



The Waveguide Solution

## Space Waveguide Components



## Introduction

The Waveguide Solution Microwave Technology is Europe's largest waveguide manufacturer, supplying high quality waveguides and microwave devices to customers all over the world.

The company works closely with its customers and sub-contractors, and has been involved in major developments of space waveguides on a number of high profile programs.

TWS has the facilities to carry out the design, drawing, manufacturing and test of complete waveguide assemblies and sub-systems.

## Projects

TWS, through their experience at Quasar, have supplied space flight components for over 15 years. The company developed seamless flexible twistable waveguide with European Space Agency during 1984-1988, and more recently has been involved with the following civil/military projects:

<b>Orion</b>	High performance electro-formed antenna feeds
<b>Hotbird II, III, IV &amp; V</b>	<b>(WG16 thin / std wall, 17 thin wall, 18 std wall)</b> Payload waveguide and high power transmit antenna feeds. RX antenna system, RX band pass filters, made to measure interfaces.
<b>Skynet 4D, 4E, 4F</b>	<b>WG15 thin wall)</b> High performance TX antenna feed networks.
<b>Koreasat</b>	<b>(WG17 thin wall)</b> Payload and antenna feeds
<b>Astra 2B</b>	<b>(WG16 thin wall, 17 std / thin wall, WG18 std / thin wall)</b> Payload and antenna feeds, made to measure interfaces.
<b>Intelsat KTV</b>	<b>(WG17, 18 thin wall)</b> Payload waveguides
<b>ST1 A</b>	<b>(WG11A, 16, 17, 18 thin wall)</b> Payload waveguides, antenna feeds, output test couplers, made to measure interfaces.
<b>Nilesat F1, F2</b>	<b>(WG16 std wall, WF17 thin wall, WG18 std wall)</b> TT&C system, high performance TX antenna feeds.
<b>Ressat</b>	<b>(WG17, 18 thin wall)</b> Payload waveguide, ultra low PIM TX antenna feed waveguide.
<b>FedSat</b>	<b>(WG20 / 22 std wall)</b> High performance RX & TX antenna feeds SMA to WG transitions.

## Astrolink

## Rosetta

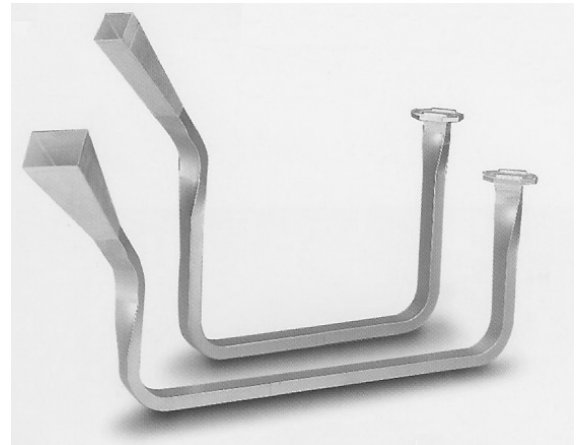
## EGSE Hardware

**(Ka Band)** High performance electroformed horns.  
**(WG15 thin wall)** High Rel' feed waveguide for high gain antenna assembly.  
ST1, Eurostar, Eurasiasat, Nilesat 102, Astra 1K.

The total number of waveguide assemblies supplied for these projects is over 1500 items.

## In house design capability

In the mechanical engineering department there are senior mechanical engineers/project engineers, with a wide range of experience in space project engineering and design. There are also drawing office staff who specialize in the design of components and assemblies for space projects. The computer aided drawing system used is Solidworks. IGES, STEP, 3D-DXF, SAT and STL files can all be imported/exported from the design department on



CD-R or DVD, and electrical transfer of design data by E-mail is also possible.

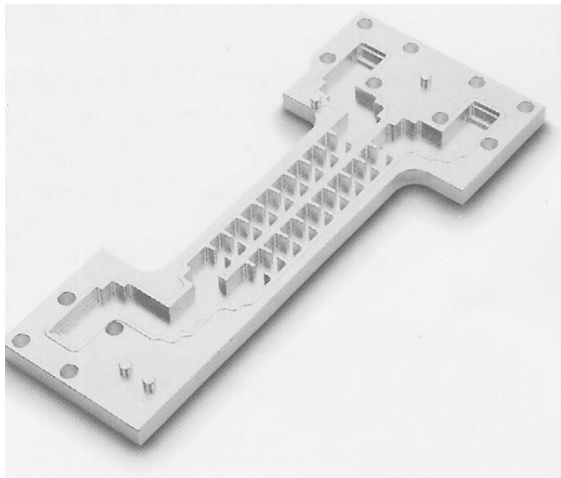
The microwave design and development department uses mode matching and finite-difference time-domain software, on both PC's and workstations. TWS are able to optimize design performance over specific customer frequency bands, to ensure the highest quality components.

Specialist microwave components like filters and duplexers can be designed to specific customer requirements with a fast turnaround time. Advanced software and high precision machining techniques enable the company to eliminate the need for tuning screws. Thereby reducing lead-time as well as costs.

The whole electrical and mechanical design process runs concurrently alongside QA procedures for materials and process selections, resulting in high performance designs to meet individual mission constraints.

## Manufacture

The in-house machining capability includes 3-axis high speed machining centres, and a variety of lathes and milling machines. There is also a department specializing in rigid waveguide tube bending and manipulation. This highly skilled area bends, twists, and assembles thin wall waveguide sections to very high standards and tolerances. There are operators that have been independently qualified for the brazing and soldering of space components. In addition TWS are able to offer dip brazing, which is approved for space work. The in-house plating and metal treatment facilities include copper, tin, nickel, silver and gold plating as well as chromate conversion and passivation treatments. TWS can also offer thermal control surfaces on all



products using recognized thermo-optical coatings.

## Inspection

TWS has a fully equipped inspection and metallurgical examination facility including X-ray fluorescence for the accurate measurement of plating thickness. 3D co-ordinate measuring machines one of which is CNC operated with a linear accuracy of better than 0.0015mm, and a repeatability of 0.0015mm. All equipment is regularly calibrated to international standards, which ensures that measurements are taken to the stated accuracy. For the internal examination of waveguides, rigid and flexible endoscopes are used; both are linked to a TV colour monitor with the facility of a colour image printout. A metallurgical microscope is used for the detail examination of micro-sections and coupon samples.

## Microwave test

The in-house microwave test equipment includes Hewlett Packard 8510 vector network analyzer with the ability to measure up to 75GHz. The other test equipment comprises of the following:

- 50GHz synthesized sweepers
- 40GHz sweeper and analyzer
- 27.5GHz sweeper and analyzer
- 20GHz sweeper and analyzer

On rigid and flexible waveguide assemblies, the technicians in the test department use an approved dent tuning procedure to enhance to return losses of individual components. On recent projects, we have mated several waveguide assemblies together, and tuned as a complete system – enabling the performance of the whole system to be maximized.

## Quality Approvals

TWS undertakes to provide customers with a high quality product and service from the initial order review, through the design process, to the delivery of actual hardware.

The company operates a policy of TQM throughout the life of any project that we undertake with regular reviews and standardized working practices.

In relation to space hardware, the company has project and QA personnel that are familiar with current ESA practices. We are able to supply comprehensive, product assurance documentation to both recognized ESA guidelines and specific customer needs.

TWS currently hold the following approvals:

- BS EN ISO9001 certificate number 860469
- Matra Marconi Space Quality Assurance Approval.

TWS are currently going through the approval process for BS EN ISO14001 – an environmental standard.

## Products

- Aluminium alloy Waveguide assemblies in standard, ½ wall and ¼ wall thicknesses. Silver plated or chromated with options for flexible sections, low PIM designs and thermal control coatings.
- Machined from solid components, including coax transitions, hybrid couplers, input/output test couplers (cross guide), low/medium power load terminations, filters and diplexers.
- Electroformed nickel horns and feed assemblies with options for copper/silver electroplating, and thermal control coatings.