V.H.F Aerials

A COMPREHENSIVE RANGE of aerials has been designed to meet the varied requirements of modern v.h.f equipment.

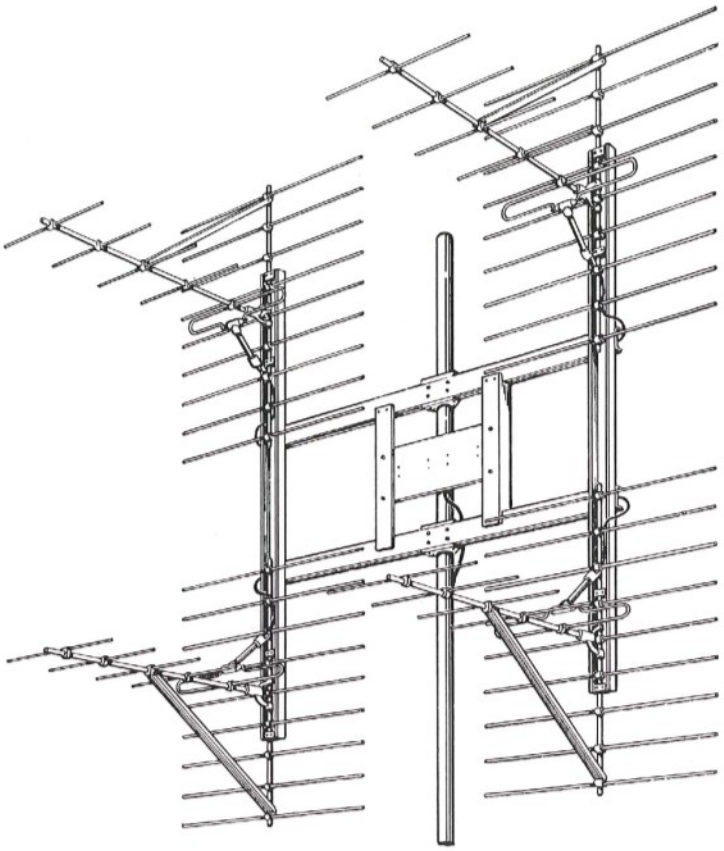
The aerials are equipped with a cable harness incorporating coaxial aerial transformers moulded in polythene. A feeder-matching transformer of similar type is also available where a particularly good standing-wave ratio is required.

Several of the compact Yagi aerials may be mounted on the same tower. Each aerial consists of a folded half-wave dipole radiator, one reflector and two or four directors. A range of lightweight self-supporting galvanized lattice steel towers, of heights from 50 to 400 ft, has been specially designed to support these arrays. Heavy duty towers are available for sites subject to strong winds.

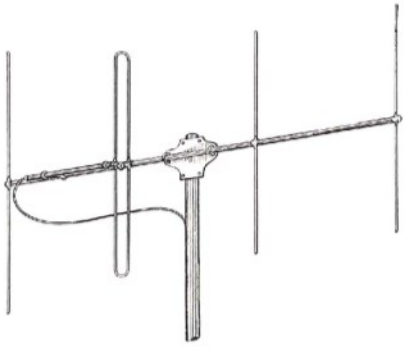
For point-to-point single-channel v.h.f communication a lightweight four-element Yagi array, suitable for operation in the 60–185 Mc/s band is available, having a nominal gain of 8 dB over a half-wave dipole. This aerial may be arranged to give either horizontal or vertical polarization. A half-wave concentric vertical dipole may be used for fixed stations or ships. A fully-flexible end-fed quarter-wave rod, suitable for mounting on a vehicle roof, is also available. Special arrays of half-wave elements giving combined polarization have been designed for use at aerodrome ground stations.

For use with the HM 100 and HM 150 series of v.h.f multi-channel f.m radio links the following aerials are available.

Half-wave dipole.



A typical four-stack six-element Yagi aerial array.



Lightweight 4-element Yagi array.

Type	Nominal Gain* dB	Wind Area sq. ft	Beam Angle† vertical	Beam Angle† horizontal	Weight lb
FOR USE BELOW 80 Mc/s					
4-element Yagi	7–8	2·6	70°	57°	90
2-stack 4-element Yagi	10–11	9	36°	57°	250
FOR THE BAND 132–220 Mc/s					
6-element Yagi	10–11	2·6	49°	42°	100
2-stack 6-element Yagi	13–14	9	25°	42°	260
4-stack 6-element Yagi	15–16	25	25°	21°	700

**Referred to half-wave dipole.* *† Taken at mid-band frequency.*

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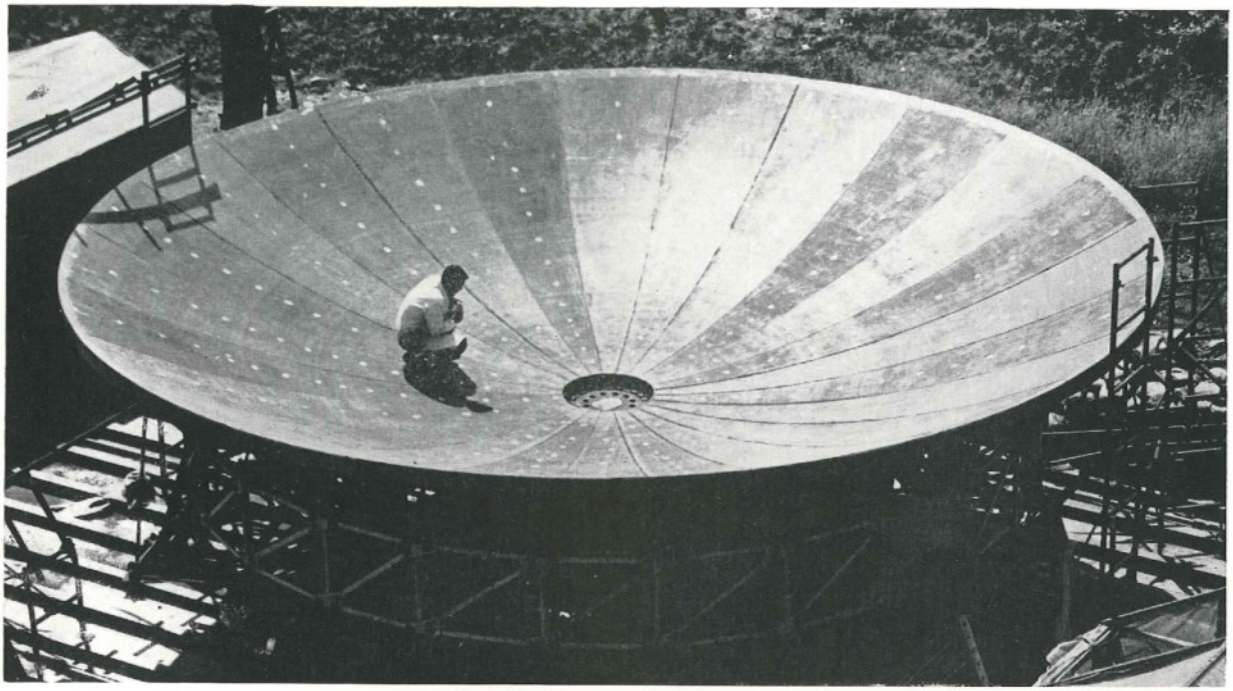
Marconi Aerial-Reflector Surfaces 'Marconi Surface'



9704

THIS is a special reflecting surface developed by Marconi specifically for the following applications:

Radar surveillance and height-finding aerials.

Radio telescope and satellite tracker aerials.

Microwave aerials of both dish and cornucopia types.

Passive reflectors and passive repeaters.

All these applications require high-accuracy double-curvature reflectors, completely resistant to atmospheric deterioration. The surface consists of a furane resin treated paper honeycomb, sealed between two glass-fibre polyester laminate skins. The structure forms a stiff compound plate with the electrical reflecting surface, a fine galvanized steel wire mesh, built into one of the glass-fibre skins.

To transfer applied loads to the aerial supporting structure, a specially constructed channel section is moulded into the 'sandwich' at pre-determined intervals, and to this channel a backing rib is fitted for load transfer to the main supporting structure.

The surface is not affected by erosive, corrosive, or humid atmospheres, nor is it attacked by living organisms.

The illustration shows a 30 ft (915 cm) dia. experimental dish for use with satellite tracking equipment.

Data Summary

Frequency range:
All operational frequencies up to and including X band (max. frequency 11,500 Mc/s).

Environmental withstand conditions:
Max. mean hourly operational wind velocity, 90 mile/h (145 km/h).
Max. one-second gust survival wind velocity, 150 mile/h (240 km/h).
Temperature range, −50° to +50°C.
Surface temperature due to solar radiation, 70°C.
Ice load, mean over-all thickness $\frac{1}{2}$ in. (1·3 cm).
Snow load, mean over-all thickness 12 in. (30 cm).

Surface accuracy: Within 0·030 in. r.m.s departure from true profile.

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Microwave aerials for Communications

(USING 'MARCONI-SURFACE' CONSTRUCTION)

UTILIZATION of the centimetric waveband for the purpose of radio communication continues to advance, and there is an increasing need to exploit the higher frequencies up to and beyond 10,000 Mc/s.

The Marconi Company has developed a range of horn-fed paraboloidal dish aerials manufactured from glass-fibre and wire mesh. To obtain maximum forward gain at any particular frequency, high illumination efficiency and extreme accuracy of reflecting surface are required. 'Marconi-surface' microwave aerials are produced with a reflecting surface accurate to within less than 0·030 inch r.m.s departure from the true profile. This permits normal operation of the aerial up to a frequency of 11,500 Mc/s and operation up to 20,000 Mc/s with only a slight loss in illumination efficiency.

Features

Low weight/stiffness ratio.

High resistance to extreme environmental conditions.

Independent panning in azimuth and elevation.

High degree of profile accuracy of the galvanized steel wire mesh, stabilized in the glass-fibre surface.

High front-to-back ratio by the use of a special diffraction ring.

Glass-fibre radomes available for protection against weather effects.

CONSTRUCTION

The dish is manufactured by stretching a fine galvanized-steel wire-mesh over a mould. Glass fibre is then laid on the mesh to the requisite thickness. Fibre and mesh are then impregnated with polyester resin in such a manner that the mesh is uniformly embedded in the resin. This method of manufacture ensures that the reflecting surface is completely protected from environmental conditions. A glass-fibre backing structure is then bonded to the rear surface of the dish to provide the necessary rigidity and galvanized steel plates let into the structure. These plates pick up and transfer loads to the panning system and supporting tower structure.

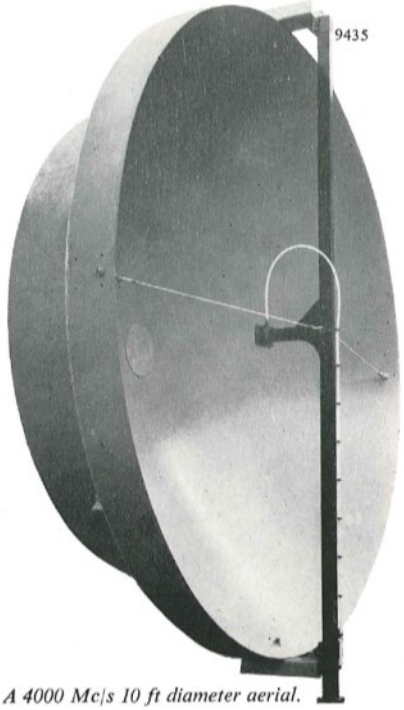
A panning mechanism of a novel design, using a universal joint and a system of supporting rods provides independent panning in azimuth and elevation to a total angular movement of 45°.

Editions

Standard versions are 10 ft (305 cm) dia., and 15 ft (457 cm) dia., but other sizes will be designed in the near future.

The dish aerials can be supplied either solid or in halves, the latter type of construction being sometimes desirable for ease of transportation. Two types of horn feed can also be supplied with the dish, a front feed or a centre feed.

Both types of feed are sealed against the environment by a sheet of dielectric material. With the former arrangement, the feeder is supported by a galvanized steel tube and led to the side of the dish. With the latter arrangement (for the higher frequencies), the main waveguide feeder is led to the rear of the dish.



9435

A 4000 Mc/s 10 ft diameter aerial.

An 11,500 Mc/s 10 ft microwave aerial in service.

9344

Data Summary

Type No.	*J 0010*		*J 0015*	
Diameter:	10 ft (305 cm)		15 ft (457 cm)	
	4000 Mc/s	8000 Mc/s	4000 Mc/s	8000 Mc/s
Gain:	39·9 dB	45·9 dB	43·4 dB	49·4 dB
Beamwidth:	1·8°	0·9°	1·2°	0·6°
V.S.W.R:	Better than 1·05:1		Better than 1·05:1	
Front/back ratio:				
With diffraction ring	61 dB	60 dB	65 dB	65 dB
Without diffraction ring	54 dB	52 dB	58 dB	55 dB
Weight of reflector and horn feed	500 lb (227 kg)		1100 lb (499 kg)	

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Passive Reflectors

PASSIVE reflector equipment can be supplied as part of the comprehensive range of mechanical engineering services for microwave communications systems. The equipment currently available consists of two distinct types.

(a) *Tower-mounting*

The passive reflector may be fixed to a tower above a ground-mounted paraboloid aerial and inclined at an angle of approximately 45°. The vertically radiated signal from the aerial is thus in a horizontal plane. Such an arrangement has the advantage of dispensing with lengthy feeder runs. This type of reflector, which is normally used with a 10 ft (3 m) paraboloid dish aerial, is approximately 14 × 10 ft (4·2 × 3 m) in size.

The reflector is panned using two screwjacks situated between the reflector panels and support structure. This method provides two entirely separate movements in azimuth and elevation to an angle of ±5° in each plane.

The reflecting surface is made up of unit panels bolted together, each panel being a rivetted box section of steel sheets coated with PVC. No maintenance to the surface is necessary after erection. Under operational conditions the surface accuracy is within less than 0·075 in r.m.s departure from the true profile.

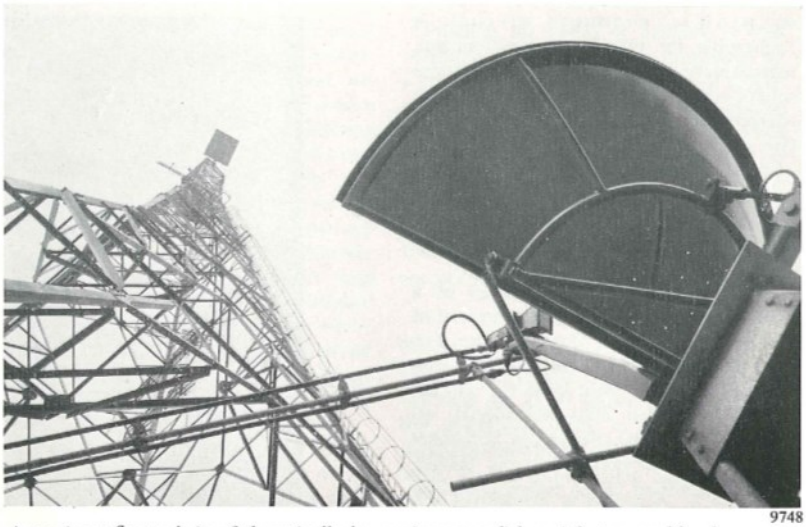
Glass-fibre radomes can be supplied to enclose both the 10 ft and 15 ft aerials with passive reflectors in this type of installation.

(b) *Billboard-mounting*

In this case the passive reflector is ground-mounted and in the path of an incident radiated field. By suitably positioning the reflector, the beam is re-radiated towards a distant receiver, enabling signals to by-pass any obstructions which may be situated on the line-of-sight path between transmitter and receiver.

The Marconi Company have designs for three sizes of passive reflector, details of which are shown in the table below. Each of the reflector surfaces is made up of unit panels 10 × 8 × 1 ft (3 × 2·4 × 0·3 m). By using these unit panels and modifying the backing and support structure, the range of billboard reflectors can be extended up to a maximum of 1000 sq.ft surface area.

Reflectors of the billboard type are secured by two triangular steel frames laterally braced to counteract windloading .The supporting frames lead from the backing structure to concrete stubs set into the ground. The panning mechanism and reflecting surface are similar in design and construction to the tower-mounted type.



9748

A passive reflector being fed vertically by a microwave dish aerial at ground level.

WIND SPEED

Type	*Size (ft)*	*Operational*	*Survival*	*Ice loading*	*Snow loading*
J 0401	10 × 14	70 mile/h	150 mile/h	½ in. (1·3 cm)	12 in. (30 cm)
J 0421	20 × 16	70 mile/h	150 mile/h	½ in (1·3 cm)	12 in. (30 cm)
J 0420	24 × 20	70 mile/h	150 mile/h	½ in. (1·3 cm)	12 in. (30 cm)
J 0422	10 × 24	70 mile/h	150 mile/h	½ in. (1·3 cm)	12 in. (30 cm)

The snow loading is for 12 in. (30 cm) on the horizontal and sloping surfaces of the tower-mounted reflector. A combination of both is acceptable provided the total weight does not exceed 800 lb (360 kg).

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Horn Paraboloid Aerials and Associated Feeder Systems

HORN paraboloid aerial systems are used on microwave radio-relay networks transmitting 960–1800 telephone channels or 625-line N.T.S.C colour television signals.

Features

Simultaneous operation in the 4000 Mc/s and 6000 Mc/s bands.

Capable of operation on dual polarization.

Front-to-back ratio better than 65 dB.

Higher illumination efficiency than paraboloid dishes (a minimum of 60%).

CONSTRUCTION

Marconi's currently manufacture two sizes of aerial 108 and 54 sq.ft in aperture. Choice of size depends on the individual system characteristics and path lengths involved.

The design developed by The Marconi Company has double-skin construction. The aerial can therefore withstand the severe wind loadings encountered in service without distortion of the internal reflecting surfaces, which would lead to a substantial degradation of electrical performance.

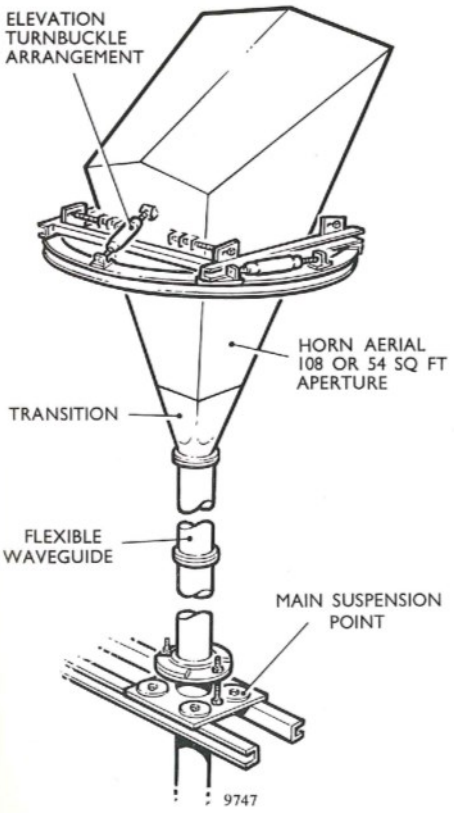
The double-curvature reflecting surface situated at the top of the horn, above the flare portion, is formed from 'Marconi-Surface' construction, described on page 389. A Hypalon terylene window, attached to the outer framework, seals the aerial aperture. This permits pressurization of the aerial up to 6 inches (15·24 cm) water guage without applying a bending moment to the top reflecting surface.

The main vertical run of feeder to the aerial consists of circular-section waveguide, the support systems being so arranged that all main vertical loads are taken at the top of the tower.

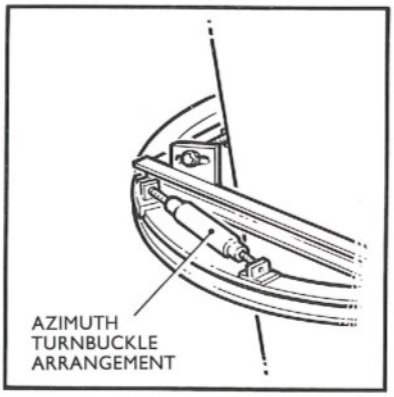
Panning the aerial in azimuth is performed by rotating the aerial framework on a circular ring. Large panning angle adjustment (up to 360°) may be made manually, and fine adjustments (up to $\pm 5°$) are made by screwing a turnbuckle connected between the aerial frame and the circular track. Panning in elevation (up to $\pm 1\frac{1}{2}°$) is made by screwing a turnbuckle connected between the circular ring and the back of the horn.

FUNCTION

Radio energy from transmitter/receiver is fed into the aerial feeder system through the respective ports of band-branching equipment normally situated near ground level. The band-branching equipment enables orthogonal polarizations in different frequency bands to be transmitted simultaneously through the aerial system.



Type No.	*J 0201*	*J 0202*
Aperture size:	54 sq.ft	108 sq.ft
Gain of aerial (at 6200 Mc/s):	42 dB	45 dB
Beamwidth (at 6200 Mc/s):	1·4°	0·9°
Weight:	1100 lb (500 kg)	2200 lb (1000 kg)
Frequency range:	3770–7110 Mc/s	
V.S.W.R (measured at horn transition):	Better than 1·02:1	
Back-to-front ratio:	65 dB	
Cross polarization discrimination (in direction of main beam):	Better than 35 dB	
Max. height above ground level:	Up to 300 ft (90 m)	
Maximum wind speed for normal operation:	100 mile/h (160k m/h)	
Operational temperature range:	0 to 120°F	



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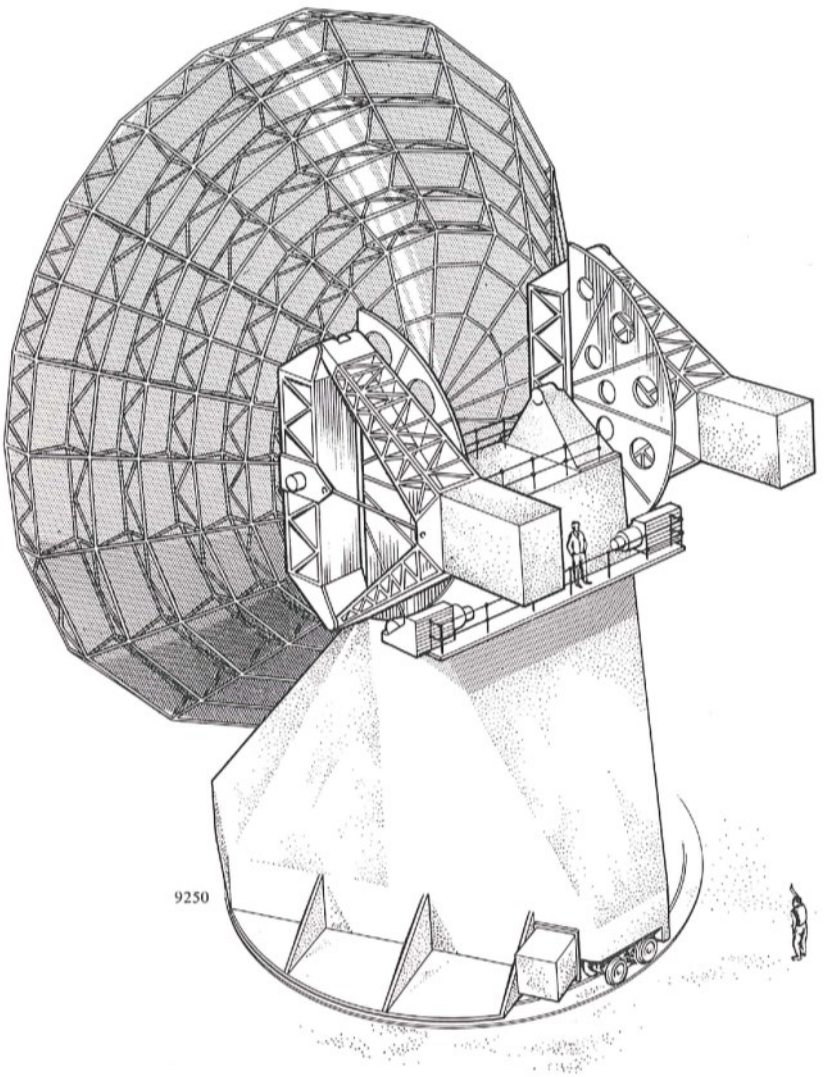
Steerable Aerials for Satellite Tracking and Radio Astronomy



An 85 ft (25·5 m) diameter satellite-tracking system.

MECHANICAL PRODUCTS DIVISION is equipped to design, develop, manufacture and install all mechanical equipment associated with radio-telescope and satellite tracking applications. With the continuous development of space research, and the advent of worldwide satellite communications systems, there is an increasing requirement for this type of aerial equipment, and this Division's proficiency in developing radar acrial systems is now being applied to meeting the new challenge.

There are detailed technical differences in the requirements for radio telescopes and satellite tracking equipment, not the least of which is the differing frequency bands used. However, the following are the broad features of any specification.

(a) A highly accurate reflector bowl surface supported on a steel framework, sufficiently rigid to give a highly directional radio beam at all specified frequencies.

(b) A radio-energy feed horn system and a waveguide-run to the transmitter/receiver equipment.

(c) Equipment to steer the aerial both in azimuth and elevation, within predetermined standards of accuracy, using electrical or hydraulic power and servo feedback control techniques.

(d) Equipment to accept the following alternative control inputs:
  (i) Paper-tape programme in digital form.
  (ii) Analogue or digital error information from the installation's own receivers.
  (iii) Co-ordinate positions from a master tracker in digital form.

(e) Remote control with facilities for:
  (i) Raster scan and means of centring on a signal.
  (ii) Manual correction of position and velocity.
  (iii) Manual control of programme time.
  (iv) Visual indication of reflector bowl position.

In addition, the equipment must be capable of remaining operational within a specified range of wind velocity, and survive under extreme environmental conditions.

Each specific application, of course, needs examination in detail and Mechanical Products Division is pleased to discuss the individual requirements of customers.

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