Gaia-Wind
YOUR OWN WIND TURBINE

Tubular Tower Foundation Guide

Gaia-Wind 11 kW Turbine

Your own
Wind Turbine

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Reference number: GW-UK-23-0808 Foundation Guide Tubular

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Health and Safety Information

Ensure that these instructions are read thoroughly and understood. It is essential that they are retained, along with the remainder of the manual, as they contain important safety information that must be adhered to.

- It is compulsory that anybody involved in the construction wear appropriate personal protective equipment at all times; including, but not limited to, a high visibility jacket, hard hat, and safety boots

- All workers involved in installation must be fully briefed on the sequence of operations before commencement. This is to include the identification of danger areas that must not be occupied

- Existing site factors, e.g. overhead or underground electric cables should be identified and an exclusion zone set

- Temporary signs, notices, and barriers should be erected

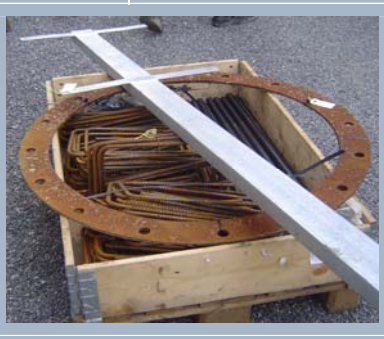
- Structural and mechanical installation must be actively managed and supervised by a suitably experienced and competent person

Foundation Kit

Supplied by Gaia-Wind

Quantity	Part Description	Position	Size (mm)
1	Stand for Control Cabinet	88.00	2700 x 600 x 10
16	Threaded Rods	81.10	1200 x 30
16	M 27 Nuts	1.243	n/a
16	M 27 Washer	1.037	n/a
2	Bolt Circle Template	81.2	

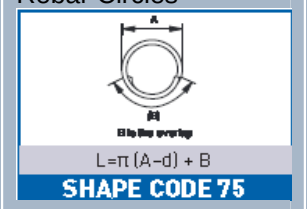
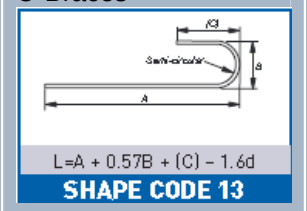
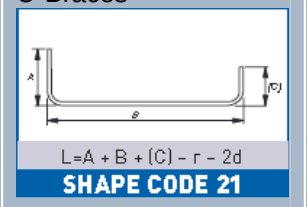
Threaded Rods and Bolt Circle Template



Control Cabinet Stand, Bolt Circle Template, & U-Braces

To be provided by the Installer

Quantity	Part Description	Position	Size (mm)
1	Coil of 16 Gauge Tying Wire	N/A	75 m (length)
8	Reinforcement Mesh (12mm diameter main & cross)	84.0	Shape Code A393 4800 x 2400

5	Rebar Circles 	81.4	Shape Code 75 – Simple circle Bar diameter: 16mm A (diameter): 1065 mm B (overlap): 400 mm Overall length: circa 3695 mm
1	Concrete Collar		Min. outside diameter:1250 mm Min. inside diameter: 1150 mm Height: 750 mm
104	U-Braces 	84.2	Shape code 13 Bar diameter 12 mm A =400 mm B = 140 mm C = 400 mm Overall bar length = 850 mm
104	U-Braces 	84.3	Shape code 21 Bar Diameter 12 mm A = 400 mm B = 250 mm C = 350 mm Overall bar length = 1000 mm
4	Earth Rods	N/A	M16 x 1000
1	Earth Wire	N/A	25mm^2
6	Single Cover Concrete Spacers	N/A	Height: 50mm
Concrete	Strength Class: Max. Gravel Content: Water/Cement: Quantity:	30 MPa 32 mm 0.55 16 m^3 (aprox.)	

Tools and Plant Requirements

The provision of all suitable tools and plant are the responsibility of the individual contractor.

1. Introduction

This guide outlines the procedures relating to the installation of the foundations for a Gaia-Wind 11kW wind turbine with a tubular tower.

Please ensure that this document is read thoroughly prior to commencing the foundation installation and pay specific attention to the health and safety guidelines on the opening page. We would also strongly advise that this document is retained for future reference.

The tubular tower foundation kit consists of bespoke parts for the assembly of the steel work required for the foundation. The preceding pages catalogue the contents of the foundation kit. This is divided into two sections; bespoke parts supplied by Gaia-Wind, and equipment to be supplied by the installer. It should be ensured that all the necessary parts are accounted for prior to commencing with the installation.

Provided are details and step-by-step instructions concerning the excavation, earth connection, and steelwork assembly, with specific reference to the Foundation Specification Drawings that are attached to this document.

It remains the responsibility of the contractor to ensure that the foundation work is complete and acceptable standard and to exact requirements of the Gaia-Wind foundation specifications. Should there be any additional queries or comments please contact Gaia-Wind.

2. Installation

2.1 Location

The precise location for the installation of the wind turbine foundations will be dependent on that outlined in the approved planning application.

It must be ensured that prior to the commencement of any work that the exact location of the foundations exactly matches that of the detailed in the planning consent.

2.2 Excavation

The excavation for the turbine base requires a volume of approx. **29** cubic meters; that is **5** m length and breadth, and **1.15** metres in depth.

The ground should be levelled, and all large rocks removed from the excavated dig.

In adittion It is required that a cable trench is excavated, leading away from the hole.
The trench will be used for the laying of electrical power cables.

It is required that the trench is at least 750 mm in depth.

The exact positioning, direction, and length of this trench will be site specific.

2.3 Earth Connection and Cabling

The dedicated turbine earth connection requires digging a small channel for the running of the earth cables.

This channel should form the outline of a square on the inside of the excavated hole - 1 metre in from the outside walls and approximately 100 mm in depth.

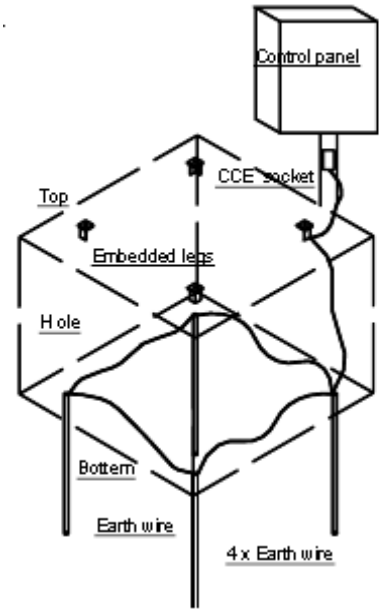
Four earth rods should be hammered into the ground at each corner.

Interconnect the earth rods with

25mm^2 bare copper wire using rod to cable clamps to secure.

Attach a separate sheathed earth wire to one of the earth rods. This earth wire will protrude from the finished foundation and be attached to the tower base during the turbine installation. It should be ensured that the wire is sufficiently long for this to be achieved.

The earth wire channel should be backfilled with earth.



2.4 Level and Compact

Prior to advancing with the installation of the steelwork it should be ensured that the base of the foundation excavation is suitably levelled and that all obstructions are removed.

The earth at the base of the foundation should be suitably compacted as site conditions dictate.

2.5 Steelwork Install

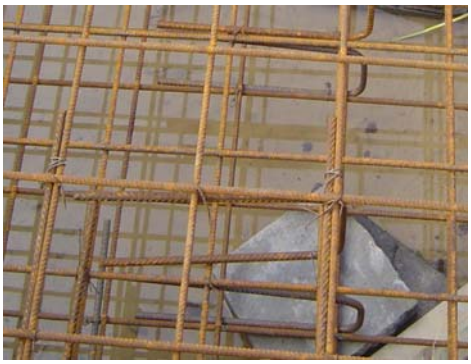
The foundation steelwork must be raised 50mm above the base of the excavation.

This can be achieved with spacers spread evenly across the excavated area.

Assemble the three layers of mesh.

Use the U and Z-Braces to hold the three layers a mutual distance apart, as detailed in the foundations specification drawings – *see 'LAL-1060-02'*, attached to this document.

Ensure that all U and Z braces are securely fastened to each layer of mesh using sufficient tying wire.



Locate the 16 threaded rods, the two bolt circle templates, and the rebar rings.

Assemble each of the threaded rods through one of the bolt circle templates.

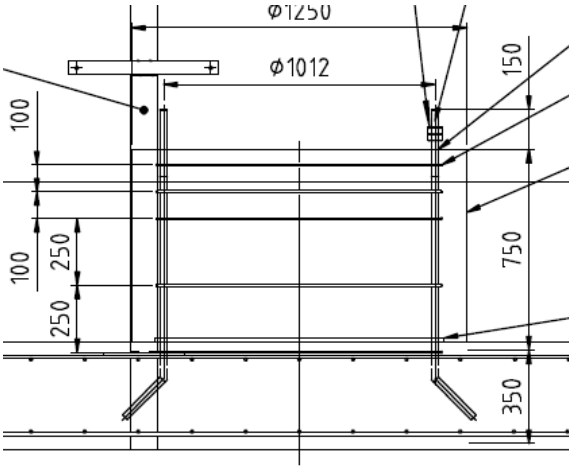
Carefully move the unit onto the mesh, with the angled end protruding through the mesh layers.

Place the 5 rebar rings over the threaded rods.

The foundation specification drawing – *110-810-000E* – indicates that a 50mm gap must exist between the mesh and bottom bolt template.

To ensure this prescribed gap concrete spacers should be

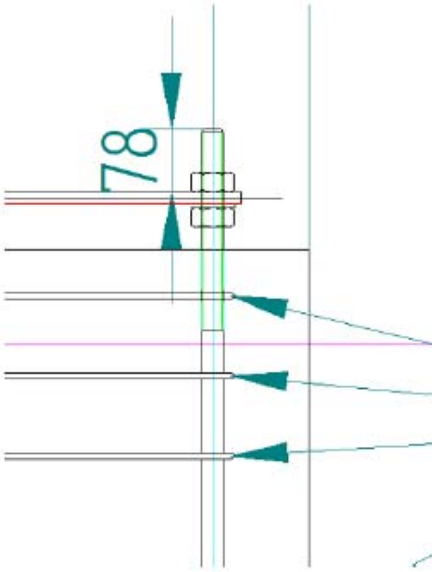
placed between the mesh and the bottom bolt template. These should be secured to the mesh layers with tying wire.



Place the second bolt circle template over the top of the 16 threaded rods.

Secure the top bolt template at the top and bottom with the M27 nuts provided.

Ensure that the spacing between the top surface of the rods and the top bolt template (78mm) are accurate with respect to the foundation specification drawing for each of the 16 bolts.



Raise each of the 5 rebar rings up the outside of the threaded rods and securely fix with tying wire.

Consult drawing *LAL-1060-02* and ensure the correct spacing between the rebar rings.

It may prove convenient to use sections of wood or steel mesh off-cuts to ensure that the assembly is plumb and rigid around the whole perimeter.

Blocks of wood or steel mesh off-cuts should be cut to appropriate size and placed in between the upper and lower bolt templates.

Measure the level at a number of points on the top of the top bolt circle template using a digital spirit meter. This is important as all of the threaded rods are required to be at the same height.

Ensure that the assembled steelwork is firmly secured, plumb, and level before proceeding.

2.6 Install Concrete Collar

Locate the concrete collar.

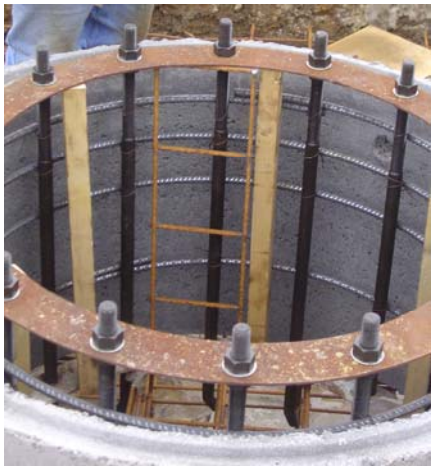
The concrete collar will be used as formwork around the assembled steelwork.

The collar should be lifted into position by slinging with appropriately rated lifting tackle.

Lift the concrete collar over and around the assembled steelwork.

Be careful to ensure that at no point does the concrete collar come into contact with the steelwork.

Once in place ensure that the steelwork and collar are concentric, with equal clearance between both their inside and outside diameters.



Any wooden spacers added between the two bolt-templates must be removed prior to casting concrete. To ensure maintaining the level of the steelwork excess steel mesh should be cut and added to the assembly.

2.7 Mount Controller Stand

Locate the control box stand.

The control box stand should be placed onto the mesh according to the foundation specification drawings.

The stand should be secured to the mesh with tying wire.

Additionally the stand can be strapped or pegged into the ground. This will avoid movement whilst the concrete is curing.

2.8 Casting Concrete

Firstly, ensure that the earth wire is secured against the top of the assembled steelwork. It is vitally important that the earth wire is not embedded into the concrete.

Ensure once more that the steelwork has been assembled exactly according to the foundation specification drawings and suitably plumb and level.

The grade of concrete should match that according to the attached foundation specification.

Concrete should be poured firstly into the foundation base, 5m x 5m x 0.55m.

The concrete should be vibrated using a vibration poker for the removal of air pockets. This is essential for the concrete to achieve full strength and therefore durability.

Secondly concrete should be poured into the concrete collar.

It is vitally important that concrete poured into the collar does not exceed the lip to ensure the correct spacing of the threaded rods.

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The foundation should be given a minimum of 10 full days prior to carrying out the mechanical installation. This is to allow for adequate curing of the concrete before it is loaded

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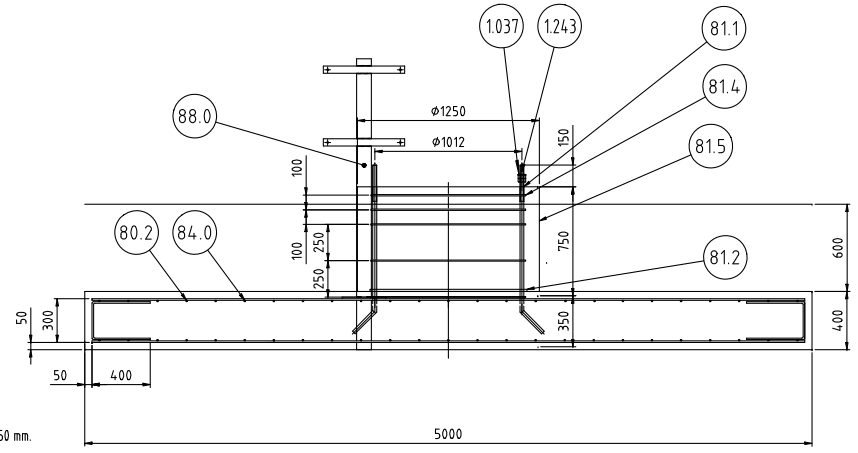
3. Foundation Specification Drawings

Please find the following drawings;

110-810-000^{E}: The standard Danish foundation specification

LAL-1060-02 (Edited to show tubular foundation): The UK foundation specification – compared to that of the Danish specifications the foundations require additional concrete. This is achieved by the virtue of an additional layer of mesh and additional U-Brackets to keep the spacing between the mesh layers.



CONCRETE

Environment class	Passive
Strength class	30 MPa
Control class	Normal
Max. gravel size	32 mm.
Water/cement	0.55

Covering concrete layer against form work = 50 mm.
Concrete layers otherwise = 100 mm.
Concrete work according to "Code for concrete construction DS 411"

SOIL

The soil, on which the foundation is placed, must meet the following conditions.

Foundation of Sand : $\Phi > 30°$
Foundation of Clay : $Cv > 80 kN/m^2$
Effective density of filling Soil : $Y > 18 kN/m^2$

It is provided that max. ground water level is at terrain level.
Soil survey has be done to secure the bearing capacity and effective density.

LOADS

The foundation is calculated for the following extreme loads :

Nd = 27 kN. (Normal load)
Vd = 22 kN. (Horizontal load)
Md = 331kN. (Bending moment)

The loads includes the following safety factors:
1.0 on static loads (eg. gravity load)
1.3 on dynamic loads (eg. Wind)

REMARKS

All dimensions are in mm.
Concerning further demands and conditions for the construction of the foundation, see other foundation drawings

BUILDING CODES

For the carrying out, the following are applicable :

Concrete structures : DS 411
Foundation : DS 415
Basic concrete description : BBB

Pos.nr. Technical

81.1 Steel rods
81.2 Bolt template
81.4 Spacing ring
81.5 Solid cylinder of concrete
80.2 Concrete
84.0 Reinforcing mesh complete
88.0 Control box stand
1.037 M30 Washer
1.243 M30 Nuts

Standard foundation for 18 m. tubular tower

Gaia Wind A/S
Salgsafd.
Produktionafd.
Absalonsvej 1
8800 Viborg
Tel :86621766
Fax:86621726

Drawing: Tubular Tower Foundation	Drawing Number: 110-810-000E	Raw material: Refer to assembly	
Assembly: Foundation	Assembly Number: 110-000-000	Material: St.37-2	
Main Assembly: Gaia 11 kW complete	Part list No.: 110-810-020	Pos.nr.: 81.0	Revised On: 10-01-08
File Name:	Raw material dimension: U.sam.	Kg/stk.	Q.ty: 1
Draughtsman: Kenneth Buthler / Approved By:	Item No.	Drawn On: 19-02-01	Scale: 1:20

Gaia Wind A/S
Salgs.-/Produktionsafdeling
Absalonsvej 1
8800 Viborg
Tel : 86 62 17 66
Fax: 86 62 17 29

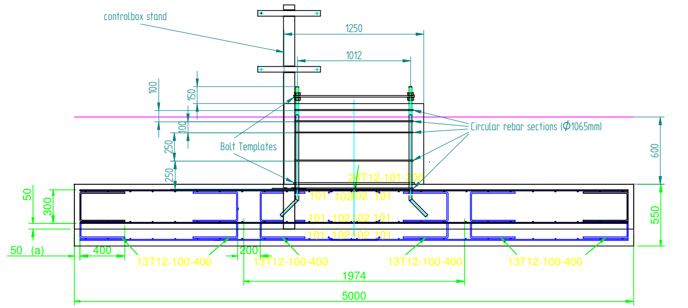
PARTS LIST

Order No.

Drawing: Tubular Tower Foundation	Main Assembly: Gaia 11kW compl				
Drawing No.: 110-810-000E	Assembly No.: 110-000-000			Series	Page: 1 of 1 / Drawn On: 19-02-01
Part List: 110-800-020	Pos.nr.: 81.0	Kg/stk.	Qty: 1	Approved: Kenneth Buthler	
Item No.	File Name			Name	

Pos.nr.	Partlo.	Qty	Description 1		Material 1
			Description 2		Material 2
			ID Number		Weight
1.037	810	16	Washer		St. Kv. 8 DIN 125 fzv.
					M30
			000-037-001		
1.243	810	32	Nuts		St. Kv. 8 DIN 934 fzv.
					M30
			000-243-001		
80.2	810	12 m³	Concrete		30Mpa Sten kl.P D max. 32mm.
					Sand Kl. P Zn8l 90 m.bind
			110-802-000		
81.1	810	16	Threaded Steel rods		St. Kv. 8.8
					Φ30x1200
			110-811-000		
81.2	810	2	Bolt template		St. 37-2
					Plade Φ1102x15
			110-812-000		
81.4	810	5	Spacing ring		St. 37-2 Φ1065
					Rundjern Φ16x3695
			110-814-000		
81.5	810	1	Solid cylinder of concrete		concrete
					Φ1250
			110-815-000		
84.0	810	1	Reinforcing mesh complete		U.sam.
					U.sam.
			110-800-000		
88.0	810	1	Control box stand		U.sam.
					U.sam.
			110-880-000		

Arbejde Kørsel



SECTION THROUGH FOUNDATION

THIS DRAWING MUST BE READ IN CONJUCTION GAIA WIND DRAWINGS 110-8000-000E & 110-840

BAR SCHEDULE

Bar Mark	Type & Size	Number of Bars	Length	Shape Code	A	B	C	D
100	T12	104	850	13	400	140		
101	T10	78	600	00				
102	T10	12	2600	00				

4 Sheets of A393 BRC Steel Mesh Standard Flying End (4.8m x 2.4m) laping with Bar Marks 101 and 102

REINFORCEMENT

Cross wise reinforcement in top and bottom of base plate and to bottom of base BS 393 Standard Flying End Fabric 4.4mx2.8m lapped with loose 600mm T10 bars.

Edge bows - T12/400 mm

4 x 4 pcs, T12 U-bows at the steel parts.

T (Rib bar - fyk } 460 N/mm2)

SOIL

The soil, on which the foundation is placed, must meet the following condition

Foundation on sand : $\varphi > 30°$

Foundation on clay : $Cv > 80$ kN/m²

Effective density of filling soil : $\gamma > 18$ kN/m²

It is provided that max. ground water level is at terrain level.

Soil survey must be done to secure the above conditions is fulfilled

BUILDING CODES

For carrying out, the following are current:

Concrete structures : BS-8110-1-1997

Foundation : BS-8004 1986

CONCRETE

Concrete composition, mix and according to

Concrete Constr.	BS 8500-1
Strength class	C35
Control class	Normal
Max. gravel size	32 mm.
Water/Concrete	0.60

Covering concrete layer against form work = 50 mm.

Concrete work according to

"Code for concrete constructions BS8110-1-1997.

LOADS

The foundation is calculated for the followinf extrreme loads:

N = 14.7 kN. (Vertical load)

V = 35.8 kN. (Horizontal load)

M = 523.0 kN. (Bending moment)

The loads includes the following safety factors:

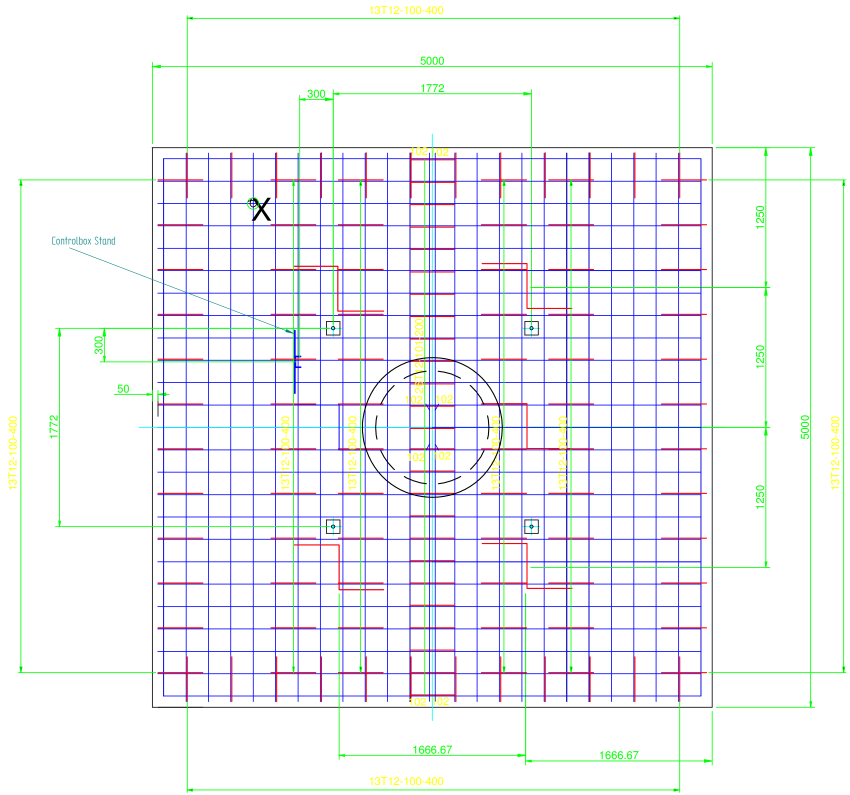
1.0 on static loads (eg. gravity load)

1.5 on dynamic loads (eg. Wind)

All dimensions are in mm

Please consult "Electricity installation guide" and subdrawings for further demands for foundation

When pouring, FRAME pos. 8900 should be used to maintain correct distanse between legs



PLAN OF REINFORCEMENT AT BOTTOM LAYER

rev.	date	amendment	by

client: GAIA WIND

architect:

project: G. TAYLOR WIND TURBINE INSTALLATION

LAL Design

Civil and Structural Engineers.

83D Patrick Thomas Court, Candleriggs, GLASGOW G1 1LF

Tel: 0141 552 7380
Fax: 0141 552 0517
e-mail: LALDESIGN@aol.com

drawing: GENERAL ARRANGMENTS DETAILS FOR CONSTRUCTION

date	drawn	checked	issued for
14.01/08	DLR		CONSTRUCT

scale (a1)	drawing number	revision
1/20	LAL-1060-02	

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