M579

S-BAND MAGNETRON

Frequency variant of M566, M569, M570

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	3050 to 3160	MHz
Typical peak output power	2.5	MW
Magnet and launching section	separate electromagnet and launching section assembly M4011 (see page 12 also)	
Isolator	use of an isolator is recommended (see note 8, page 6)	
Output	no. 10 waveguide (2.840 x 1.340 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	12	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum) (see note 1)	3	min

Mechanical

Overall dimensions	15.00 x 4.00 x 4.00 inches max 381 x 102 x 102mm max
Net weight	9¾ pounds (4.5kg) approx
Mounting position	vertical only

Any lubricants used on the anode should be sulphur free.

Electro-magnet and Launching Section

The complete electro-magnet and launching section is designated M4011 (see page 14); the launching section can be supplied as a separate item if required and is designated M4017 (see page 16).

	Min	Max	
D.C. current for 1580 gauss field (see note 2 and page 9)	27	30	A
Resistance of field windings:			
at 20°C	0.9	1.15	Ω
during operation	—	1.65	Ω
Overall dimensions (see page 14)	15.437 x 12.625 x 12.250 inches approx 392 x 320 x 310mm approx		
Net weight	110 pounds (50kg) approx		
Output flange	UG-53/U		

Cooling

The electro-magnet is water cooled and provides cooling for the magnetron anode by conduction through the inner liner of the magnet assembly into which the magnetron fits. The liner is machined to very fine limits and it is essential that the inner surface is carefully cleaned before the magnetron is fitted. Precautions must be taken to ensure that power to the magnetron and the electro-magnet is removed in the event of a cooling water supply failure. A flow of 1.5 imp. gal/min (6.8 l./min) is usually adequate, although this will depend on the method employed for mounting the assembly. The water pressure required for a flow of 1.5 imp. gal/min (6.8 l./min) is 4 lb/in^2 (0.28kg/cm^2) maximum.

The temperature rise across the water jacket should not exceed 15°C nor the water flow be less than 0.75 imp. gal/min (3.4 l./min). The design maximum temperature of the outlet water should be 70°C; under no conditions must 80°C be exceeded.

The magnetron output window is cooled by air at high pressure in the waveguide; the minimum window cooling air flow is 3ft^3/min (0.085m^3/min) N.T.P., and the maximum air inlet temperature is 70°C.

The cathode terminal may be cooled by low pressure air.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 3)	1200	1675	gauss
Heater voltage (see note 1)	11.4	15.0	V
Heater starting current (peak)	–	40	A
Anode voltage (peak)	27	41.5	kV
Anode current (peak)	70	176	A
Input power (peak)	–	6	MW
Input power (mean) (see note 4)	–	8.5	kW
Duty cycle	–	0.0015	
Pulse length (see note 5)	0.5	5.0	μs
Pulse repetition rate	–	600	p.p.s.
Rate of rise of voltage pulse (see note 6)	100	150	kV/μs
Anode temperature (see note 7)	–	150	°C
Cathode terminal temperature (see note 7)	–	150	°C
V.S.W.R. at the output coupler (see note 8)	–	1.5:1	
Pressurising of waveguide (see note 9)	35	65	lb/in^2
	2.46	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	1580	gauss
Anode current (peak)	145	A
Pulse length	5.0	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak)	38.5	kV
Output power (peak)	2.5	MW
Output power (mean)	3.75	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions (see note 10)

	Oscillation 1	Oscillation 2	Oscillation 3	
Air flow			see note 11	
Magnetic field (see note 12)	1580	1580	1675	gauss
Heater voltage (for test)	0	0	0	V
Anode current (mean)	210	180	187	mA
Duty cycle	0.0015	0.001	0.0015	
Pulse length (see note 5)	2.5	5.0	5.0	μs
V.S.W.R. at the output coupler			see note 13	
Rate of rise of voltage pulse (see note 6)	72 to 90	150 to 180	113 to 137	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	38.0	41.5	—	—	—	—	kV
Output power (mean)	3375	—	—	—	—	—	W
Frequency	3050	3160	—	—	—	—	MHz
R.F. bandwidth at ¼ power (see note 14)	—	1.0	—	0.5	—	0.5	MHz
Frequency pulling	—	7	—	—	—	—	MHz
Frequency pushing (see note 15)	—	1.0	—	—	—	—	MHz
Stability (see notes 14 and 16)	—	0.5	—	0.5	—	0.5	%
Heater current					see note 17		
Temperature coefficient of frequency					see note 18		

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Life Test Conditions

Heater voltage	0	V
Magnetic field	1580	gauss
Anode current (mean)	218	mA
Duty cycle	0.0015	
Pulse length	5	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage pulse	113 to 137	kV/μs

Switched off for 60 minutes every 24 hours.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2700	W min
R.F. bandwidth at ¼ power (see note 14)	1.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see notes 14 and 16)	1.0	% max

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12 volts to the heater for at least four minutes or by the application of 15 volts for three minutes. The heater voltage must not exceed 12.6 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the following formulae:

   V_h = 12.0–0.0010Pi for Pi less than 6000 watts

   V_h = 30.0–0.0040Pi for Pi greater than 6000 watts

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. The current required to give a field of 1580 gauss is marked on each M4017 electro-magnet assembly. Arrangements should be made for the magnetron input pulse to be switched off if the electro-magnet current varies by more than ±5% from this value.

   The ripple on the electro-magnet current should not exceed 1.5% overall. A three phase full wave rectifier output is normally suitable.

3. Measured at the point specified on the electro-magnet and launching section (page 12).

4. The various parameters are related by the formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

5. Tolerance ±10%.

6. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

7. Measured at the point indicated on the outline drawing.

8. In order to prevent malfunction, e.g. spectrum degradation, it is necessary to control the load v.s.w.r. in certain frequency bands other than the operating band; it is also necessary to avoid high Q resonances at frequencies adjacent to these band edges. The use of an isolator of approved design will facilitate the realization of these conditions.

Frequency Band (MHz)	**Maximum V.S.W.R.**
3300 to 3400	2.0:1
3620 to 3730	1.5:1

9. At the maximum pressure of 65lb/in^2 (4.57kg/cm^2) the leakage will not exceed 0.03 litre (N.T.P.) per minute.

10. The modulator shall be such that the pulse energy delivered to the magnetron, followed by an arcing pulse, cannot greatly exceed the normal energy per pulse.

11. During this test the waveguide air pressure shall not exceed 35lb/in^2 (2.46kg/cm^2) absolute and the cooling air flow shall not exceed

$3ft^3$/min ($0.085m^3$/min) free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

12. The value of the axial magnetic field shall fall to between 87.5% and 92% of the value at the specified point at points distant ±2 inches along the magnetron axis from the specified point. The sense of the field shall be such that a north-seeking pole at the specified point is attracted towards the cathode terminal of the magnetron.

13. The load termination of the magnetron during this test shall be a waveguide with a v.s.w.r. of less than 1.1:1 at the oscillation frequency and less than 1.5:1 between frequencies 3300 and 3400MHz, and between 3620 and 3730MHz, unless otherwise specified.

14. There shall be a range of at least $\lambda g/4$ where both the stability and bandwidth are less than the specified maxima, and they shall also be less than the maxima into a matched load.

15. The change in frequency when the mean input current is varied between the limits of 202 and 233mA shall be less than 1MHz. The current shall be varied continuously between the limits with a period not exceeding 5 seconds.

16. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 3050 to 3160MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

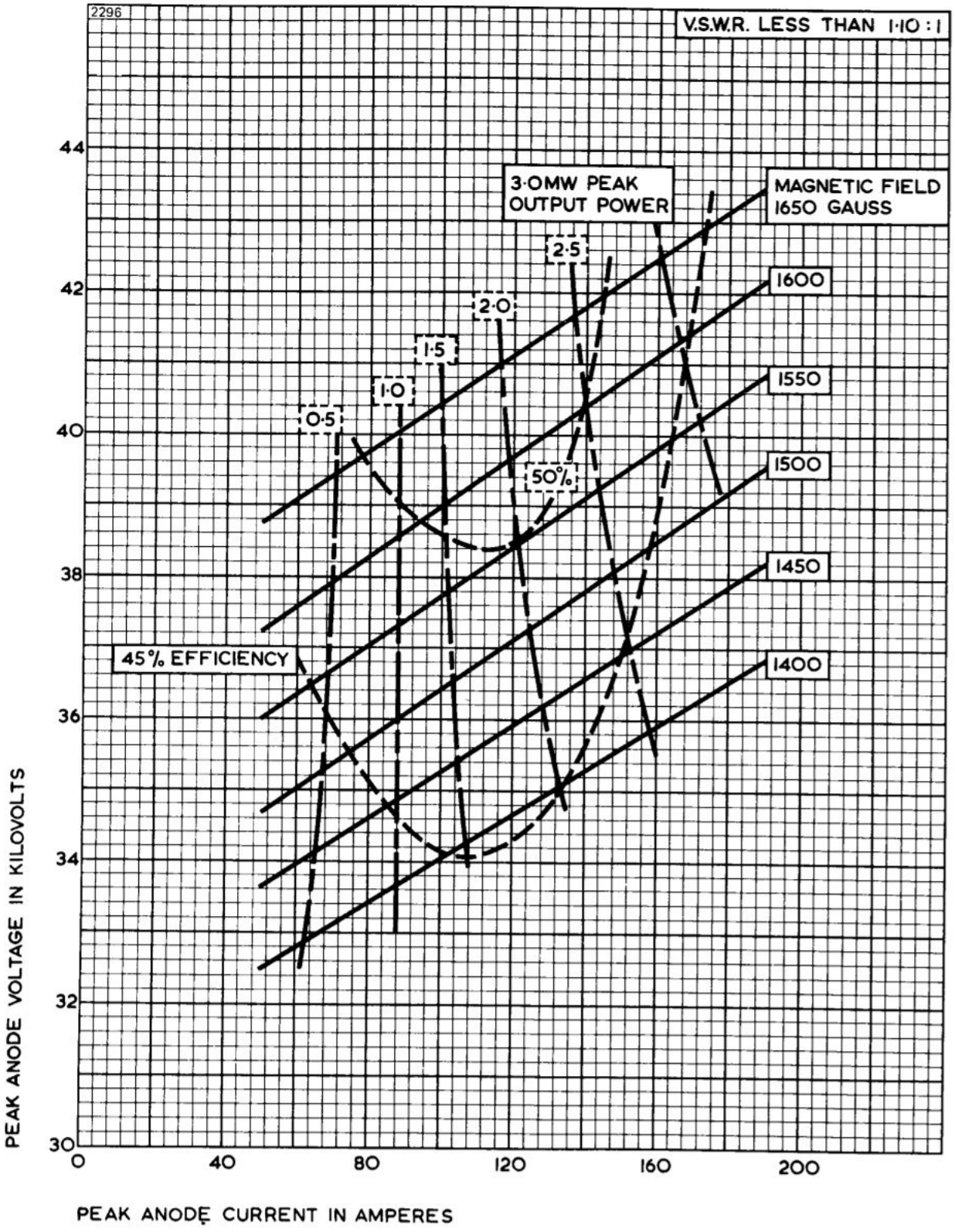
17. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

18. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.05MHz/°C.

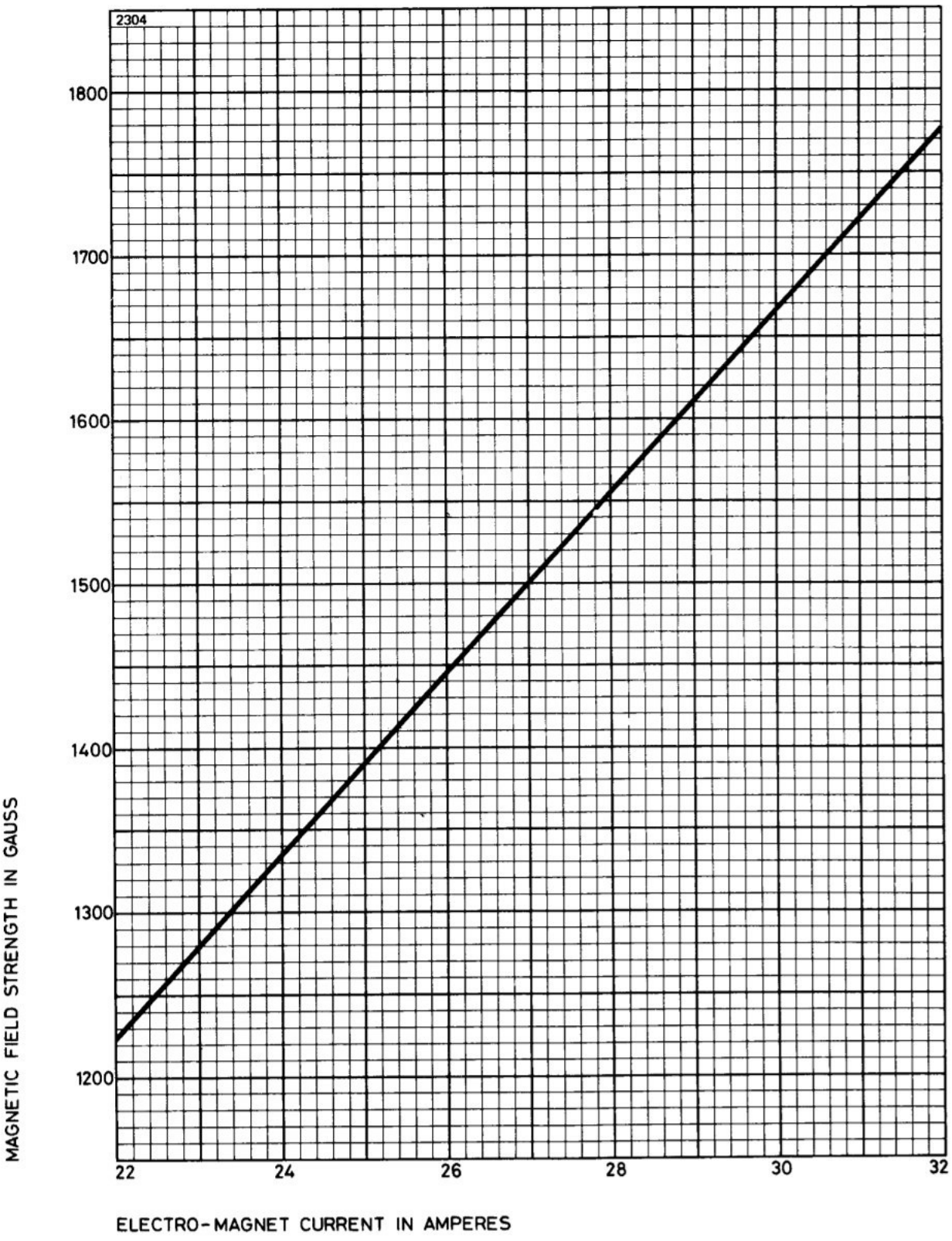
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART

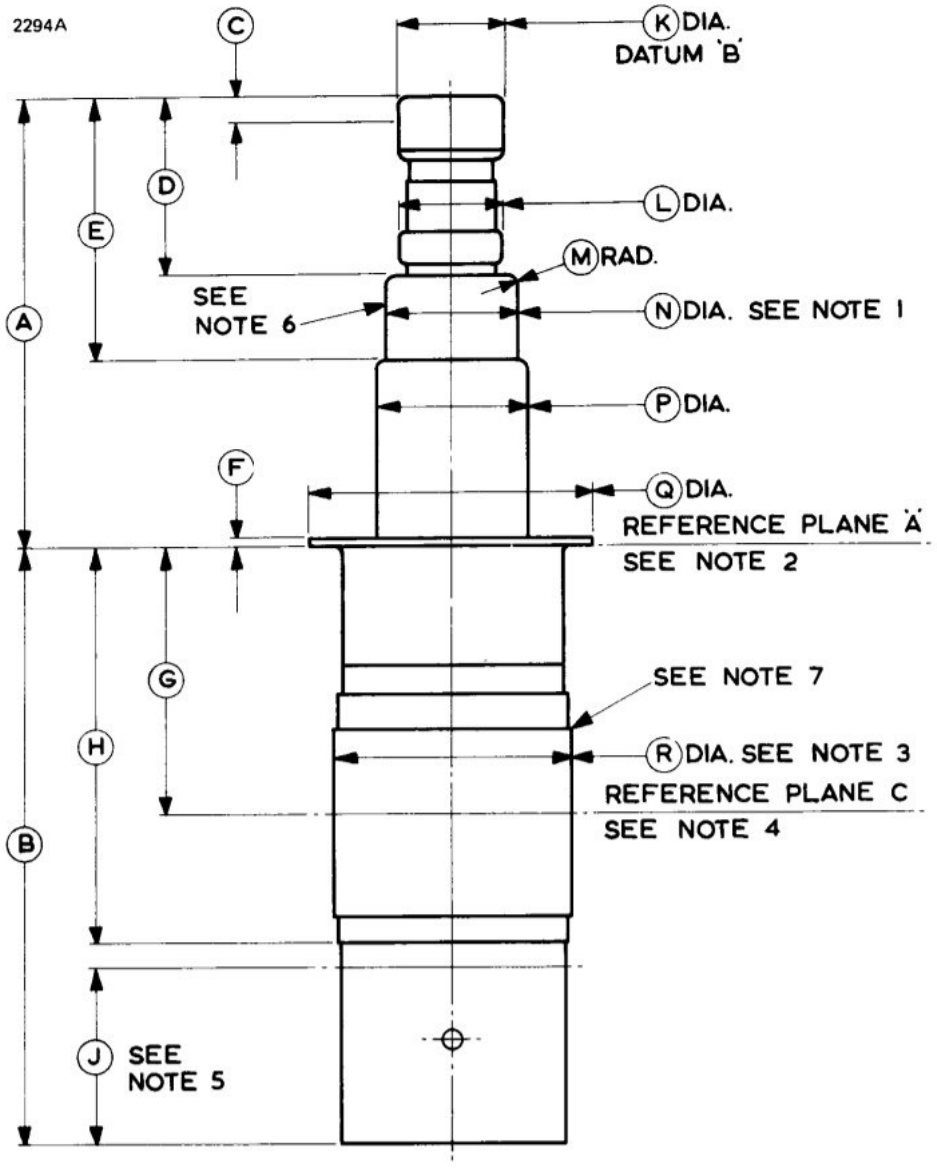


TYPICAL CURRENT CHARACTERISTIC FOR M4017



An individual calibration curve is supplied with each M4017 (see note 2 on page 6 also). Other types of electro-magnet will require calibration.

OUTLINE


2294A
C
K DIA.
DATUM 'B'
D
L DIA.
E
M RAD.
SEE
NOTE 6
A
N DIA. SEE NOTE 1
P DIA.
F
Q DIA.
REFERENCE PLANE 'A'
SEE NOTE 2
G
SEE NOTE 7
H
R DIA. SEE NOTE 3
REFERENCE PLANE C
SEE NOTE 4
B
J SEE
NOTE 5

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	6.427 max	163.2 max
B	8.514	216.3
C	0.375 min	9.53 min
D	3.063 max	77.80 max
E	3.563 min	90.50 min
F	0.125 ± 0.005	3.18 ± 0.13
G	3.939	100.1
H	5.689	144.5
J	2.500 min	63.50 min
K	1.500 ± 0.010	38.10 ± 0.25
L	1.550 max	39.37 max
M	0.100 min	2.54 min
N	1.750 ± 0.010	44.45 ± 0.25
P	1.937 max	49.20 max
Q	3.995 ± 0.005	101.5 ± 0.13
R	3.251 max	82.58 max

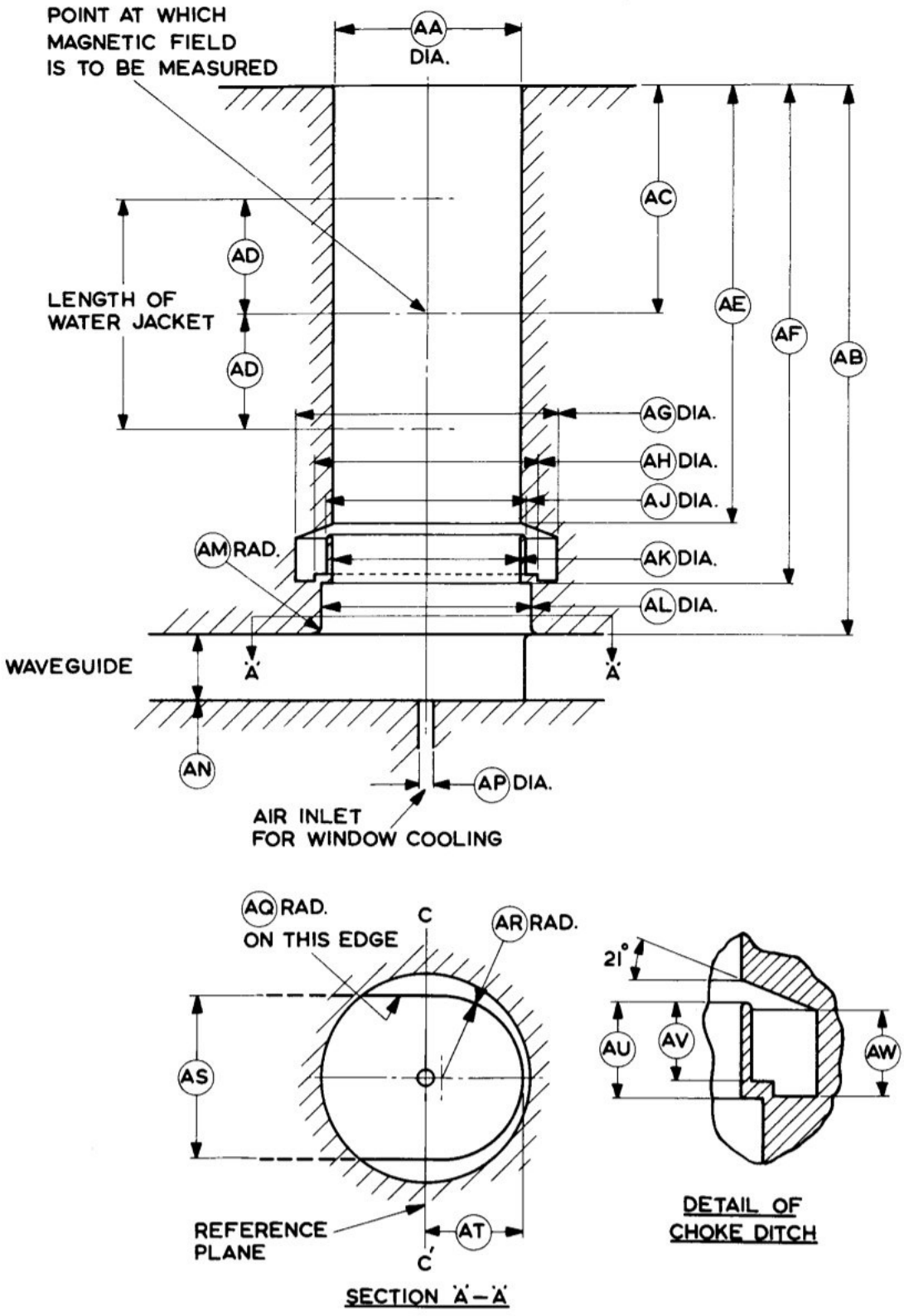
Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Concentric tolerance 0.050 inch (1.27mm) diameter, Datum 'B' B.S.308-1953.
2. This plane will be square to the axis of diameter 'R' to within 10'.
3. This surface will be silver or nickel plated.
4. Reference plane 'C' is the plane at which the magnetic field is measured. The magnetic field must be within the specified limits for an axial distance of ±2.000 inches (50.80mm) from plane 'C' and the valve must be fitted into a water jacket 3.253 ± 0.001 inches (82.626 ± 0.025mm) diameter which extends for ±2.000 inches (50.80mm) from plane 'C'.
5. The diameter over dimension 'J' will be 3.200 ± 0.010 inches (81.28 ± 0.25mm).
6. Cathode terminal temperature measured here.
7. Anode temperature measured here.
8. All metal surfaces will be silver or nickel plated or black finish.

CROSS SECTION OF SUITABLE ELECTRO-MAGNET AND LAUNCHING SECTION

2295

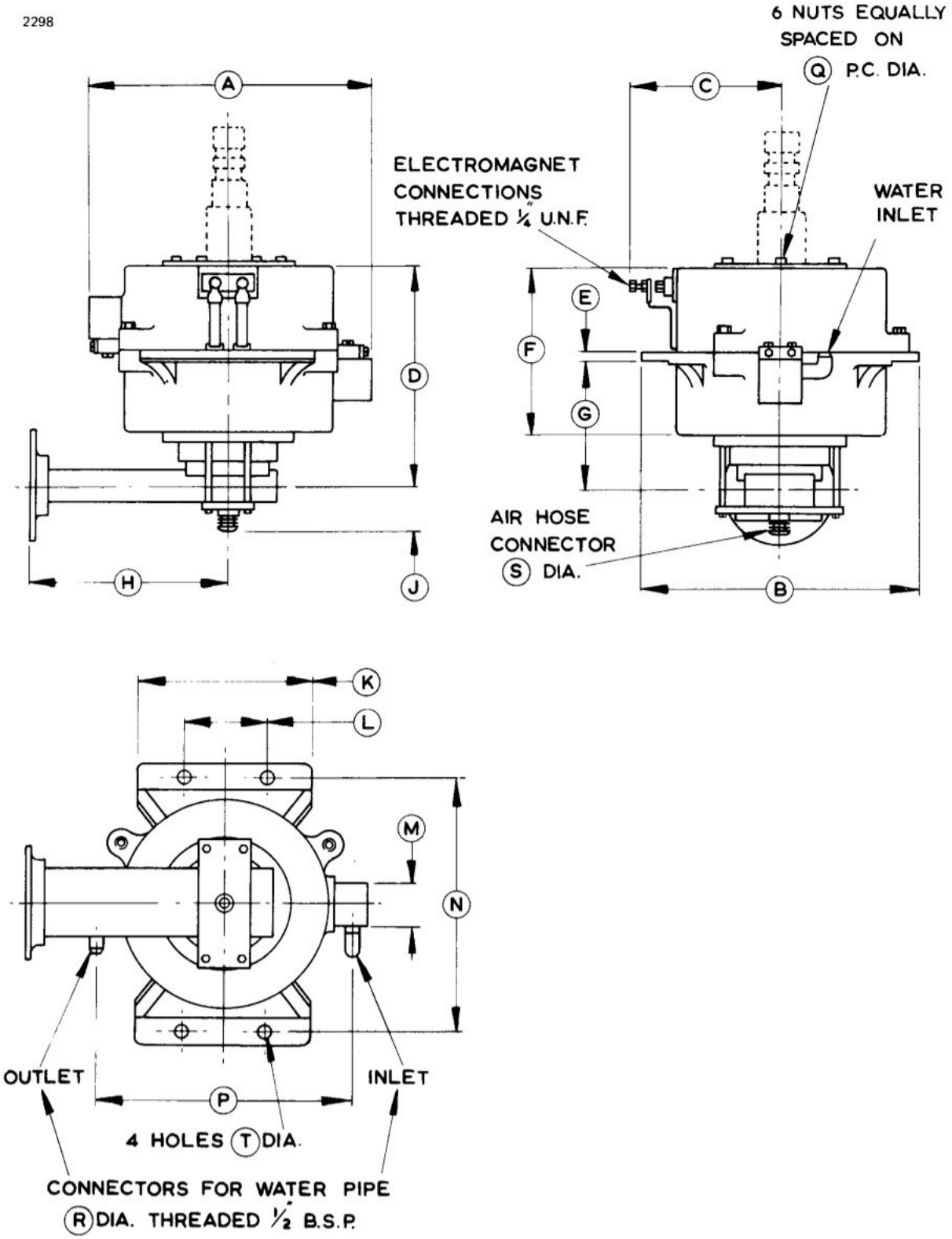


DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	3.253 ± 0.001	82.626 ± 0.025
AB	9.551	242.6
AC	3.939	100.1
AD	2.000 min	50.80 min
AE	7.637	194.0
AF	8.601	218.5
AG	4.340 ± 0.005	110.2 ± 0.13
AH	3.713 ± 0.003	94.310 ± 0.076
AJ	3.410 ± 0.005	86.61 ± 0.13
AK	3.250 ± 0.005	82.55 ± 0.13
AL	3.625 ± 0.003	92.075 ± 0.076
AM	0.125	3.18
AN	1.340	34.04
AP	0.250	6.35
AQ	0.125	3.18
AR	1.417 ± 0.005	35.99 ± 0.13
AS	2.840	72.14
AT	1.667 ± 0.010	42.34 ± 0.25
AU	0.813 ± 0.010	20.65 ± 0.25
AV	0.688 ± 0.010	17.48 ± 0.25
AW	0.750 ± 0.010	19.05 ± 0.25

Millimetre dimensions have been derived from inches.

OUTLINE FOR M4011



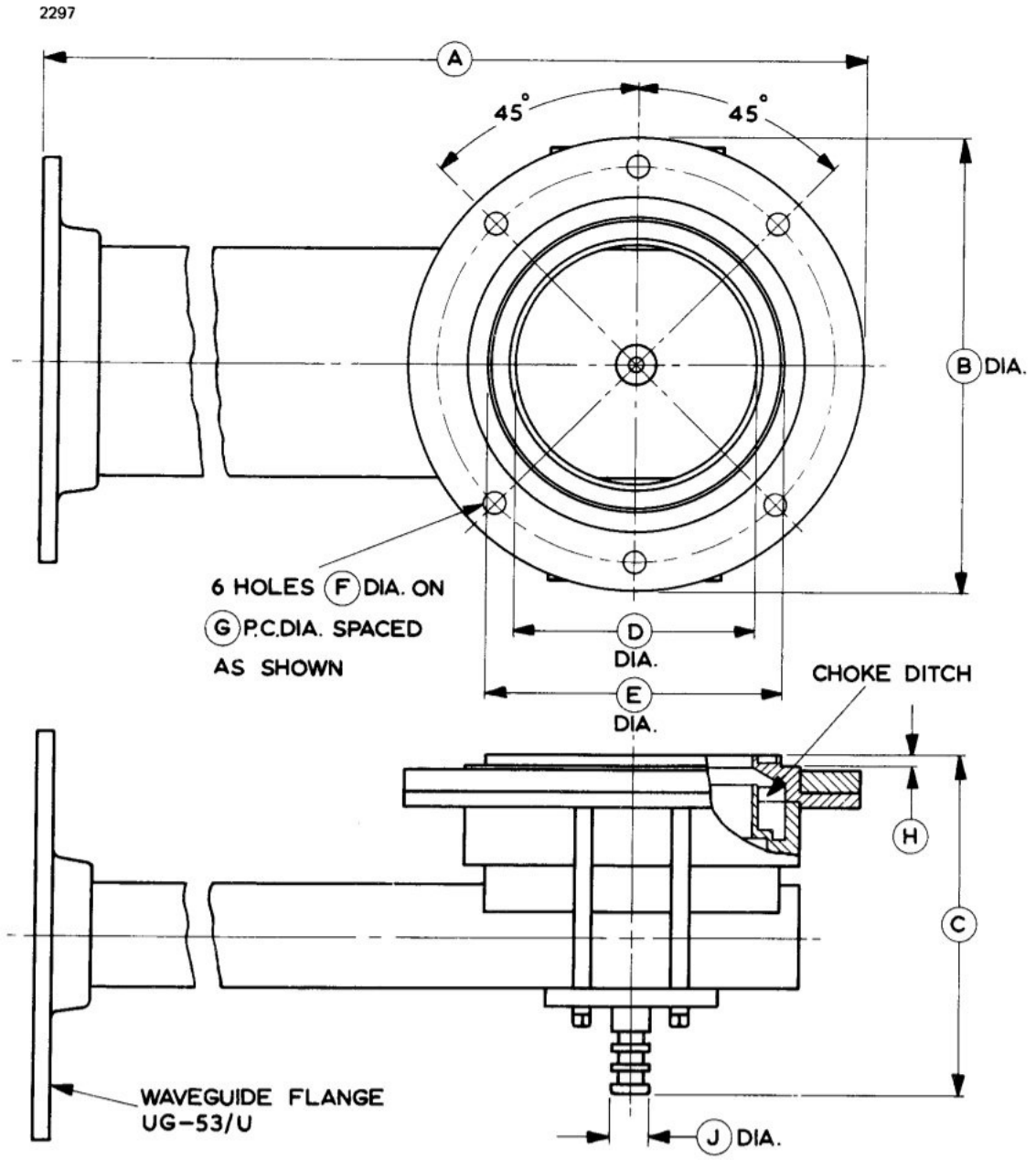
OUTLINE DIMENSIONS FOR M4011

Ref	Inches	Millimetres
A	12.875	327.0
B	12.625	320.7
C	7.000 max	177.8 max
D	10.031	254.8
E	0.375	9.53
F	7.500	190.5
G	5.906	150.0
H	9.000	228.6
J	2.000 max	50.80 max
K	8.000	203.2
L	3.750	95.25
M	2.000	50.80
N	11.625	295.3
P	11.375	288.9
Q	5.250	133.4
R	0.500	12.70
S	0.500	12.70
T	0.406	10.31

Millimetre dimensions have been derived from inches.

OUTLINE FOR M4017

2297



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.969	304.0	F	0.265	6.73
B	5.938	150.8	G	5.250	133.4
C	4.406	111.9	H	$0.140^{+0.005}_{-0.000}$	$3.56^{+0.13}_{-0.00}$
D	3.255	82.68			
E	3.865 ± 0.002	98.17 ± 0.25	J	0.500	12.70

Millimetre dimensions have been derived from inches.