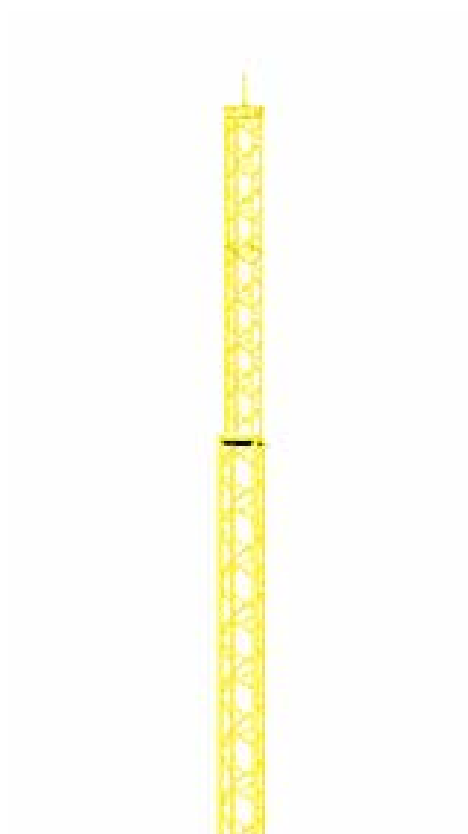




Frangible Safety Weather Masts



INSTALLATION MANUAL

AllWeather Inc.

10 m lattice mast
Revision B

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APPENDICES

1 GENERAL

1.1 Symbols used in this manual

Specific symbols are used in this manual in order to attract readers' attention to information of special importance. These symbols, their reference and explanations are presented in the table below.





Symbol	Referent	Explanation
	INFO	<ul style="list-style-type: none">• A useful hint to facilitate installation.
	NOTE	<ul style="list-style-type: none">• In case of incorrect action, the structures are in danger of being broken. When performing this action, please exercise extreme caution.• Note related to the matter.
	DANGER	<ul style="list-style-type: none">• In case of incorrect action, fitters or persons in the proximity are in danger of accident. Please exercise extreme caution when performing this action.
	REFERENCE	<ul style="list-style-type: none">• Further information about the subject elsewhere in the manual

Table 1: Symbols.

1.2 Requirements of ICAO

According to the requirements of ICAO (International Civil Aviation Organisation) all airports operating under rules of ICAO shall be equipped with frangible safety approach light masts from the beginning of the year 2005 onwards. Below is an extract from International Standards and Recommended practices, Annex 14 Vol.1, second edition July 1995, § 5.3.13.

“Elevated approach lights

5.3.1.3 Elevated approach lights and their supporting structures shall be frangible except that, in portion of the approach lighting system beyond 300 m from the threshold:

- a) where the height of the supporting structure exceeds 12 m, the frangibility requirements shall apply to the top of 12 m only; and
- b) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects shall be frangible.

5.3.1.4 The provisions of 5.3.13 shall not require the replacement of existing installations before 1 January 2005.

5.3.1.5 When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it shall be suitably marked.”

(Annex 14. AERODROMES, International Standards and Recommended Practices, Montreal: International Civil Aviation Organisation, July 1995 Volume 1, Second Edition.)

Wind direction indicators and anemometers follow the same ruling. Attachment C to ICAO State Letter AN 4/1.1.37-91/64, **Interim Guidance on Frangibility**, item 1.2, “Obstacles to be made frangible” lists, among other things, wind direction indicators, anemometers and transmissometers. Draft Aerodrome Design Manual 6, chapter 5 (from 1999) lists navigational aids that shall be verified for frangibility through full scale dynamic testing. “Such aids include approach lighting towers, wind direction indicators, transmissometers,...”.

1.3 Mast family of Exel Oyj

Exel Oyj has accepted the challenge of ICAO requirements by designing a light, frangible, approach light mast family based on composite materials. The Exel mast has passed a full-scale impact test as a proof of meeting the requirements of ICAO. In Exel masts, frangibility is a unique built-in feature and no break-away points at regular intervals used by other manufacturers are needed. In case of a collision, the mast will break down at the point of impact, and there is no danger of the broken pieces of the mast wrapping around the wing of the aircraft.

Due to its design and materials, an Exel mast is light but at the same time very stiff and strong, and can thus well withstand wind loads and jet blast loads caused by aircraft jet engines. In case of a side impact, however, the mast will break down safely to small pieces.

Exel masts are in practice maintenance-free and the composite materials used in them resist fatigue and corrosion. The masts will maintain their physical properties regardless of the weather and temperature. They can be safely used in maritime or other climate conditions causing corrosion.

Exel-masts have been painted with visible aviation yellow colour, and therefore they do not need to be marked separately for visibility. The chosen materials make the masts transparent to electromagnetic signals. Exel masts do not distort ILS signals and as a result, the need for calibration of ILS antenna system is decreased. The shape and dimensions of Exel masts will not be deformed when the masts are lowered down for light maintenance, and consequently, re-aligning of lights is not necessary.

1.4 Exel lattice masts

Exel lattice masts have a modular construction. Medium-tall masts consist of a single module of 400 mm, and the top frame for fixing the weather instruments is mounted on top of the 400 mm module. The maximum height of single-module masts is approximately 6,5 m.

In tall masts, the lower section consists of a module of 500 mm, and the top section of a module of 400 mm. The top frame is mounted on top of the 400 mm module. The maximum height of two-module masts is approximately 10 m.

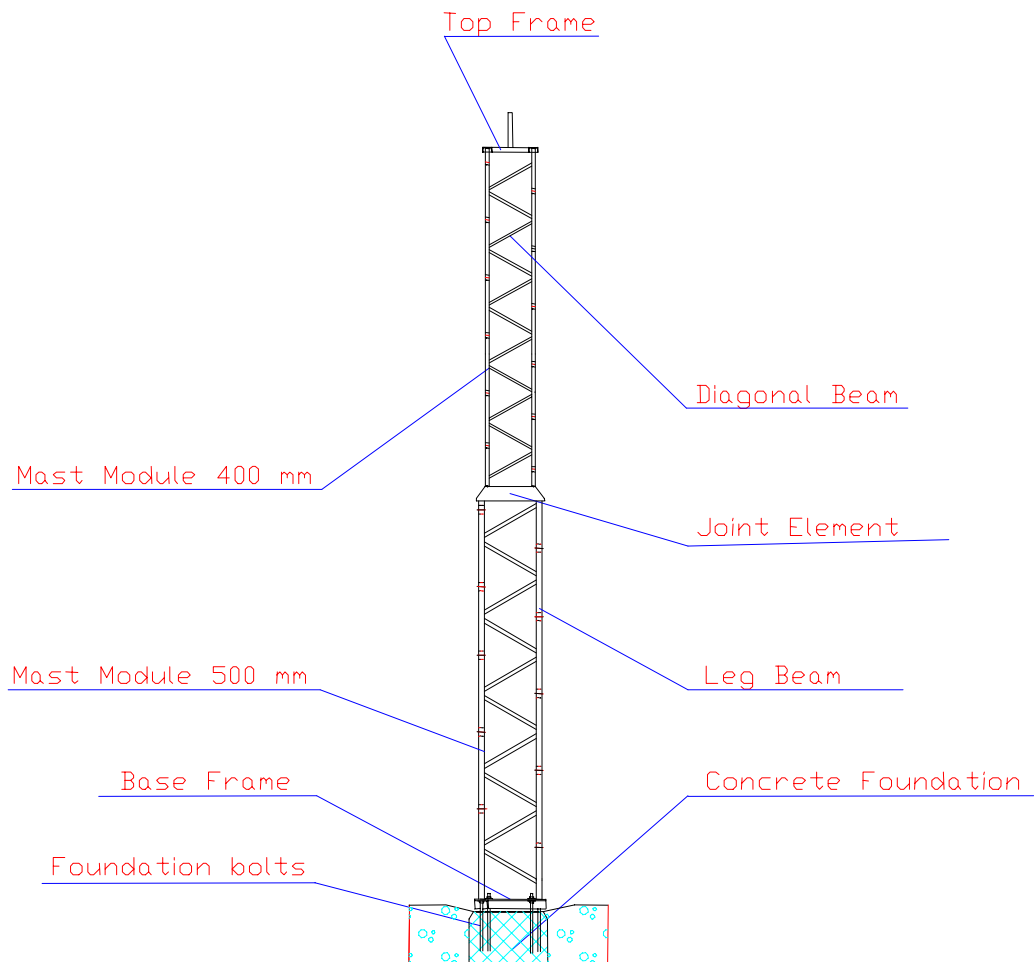


Illustration 1: Exel lattice mast



- *The design of lattice masts has been explained more in detail in the assembly drawings and in the mast list.*

2 FOUNDATION

2.1 Foundation design

The factors affecting the foundation design are:

- Height of the mast
- Wind exposed area of the instruments (including the obstruction light and the lightning conductor, if fitted)
- Wind load (including jet blast loads caused by the aircraft engines in the proximity of the threshold)
- Soil quality

The following tables describe some typical examples of mast foundations. The calculations have been made for lattice masts carrying instruments with total wind exposed area of 0,7 square metre (700 000 mm²). The maximum wind speed used in the calculations is 40 m/s. Dimensioning of the foundations has been done according to DIN V 4017-100.

Two types of foundations have been calculated, slab foundation and drum foundation.

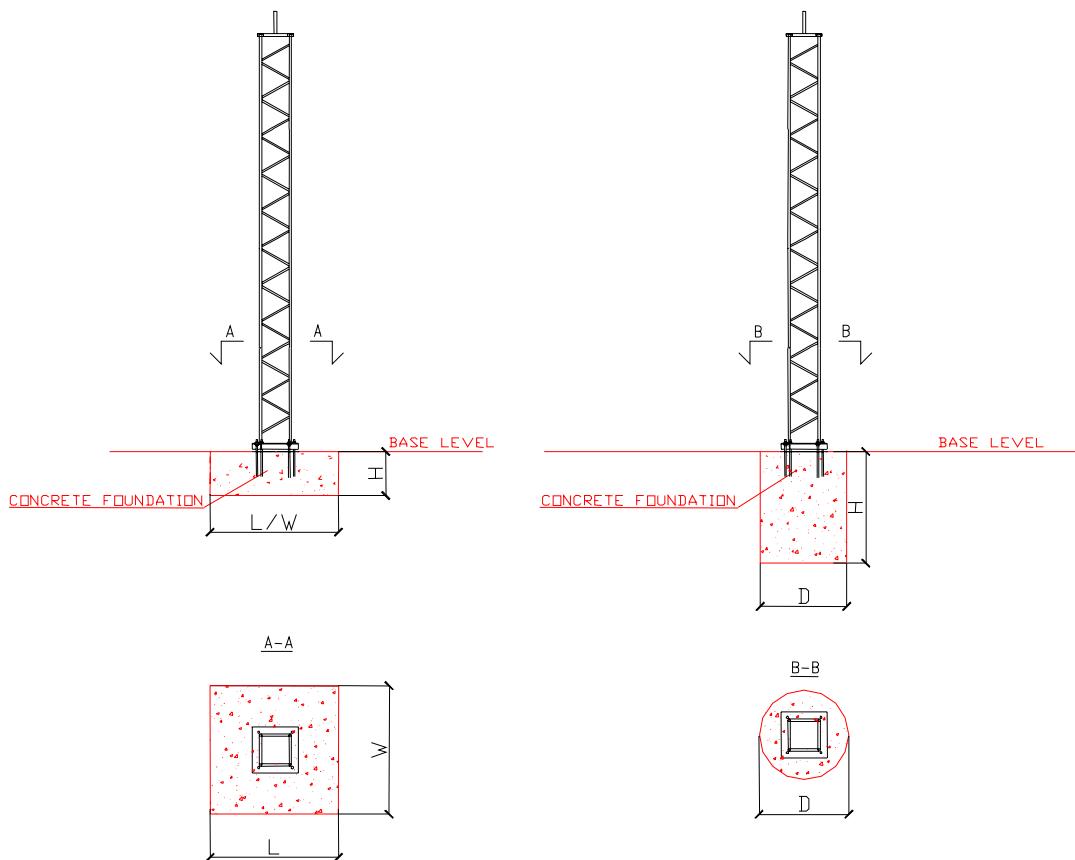


Illustration 2: Slab foundation and drum foundation

Slab foundation		SOIL TYPE 1			SOIL TYPE 2			SOIL TYPE 3		
Mast height	Type	L=W	H	Mass	L=W	H	Mass	L	H	Mass
Meters	-	mm	mm	kg	mm	mm	kg	mm	mm	kg
H = 4	Lattice	1200	400	1400	1100	400	1200	1300	500	2100
H = 7	Lattice	1400	600	2900	1300	600	2500	1600	700	4400
H = 10	Lattice	1700	700	5000	1600	700	4400	1900	800	7100

Table 2: Dimensioning of the concrete slab foundation for mast heights up to 10 m.

Drum foundation		SOIL TYPE 1			SOIL TYPE 2			SOIL TYPE 3		
Mast height	Type	D	H	Mass	D	H	Mass	D	H	Mass
Meters	-	mm	mm	kg	mm	mm	kg	mm	mm	kg
H = 4	Lattice	1200	1100	3000	1200	900	2500			
H = 7	Lattice	1200	1500	4150	1200	1200	3350			
H = 10	Lattice	1200	1900	5260	1200	1500	4200			

Table 3: Dimensioning of the concrete drum foundation for mast heights up to 10 m.

Soil type 1: Sand, sandy soil
 angle of friction $\delta = 25^\circ$
 weight by volume $\gamma = 17 \text{ kN/m}^3$
 cohesion $c = 0 \text{ kN/m}^2$

Soil type 2: Compacted coarse sand and moraine
 angle of friction $\delta = 40^\circ$
 weight by volume $\gamma = 21 \text{ kN/m}^3$
 cohesion $c = 0 \text{ kN/m}^2$

Soil type 3: Hard clay (drum foundation should not be used!)
 angle of friction $\delta = 0^\circ$
 weight by volume $\gamma = 19 \text{ kN/m}^3$
 cohesion $c = 20 \text{ kN/m}^2$

Concrete: > K30

-
- i**
- In a groundwater area the foundation shall be deeper.
 - In a soil frost area, the foundation shall reach below the soil frost penetration depth.



-
- All design values mentioned in this instruction are purely indicative. Exel Oyj shall not take responsibility for their applicability to the area in question.
 - It is highly recommended to always consult a local civil engineer about the dimensioning of the foundation.
 - Exel Oyj will provide the necessary load calculations (shear force and bending moment), when requested.
-

2.2 Preparation of foundation

Hinged base plate

Part of foundation bolt remaining visible	100 ±2mm
Allowed deviation of the position of the jig/base frame from the horizontal level.	± 0,3° =5,2mm/1000mm
Correct position of the base frame	Even side up

Table 4: Essential information necessary for preparation of foundation.



-
- Hot dip galvanised foundation bolts shall in no case be welded to the steel reinforcement of the foundation. Fasten the foundation bolts with wire.
 - Protect the thread of the foundation bolts during the casting for example with tape.

-
- i**
- Plywood jigs (option) are available for locating of the foundation bolts in the concrete when casting the foundation.
 - The position of foundation bolts is the same for both 400 mm and 500 mm module masts.
 - The same hinged base plate can be used for both 400 mm and 500 mm masts.
 - See appendices: "Assembly drawings".
 - See appendices: "Foundation parts".
-

2.2.1 Equipment needed for preparation of foundation

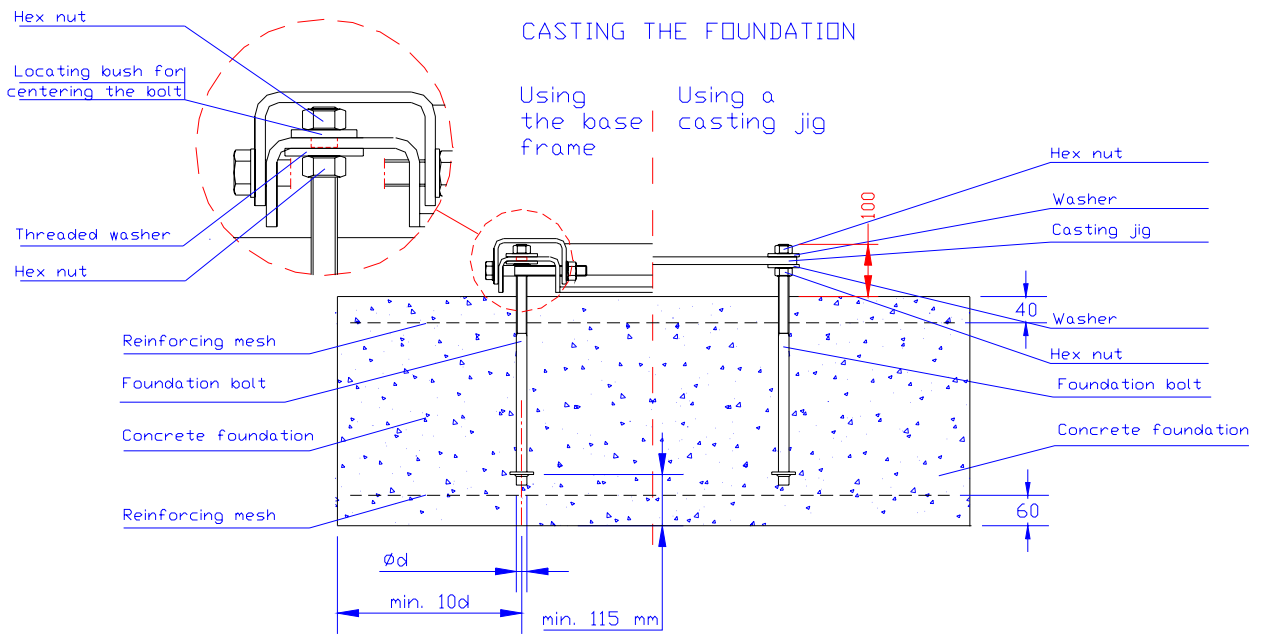
Measure	Instrument	Size
-	Foundation bolt, 4 pcs 641861	M24-430(1160)
Fastening of foundation bolts to the jig	Nut, 8 pcs	M 24
-:-	Washers, 8 pcs	Ø26
-:-	Wrench	S=36mm
Positioning of foundation bolts (alternative 1)	Casting jig 641794C 1 pc	For 400 or 500 mm mast
Positioning of foundation bolts (alternative 2)	1 Base frame + locating bushes 641878, 4 pcs	For 400 or 500 mm mast
Protection of screw thread	Masking tape	-
Fastening of screws to steel reinforcement	Wire	-
Casting of foundation	Normal casting accessories (moulds and steel re-inf.)	-
Verification of level of the jig	Water level	-

Table 5: Equipment needed for preparation of foundation.

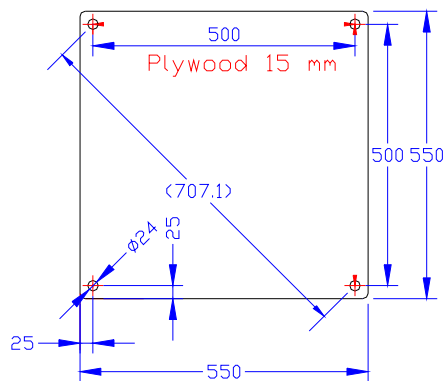
2.2.2 Work instruction for casting of foundation

If a locating jig is not available (option), the base frame can be used as a jig. Fit the base frame with locating bushes. They will centre the foundation bolts to the holes in the base frame and make sure that the bolts will be positioned accurately at their correct places in the concrete (see the illustration on the following page).

- Make a cast mould with its steel reinforcements in accordance with the design of a local civil engineer.
- Place the cable duct tubes in foundation prior to casting. Recommended duct tube IR 65. The cable duct is drawn under the ground through the foundation up to and as close as possible to either inside corner of the base plate that is facing the felling direction of the mast.
- Fasten the foundation bolts to the cast jig (or with the locating bushes to the base frame). If you use the base frame as a jig, make sure that you fasten and install the bolts correctly in accordance with the illustration on the following page, the flat surface up.
- Protect the threads in the anchor bolts by using for example tape.
- Place the casting jig (or the base frame) with its bolts at its' position. Fasten the bolts to the steel reinforcement with wire if necessary. The foundation bolts shall remain for the length of 100 mm above the concrete surface.
- Cast concrete in the foundation mould.
- Make sure that the cast jig (or base frame) is in a horizontal position. Correct the position before the concrete hardens.
- When the concrete is hard, remove the cast jig (or base frame).



CASTING JIG



FOUNDATION BOLTS

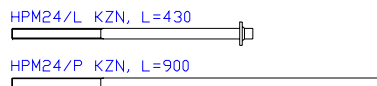


Illustration 3: Principal draft of foundation, casting jig and foundation bolts of the mast.

3 LATTICE MAST ASSEMBLY

3.1 Unpacking and handling of mast

Unpack the mast carefully on the assembly site. Handle mast modules with care. Be sure not to damage the glass fibre structures, because they are designed to be frangible.

Masts are delivered as assembled modules, which will then be connected on the assembly site. The 400 mm mast module is packed inside the 500 mm module.

A joint element is mounted on top of the 500 mm module. This joint element is used for connecting modules of different sizes. On top of the 400 mm module is the top frame, to which the meteorological instruments will be attached. All necessary screws, nuts, washers and shims have been fitted.

- i**
- If any damage is found in the masts, contact the representative of Exel Oyj. Exel will either repair the damaged parts or provide the repairing instructions.



- Make sure that the masts have not been damaged during transportation.
- Recommended lifting points of a mast are the top frame, the joint element and the base frame. In addition to those points, mast modules may only be lifted from leg beams. Never lift a mast from diagonal beams!
- Be careful not to damage masts during treatment, because they are designed to be frangible.



Mast assembly drawing is attached. See appendices "Assembly drawings".

3.2 Joining of mast modules

3.2.1 Equipment needed for joining mast modules

Mast module	Object	Part	Size	Qty
500 mm	Lower module	Mast module 641148	500 mm	1
400 mm	Upper module	Mast module 641029	400 mm	1
-	Joint element of modules	Exel joint element 641000A	-	1
500 mm	Connection to joint element	Hex screw	M24x50	4
400 mm	Connection to joint	Hex screw	M16x40	4

	element			
500 mm	Upper and lower washers	Exel washer 641085	ø56/24 x5	8
400 mm	Upper washers	Exel washer 641087	ø55/16 x5	4
400 mm	Lower washer	Exel washer 641086	ø34/16 x5	4
400 mm	Load adjustment	Exel shim	ø32/17 x0.5	n
500 mm	Load adjustment	Exel shim	ø50/25 x0.5	n

Table 6: Accessories needed for joining lattice mast modules and joint element.

Mast module	Action	Tool	Size
500 mm	Tightening of M24 fastening screw	Fork spanner	S=36 mm
400 mm	Tightening of M16 fastening screw	Fork spanner	S=24 mm
Both	Applying torque against tightening	Hook wrench	32 / 50 mm
-:-	Support of lattice masts	Trestles	-
400 mm	-:-	Blocks of wood	-

Table 7: Tools needed for joining lattice mast modules and joint element.

3.2.2 Tightening torque in joining mast modules

Mast Module	Action	Size	Torque
500 mm	Tightening of module to joint element	M24	100 Nm
400 mm	Tightening of module to joint element	M16	65 Nm

Table 8: Tightening torque in joining lattice mast modules

3.2.3 Work instruction for joining mast modules

Tall masts consist of two modules. The modules of 400 mm and 500 mm are joined by using a joint element.

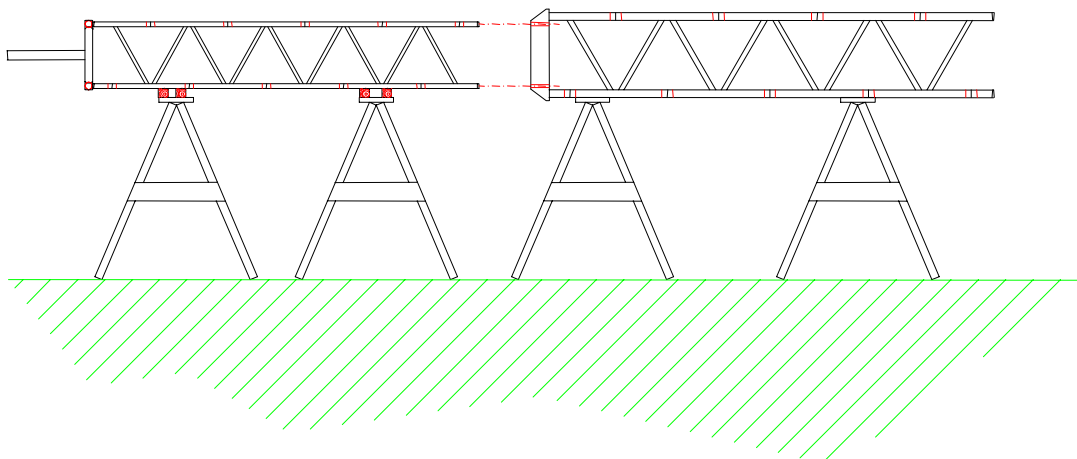


Illustration 4: Mast modules in assembly position.

- Place modules in a lying position on wooden support frames placed on an even base.
- The joint element has been mounted by the manufacturer on top of the module of 500 mm with M24x50 mm screws.
- Make sure that the bolts of the joint element have been tightened to their torque setting. Use a hook wrench when applying torque against tightening. There is a hole in the aluminium bush at the end of the leg beam. This way no torsion stress will be directed to the glass fibre construction of the leg beam.
- Adjust the position of trestles under the module of 400 mm in order to locate the threaded holes in the leg beams of the module to the holes in the joint element
- Join the module of 400 mm to the joint element with M16x40 mm screws. Place a washer $\varnothing 34/16 \times 5$ (total 4 pcs) under each fastening screw head. Place a washer $\varnothing 55/16 \times 5$ (total 4 pcs) under each leg beam.
- Compensate the length differences of leg beams by using shims under a shorter leg beam.
- Tighten the M16 screws to their torque. Use a hook wrench as described above.

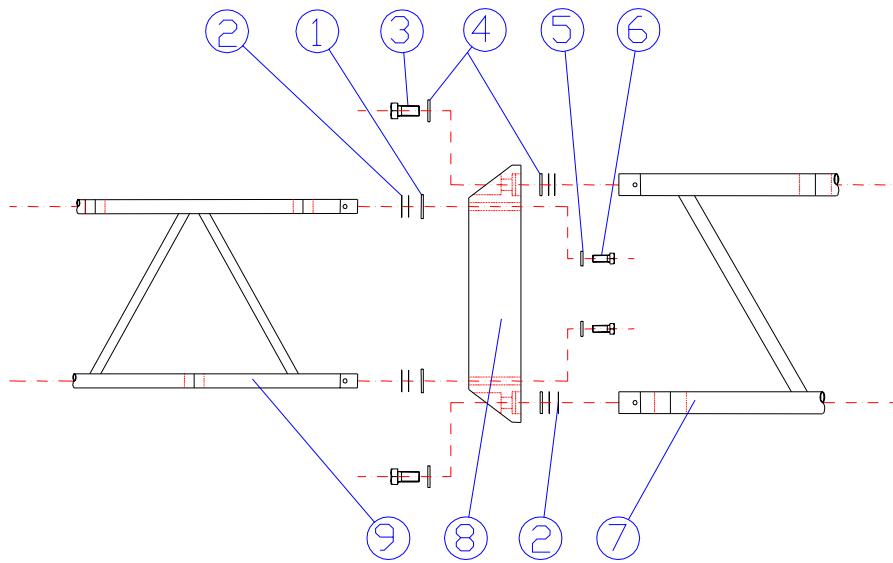


Illustration 5: Connection of mast modules to joint element.

No.	Part name	Size / model / ref.	Qty
1	Washer	ø55/16x5	4
2	Shim	ø50/24x0.5	n
3	Hex screw	M24x50	4
4	Washer	ø56/24x5	8
5	Washer	ø34/16x5	4
6	Hex screw	M16x40	4
7	Mast module	500mm	1
8	Joint element	500/400mm	1
9	Mast module	400mm	1

Table 9: List of connection parts of the joint element.



- *Recommendable lifting points of a mast are for example the top frame, the joint element and the base frame. In addition to those points, mast modules shall be lifted only from the leg beams. Never lift a mast from the diagonal beams!*
- *Be careful not to damage masts when handling them; they are designed to be frangible.*
- *Shims must be used for all leg beams in order to even the torsion load. Never tighten the leg beams to the level of the joint element by force. The diagonal beams are designed to be frangible.*
- *A hook wrench must be used for applying torque against tightening. Torsion stress caused by tightening shall not be directed to the glass fibre structure of the leg beam.*

3.3 Mounting of base frame to the mast

The base frame is manufactured of steel profile and it is finished with hot dip galvanising. The hinged base frame is suitable for both 400 mm and 500 mm mast modules. The holes of the foundation bolts in the base frame are slightly oversized. This enables the necessary adjustment of deflection $\pm 0,5^\circ$ of the masts.

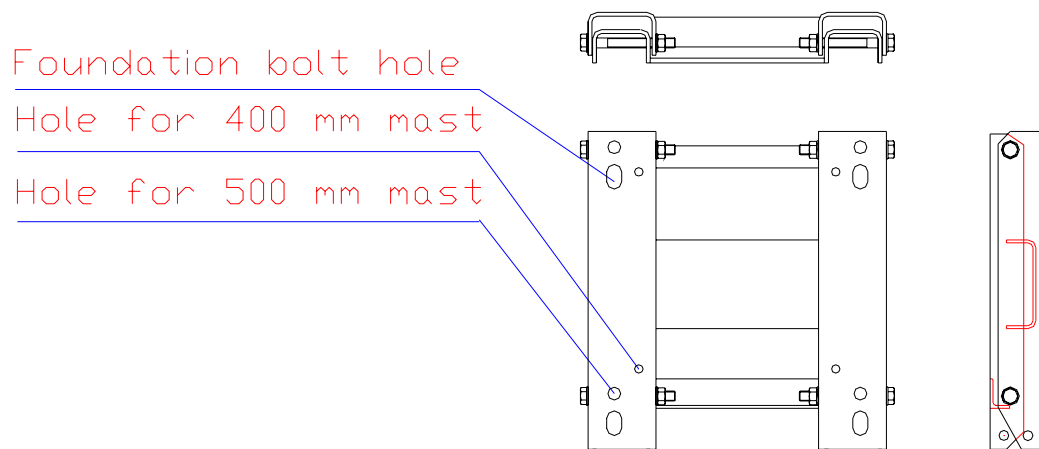


Illustration 6: Hinged base frame

3.3.1 Accessories needed for mounting the base frame

Mast module	Object	Part	Size	Qty
500 mm	-	Mast module 641148	500 mm	1
400 mm	-	Mast module 641029	400 mm	1
400 and 500 mm	-	Hinged base frame 641897B	-	1
500 mm	Connecting of mast to base frame	Hex screw	M24x50	4
400 mm	Connecting of mast to base frame	Hex screw	M16x40	4
400 mm	Load adjustment	Exel shim	Ø32/17 x0.5	n
500 mm	Load adjustment	Exel shim	Ø50/25 x0.5	N

Table 10: Accessories needed for mounting the base frame.

Mast	Action	Tool	Size
500 mm	Tightening of M24 fastening screw	Fork spanner	S=36 mm
400 mm	Tightening of M16 fastening screw	Fork spanner	S=24 mm
Both	Applying torque against tightening	Hook spanner	32 / 50 mm

Table 11: Tools needed for mounting the base frame.

3.3.2 Tightening torque for base frame screws

Mast size	Screw size	Torque
500 mm	M24	100 Nm
400 mm	M16	65 Nm

Table 12: Tightening torque for base frame screws

3.3.3 Work instruction for mounting the base frame

- The necessary bolts have been fitted to the lower end of the mast. The 400 mm mast module will be fixed with M16x40 bolts and the 500 mm mast module with M24x50 bolts. Detach the bolts from the mast.
- Detach the hinge pins and the lower half of the base frame. If you are handling more than one mast, make sure not to separate the base frame halves, because they have been matched together during frame assembly.
- Fasten the upper half of the hinged base frame to the mast. Compensate the length differences of leg beams by using shims under a shorter leg beam in order to distribute the tightening load equally between all leg beams.
- Tighten the screws of the base frame to their torque setting. Use a hook wrench to apply torque against tightening. There is a hole for the hook wrench in the aluminium bush in the end of the leg beam. This way no torsion stress is directed to the glass fibre construction of the leg beam.

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- *The mass of a hinged base frame is approximately 50 kg.*



- *Shims must be used in order to distribute the tightening load equally between all leg beams. Leg beams shall in no case be tightened to the level of the base frame by force. The diagonal beams do not sustain such stress; they are designed to be frangible.*
 - *A hook wrench must be used to apply torque against tightening. No torsion stress created by tightening shall be directed to the glass fibre construction of the leg beam.*
 - *Make sure not to separate the base frame halves, because they have been matched together during frame assembly.*
-

3.4 Installations of the top section of the mast

3.4.1 Top frame

A top frame has been mounted to the top of the mast for installation of the meteorological instruments.

- Check that the attachment bolts are tight.

3.5 Installation of electrical wires

3.5.1 Equipment needed for installation of electrical wire cover tubes

Object	Equipment	Size
Cover tube of lattice section	Plastic tube, UV-protected	ø 25-50 mm
Cover tube over joint element and base frame	Flexible plastic tube, UV-protected	ø 25-50 mm
Joint between flexible and ordinary cover tube	Cover tube joint	ø 25-50 mm
Fastening of cover tubes	UV-protected plastic straps	Suitable
Sealing of cover tubes in the bottom section	Sealing compound or tape	

Table 13: Equipment needed for installation of electrical wire cover tubes.

3.5.2 Work instruction for wiring

ICAO's recommendation for wiring of an approach mast encourages the designer to provide points of disconnection for the wires to ensure that segmentation is not hindered in case of a collision. The wiring method presented in this document satisfies that recommendation and has been found practical. These cable installation instructions can be considered a recommendation. Installation can be carried out also by using another method.

Wiring on the foundation site

- Place the cable duct tubes to the foundation prior to casting the foundation. Recommended duct tube IR 65. The cable conduit is drawn under the ground through the foundation up to and as close as possible to either inside corner of the base plate that is facing the felling direction of the mast.

Wiring to be carried out on the mast assembly site

It is recommended to wire the mast to the greatest possible extent on the mast assembly site. Only the connection of the leads in the mast to the cables drawn from the transformer housing should be carried out on the erection site.

- Follow the instructions of the meteorological instrument supplier.

4 MOUNTING AND ERECTING THE MAST

- i** • If the masts are located near to the sea or in some other corrosive environment, spread grease “Molykote Cu-7439 Plus” to aluminium and steel surfaces to prevent corrosion. Spread the grease on dry and clean surfaces.



- Check that the mast sections have not been damaged during the previous handling.
- Be careful not to damage the masts; they are frangible.

4.1 Tools needed for mounting the mast

Action	Tool	Size
M24 nuts of foundation bolts	2 pcs Fork spanner	S=36 mm
M20 screws of the hinge in the base	--:--	S=30 mm
Adjustment of upright position of mast	Water level	
Adjustment of the alignment	Optic device	
Adjustment of light height and of light alignment	Allen key	S=6 mm
Adjustment of light height	Optic device	
Lifting of mast	(Hydraulic felling device)	

Table 14: Tools needed for mounting of the mast.

4.2 Tightening torque applied in mounting the mast

Object	Size	Torque
Nuts of foundation bolts	M24 hex nut	180 Nm
Screw of hinge	M20 hex screw	50 Nm
Fastening screw of approach light	M5 allen screw	2 Nm
Clamp of adjustment tube	M8 allen screw	13 Nm

Table 15: Tightening torque settings applied in mounting of the mast.

4.3 Moving the lattice mast to its' final position

When the mast modules have been joined to each other, the mast will be moved from the assembly site to its' final position for erection. Place the mast in a horizontal position beside its' concrete foundation to wait for erection.



- Lift the mast from the top frame, joint element, base frame or leg beams. Never lift the mast from the diagonal beams.

4.4 Preparation of foundation for erection of the mast

- Remove protective tapes from foundation bolts.
- The foundation bolts have been supplied with one nut fitted. Adjust the distance between the nut bottom and the top of foundation to approximately 45 mm. Place $\varnothing 56/25 \times 6$ (No. 641879) washers on top of the nuts. Approximately 30 mm of the foundation bolt shall remain above the base plate.
- Adjust the base plates in a horizontal position with a water level. Place the lower half of the base frame on the washers, and check with the water level that the frame is horizontal. Verify that the felling direction is correct. The edge with only one hole for the hinge pin is placed on the side of the felling direction. Place $\varnothing 56/25 \times 6$ (No. 641879) washers on the frame and screw M24 lock nuts at their places. Tighten the lock nuts to their torque setting. Check after tightening that the frame is horizontal.
- Move the mast onto its' foundation so that the base frame halves can be connected with hinge screws. Fit the screws to their holes, fit the washers and nuts and tighten the nuts lightly.

i

- 2 –3 persons are needed for erection of the mast.
- Use a water level to check the horizontal position of the base frame.



- Check the correct felling direction of the mast.
 - Verify before the erection that the masts have not been damaged during handling.
 - Make sure not to separate the base frame halves, because they have been fitted together during frame assembly.
-

4.4.1 Work instruction for erection of a mast

The mast can be erected by using manual power, or by using a crane. If a crane is used, it has to be equipped with soft lifting straps.

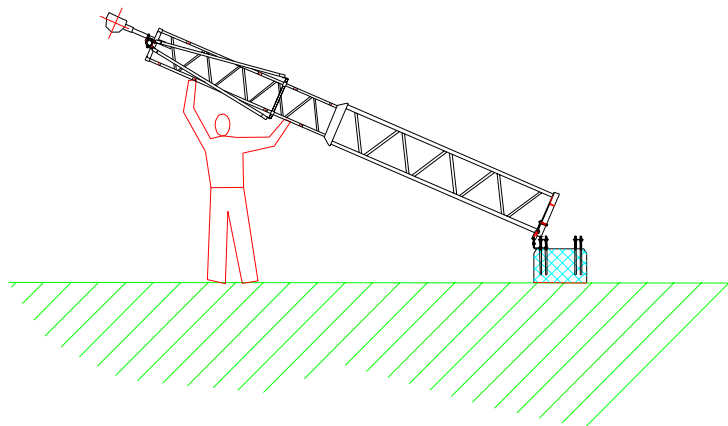


Illustration 7: Manual erection of a mast

- When erecting a mast manually, two to four persons are needed depending on the height of the mast.
- Erect the mast carefully by hand. Remember to grab the mast only from the leg beams.
- When the mast is in an upright position and the locking screw holes in the top and bottom halves of the base frame are aligned, fit the lock screws to their places, fit the washers and nuts. The holes can be aligned best by placing a pry bar between the base frame halves at both sides and then by lifting carefully upwards until the holes are at their correct places.
- Check with a water level that the mast is vertical and tighten the nuts of the hinge and lock screws to their torque setting.

Erecting the mast with a crane

- Fasten soft hoisting straps to the top frame of the mast.
- Lift the mast from the ground and lower down on the foundation steering the base frame in the correct position over the foundation bolts. Tighten the nuts lightly.
- Connect the electrical wires, take into consideration the supplementary cable length required by lowering and raising of the mast.
- Adjust the mast position and tighten the foundation bolt nuts to the torque.

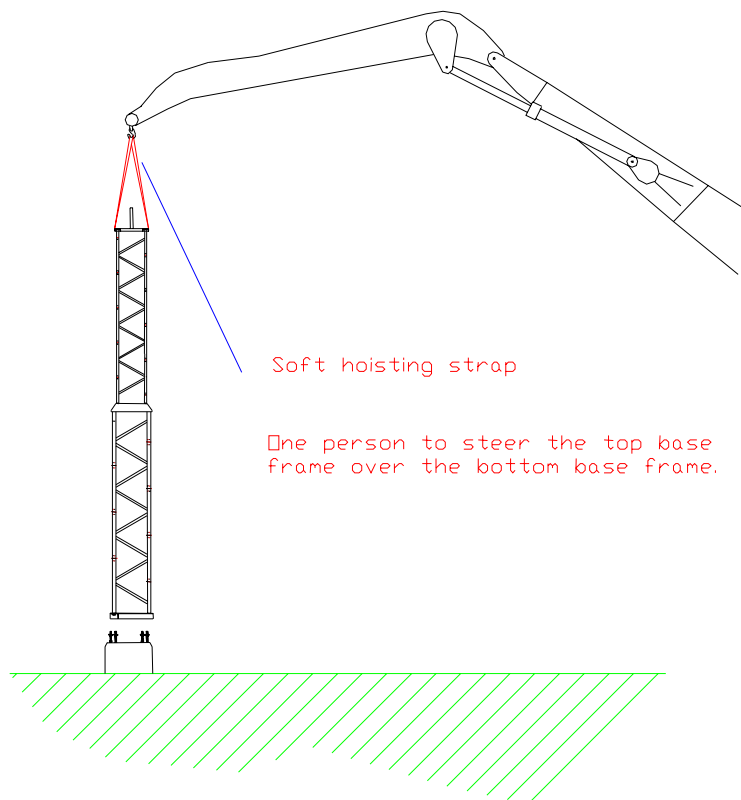


Illustration 8: Erecting the mast with a crane.

i

- When lifting the mast, 1 – 3 persons or a crane with its' driver and 1 person are needed.
- Use a water level to verify the vertical position of the mast.
- Use an optic device to measure the adjustment of alignment of the mast.



- Verify before the erection that the masts have not been damaged during handling.
 - Recommended lifting points are the top frame, the joint element and the base frame. Never lift the mast from the diagonal beams.
-

5 USE AND MAINTENANCE OF LATTICE MASTS

An Exel lattice mast is normally service- and maintenance-free. For servicing the meteorological instruments, the mast can be tilted, or the servicing is done from the basket of an access platform. Please follow the instructions of the instrument supplier.

5.1 Lowering and raising of lattice mast

5.1.1 Tools needed for lowering and raising the mast, tightening torque

Action	Tool	Size
Nuts of foundation bolts, opening/tightening	2 pcs Fork spanner	S=36 mm
Lock screws of base frame, opening / tightening	---:--	S=30 mm
Verification of vertical position of mast	Water level	
Resting the mast when lowerd	Wooden rest	

Table 16: Tools needed for lowering and raising the mast.

Object	Size	Torque
Nuts of foundation bolts	M24hex nut	180 Nm
Lock screw of base frame	M20 hex nut	50 Nm

Table 17: Tightening torque settings applied in locking the mast in vertical position.

5.1.2 Work instruction for lowering and raising of lattice mast

Depending on the mast height, 2 – 4 persons are needed for lowering and raising the mast.

Lowering

- Check that no obstacles exist in the felling area.
- Set a pry bar between the base frame halves. Detach the lock screws of the base frame from either side. While doing this, one person should support the mast assuring that it does not fall down.
- Lower the mast down carefully and set it to rest on a wooden rest.

Raising

- Raise the mast by hand, lift only from the leg beams of the mast.
- When the mast is in an upright position and the locking screw holes in the top and bottom halves of the base frame are aligned, fit the lock screws to their places, fit the washers and nuts. The holes can be aligned best by placing a pry bar between the base frame halves at both sides and then by lifting carefully upwards until the holes are at their correct places.

-
- Check with a water level that the mast is vertical and tighten the nuts of the hinge and lock screws to their torque setting.



- *Observe especially that the mast base does not damage the anchor bolt threads during lowering/raising of the mast.*



- *See the previous instructions "Work instruction for erection of lattice mast" for more detailed instructions related to mounting of the hinge tool and erection of the mast.*
-

5.2 Repair painting

5.2.1 Material needed for repair painting

Description	Quality/colour/size
Sand paper	Fine, 200-400
Acetone	
Paper or cloth towel	
Two-component polyurethane paint	Orange (RAL 2004) and Traffic White (RAL 9016)
Brush	Width app. 20-50 mm
Tape	Polypropylene, PP
Mixing stick	Wood, plastic etc.
Rubber gloves	

Table 18: Material needed for repair painting of lattice mast.

5.2.2 Repair painting

- Clean all surfaces with sand paper.
- Wipe the dust off with acetone and paper/towel.
- Mix the paint carefully. Follow the paint manufacturer's instructions.
- Brush the paint on the clean surface.

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- *Repair paint kit is available from the mast supplier.*
- *Read the instructions of the paint manufacturer for painting conditions.*
- *Recommended temperature during painting work: minimum 18 °C*



- *Read and follow the manufacturer's safety instructions.*
 - *Wear safety glasses all the time.*
 - *Use rubber gloves all the time.*
 - *Wear a dust respirator filter when necessary.*
 - *Assure good ventilation.*
 - *Avoid skin contact.*
 - *Acetone is flammable.*
-

5.3 Glass fibre tube repair

5.3.1 Material needed for glass fibre tube repair

Description	Quality/colour/size
Sand paper	Fine, 200-400
Acetone	
Paper or cloth towel	
Pre-accelerated Epoxy Vinyl Ester Resin (Component A)	Derakane 411-45/ the Dow Chemical Company
Hardener (Component B)	Butanox 50/Neste Oy
Syringe	20 ml
Glass fibre mat reel	Reel B=35-50 mm. For example Weight 425g/m ² Ward 70x320 Weft 53x272 Thickness 0,32 Weave Plain.
Two-component polyurethane paint	Orange (RAL 2004) and Traffic White (RAL 9016)
Brush	Width app. 20-50 mm
Tape	Polypropylene, PP
Mixing pots	PE/PP-plastic, 1 litre
Mixing sticks	Wood, plastic etc.
Rubber gloves	

Table 19: Material needed for glass fibre tube repair.

- i**
- Glass fibre tube repair kit is available from the mast supplier.
 - Due to the flammability of the components special packaging is required. Be prepared for higher air freight cost than normal.
 - Arrange the repair conditions as instructed by the resin/hardener producer.
 - Recommended minimum temperature for repair and painting +18 °C

5.3.2 Repairing the damage

Pre-treatment

- Remove dirt and old paint with acetone and paper.
- Abrade and clean the surfaces with sand paper.
- Wipe off the dust with acetone and paper/towel.

Mixing the components

- Read carefully the manufacturer's instructions and follow them.
- Use a syringe and/or a scale to measure the quantities of different components.
- Do not mix more than 100 g at a time, you have only about 25 min to work.

Normal mixing ratio: $\frac{\text{Component A}}{\text{Component B}} = \frac{100}{1,5}$

Doing the repair

- Spread the mixed resin on the damaged area.
- Try to soak the damaged area with the resin.
- Wind glass fibre mat tightly around the damaged area spreading more resin over the mat at the same time. Make sure that the mat is fully soaked, this is to obtain as much strength as possible.
- Wind minimum of 2 full layers, 3-4 layers where possible. Direct the layers in 30-45° angle to each other.
- Finish the repair by winding polypropylene tape around the repaired area to squeeze air out and to penetrate the resin into the tube structure.

Hardening

- Let the resin cure in the instructed temperature for 24 hours.

Surface finishing

- Remove the polypropylene tape.
- Abrade the surface with sand paper.
- Paint the repaired area as instructed earlier in this manual.

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- *The damage can be repaired as long as it is less than half of the circumference of the tube.*
- *If the tube is fully broken, contact the representative of Exel Oyj.*



- *Read the manufacturer's safety instructions and follow them carefully.*
 - *Wear safety glasses all the time.*
 - *Use rubber gloves all the time.*
 - *Wear a dust respirator filter.*
 - *Assure good ventilation.*
 - *Avoid skin contact.*
 - *Acetone is flammable.*
-

6 LISTS OF ILLUSTRATIONS AND TABLES

6.1 List of illustrations

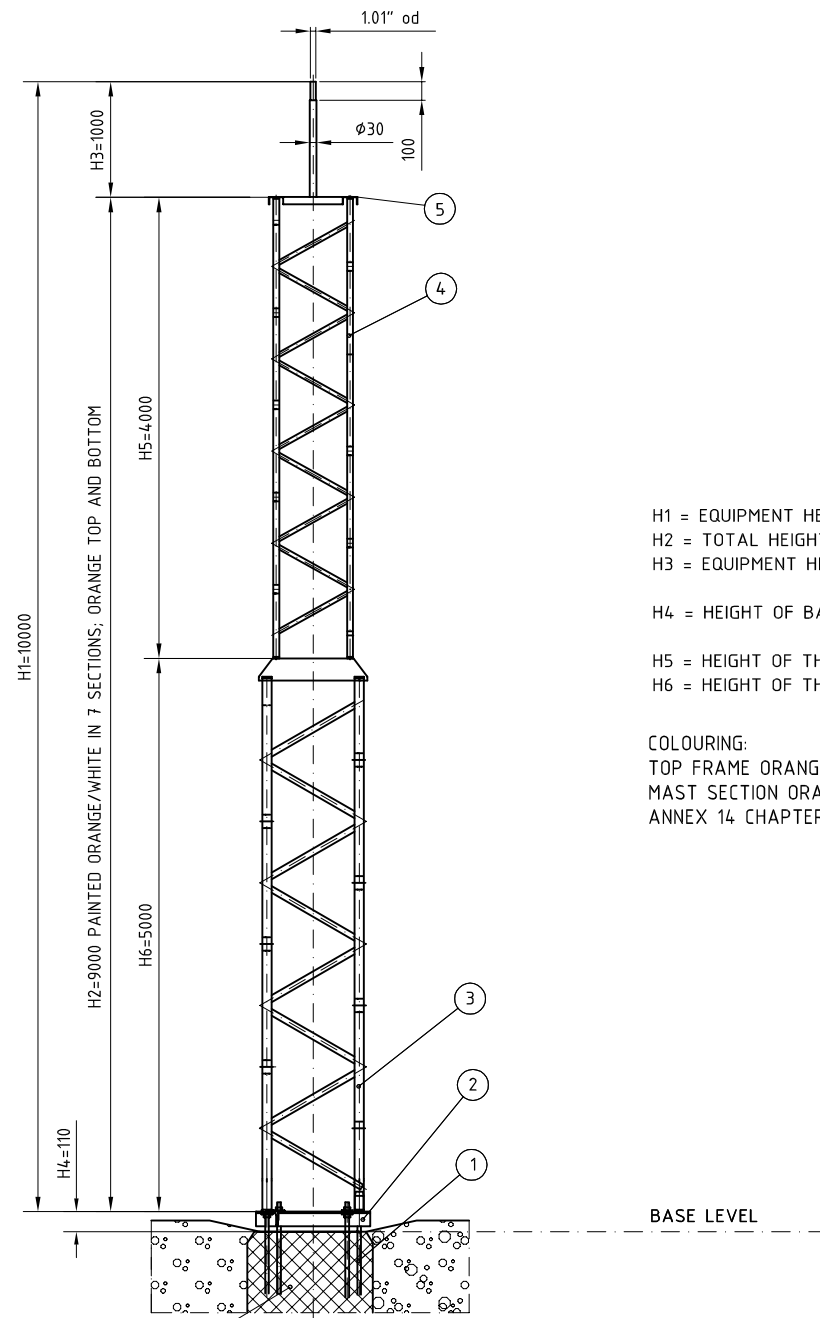
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APPENDICES

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Hinged base frame for 400 and 500 mm masts	641897B
Foundation bolt lay-out.....	641893
Foundation bolt.....	641883
Locating bush.....	641878A
WasherM24	641879
Casting jig for hinged base plate	641794C
Junction box fasteners 400 and 500 mm masts.....	641804A
Junction box fastener beam 400 mm mast.....	641805C
Junction box fastener beam 500 mm mast.....	640918C



Item	Qty	Name	Shape, dim., draw. no.	Material	Remark
1	1	FOUNDATION PARTS	641893A		
2	1	HINGED BASE FRAME	641897B		
3	1	MAST MODULE 500 mm	641148		
4	1	MASTMODULE 400 mm	641027		
5	1	TOP FRAME	642016-1000		Ø30 rod

H1 = EQUIPMENT HEIGHT FROM BASE LEVEL
 H2 = TOTAL HEIGHT OF MAST MODULES
 H3 = EQUIPMENT HEIGHT FROM THE TOP END OF THE UPPER MAST MODULE=1000 mm
 H4 = HEIGHT OF BASE FRAME UPPER SURFACE FROM BASE LEVEL=110 mm
 H5 = HEIGHT OF THE 400 MM MAST MODULE
 H6 = HEIGHT OF THE 500 mm MAST MODULE

COLOURING:
 TOP FRAME ORANGE RAL2004
 MAST SECTION ORANGE/WHITE ACC. TO ICAO
 ANNEX 14 CHAPTER 6

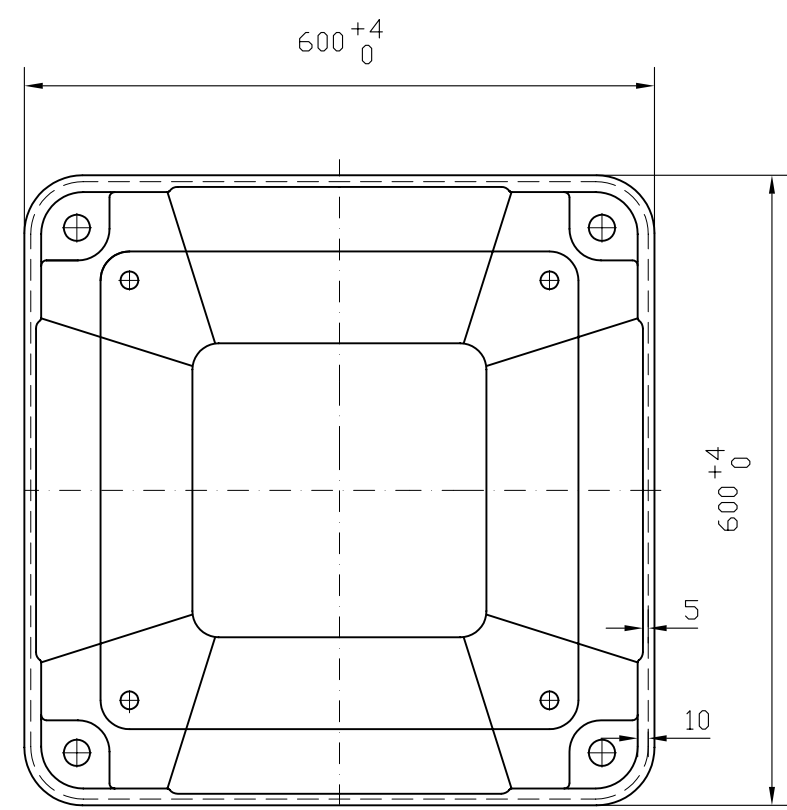
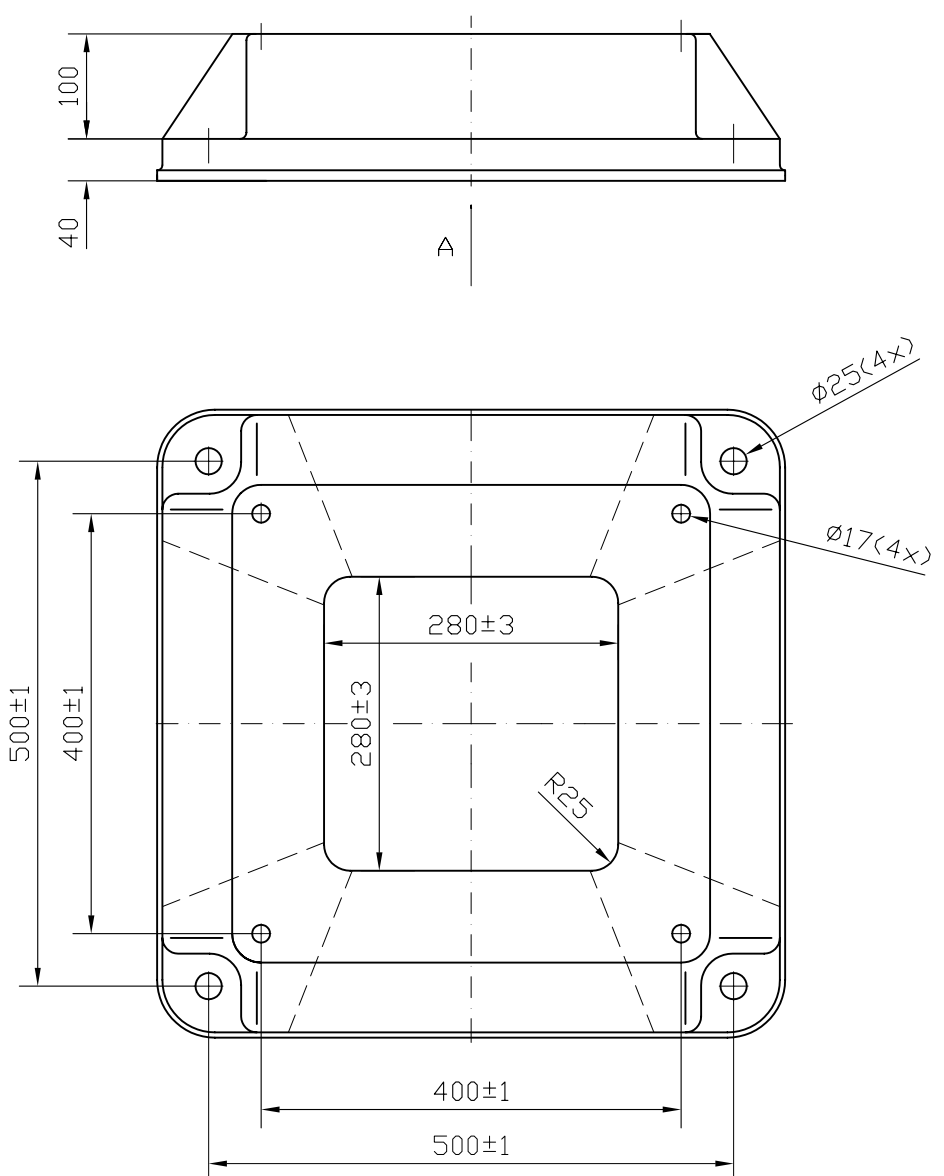
FOUNDATION BOLT LAY-OUT 641893A

CONCRETE FOUNDATION

E	2007-07-30		JMA
Rev.	Date	Information	Design.

Project	Title	 KIVARA FACTORY MUOVILAAKSONTIE 2 FI-82110 HEINÄVAARA
Reference	METEOROLOGICAL MAST	
	500-5000/400-4000/30(1.01")-1000	
Scale	ASSEMBLY	Draw. no.
1:20		640789E

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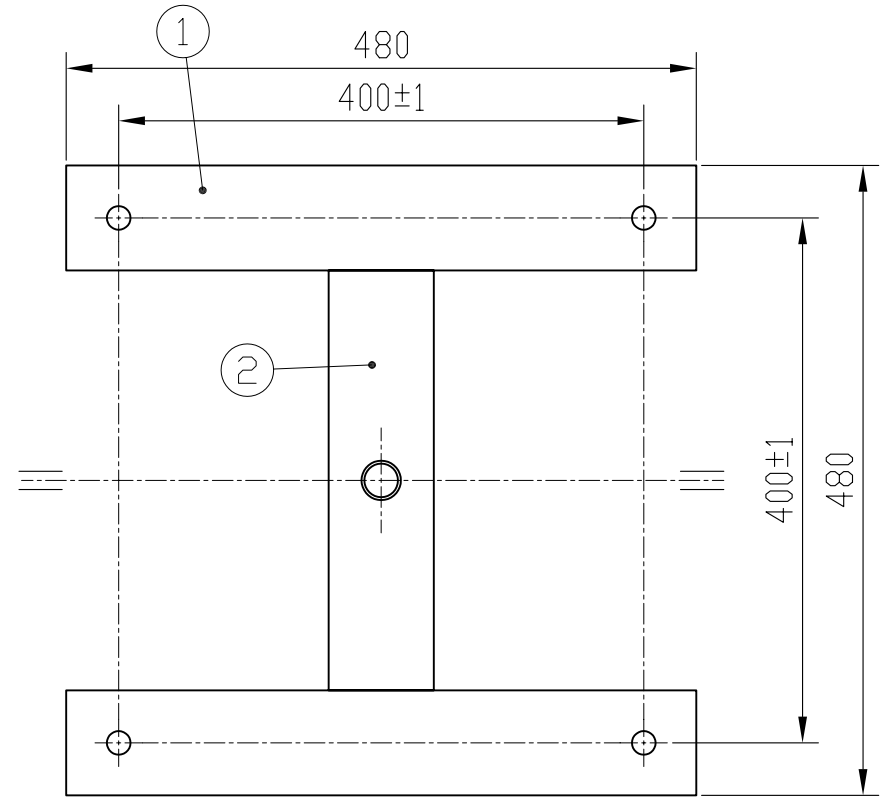
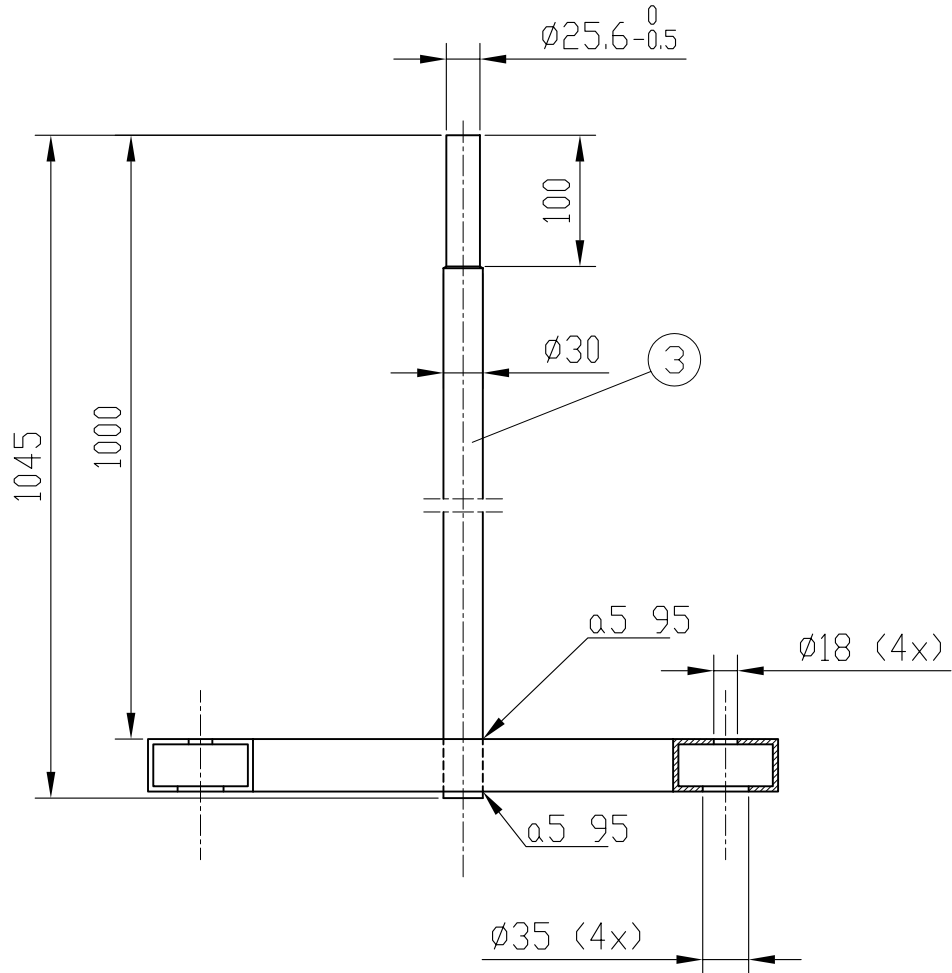


VIEW A


Project	Title	
Reference		
	LATTICE MAST JOINT ELEMENT	KIVARA FACTORY MUOVILAAKSONTIE 2 FIN-82110 HEINAVAARA
Scale 1:5		Drw. no. 641000A

A	6.2.2002	SHAPE CHANGED	JMa
Rev.	Date	Information	Design.

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1	2	RHS 80x40x3	L=480	AlMgSi T6	
2	1	RHS 80x40x3	L=320	AlMgSi T6	
3	1	Rod $\phi 30$	L=1045	AlMgSi T6	



Terävät reunat viistetään
Sharp edges chamfered

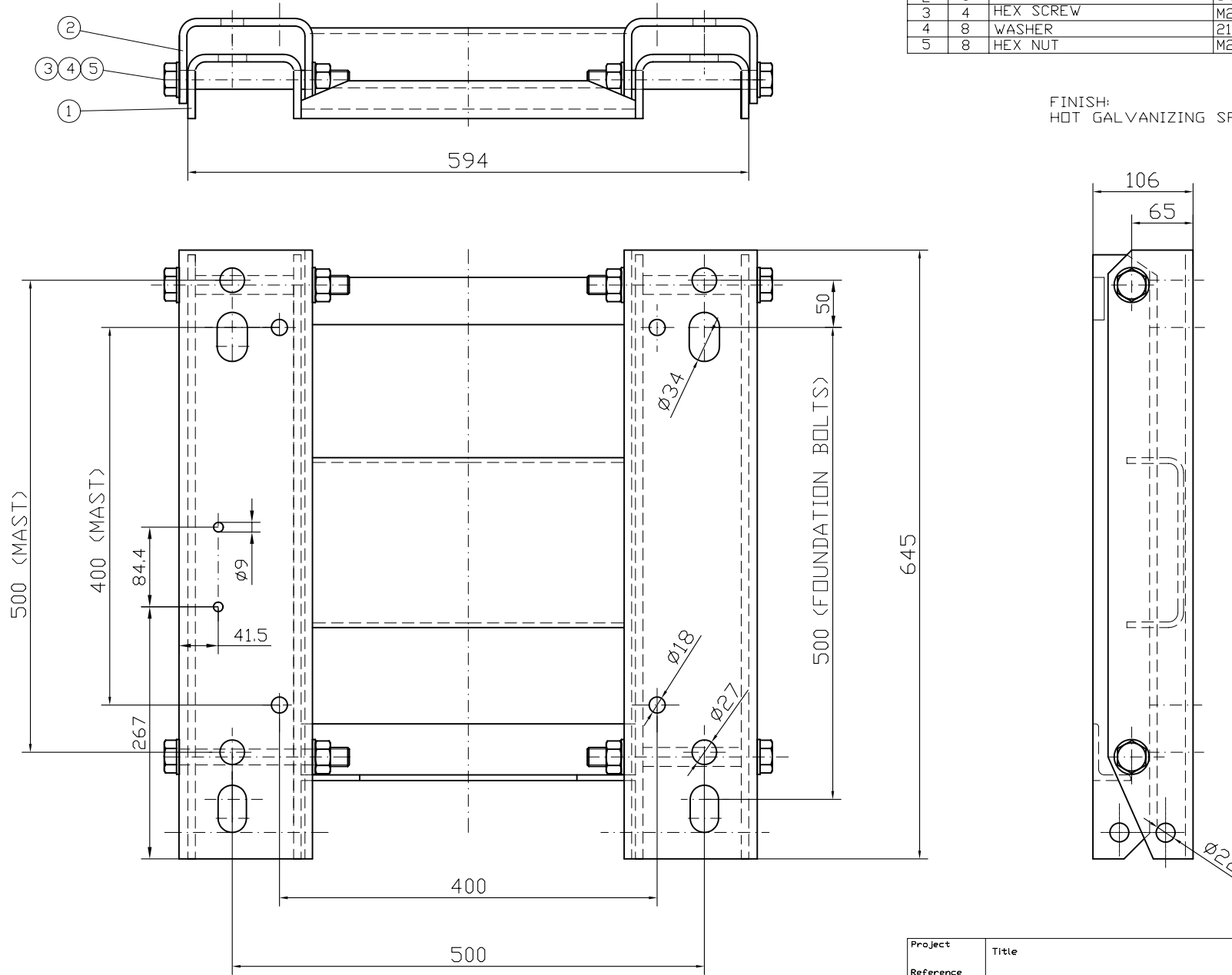
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Reference	YLÄKEHÄ $\phi 25,6-1000$			
Scale	TOP FRAME dia. 1.01"-40"			
Rev.	Date	Information	Design.	Drw. no. 642016A

31.5.2001	JMa		
Rev.	Date	Information	Design.

Item	Qty	Name	Shape, dim., drw. no.	Material	Weight
1	1	BOTTOM PLATE	641896		
2	1	TOP PLATE	641895A		
3	4	HEX SCREW	M20x180 SFS2063	KZN	
4	8	WASHER	21 SFS2041	KZN	
5	8	HEX NUT	M20	KZN	

50 kg

FINISH:
HOT GALVANIZING SFS 2765 ZNK 420, 60µm



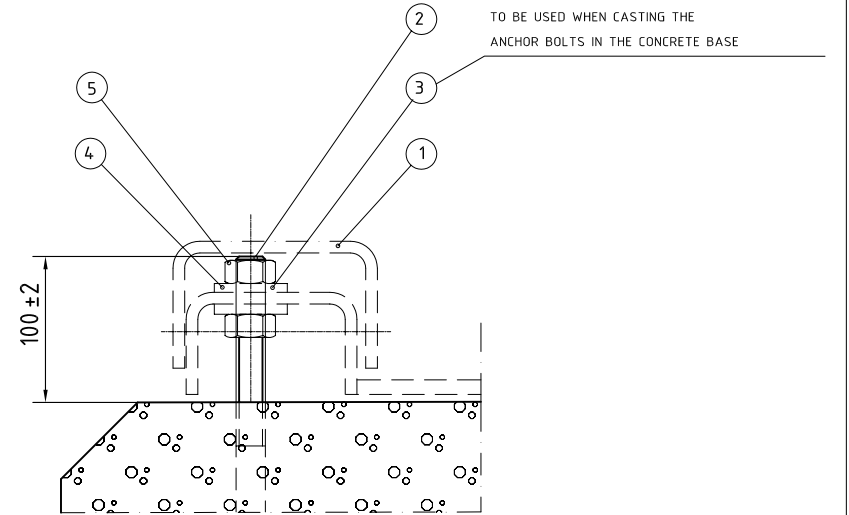
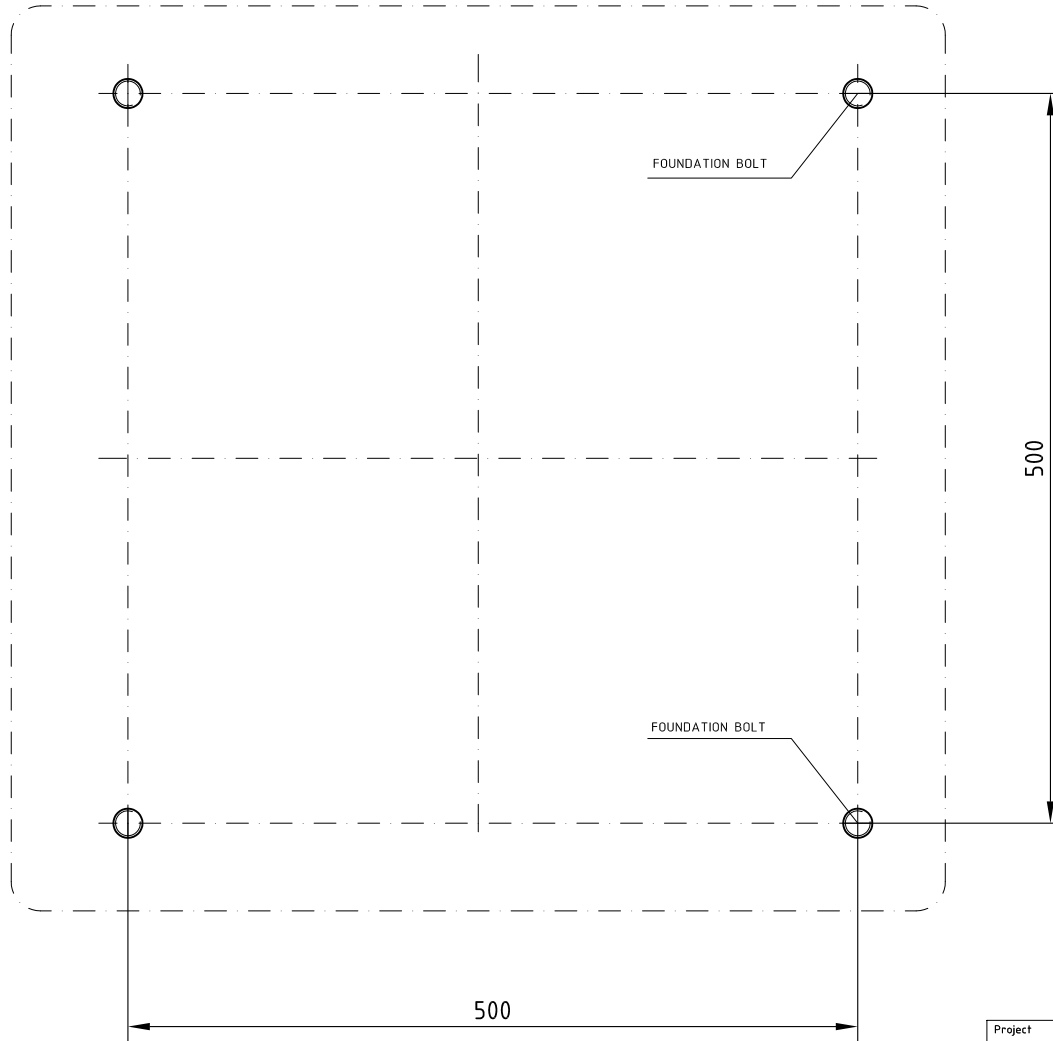
Rev.	Date	Information	Design.
B	26.02.2001	Holes $\phi 9$ - 2 pcs added	JMA

Project	Title
Reference	
Scale	500 and 400mm MASTS
1:2.5	

exel
KIVARA FACTORY
MUOVILAAKSONTIE 2
FIN-82110 HEINÄVAARA

Drw. no.
641897B

Item	Qty	Name	Shape, dim., drv. no.	Material	Remark / Weight
1	(1)	BASEPLATE	641897B		
2	4	FOUNDATIONBOLT M24	641883 / 641882		
3	(4)	LOCATING BUSH	641878		
4	8	WASHER $\phi 50/\phi 26$	641879		
5	8	NUT M24 GALVANIZED	DIN 934		

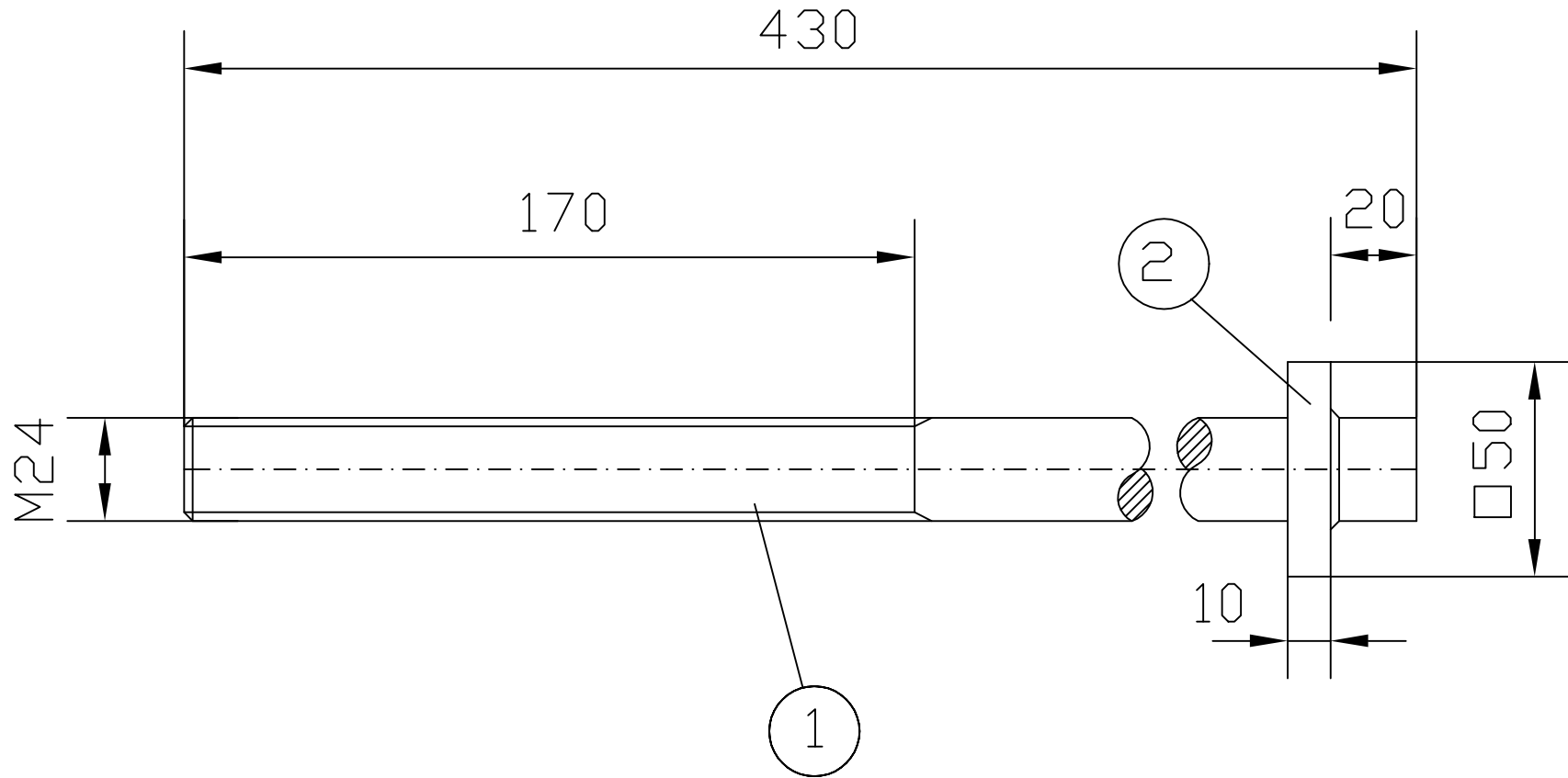


Rev.	Date	Information	Design.
	1999.01.19		MP

Project	Title
Reference	
Scale	
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exel
 KIVARA FACTORY
 MUOVILAAKSONTIE 2
 FIN-82110 HEINÄVAARA

Drw. no.
641893



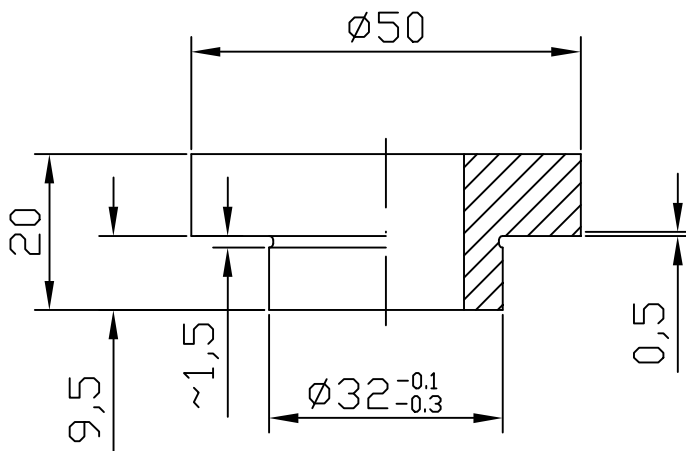
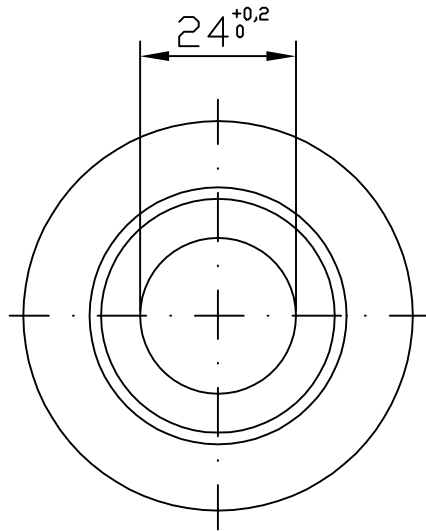
2	1	LEVY	10x50x50	Fe 52C	0.2kg
1	1	HARJATANKO	Ø25x430	A 500HW	2.6kg
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Scale		1 : 1			
Design.		MPä			
Rev.		Date		Information	
20.1.1999					
641883					

exel


KIVARA FACTORY
MUDVILAAKSONTIE 2
SF-82110 HEINÄVAARA

Drw. no.
641883

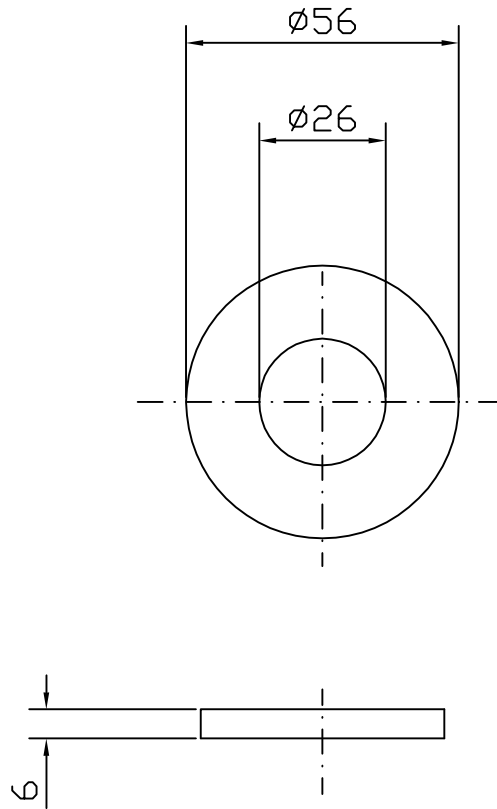
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Scale 1:1		

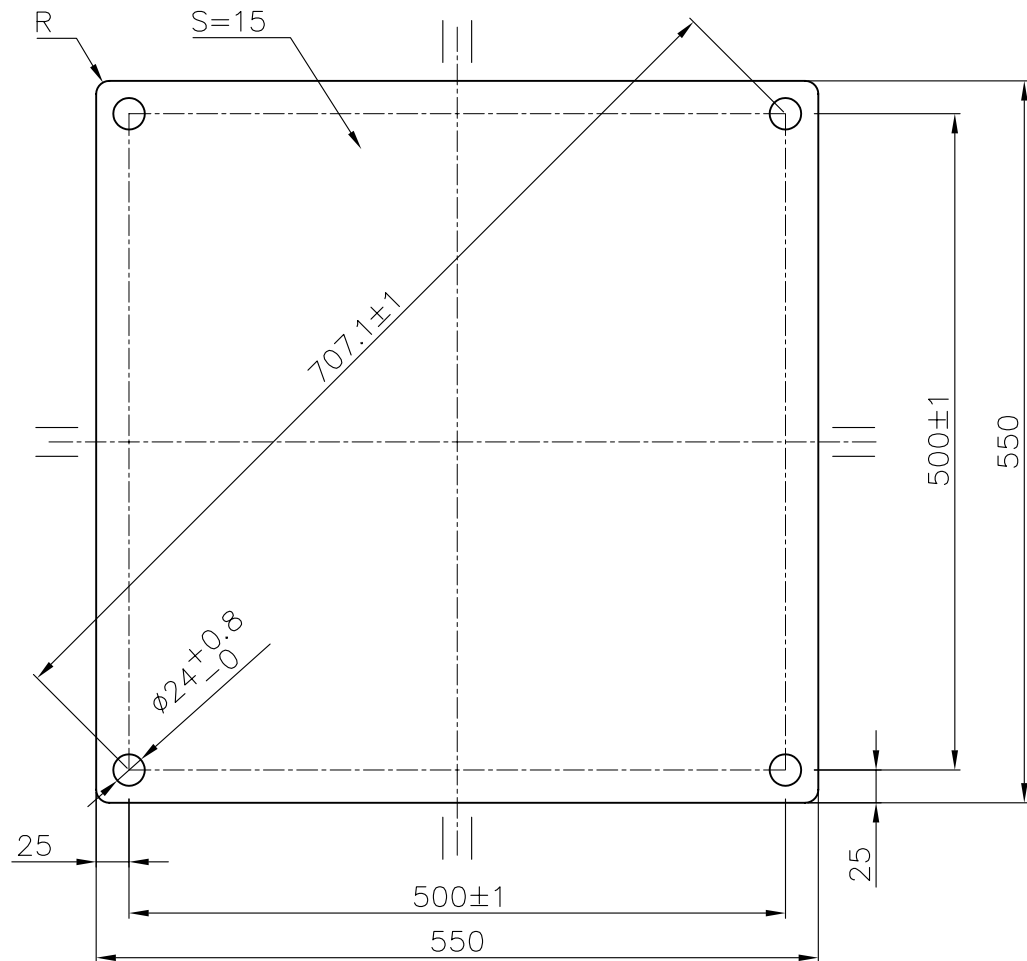
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Pintakäsittely: Kuumasinkitys SFS 2765 Zn_k 420 60_{um}
 Finish: Hot Galvanizing SFS 2765 Zn_k 420 60 _{um}

Project	Title ALUSLEVY Ø56/26 WASHER Ø56/26	 KIVARA FACTORY MUOVILAAKSONTIE 2 SF-82110 HEINÄVAARA
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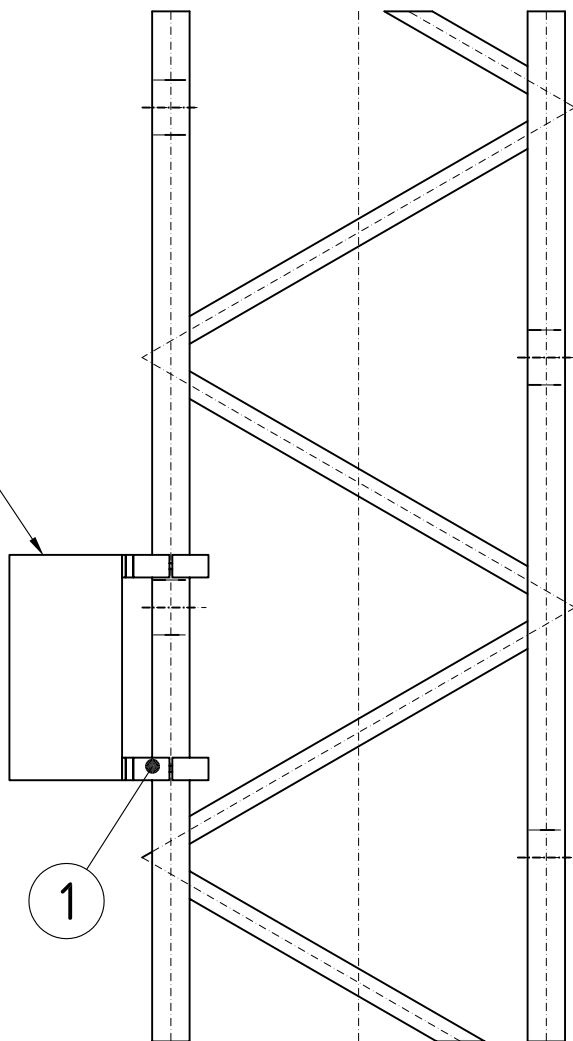
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Scale						
Rev.	Date	Information	JMA Design.	1:4	Drw. no.	641794C



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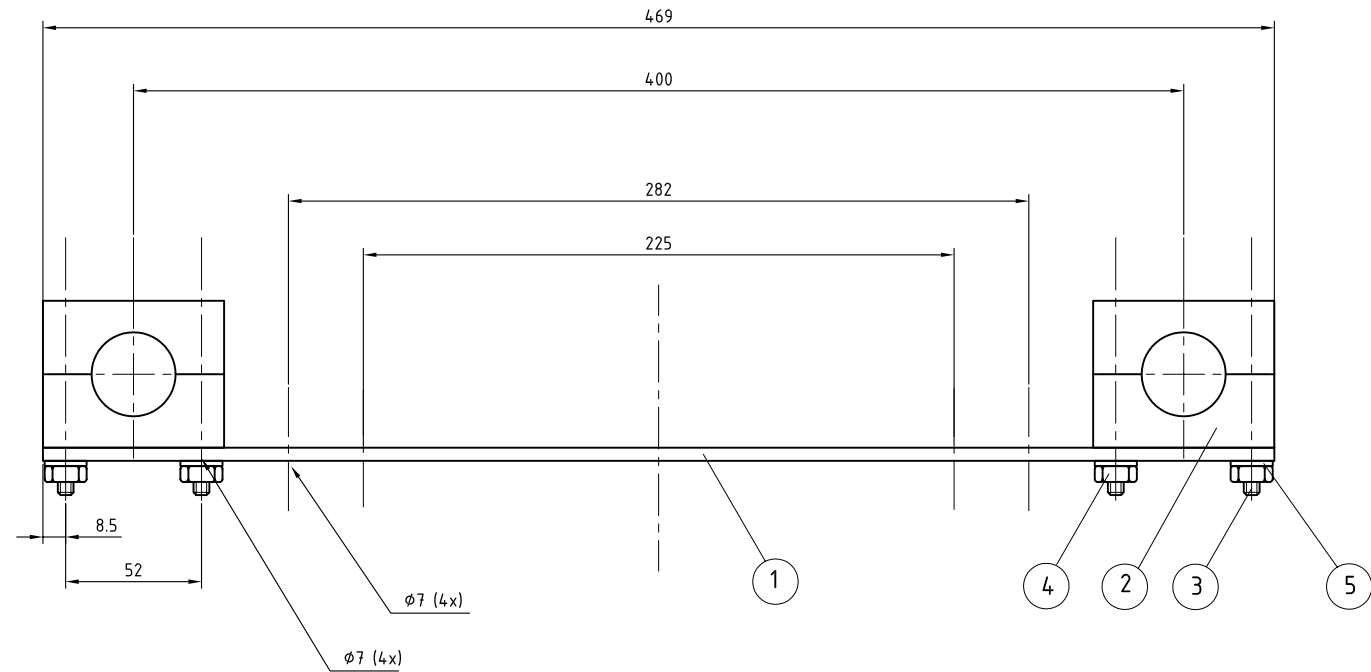
junction box



641805C for 400mm Mast
640918C for 500mm Mast

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1:10		Drw. no.			641804A	
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Rev.	Date	Information				Design.

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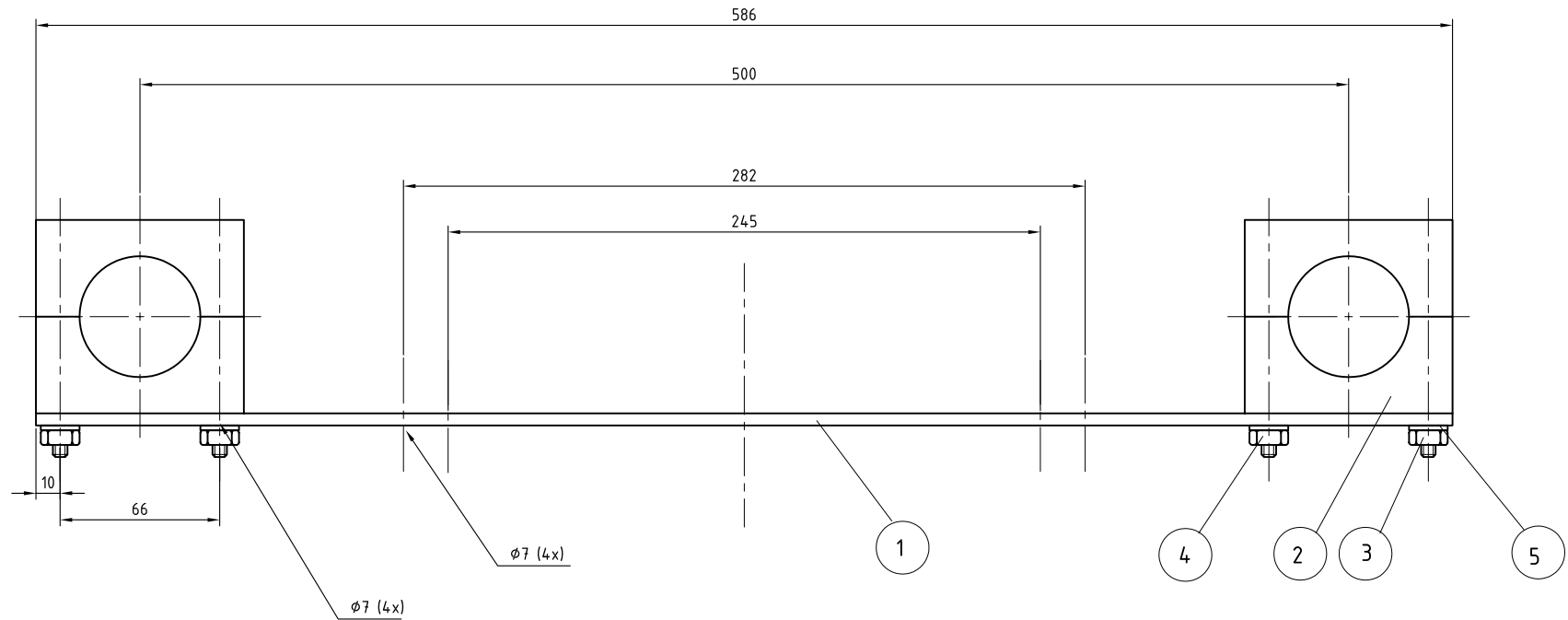


5		Washer	DIN 125	M6	A2	4
4		Nut	DIN 985	M6 NYLOC	A2	4
3		Allen screw	DIN 912	M6x70	A2	4
2		Clamp	STAUFF	532	PP	2
1		Beam	K-C04118	30*6*469	GRP	1
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Project	Junction box fastener beam 400 mm mast	 KIVARA FACTORY MUOVILAAKSONTIE 2 FIN-82110 HEINÄVAARA
Reference		
Scale		
Drw. no. 641805C		

C	2000-01-20	Dimensions and material changed	JMA
Rev.	Date	Information	Design.

Item	Qty	Name	Shape, dim., drw. no.	Material	Weight
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5		Washer	DIN 125	M6	A2	4
4		Hex nut	DIN 985	M6 NYLOC	A2	4
3		Allen screw	DIN 912	M6x80	A2	4
2		Clamp	STAUFF	650	PP	2
1		Beam	K-C04118	30*6*586	GRP	1
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Project	Junction box fastener beam 500 mm mast	 <small>KIVARA FACTORY MUOVILAAKSONTIE 2 FIN-82110 HEINÄVAARA</small>								
Reference										
Scale										
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