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OPTIBEAM

optimale Kurzwellen-Antennen

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entwickelt von Funkamateuren für Funkamateure

optimum short-wave antennas

computer-designed / computer-optimized

developed by hams for hams

OB 12-4

12 Element Yagi 40/20/15/10

!!! Quality made in Germany !!!

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1. Introduction

The OB12-4 is a high performing 12 element four band shortwave Yagi for the classical frequency spectrums 7, 14, 21 and 28 MHZ.

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.

The core of the antenna consists of a direct coupled 4-element-drivercell, where the drivers are connected with a phase line of square tubes. In addition there is a reflector for the 40m band, a reflector and a director for each of the 20m and the 15m band and a reflector and two directors for the 10m band.

A speciality are the high Q coils (no traps), carefully fabricated by OptiBeam, used on the 40m elements. Hereby achieved is an almost loss free shortening of the element lengths.

By this new concept of feeding in combination with a special element order, the use of full size elements and the high Q coils in the 40m band highest efficiency, optimum bandwidth concerning high gain, clear pattern and low SWR together with almost unlimited power handling are achieved.

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

Bands	40 / 20 / 15 / 10
Gain (dbd)*	3,6 / 5,2 / 5,9 / 6,8
Gain (dbi)**	10,5 / 12,5 / 13,5 / 14,5
F/B (db)	15 / 25 / 20 / 20
SWR **40m CW/Europe Setting:** **7,00 - 7,05 - 7,10** **40m USA phone Setting:** **7,15 - 7,20 - 7,30** **14,00 - 14,18 - 14,35** **21,00 - 21,25 - 21,45** **28,00 - 28,50 - 29,00**	 1,6 - 1,1 - 1,6 1,6 - 1,1 - 1,9 1,4 - 1,1 -..1,4 1,3 - 1,1 -..1,4 1,5 - 1,1 - 1,5
Impedance (Ohm)	50
Elements	12
Active elements	2 / 3 / 3 / 4
Max. element length (m)	14,90
Boom length (m)	7,60
Turning radius	8,36
Weight (kg)	58
Windload at 130 km/h	1250 N / 1,56 m² / 16,8 feet²

* = 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, D = Director) 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).

When assembling the following **order** is recommended:

1) coupling of the boom sections, simultaneously mounting of the boom to mast plate (see fig. 2.2)
2) installation of the element middle sections, which are mounted on the element platforms, at the marked positions on the boom (see fig. 2.4)
3) connection of the four driven elements by means of the phase line (see fig. 2.5)
4) adjustment of all mounted middle sections on the boom and final fastening
5) mounting of this „skeleton" to the mast or temporarily to a separate pipe
6) complete installation of the 40m beam
7) completing the elements for the 20m, 15m and the 10m band
8) installation of the boom truss (see fig. 2.13)

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 per band.

2.2 Assembly of boom

The square boom consists of four 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. 2.12 and 2nd picture page) over the second section (counted from the rear) and to prefix it shortly in front of S20 (direction towards the reflectors, between S20 and R10). Hereby avoided are unnecessary working steps later on.

2.3 Element-Platforms / Element-Centre-Sections

As element-to-boom brackets **for the 40m band** 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).

As element to boom brackets **for the 20m, 15m and 10m band** 4-cornered plates are used and the insulation of the elements is done by 2 (driver = 4, see below) special UV stabilised tube holders (see picture on picture page).
According to the diameters of the elements there are 3 plates with 30mm (S20/R20/D20), 3 plates with 20mm (S15/R15/D15) and 4 plates with 16mm (S10/R10/D10a/D10b) tube holders.
The driver element platforms for 20, 15 and 10m are a bit longer. On them you find a pair of tube holders left and right plus the bottom half of a tube holder in the middle to reinforce the centre of the driven element which is split with the insulator.

Furthermore the 10m and 15m driven elements are lifted up a bit by means of additional half tube holder pieces. Hereby these elements, later on at the phase line installation (see fig. 2.5), will be at one level with the other and much ticker centre tubes of the 20m and 40m band.

The element-middle-sections for 20m, 15m and 10m have to be fixed **exactly centred** on the plates (orientation = black middle line on parasites / insulator middle piece on driven elements which finally has to sit centred in the pre assembled bottom half of the support tube holder). For that the element middle sections have to be put in to the tube holders (only concerning the driven elements the tube holders at one side have to be opened for this process). Then the screws of the tube holders have to be **tightened solidly** (use one of the included screw drivers). The screws of the driver middle sections divided with the insulators have to point **straight upwards**.

2.4 Attaching the element-centre-sections to the boom

The 12 elements-centre-sections fixed on the plates have to be mounted at their marked positions at the **underside** of the boom.

The plates are attached to the boom by 2 square brackets (already inserted into the platform by us) which embrace the boom from the top and 4 self securing nuts (see pictures on the corresponding picture pages). When finally 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 tools.

In case the antenna cannot be reached easily while assembling naturally the elements can be assembled completely and then be mounted below the boom in one piece. In any other case we highly recommend the above mentioned order.

2.5 Installation of the phase line

The four driven elements (S20, S10, S15, S40) are connected with 2 parallel 20mm square tubes (=phase line).

The square tubes have to be in **direct contact** to the elements (put the washers only below the screw heads). First remove the element screws and washers. Then insert the predrilled square tubes (move the elements slightly if needed) by means of the element screws. Likewise insert the coax connector at S20 at the bottom of the phase line (=elements below boom) directly with the screws of S20 (see picture page). A balun might be used alternatively. Be sure that the screw at the backside of the connector which holds the strap is **tightened solidly**.

Furthermore the termination stub has to be mounted at S40 (see fig. 2.6)

Finally the phase line square tubes have to be **tightened really solidly** (though carefully) together with the driven elements (=important electrical contact).

The entire construction can bee seen on the picture page.

2.6 Installation of the termination stub

Due to the shortened elements the antenna has an impedance on the 40m band in the range of 29 Ohms.
Therefore the 40m driver is terminated with a stub which transforms the impedance at the source up to the desired 50 Ohms.
The included stub is a pre assembled right angle part which consists of flat aluminium pieces.
We have pre adjusted the stub length by practical measurements so that the correct transformation to 50 Ohms takes place. This pre adjusted length is automatically achieved by screwing the horizontal parts together with the two vertical parts and by choosing the **centre hole** of the 7 holes which you find at the outsides of the horizontal parts.
This pre adjusted length can be changed, if required (in case no satisfying SWR due to influences of the surroundings).
By choosing holes which are located more to the outside the stub inductivity is enhanced, by choosing holes which are located more towards the centre the stub inductivity is reduced.
The single parts of the stub have to be screwed together solidely by the use of the screws and the self locking nuts.

The stub has to be fixed at the **bottom side** of the driver (= elements hang below the boom) with the two already inserted driver screws. The opposite side of the stub is solidly hung below the boom by means of a square bolt and two screwed on insulators (see pictures at 2nd picture page).

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

2.7 Screw connections of the element sections

While assembling the element sections the following segments have to be inserted into the previous ones 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 transitions (only 40m elements), the shorter ones are used for the 30/25mm transition of the 40m and the 20m band (orientate by the schematic diagram of the antenna).
The **4mm screws** have to be used as follows:
-> 25/20mm transition of the 40m elements = longest screw (important, will later be used to turn on the corresponding insulator of the decoupling stub).
-> 25/20mm transition of the 20m elements = second longest screw.
-> 20/16mm transition of all elements = third longest screw
-> 16/12mm transition of all elements = 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 not 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**.
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.

2.8 Assembly of the element sections for the 40m band

The two 40m element middle sections (d = 40mm) are already pre assembled and fixed to the element platforms.
The following segment which has to be pushed in to the centre section is the one with the coil (already pre assembled) with a diameter of 35mm (see picture on 3rd picture page), followed by the 30mm segment (orientate by the schematic diagram of the antenna).
Before the following 25mm section is inserted into the 30mm segment (this counts for all four element halves) slide the **ring insulator** (see picture on 3rd picture page) -which represents the outer fastening of the centre element truss (see fig. 2.10)- 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 ‚CW/Europe' and ‚USA phone'.
The outer hole row **‚CW/Europe'** 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.

This way the SWR in the frequency spectrum 7.150 to 7.300 KHZ is still manageable, but partly only by means of a tuner.
This setting mainly covers the "European 40m part" and at the same time serves the US ham who mainly wants to operate CW.
The inner hole row **‚USA phone'** represents the US SSB 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 „CW/European 40m part" is considerably higher and principally not suitable for transmitting. 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 centre hole of the corresponding hole row has to be chosen (regarding tuning facilities, see fig. 4)

The 20mm segments are followed by the 16mm ones and they by the 12mm tips.
Concerning the 12mm tips of the driven 40m element as well the **middle one** of the three drill-holes has to be chosen (regarding tuning facilities, see fig. 4).

2.9 Assembly of the element sections for the 20m, 15m and 10m band

Equivalently to the element sections of the 40m band the segments for the 20m, 15m and 10m band will be put together (orientate by the schematic diagram of the antenna).
The following sections have to be inserted into the previous sections, as already explained with their side which has two drill-holes **equal in size**. Then the sections have to be screwed together, following **fig. 2.7**. Pay attention again that all screw heads point **upwards**.

Concerning the outer 12mm tubes of the drivers again the **middle one** of the three drill-holes has to be chosen (regarding tuning facilities, see fig. 4).

2.10 Installation of the centre element truss on the 40m elements

Due to reasons regarding stability and optic the 40m 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. 2.8).

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.

2.11 Installation of the decoupling stubs on the 40m elements

OptiBeam has designed special decoupling stubs (software aided design) which efficiently eliminate negative interaction between the 40m band and the other three bands of this antenna as well as between the 40m part of this antenna 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 a 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 and 25/20mm (orientate by the schematic diagram of the 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.

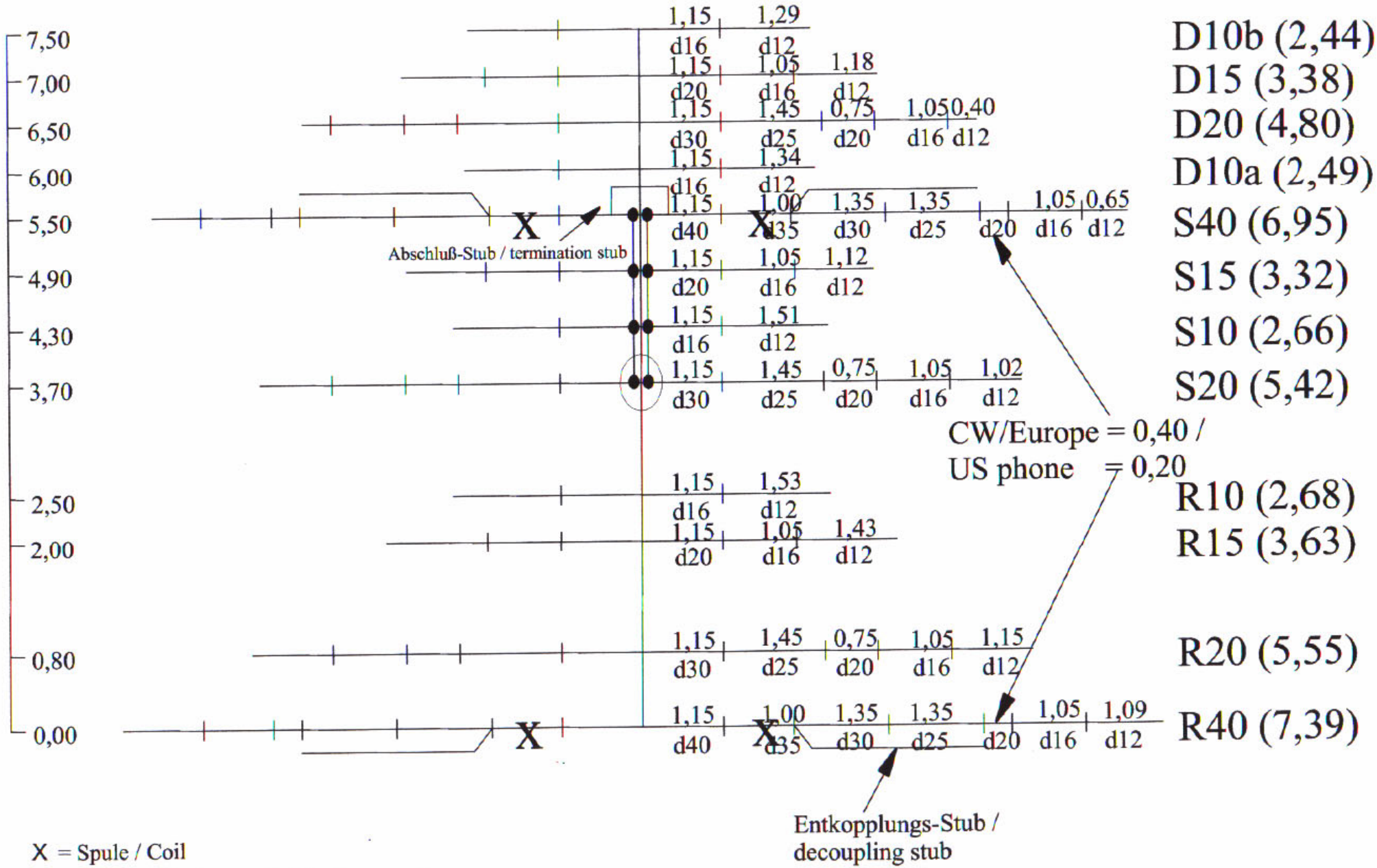
Two insulators have a 6mm thread (transition 35/30mm and 30/25mm) and one insulator has a 4mm thread (transition 25/20mm).

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 **into the direction of the element** (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 ss 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).

2.12 Installation of the boom to mast plate

The boom to mast plate is a completely pre assembled part (see 2nd 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 has to be located close to S20, in direction towards the reflectors = between S20 and R10.
It now can be fixed, but it will slightly be out of the **balance point** of the antenna which is pretty exactly below S20.

OptiBeam OB12-4



X = Spule / Coil

alle Längenmaße in m ; alle Durchmesser in mm

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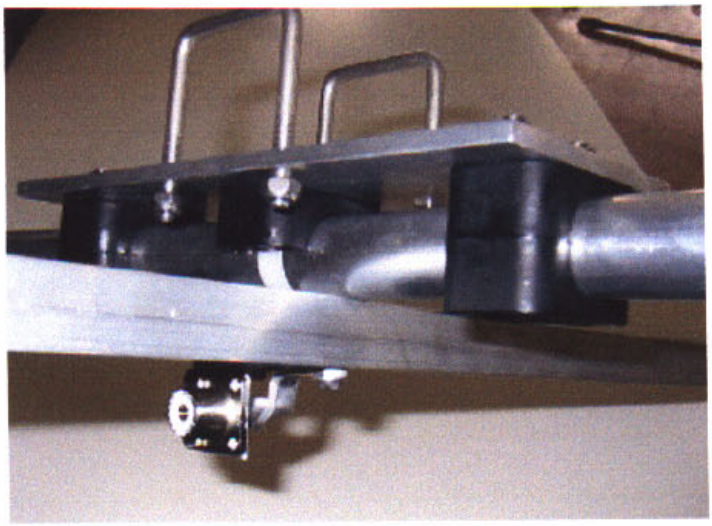
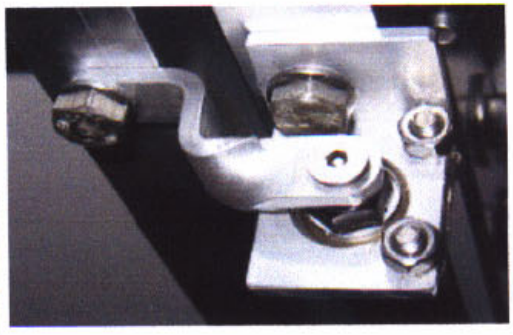
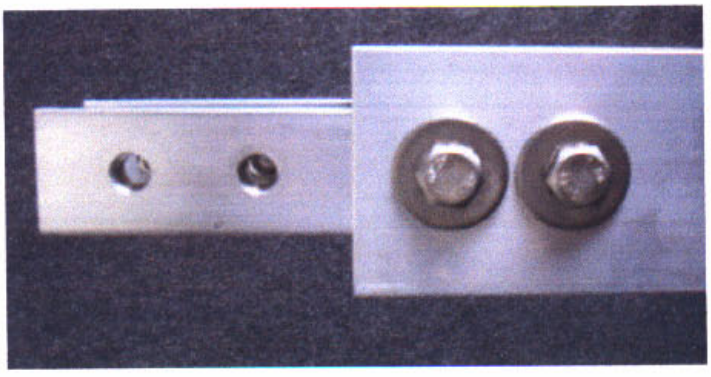


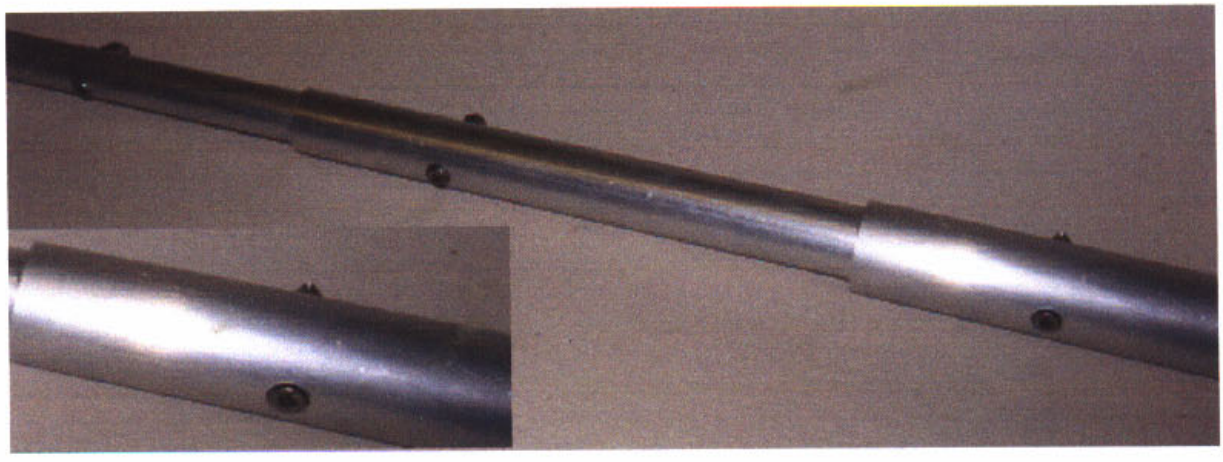
Ansicht Element-Plattform Strahlerelement mit Phasenleitung und Mittenunterstützung / view element platform driven element with phaseline and centre support



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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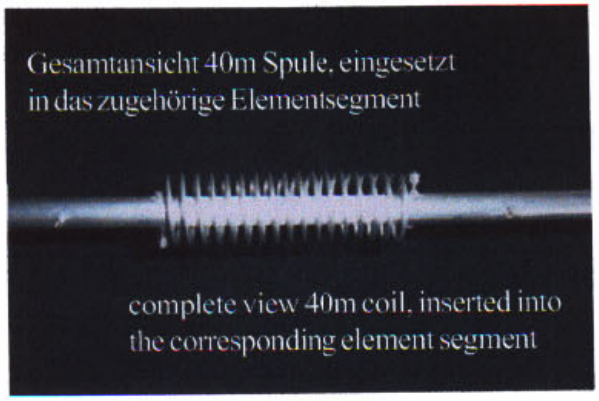

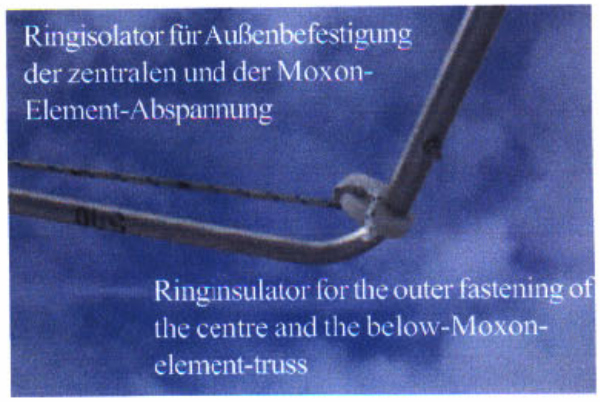

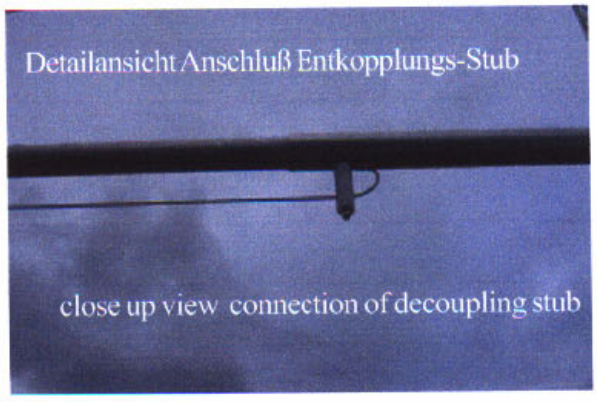

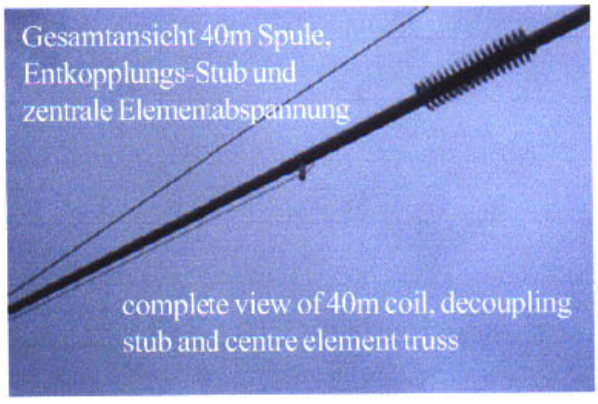

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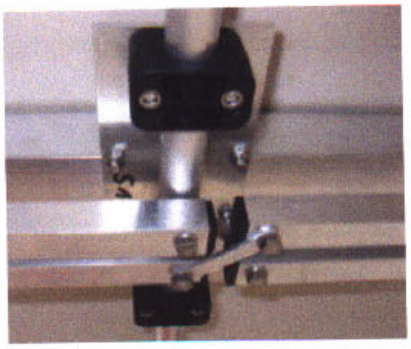
Boom-Masthalterung für kleinere Modelle /
boom to mast mounting for smaller models

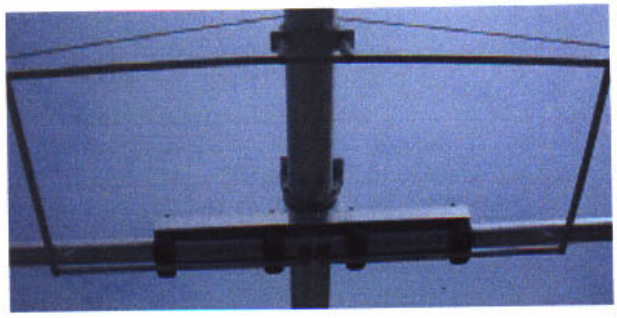
Boom-Masthalterung für mittlere Modelle /
boom to mast mounting for medium size models

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



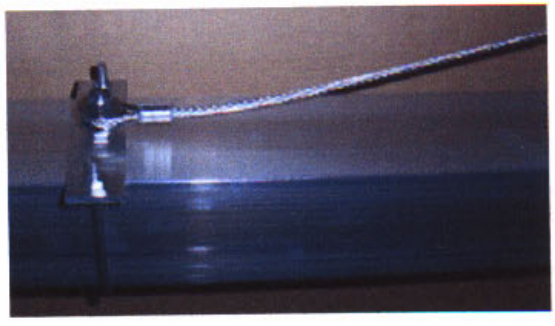
Seitenansicht Überkreuzung Phasenleitung bei Modell 9-5 u. 4-40 /
side view crossing of phase line at model 9-5 and 4-40

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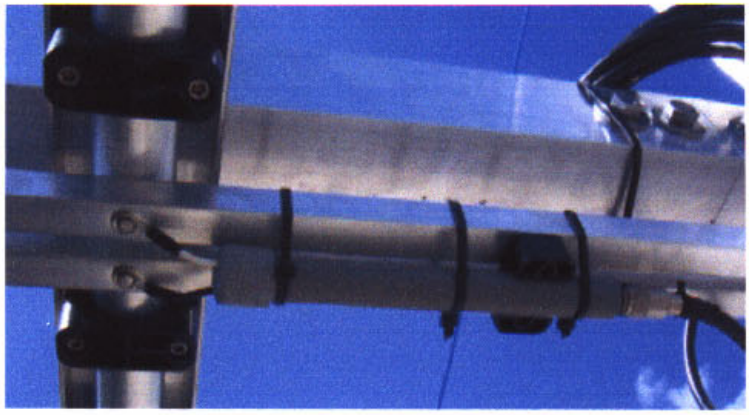
Installation des EB-2-OB Baluns / Installing the EB-2-OB balun



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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