INCH-POUND

MIL-PRF-1/851H
17 September 1999
SUPERSEDING
MIL-E-1/851G
5 May 1975 23/

PERFORMANCE SPECIFICATION SHEET

# ELECTRON TUBE, MAGNETRON
# TYPE 5780

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-PRF-1.

DESCRIPTION: Oscillator, tunable frequency 8,500 to 9,600 MHz, 250 kw peak power output, pulsed operation, air cooled.

ABSOLUTE RATINGS:

| Parameter: Unit: | Ef V | If (surge) A | tk sec | ib a | Pi W | epy kv | tpc µs | rrv 3/ 7/ kv/µs |
|---|---|---|---|---|---|---|---|---|
| Maximum: | 22 | 16 | --- | 36 | 600 | 38 | 0.3 | 300 |
| Minimum: | --- 1/ | --- 2/ | 180 1/ | 18 | --- | --- | 0.18 | --- |

ABSOLUTE RATINGS:

| Parameter: Unit: | prr --- | Du --- | VSWR --- | T(input connector) °C | T(body) °C | Tuner torque in.-lb | Output pressure psia | Alt ft |
|---|---|---|---|---|---|---|---|---|
| Maximum: | 4,800 | 0.001 | 2.0 | 300 | 100 | 3 | 30 | 4,000 |
| Minimum: | 200 | --- | --- | --- 4/ | --- 4/ | --- | --- | --- |

PHYSICAL CHARACTERISTICS:

| | | | |
|---|---|---|---|
| Cooling: | Forced air. | Connectors: | |
| Weight: | 16 pounds (approx) 7.26 kg. | RF output: | Mates with UG-52U. |
| Mounting position: | Any. | Input: | Jettron 90-009, or equivalent. |

TEST CONDITIONS:

| Parameter: Unit: | Ef V | tk sec | Ib 6/ mA dc | tpc µs | rrv 3/ 7/ kv/µs | Du --- | Frequency --- |
|---|---|---|---|---|---|---|---|
| Tolerance: | ±0.5 | +10 | ±0.5 | ±0.02 | ±40 | ±0.00001 | --- |
| Test condition 1: | --- | >720 | 10 | 0.24 | 200 | 0.00033 | F2 |
| Test condition 2: | 14.4 | >720 | 6 | 0.24 | 200 | 0.00033 | F2 |
| Test condition 3: | --- | >720 | 16 | 0.18 | 130 | 0.00072 8/ | F2 |
| Test condition 4: | 20 | --- | 0 | --- | --- | --- | F2 |
| Test condition 5: | 8.8 | 5/ | 16 | 0.18 | 130 | 0.00072 8/ | F2 |
| Test condition 6: | --- | 5/ | 11 | 0.18 | 130 | 0.00036 | F2 |

| Frequency | |
|---|---|
| F1 | 8,500 MHz |
| F2 | 9,000 MHz |
| F3 | 9,600 MHz |

See footnotes at the end of table I.

GENERAL:

Qualification - Required.


DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

TABLE I. Testing and inspection.

| Inspection | Method | Notes | Test | Conditions | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max | |
| Qualification inspection | | | | | | | | |
| Barometric pressure, reduced | 1002 | --- | 1 | Pressure = 656 mmHg (absolute)<br>σ' = 1.05 (max) | --- | --- | --- | --- |
| Temperature coefficient | 4027 | --- | 1 | T(body) = +60°C to +90°C;<br>F = F3 | $\frac{\Delta F}{°C}$ | --- | 0.4 | MHz |
| Tuner drive torque (1) | 4223 | 21/ | --- | F = F1 through F3;<br>at 30 rpm ±10 percent;<br>TA = -55°C<br>T = 125°C | Torque | --- | 12 | in.-oz. |
| Air cooling | 1143 | 4/ | 3 | TA = +50°C (max);<br>Pi-Po = 450 W;<br>adjust Ib;<br>air = 20 cfm (max) | ΔT(body) | --- | 50 | °C |
| Phase of sink | 4309 | 10/ | --- | F = F3; no voltage applied | Distance | 0.18 | 0.22 | λg |
| Conformance inspection, part 1 | | 22/ | --- | | | | | |
| Pressurizing | 4003 | 11/ | --- | Waveguide output;<br>30 psia (min) | --- | --- | --- | --- |
| Heater current | 4289 | --- | 4 | tk = 180 seconds (min) | If | 3.6 | 4.4 | A |
| Pulse voltage | 4306 | --- | 1 | F = F1 | epy | 32 | 34 | kv |
| Power output (1) | 4250 | 6/ 12/ | 1 | σ' = 1.05 (max) | Po | 85 | --- | W |
| Stability (1) | 4315 | 12/ 13/ | 1 | σ' = 1.5 (min);<br>pulse energy level<br>70 ± 5 percent | MP | --- | 2.0 | % |
| Tuning characteristics | 4223 | 14/ | 1 | | g1 +0.95<br>g1 +2.75<br>g1 +5.35 | 9,280<br>8,960<br>8,450 | 9,340<br>9,060<br>8,590 | MHz<br>MHz<br>MHz |
| Tuner drive torque (2) | 4223 | 15/ | --- | No voltages applied;<br>TA = +25°C | Torque | --- | 6 | in.-oz. |
| Power output (2) | 4250 | 12/ | 3 | σ' = 1.05 (max) | Po | 90 | --- | W |
| Stability (2) | 4315 | 12/ 13/ 16/ | 3 | σ' = 1.5 (min);<br>pulse energy level<br>50 ± 5 percent | MP | --- | 2.0 | % |

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

| Inspection | Method | Notes | Test | Conditions | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Min | Max | |
| Conformance inspection, part 2 | | | | | | | | |
| RF bandwidth | 4308 | 12/ | 1 | σ' = 1.5 (min); phase and frequency which produces greatest bandwidth | BW | --- | $\frac{2.0}{tpc}$ | MHz |
| Pulling factor | 4310 | 12/ | 1 | σ' = 1.5 (min) | ΔF | --- | 16 | MHz |
| Tunable frequency | 4223 | 17/ | 2 | σ' = 1.05 (max); tuning at mechanical limit | | | | |
| | | | | High frequency | F | 9,600 | 9,620 | MHz |
| | | | | Low frequency | F | 8,440 | 8,500 | MHz |
| Resettability | 4223 | 12/ 18/ | 1 | σ' = 1.05 (max) | F | --- | 10 | MHz |
| Minor lobes | 4308 | 9/ 12/ | 1 | σ' = 1.5 (min) | Ratio | 6 | --- | dB |
| Shock | 1041 | 19/ | --- | No voltages applied; 50 G; 4 ms | --- | --- | --- | --- |
| High-frequency vibration | 1031 | 20/ | --- | No voltages applied; 10 G | --- | --- | --- | --- |
| Conformance inspection, part 3 | | | | | | | | |
| Life test | --- | 5/ | --- | Group D; cycled hourly | t | 1,000 | --- | hr |
| Life-test end points: | --- | | | | | | | |
| Pulse voltage | 4306 | --- | 1 | F = F1 | epy | 30.5 | 36 | kv |
| Power output (1) | 4250 | 6/ 12/ | 1 | σ' = 1.05 (max) | Po | 65 | --- | W |
| RF bandwidth | 4308 | 12/ | 1 | σ' = 1.5 (min) | BW | --- | $\frac{2.5}{tpc}$ | MHz |
| Stability (1) | 4315 | 12/ 13/ | 1 | σ' = 1.5 (min); pulse energy level 70 ± 5 percent | MP | --- | 3 | % |
| Minor lobes | 4308 | 12/ | 1 | | Ratio | 6 | --- | dB |
| Tunable frequency | 4223 | 17/ | 2 | σ' = 1.05 (max) tuning at mechanical limit | --- | --- | --- | --- |
| | | | | High frequency | F | 9,580 | 9,630 | MHz |
| | | | | Low frequency | F | 8,420 | 8,510 | MHz |
| Power output (2) | 4250 | 12/ | 3 | σ' = 1.05 (max) | Po | 65 | --- | W |
| Stability (2) | 4315 | 12/ 13/ 16/ 19/ | 3 | σ' = 1.5 (min); pulse energy level 50 ± 5 percent | MP | --- | 3 | % |

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

1/ Prior to the application of high voltage, the cathode shall be heated by applying either 16 volts for 12 minutes (this shall be typical equipment standby voltage) or 20 volts for 3 minutes (this shall be maximum voltage minimum time condition). On the application of anode voltage, the heater voltage or current shall be lowered to the specified value.

2/ This shall be the maximum instantaneous surge current. There shall be a suitable series impedance during starting time to limit surge current to this value. The cold resistance of the heater is approximately 0.5 ohm.

3/ The input circuit shall be designed so that the energy per pulse delivered to the tube, if arcing occurs, cannot greatly exceed the normal energy per pulse. Modulators of the discharging network type may satisfy this requirement. The total input capacitance of the tube and circuit shall be 15 pF minimum.

4/ The temperature shall be measured at the points indicated on figure 2.

5/ Life-test cycle. Ten minutes at no voltage, 3 minutes at Ef = 20 V 400 Hz, 7 minutes at Ef = 16 V 400 Hz, 20 minutes at test condition 5, 20 minutes at test condition 6, $\sigma' = 1.5 \pm 5$ percent with phase varied through 180° at least five times during the pulsing part of the hourly cycle. Frequency shall be changed at the rate of approximately 100 MHz per hour, either continuously or in steps. t shall also include all time during which the heater is operating.

6/ After application of heater voltage for the required warmup time, apply a pulse voltage with the rise characteristics specified in the test conditions and increase slowly (within 15 seconds) to the value of Ib required. Unless otherwise specified, VSWR of the load shall be less than 1.05. In power output (1), the tube should attain the specified minimum power output within 5 minutes after high voltage is applied.

7/ The rate of rise of voltage (rrv) shall be expressed in kilovolts per microsecond, defined as the steepest tangent to the leading edge of the voltage pulse above 80 percent amplitude when amplitude is defined as a horizontal line drawn tangent to the top of the smooth peak.

8/ The duty cycle shall be obtained by applying pairs of pulses separated from each other by a value of $15 \pm 1$ µs, with alternate pulses occurring at a nominal repetition rate of 2,000 pulses per second (pps). This is comparable to a combined repetition rate of 4,000 pps.

9/ When observed on a spectrum analyzer, a suitable spectrum is considered one in which the major lobe has a shape such that its slope does not change sign more than once for power levels greater than the minor lobe value specified herein. This shall be expressed as the difference in power levels in terms of dB.

10/ This test shall be made with the magnetron tuned to an operational frequency of 9,600 MHz. The phase of maximum loading to be coupled to the magnetron output shall be determined by the distance from the output flange at which a standing wave ratio minimum can occur, expressed in terms of a fraction of wavelength in the guide ($\lambda g$).

11/ With pressure of 30 psia applied at the waveguide output, internal-to-external leak rate shall not exceed 0.1 cubic inch per minute.

12/ Requirements shall be satisfied over the entire tuning range. Radio-frequency bandwidth, stability (1) and (2), backlash, and spectrum shape tests may be done at 100 MHz intervals over the range from 8.5 to 9.6 GHz.

13/ Stability shall be measured in terms of the average number of output pulses missing, expressed as a percentage of the number of input pulses applied during the period of observation. Missing pulses (MP), including those due both to arcing and moding, shall be considered to be missing if the rf energy is less than the percentage specified herein of the normal pulse energy level at the specified frequency. Test shall be performed under least stable conditions of phase of load and frequency for any 5 minute maximum period of a 30-minute period.

14/ The reading of the tuning dial at 9,500 MHz is designated as g1. The frequency at other tuning settings as indicated in the symbol column (g1 + dial turns) shall be as specified, always setting tuner readings by tuning toward higher frequencies. Allow 5 minutes for tube to reach equilibrium after a frequency change.

15/ Tuning mechanism shall be smoothly operable throughout entire mechanical tuning range with torque of 6 inch-ounces maximum applied to tuning shaft.

16/ Stability (2) shall follow stability (1).

TABLE I. Testing and inspection - Continued.

17/ The tube shall be tuned to the extremes of the mechanical tuning range. The frequency limits shall be measured after the tube reaches temperature stabilization. The upper frequency limit condition may be considered met after 20 minutes of operation at the high-frequency mechanical limit. The lower frequency limit condition may be considered met after 5 minutes of operation at the low-frequency mechanical limit.

18/ The frequency obtained by turning the tuning mechanism to a given setting in one direction shall be reproducible when returning to the same setting from the opposite direction to within the specified limits.

19/ Shock test.

(a) A resilient cushion (see figure 1, note 2) shall be interposed between hammer and anvil of table and a suitable hammer angle shall be selected to produce a shock of approximate cubic waveform and of the specified magnitude and duration (see figure 1, note 3). The mounting plate of the tube shall be bolted with brass bolts to either the table or the standard angle bracket, depending upon the direction of the desired shock, using a 1.562 inch (39.67 mm) thick brass spacer between the tube mounting plate and table or angle bracket. The shock shall be measured on the brass spacer. The tube shall be given one shock in each of the following directions:

(1) Parallel to cathode axis, with cathode terminals pointing away from hammer.

(2) Perpendicular to cathode axis and to the output waveguide axis.

(3) Perpendicular to cathode axis and parallel to the output waveguide axis.

(b) A resilient cushion consisting of a .281 inch (7.14 mm) thick rubber sheet of 30 shore durometer hardness, covering the entire anvil of the table, produces the specified shock duration under the given conditions of table load and shock magnitude.

(c) Because of the varying resilience of the tube on its mounting plate with different shock directions and the high ratio of tube to table weight, the hammer angle will vary with the tube orientation to produce the required magnitude of shock.

(d) Criteria for passing shock test. After the shock test, the tube shall show no mechanical failure and shall meet all initial electrical test requirements.

20/ The tube shall be rigidly mounted by the mounting plate and vibrated perpendicular to cathode and output axis. The mounting plate shall be bolted with nonmagnetic bolts to the table using a nonmagnetic metallic spacer to maintain the required minimum 2 inch (50.80 mm) clearance between the magnets and other magnetic materials. After the vibration test, the tube shall show no mechanical failure and shall conform to the test requirements of power output (1), stability (1), pulse voltage, tuning characteristics, and tuner drive torque as these tests are specified in conformance inspection, part 1.

21/ The tuner drive torque shall not exceed the amount specified. The drive mechanism shall not be set against either stop.

22/ The acceptance level for the combined attributes in conformance inspection, part 1, shall be 1.0, inspection level II. This specification uses an accept on zero (c = 0) sampling plan in accordance with MIL-PRF-1, Table III.

23/ Revision letters are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

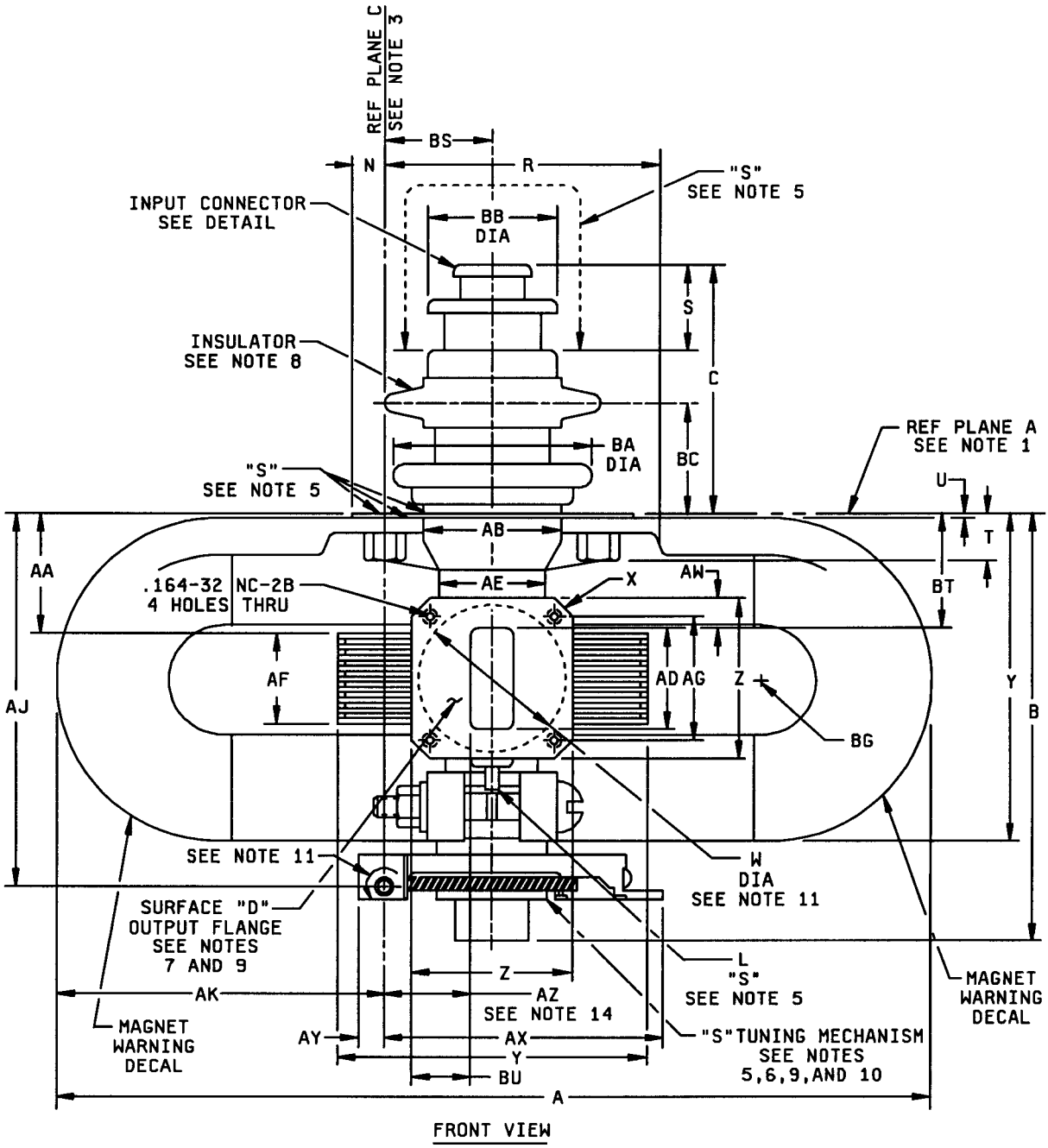



FIGURE 1. Outline drawing of electron tube type 5780.

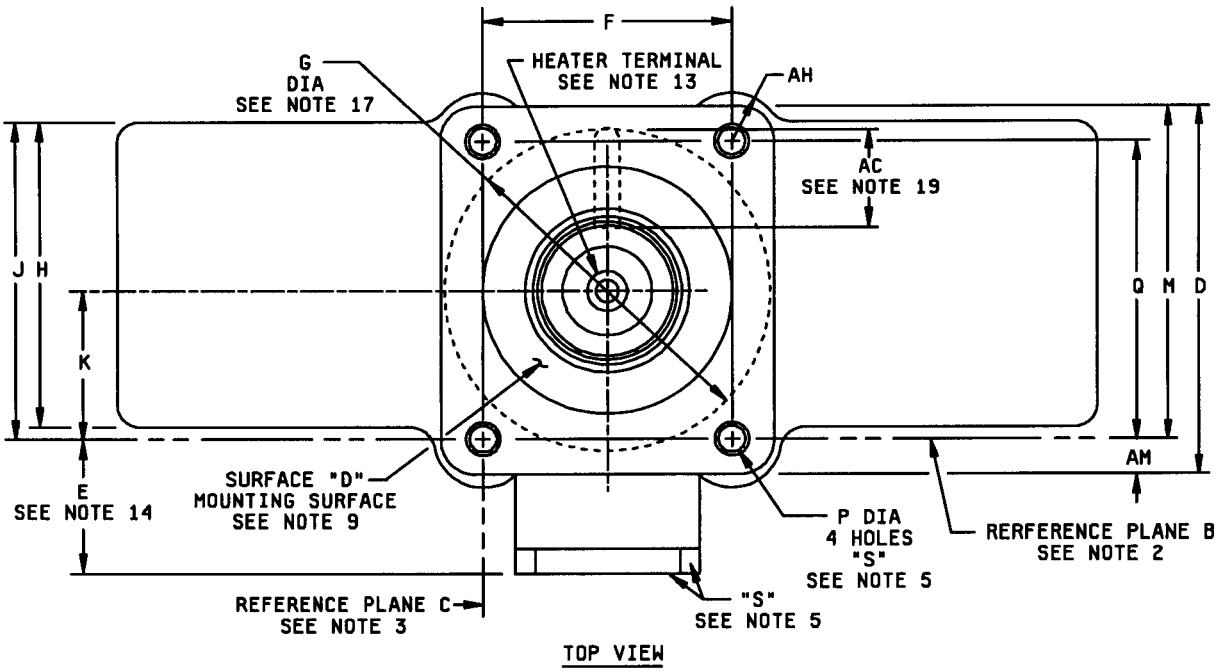



FIGURE 1. Outline drawing of electron tube type 5780 - Continued.

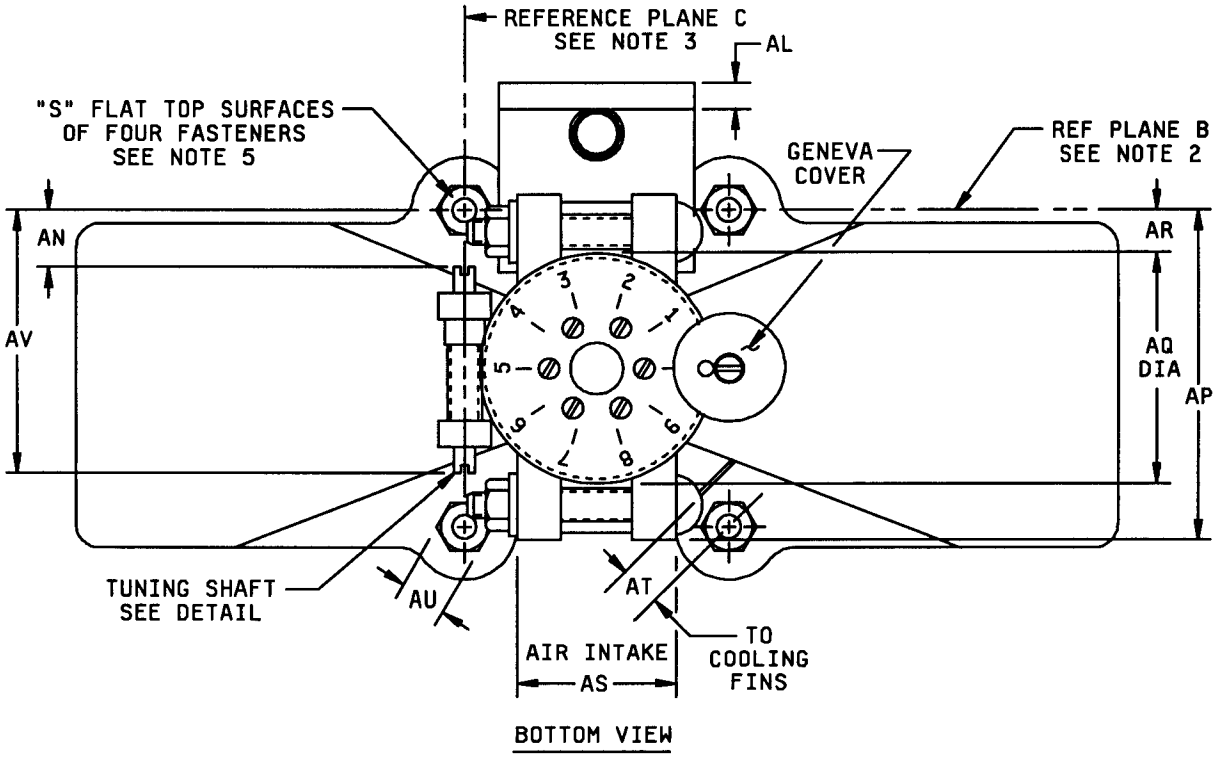
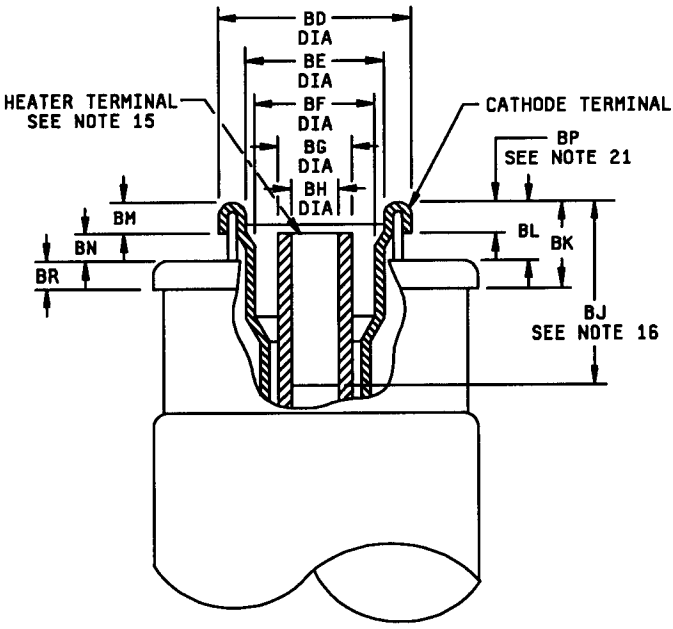
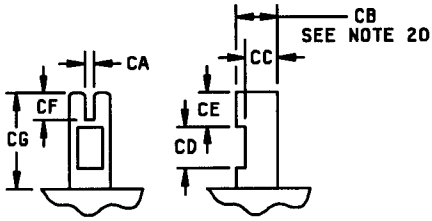



FIGURE 1. Outline drawing of electron tube type 5780 - Continued.




DETAIL OF INPUT CONNECTOR




DETAIL OF TUNING SHAFT
SEE NOTE 12

WARNING
MAINTAIN MINIMUM 2 INCHES BETWEEN THIS MAGNET AND MAGNETIC MATERIALS (MAGNETS, STEEL TOOLS, PLATES, ETC)

MAGNETIC WARNING DECAL

FIGURE 1. Outline drawing of electron tube type 5780 - Continued.

| Ltr | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| Qualification inspection | | | | |
| A | --- | 10.000 | --- | 254.00 |
| B | --- | 5.000 | --- | 127.00 |
| D | --- | 4.000 | --- | 101.60 |
| H | --- | 3.125 | --- | 79.38 |
| J | --- | 3.250 | --- | 82.55 |
| L | Cap: C1-3 | | | |
| R | --- | 3.250 | --- | 82.55 |
| V | --- | 3.813 | --- | 96.85 |
| Z | 1.820 | 1.840 | 46.23 | 46.74 |
| AC | --- | 1.000 | --- | 25.40 |
| AX | --- | 3.250 | --- | 82.55 |
| BF | .532 | .545 | 13.51 | 13.84 |
| BJ | .750 | --- | 19.05 | --- |
| BK | .516 | --- | 13.11 | --- |
| BL | --- | .156 | --- | 3.96 |
| BP | .115 | .135 | 2.92 | 3.43 |
| Conformance inspection, part 1 (see note 23) | | | | |
| E | 1.020 | 1.050 | 25.91 | 26.67 |
| F | 2.490 | 2.510 | 63.25 | 63.75 |
| K | 1.495 | 1.505 | 37.97 | 38.23 |
| P | .276 | .286 | 7.01 | 7.26 |
| Q | 2.990 | 3.010 | 75.95 | 76.45 |
| T | --- | .475 | --- | 12.07 |
| U | .031 | --- | 0.79 | --- |
| Y | --- | 3.500 | --- | 88.90 |
| AB | 1.470 | 1.478 | 37.34 | 37.54 |
| AD | 1.118 | 1.126 | 28.40 | 28.60 |
| AE | .493 | .501 | 12.52 | 12.73 |
| AF | 1.029 | 1.089 | 26.14 | 27.66 |
| AG | 1.348 | 1.356 | 34.24 | 34.44 |
| AJ | 4.264 | 4.354 | 108.31 | 110.59 |
| AP | --- | 3.125 | --- | 79.38 |
| AS | --- | 1.688 | --- | 42.88 |
| AT | .250 | --- | 6.35 | --- |
| AW | .344 | .364 | 8.74 | 9.25 |
| AZ | .985 | 1.019 | 25.02 | 25.88 |
| BA | --- | 2.250 | --- | 57.15 |
| BB | 1.345 | 1.358 | 34.16 | 34.49 |
| BC | --- | 1.250 | --- | 31.75 |

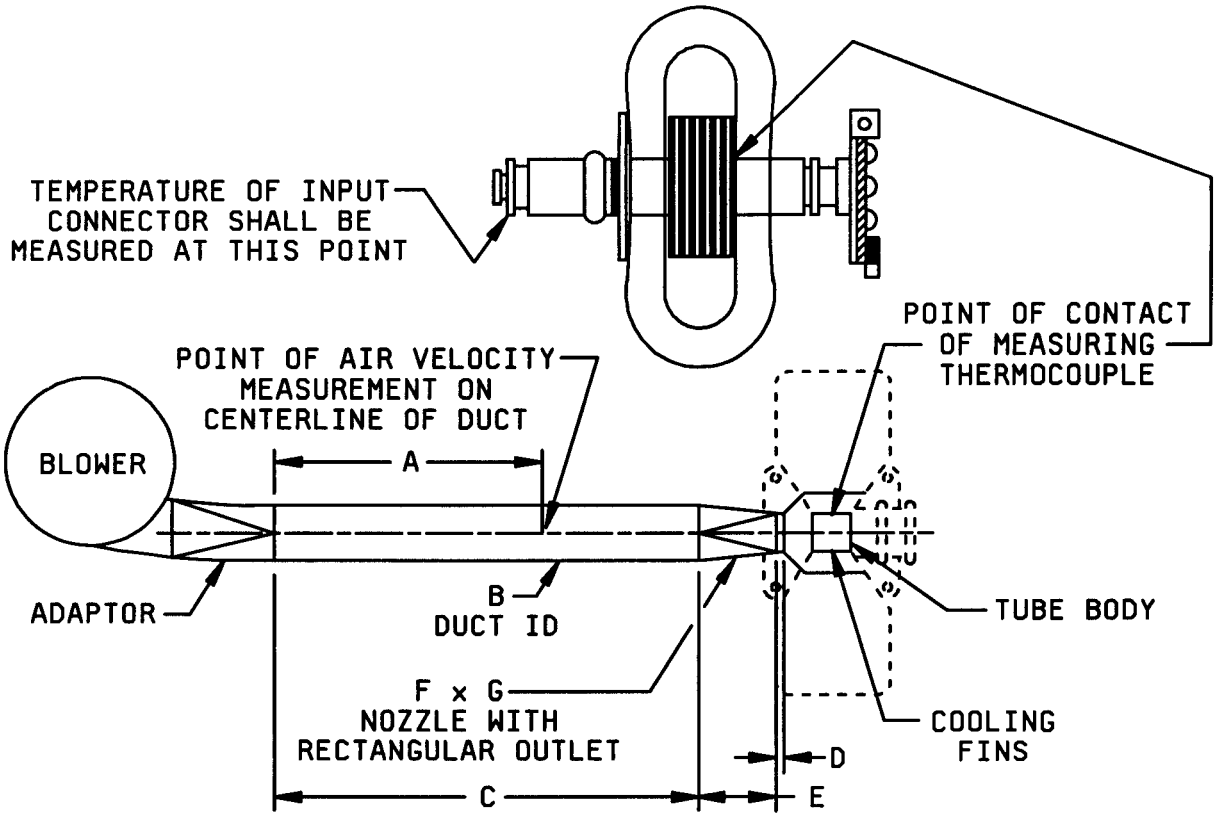
| Ltr | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| Conformance inspection, part 1 (see note 23)- Continued. | | | | |
| BD | .825 | .838 | 20.96 | 21.29 |
| BE | .594 | --- | 15.09 | --- |
| BG | .234 | .266 | 5.94 | 6.76 |
| BH | .164 | .174 | 4.17 | 4.42 |
| BT | 1.292 | 1.336 | 32.82 | 33.93 |
| BU | .656 | .676 | 16.66 | 17.17 |
| CA | .040 | .045 | 1.02 | 1.14 |
| CB | .1865 | .1895 | 4.74 | 4.81 |
| CC | .151 | .161 | 3.84 | 4.09 |
| CD | .188 | .203 | 4.78 | 5.16 |
| CE | .141 | .156 | 3.58 | 3.96 |
| CF | .115 | .135 | 2.92 | 3.43 |
| CG | .428 | .448 | 10.87 | 11.38 |
| Conformance inspection, part 2 | | | | |
| C | 2.714 | 2.770 | 68.94 | 70.36 |
| M | --- | 3.500 | --- | 88.90 |
| N | --- | .417 | --- | 10.59 |
| S | .938 | --- | 23.83 | --- |
| AA | 1.313 | 1.375 | 33.35 | 34.93 |
| AK | --- | 3.625 | --- | 92.08 |
| AM | --- | .500 | --- | 12.70 |
| AN | .485 | .545 | 12.32 | 13.84 |
| AV | 2.360 | 2.420 | 59.94 | 61.47 |
| AY | --- | .281 | --- | 7.14 |
| BM | .125 | .187 | 3.18 | 4.75 |
| BS | 1.245 | 1.255 | 31.62 | 31.88 |
| Nominal dimensions | | | | |
| G | 3.250 | | 82.55 | |
| W | 1.625 | | 41.28 | |
| X | 1.156 R | | 29.36 R | |
| AH | .375 R | | 9.53 R | |
| AL | .250 | | 6.35 | |
| AQ | 2.188 | | 55.58 | |
| AR | .406 | | 10.31 | |
| AU | .500 | | 12.70 | |
| BN | .250 | | 6.35 | |
| BQ | .625 R | | 15.88 R | |
| BR | .125 | | 3.17 | |

FIGURE 1. Outline drawing of electron tube type 5780 - Continued.

NOTES:

1. Reference plane A is defined as that plane which is coincident with the face of the mounting surface as shown.
2. Reference plane B is defined as that plane which is perpendicular to reference plane A, and which passes through centers of mounting holes as shown.
3. Reference plane C is defined as that plane which is mutually perpendicular to reference planes A and B, and which passes through centers of mounting holes as shown.
4. All metal parts except those designated "S" shall be painted with heat resistant, noncorrosive paint. Qualification inspection shall apply.
5. Surfaces designated "S" shall be noncorrosive. This requirement shall apply also over full extent of maximum plug penetration.
6. Gear and worm threads of tuning mechanism shall be free from corrosion, paint, or other obstructions. All metal parts of tuning mechanism except, worm, worm shaft, and striking pin shall be noncorrosive.
7. Output flange shall be M85/1-073-120 waveguide output flange modified as shown. Protective cover shall be provided with tube and shall be kept in place when tube is not in use.
8. Insulator should be Silastic 65. Dimensions are 2.02 inches (51.31 mm) outside diameter by 1.075 inches (27.31 mm) inside diameter by .50 inch (12.70 mm) thick before assembly with tube.
9. Surfaces designated "D" are for hermetic connections.
10. Tuning mechanism shall be set at midband frequency for shipment..
11. Counterclockwise rotation of tuning shaft, as viewed from direction of output flange, increases frequency. Complete frequency range shall be covered in not more than 180, nor less than 150 turns of tuning shaft. Number which appears through hole in geneva cover indicates revolutions from 0 to 6. Centerline of tuning shaft shall coincide with reference plane C within .045 inch (1.14 mm).
12. A sleeve .195 inch (4.95 mm) inside diameter by .406 inch (10.31 mm) outside diameter by 1.0 inch (25.4 mm) long shall pass over ends of tuning shaft to face of worm bracket. Conformance inspection, part 2, shall apply.
13. Axis of heater terminal shall occupy specified locations with .047 inch (1.19 mm) R. Note 17 shall apply.
14. Limits include angular and lateral deviations.
15. Heater terminal and cathode terminal shall be concentric within .010 inch (0.25 mm).
16. Dimension "BJ" defines the minimum length of diameter "BH".
17. With diameter "G" resting on a plane surface coincident with reference plane A, a gauge .010 inch (0.25 mm) thick and .125 inch (3.18 mm) wide shall not enter, and areas coincident with reference plane A beyond diameter "G" shall be flat within .010 inch (0.25 mm).
18. With diameter "W" resting on plane surface, a gauge .005 inch (0.13 mm) thick and .125 inch (3.18 mm) wide shall not enter.
19. Exhaust tubulation.
20. Diameter "CB" may be .178 inch (4.52 mm) minimum and .190 inch (4.83 mm) maximum for a distance of .062 inch (1.59 mm) beyond extremity of dimension "CD".
21. No clamping means shall bear beyond dimension "BP".
22. Mounting: Any position.
23. The acceptance level for the combined attributes in conformance inspection, part 1, shall be 1.0, inspection level II.

FIGURE 1. Outline drawing of electron tube type 5780 - Continued.




| Ltr | Dimensions | | | |
|---|---|---|---|---|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A | 14.995 | 15.005 | 380.87 | 381.13 |
| B | 1.995 | 2.005 | 50.67 | 50.93 |
| C | 19.995 | 20.005 | 507.87 | 508.13 |
| D | .057 | .067 | 1.45 | 1.70 |
| E | 2.995 | 3.005 | 76.07 | 76.33 |
| F | .933 | .943 | 23.70 | 23.95 |
| G | 1.495 | 1.505 | 37.97 | 38.23 |

FIGURE 2. Cooling arrangement.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Army - AR, MI
Navy - AS, CG, MC, OS, SH
Air Force - 17, 99

Preparing activity:
DLA - CC

(Project 5960-3558-04)