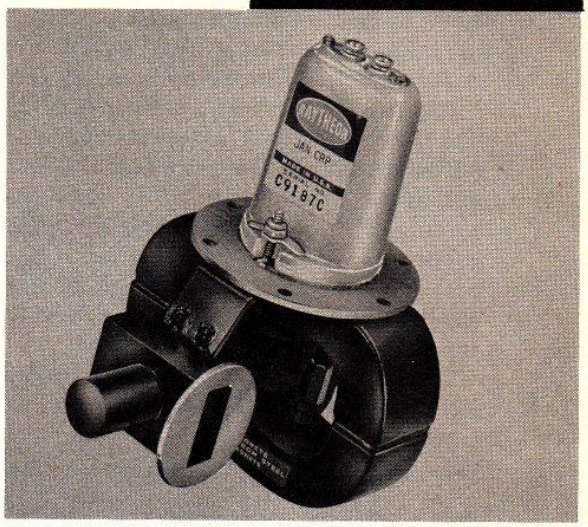
RAYTHEON

TECHNICAL INFORMATION

PULSED-TYPE MAGNETRON OSCILLATOR

Excellence in Electronics

TYPE 2J55-2J56



The type 2J55-2J56 magnetron tube with integral magnet, is a super-high frequency oscillator with internal resonant circuits, designed to operate in the 3 centimeter band and capable of delivering 70 kilowatts of peak power under pulsed conditions.

GENERAL ELECTRICAL CHARACTERISTICS

Heater

Indirectly heated, oxide coated, unipotential cathode.

Heater voltage	6.3 V
Heater current	1.0 A
Minimum heating time	1 Minute

Maximum Ratings

Heater voltage	7.0 V
Peak anode voltage	16 kv
Peak anode current	16 a
Maximum duty cycle product	.001
Maximum pulse duration	2.5 μs
Average input power	180 W
Frequency pulling (at a standing wave ratio of 1.5 in voltage)	15 Mc
Anode temperature	100° C.

The tube should not be operated longer than 5 microseconds in any 100 microsecond interval.

Minimum pressure at which output circuit will pass 50 kw. without breakdown — .5 Atmosphere

Typical Operation

Heater voltage	(See operating notes)
Recurrence frequency	1000 Pulses per second
Pulse duration	1 μs
Peak anode voltage	12.8 kv
Peak anode current	12.0 a
Peak power output	50 kw
Maximum frequency change due to temperature	.25 Mc./°C.
Frequency (fixed frequency in the following range)	
2J55	9345 —9405 Mc.
2J56	9215 — 9275 Mc.

DETAILED MECHANICAL INFORMATION

The outline drawing shows the principal external dimensions and arrangement of the magnet, cooling fins, heater, common heater-cathode terminals, and R.F. output coupling flange. The letter

"C" etched on the glass protector indicates the common heater-cathode terminal which is connected to the pulsating high voltage. No direct connection is made to the output circuit of the tube.

The tube is mounted from the circular flange and may be operated in any orientation. The output circuit of the tube is preplumbed to have a certain frequency pulling figure for operation into a waveguide load and is designed for optimum frequency insensitivity and breakdown characteristics. The coaxial to the waveguide junction is matched so that little or no electrical reflection exists in any part of the output circuit.

Both mounting flange and R.F. output flange are suitable for application whre pressure seals are required.

Net weight of 2J55-2J56 magnetron 3 Lb. 2 Oz.

OPERATING CHARACTERISTICS

Figure 1, Rieke Diagram, shows the power and frequency contours for a typical tube operating into a ½"×1⅛" (internal dimensions) waveguide with standing wave ratio and phase angle varied. The pulling figure at 1.5 ratio in voltage is 11.5 megacycles. It should be noted that this data is representative of average tubes and was taken under conditions simulating typical operating characteristics. Slight variations may be expected with different tubes in different systems.

Figure 2, Operating Characteristics, shows peak power output, frequency, efficiency, R.F. bandwidth at ¼ power, and peak anode potential contours, as a function of peak current for a typical tube.

Figure 3, Vibration Characteristics, shows the change of frequency (effective spectrum width) as a function of sinusoidal acceleration (G) for a typical tube.

OPERATING NOTES

Satisfactory operation of the tube will depend largely on the waveform characteristics of the input voltage pulse which should fulfill the following conditions:

Voltage time of rise	— 0.1 to 0.2 microsecond
Voltage time of fall	— less than 0.4 microsecond
Current variation	— less than ±10% of average pulse current

A poor pulse shape may cause excessive frequency modulation and general instability.

Adequate forced air should be provided to keep anode temperature of the tube less than 100°C.

The life of the 2J55-2J56 packaged magnetron is limited by the usefulness of the cathode. In general, magnetron life is inversely proportional to pulse width and duty cycle. It is therefore recommended that the tube be operated at a low recurrence rate when high peak power is required. The use of a transmission line not properly matched to the magnetron is another factor reducing the life of the tube. This is due to excessive cathode heating.

The maximum ratings with respect to pulse voltage, pulse current, and pulse duration, represent limiting values for each quantity independently. They do not form a set of values at which the tube can be satisfactorily operated.

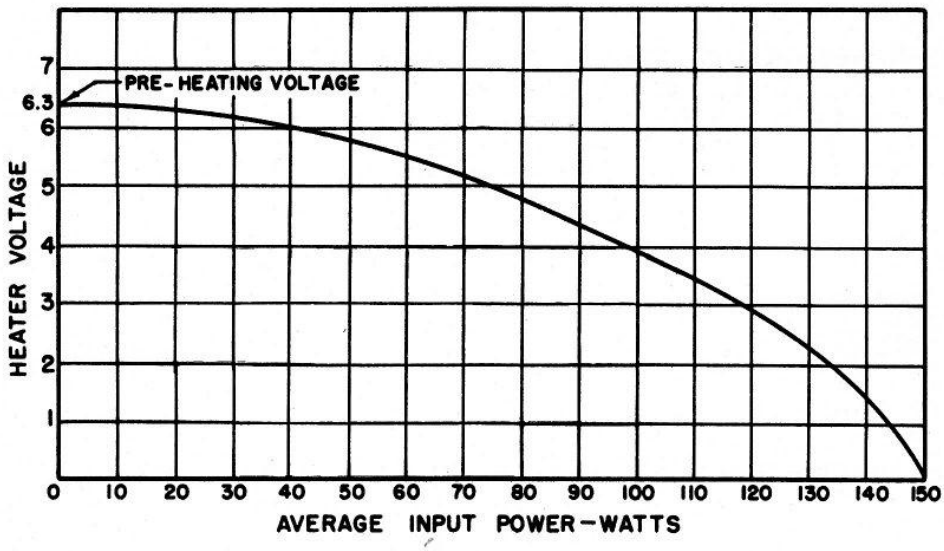
The duty cycle product must not exceed 0.0007 for peak power input of 150 kw or greater, and must not exceed 0.001 under any circumstances.

Extreme care should be used in handling and mounting the 2J55-2J56 packaged magnetron. The integral magnet has a protective coating to minimize the loss of magnetism resulting from direct contact with magnetic materials. When the tube is mounted in a system, the spacing between the magnet and other magnetic material should be at least 2 inches, along the circular section and at the poles.

In starting a new magnetron a temporary unsteadiness in its operation may result. It is recommended that the tube be "seasoned" under prevailing conditions of oscillation to the point where it becomes stable and normal operating values are obtained.

Heater voltage (6.3 volts) should be turned on one minute before the high voltage pulsations are applied. During high voltage pulse operation at recurrence rates below 500 pulses per second, it is essential to maintain the heater voltage at 3.0 volts. At recurrence rates above 500 pulses per second, the heater voltage should be reduced in proportion to the average power input according to the schedule below. Failure to start the tube at the rated heater voltage, or to improperly reduce the heater voltage after oscillation starts, may seriously reduce the life of the tube.

HEATER VOLTAGE VS. INPUT POWER SCHEDULE



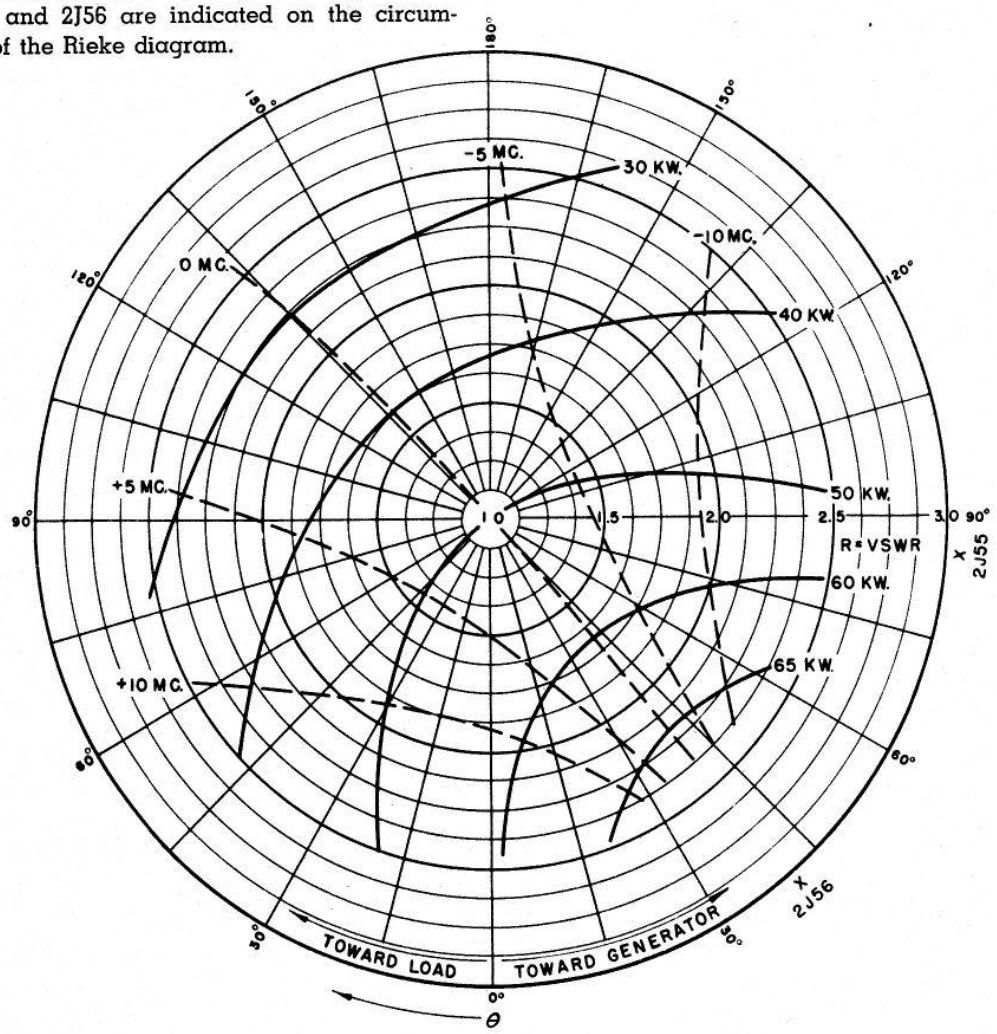
NOTES: E_f = 0 FOR ALL VALUES OF INPUT POWER GREATER THAN 150 WATTS

MAXIMUM DEVIATION OF HEATER VOLTAGE SHOULD NOT EXCEED ±10% OF RATED SCHEDULE.

AVERAGE PERFORMANCE CHARACTERISTICS

FREQUENCY-POWER CONTOUR DIAGRAM

Average location of frequency convergence for the 2J55 and 2J56 are indicated on the circumference of the Rieke diagram.



RIEKE DIAGRAM

FIGURE 1

OPERATING CONDITIONS

Recurrence rate = 1000 cps.

Pulse duration = 1 microsecond.

Peak magnetron current = 12.0 a

Recommended load for 2J55-2J56 at center of diagram.

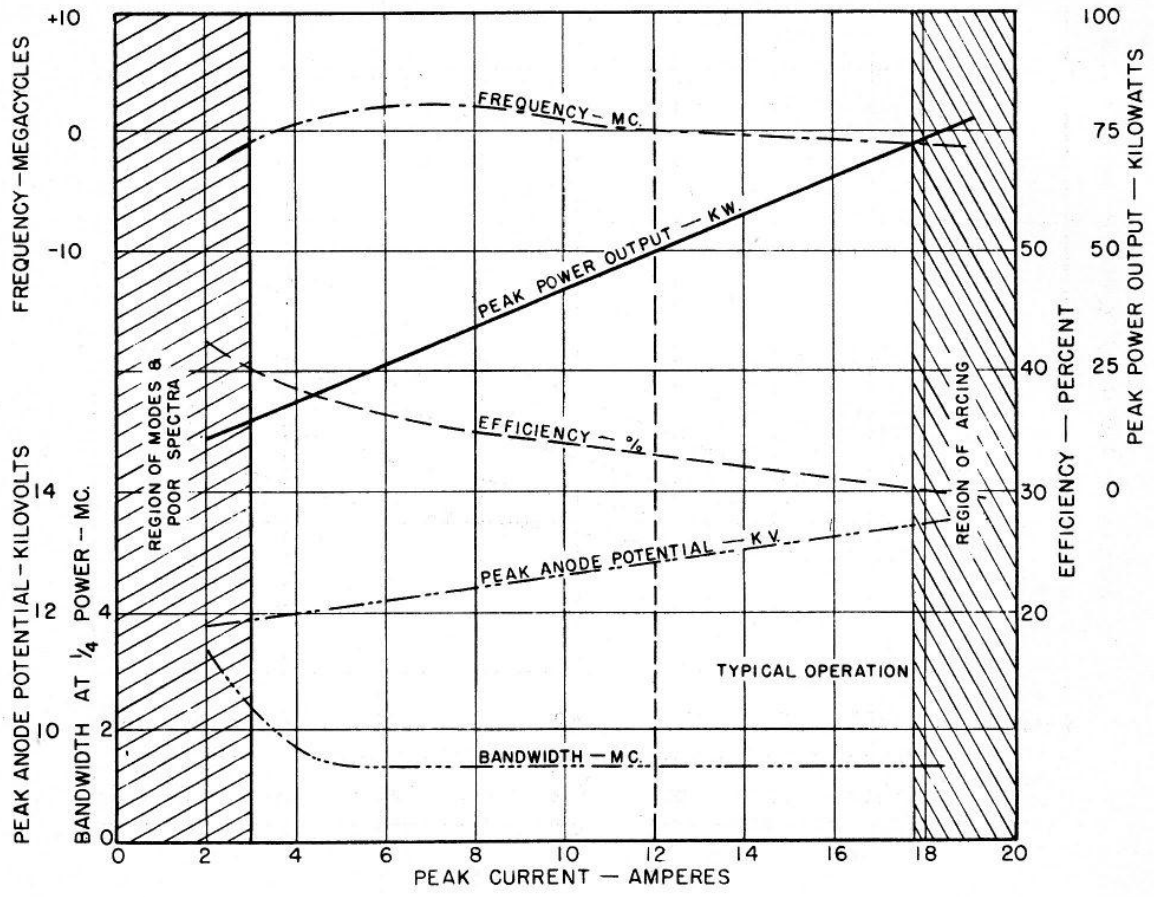
R = Standing wave ratio in voltage.

θ = Distance of standing wave minimum from face of output flange of tube toward load.

——— = Power contours (peak kw).

– – – = Frequency contours (megacycles deviation from frequency of magnetron feeding into a matched waveguide).

AVERAGE PERFORMANCE CHARACTERISTICS



OPERATING CHARACTERISTICS

FIGURE 2

Pulse duration = 1 microsecond

Recurrence rate = 1000 pulses per second

— - - — = Peak anode potential (kilovolts)

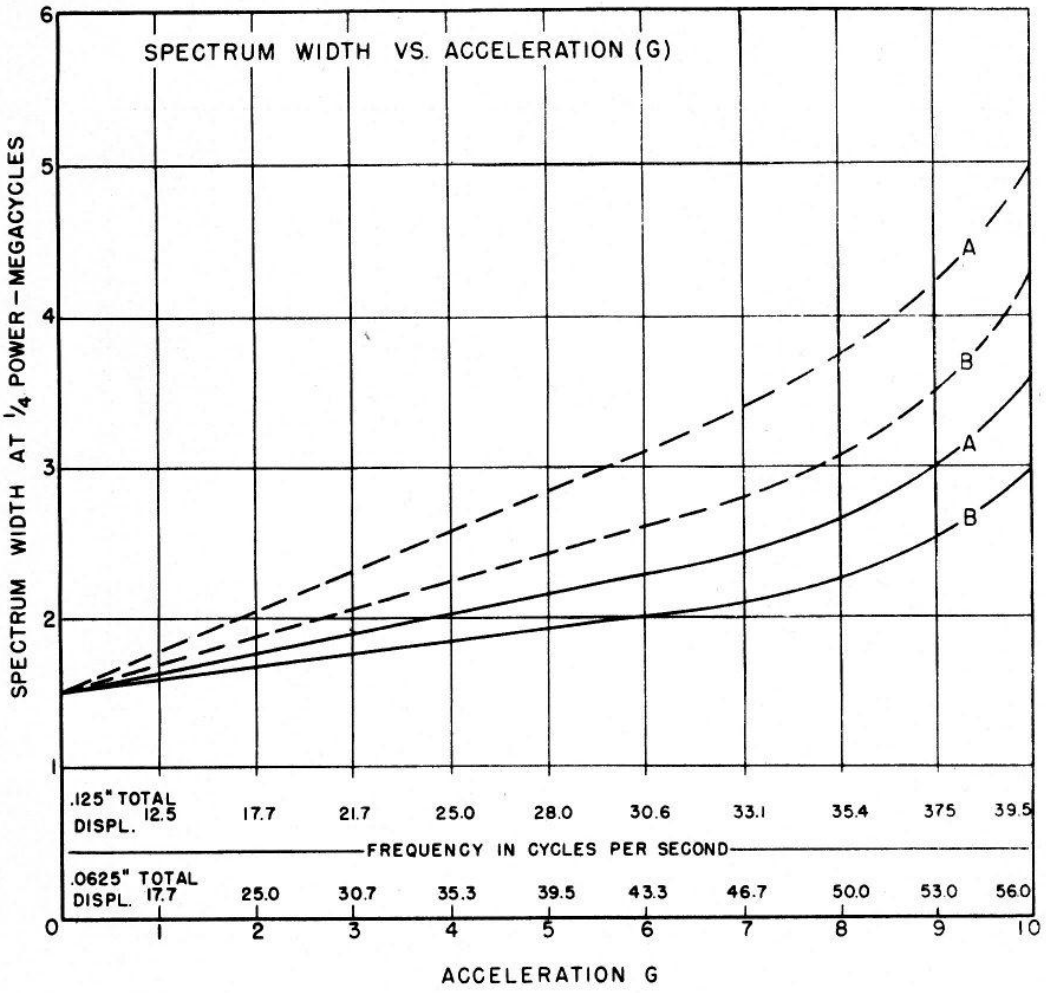
——— = Peak power output (kilovolts)

— — — = Efficiency (per cent)

— - - - — = Bandwidth @ ¼ power (megacycles).

— - - — = Frequency (megacycles deviation from mean frequency as determined by corresponding Rieke Diagram, and taken under conditions of constant temperature.)

AVERAGE PERFORMANCE CHARACTERISTICS



VIBRATION CHARACTERISTICS

FIGURE 3

– – – = .0625″ Total Displacement

——— = .125″ Total Displacement

Pulse duration = 1 microsecond

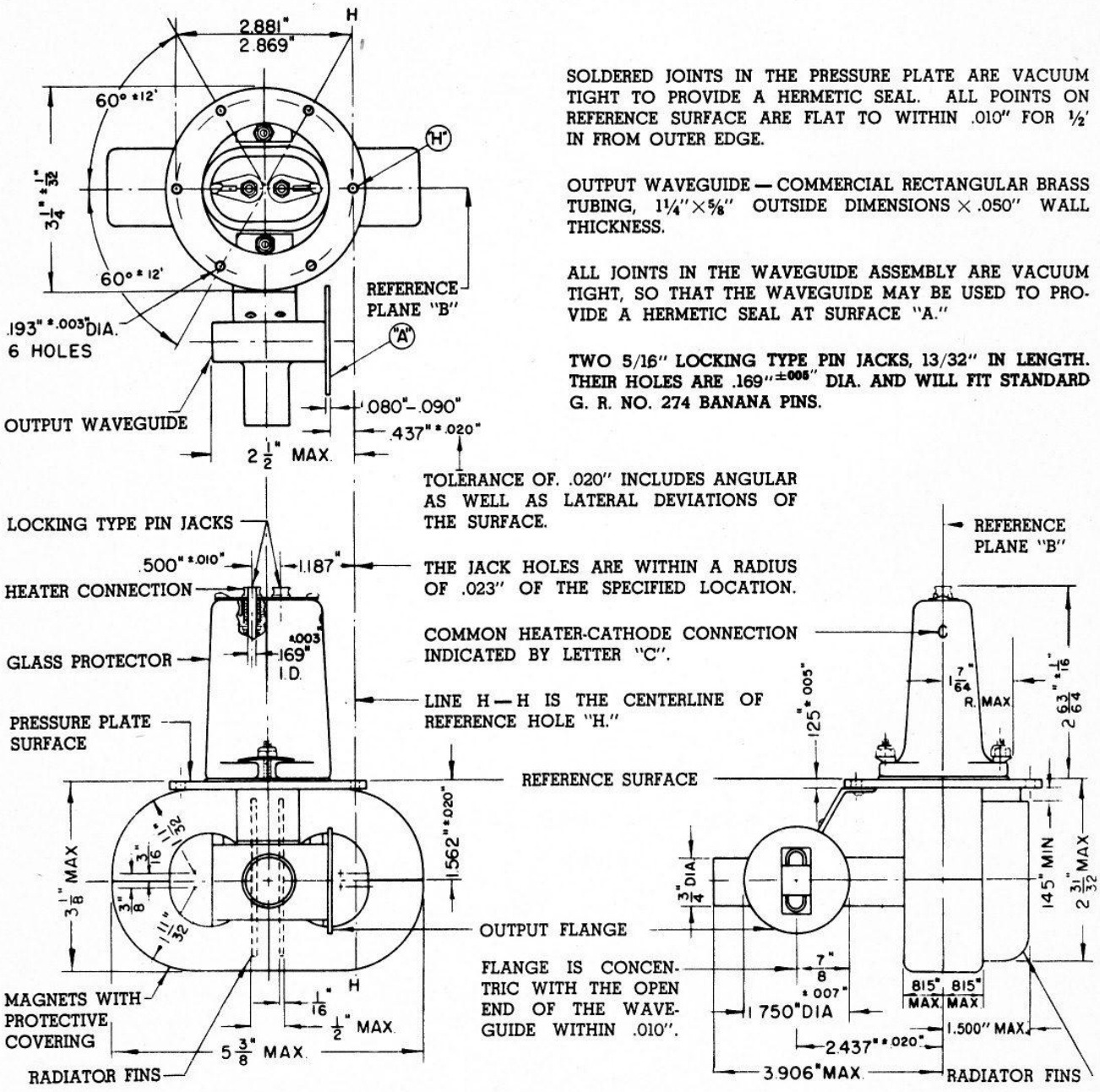
Recurrence rate = 1000 pulses per second

Peak magnetron current = 12 a

Curve A = Displacement perpendicular to the cathode and its associated lead in any plane at 360°.

Curve B = Displacement parallel to the cathode and its associated lead in any plane of 360°.

OUTLINE DRAWING



SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½' IN FROM OUTER EDGE.

OUTPUT WAVEGUIDE — COMMERCIAL RECTANGULAR BRASS TUBING, 1¼"×⅝" OUTSIDE DIMENSIONS × .050" WALL THICKNESS.

ALL JOINTS IN THE WAVEGUIDE ASSEMBLY ARE VACUUM TIGHT, SO THAT THE WAVEGUIDE MAY BE USED TO PROVIDE A HERMETIC SEAL AT SURFACE "A."

TWO 5/16" LOCKING TYPE PIN JACKS, 13/32" IN LENGTH. THEIR HOLES ARE .169" ±.005" DIA. AND WILL FIT STANDARD G. R. NO. 274 BANANA PINS.