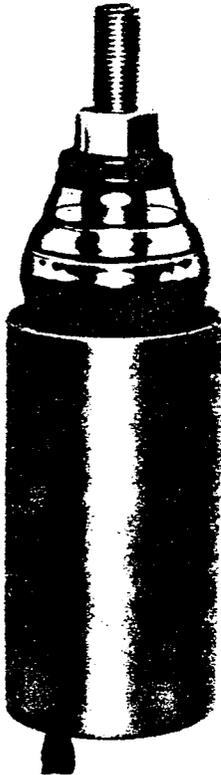




NATIONAL

HIGH VOLTAGE SWITCHING IGNITRONS



National Electronics, Inc. High Voltage Switching Ignitrons are used in a variety of applications including capacitor discharge, clamping, and crowbar. Each application has its own particular switching requirement depending upon voltage, current, pulse repetition rate, pulse shape and load characteristics.

RATINGS AND CHARACTERISTICS

*(NOT INTENDED FOR SIMULTANEOUS USE)

	NL-1036 Improved 7171	NL-1037	NL-1038	NL-1039	NL-1040	NL-1059A	NL-7703 NL-7703H
Approx. OD, Inches	2	2	4	2	4½	5	2
Height, Inches	8	8	7	8	7	21	8
¹ Maximum Peak Current, Kiloamperes	35	100	100	100	65	100	100
¹ Maximum Average Current, Amperes	.75	.75	1.7	.75	.25	2.0	.75
¹ Maximum Averaging Time, Minutes	1	1	1	1	1	1	1
Maximum Peak Anode Voltage, Kilovolts	15	20	15	20	50	20	20
¹ Maximum Energy Switching Capability, Ringing Applications, Kilojoules per Minute (J)	20	30	50	30	12	50	30
Ionization Time	Less Than 1 Microsecond						
² Number of Ignitrons	1	1	2	1	1	3	1
³ Anode Material	G	G	G	SS	M	G	M
⁴ Anode Insulator	P	DP	P	DP	—	P	DP
Anode Seal and Stud Potting	On Order	Yes	No	Yes	No	No	Yes
⁵ Maximum Cathode Temperature, °C	35	35	35	35	20	35	35
⁵ Cooling Method	Clamp	Clamp	Clamp	Clamp	plates	Liquid	Clamp
Net Weight, Lbs.	1.9	2.0	7.5	2.7	13	22	2.8
Approximate Shipping Weight, Lbs.	6	6	10	6	16	26	6

NATIONAL ELECTRONICS

A Division of Richardson Electronics, Ltd.

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ANODE MATERIAL

Anode materials, (G) graphite, (SS) stainless steel, and (M) molybdenum, affect life and reliability. Life is equated to the number of times a tube will operate before prefires or misfires become too frequent for the application. Reliability is dependent upon the number of acceptable prefires or misfires during life. What may be considered end of life for one application may be acceptable reliability for another. This is especially so in parallel operation when a few microseconds prefire may be

objectionable. In single tube operation, this would never be noticed. Applications requiring extremely high reliability have had more success with (M) molybdenum anodes. (G) Graphite, on the other hand, does not display as high of reliability but has less tendency towards ignitor wetting.

MOUNTING

The performance and life of the ignitron is greatly improved if it is operated in a field free space. Magnetic fields tend to force the arc toward the tube sidewall and aggravate sidewall arcing. Metal vapor produced by

sidewall arcing is one of the major contributors to ignitor wetting. We recommend a coaxial type mounting to minimize field effects.

INSTALLATION INFORMATION

RECOMMENDED CONDITIONING BEFORE INITIAL USE — The ignitron is in high voltage operating condition before leaving the factory. Shipping tends to redistribute mercury throughout the ignitron making certain conditioning steps desirable before installation.

Heat Conditioning — Before applying voltage, heat anode stud to 100-125° C (keeping cathode near room temperature) for two hours minimum. This drives mercury away from anode and anode seal area.

Voltage Conditioning (after Heat Conditioning) — Apply minimum voltage (Table 1) across ignitron (anode positive and ignitor not connected) with a series combination of a 1 to 4 ufd capacitor and a 1 ohm resistor in parallel with the ignitron. NATIONAL will replace any ignitron that will not hold off minimum voltage at initial test when caused by a manufacturing defect. Additional conditioning at higher voltages is recommended to stabilize the ignitron after shipping. Slowly increase voltage above minimum. Breakdown may occur but ignitron will stabilize above Hi-Pot Stabilization Voltage (Table 1).

NOTE: The time required for conditioning to Hi-Pot Stabilization Voltage can be reduced by using a variable ac voltage source connected directly across the ignitron (ignitor not connected). Slowly increase the voltage, permitting a maximum of 30 milliamperes to flow.

RECOMMENDED PRACTICE AFTER INITIAL USE — Mercury condensed in the anode and anode seal area greatly decreases the tube's voltage hold-off ability. Heat conditioning before initial use corrects improper mercury distribution before the tube is first placed in operation. Once the tube is in operation, the anode and anode seal area temperature must be equal to or greater than that of the cathode. This is also true during any cooling period. The anode and anode area must not cool faster than the cathode.

The ignitor becomes susceptible to damage by movement of mercury after use in a capacitor discharge or crowbar application. For maximum life, we recommend that an ignitron not be moved until end-of-life once it has been placed in service.

Table 1

Tube Type	1036	1037 1038	1039 1059	7703 7703H	1040
Minimum Voltage (Kilovolts, DC)	17	22	22	22	55
Hi-Pot Stabilization Voltage (Kilovolts, DC)	30	35	35	35	65

LIFE AND WARRANTY

National Electronics, Inc. warrants the tube types listed above to be free from defects of design, material, and workmanship when received and, after receiving Recommended Conditioning Before Initial Use, to operate satisfactorily when first installed and, if used within ratings, to give a minimum of 1000 operations. No adjustment will be made if the tube is not placed in service within six months after date of shipment by

manufacturer. This warranty expires 18 months after date of shipment by manufacturer.

National High Voltage Switching Ignitrons have an expected life of many times the warranted number of operations in most applications. Operating within the recommended ratings and following the Recommended Practices After Initial Use will greatly increase the life or operations obtained.

RATINGS AND CHARACTERISTICS (Cont.)

¹ In the peak voltage range from 5000 volts to maximum rating, the maximum coulomb-per-second transfer capability of the ignitron is basically a constant. In unidirectional current applications this capability is defined by specifying the maximum peak anode current, maximum average anode current, and the maximum averaging time. In applications with current reversal (ringing), it is more convenient to specify the maximum energy that can be switched per minute as a function of peak anode voltage and percentage of reversal; maximum peak anode current also applies. While the exact relationship has not been determined, the following expression gives conservative values of energy switching capability for anode voltages down to 5000 volts and for 30% to 85% reversal.

$$\text{Maximum energy switched per minute} = J \times \frac{V_a}{V_r} \times \left(\frac{85}{R}\right)^2$$

J = Rated maximum energy switching capability per minute.

V_a = Actual peak anode voltage.

V_r = Rated peak anode voltage.

R = Actual percent reversal.

The maximum energy ratings listed are for rated peak anode voltage and 85% reversal.

² NL-1036, NL-1037, and NL-7703 have standard welder ignitors.

NL-1038, NL-1039, NL-1040, NL-1059, and NL-7703H have high resistance ignitors.

³ G — Graphite. M — Molybdenum.
SS — Stainless Steel.

⁴ P — Straight insulator, no pant leg.
DP — Double pant leg.

⁵ Cathode temperature should be lower than anode stud temperature during operation. Cooling by means of a cooling clamp permits coaxial type mounting to minimize inductance. Cooling clamp may also be used for mounting.

TUBE LIFE CONSIDERATIONS

Tube life (number of shots) is a function of the operating peak anode voltage, peak current, and average current, and is increased by operation at values below the maximum ratings. While the specific relationship has not been determined, we suggest the following exponential expression as a conservative approximation:

$$\text{Number of expected operations multiplier} = e^{a \cdot b \cdot c - 3}$$

$$a = \frac{\text{Rated maximum peak anode voltage}}{\text{Actual peak anode voltage}}$$

$$b = \frac{\text{Rated maximum peak anode current}}{\text{Actual peak anode current}}$$

$$c = \frac{\text{Rated maximum average current}}{\text{Actual average current}}$$

or

$$c = \frac{\text{Rated maximum energy switched at actual operating conditions}}{\text{Actual energy switched}}$$

IGNITOR

Standard Welder Ignitrons fire in less than 100 microseconds with an applied voltage of 200 volts. Shorter firing times can be obtained by using high voltages. Three thousand to five thousand volts will give less than one microsecond firing time.

High Resistance Ignitrons are heavy-duty-shaped, have long life and minimize ignitor wetting in applications of severe service. They will fire in less than 100 microseconds with an applied voltage of 800 volts. Ignitor voltages from 2 to 5 kilovolts are required for reliable fast firing.

Anode firing (using anode voltage supply) or separate excitation can be used with either type ignitor. In both

cases, sufficient energy must be available to the ignitor for reliable firing. A firing circuit supplying minimum energy needed by a new tube is not the best practice since ignitor energy requirements increase with tube life. While each application dictates its own energy requirements, four to eight Joules per ignitor is reasonable for the most severe applications at maximum ratings and for maximum life consistent with this type operation to insure firing in parallel ignitron applications.

