# VACONO*DOME*

**Aluminium Geodesic *DOME* Roof**

## INSTALLATION MANUAL

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# Contents

# 1. Introduction

The VACONO*DOME* parts are pre-fabricated in Rheinfelden and delivered ready for assembly, complete with all necessary erection plans and instructions. All items are individually numbered for easy identification ( see overview drawing ).

The erection of the VACONO*DOME*, begins at its centre, and is constructed on a ring by ring basis until the outer ring is finished. The VACONO*DOME* structure comprises of profiles and hub plates which are fastened together by Huck Bolts.

The *DOME* sheets can then be installed and fastened with the clamping profiles.

The completed *DOME* can then be lifted and fastened on to the tank.

Thereafter the flushing sheets and negotiation devices can be fitted to the *DOME*.

## 2. General Erection Instructions

- Receipt of material on site.
- Unload material and examine for transport damage and missing parts.
- Move material to a point adjacent to the construction area.
- Mark out the construction area and check lifting equipment, cranes etc. for capacity against *DOME* weight
- Assemble tripod (see drawing SGB-60943-1) and chain block lifting gear.

**Attention:** **The Aluminium *DOME* sheets have to be stored always upright, clean and dry. If this instruction is not followed, the *DOME* sheets can become discoloured through surface corrosion, which has no affect on the material, but visually it is unsightly.**

# 3. Special Tools for Erection

## 3.1 Erection Tripods

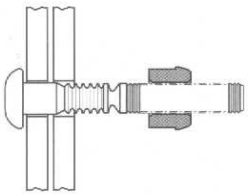
The erection tripods are to be used during installation on the ground. The quantity required depends on the diameter of the VACONO*DOME* (see installation drawing). It is a very simple construction, but effective. We will provide our customers with the drawing (SGB-60943-1) for local manufacture. The chain block is a standard tool. The required capacity of each should be 3t.


## 3.2 The Huck Bolt System

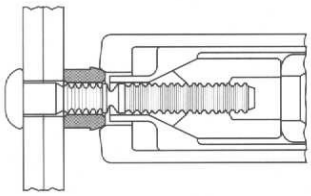
The Huck Bolt System is a very simple, quick, versatile and advanced fastening system. It is designed to eliminate installation errors caused by operator or tool variables. The consistent high uniform clamp force is guarantied. With a visual inspection you can see that the bolts are installed correctly.

Principle of System:

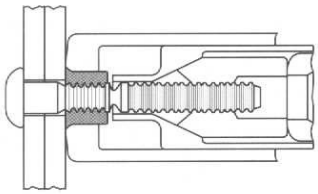
The pin is inserted through a prepared hole.
Place the collar over the pin.



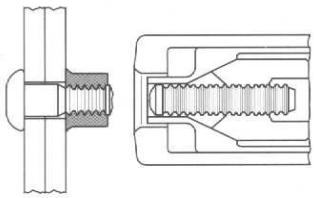
Place the nose assembly, attached to Huck`s installation tool, over the pintail and against the collar.



The nose assembly pulls on the pin, drawing the materials together, and swaging the collar into the locking groves.

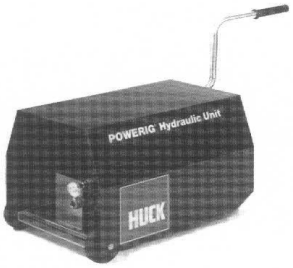


The nose assembly continues to pull until the pintail breaks. The nose is pushed off the swaged fastener

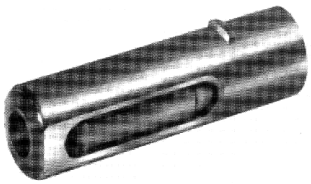


## Tools - Hydraulic System:

Tool 2600



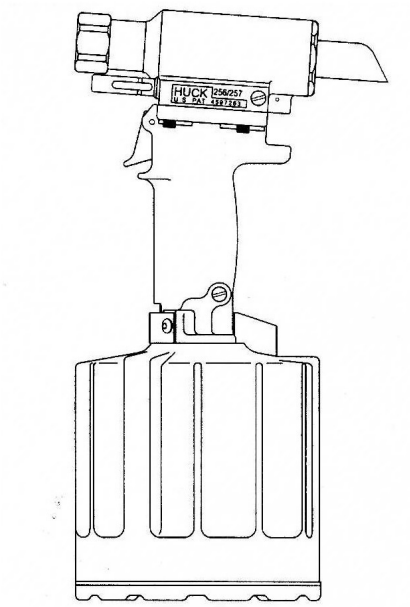

Hydraulic Pump HK 432



Nose 99-2663

## Tools - Pneumatic System:

The principle is simple like the hydraulic Huck Bolt System. It can be used in connection with a local standard compressor.




Tool 256


Standard Compressor to be locally provided
Tool 256
Minimum Specification:
Pressure: 8 bar at the tool
Air Tank Volume: 50 l
Air System 240 l/min

## 4. Pre-Assembly Instruction

- Co-ordination of time schedules

- Obtain permissions, if necessary

- Keep materials secure and clean

- Before starting work at site check with the operator or site supervisor the safety regulations; and other formalities to be observed or completed

- Unload material as close to tank as possible and check for damage during transport. If damage is found, request signature of driver immediately and – if possible – notify representative of customer. Report damage to be sent immediately to VACONO in Rheinfelden.

- Supply of electricity, air and water required

- Check the orientation of the *DOME* according to drawing

- Special and standard tools in accordance with tool list

- If oxy-acetylene cutting and welding operations have to be carried out on the tank customer has to be advised. Check the relevant safety regulations

- Check that all workers have put on their personal protective clothing

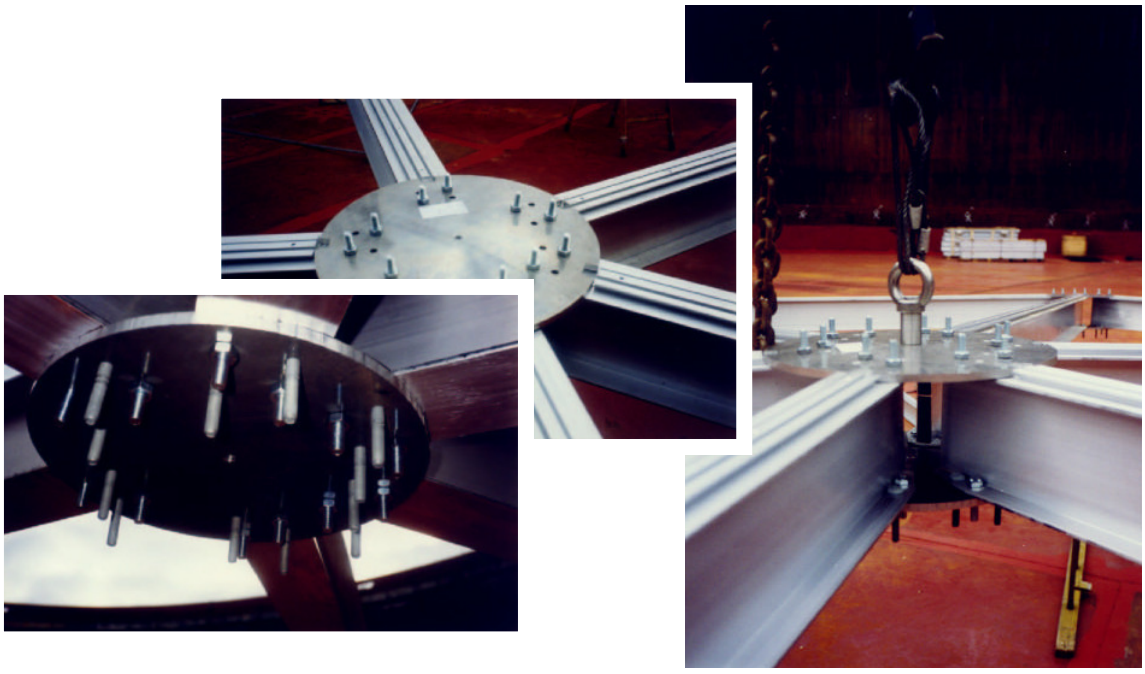
## 5. Assembly of Supporting Structure

Place the tripod in the center of the tank or center of assembling area.

According to the numbered positions in the overview drawing you can clearly see where the struts and gusset plates have to be placed, which position the *DOME* they are located on.

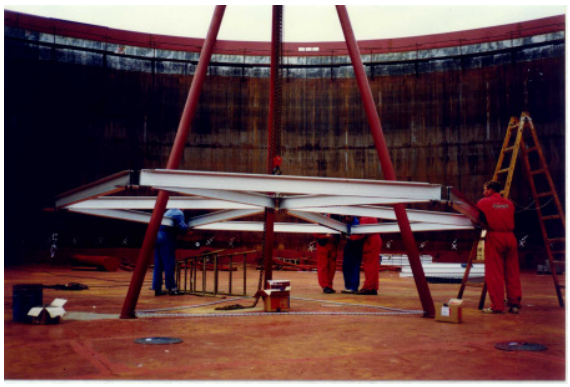
Lock bolts out of galvanized Steel, Stainless Steel or Aluminium can be used according to the design.

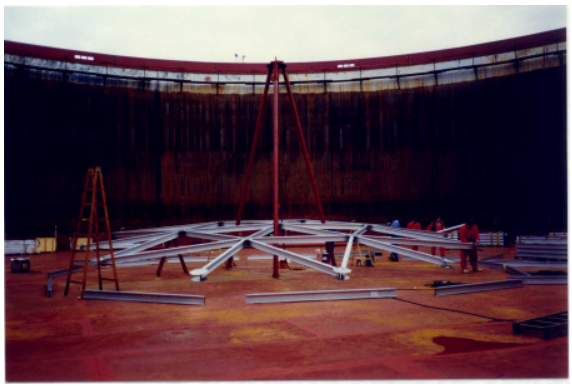
Fit an eye bolt to centre top gusset plate (see 10.2 anchor point) and hang on the lifting hook. Locate the carriage profiles and hang them on to the centre top gusset plate, using two bolts in each. Locate and secure the centre lower gusset plate to the underside of the carriage profiles (see drawing SGB-60751-4E), using 2 bolts and 2 Huck Bolts. Locate and fit top and bottom gusset plates to the outer end of the carriage profiles, using bolts and Huck Bolts.



Locate and fit the inner tension ring profiles to the top and bottom gusset plates, using bolts and Huck Bolts.

Using the tripods, ensure the materials are above ground level to avoid dirt. Locate and fit the second ring carriage profiles, using bolts and Huck Bolts. Locate and fit the top and bottom hub centre plates for the second ring, using bolts and Huck Bolts. Locate and fit the second tension ring profiles, using bolts and Huck Bolts. Use suitable packing to ensure that the assembly, when lowered sits flat, and is supported on it's total circumference.





**Attention:** **When lowering the *DOME* (either from the tripod or by crane) it should at all times be supported through the use of wooden blocks or other suitable materials as close to the hubs as possible. Placing supports on the beams is to be totally avoided. Damage may occur if the correct lifting procedure is not adhered to.**

Commencing in the centre, line up the holes through the gusset plates and the carriage profiles, insert Huck Bolts and fasten them using the Huck Bolt Machine. Continue until the first carriage profiles and the first tension ring are completely secured.
Raise the assembly and commence assembling further carriage profiles and tension rings, using bolts and Huck Bolts. Lower the assembly onto suitable packing and fasten the second tension ring and carriage profile with Huck Bolts.
Continue the process of assembling the next ring of carriage profiles, hubs and tension ring profiles, securing the previous tension ring with Huck Bolts until the assembly of the outer ring is complete .

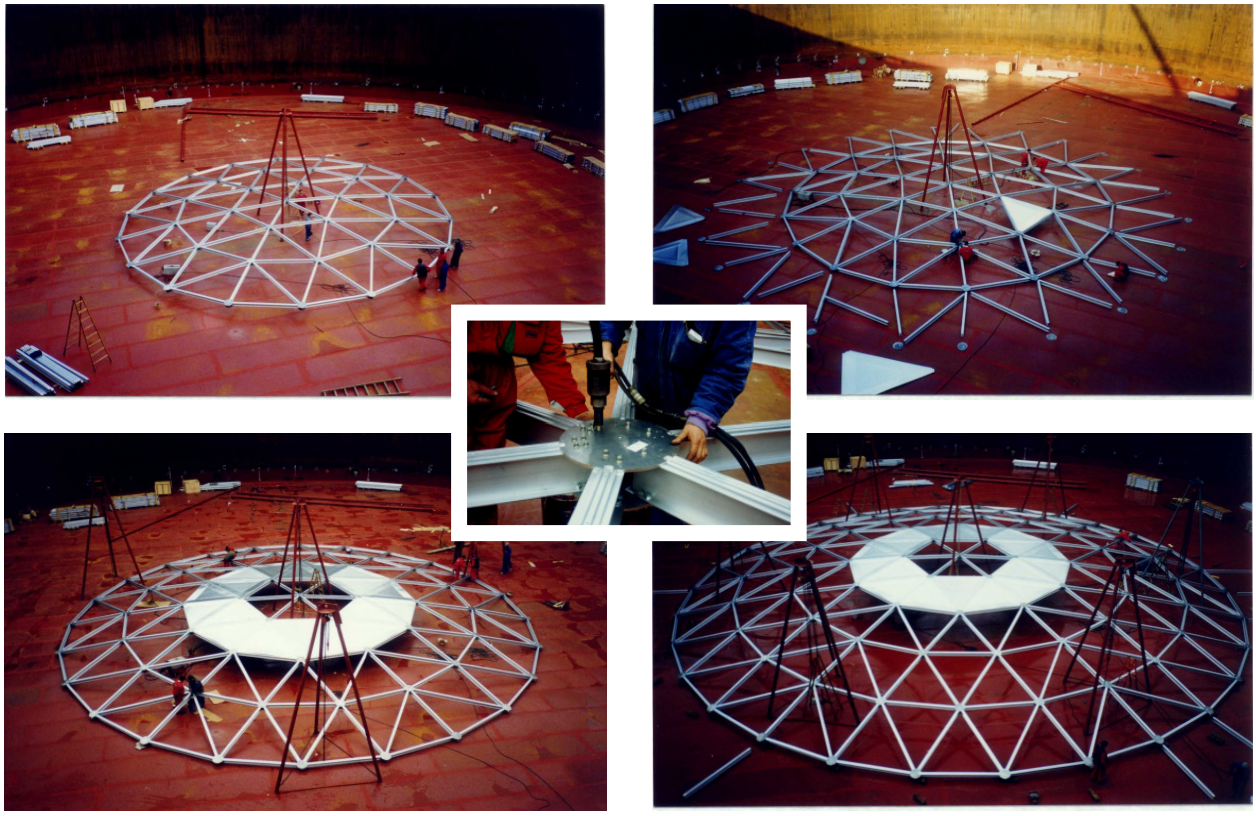
Note: Care should be taken that the Huck Bolts are not permanently fixed until the next ring of carriage profiles hubs and tension rings is placed on the *DOME*.

Lower the assembly onto suitable packing on the ground and level the structure with the aid of a dumpy level and further packing.
Locate and fit the outer profile and supports using bolts.

**Attention:** **Should the bottom hub-plate be of the thicker type (15 mm) use the longer Huck Bolts if there are two types of Huck Bolts.**

Fasten the outer ring of carriage profiles, tension ring profiles and supports (see drawing SGB-60752-4E), using Huck Bolts.

Again check to ensure that the structure is level.
Using a compressed air line, clean out all the top channels.



After the structure is complete the galvanized Steel Huck Bolts have to be protected at the break points against corrosion with an Aluminium spray. The break of Stainless Steel - and Aluminium Bolts have not to be protected against corrosion.

## 5.2 Erection using Nuts and Bolts

Instead of using Lock Bolts the dome structure can also be assembled using standard nuts and bolts whereby the procedure described under para. 5.1. necessitating the pre-fixation of the structure using " erection bolts " is no longer required.
The nuts and bolts should however not be completely tightened until complete pre-assembly of the next *DOME* ring has been made. Thereafter the nuts and bolts shall be fully tightened to the following torque values given. This procedure shall be followed ring for ring until the *DOME* structure is complete.

| Bolt Type | Bolt Quality | Thread | Torque $M_k$ [Nm] |
|---|---|---|---|
| Galvanised Steel | 10.9 | M 10 x 1.5 | 72 |
| | 10.9 | M 16 x 2,0 | 310 |
| Stainless Steel | A2-70 | M 10 x 1.5 | 30 |
| | A2-70 | M 16 x 2,0 | 121 |

**Important:** Once each nut and bolt has been tightened to the required torque it should be marked with a dab of paint colour for confirmation.

## 6. Assembly of *DOME* sheets

Triangular *DOME* sheets to be laid by hand starting from the *DOME* centre (top) so that they fit cleanly into the profile slots. Ensure that the slots are free and clean of debris and other matter.

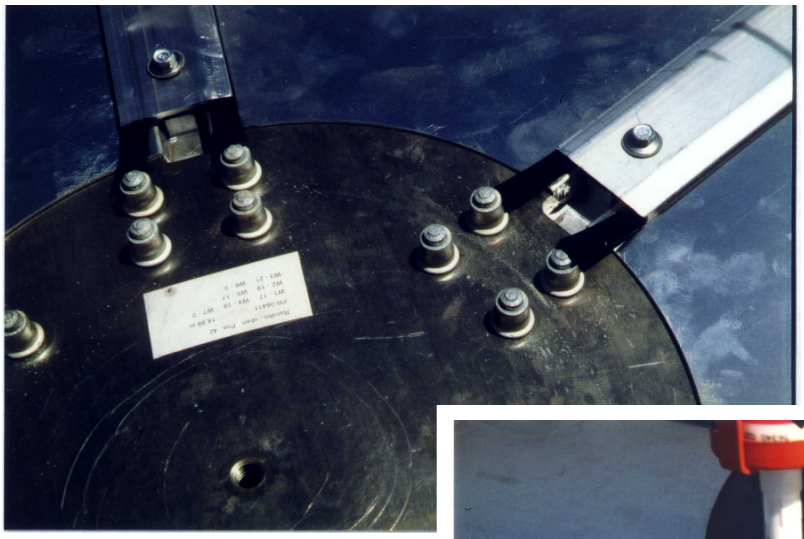
Thereafter fix the clamp bar profiles and tighten it to the screw channel using the provided screws. In order to place the clamp bar at the correct position follow the instruction as shown in the attached detail. Leave the outer 2 holes (1 either end) at the end of the support structure free until the hubs are installed.

Complete the above procedure up until the last ring of the *DOME* with the exception of the negotiation devices. *DOME* accessories such a manholes, vents etc., should be incorporated into the appropriate cover panels prior to their being mounted if possible.

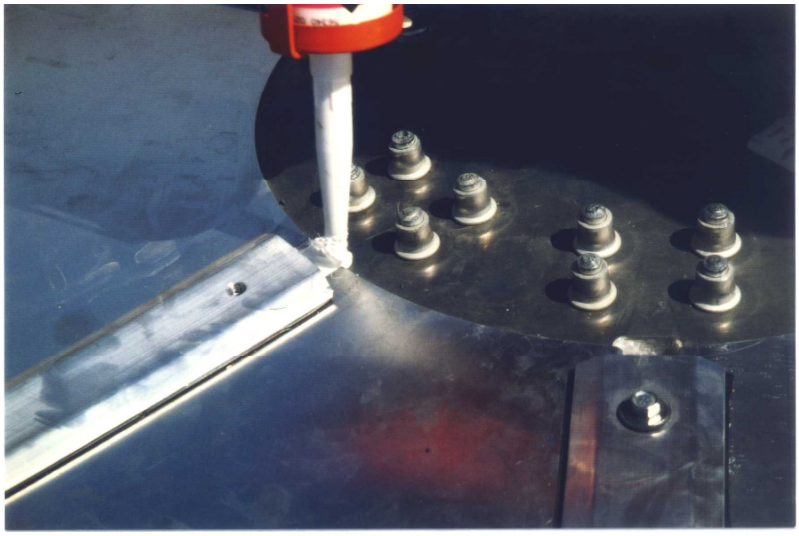
**Attention:** **Do not step on the *DOME* sheets until they have been secured on all three sides with the clamping profile!**

## 7. Assembly of Hubcaps

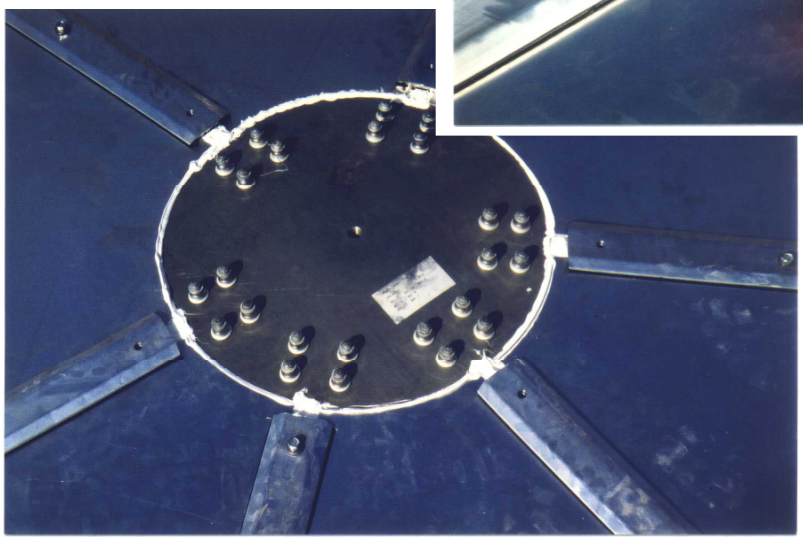
When all the *DOME* sheets and clamp profiles having been installed, great care should be taken on the following work.



Over long seal gasket of clamp profiles have to be cut to the same length as the profiles.



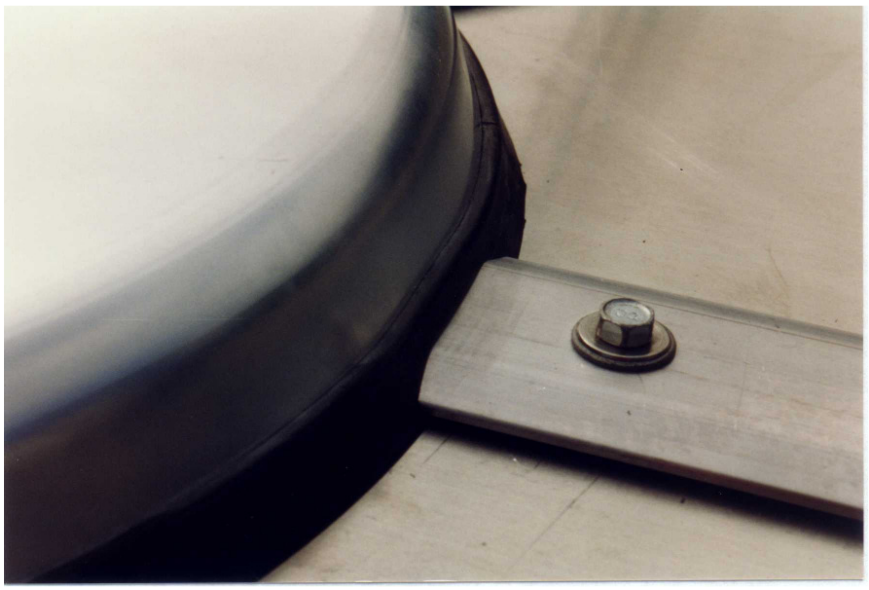
Each of the hub connections to the carriage profiles should be filled with silicon.

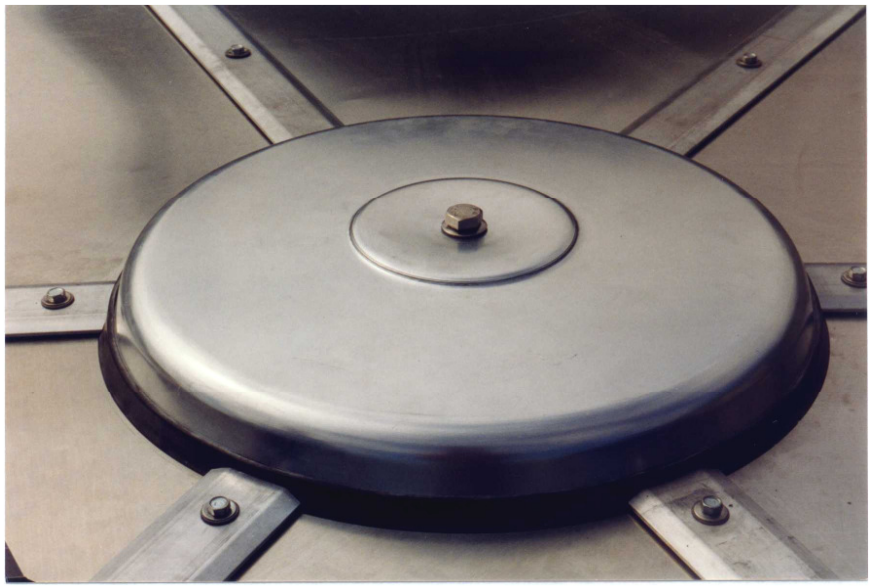


The gap found between the upper part of the hub and *DOME* sheets should also be filled with silicon.

**Note:** Usually always transparent silicon will be supplied, white silicon is only used on the photo.

Now the hub covers can be installed. Place the round gasket on the edge of the hub cover. Put some silicon on the part of the gasket where it is in contact with the *DOME* sheets. Thereafter the hub covers are to be centrally positioned over the middle of the hub, the sealing ring and clamp profile pressed down and tightened using the centre bolt provided. Lifting of the clamping profile may make the task a little easier. Afterwards the two outer holes left open in the carriage profile can be screwed tight and the remaining accessories installed.





# 8. Lifting of the VACONO*DOME*

## 8.1 Lifting after erection outside the tank

The nearly completed *DOME* is lifted to the tank rim using steel wires, ropes etc. which are attached to outer hubs. The number of lifting points necessary will depend on lifting capacity as well as the weight of the *DOME*. Referring details see static report.

**Attention: Please note the lifting points should always be arranged symmetrically!**

When lifting by crane the attention should be given to the number of lifting points required otherwise the maximum permissible stress on the hubs may be exceeded and/or the *DOME* structure may deform (see static report and installation drawing).

Web slings are to be used and looped round 2 or 3 carriage profiles. The hubs and profiles are to be protected and the underside of the hub gussets should be supported (through the use of wood etc.). After lifting the *DOME* those *DOME* sheets not installed adjacent to the lifting point, can be fitted.

Lifting of the *DOME*

The following steps are to be taken after lifting and positioning the *DOME*:

**Important: For the support arm longer Huck Bolts are to be used!**

Bolting the support arms to the outer gusset plates.

The *DOME* can be lowered on the tension ring.

## 8.2 Lifting after erection inside the tank

**When using the specially provided erection hubs a special attention should be paid to the procedures.**

The *DOME* will be erected on the ground of the tank according to our installation manual. On the outer side the special erection gusset plates (half plates) are used, otherwise a lifting is not possible, because of the distance to the tank shell and passing the tension ring. For the mounting **regular bolts** are used, no Huck Bolts, because the half erection gusset plates have to be replaced later.

When using lifting devices the particular attention should be given to the number of lifting points required as otherwise the maximum permissible stress on the gusset plates may be exceeded and/or the *DOME* structure may deform (see static report and installation drawing).

1) On the tank curb angle, where the supports are installed, the lifting devices will be welded and bolted. The quantity is depending on the number of lifting points. A lifting device has to be installed at each lifting point. Please note the lifting points should always be arranged symmetrically.

2) Web slings are to be placed at each lifting point under the lower gusset plates. The gussets and profiles are to be protected and the underside of the gussets should be supported (through the use of wood etc.).

3) The web slings will be connected with steel wires to the gripper. On every lifting device a worker or two have to control a slow and simultaneous lifting.

4) Lift the *DOME* until the gussets of the *DOME* are over the tank shell edge, one after the other, the erection gusset plates will be replaced by the regular ones and bolted with the Huck Bolts. The outer support arms will be mounted together with the supports.

5) Bolting the support arms to the outer gusset plates.

**Important: For the support arm the longer Huck Bolts are to be used.**

6) The *DOME* can be lowered on the tension ring.

## 8.3 Lifting after erection inside the tank on the floating roof

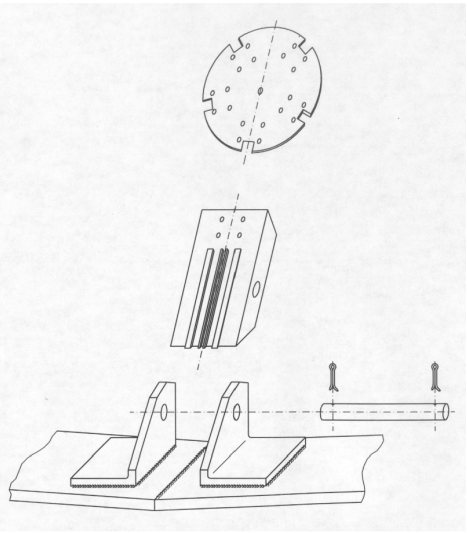
The *DOME* can be erected on the top of the steal floating roof in the same way as on the ground. The tank has to be filled with water, so that the floating roof is going up. The last ring of the structure can be mounted as soon the floating roof reaches the highest position. With the tripods the structure can be lifted over the tension ring. Then the support arms and the supports can be installed.

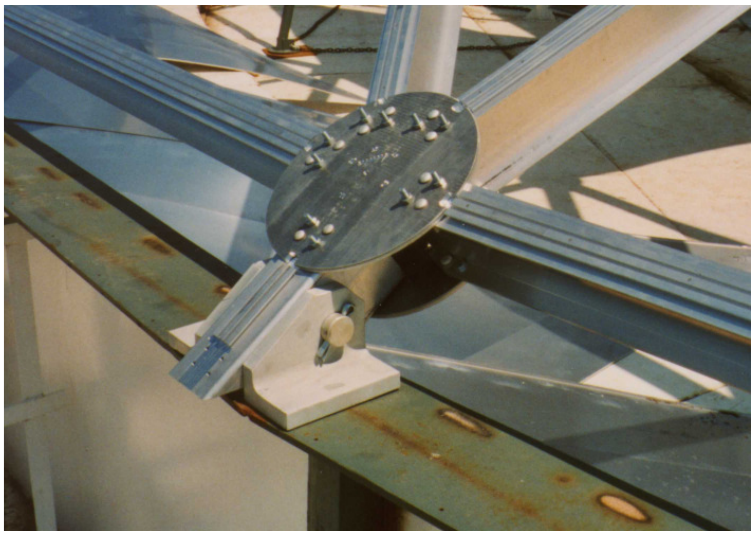
# 9. Mounting of the Supports

## 9.1 Version Fixed Supports

Attach the steel support to the support arms using the steel bolts provided and secure using the split pins. Set and position the *DOME* on to the steel tension ring and weld or bolt on the steel supports. (minimal weld seam thickness a=6mm)

Support welding**:**
**Attention: The supports have to be welded on all accessible sides.**





**Alternative joining technique:**

Support bolting:
Drill ∅ 18 mm hole to the rim angle / tension ring through the steel support.

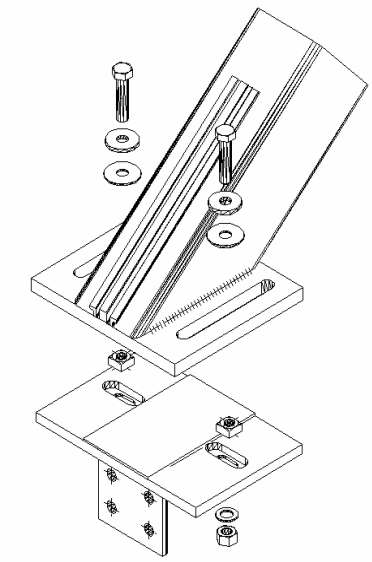
Fix the support bracket according to the static report i.e. by M16 bolts with a force of
**Fv = 100 kN**

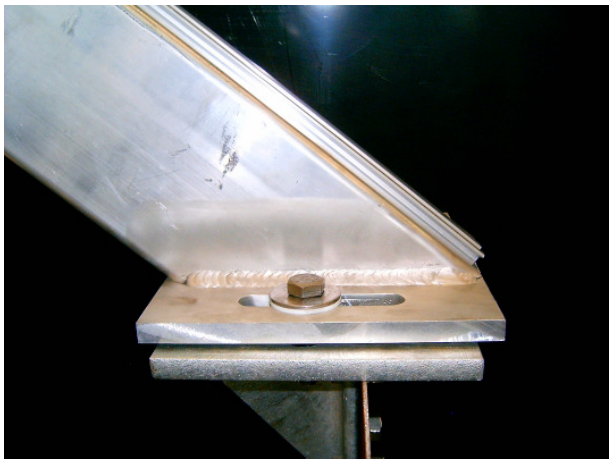
## 9.2 Version Sliding Supports

1) Mount DOME Support Bracket Nr. 1

2) Secure all DOME Support Brackets to the DOME Slide Plates
   a. Drop the bolts with washers above the DOME Slide Plates ensuring that white Teflon washer is under steel washer (see detail below )
   b. Tighten square nut all the way to the bolt shoulder
   c. Secure DOME Support Brackets to DOME Slide Plates with washers and nuts (finger tight only) and ensure square nut sits inside the bracket slots

3) DOME Mounting
   a. Lift DOME with DOME Support Brackets attached (as per point 2)
   b. Lower the DOME on to top of tank with bracketless Slide Shoe aligned with previously mounted DOME Support Bracket as per item 1)
   c. Approximately locate the DOME on the 2 other supports
   d. Support Nr.1: before DOME is set on top of tank ensure that bolts and square nuts are seated properly (similar to 2c) and install washer and nut finger tight from underneath the DOME Support Bracket Nr. 1 and ensure all other DOME Support Brackets are moved outward into contact with tank shell.
   e. Lower the dome
   f. Verify location and secure the other 2 DOME Support Brackets to tank shell
   g. Secure all DOME Support Brackets
   **h. Tighten all nuts of DOME Support Brackets with a torque of F = 120 Nm (SS M16)**





# 10. Completion of Assembly

## 10.1. Edge plates and accessories

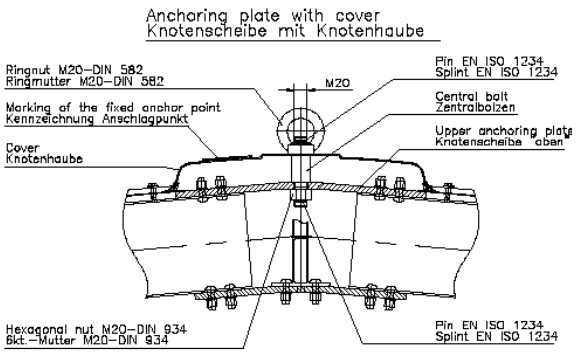
Fasten a curved extension on each bracket.

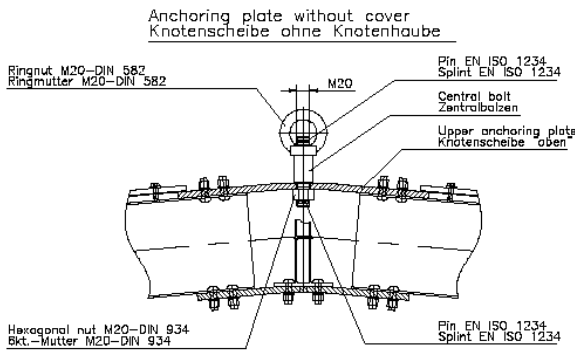
a) Position the edge plates and connect them to the edge strip with drywall screws.
b) Fix the anchoring plate covers (last ring)
c) Cut out and assemble the bird protection screens
d) Cut the edge plates to shape if there are platforms or other devices resting against or on the wall of the tank.
e) If there is enough room, it is recommended to assemble a walkway in connection with an existing platform.

## 10.2. Fixed anchor point (as per EN795 A)

### 10.2.1 How to use the fixed anchor point

a) The fixed anchor point is used to ensure the safety of people having to go on the dome for assembly or maintenance work. A fixed anchor point is provided for the fastening of a maximum of 6 people.
b) Caution: any user must have the necessary physical fitness enabling him to use the anchor point in a normal situation and to use it in an emergency situation.
c) Caution: only people trained in the use of the system and with the required experience are authorised to use it.
d) Caution: an emergency plan must be drawn up with provision for all such emergency situations as may arise in the course of work.
e) Caution: it is forbidden to undertake any modifications or additions without the prior agreement of the manufacturer. All repair work must strictly comply with the procedures authorised by the manufacturer.
f) Caution: the equipment must be used only for the purpose for which it is intended.
g) The fixed anchor point must be used only when it is used as shown in the diagram.



h) Caution: if more than two snap hooks are connected to the fixed anchor point, they can interfere with each other. No more than two snap hooks should therefore be connected to the anchor point.
i) Before use, make a visual inspection to ensure that there are no cracks and no distortions
j) The upper pin must be positioned in place as shown. If not, it must be reconditioned before any further use.
k) Caution: immediately stop using the anchor point:
   - If there are any doubts about the safety of the equipment
   - If the equipment has been strained by a fall
   - If the fixed anchor point has been distorted by a fall.

   Any distorted fixed anchor point must be replaced.
   After any replacement, a fixed anchor point can only be used once it has been properly inspected and given written approval by an authorised person.
l) As illustrated in the diagram, the fixed anchor point must be firmly connected to a bearing structure of the dome.
m) Before any use is made of a fixed anchor point, the possible fall area must be cleared to prevent hitting the ground or any other obstacle in the event of a fall
n) During assembly work, make sure that all sharp edges are properly neutralised.

### 10.2.2 Maintenance

The fixed anchor points are maintenance-free. A visual inspection every year is all that is required (see 10.2.3)

### 10.2.3 Periodic inspection

a) Caution: a periodic inspection is required to ensure the efficacy and safety of a fixed anchor point.
b) A visual inspection must be made at least every 12 months.
c) Caution: the inspection must be carried out by an authorised person trained by the manufacturer.

### 10.2.4 Marking

| | | |
|---|---|---|
| | Manufacturer<br>Vacono Aluminium Covers GmbH | Description<br>Fixed anchor point |
| | Standard(s) EN<br><br>EN 795 A/EN 362/EN 355 | 6 persons maximum, no loads<br>Attach a maximum of 2 snap hooks<br>If used by 3 to 6 persons, provide a rigging plate<br>(The cautions and instructions must always be observed) |

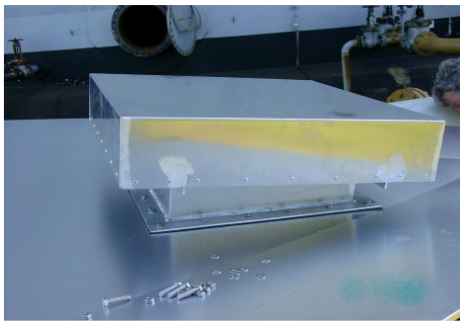
### 10.2.5 Additional regulations

a) The marking « Fixed anchor point as per EN 795 A, 6 persons maximum, no loads » must remain visible after fitting of the cover of the anchoring plate.
b) Maximum acceptable load of a fixed anchor point: 6 persons
c) The fixed anchor point is provided ONLY for the safety of people and NOT for the fastening of loads.
d) The snap hooks used for fastening to a fixed anchor point must comply with the EN 362 standard and be capable of withstanding a breakage load of 3 tons. Automatic locking is recommended.
e) Energy absorbers as per the EN 355 standard must be used.
f) The fixed anchor point can take only 2 snap hooks at a time on each ring. If more snap hooks are to be used, a rigging plate must be installed.

## 11. Installation of Accessories

### 11.1 Manholes

After positioning the manhole a hole is cut in the DOME sheet. The manhole is the bolted at equal points to the DOME sheet. The same procedure applies for the centre vent.



### 11.2 Centre Vents

## 11.3 Walkways

Walkways on the DOME has to be installed according to the drawings which will be attached to the documentation.

In case that Anti Skid Pads will be adhesive bonded to the DOME sheets, i.e. for the Walkway or for the centre platform the following installation manual has to be considered:

### Application of Anti-Slip Tapes on metal surfaces

#### a) State of surface

It is strictly recommended that the bonding will take place in a dust-free environment. In addition, the ground must be clean, dry and uniform. Ideally, the bonding temperature should be between 18-20°C (but not below 10°C). Before bonding, the metal surface must be at room ambient temperature minimum (at least 1 hour prior). For this purpose, please use a hot-air dryer if necessary.

#### b) Preparation of the surface

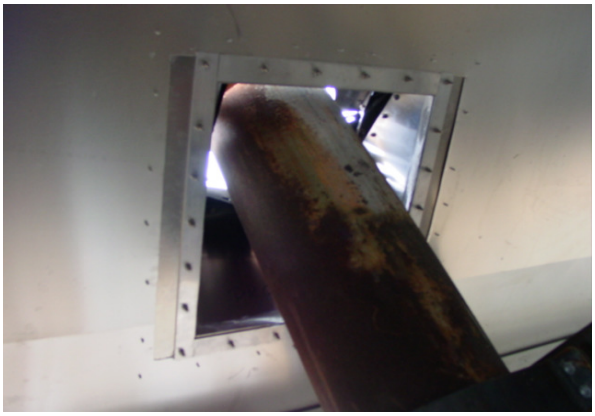
Please clean the surface with 40/60 alcohol/water-ratio (e.g. Isopropanol) and a dust-free disposable cloth. Moreover, please use a scratch-free cleaning pad lager fouling. Please do not touch the bonding surface after cleaning.

#### c) Bonding of anti-slip coverings

Anti-slip coverings can be trimmed accordingly. Please do not touch the adhesive surface of the anti-slip tapes. The protective paper of the anti-slip coverings can be removed manually.
Please fix the anti-slip tapes as requested and remove approx. 20-30 cm of the liner.
Then please press on the anti-slip tapes on the surface.
Important: The edges and endings must be pressed on accurately. For this purpose, it is recommended to use a hard rubber role. Instruction: Never bond over splices!

## 11.4 Negotiation Devices

The assembly procedure of the negotiation devices corresponds with that of the central exhaust as well as those of the manholes. However this negotiation device must be aligned and can only be fitted after the sheet is installed.



### 11.5 Suspension Supports for the Hanging DECK and the Anti-Rotation System

All details for the installation of the suspension supports for the Hanging DECK and Anti-Rotation System are visible in the assembly and sectional drawings.

## 12. Water Test

Final water-test to be carried out followed by final inspection
- potable water have to be sprinkled on the *DOME* surface
- look inside the tank if there is a leak
- in case of leakage the areas have to be sealed