# 6181

# BEAM POWER TUBE

FORCED-AIR COOLED

## GENERAL DATA

### Electrical:

| | | |
|---|---|---|
| Heater, for Unipotential Cathode: | | |
| Voltage* | 120 max. | ac or dc volts ← |
| Current at 120 volts | 1.6 | amp |
| Minimum heating time at 117 volts | 5 | minutes ← |
| Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 1000, grid-No.2 volts = 400, and plate amperes = 1 | 7 | ← |
| Direct Interelectrode Capacitances: | | ← |
| Grid No.1 to plate** | 0.40 max. | μμf |
| Grid No.1 to cathode & heater | 46 | μμf |
| Plate to cathode & heater**,*** | 0.10 max. | μμf |
| Grid No.1 to grid No.2 | 50 | μμf |
| Grid No.2 to plate | 22 | μμf |
| Grid No.2 to cathode & heater*** | 4.4 max. | μμf |

### Mechanical:

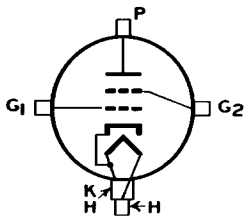
| | |
|---|---|
| Mounting Position | Vertical, cathode end up or down |
| Maximum Overall Length | 7-1/4" ← |
| Greatest Diameter | 5" ± 1/32" |
| Weight (Approx.) | 5 lbs ← |
| Radiator | Integral part of tube |

Terminal Connections *(See Dimensional Outline)*:

$G_1$ – Grid No.1

$G_2$ – Grid No.2

H – Heater




K – Cathode

P – Plate

Air Flow:

*Through Radiator*--The specified flow of incoming air for various plate dissipations, as indicated in the following tabulation, should be delivered by a blower through the radiator in either direction before and during the application of any voltages. In this tabulation, the flow and pressure values are for condition with radiator-temperature rise held constant at 135 °C above incoming-air temperature. Under any condition, the air flow must be ade-

* Because the cathode is subjected to considerable back bombardment as the frequency is increased, with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

** With external flat metal shield having a diameter of 8" and center hole approximately 3-7/16" in diameter. Shield is located in plane of the grid-No.2 terminal, perpendicular to the tube axis, and is connected to grid-No.2 terminal.

*** Same as (**) except that center hole has diameter of approximately 3", and shield is connected to grid-No.1 terminal.

← Indicates a change.



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quate to limit the temperature of the radiator to its specified maximum value. Heater power, plate power, and air flow may be removed simultaneously.

| Percentage of maximum rated plate dissipation for each class of service | 100 | 75 | 50 | % |
|---|---|---|---|---|
| Minimum air flow | 75 | 50 | 30 | cfm |
| Static pressure | 0.56 | 0.25 | 0.10 | in. of water |

*To Grid-No.2 Terminal*--A sufficient quantity of air should be delivered to this terminal so that its temperature does not exceed the specified maximum value.

*To Grid-No.1 Terminal, Cathode Terminal, and Heater Pin*--An air flow of about 20 cfm from a 1"-diameter nozzle at a distance of 1/2" from the heater pin should be directed onto the cathode terminal and heater pin, and then over the grid-No.1 terminal. The quantity of air should be sufficient so that the temperature of the cathode, heater, and grid-No.1 seals does not exceed the specified maximum value.

| | | |
|---|---|---|
| Radiator Temperature (Measured on core at end adjacent to plate-terminal flange) | 180 max. | °C |
| Seal and Terminal Temperature: Cathode, heater, grid No.1, grid No.2, and plate | 180 max. | °C |

## RF POWER AMPLIFIER--Class B Television Service

*Synchronizing-level conditions per tube unless otherwise specified*

**Maximum CCS● Ratings,** *Absolute Values:*

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 2000 max. | volts |
| DC GRID-No.2 (SCREEN-GRID) VOLTAGE | 500 max. | volts |
| DC PLATE CURRENT | 1.75 max. | amp |
| DC GRID-No.1 (CONTROL-GRID) CURRENT | 0.2 max. | amp |
| PLATE INPUT | 3500 max. | watts |
| GRID-No.2 INPUT | 40 max. | watts |
| PLATE DISSIPATION | 2000 max. | watts |

**Typical Operation in Cathode-Drive Circuit at 900 Mc:**

*Bandwidth▲ of 8 Mc*

| | | |
|---|---|---|
| *Air Flow Through Radiator:* | | |
| *Minimum, with incoming air at 45 °C* | *60* | *cfm* |
| *Static pressure* | *0.36* | *in. of water* |
| DC Plate-to-Grid-No.1 Voltage | 1875 | volts |
| DC Grid-No.2-to-Grid-No.1 Voltage | 550 | volts |
| DC Cathode-to-Grid-No.1 Voltage | 75 | volts |
| Peak RF Cathode-to-Grid-No.1 Voltage: | | |
| Synchronizing level | 120 | volts |
| Pedestal level | 90 | volts |

●,▲: See next page.



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| | | |
|---|---|---|
| DC Plate Current: | | |
| Synchronizing level | 1.7 | amp |
| Pedestal level | 1.3 | amp |
| DC Grid-No.2 Current (Pedestal Level) | -0.025 | amp |
| DC Grid-No.1 Current (Approx.): | | |
| Synchronizing level | 0.075 | amp |
| Pedestal level | 0.020 | amp |
| Driver Power Output (Approx.):♣ | | |
| Synchronizing level | 200 | watts |
| Pedestal level | 115 | watts |
| Output-Circuit Efficiency (Approx.) | 75 | % |
| Useful Power Output (Approx.): | | |
| Synchronzing level | 1200●● | watts |
| Pedestal level | 675●● | watts |

**BIAS-MODULATED RF POWER AMPLIFIER--Class C Television Service**

*Synchronizing-level conditions per tube unless otherwise specified*

**Maximum CCS● Ratings,** *Absolute Values:*

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 2000 max. | volts |
| DC GRID-No.2 (SCREEN-GRID) VOLTAGE | 500 max. | volts |
| DC GRID-No.1 (CONTROL-GRID) VOLTAGE (White Level) | -300 max. | volts |
| DC PLATE CURRENT | 1.75 max. | amp |
| DC GRID-No.1 CURRENT | 0.2 max. | amp |
| PLATE INPUT | 3500 max. | watts |
| GRID-No.2 INPUT | 40 max. | watts |
| PLATE DISSIPATION | 2000 max. | watts |

**Typical Grid-Bias-Modulated Operation in Cathode-Drive Circuit at 900 Mc:**

*Bandwidth▲ of 8 Mc*

| | | |
|---|---|---|
| *Air Flow Through Radiator:* | | |
| *Minimum, with incoming air at 45 °C* | *60* | *cfm* |
| *Static pressure* | *0.36* | *in. of water* |
| DC Plate-to-Grid-No.1 Voltage | 1875 | volts |
| DC Grid-No.2-to-Grid-No.1 Voltage | 550 | volts |
| DC Cathode-to-Grid-No.1 Voltage: | | |
| Synchronizing level | 75 | volts |
| Pedestal level | 105 | volts |
| White level | 230 | volts |
| Peak RF Cathode-to-Grid-No.1 Voltage | 120 | volts |
| DC Plate Current: | | |
| Synchronizing level | 1.7 | amp |
| Pedestal level | 1.2 | amp |
| DC Grid-No.2 Current (Pedestal Level) | -0.025 | amp |
| DC Grid-No.1 Current (Approx.): | | |
| Synchronizing level | 0.075 | amp |
| Pedestal level | 0.020 | amp |

●,▲,♣,●●: See next page.



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| | | |
|---|---|---|
| Driver Power Output (Approx.):♣ | | |
| Synchronizing level | 200 | watts |
| Output-Circuit Efficiency (Approx.) | 75 | % |
| Useful Power Output (Approx.): | | |
| Synchronizing level | 1200●● | watts |
| Pedestal level | 675●● | watts |

**Typical Cathode-Bias-Modulated Operation in Cathode-Drive Circuit at 900 Mc:**

*Bandwidth▲ of 8 Mc*

| | | |
|---|---|---|
| *Air Flow Through Radiator:* | | |
| *Minimum, with incoming air at 45 °C.* | *60* | *cfm* |
| *Static pressure* | *0.36* | *in. of water* |
| DC Plate-to-Grid-No.1 Voltage | 1875 | volts |
| DC Grid-No.2-to-Grid-No.1 Voltage | 550 | volts |
| DC Cathode-to-Grid-No.1 Voltage: | | |
| Synchronizing level | 75 | volts |
| Pedestal level | 105 | volts |
| White level | 210 | volts |
| Peak RF Cathode-to-Grid No.1 Voltage | 120 | volts |
| DC Plate Current: | | |
| Synchronizing level | 1.7 | amp |
| Pedestal level | 1.2 | amp |
| DC Grid-No.2 Current (Pedestal Level) | -0.025 | amp |
| DC Grid-No.1 Current (Approx.): | | |
| Synchronizing level | 0.075 | amp |
| Pedestal level | 0.020 | amp |
| Driver Power Output (Approx.):♣ | | |
| Synchronizing level | 200 | watts |
| Output-Circuit Efficiency (Approx.) | 75 | % |
| Useful Power Output (Approx.): | | |
| Synchronizing level | 1200●● | watts |
| Pedestal level | 675●● | watts |

## PLATE-MODULATED RF POWER AMPLIFIER--Class C Telephony

*Carrier conditions per tube for use with a max. modulation factor of 1.0*

**Maximum CCS● Ratings,** *Absolute Values:*

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 1600 max. | volts |
| DC GRID-No.2 (SCREEN-GRID) VOLTAGE | 400 max. | volts |
| DC GRID-No.1 (CONTROL-GRID) VOLTAGE | -300 max. | volts |
| DC PLATE CURRENT | 1.05 max. | amp |
| DC GRID-No.1 CURRENT | 0.2 max. | amp |
| PLATE INPUT | 1650 max. | watts |
| GRID-No.2 INPUT | 25 max. | watts |
| PLATE DISSIPATION | 1300 max. | watts |

▲ Measured between half-power points.

●,♣,●●: See next page.



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**Typical Operation in Cathode-Drive Circuit at 400 Mc:**

| | | |
|---|---|---|
| *Air Flow Through Radiator:* | | |
| *Minimum, with incoming air at 45 °C* | *40* | *cfm* |
| *Static pressure* | *0.16* | *in. of water* |
| DC Plate-to-Grid-No.1 Voltage | 1775 | volts |
| DC Grid-No.2-to-Grid-No.1 Voltage | 550 | volts |
| DC Cathode-to-Grid-No.1 Voltage | 175 | volts |
| Peak RF Cathode-to-Grid-No.1 Voltage | 210 | volts |
| DC Plate Current | 1 | amp |
| DC Grid-No.2 Current | 0.065 | amp |
| DC Grid-No.1 Current (Approx.) | 0.045 | amp |
| Driver Power Output (Approx.)♣# | 250 | watts |
| Output-Circuit Efficiency (Approx.) | 90 | % |
| Useful Power Output (Approx.) | 950●● | watts |

**RF POWER AMPLIFIER & OSCILLATOR--Class C Telegraphy□**
**and**
**RF POWER AMPLIFIER--Class C FM Telephony**

**Maximum CCS● Ratings,** *Absolute Values:*

| | | | |
|---|---|---|---|
| DC PLATE VOLTAGE | 2000 | max. | volts |
| DC GRID-No.2 (SCREEN-GRID) VOLTAGE | 500 | max. | volts |
| DC GRID-No.1 (CONTROL-GRID) VOLTAGE | −300 | max. | volts |
| DC PLATE CURRENT | 1.25 | max. | amp |
| DC GRID-No.1 CURRENT | 0.2 | max. | amp |
| PLATE INPUT | 2500 | max. | watts |
| GRID-No.2 INPUT | 40 | max. | watts |
| PLATE DISSIPATION | 2000 | max. | watts |

**Typical Operation in FM Service with Cathode-Drive Circuit at 900 Mc:**

| | | |
|---|---|---|
| *Air Flow Through Radiator:* | | |
| *Minimum, with incoming air at 45 °C* | *30* | *cfm* |
| *Static pressure* | *0.09* | *in. of water* |
| DC Plate-to-Grid-No.1 Voltage | 1910 | volts |
| DC Grid-No.2-to-Grid-No.1 Voltage† | 550 | volts |
| DC Cathode-to-Grid-No.1 Voltage†† | 110 | volts |
| Peak RF Cathode-to-Grid-No.1 Voltage | 120 | volts |
| DC Plate Current | 0.9 | amp |
| DC Grid-No.2 Current | 0.05 | amp |
| DC Grid-No.1 Current (Approx.) | 0.015 | amp |
| Driver Power Output (Approx.)♣ | 150 | watts |
| Output-Circuit Efficiency (Approx.) | 70 | % |
| Useful Power Output (Approx.) | 600●● | watts |

● Continuous Commercial Service.

♣ The driver stage is required to supply tube losses, rf-circuit losses, and rf power added to the plate input. The driver stage should be designed to provide an excess of power above the indicated value to take care of variations in line voltage, in components, in initial tube characteristics, and in tube characteristics during life.

●●,#,□,†,††: See next page.



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## CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

| | Note | Min. | Max. | |
|---|---|---|---|---|
| Heater Current | 1 | 1.5 | 1.7 | amp |
| Direct Interelectrode Capacitances: | | | | |
| Grid No.1 to plate** | - | - | 0.40 | μμf |
| Grid No.1 to cathode & heater | - | 42.5 | 49.5 | μμf |
| Plate to cathode & heater**,*** | - | - | 0.10 | μμf |
| Grid No.1 to grid No.2 | - | 47 | 57 | μμf |
| Grid No.2 to plate | - | 20.5 | 24.5 | μμf |
| Grid No.2 to cathode & heater*** | - | - | 4.4 | μμf |
| Mu-Factor, Grid No.2 to Grid-No.1 | 1,2 | 2.5 | 11.5 | |
| Grid-No.1 Voltage | 1,3 | -50 | -140 | volts |
| Peak Cathode Current | 1,4 | 12 | - | amp |

Note 1: With 120 volts ac on heater.

Note 2: With dc plate volts = 1000; dc grid-No.2 volts = 400; and dc grid-No.1 voltage adjusted to produce a dc plate current of 1.0 ampere.

Note 3: With dc plate volts = 1750; dc grid-No.2 volts = 500; and dc grid-No.1 voltage adjusted to produce a dc plate current of 0.1 ampere.

Note 4: Designers should limit the maximum usable cathode current (Plate current plus grid-No.2 current plus grid-No.1 current) to this value under any condition of operation.

** With external flat metal shield having a diameter of 8" and center hole approximately 3-7/16" in diameter. Shield is located in plane of the grid-No.2 terminal, perpendicular to the tube axis, and is connected to grid-No.2 terminal.

*** Same as (**) except that center hole has diameter of approximately 3", and shield is connected to grid-No.1 terminal.

# In cathode-drive, plate-modulated, class C rf power amplifier service, the 6181 can be modulated 100% if the rf driver stage is also modulated 100% simultaneously. Care should be taken to insure that the driver-modulation and amplifier-modulation voltages are exactly in phase.

●● This value of useful power is measured at load of output circuit having indicated efficiency.

□ Key-down conditions per tube without amplitude modulation. Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

† Obtained preferably from a separate source, or from the plate-supply voltage with a voltage divider, or through a series resistor. A series grid-No.2 resistor should not be used if the 6181 or a preceding stage is keyed. In this case, the regulation of the source should be sufficient to prevent the grid-No.2 voltage from rising above 500 volts under key-up conditions; and additional fixed grid-No.1 bias must be provided to limit the plate current.

†† Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.

→ Indicates a change.

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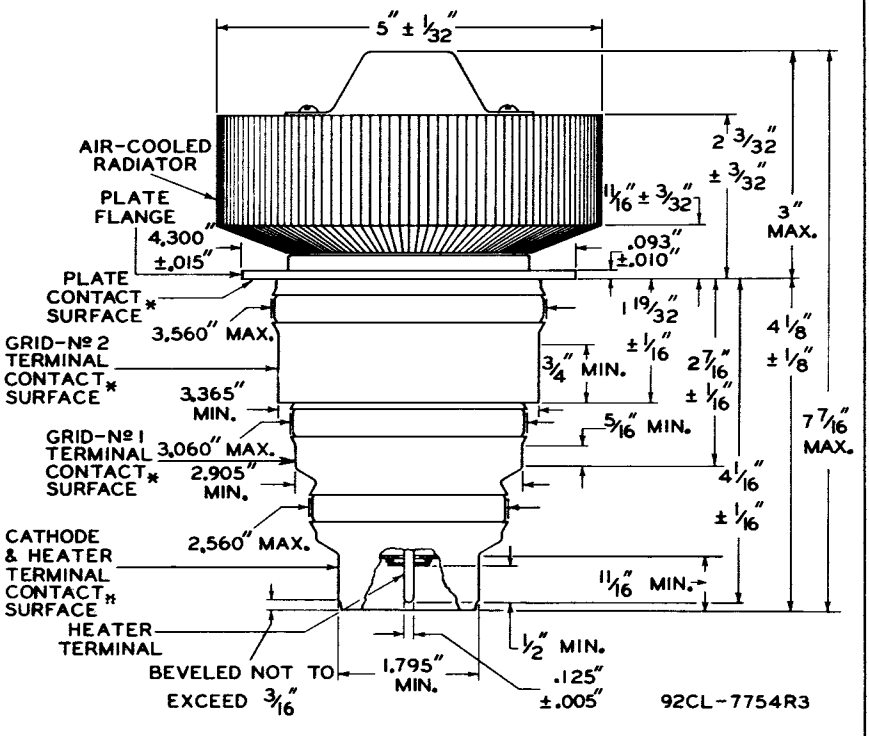


* WITH THE CYLINDRICAL SURFACES OF THE PLATE FLANGE, GRID-No. 2 TERMINAL, GRID-No. 1 TERMINAL, CATHODE TERMINAL, AND HEATER-PIN TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH $G_1$. PROPER ENTRY OF THE TUBE IN THE GAUGE IS OBTAINED WHEN THE PLATE FLANGE IS SEATED ON THE SHOULDER BETWEEN HOLES $H_1$ AND $H_2$. SEATING IS DETERMINED BY FAILURE OF A .010" THICKNESS GAUGE 1/8" WIDE TO ENTER MORE THAN 1/16" BETWEEN SHOULDER SURFACE AND PLATE FLANGE. SLOTS ARE PROVIDED TO PERMIT THIS MEASUREMENT TO BE MADE.



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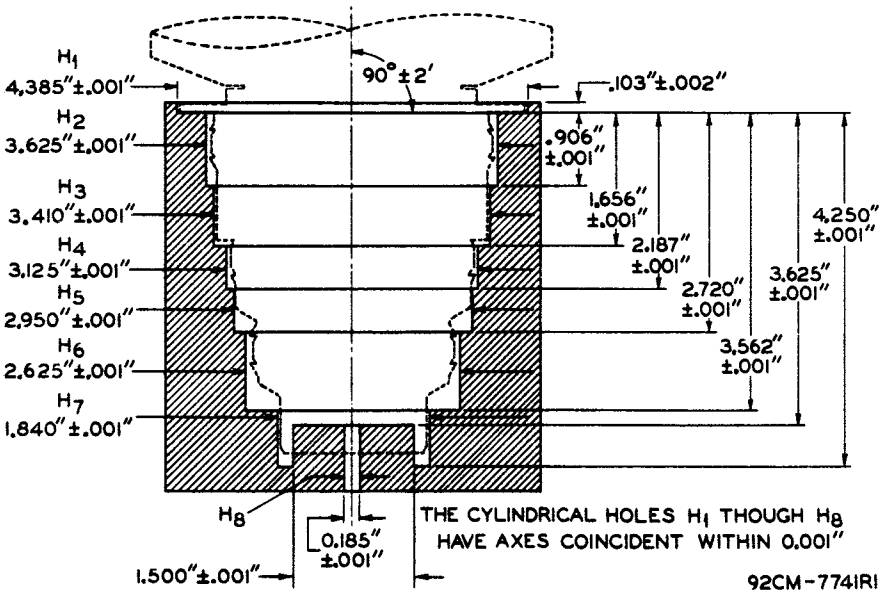
SKETCH $G_1$



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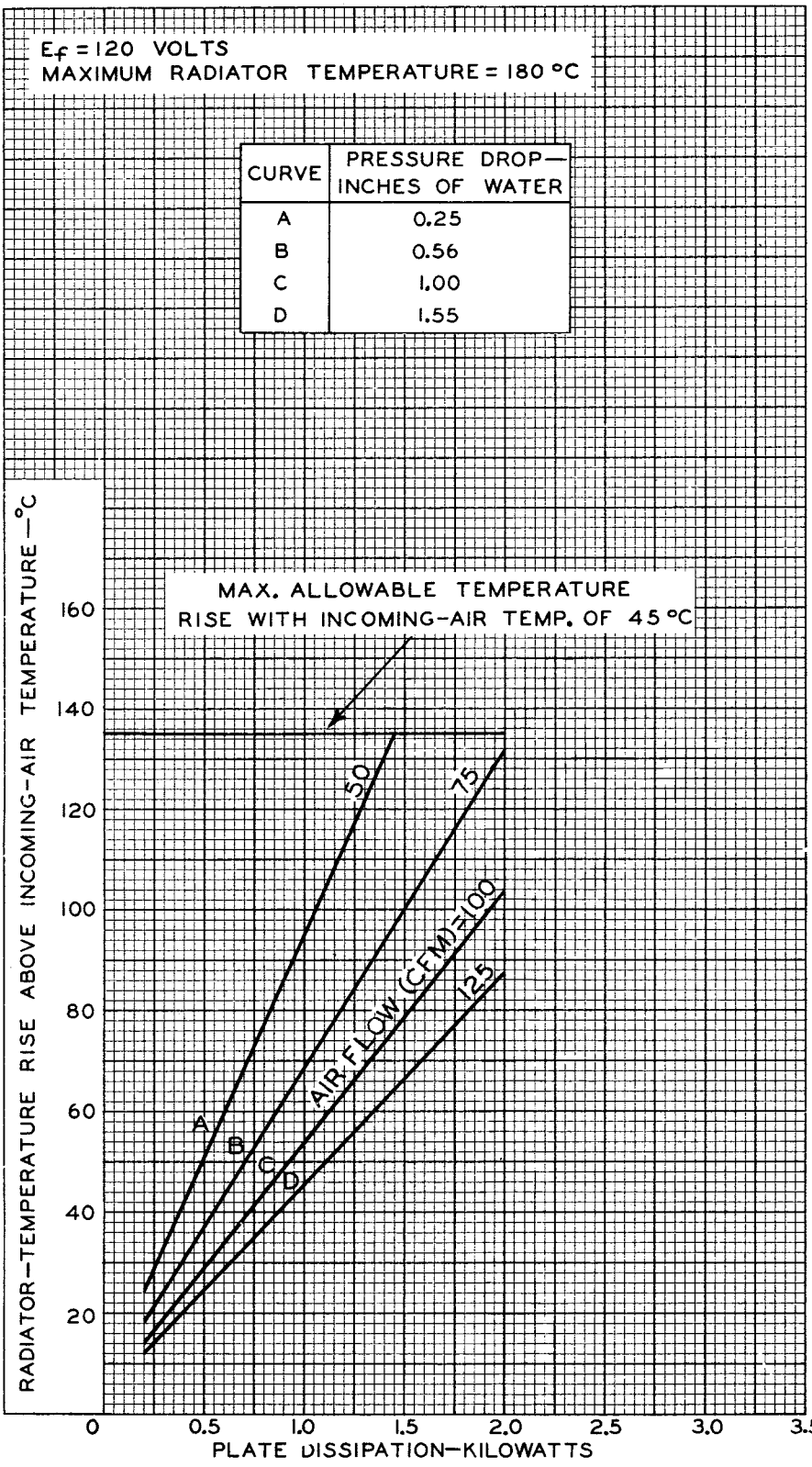
## COOLING REQUIREMENTS



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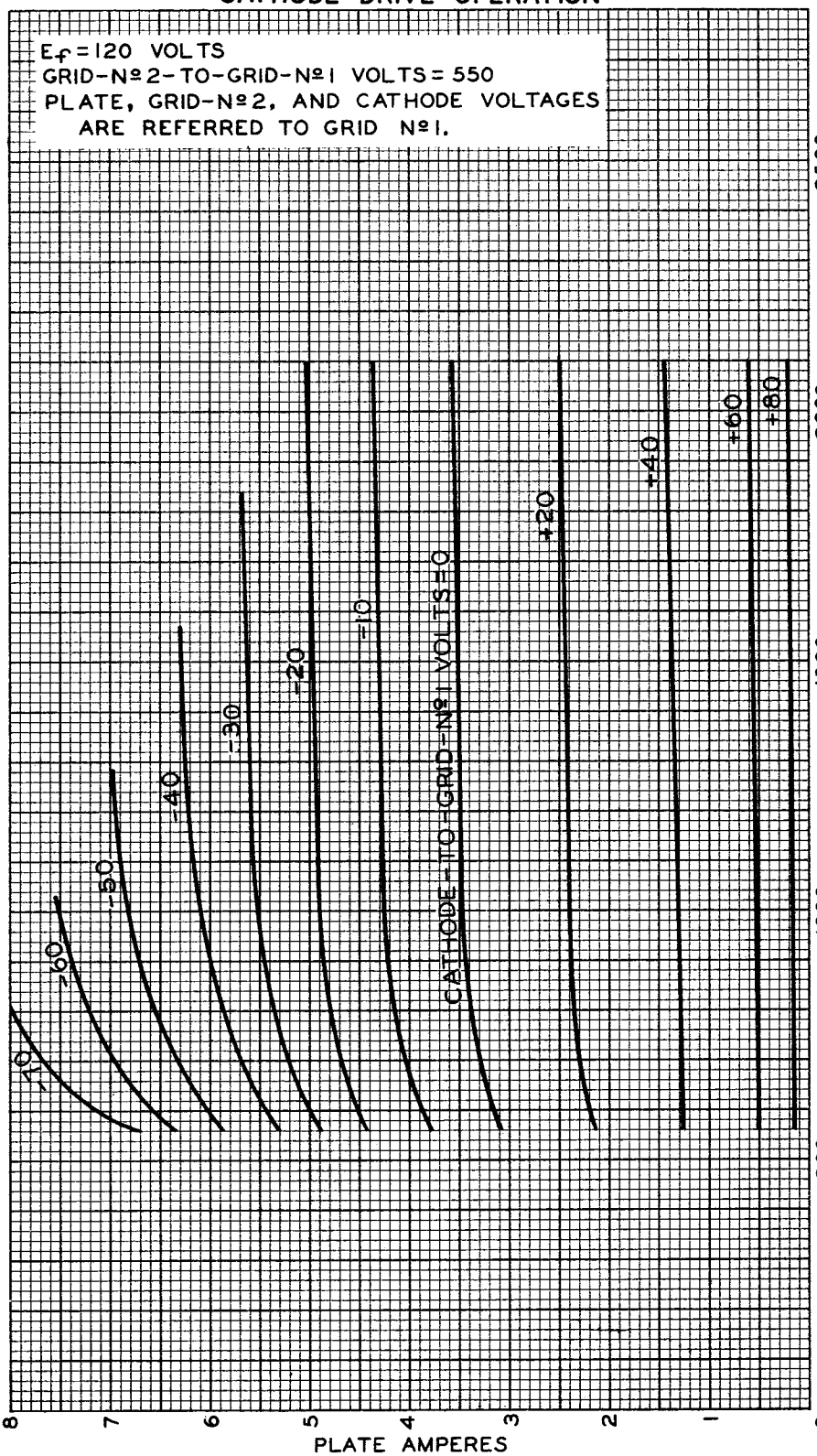
## AVERAGE PLATE CHARACTERISTICS

### CATHODE-DRIVE OPERATION





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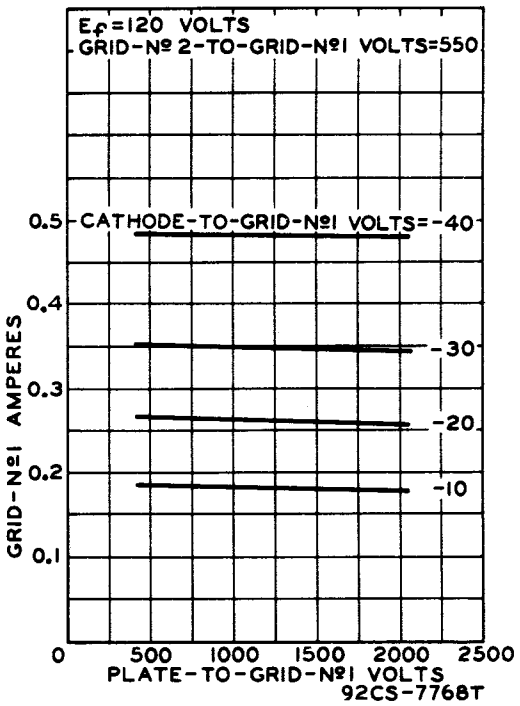
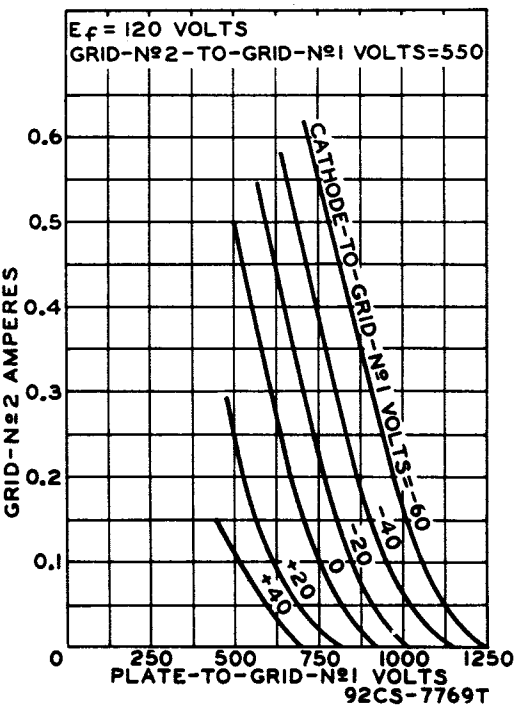
## AVERAGE CHARACTERISTICS
### CATHODE-DRIVE OPERATION



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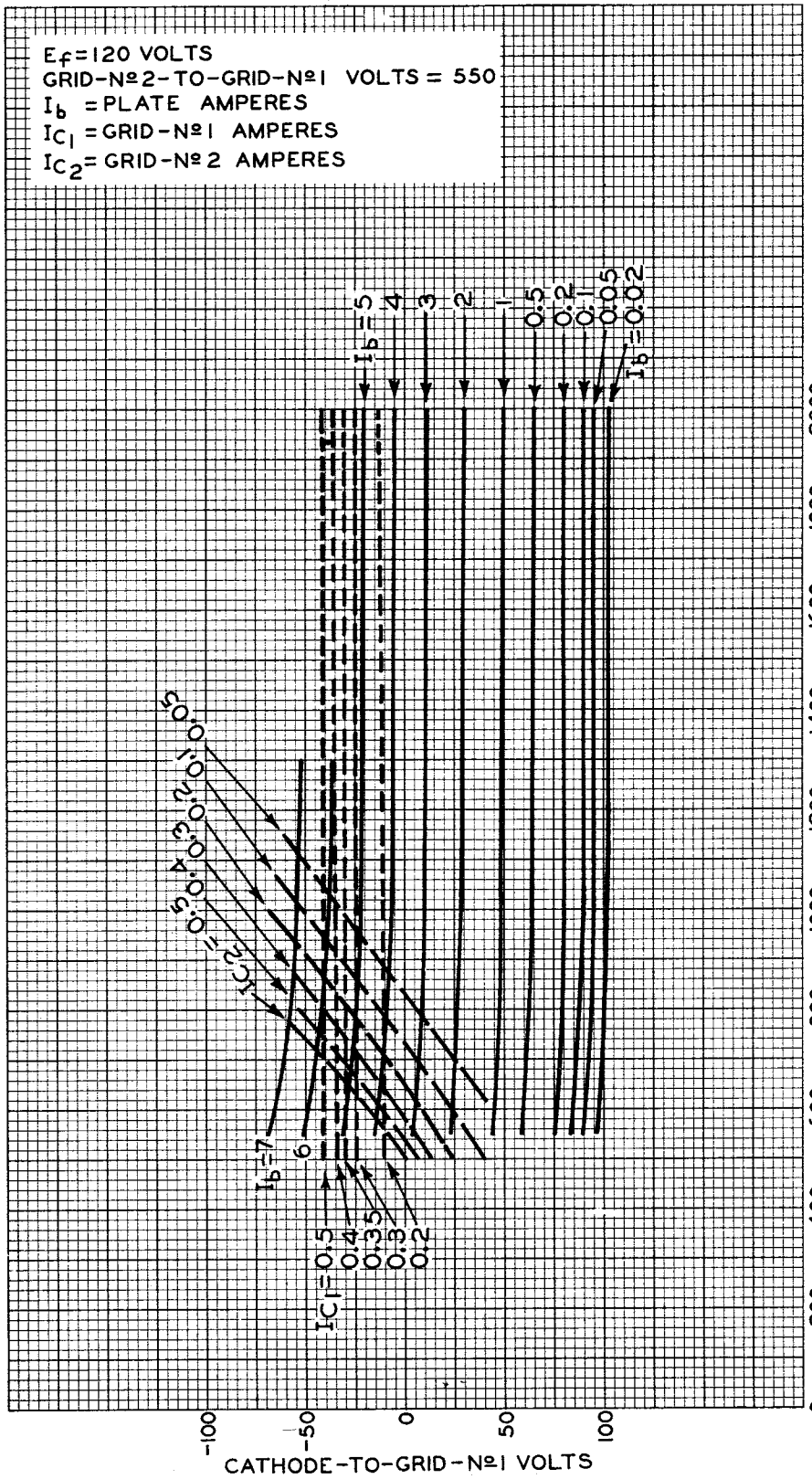
## AVERAGE CONSTANT-CURRENT CHARACTERISTICS

### CATHODE-DRIVE OPERATION

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