

Delmec Engineering Limited

DEL6 Tower Maintenance Specification “Delmec Product Manual 2”

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Revision History		
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1.0 Introduction

The following document sets out the maintenance required on the Delmec Engineering Ltd DEL6 tower product range. It is advised by Delmec Engineering Ltd that the following maintenance be carried out. It is a requirement of any warranty given by Delmec Engineering Ltd that this work is carried out every 12 months.

Maximum interval between maintenance is 12 months.

2.0 Fall Arrest Systems

Proprietary fall arrest systems are provided with the DEL6 tower by Delmec Engineering Ltd. These systems have their own maintenance requirements. A maintenance schedule for these systems can be obtained from Delmec Engineering Ltd.

3.0 Climb Down

The maintenance check should be performed in conjunction and as part of a tower climb down. This climb down requires trained personnel, as set out in section 7.0. . A suggested climb down checklist is provided in appendix 1.

4.0 Galvanise

The tower and all ancillary steelwork such as anti-climbs/standoffs and face frames should be checked for signs of corrosion. Any areas showing signs of corrosion should be made good using a zinc rich paint... (Specification can be obtained from Delmec Engineering Ltd)

5.0 Nuts & Bolts

Nuts and bolts should be checked on a yearly basis as follows:

- a. That all nuts and bolts are in position and no bolt holes are left empty. The bolt should be replaced with the bolt size and grade specified in the tower design/drawing. If this is not available Delmec can advise
- b. That the bolts are properly torqued. (See appendix 3 for torque levels) Bolts should never be torqued above the maximum torque level specified in appendix 3. During a maintenance check bolts below the minimum torque level listed in appendix 3 are deemed to be insufficiently torqued.
- c. 10% of bolts should be checked and colour coded for each year that they are checked. Therefore a separate set of bolts (10%) will be checked every maintenance year. A minimum of one bolt from each flange and 3 bolts on the bracing members of each section should be checked each year. If any bolts show torque levels below recommended levels then all bolts should be checked. The minimum levels stated in the table in appendix 3 are the minimum torque levels deemed to be acceptable.
- d. A minimum of 3 threads are visible on the ends of each bolt.

- e. The bolting assembly is as follows:
 - Bolt
 - Washer
 - Bracing/Plates/Flanges
 - Washer
 - Spring Washer
 - Nut

- f. That the holding down bolt assembly is:
 - 1 Nut below flange
 - Washer
 - Flange
 - Washer
 - 2 Nuts

6.0 Welds

Welds should be checked for cracking, 3% of bracing welds and all leg flange welds should be checked. If cracks are found Delmec Engineering Ltd., should be notified immediately.

7.0 Training

The person carrying out the maintenance needs to have the following qualifications and experience:

- a. Structural Engineer qualified to degree level and be competent in the maintenance of Delmec towers. Or a person with a current Delmec certificate for the maintenance of Telecom Towers.
- b. Have proper climbing certification
- c. Have a working knowledge of the required standards: See appendix II

APPENDIX I – Recommended Climb Down

**Please note that this check list is not exhaustive and any other defects or damage noted during the climb down should be included and noted.

Question No.	Structure Climb Down	Comment/Work Required	Checked
1	Are all operators stand-off poles plumb & secure?		
2	Are all operators equipment secured with a minimum of 4 number U bolts and plates (2 top 2 bottom) fixed to structural element of structure?		
3	Is there any Jubilee clips used to support any operators equipment?		
4	Fall arrest system checked as per manufacturers' specification?		
5	Any visible signs of corrosion on any elements of the structure?		
6	Any visible signs of stainless being used against galvanized steel or any other bimetallic connections? (Ref: PD 6484:1989 Commentary on corrosion at bimetallic contacts and its alleviation)		
7	All lanyard hoops in place and secured on all designated working platforms except rest platforms.		
8	Any excess steel/bars protruding causing a hazard to personnel while climbing? (Ref: SI NO 481 Safety Health and Welfare at Work (Construction) Regulations 2001 Working at height part 13)		
9	Any excess material left on structure/platforms?		
10	Are all bolts properly torqued as per designer's instructions?		
11	Any part or member of the structure damaged, bent or missing?		
12	Any damage to the ladder?		
13	Any bolts/brackets missing, damaged or incorrectly fitted on the ladder?		
14	Any evidence of structural steelwork corrosion?		
15	Are all feed cables properly secured at 1m centre to centre with the use of Cable Management Bracket and Cable clamps?		
16	Are any cable runs preventing safe access up structure?		
17	All bolts are correct length thread to extend 3 threads should run beyond nut?		
18	Do all feeders have adequate and specified labeling by each of the operators?		
19	Is there an aircraft beacon light installed and operative if a condition of planning?		
20	Any bracing members bent or damaged?		
21	Any bolts loose or damaged?		
22	All bolts at tower section joints correct size and length? (check against manufacturers design)		
23	Any power mains cable connected directly to mast? (If cable becomes damaged tower could become live)		
24	Are flat and spring washers fitted according to the manufacturers' specification or 2 flat washers and one spring washer if no specification exists?		
25	Any sign of corrosion of nuts or bolts?		
26	Any signs of thread damage to bolts?		
27	Any cable ties used for supporting cables on structure?		
28	Any delta frames properly secured?		
29	Any bolt holes with no bolts?		
30	Is the tower true and straight?		
31	Are all dish poles and face frames properly secured?		

APPENDIX II – Design & Fabrication Codes

1.0 Delmec Engineering Ltd., design, manufacture, galvanizing, inspect, test and supply steelwork which complies with the following specifications and standards unless otherwise requested.

2.0 Standards:

The latest editions of the standards, codes of practice and publications listed below are applied to the steel works:

2.1 Design Codes:

BSI CP 3 Code of Basic Data for the Design of Buildings – Chapter 5/2

BS8100 Lattice Towers and Masts

BS5950 Specification of the Use of Structural Steel in Building

2.2 Product Dimensional Standards:

Angles, Equal BS EN10056-2

Angles, Unequal BS EN10056-2

Plates BS EN10029

Sheets BS EN10051

CHS BS EN10025

2.3 Quality Standards:

Delmec Engineering Ltd., works to a QA system based on ISO 9002. It is intended to apply for ISO 9002 in 2005.

2.4 Galvanizing:

BS EN1461

2.5 Welding

BS 5135

2.6 Inspection & Testing

ISO 9002 Level System

3.0 Design:

The steel work is designed as per requirements given in the customer specification and drawings.

4.0 Materials:

All materials shall be of quality in accordance with specifications.

The minimum yield and tensile strength of steel to be used for manufacture of steel work shall be in accordance with specifications.

Materials used in production of steel work are provided free from blisters, mill scale, laminations and other defects.

Dimensions and tolerances of raw materials are inspected for their conformity with relevant DIN, EN and/or ISO standards. Materials which dimensionally do not conform to the standards are rejected.

Test certificates are supplied for the materials used in manufacturing of steel work. These certificates cover mechanical and/or chemical properties of materials.

5.0 Fabrication

5.1 General

All fabrication processes are carried out with machinery suitable for the manufacture of steel work.

Before and during working of the individual structural parts, the raw material is subjected to visual and dimensional inspection especially at the points of working or assembly to check if any deviations in dimensions or shape or other defects that can impair the structure are present. Any deviations or defects observed are treated in accordance with Delmec Engineering Ltd quality control procedures.

The fabrication is carried out in a thoroughly reliable and workmanlike way in order to assure satisfactory assembly and erection, interchangeability of similar member, accuracy of dimensions, position and alignment of holes.

The structural parts are fabricated sufficiently accurately that the tolerances given for the maximum deviations from working drawings of the completed steel work are complied with.

5.2 Cutting and Shearing

Cutting is done either by cropping, shearing, flame cutting or cold sawing depending on the section type and size.

Finished edges are provided free from rags, burrs, notches and distortion. The flame-cut edges are lightly dressed after cutting to remove notches etc.

5.3 Punching and Drilling

Bolt holes are punched or drilled. Bolt holes without zinc coating are or a diameter 1.5mm greater than the nominal diameter of the corresponding bolts in case of punching and 2.0mm greater in case of drilling. Holes are punched true to form and free from distortion.

Holes can be punched up to the thickness of 12mm (including 12mm), provided that the hole diameter is equal to or greater than the material thickness. All other holes must be drilled over than the thickness of 12mm.

All burrs and irregularities occurred during fabrication are removed by grinding.

5.4 Bending

Bending is done by vertical or horizontal press.

Bends are provided to be of even profile and free from surface damage due to press tools indentation.

Materials shall not be worked at temperatures lower than 0°.

All bends over 15 degrees for high yield steel with a thickness of 6mm and over are to be heated before the bending process. Bends are to be made between 850-950° C. After treatment the piece shall be allowed to cool freely in ambient temperature, sheltered against wind and water in order to avoid impairment of steel quality.

5.5 Welding

All welding of the steel work is carried out before galvanizing in accordance with BS 5135 standard. Weld seams are provided to comply to BS 5135.

All welders who are to take part in the work have a valid welder's certificate in accordance with BS 5135.

Welding method is gas-shielded arc welding or flux-shielded welding.

Before commencing the welding work, welding procedure specifications which cover welding parameters to be applied are prepared, and welding is done in accordance with these parameters.

During welding, rust, scale, metal coating, paint, oil, slag from flame cutting, burrs from shearing, ice or snow or other substances on or near the weld that might impair the welding quality are cleaned appropriately.

When matching pieces, the individual structural parts are correctly located relative to each other by fixing together and/or tack welding in such a manner that welding stresses, welding deformations and any corrective work are kept to a minimum. The prepared pieces are treated to have no deformations which can cause gaps in the structure after assembly or cause induced stresses in structural parts when bolts are tightened.

5.6 Quality Inspection and Testing

All fabrication processes are visually and dimensionally inspected for their conformity in accordance with this specification and drawings, taking the tolerances given or design codes specifications.

Results of fabrication and welding inspection and testing are documented on the relevant inspection and test reports.

6.0 Hot Dip Galvanizing

6.1 General

All steel is hot-dip galvanized in accordance with BS EN1461 standard.

The items are subjected to surface pre-treatment in the following sequence for removal of grease, oil, paint, rust and any other surface contaminants prior to galvanizing:

Degreasing

Pickling

Rinsing

Fluxing

Drying

Surface pre-treated items shall be dipped into the galvanizing bath for the period required for specified coating thickness.

The coating thickness on articles is in accordance with BS EN1461.

Projections and accumulations of zinc in bolt holes shall be carefully removed by filing or grinding, such that removal of the zinc coating is avoided.

Zinc accumulations and runs on joint surfaces at both holes shall be carefully removed by grinding, avoiding damaging the zinc layer and ensuring that the specified layer thickness is met.

6.2 Repairs to Coating Damage

If items warp during galvanizing, straightening is undertaken with great care to avoid damaging the zinc coating or over-stressing the steel. Straightened items are re-inspected for coating damage.

Uncoated areas and damages to zinc coating which may occur during handling are repaired as specified in BS EN1461 standard.

Repairs may only be carried out on completely dry surfaces and in accordance with the manufacturer's instructions for application conditions.

6.3 Quality Inspection & Testing

Galvanized coated items are subjected to visual and gauge inspections.

The surfaces of hot-dip galvanized items shall be free from drips, projections and burrs of zinc which could impair the erection and use of the items.

Any item which does not have a minimum average coating thickness as specified in BS EN1461 standard shall be re-galvanized again.

7.0 Test Assembly

Test assembly of the steel work may be done depending on the design of structure. The assembly demonstrates that all units can be assembled without force, that when loosely tightened there are no gaps in the joints.

Test assembly shall be carried out with parts black or hot-dip galvanized, produced in accordance with this specification.

Should it be established during test assembly that individual items have not been produced as required, all affected items shall be corrected or rejected and new ones are produced. In case of galvanized test assembly re-galvanizing or repair of coating is applied for corrected members.

8.0 Handling, Packing, Storage & Shipment

All handling, packing, storage and shipment of the steel work are carried out diligently and carefully to reduce the risk of damage to the articles and zinc coating to a minimum.

The steel work is packed in bundles containing articles in accordance with the prepared packing lists.

The parcels are bundled with polyester bands of suitable strength which are evenly distributed along the length of the parcels.

The galvanized items are stacked such that water and moisture can run off them are the surfaces are able to dry out.

9.0 Quality Documentation

A file of documentation shall be prepared in covering documents of all checks carried out in connection with the manufacturing and galvanizing.

The QA file shall contain, amongst other things, the following:

- Inspection and test plan
- Mill certificates of raw materials
- Welding Certificates
- Certificates for welders and NDT operators
- Bolt Certificates
- Galvanising Certificates

In case of that specified requirements are not met, the customer shall be informed of this to decide whether repairs can be permitted or the work is to be rejected.

APPENDIX III – Recommended Torque Levels

Recommended Torque Values for Del 6 Tower Galvanised Bolts, Nuts and Washers.

Grade 8.8	M12	M16	M20	M24	M30	M36
Tensile Area mm ²	84.3	157.0	245.0	353.0	561.0	817.0
Minimum Torque Nm	69.0	173.0	339.0	584.0	1173.0	2056.0
Maximum Torque Nm	88.2	220.0	430.0	740.0	1470.0	2570.0

Important Notes:

- Under no circumstances should you torque a bolt above the Maximum torque value.
- A bolt is deemed inadequately torqued if it is below the minimum torque level.
- For Standard DEL6 towers Grade 10.9 bolts should be torqued to the same levels as Grade 8.8 bolts
- Torqueing of bolts should only be carried out by a competent person. As listed in section 7.0.
- Torque values are for non-lubricated bolts.
- Before torqueing the condition of the bolt assembly and structure needs to be assessed.
- All torqueing equipment should be calibrated, in proper working order and free from defects.
- Care should be taken not to over torque the bolts.
- Recommendations of the torque wrench manufacturer should be followed. Careful consideration should be given to the torqueing trajectory, torqueing equipment and torqueing process prior to maintenance.
- Pneumatic guns, or other equipment with hammer action should not be used as these will damage the galvanised bolts.