IGNITRON TYPE WL-5555A

The WL-5555A is a sealed, stainless-steel jacketed, water-cooled, mercury-pool tube designed primarily for power rectification. In this service six tubes will rectify 600 kilowatts at 300 volts dc and 500 kilowatts at 600 and 900 volts dc. The WL-5555A is also used for alternating current control at 2400 volts, rms. The WL-5555A features an intergral thermostat bracket to permit installation of tube temperature-operated safety control circuitry.

GENERAL DATA

Electrical

Type of Cathode Excitation		Cyclic
Type of Cathode Spot Starting		Ignitor
Number of Electrodes		
Main Anodes	1	
Main Cathodes	1	
Auxiliary Anodes	1	
Ignitors	2	
Arc Drop at 600 Peak Amperes (See Figure 13)	16.2	volts
Ignitor Excitation Requirements (See page 2 for ignitor ratings)		
Separate–Excitation Source (See Figures 2 and 11)		
Open–Circuit Voltage Range	450 – 750	volts
Short–Circuit Current Range	45 – 75	amp
Anode Firing (2400 Volts, Welding Service), 50 ohms in series with ignitor	Anode	volts

Mechanical

Mounting Position		Vertical, cathode down
Envelope Material		Stainless steel
Length, maximum	29-3/4	in
Width, not including water connections	5-3/4	in
Type of Cooling		water
Characteristics for Water Cooling, at continuous average current and rated minimum water flow of	3	gpm
Water Temperature Rise, maximum	5	°C
Maximum Pressure Drop, at 3 gallons per minute	7	lbs/sq in
Net Weight	25	lbs
Shipping Weight	33	lbs

MAXIMUM RATINGS

AS A POWER RECTIFIER (6-phase double-wye or 3-phase rectifier) See Note 1.

DC Output Voltage, maximum	300	600	volts
Maximum Voltage Reduction by Phase Retard	0	0	percent
Maximum Average Current Per Tube			
Continuous	200	150	amp
Two-Hour Overload	300	225	amp
One-Minute Overload	400	300	amp
Outlet Water Temperature, maximum	50	40	°C
Inlet Water Temperature, minimum	3	3	°C
Minimum Water Flow Ratings			
For Recirculating Cooling	3	3	gpm
For Direct Raw Water Cooling (See Note 2)	1	1	gpm
Frequency Range	25-60	25-60	cps

AS AN AC CONTROL (Two tubes in inverse parallel) See Note 3 and Figure 15.

Maximum Voltage, rms	2400	volts
Maximum Demand (See Note 4)	2400	kva
Average Current at Maximum Demand	135	amp
Maximum Average Current	207	amp
Demand at Maximum Average Current	1105	kva
Maximum Averaging Time at 2400 Volts, rms	1.66	sec
Maximum Surge Current, Peak	6000	amp
Maximum Duration of Surge Current	0.15	sec
Outlet Water Temperature, maximum	30	°C
Inlet Water Temperature, minimum	10	°C
Minimum Water Flow	3	gpm

IGNITOR RATINGS

For power rectifier or ac control service

See page 1 for ignitor excitation requirements

Maximum Voltage		
Positive	Anode	volts
Negative	5	volts

Maximum Current		
Peak	100	amp
Root Mean Square	15	amp
Average	2	amp
Maximum Averaging Time	10	sec

Note 1.
These ratings are in accordance with American Standards Association Report C34.1-1949 "Pool Cathode Mercury Arc Power Converters for Railway Substations or Mining Service". For ratings apply to other voltages, voltage reduction by phase retard, or various outlet water temperatures See Figure 14.

Note 2.
For water flow controlled by a thermostatic valve. At highest ambient water temperature and minimum water pressure, water flow must be enough to insure outlet water below maximum rated temperature.

Note 3.
Rms demand voltage, current, and kva are all on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

Note 4.
With the use of log-log paper, straight-line interpolation between tabulated points may be used for other tabulated ratings of demand kva versus average anode current.

MAXIMUM FAULT CURRENT RATINGS

The ratio of rated maximum fault current to rated zero–phase–retard continuous average tube current, occurring during the following intervals after fault initiation, shall not exceed the values tabulated below:

Interval	Peak Forward	Peak Reverse
0 to .016 second	80	185
.016 to .05 second	80	130
.05 to .15 second	80	92
.15 to .20 second	55	-

These fault–current ratios are based on field experience and measurements on commercial rectifiers and are to be construed as a basis for circuit design. The fault current has transient components which account for the higher values for the shorter times. The current corresponding to the last interval is the sustained dc short–circuit tube current. It may be used to calculate the minimum transformer commutating impedance (Z_c), referred to the secondary, required to insure proper protection of the tubes. Z_c is determined by the following formula:

$$Z_c = \frac{\sqrt{2}\, E_s}{I_{ss}}$$

E_s = line to neutral rms voltage of the dc winding in volts
I_{ss} = sustained dc short–circuit current in amperes
Z_c = commutating impedance in ohms

SELF OR ANODE IGNITOR EXCITATION

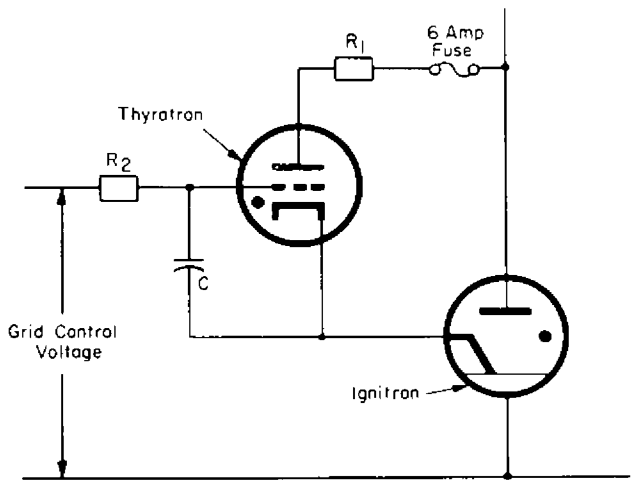


FIGURE 1

SATURATING REACTOR-CAPACITOR
SEPARATE EXCITATION IGNITOR CIRCUIT

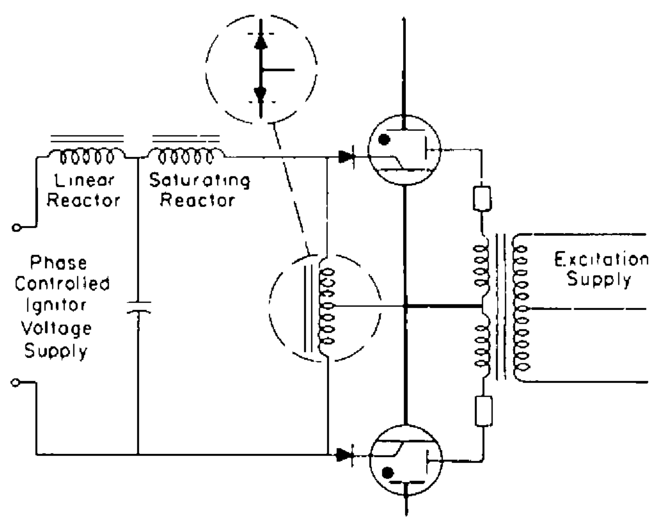


FIGURE 2

SINGLE-PHASE HALF-WAVE

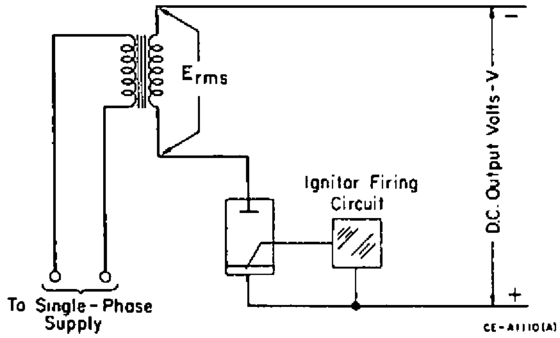


FIGURE 3

THREE-PHASE HALF-WAVE

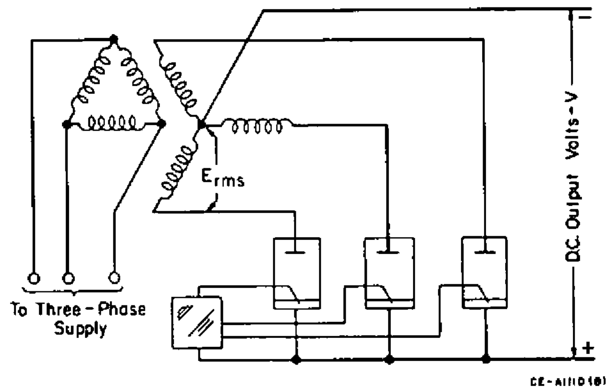


FIGURE 4

SINGLE-PHASE FULL-WAVE

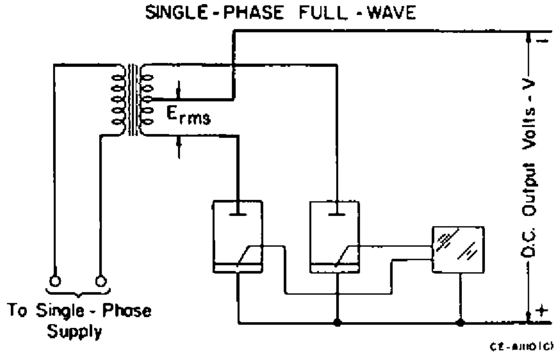


FIGURE 5

SINGLE-PHASE FULL-WAVE BRIDGE

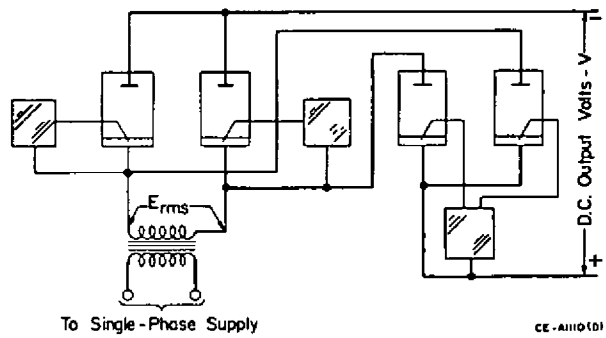


FIGURE 6

THREE-PHASE BRIDGE

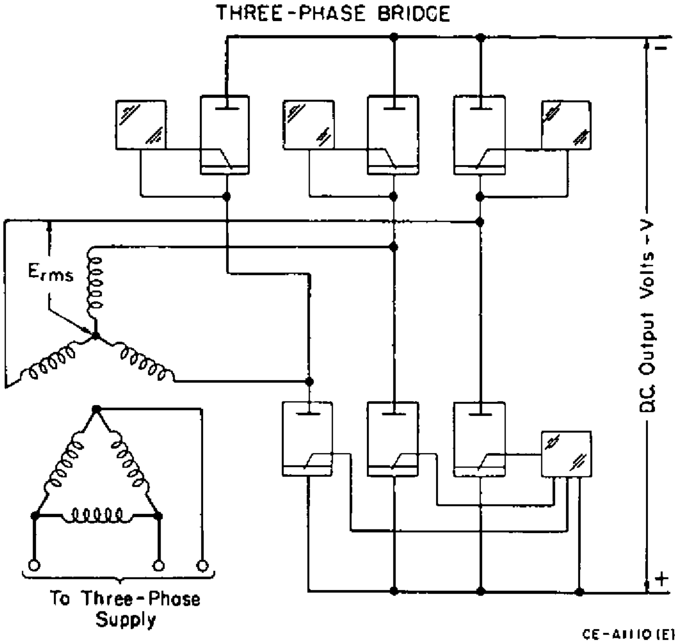


FIGURE 7

QUARTER PHASE

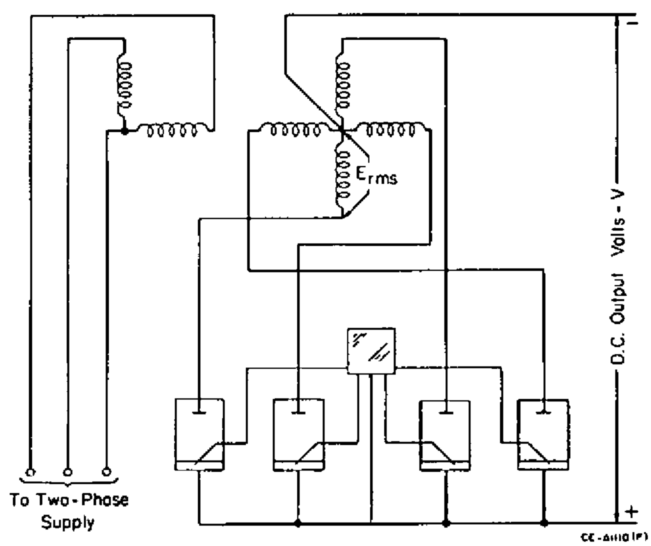


FIGURE 8

DOUBLE THREE-PHASE

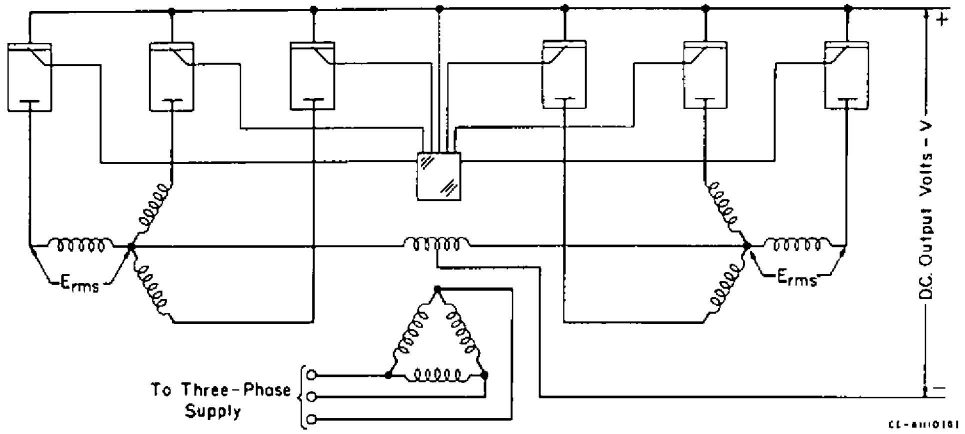


FIGURE 9

SIX PHASE

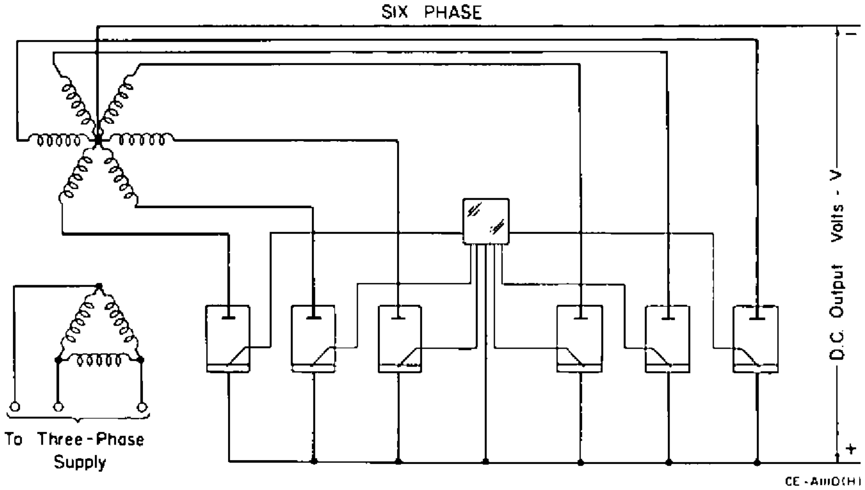


FIGURE 10

The information contained herein is furnished without assuming any obligations. The description and illustration of circuits herein does not convey to the purchaser of tubes any license for circuits under the patent claims of Westinghouse Electric Corporation or others.

	Symbol	Fig. 3	Fig. 4	Fig. 5	Fig. 6	Fig. 7	Fig. 8	Fig. 9	Fig. 10
Transformer Secondary Voltage, rms	E	2.22V	.854V	1.11V	1.11V	.427V	.785V	.854V	.740V
Peak Inverse Voltage	E_1	1.41E	2.45E	2.83E	1.41E	2.45	2.83E	2.45E	2.83E
Peak Inverse Voltage	E_1	3.14V	2.09V	3.14V	1.57V	1.05V	2.22V	2.09V	2.09V
Anode Current, rms	I	1.57A	0.578A	0.785A	0.785A	0.578A	0.500A	0.289A	0.408A
DC Output Voltage, average	V	–	–	–	–	–	–	–	–
DC Output Voltage, peak	V_1	3.14V	1.21V	1.57V	1.57V	1.05V	1.11V	1.05V	1.05V
Major Ripple Voltage, rms	V_2	1.11V	0.177V	0.472V	0.472V	0.04V	0.106V	0.04V	0.04V
Major Ripple Frequency	f	f	3f	2f	2f	6f	4f	6f	6f
DC Output Current, average	A	–	–	–	–	–	–	–	–
Anode Current, peak (resistive load)	A_1	3.14A	1.21A	1.57A	1.57A	1.05A	1.11A	0.52A	1.05A
Anode Current, peak (resistive load)	A_1	$3.14A_3$	$3.63A_3$	$3.14A_3$	$3.14A_3$	$3.15A_3$	$4.5A_3$	$3.15A_3$	$6.3A_3$
Anode Current, peak (inductive load)	A_2	–	A	A	A	A	A	0.5A	A
Anode Current, average	A_3	A	0.33A	0.5A	0.5A	0.33A	0.25A	0.167A	0.167A
Transformer Primary Volt–Amperes	–	3.49VA	1.21VA	1.11VA	1.11VA	1.05VA	1.11VA	1.05VA	1.29VA
Transformer Secondary Volt–Amperes	–	3.49VA	1.71VA	1.57VA	1.11VA	1.05VA	1.57VA	1.48VA	1.81VA
Line Volt–Amperes	–	3.49VA	1.21VA	1.11VA	1.11VA	1.05VA	1.11VA	1.05VA	1.05VA

NOTES

Symbols E and V are shown on circuit diagrams. Allowance must be made for voltage drop in tubes, transformer and circuit.

Circuit, Figure 3 results in considerable transformer unbalancing with consequent reduction of kva output.

Peak inverse voltage 2.45E, Figure 9, becomes 2.83E for light loading.

Ratios given are on the assumption that there is no back emf in the load circuit and no phase–back.

Primary volt–amperes required do not include transformer losses which must be considered.

IGNITOR FIRING CIRCUIT REQUIREMENTS

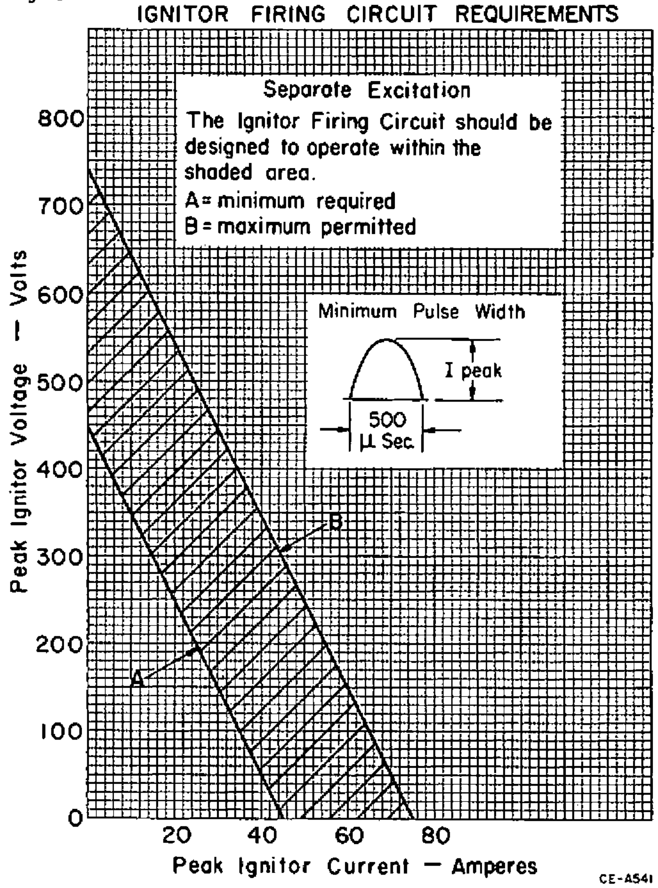


FIGURE 11

CIRCUIT DIAGRAM OF WELDER USING IGNITRONS AND THYRATRONS

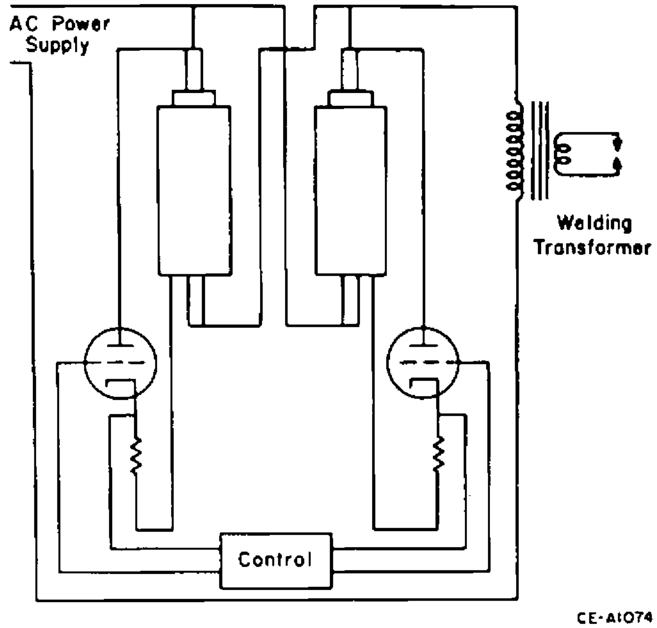


FIGURE 12

ARC DROP CHARACTERISTICS

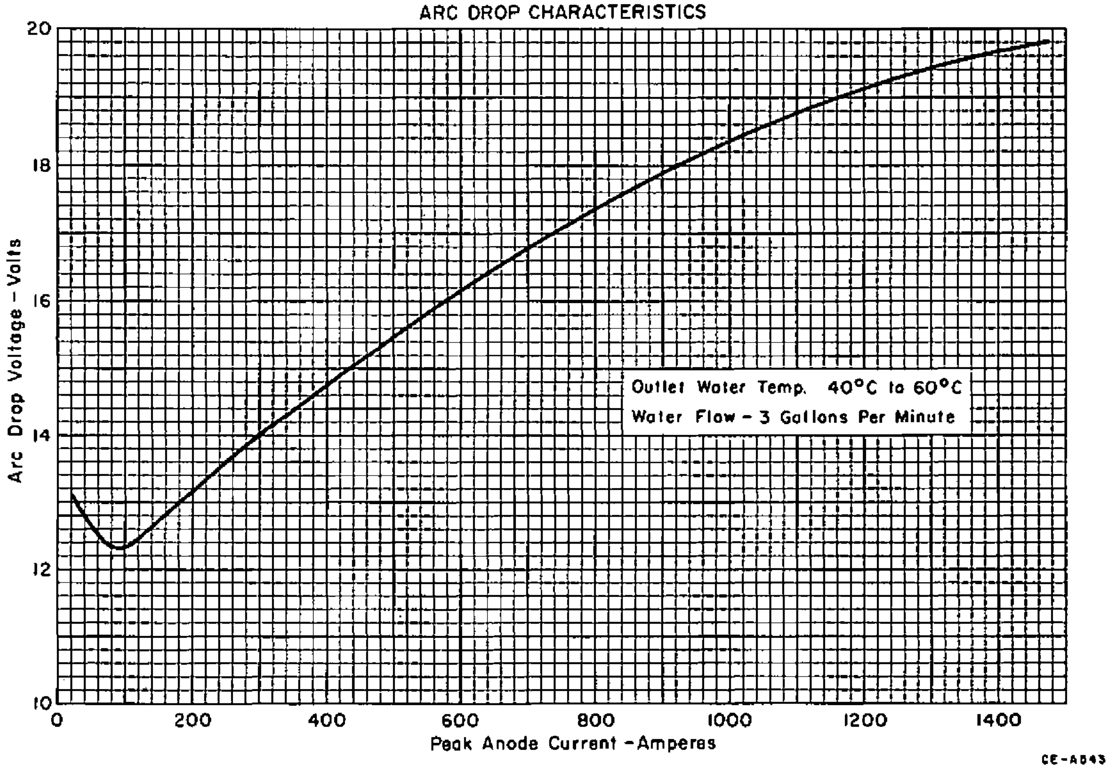


FIGURE 13

RATING CHART FOR SIX-PHASE DOUBLE-WYE
OR THREE-PHASE RECTIFICATION SERVICE
Showing
D. C. Output Voltage and Current
Percent Voltage Reduction by Phase Retard

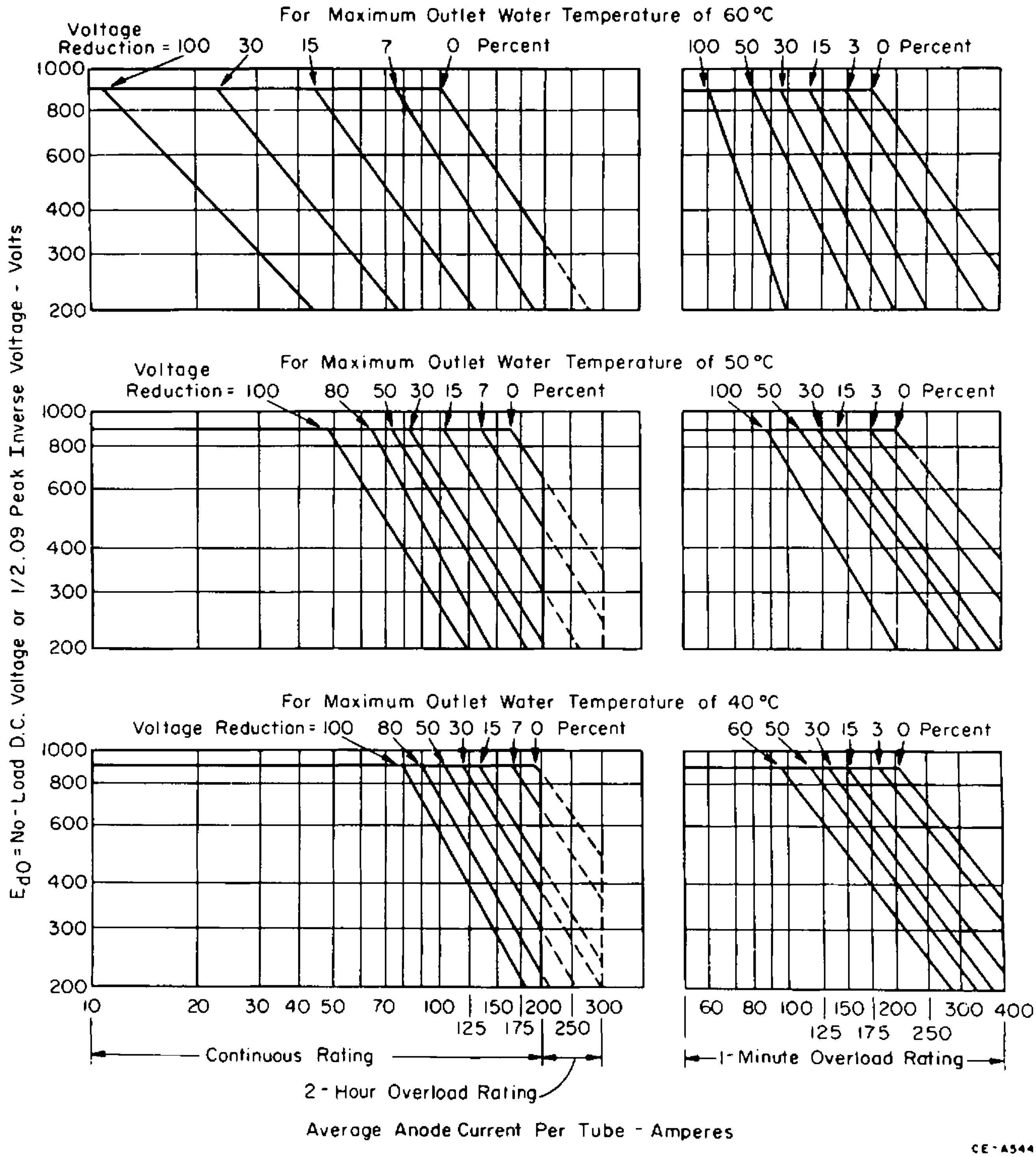


FIGURE 14

A.C. CONTROL TUBE RATINGS
(Two Tubes in Inverse Parallel)

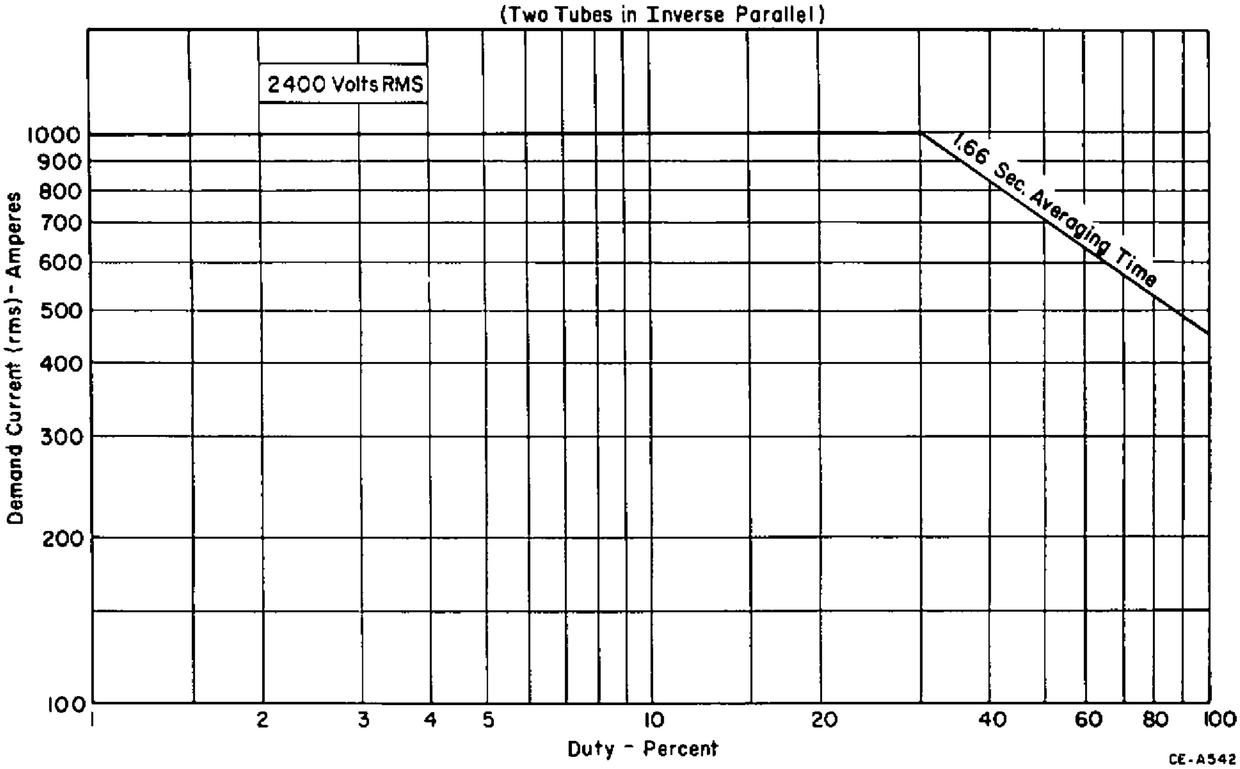
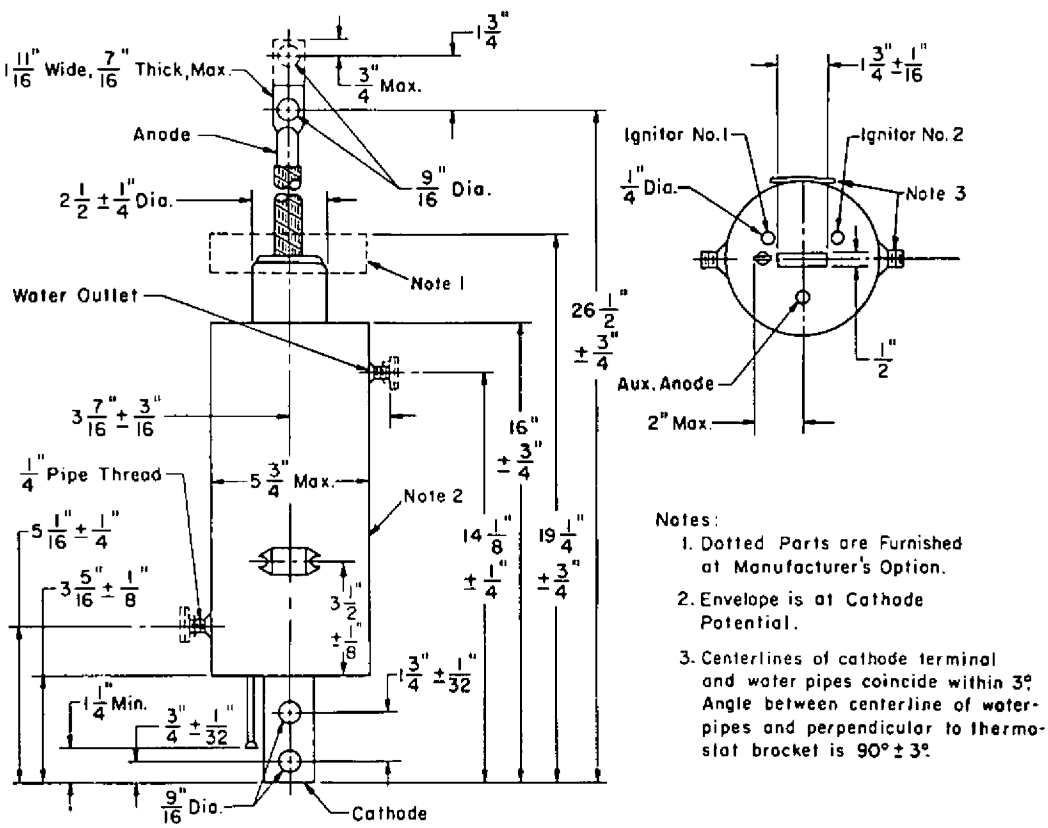


FIGURE 15



Notes:

1. Dotted Parts are Furnished at Manufacturer's Option.
2. Envelope is at Cathode Potential.
3. Centerlines of cathode terminal and water pipes coincide within 3°. Angle between centerline of water-pipes and perpendicular to thermo-stat bracket is 90° ± 3°.

FIGURE 16