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optimum short-wave antennas

computer-designed / computer-optimized

developed by hams for hams

OB 2 – 40 M

2 Element Yagi 40m

!!! Quality made in Germany !!!

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1. Introduction

The OB2-40M is a high performing 2el yagi antenna for the 40m band.

OptiBeam shortwave antennas are designed and optimised by support of modern techniques such as computerised antenna simulation and are finally adjusted by extensive tests in practice.

A specialty of this antenna, following the ‚Moxon rectangle technique', is that the tips of the driver and reflector are folded in a 90 degrees angle, finally pointing towards each other in a certain distance.
In addition high Q coils (no traps), carefully fabricated by OptiBeam, are used. Hereby achieved is an almost loss free shortening of the element lengths.
By the ‚Moxon principle' and the use of the high Q coils the benefits are as follows:
- a strong positive coupling between driver and reflector
- an extremely compact shape of the antenna, which physically is only as big as 50% of a 2el 40m full sized yagi
- in spite of the compactness a gain is realised which is only about 0.6 dbd less than that of a corresponding full size yagi
- outstanding bandwidth and fine SWR
- straight 50 Ohm coaxial feed without any hairpins, T-matches etc.
- unlimited power handling.

In the following table the essential electrical and mechanical data can be seen:

Bands	40m
Gain (dbd)*	3,5
Gain (dbi)**	10,7
F/B (db)	15 - 18
SWR general setting: **7,00 - 7,05 - 7,10 - 7,30** **SWR USA phone setting:** **7,15 - 7,20 - 7,30**	1,7 - 1,25 - 1,4 - 1,9 1,7 - 1,25 - 1,4
Impedance (Ohm)	50
Elements	2
Max. element length (m)	10,60
Boom length (m)	5,60
Turning radius	6,00
Weight (kg)	28
Windload at 130 km/h	430 N / 0,54 m^2 / 5,9 $feet^2$

* = average gain over a dipole in free space
gain of monobanders for comparison: 2-element Yagi: 4 dbd, 3-element Yagi: 5-6 dbd
** = average gain at 20m above ground

2. Assembly

The included schematic diagram is needed for the assembly and the following information is given:

-> type of element (R=Reflector, S=Driver) and the position on the boom
-> measurements of the element sections (length and diameter)
-> lengths of the element halves
-> distances between the elements.

The lengths are given in m (meters) and the diameters are given in mm (millimeters).

2.1 Sorting the parts

The antenna to a high amount consists of already pre assembled parts.
All parts of the antenna are marked.
For faster and easier assembly it is recommended to sort the parts for reflector and director.

2.2 Assembly of boom

The square boom consists of three parts which have to be assembled each by two coupling pieces that are already installed at one side of the boom parts.
For each coupling piece 4 screws are needed. The screws have to be tightened finally not before the parts of the boom really **fit** to each other perfectly.
It is recommended to slide the boom to mast plate (totally pre assembled finished part, see fig. 2.9 and 2nd picture page) over the middle section before the boom sections are put together. Hereby avoided are unnecessary working steps later on.

2.3 Element-Platforms

For the element-to-boom brackets 4-cornered angle profiles in a length of 500 mm are used. The insulation and solid fixing of the elements is realised by 4 special UV stabilised tube holders, mounted on each of the platforms.
The driver and reflector middle section (d = 40mm) is already inserted into the platforms (see picture on 3rd picture page).

The elements fixed on the plates have to be mounted at the **underside** of the boom in a way that the outer edge of the platform is located 1 cm in front of the tip of the boom.
The plates are attached to the boom by 2 square brackets which embrace the boom from the top and 4 self securing nuts (see 3rd picture page). When tightening the square brackets pay attention that all elements are **parallel** to each other.
The square boom makes a straightening of the elements in the vertical plane unnecessary.
For the tightening procedure use the included special tool (nut driver M10/13).

In case the antenna cannot be reached easily while assembling naturally the elements can be assembled completely (at least the straight parts) and then be mounted below the boom in one piece.

2.4 Screw connections of the element sections

While assembling the element sections the following segments have to be inserted into the previous segments with their side which has two drill-holes **equal in size**. The tubes have to be put in until the drill-holes of both segments overlap perfectly. The enlarged drill hole of the previous segment has to point **upwards**.
Then the corresponding ss screws have to be pushed through **from the side of the enlarged drill-hole** of the previous segment.

There are **screws of two different diameters** (6mm and 4mm) and of different lengths.
The longer **6mm screws** are used for the 40/35mm and the 35/30mm transition, the shorter ones are used for the 30/25mm transition (please orientate by the included schematic diagram of the antenna).
The **4mm screws** have to be used as follows: 25/20mm transition = longest screw, insulators on the 16mm tubes = middle size screw (already inserted), 20/16mm transition = shortest screw.
On the opposite side the washers have to be inserted and the self securing nuts have to be screwed on and **tightened solidly** (hold the screw heads with the included special screw-driver against turning, depending on the screw diameter use the thicker or thinner screw-driver, do it carefully, don't break the screws, the screw heads dive into the enlarged drill-hole, see picture page). This method results in an extremely solid mechanical connection and rattle sounds inside the segment overlaps are totally avoided.

By this way of assembling the required lengths of the sections and the element halves are achieved automatically.

While mounting the elements pay attention that all screw heads show **upwards**.
This counts as well for the screws which are inserted in the distance insulators of the outer 16mm connection transverse tube.
Keep in mind that the elements hang below the boom. Therefore the screw heads have to be on the same side of the elements where the element plates are located at.

2.5 Assembly of the element sections

We start with the already pre assembled middle section (d = 40mm) which is already fixed onto the element platform.
The following segment is the one with the coil (already pre assembled) with a diameter of 35mm (see picture on 3rd picture page).
The next one following has a diameter of 30mm (please orientate by the included schematic diagram of the antenna).
Before the following 25mm section is inserted into the 30mm segment (this counts for all four element halves) please slide the **ring insulator** (see picture on 3rd picture page) -which represents the outer fastening of the centre element truss (see fig. 2.6)- over the 25mm tube. We have already fixed the centre truss rope to the two ring insulators by means of a special loop. Pay attention that the ring insulator is slid over the segment in a way that the truss rope which comes out of the smaller hole leads **towards the centre of the element**.
When the two ring insulators are slid over on the left and the right half of the driver and reflector the **centre element truss rope** will hang slack below the element for the moment.
Do not remove the centre insulator which is already inserted into the truss rope, but for the moment remove the truss mast from the centre insulator for this installation step!

You now have to insert the short 20mm segment into the 25mm section. This 20mm segment has seven drill holes, one for the following 16mm element transition with an enlarged drill hole on top and six drill holes in the order of two **3-hole-rows**.
The hole rows are inscribed with ‚general' and ‚USA phone'.
The outer hole row **‚general'** represents the setting which mainly covers the frequency spectrum from 7.000 to 7.100 KHZ, i.e. SWR, gain and f/b are optimised in this frequency range.
Simultaneously the SWR is arranged in a way that even up at 7.300 KHZ it still is acceptable with a value of about 1.9. Of course, in this upper portion of the band with this setting gain and f/b ratio are not as great as in the bottom portion. This setting mainly covers the "European 40m part" and at the same time serves the US ham who wants to operate SSB as well as CW.
The inner hole row **‚USA phone'** represents the US setting. It mainly covers the frequency spectrum between 7.150 and 7.300 KHZ regarding an optimum SWR, gain and f/b. With this setting the SWR in the „European 40m part" is considerably higher and not suitable for transmitting without a tuner. This setting especially serves the US ham who concentrates on SSB and who can work Europe split this way, of course.
The antenna is tuned by us in a way that with each setting the **first hole** (marked) of the corresponding hole row has to be chosen (regarding tuning facilities, see fig. 4)

The straight element part ends with the short 20mm section. The following 16mm segment is bent in a 90 degrees angle. Before you insert it into the 20mm segment of the driver and reflector (counts for the left and right antenna half) please slide the **ring insulator** (see picture on 3rd picture page) -which represents the outer fastening of the 'below element truss' of the Moxon element part (see fig. 2.7)- over the 16mm tube close to where the curve of the element starts. We have already fixed the corresponding truss rope to the two ring insulators by means of a special loop.
Do not remove the two little insulators that are slid over the rope and which themselves are already inserted into the distance tubes!
When the ring insulators are slid over on the driver and reflector (counts for both antenna sides) the **below Moxon element truss rope** will hang slack down for the moment.

The folded element tips now point towards each other in a distance of about 1.60 meters (not stable). Now they have to be connected mechanically (not electrically) by means of a transverse tube and two insulators. The insulators are already fixed to the transverse tube in the factory.

The transverse tube has to be connected to the element tips in a way that the half hole which is drilled into each insulator points straight **down**. This half hole serves for the later inserting of the distance tubes which are needed to achieve tension on the 'below Moxon element truss rope' (see fig. 2.7).
Alternatively this mechanical connection can be established first and the 16mm outer element parts can be inserted into the previous 20mm sections in one piece.

Up to this point the antenna itself is assembled. Missing are the stabilising element trusses.

2.6 Installation of the centre element truss

Due to reasons regarding stability and optic the driver and reflector are trussed in the centre by means of a little truss mast and a corresponding truss rope (see picture on 3rd picture page).
The pre assembled **truss mast** is mounted on a little right angle platform. A square-bracket is already inserted into this little platform. This right angle platform has to be placed straight in front of the element (counts for driver and reflector) and fixed solidly onto the boom.
The centre element truss rope already hangs slack below the element since it was already fixed to the outer element parts by means of the two ring insulators in the moment of the element assembly (see fig. 2.5).

In the centre of the rope we have already fixed an insulator by means of a special double loop. This insulator now simply has to be inserted **on top** of the truss mast.
The ends of the truss rope are fixed to the ring insulators by means of a special loop (see picture on 3rd picture page). This loop means a continuous exact fastening and simultaneously delivers the possibility for an adjustment of the truss rope at any time.
The element now can be brought into the horizontal position (no sag) by tightening the rope on both sides at the ring insulators. For convenience we recommend to first remove the insulator from the truss mast so that the rope is slack again. Now the loop can easily be pushed through the hole of the ring insulator and the rope can be pulled as much as needed. Then the loop has to be fixed again and the insulator has to be reinserted into the top of the truss mast.
Long remaining rests of the rope can either be cut off or somehow fixed at the main rope.

Important: Pay attention that the **hole in the ring insulator where the rope is fixed** points upwards when the rope is under tension.

In case the centre insulator might not be exactly in the middle the double loop can be loosened as well and a fine adjustment can be done.

2.7 Installation of the 'below Moxon element truss'

The outer Moxon element parts which run in parallel to the boom still sag in this moment.
So due to reasons regarding stability and optic a special truss system is used here as well.

The necessary truss rope already hangs slack below the outer Moxon element part (left and right side) since it was already fixed to the bent 16mm element sections by means of the two ring insulators in the moment of the element assembly (see fig. 2.5).

Now the two little **distance tubes** (two per side), still moveable on the rope due to the two inserted insulators, have to be pushed into the half holes of the two transverse tube insulators. After this procedure the distance tubes have to point **straight down**.
Likewise the ends of this rope are fastened by means of a special loop into the ring insulators (see picture on 3rd picture page). So this rope can be adjusted at any moment as well.
The outer Moxon element parts which run in parallel to the boom can now be brought into the horizontal position (no sag) by tightening the ropes on one or both sides at the ring insulators. For convenience we recommend to first remove the two little insulators from the distance tubes so that the rope is slack again.

Now the loop can easily be pushed through the hole of the ring insulator and the rope can be pulled as much as needed. Then the loop has to be fixed again and the little insulators have to be reinserted into the distance tubes.
Long remaining rests of the rope can either be cut off or somehow fixed at the main rope.

Important: Pay attention that the **hole in the ring insulator where the rope is fixed** points down into the same direction where the rope runs along.

As soon as the below Moxon element truss rope is in the desired position (= outer Moxon element parts are horizontal) **slightly tighten the PVC screws** which are inserted into the little insulators until the truss rope is fixed there.

The entire 'below Moxon element truss system' can be seen on the 3rd picture page.

2.8 Installation of the decoupling stubs

OptiBeam has designed special decoupling stubs (software aided design) which efficiently eliminate negative interaction between this Yagi and other antennas in the frequency range between 10 and 20m.
Such a decoupling stub is used on each element half of the driver and reflector (therefore all over all = four pieces).
The stubs consist of 2mm strong ss wire which runs in a short distance below the tubes of the straight outer element halves. The wire is held tight and stable in the correct distance by means of three insulators. These insulators are located at the element transitions 35/30mm, 30/25mm und 25/20mm (orientate by the schematic diagram of this antenna). The insulators have a thread on both sides. On one side there is already inserted a PVC screw which will be used to fix the wire later on. The free insulator side has to be turned onto the corresponding transition screw. Two insulators have a 6mm thread (transition 35/30mm and 30/25mm) and one insulator has a 4mm thread (transition 25/20mm).

Remove the three insulators from the wire first of all (they are slid over for transportation purposes).
The ss wire has a loop at one end. This loop has to be slid over the downpointing shaft of the screw at the 35/30mm transition.
First remove the selflocking nut and the washer at the transition screw. Now slide the loop over the screw shaft, put the washer on and turn the self locking nut on again and tighten it solidly. Hereby the rope will be fixed as well. Pay attention that the rope will be fixed in a way that you will be able to realise a **half bow** of the rope towards the centre of the element.
One of the two insulators with the 6mm thread has to be turned onto the screw now until it **sits solidly** (= not turns any more) and the hole at the bottom part of the insulator points transverse (hole for wire lead).
Now making a little **half bow** towards the centre of the element lead the wire through the insulator transverse hole and fix it by means of the PVC screw at the bottom side of the insulator (see picture on 3rd picture page).
Then the two other insulators have to be turned onto the corresponding screws at the transitions 30/25 und 25/20mm until they sit solidly as well (not turning any more) and the hole for the wire in the bottom part of the insulator points into the **direction of the element**.
Now the ss wire can be pushed through these transverse holes, pulled tight and **fixed** by means of the PVC screw.
The remaining rest of the wire which shows out of the last insulator can now be cut off (the wire should finally show out of the transverse hole by about two to three cm).

2.9 Installation of the boom to mast plate

The boom to mast plate is a completely pre assembled part (see picture page) with four horizontal square-bolts which embrace the boom and four vertical U-bolts (depending on the corresponding installation 54mm, 65mm or 75mm) which embrace the mast.
The boom to mast plate should have already been slid onto the boom middle section in the moment of the boom assembly (see fig. 2.2).
It now can be fixed at the **balance point** of the antenna (about the centre of the boom).

3. Connection of coax cable

The feeding of the antenna is done by 50 Ohm coax cable.
For connection a PL-259 connector is required. The connector should be sealed against water entry.

Close to the feed point the cable should be winded to a choke coil with 5 to 6 turns of about 20 cm of diameter. Hereby the antenna is electrically balanced and unwanted radiation of the cable itself is prevented.
Instead of the choke coil a 1:1 balun can be used as well.

4. Adjustment of the antenna

An adjustment of the antenna is not necessary if the given dimensions are exactly observed.

By some influences of the direct surroundings it may happen that the resonance of the antenna (= point of best SWR) shifts slightly.
By minimum changes of the lengths of the 20mm sections (driver and reflector in the same way) the resonant frequency can be shifted to the desired point.

By a slight decrease of the lengths of both element halves (push the 20mm segment in to the next drill-hole of the corresponding 3-hole row) the resonant frequency will be shifted upwards.
Since the antenna is tuned for the bottom part of the corresponding frequency spectrum an adjustment into this direction is non relevant.

Normally these adjustments don't have to be done as the antenna does not react very sensitive against influences of the surroundings and the SWR curve is flat anyway.

5. Position of the antenna at strong winds

At strong winds the antenna should be placed in a way that the broadside of the elements **show straight into the wind** which means that the tip of the boom points into it.
This way is contrary to how a "normal" yagi is positioned in strong winds. But since the straight parts of the elements of this antenna are considerably thicker than the outer bent parts they can handle more physical stress and so the duration of the elements will be enlarged.

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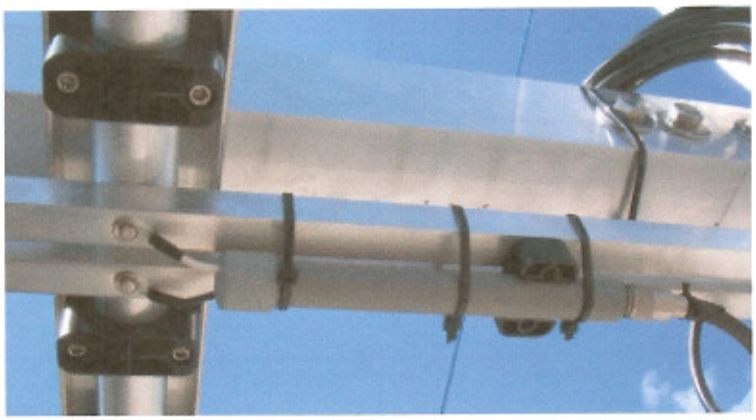
Installation des EB-2-OB Baluns / Installing the EB-2-OB balun



Durch die Verwendung eines hochwertigen 1:1 50 Ohm Baluns am Speisepunkt, wie z.B. des mitgelieferten EB-2-OB, wird die Antenne elektrisch symmetriert und Eigenstrahlung des Koaxkabels wird unterbunden.

Installation

1. Zuerst sind die zwei Schrauben des Strahlerelementes zu entfernen, an dem die Antenne gespeist wird und die auch die Phasenleitungsrohre halten.
2. Der Balun läßt sich gut in der Spalte zwischen den beiden Phasenleitungsrohren befestigen. Er ist mit seinen beiden Anschlußkabeln und den vorher entfernten Strahlerschrauben am Strahler zu befestigen. Dabei sind die Anschlußösen jeweils zwischen zwei U-Scheiben zu schieben.
   Es spielt beim Anschluß keine Rolle, auf welcher Seite das weiße oder schwarze Balun-Anschlußkabel sitzt.
   Lediglich wenn mehrer Yagis in Phase betrieben werden, müssen die Anschlüsse gleichseitig angebracht werden.
3. Das Einschmieren der Balun-Anschlußringe mit einer Konduktionspaste kann den einwandfreien Kontakt zwischen Balun und Element dauerhaft fördern.
4. Der Balun ist mittels der drei Kabelbinder an der Unterseite der Phasenleitungsrohre zu befestigen. Das beigefügte Halbschalenstück ist dabei im vorderen Drittel Richtung SO239 Anschluß zu plazieren, um einen Kontakt zwischen diesem und den Phasenleitungsrohren zu verhindern. Die Details gehen aus obigem Photo hervor.
5. Das Koaxkabel ist am SO239 Anschluß des Baluns zu befestigen und sollte hier gegen Wassereindringen geschützt werden (z.B. mit selbstverschweißendem Klebeband oder Silikon).

The antenna is electrically balanced and unwanted radiation of the coax cable itself is prevented by the use of a high quality 1:1 50 ohm balun, such as the EB-2-OB, at the feed point.

Installation

1. Un-screw the two bolts of the driven element where the source is located at and which hold the two square tube transmission lines.
2. The balun will mount below the phase line in the gap between the two phase line tubes close to the main driven element (= feed point). The black and white wire terminals should be attached to the two bolts removed earlier, one on each bolt and washer. ***If you are phasing two or more beams them make sure you attach these wires exactly the same.*** It does not matter where you put the black or white wires since these are balanced output wires from the balun.
3. You may want to put some anti-oxidant paste such as No-Alox, or Penetrox on the terminal connection before you tighten the bolts.
4. Use the three plastic ty-wraps to secure the balun to the transmission line, placing the half tube holder on the connector end as shown in the picture.
5. Attach your feedline jumper to the balun's SO239 connector and weather proof this connection to protect it from water.

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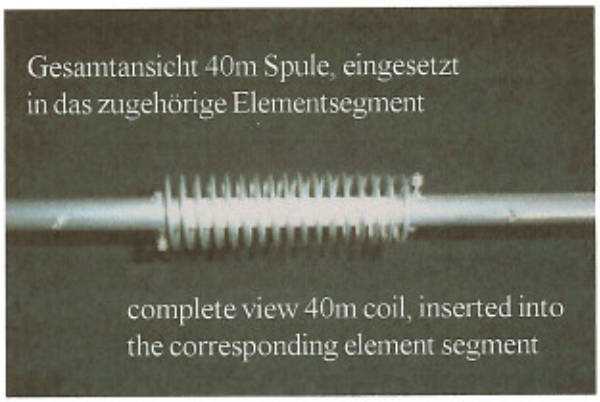

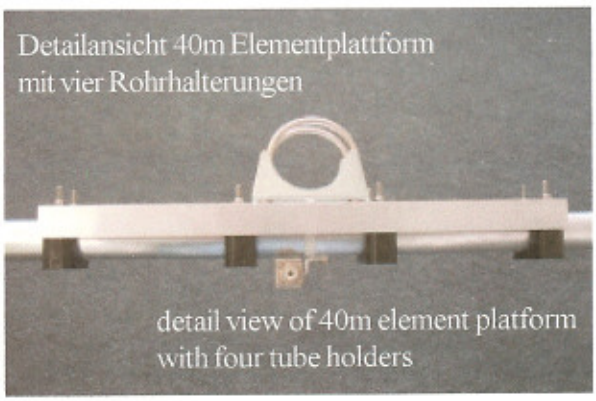

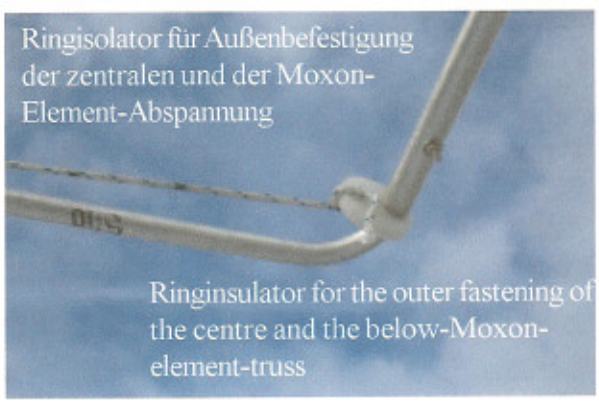

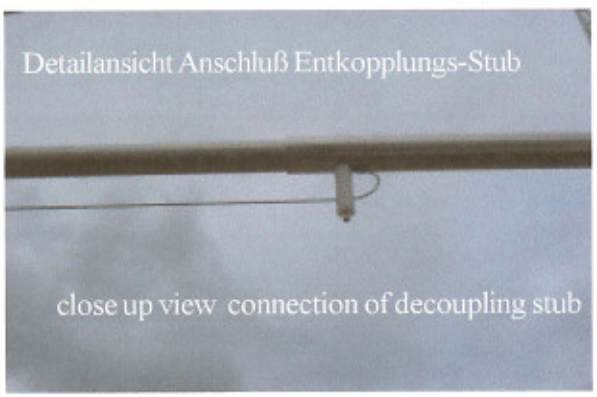

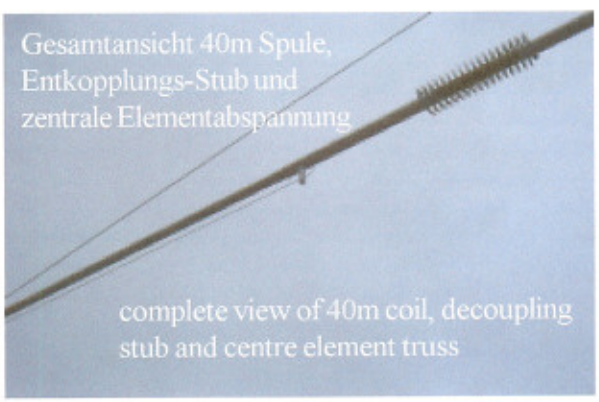

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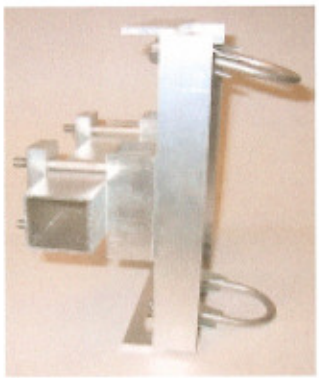
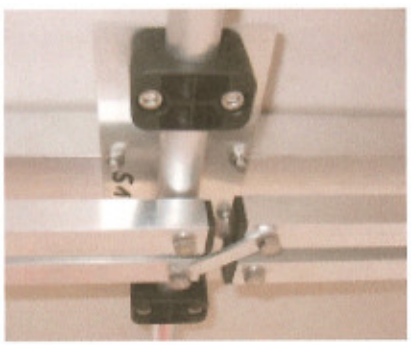
Boom-Masthalterung für kleinere Modelle /
boom to mast mounting for smaller models



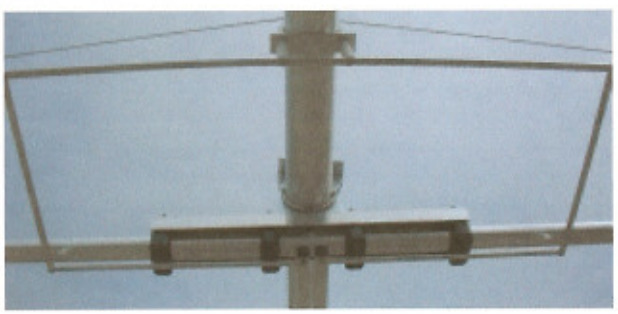
Boom-Masthalterung für mittlere Modelle /
boom to mast mounting for medium size models

Boom-Masthalterung für große Modelle /
boom to mast mounting for big models



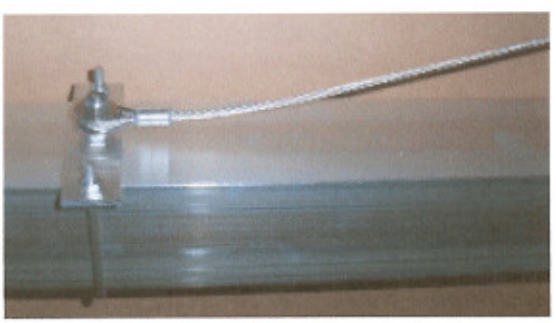
Seitenansicht Überkreuzung Phasenleitung bei Modell 9-5 u. 4-40 /
side view crossing of phase line at model 9-5 and 4-40

Ansicht zentrale und äußere Boomabspannung für OB11-3 /
view centre and outer boom truss for OB11-3



Gesamtansicht Abschlußstub mit Isolatoraufhängung an Boom bei diversen Modellen /
total view termination stub with insulated fixing to the boom at diverse models

Ansicht variable äußere Boomabspannung div. Modelle /
view variable outer boom truss diverse models



Zentrale Seilabspannung für Modelle über 6 Meter Boomlänge /
centre boom truss for models over 6 meter boom length

Äußere Seilabspannung für große Modelle, Rundboom dto. /
outer boom truss for big models, round boom equivalent

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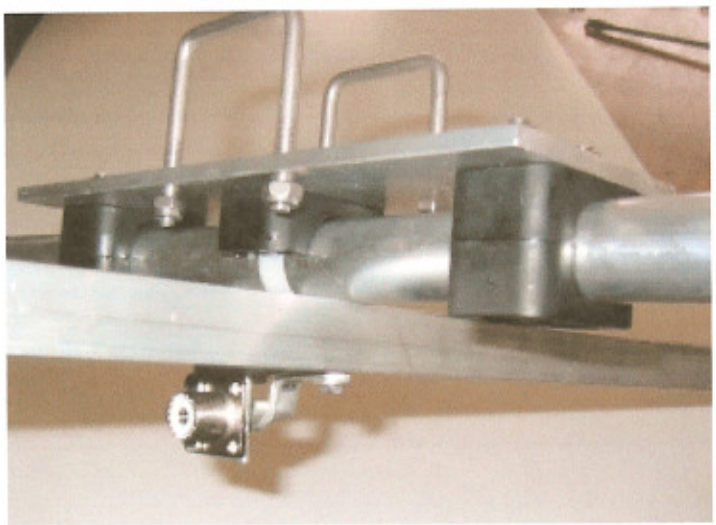
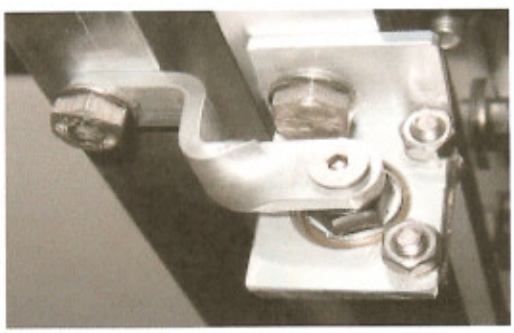
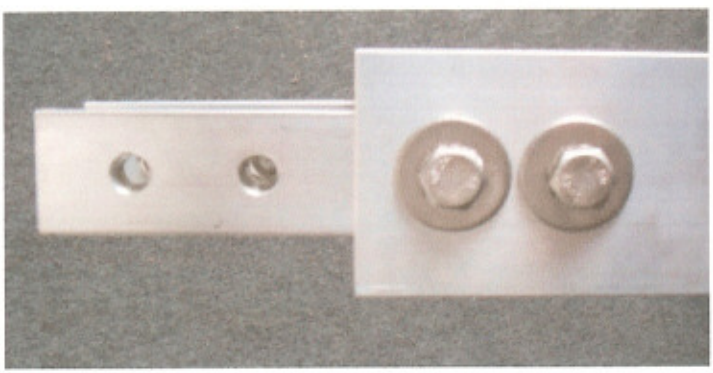


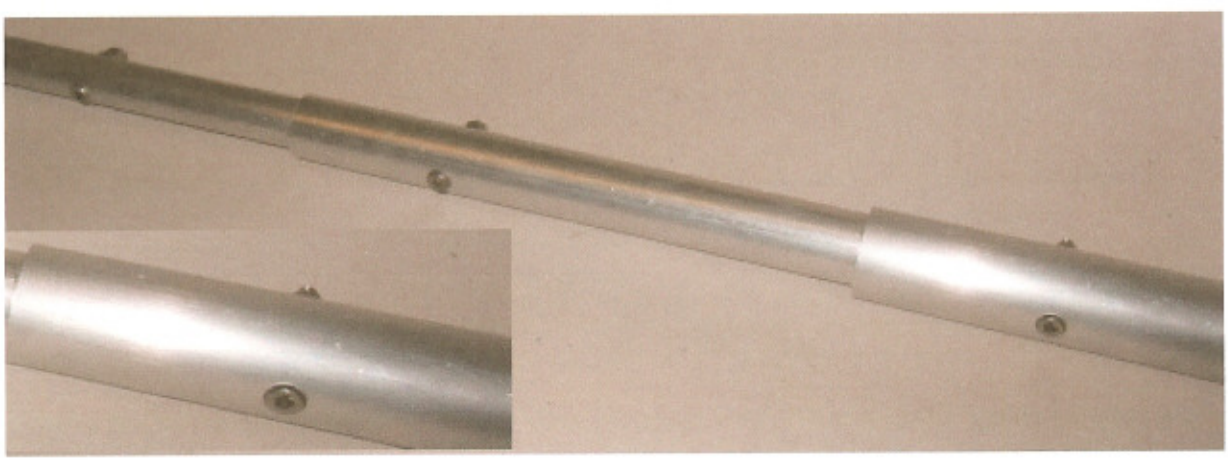
Ansicht Element-Plattform Strahlerelement mit Phasenleitung und Mittenunterstützung / view element platform driven element with phaseline and centre support



Ansicht Koax-Anschlußbuchse SO239 mit Strahlerelement und Phasenleitung /
view coax connector SO239 with driven element and phaseline



Ansicht Boomkopplung bei Vierkantboom /
view boom coupler at square boom



Detailansicht Elementübergänge / close up view element transitions

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