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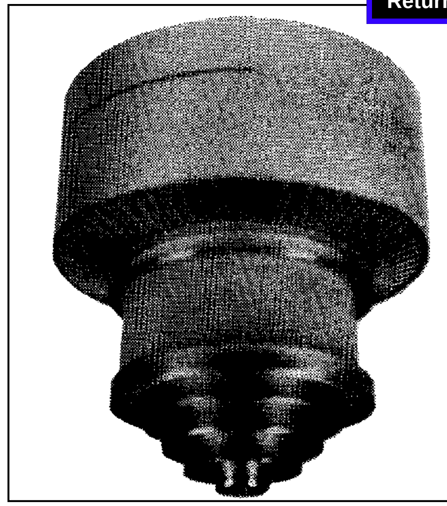
8890
Power Tube



Linear Beam Power Tube

- **CERMOLOX® Tube**
- **High Gain-Bandwidth Products**
- **Full Input to 400 MHz**
- **7000W Peak Sync Output Through VHF-TV Band with 16 dB Gain**

The BURLE 8890 is designed specifically to meet the high linearity, high gain requirements of modern, reliable, VHF-TV and UHF linear amplifier equipments.

In VHF-TV service at 220 MHz, the 8890 will deliver a full 7.0 kW peak sync output with 6.3 MHz bandwidth and 16 dB gain. At 220 MHz it can supply the 5.0 kW aural power output required for a 25 kW TV transmitter.

Rated for full input for the VHF-TV band and for other service to 400 MHz, the 8890 can be readily circuited for these frequencies. The 8890 and available variants are also well suited for other applications such as SSB, CW, pulsed RF, or modulator service.

Its sturdy, CERMOLOX® tube construction and thoriated tungsten, mesh filament minimize tube inductances and feedthru capacitances. Its coaxial, forced-air-cooled radiator reduces noise to a minimum and insures against spurious outputs. These features make possible the use of simple, economical, broadband circuit techniques in VHF and UHF operation.

This data sheet gives application information unique to the BURLE 8890. It is to be used in conjunction with the publication, "Application Guide for BURLE Power Tubes," TP-105, for general application information for tubes of this type.

Additional information of a general nature applicable to tubes of this type is given in the following publications:

TP-105 Application Guide for BURLE Power Tubes
TP-122 Screen-Grid Current, Loading and Bleeder
TP-117 Handling and Operating Considerations When Using BURLE Tetrodes
TP-118 Application Guide For Forced Air Cooling BURLE Power Tubes

Close attention to the instructions contained in these publications will assure longer tube life, safer operation, less equipment downtime and fewer tube handling accidents. For copies of publications, specific information or application assistance, contact your nearest BURLE Representative or write BURLE INDUSTRIES, INC., New Holland Avenue, Lancaster, PA 17601-5688.

General Data

Electrical

Filamentary Cathode:			
Type……………………………	Thoriated-Tungsten Mesh		
Voltage[1] (ac or dc)……………….	5.7	typ.	V
	6.0	max.	V
Current:			
Typical value at 5 7 volts[2]…….	115		A
Maximum value for starting even momentarily……………..	300		A
Cold resistance……………………	0.005		ohms
Minimum heating time[3]…………..	15		s
Mu-Factor:[4]			
(Grid No.2 to grid No 1)………….	20		
Direct Interelectrode Capacitances			
Grid No.1 to plate[5]………………..	0.20	max.	pF
Grid No.1 to filament……………..	76		pF
Plate to filament[5, 6]………………..	0.02	max.	pF
Grid No.1 to grid No.2……………	86		pF
Grid No.2 to plate…………………	12		pF
Grid No.2 to filament[6]…………….	1.5	max.	pF

ISO 9001

BURLE

Mechanical

Operating Attitude	Vertical, either end up
Overall Length	136.6 mm max. (5.38 in)
Greatest Diameter	116.1 mm max.(4.57 in)
Terminal Connections	See Dimensional Outline
Socket	CD 89-085[7], or equivalent
Chimney	8822[7], or equivalent
Radiator	Integral part of tube
Weight (Approx.)	2.7 kg (6.0 lbs)

Thermal

Seal Temperature[8] (Plate, grid No.2, grid No.1, filament-cathode and filament)	250 max.	°C
Plate-Core Temperature[8]	250 max.	°C

RF Power Amplifier - Class AB_2 Television Service[9]

Synchronizing-level conditions per tube unless otherwise specified

Maximum CCS Ratings, Absolute-Maximum Values

DC Plate Voltage[9,10]	8000	V
DC Grid-No.2 Voltage[9]	1650	V
DC Grid-No.1 Voltage[9]	-450	V
DC Plate Current	4	A
Plate Dissipation	5000	W
Grid-No.2 Input	150	W
Grid-No.1 Input	50	W

Typical CCS Operation

In a cathode-drive circuit at 216 MHz and a bandwidth of 6.3 MHz[11]

DC Plate Voltage	3750	V
DC Grid-No.2 Voltage	1000	V
DC Grid-No.1 Voltage[12]	-22	V
Zero Signal DC Plate Current	1.30	A
DC Plate Current:		
Synchronizing level	1.90	A
Blanking level	1.45	A
DC Grid-No.2 Current:		
Synchronizing level	35	mA
Blanking level	20	mA
DC Grid-No.1 Current:		
Synchronizing level	6.0	mA
Blanking level	3.5	mA
Input Circuit Efficiency	95	%
Driver Power Output:		
Synchronizing level	35	W
Blanking level	20	W
Plate Dissipation		
Blanking level	4770	W
Output Circuit Efficiency	95	%
Useful Power Output:		
Synchronizing level	1100	W
Blanking level	650	W

RF Power Amplifier or Oscillator - Class B Telegraphy or FM Telephony[9]

Maximum CCS Ratings, Absolute-Maximum Values

	Up to 400 MHz	
DC Plate Voltage[9,10]	8000	V
DC Grid-No.2 Voltage[9]	1650	V
DC Grid-No. 1 Voltage[9]	-450	V
DC Plate Current	4.0	A
DC Grid-No.1 Current	500	mA
Grid-No.1 Input	50	W
Grid-No.2 Input	150	W
Plate Dissipation	5000	W

Maximum Circuit Values

Grid-No.1 Circuit Resistance Under Any Conditions:	
With fixed bias	5000 max. ohms
With cathode bias	Not recommended
Grid-No.2 Circuit Impedance	See note 9
Plate Circuit Impedance	See note 9

1. Measured at the tube terminals. For accurate data the ac filament voltage should be measured using an accurate RMS type meter such as an iron-vane or thermocouple type meter. The dc voltage should be measured using a high input impedance type meter. For high-current, low-voltage filaments **such** as are used in this tube, it is recommended that the filament current be monitored, since very small changes in resistance can produce misleading changes in voltage. For maximum life, the filament power should be regulated at the lowest value that will give stable performance. For those applications where hum is a critical consideration, dc filament or hum-bucking circuits are recommended. See also Application Note TP-117.

2. The characteristic range of current at 5.7 volts is from 106 to 126 amperes. It is recommended that an additional six amperes be available to allow for the normal reduction of filament resistance with life. Thus, the filament supply should be designed for a mean value of 132 amperes at 5.7 volts.

3. Sequence for applying voltage is asfollows: Filament, Bias, Plate, Screen and RF Drive.

4. For plate voltage = 2000 V, grid-No.2 voltage = 1375 V, and plate current = 6.0 A.

5. With external flat metal shield 200 mm (8") in diameter having a center hole 76 mm (3") 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.

6. With external flat metal shield 200 mm (8") in diameter having center hole 60 mm (2-3/8") in diameter. Shield is located in plane of the grid-No.1 terminal, perpendicular to the tube axis and connected to grid No.1.

7. **As manufactured by Jettron Products Inc.,** 56 Route **Ten, Hanover, NJ** 07936.

8. See Dimensional Outline for Temperature Measurement points.

9. See TP-105.

10. The maximum fault energy that can be dissipated within the tube is approximately 100 joules. Therefore, the energy available for a high-voltage arc or fault must be limited to this value by means **of** current limiting resistors or fault-protection circuitry. This is especially important in pulse service where high, stored energy and large capacitors are used. For typical 5000 watt TV transmitters, series resistor values are:

    Plate = 10 ohms

    Screen = 30 to 50 ohms

    Grid = 50 ohms

    For additional information see TP-105 "Application Guide for BURLE Large Power Tubes."

11. The bandwidth of 6.3 MHz is calculated at the -0.72 dB power points of a double tuned output circuit using two times the tube **output capacity and a damping factor of $\sqrt{1.5}$ as shown in Figure 3.**

12. Adjusted for Ib. = 1.3 A.

Protection Circuits

Protection circuits serve a threefold purpose: safety of personnel, protection of the tube in the event of abnormal circuit operation, and protection of the tube circuits in the event of abnormal tube operation.

Power tubes require mechanical protective devices such as interlocks, relays, and circuit breakers. Circuit breakers alone may not provide adequate protection in certain power-tube circuits when the power-supply filter, modulator, or pulse-forming network stores much energy. Additional protection may be achieved by the use of high-speed electronic circuits to bypass the fault current until mechanical circuit breakers are opened. These circuits may employ a controlled gas tube, such as a thyratron or ignitron, depending on the amount of energy to be handled.

The voltages applied to power tubes are extremely dangerous. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel cannot possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies and discharge high-voltage capacitors when any gate or door on the protective housing is opened, and should prevent the closing of this primary circuit until the door is again locked.

A time-delay relay should be provided in the plate-supply circuit to delay application of plate voltage until the filament has reached normal operating temperature.

An interlocking relay system should be provided to prevent application of plate voltage prior to the application of sufficient bias voltage otherwise, with insufficient bias, the resultant high plate current may cause excessive plate dissipation with consequent damage to the tube. RF load shorts or other causes of high output VSWR may also cause high dissipations, excessive voltage gradients, or insulator flashover. The load VSWR should be monitored and the detected signal used to actuate the interlock system to remove the plate voltage in less than 10 milliseconds after the fault occurs.

Forced-Air Cooling

Air Flow:

Through radiator -- Adequate air flow to limit the plate-core temperature to 250°C should be delivered by a blower through the radiator before and during the application of filament, plate, grid-No.2 and grid-No.1 voltage.

For a plate dissipation of 5000 watts and an incoming air temperature of 50°C, and air flow of 105 cfm is required in accordance with the Typical Cooling Characteristics as shown in **Figure 4.**

To Plate, Grid-No.2 and Grid-No.1 Terminals -- A sufficient quantity of air should be allowed to flow past each of these terminals so that its temperature does not exceed the specified maximum value of 250 °C.

To Cathode-Filament and Filament Terminals - A sufficient quantity of air should be blown directly at these terminals so that their temperature does not exceed the specified limit of 250°C. A value of at least **40** cfm is recommended.

During Standby Operation -- Cooling air is required when only filament voltage is applied to the tube.

During Shutdown Operation -Air flow should continue for a few minutes after all electrode power is removed.

For further information on forced air-cooling, see TP-105 and also TP-118, "The Application Guide for Forced Air Cooling of BURLE Power Tubes."

Tube Removal From Socket (Suggested Design)

The tube should not be removed from the socket by rocking the tube back and forth. This motion crushes the contact fingers and applies undue force to the internal structure of the tube.

It is recommended that the tube be removed from the socket with an assembly similar to that shown in **Figure 5.** The extractor portion should be constructed with the dimensions shown in **Figure 6.**

Mounting

See the preferred mounting arrangement **(Figure 8).** For other arrangements, cavity-type mounting for multiple-ring terminal-type tubes, may be constructed by using either fixed or adjustable contact rings of finger contact strips in the transverse plane.

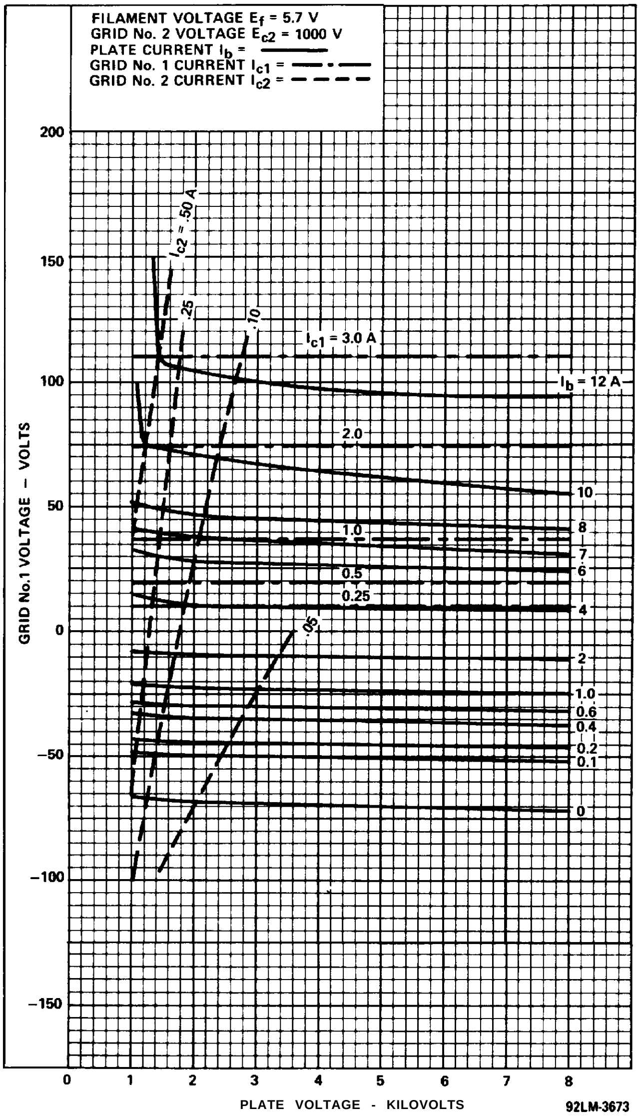


Figure 1 - Typical Constant Current Characteristics

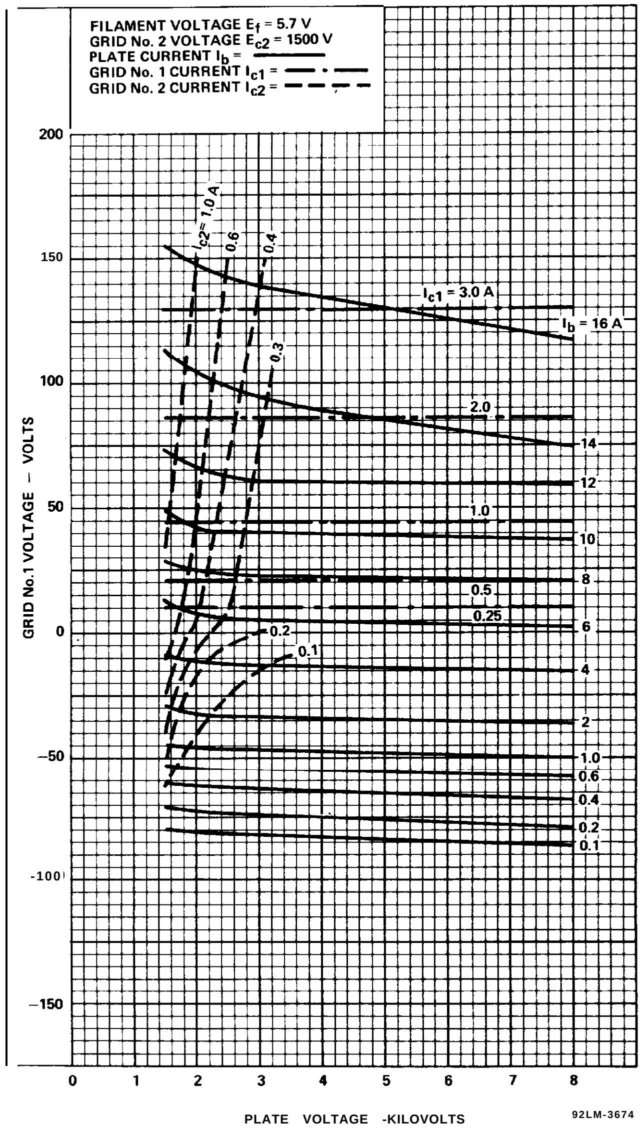


Figure 2 - Typical Constant Current Characteristics

s Adjusted for I_{b_0} = 1.3 A.

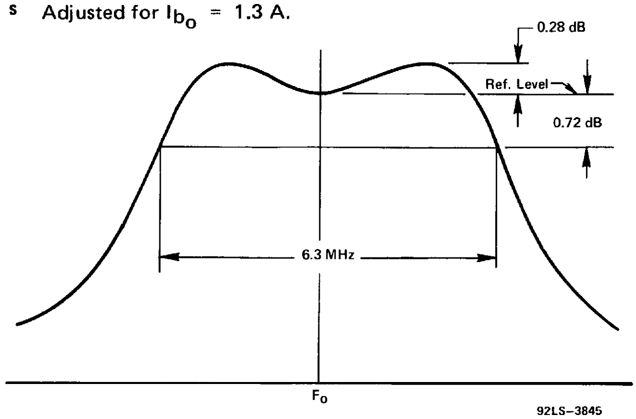


Figure 3 - Bandwidth Calculation

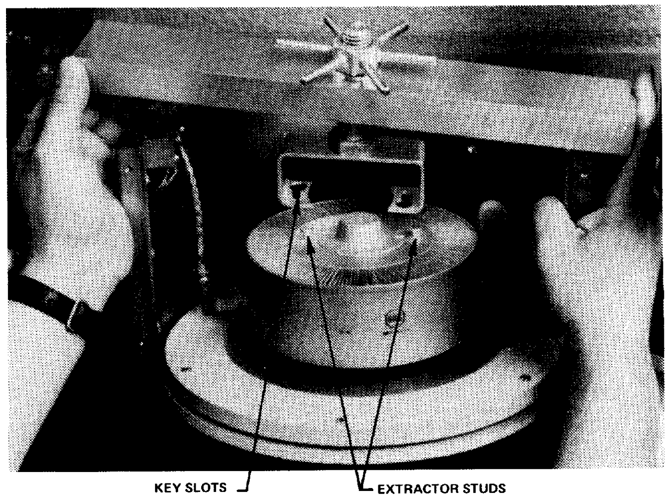


Figure 5 - Recommended Tube Puller

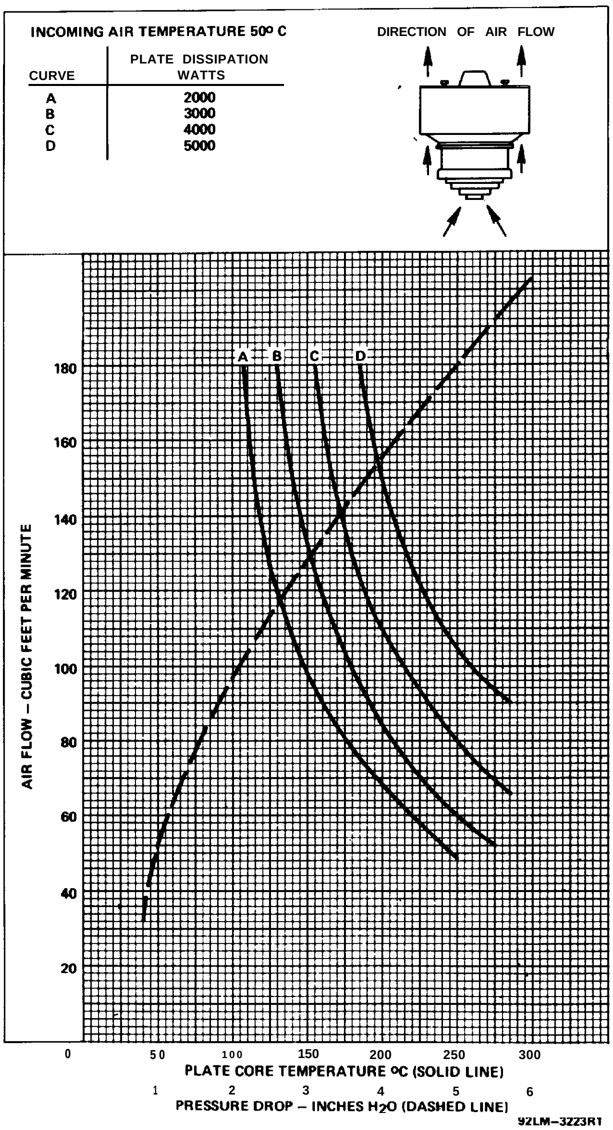
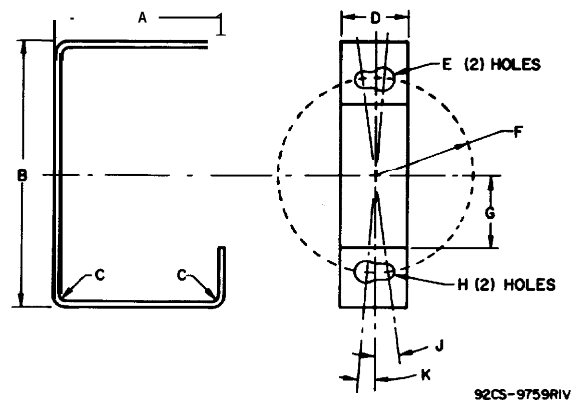


Figure 4 - Typical Cooling Characteristics



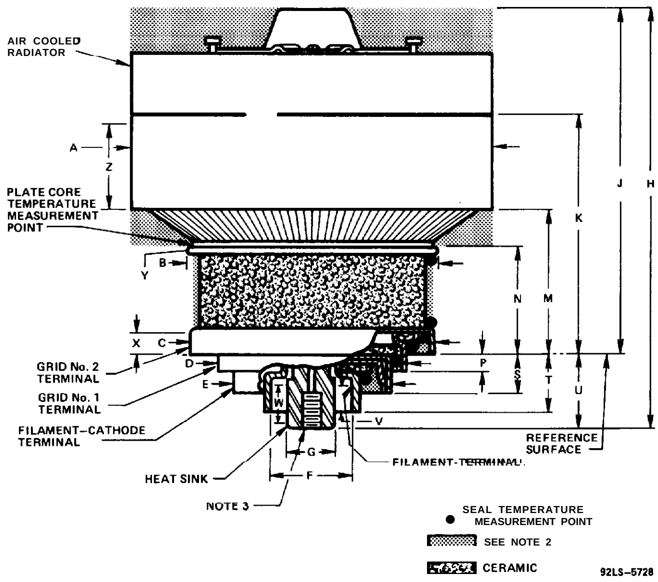
Tabulated Dimensions

Dimension	Millimeters	Inches
A	46	1.8
B	79	3.1
C	1.5	0.08
D	18	0.7
E Dia.	6.35	0.250
F Radius	29.85	1.175
G	23	0.9
H Dia.	3.56	0.140
J		8.3°
K		4.5°

Notes

Material 1 /16" CRS
Slot between holes
Round all edges

Figure 6 - Tube Extractor



Note 1 - The diameter of each terminal is maintained only over the indicated minimum length of its contact surface.

Note 2 - Keep all stippled regions clear. Do not allow contacts or circuit components to intrude into these annular volumes.

Note 3 - Tapped 1/4-20 NC x 12.7 mm (0.5 inch) deep.

Figure 7 - Dimensional Outline

Tabulated Dimensions

Dimension	Millimeters	Inches	Notes
A Dia.	114.6 ± 1.5	4.510 ± .060	Note 1
B Dia.	80.14 ± 0.38	3.155 5.015	
C Dia.	76.91 ± 0.36	3.028 ± .014	Note 1
D Dia.	58.90 ± 0.30	2.319 ± .012	Note 1
E Dia.	46.99 ± 0.25	1.850 ± .010	Note 1
F Dia.	30.48 ± 0.25	1.200 ± .010	Note 1
G Dia.	15.67 ± 0.08	0.617 ± .003	Note 1
H	134.6 ± 2.0	5.300 ± .080	
J	110.4 ± 1.1	4.345 ± .045	
K	77.7 ref.	3.060 ref.	
M	45.5 ± 1.0	1.790 ± .040	
N	33.8 ± 0.8	1.330 ± .030	
P	5.1 ± 0.6	0.200 ± .025	
S	12.1 ± 0.8	0.475 ± .030	
T	18.4 ± 1.0	0.725 ± .040	
U	24.3 ref.	0.955 ref.	
V	6.35 min.	0.250 min.	
W	9.53 min.	0.375 min.	
X	5.59 min.	0.220 min.	
Y Radius	0.38 ref.	0.015 ref.	
Z	30.48 min.	1.200 min.	

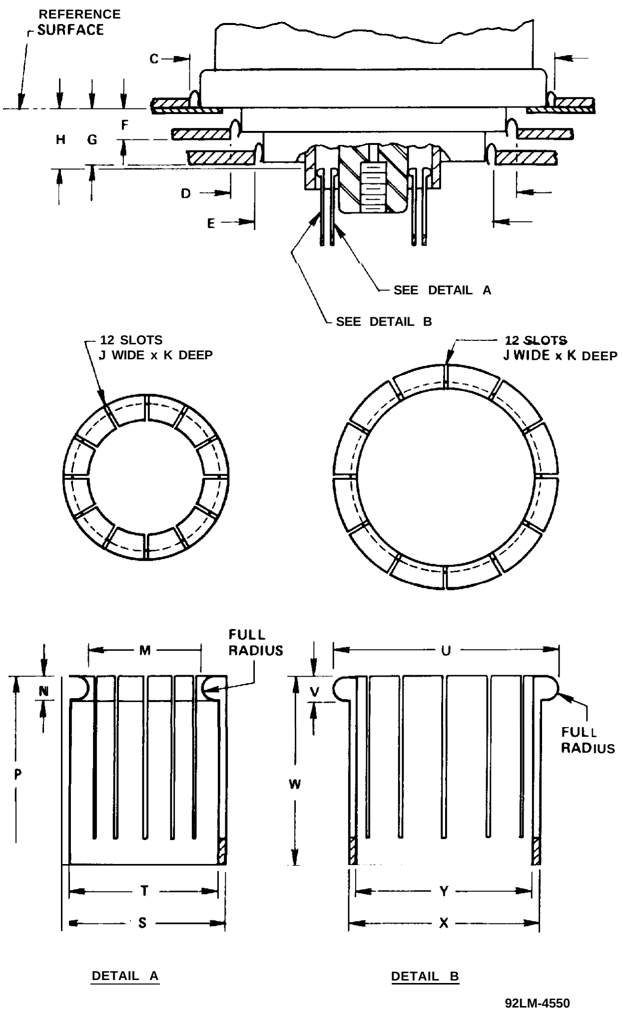


Figure 8 - Preferred Mounting Arrangement

Tabulated Dimensions

Dimension	Millimeters	Inches	Notes
C Dia.	81.79	3.220	Note 1
D Dia.	63.75	2.510	Note 1
E Dia.	51.82	2.040	Note 1
F	5.46	0.215	
G	10.92	0.430	
H	12.07	0.475	
J	0.38	0.015	
K	20.32	0.800	
M Dia.	15.24	0.600	Note 2
N	3.18	0.125	
P	25.40 min.	1.000 min.	
S Dia.	21.59	0.850	
T Dia.	19.43	0.765	
U Dia.	30.99	1.220	Note 3
V	3.18	0.125	
W	25.40 min.	1.000 min.	
X Dia.	26.92	1.060	
Y Dia.	24.77	0.975	

Note 1 - The tolerance for the indicated dimensions is:
plus 0.25 mm (0.010 inch)
minus 00 mm (00 inch)

Note 2 - The tolerance for the indicated dimension is:
plus 00 mm (00 inch)
minus 0.05 mm (0.002 inch)

Note 3 - The tolerance for the indicated dimension is:
plus 0.05 mm (0.002 inch)
minus 00 mm (00 inch)

Note 4 - Finger stock is No.97-135 A, as made by:
Instrument Specialties Company, P.O. Box A, Delaware Water Gap, PA 18327

Note 5 - Sockets and chimneys are available and may be obtained in limited quantities from BURLE and in production quantities from: Jettron Products Inc., 56 Route Ten, Hanover, NJ 07936

Supplier	Socket No.	Chimney No.
Jettron	CD 89-085	8822