 | 1,20 | 2,88 | 1,37 | 1,46 | 4,78 | 1,66 | 1,26 | 7,29 | 2,70 | 1,61 | 1,87 | 1,21 | 0,77 | 3,01 |
| 42x42x4 | 77 | 42 | 4 | 4 | 3,08 | 2,42 | 1,23 | 2,95 | 1,41 | 1,50 | 5,16 | 1,75 | 1,29 | 8,41 | 2,84 | 1,65 | 1,92 | 1,28 | 0,79 | 3,24 |
| 43x43x4 | 80 | 43 | 4 | 4 | 3,20 | 2,51 | 1,27 | 3,06 | 1,46 | 1,55 | 5,77 | 1,88 | 1,34 | 9,39 | 3,07 | 1,71 | 2,15 | 1,38 | 0,82 | 3,72 |
| 46x46x4 | 85 | 46 | 4 | 4 | 3,40 | 2,67 | 1,33 | 3,24 | 1,55 | 1,64 | 6,89 | 2,12 | 1,42 | 11,20 | 3,46 | 1,82 | 2,57 | 1,57 | 0,87 | 4,32 |
| 48x48x4 | 90 | 48 | 4 | 4 | 3,60 | 2,83 | 1,39 | 3,41 | 1,64 | 1,73 | 8,14 | 2,37 | 1,50 | 13,20 | 3,88 | 1,92 | 3,05 | 1,76 | 0,92 | 5,09 |
| 51x51x4 | 95 | 51 | 4 | 4 | 3,80 | 2,98 | 1,45 | 3,59 | 1,72 | 1,82 | 9,54 | 2,63 | 1,58 | 15,50 | 4,32 | 2,02 | 3,54 | 1,97 | 0,97 | 5,95 |
| 53x53x4 | 100 | 53 | 4 | 4 | 4,00 | 3,14 | 1,52 | 3,77 | 1,81 | 1,41 | 11,10 | 2,91 | 1,67 | 18,00 | 4,78 | 2,12 | 4,18 | 2,19 | 1,02 | 6,91 |
| 56x56x4 | 105 | 56 | 4 | 4 | 4,20 | 3,30 | 1,58 | 3,94 | 1,90 | 2,00 | 12,80 | 3,20 | 1,75 | 20,80 | 5,26 | 2,22 | 4,84 | 2,43 | 1,07 | 7,96 |
| 58x58x4 | 110 | 58 | 4 | 4 | 4,40 | 3,45 | 1,64 | 4,12 | 1,99 | 2,08 | 14,70 | 3,50 | 1,83 | 23,80 | 5,77 | 2,33 | 5,56 | 2,67 | 1,13 | 9,12 |
| 61x61x4 | 115 | 61 | 4 | 4 | 4,60 | 3,61 | 1,70 | 4,30 | 2,08 | 2,17 | 16,70 | 3,82 | 1,91 | 27,10 | 6,31 | 2,43 | 6,35 | 2,92 | 1,18 | 10,40 |
| 63x63x4 | 120 | 63 | 4 | 4 | 4,80 | 3,77 | 1,77 | 4,47 | 2,17 | 2,26 | 19,00 | 4,16 | 1,99 | 30,70 | 6,86 | 2,53 | 7,21 | 3,19 | 1,23 | 11,80 |
| 66x66x4 | 125 | 66 | 4 | 4 | 5,00 | 3,93 | 1,83 | 4,65 | 2,25 | 2,35 | 21,40 | 4,50 | 2,07 | 34,60 | 7,44 | 2,63 | 8,15 | 3,47 | 1,28 | 13,20 |
| 68x68x4 | 130 | 68 | 4 | 4 | 5,20 | 4,08 | 1,89 | 4,83 | 2,34 | 2,44 | 24,00 | 4,86 | 2,15 | 38,90 | 8,05 | 2,73 | 9,17 | 3,76 | 1,33 | 14,80 |
| 71x71x4 | 135 | 71 | 4 | 4 | 5,40 | 4,24 | 1,95 | 5,00 | 2,43 | 2,53 | 26,80 | 5,24 | 2,23 | 43,40 | 8,68 | 2,84 | 10,30 | 4,04 | 1,38 | 16,60 |
| 73x73x4 | 140 | 73 | 4 | 4 | 5,60 | 4,40 | 2,02 | 5,18 | 2,52 | 2,61 | 29,90 | 5,63 | 2,31 | 48,30 | 9,33 | 2,94 | 11,40 | 4,38 | 1,43 | 18,40 |
| 76x76x4 | 145 | 76 | 4 | 4 | 5,80 | 4,55 | 2,08 | 5,36 | 2,61 | 2,70 | 33,20 | 6,03 | 2,39 | 53,60 | 10,00 | 3,04 | 12,70 | 4,71 | 1,48 | 20,40 |
| 78x78x4 | 150 | 78 | 4 | 4 | 6,00 | 4,71 | 2,14 | 5,54 | 2,70 | 2,79 | 36,70 | 6,44 | 2,47 | 59,20 | 10,90 | 3,14 | 14,10 | 5,04 | 1,53 | 22,60 |
| 81x81x4 | 155 | 81 | 4 | 4 | 6,20 | 4,87 | 2,20 | 5,71 | 2,78 | 2,88 | 40,40 | 6,87 | 2,55 | 65,20 | 11,40 | 3,24 | 15,50 | 5,39 | 1,58 | 24,90 |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IPTO S.A. / TNPD / OVERHEAD T.L. DESIGN & SPECIFICATIONS SECTION**  **KL** (UNEQUAL LEGS) | | | | | | | | | | | | | | | | | | | | | | | | |
| Designation |  | Dimension | | | | Cross  Section | Weight | Distance of axes | | | | tg a | for the bending axis | | | | | | | | | | | |
| x-x | | | y-y | | | ξ-ξ | | | n-n | | |
| **KL** | a | b | s | r | F | G | ex | ey | v | w | Jx | Wx (min) | ix | Jy | Wy (min) | iy | Jξ | Wξ (min) | iξ | Jn | Wn (min) | in |
| (mm)x(mm)x(mm) | (mm) | (mm) | (mm) | (mm) | (mm) | (cm2) | (kg/m) | (cm) | (cm) | (cm) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) |
| 46x35x4 |  | 35 | 46 | 4 | 4 | 2,98 | 2,34 | 1,50 | 0,93 | 1,65 | 3,14 | 0,592 | 6,33 | 2,04 | 1,46 | 3,21 | 1,25 | 1,04 | 8,01 | 2,55 | 1,64 | 1,53 | 0,93 | 0,72 |
| 46x36x4 |  | 36 | 46 | 4 | 4 | 3,02 | 2,37 | 1,49 | 0,97 | 1,66 | 3,16 | 0,624 | 6,39 | 2,05 | 1,46 | 3,48 | 1,32 | 1,07 | 8,25 | 2,61 | 1,65 | 1,63 | 0,98 | 0,74 |
| 52x35x4 | 80 | 34,6 | 51,9 | 4 | 4 | 3,20 | 2,51 | 1,76 | 0,87 | 1,78 | 3,49 | 0,465 | 8,84 | 2,57 | 1,66 | 3,24 | 1,25 | 1,01 | 10,40 | 2,99 | 1,80 | 1,69 | 0,95 | 0,73 |
| 55x37x4 | 85 | 36,6 | 54,9 | 4 | 4 | 3,40 | 2,67 | 1,85 | 0,91 | 1,89 | 3,69 | 0,465 | 10,50 | 2,89 | 1,76 | 3,87 | 1,40 | 1,07 | 12,40 | 3,36 | 1,91 | 2,02 | 1,07 | 0,77 |
| 58x39x4 | 90 | 38,6 | 57,9 | 4 | 4 | 3,60 | 2,83 | 1,94 | 0,95 | 2,00 | 3,89 | 0,465 | 12,50 | 3,23 | 1,86 | 4,58 | 1,57 | 1,13 | 14,60 | 3,76 | 2,02 | 2,40 | 1,20 | 0,82 |
| 61x41x4 | 95 | 40,6 | 60,9 | 4 | 4 | 3,80 | 2,98 | 2,03 | 0,99 | 2,10 | 4,10 | 0,464 | 14,60 | 3,59 | 1,96 | 5,37 | 1,74 | 1,19 | 17,10 | 4,18 | 2,12 | 2,83 | 1,34 | 0,86 |
| 64x43x4 | 100 | 42,6 | 63,9 | 4 | 4 | 4,00 | 3,14 | 2,12 | 1,03 | 2,21 | 4,31 | 0,464 | 17,00 | 3,97 | 2,06 | 6,24 | 1,93 | 1,25 | 19,90 | 4,52 | 2,23 | 3,30 | 1,49 | 0,91 |
| 67x45x4 | 105 | 44,6 | 66,9 | 4 | 4 | 4,20 | 3,30 | 2,21 | 1,07 | 2,32 | 4,52 | 0,464 | 19,60 | 4,37 | 2,16 | 7,21 | 2,12 | 1,31 | 23,00 | 5,09 | 2,34 | 3,82 | 1,65 | 0,95 |
| 70x47x4 | 110 | 46,6 | 69,9 | 4 | 4 | 4,40 | 3,45 | 2,30 | 1,11 | 2,43 | 4,73 | 0,463 | 22,50 | 4,78 | 2,26 | 8,27 | 2,33 | 1,37 | 26,30 | 5,57 | 2,45 | 4,39 | 1,81 | 1,00 |
| 73x49x4 | 115 | 48,6 | 72,9 | 4 | 4 | 4,60 | 3,61 | 2,39 | 1,15 | 2,54 | 4,93 | 0,463 | 25,60 | 5,22 | 2,36 | 9,44 | 2,54 | 1,43 | 30,00 | 6,08 | 2,55 | 5,02 | 1,98 | 1,04 |
| 76x51x4 | 120 | 50,6 | 76,9 | 4 | 4 | 4,80 | 3,77 | 2,48 | 1,19 | 2,64 | 5,14 | 0,463 | 29,00 | 5,69 | 2,46 | 10,70 | 2,76 | 1,49 | 34,00 | 6,61 | 2,66 | 6,71 | 2,16 | 1,09 |
| 79x53x4 | 125 | 52,6 | 78,9 | 4 | 4 | 5,00 | 3,93 | 2,57 | 1,23 | 2,75 | 5,35 | 0,463 | 32,70 | 6,14 | 2,56 | 12,10 | 2,99 | 1,56 | 38,30 | 7,17 | 2,77 | 6,45 | 2,35 | 1,14 |
| 82x55x4 | 130 | 54,6 | 81,9 | 4 | 4 | 5,20 | 4,08 | 2,66 | 1,27 | 2,86 | 5,56 | 0,463 | 36,70 | 6,63 | 2,66 | 13,60 | 3,23 | 1,62 | 43,00 | 7,74 | 2,88 | 7,26 | 2,54 | 1,18 |
|  | | | | | | | | | | | | | | | | | | | | | | | | |
| 47x37x5 |  | 37 | 47 | 5 | 5 | 3,78 | 2,97 | 1,56 | 1,04 | 1,68 | 3,21 | 0,633 | 8,23 | 2,62 | 1,47 | 4,54 | 1,70 | 1,09 | 10,70 | 3,33 | 1,68 | 2,07 | 1,23 | 0,74 |
| 57x37x5 |  | 37 | 57 | 5 | 5 | 4,29 | 3,37 | 1,98 | 0,95 | 1,91 | 3,78 | 0,445 | 14,13 | 3,80 | 1,81 | 4,82 | 1,75 | 1,06 | 16,42 | 4,35 | 1,96 | 2,52 | 1,32 | 0,77 |
| 57x47x5 |  | 47 | 57 | 5 | 5 | 4,79 | 3,76 | 1,80 | 1,29 | 2,07 | 3,94 | 0,688 | 15,48 | 3,97 | 1,80 | 9,61 | 2,81 | 1,42 | 20,78 | 5,27 | 2,08 | 4,31 | 2,08 | 0,95 |
|  | | | | | | | | | | | | | | | | | | | | | | | | |
| 57x37x6 |  | 37 | 57 | 6 | 6 | 5,05 | 3,96 | 2,04 | 0,99 | 1,89 | 3,75 | 0,447 | 16,34 | 4,46 | 1,80 | 5,55 | 2,05 | 1,05 | 19,03 | 5,08 | 1,94 | 2,86 | 1,51 | 0,75 |
| 57x47x6 |  | 47 | 57 | 6 | 6 | 5,65 | 4,43 | 1,85 | 1,33 | 2,06 | 3,92 | 0,690 | 17,97 | 4,67 | 1,78 | 11,13 | 3,30 | 1,40 | 24,19 | 6,17 | 2,07 | 4,91 | 2,38 | 0,93 |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IPTO S.A. / TNPD / OVERHEAD T.L. DESIGN & SPECIFICATIONS SECTION**  **K<** | | | | | | | | | | | | | | | | | | | | | | | | |
| Designation |  | Dimension | | | Cross  section | Weight | Distance of axes | | | | | for the bending axis | | | | | | | | | | | | |
| x-x | | | y-y | | | ξ-ξ | | | n-n | | | x-y |
| **K<** | b | s | r | F | G | ex | ey | w | v | v1 | Jx | Wx (min) | ix | Jy | Wy (min) | iy | Jξ | Wξ | iξ | Jn | Wn (min) | in | Jxy |
| (mm)x(mm)x(mm) | (mm) | (mm) | (mm) | (mm) | (cm2 ) | kg/m | (cm) | (cm) | (cm) | (cm) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) | (cm3) | (cm) | (cm4) |
| 34X34X3 | 65 | 33,8 | 3 | 3 | 1,95 | 1,53 | 0,99 | 1,28 | 1,91 | 1,37 | 1,47 | 2,00 | 0,85 | 1,01 | 1,53 | 0,72 | 0,88 | 2,25 | 1,17 | 1,08 | 1,25 | 0,85 | 0,80 | 0,44 |
| 36X36X3 | 70 | 36,8 | 3 | 3 | 2,10 | 1,65 | 1,05 | 1,37 | 2,03 | 1,48 | 1,58 | 2,46 | 0,99 | 1,08 | 1,88 | 0,83 | 0,95 | 2,77 | 1,35 | 1,15 | 1,58 | 0,99 | 0,87 | 0,52 |
| 39X39X3 | 75 | 38,8 | 3 | 3 | 2,25 | 1,77 | 1,10 | 1,46 | 2,16 | 1,59 | 1,69 | 2,98 | 1,13 | 1,15 | 2,31 | 0,95 | 1,01 | 3,35 | 1,55 | 1,22 | 1,95 | 1,15 | 0,93 | 0,61 |
| 41X41X3 | 80 | 41,3 | 3 | 3 | 2,40 | 1,88 | 1,15 | 1,56 | 2,28 | 1,70 | 1,80 | 3,59 | 1,28 | 1,22 | 2,78 | 1,08 | 1,08 | 4,00 | 1,75 | 1,29 | 2,37 | 1,31 | 0,99 | 0,71 |
| 44X44X3 | 85 | 43,8 | 3 | 3 | 2,55 | 2,00 | 1,21 | 1,65 | 2,41 | 1,81 | 1,91 | 4,27 | 1,44 | 1,29 | 3,32 | 1,22 | 1,14 | 4,74 | 1,97 | 1,36 | 2,84 | 1,49 | 1,06 | 0,82 |
| 46X46X3 | 90 | 46,3 | 3 | 3 | 2,70 | 2,12 | 1,26 | 1,74 | 2,53 | 1,92 | 2,02 | 5,02 | 1,60 | 1,36 | 3,93 | 1,36 | 1,21 | 5,57 | 2,20 | 1,44 | 3,38 | 1,67 | 1,12 | 0,95 |
| 49X49X3 | 95 | 48,8 | 3 | 3 | 2,85 | 2,24 | 1,31 | 1,84 | 2,66 | 2,03 | 2,13 | 5,85 | 1,78 | 1,43 | 4,60 | 1,51 | 1,27 | 6,48 | 2,44 | 1,51 | 3,98 | 1,87 | 1,18 | 1,08 |
| 51X51X3 | 100 | 51,3 | 3 | 3 | 3,00 | 2,36 | 1,37 | 1,93 | 2,78 | 2,14 | 2,24 | 6,78 | 1,96 | 1,50 | 5,35 | 1,67 | 1,34 | 7,49 | 2,69 | 1,58 | 4,64 | 2,08 | 1,24 | 1,23 |
| 54X54X3 | 105 | 53,8 | 3 | 3 | 3,15 | 2,47 | 1,42 | 2,02 | 2,91 | 2,24 | 2,34 | 7,79 | 2,15 | 1,57 | 6,18 | 1,84 | 1,40 | 8,60 | 2,96 | 1,65 | 5,38 | 2,30 | 1,31 | 1,39 |
| 56X56X3 | 110 | 56,3 | 3 | 3 | 3,30 | 2,59 | 1,48 | 2,12 | 3,03 | 2,35 | 2,45 | 8,90 | 2,36 | 1,64 | 7,09 | 2,02 | 1,47 | 9,81 | 3,23 | 1,72 | 6,19 | 2,52 | 1,37 | 1,57 |
| 59X59X3 | 115 | 59,0 | 3 | 3 | 3,46 | 2,72 | 1,53 | 2,22 | 3,17 | 2,47 | 2,57 | 10,23 | 2,59 | 1,72 | 8,18 | 2,22 | 1,54 | 11,25 | 3,55 | 1,80 | 7,16 | 2,78 | 1,44 |  |
|  | | | | | | | | | | | | | | | | | | | | | | | | |
| 34X34X4 | 65 | 34,2 | 4 | 4 | 2,60 | 2,04 | 1,09 | 1,30 | 2,00 | 1,37 | 1,50 | 2,90 | 1,20 | 1,06 | 2,07 | 0,93 | 0,89 | 3,28 | 1,84 | 0,92 | 1,56 | 1,11 | 0,80 | 0,68 |
| 37X37X4 | 70 | 36,7 | 4 | 4 | 2,80 | 2,20 | 1,14 | 1,39 | 2,13 | 1,48 | 1,61 | 3,54 | 1,38 | 1,12 | 2,57 | 1,10 | 0,96 | 3,98 | 1,87 | 1,10 | 2,07 | 1,29 | 0,86 | 0,82 |
| 39X39X4 | 75 | 39,2 | 4 | 4 | 3,00 | 2,36 | 1,19 | 1,48 | 2,25 | 1,59 | 1,71 | 4,25 | 1,57 | 1,19 | 3,16 | 1,27 | 1,03 | 4,77 | 2,12 | 1,26 | 2,56 | 1,50 | 0,93 | 0,97 |
| 42X42X4 | 80 | 41,7 | 4 | 4 | 3,20 | 2,51 | 1,25 | 1,58 | 2,38 | 1,70 | 1,82 | 5,08 | 1,77 | 1,26 | 3,77 | 1,45 | 1,09 | 5,73 | 2,41 | 1,34 | 3,12 | 1,71 | 0,99 | 1,13 |
| 44X44X4 | 85 | 44,2 | 4 | 4 | 3,40 | 2,67 | 1,30 | 1,67 | 2,50 | 1,80 | 1,93 | 6,01 | 1,98 | 1,33 | 4,51 | 1,64 | 1,15 | 6,76 | 2,70 | 1,41 | 3,75 | 1,94 | 1,05 | 1,30 |
| 47X47X4 | 90 | 46,7 | 4 | 4 | 3,60 | 2,83 | 1,36 | 1,76 | 2,63 | 1,91 | 2,04 | 7,05 | 2,21 | 1,40 | 5,33 | 1,83 | 1,22 | 7,91 | 3,01 | 1,48 | 4,47 | 2,19 | 1,11 | 1,49 |
| 49X49X4 | 95 | 49,2 | 4 | 4 | 3,80 | 2,98 | 1,41 | 1,86 | 2,75 | 2,08 | 2,15 | 8,20 | 2,44 | 1,47 | 6,24 | 2,04 | 1,28 | 9,18 | 3,33 | 1,55 | 5,26 | 2,45 | 1,18 | 1,70 |
| 52X52X4 | 100 | 51,7 | 4 | 4 | 4,00 | 3,14 | 1,46 | 1,95 | 2,88 | 2,13 | 2,25 | 9,47 | 2,69 | 1,54 | 7,26 | 2,25 | 1,35 | 10,60 | 3,68 | 1,63 | 6,15 | 2,72 | 1,24 | 1,92 |
| 54X54X4 | 105 | 54,2 | 4 | 4 | 4,20 | 3,30 | 1,52 | 2,04 | 3,00 | 2,24 | 2,37 | 10,90 | 2,95 | 1,61 | 8,38 | 2,48 | 1,42 | 12,10 | 4,03 | 1,70 | 7,13 | 3,01 | 1,30 | 2,16 |
| 57X57X4 | 110 | 56,7 | 4 | 4 | 4,40 | 3,45 | 1,57 | 2,14 | 3,13 | 2,34 | 2,47 | 12,40 | 3,22 | 1,68 | 9,60 | 2,72 | 1,48 | 13,80 | 4,41 | 1,77 | 8,21 | 3,32 | 1,37 | 2,42 |
| 59X59X4 | 115 | 59,2 | 4 | 4 | 4,60 | 3,61 | 1,63 | 2,23 | 3,25 | 2,45 | 2,58 | 14,10 | 3,51 | 1,75 | 10,90 | 2,97 | 1,54 | 15,60 | 4,80 | 1,84 | 9,39 | 3,63 | 1,43 | 2,70 |
| 62X62X4 | 120 | 61,7 | 4 | 4 | 4,80 | 3,77 | 1,68 | 2,32 | 3,38 | 2,56 | 2,69 | 15,90 | 3,80 | 1,82 | 12,40 | 3,22 | 1,61 | 17,60 | 5,21 | 1,91 | 10,70 | 3,97 | 1,49 | 2,99 |
| 64X64X4 | 125 | 64,2 | 4 | 4 | 5,00 | 3,93 | 1,73 | 2,42 | 3,58 | 2,67 | 2,80 | 17,80 | 4,11 | 1,89 | 14,00 | 3,49 | 1,67 | 19,70 | 5,63 | 1,99 | 12,10 | 4,31 | 1,56 | 3,31 |
| 67X67X4 | 130 | 66,7 | 4 | 4 | 5,20 | 4,08 | 1,79 | 2,51 | 3,63 | 2,78 | 2,91 | 19,90 | 4,43 | 1,96 | 15,70 | 3,78 | 1,74 | 22,00 | 6,07 | 2,06 | 13,60 | 4,69 | 1,62 | 3,65 |
| 69X69X4 | 135 | 69,2 | 4 | 4 | 5,40 | 4,24 | 1,84 | 2,60 | 3,75 | 2,88 | 3,02 | 22,20 | 4,76 | 2,03 | 17,60 | 4,07 | 1,80 | 24,50 | 6,53 | 2,13 | 15,20 | 5,05 | 1,68 | 4,02 |
| 72X72X4 | 140 | 71,7 | 4 | 4 | 5,60 | 4,40 | 1,90 | 2,70 | 3,88 | 2,99 | 3,13 | 24,60 | 5,11 | 2,10 | 19,50 | 4,37 | 1,87 | 27,20 | 7,00 | 2,20 | 17,00 | 5,44 | 1,74 | 4,40 |
| 74X74X4 | 145 | 74,2 | 4 | 4 | 5,80 | 4,55 | 1,95 | 2,79 | 4,00 | 3,10 | 3,23 | 27,20 | 5,46 | 2,17 | 21,70 | 4,68 | 1,93 | 30,00 | 7,50 | 2,28 | 18,90 | 5,84 | 1,80 | 4,81 |
| 77X77X4 | 150 | 76,7 | 4 | 4 | 6,00 | 4,71 | 2,00 | 2,89 | 4,13 | 3,21 | 3,34 | 30,00 | 5,83 | 2,24 | 24,00 | 5,01 | 2,00 | 33,00 | 8,00 | 2,35 | 20,90 | 6,26 | 1,87 | 5,24 |
| 79X79X4 | 155 | 79,2 | 4 | 4 | 6,20 | 4,87 | 2,06 | 2,98 | 4,25 | 3,32 | 3,45 | 33,00 | 6,21 | 2,31 | 26,40 | 5,34 | 2,06 | 36,30 | 8,53 | 2,42 | 23,10 | 6,70 | 1,93 | 5,70 |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IPTO S.A. / TNPD / OVERHEAD T.L. DESIGN & SPECIFICATIONS SECTION / JAN. 2016 TABLE OF CONSTRUCTION DRAWINGS FOR 150 KV TOWERS** | | | | | | | | | | | | |
| **LINE CATEGORY** | **LIGHT SINGLE CIRCUIT** | | | | **HEAVY SINGLE CIRCUIT** | | | | **HEAVY DOUBLE CIRCUIT** | | | |
| **TOWER TYPE** | **S2** | **R2** | **T2** | **Z2** | **S3** | **R3** | **T3** | **Z3** | **S4** | **R4** | **T4** | **Z4** |
| **General number of drawings** | **25124** | | | | **25263** | | | | **25124** | | | |
| **Body upper part** | **119g** | **124h** | **129h** | **133j** | **169d** | **174d** | **179d** | **183** | **19d** | **24d** | **29c.1** | **33c.1** |
| **Body upper part** |  |  | **129 *I* b** | **133 *I* a** |  |  | **179 *I* f** | **183 *I* e** |  |  | **29c.2** | **33c.2** |
| **Body lower part** | **120g** | **125d** | **130c** | **134b** | **170c** | **175b** | **180a** | **184b** | **20c** | **25d** | **30d** | **34d** |
| **Legs for normal tower** | **121g** | **126e** | **131c** | **135g** | **171d** | **176e** | **181d** | **185c** | **21d** | **26d** | **31h** | **35h** |
| **Legs for extended tower** | **122e** | **127d** | **132d** | **136e** | **172d** | **177d** | **182c** | **186c** | **22d** | **27c** | **32g** | **36g** |
| **Legs +4,5 for extended tower ΤΜΕΓΜ** | **1346/1** | **1346/2** | **1346/3** | **1346/4** | **1347/1** | **1347/2** | **1347/3** | **1347/4** | **1348/1** | **1348/2** | **1348/3** | **1348/4** |
| **Plates for normal & ext. tower ΤΜΕΓΜ** |  |  |  |  | **1345/1** | **1345/2** | **1345/3** | **1345/4** | **1342/1** | **1342/2** | **1342/3** | **1342/4** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Suspension of Ph. Conductor** | **137b** | **138c** |  |  | **187** | **188 *I*** |  |  | **37** | **38 *I*** |  |  |
| **Suspension of Shied Wire** | **139b** | **139b** |  |  | **189** | **189** |  |  | **39a** | **39a** |  |  |
| **Link for tension towers** |  |  | **140** | **140** |  |  | **190** | **190** |  |  | **40a** | **40a** |
| **V Hanger for jumper insul. String** |  |  | **141** | **141** |  |  | **191** | **191** |  |  | **41** | **41** |
| **Anticlimbing guard** | **142** | **142** | **142** | **142** | **192** | **192** | **192** | **192** | **42b** | **42b** | **42b** | **42b** |
| **Grounding rod** |  |  | **143** | **143** |  |  | **193** | **193** |  |  | **43** | **43** |
| **Danger plate** | **144** | **144** | **144** | **144** | **194** | **194** | **194** | **194** | **44b** | **44b** | **44b** | **44b** |
| **Number of drawings** | **30** | | | | **34** | | | | **32** | | | |

## Τ.Σ.Π.Ε.Γ.Μ 682 Δ

**Rev. Jan. 2016**