



---

# UL 2161

## **STANDARD FOR SAFETY**

## Neon Transformers and Power Supplies



UL Standard for Safety for Neon Transformers and Power Supplies, UL 2161

Second Edition, Dated April 6, 2016

**Summary of Topics**

***The second edition of UL 2161 is being issued to address the editorial maintenance of UL Standards for Safety and to remove the reference of the withdrawal date for UL 873. Any changes that were made are considered to be non-substantive and not subject to UL's STP process.***

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

UL provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

No Text on This Page

**APRIL 6, 2016**

**1**

**UL 2161**

**Standard for Neon Transformers and Power Supplies**

First Edition – September, 1996

**Second Edition**

**April 6, 2016**

This UL Standard for Safety consists of the Second edition.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

UL's Standards for Safety are copyrighted by UL. Neither a printed nor electronic copy of a Standard should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

**COPYRIGHT © 2016 UNDERWRITERS LABORATORIES INC.**

No Text on This Page

## CONTENTS

### PART 1 – ALL NEON SUPPLIES

#### INTRODUCTION

1 Scope .....	6
2 Components .....	8
3 Reference Publications .....	8
4 Units of Measurement .....	8
5 Terminology .....	8
6 Glossary .....	9

#### CONSTRUCTION

7 Enclosures .....	13
7.1 General .....	13
7.2 Metallic enclosure .....	14
7.3 Corrosion protection .....	14
7.4 Polymeric enclosure .....	14
8 Accessibility Barriers .....	16
9 Openings and Open Holes .....	18
10 Securement of Parts .....	20
11 Sharp Edges .....	21
12 Mounting .....	21
13 User Accessible Controls .....	22
14 Supply Connections (Does Not Include Equipment Grounding) .....	22
14.1 Permanently-connected supplies .....	22
14.2 Supply terminals .....	23
14.3 Supply leads .....	25
14.4 Cord- and plug-connected supplies .....	25
14.5 Source of supply other than a branch circuit .....	26
15 Equipment Grounding .....	27
16 Equipment Grounding Means .....	27
16.1 General .....	27
16.2 Grounding terminal .....	28
16.3 Grounding leads .....	29
16.4 Grounding, cord-connected neon supplies .....	29
17 Bonding .....	30
18 Internal Wiring .....	30
18.1 General .....	30
18.2 Prevention of wire damage .....	31
19 Internal Electrical Connections (Other Than Output Circuitry) .....	31
20 Output .....	32
20.1 Output ratings .....	32
20.2 Output terminals .....	32
20.3 Output cables .....	32
21 Input/Output Isolation .....	33
22 Electrical Components .....	34
22.1 General .....	34
22.2 Switches .....	34

22.3	Over-current protection	35
22.4	Capacitors	35
22.5	Transformers	36
22.6	Thermal protective devices	36
22.7	Printed-wiring boards	36
22.8	Electrode receptacles	37
23	Secondary Ground-Fault Protection	37
24	Spacings	39
25	Insulation	43

## PERFORMANCE

26	General	44
27	Input Measurement Test	46
28	Isolated Output Determination Test	47
29	Output Measurement Tests	47
29.1	Maximum output voltage	47
29.2	Maximum output current measurement	48
30	Temperature Test	49
31	Dielectric Voltage-Withstand Tests	57
31.1	General	57
31.2	Primary and secondary circuits	57
31.3	Barrier and insulating materials	59
32	Leakage Current Test	60
33	Input to Output Isolation Test	62
34	Grounding Continuity Test	63
35	Strain and Push-Back Relief Test	63
36	Switch Loading Tests	64
36.1	General	64
36.2	Overload	65
36.3	Endurance	65
37	Abnormal Operation Tests	65
37.1	General	65
37.2	Output open-circuit	67
37.3	Abnormal component short- and open-circuit	67
37.4	Output short-circuit abnormal temperature test	68
37.5	Output shorted-to-ground abnormal test	68
38	Printed-Wiring Board Tests	68
38.1	Abnormal trace-to-trace short-circuit	68
38.2	Conformal coating	69
39	Mechanical Tests	70
39.1	Polymeric mounting means load	70
39.2	Knockout	70
40	Wire-Binding Screw Terminal Tests	70
40.1	Solid-wire tightening	70
40.2	Performance verification of terminal assemblies on a terminal block	71
41	Secondary Ground-Fault Parameters Test	71
42	Secondary Ground-Fault Protection Circuit Abnormal Tests	83
42.1	General	83
42.2	Component fault	84
42.3	Thermal aging	85
42.4	Overvoltage and undervoltage	86
42.5	Power supply interruption	86



42.6 Transient surge .....	86
42.7 Humidity .....	87

## MANUFACTURING AND PRODUCTION TESTS

43 Production-Line Grounding Continuity Test .....	89
44 Production-Line Dielectric Voltage-Withstand Test .....	90

## MARKINGS

45 General .....	91
46 Identification .....	91
47 Ratings .....	92
48 Cautionary Markings .....	93

## INSTRUCTIONS

49 Installation .....	94
-----------------------	----

## PART 2 – OUTDOOR NEON SUPPLIES

### NON-WEATHERPROOF NEON SUPPLIES

50 General .....	95
51 Construction – Electrical .....	95
52 Performance .....	95

### WEATHERPROOF NEON SUPPLIES

53 General .....	95
54 Construction – Mechanical, Corrosion Protection .....	96
55 Exclusion of Water .....	97
55.1 Enclosures .....	97
55.2 Gaskets and bushings .....	98
55.3 Openings .....	98
56 Construction – Electrical .....	98

## PERFORMANCE

57 Accelerated Aging of Gaskets .....	98
58 Water Spray .....	99

## MARKINGS

59 General .....	102
------------------	-----

## APPENDIX A

Standards for Components.....	A1
-------------------------------	----

## PART 1 – ALL NEON SUPPLIES

### INTRODUCTION

#### 1 Scope

1.1 This standard applies to transformers and power supplies, including those intended to be connected to a Class 2 source of supply, that provide the voltage and ballasting for neon and cold-cathode tubing (electric-discharge tubing) consisting of electrodes and gas such as neon, mercury, helium, argon, and similar gases, enclosed in glass. Neon transformers and power supplies for use in signs and outline lighting are intended to be used in accordance with Article 600 of the National Electrical Code, NFPA 70. Cold-cathode supplies identified for use only in cold-cathode lighting systems are intended to be used in accordance with Article 410 of the National Electrical Code.

1.2 Neon transformers and power supplies covered by this standard are designated by their construction and intended use as specified in Table 1.1.

1.3 The following neon supplies are only covered as components for use in an end product that is determined to comply with the Standard for Electric Signs, UL 48:

- a) Type 1 neon supplies;
- b) Types 5 and 6 neon supplies when complying with Exception No. 3 to 23.1;
- c) Types 6, 7, and 8 neon supplies when complying with the Exception to 14.4.1 or the Exception to 14.4.3;
- d) All types of neon supplies having an isolated output when complying with Exception No. 2 to 23.1; and
- e) Cold-cathode supplies when complying with Exception No. 5 to 23.1.

1.4 These requirements do not cover transformers or power supplies intended to supply other forms of electric-discharge lighting sources such as fluorescent and high-intensity-discharge lighting. Requirements for fluorescent supply sources are covered in the Standard for Fluorescent-Lamp Ballasts, UL 935, and the requirements for high-intensity-discharge lighting supply sources are covered in the Standard for High-Intensity-Discharge Lamp Ballasts, UL 1029.

1.5 These requirements do not cover transformers or power supplies that are intended for use with oil burners. The requirements for oil ignition transformers are covered in the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1 and the Standard for Low Voltage Transformers – Part 2: General Purpose Transformers, UL 5085-2, and for oil ignition power supplies are covered in the Standard for Power Units Other Than Class 2, UL 1012.