UL 1577

STANDARD FOR SAFETY

Optical Isolators

UL Standard for Safety for Optical Isolators, UL 1577

Fifth Edition, Dated April 25, 2014

SUMMARY OF TOPICS

This revision of ANSI/UL 1577 dated June 11, 2019 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated April 5, 2019.

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APRIL 25, 2014
(Title Page Reprinted: June 11, 2019)

ANSI/UL 1577-2015 (R2019)

UL 1577

Standard for Optical Isolators

First Edition – June, 1984
Second Edition – May, 1989
Third Edition – March, 1995
Fourth Edition – May, 2000

Fifth Edition

April 25, 2014

This ANSI/UL Standard for Safety consists of the Fifth Edition including revisions through June 11, 2019.

The most recent designation of ANSI/UL 1577 as a Reaffirmed American National Standard (ANS) occurred on June 11, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover optical isolators, also called optical couplers or photocouplers:

a) Intended to provide unidirectional signal transfer between dielectrically isolated circuits and,

b) Intended for use in equipment with a supply voltage not exceeding 600 V ac rms or dc.

1.2 These requirements cover the electrical isolation properties of the insulation between the isolated circuits of the optical isolator.

1.3 These requirements also cover double protection optical isolators that are employed in circuits rated up to 250 V, 50 or 60 Hz, in radio, video, and television equipment, and similar equipment in applications in which breakdown of the optical isolator may result in a risk of fire, electric shock, or injury to persons.

1.4 These requirements do not cover the electrical properties of the separate circuits of the optical isolator.

1.5 These requirements apply to optical isolators for use as components in devices and appliances. Compliance of an optical isolator with these requirements does not indicate that the isolator is acceptable for use as a component of an end product without further investigation.

1.6 *Deleted*

2 Units of Measurement

2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3 Undated References

3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4 Glossary

4.1 For the purpose of this standard the following definitions apply.

4.2 DERATING CURVE – A graph of ambient temperature versus power or current, provided by the manufacturer, where the power and/or current is reduced as the operating ambient temperature is increased.

4.3 DIELECTRIC ISOLATION-VOLTAGE RATING – The maximum voltage-withstand potential between the input and output circuits of the optical isolator.

4.4 DOUBLE PROTECTION OPTICAL ISOLATORS– Optical isolators employed in some unique audio, video and similar applications bridging reinforced insulation.

4.5 HERMETICAL SEAL – Any material employed, such as a case or housing, that completely prevents air filtration, for example an encapsulant.

4.6 INSULATING MATERIALS – Any material providing isolation between the input and output of the optical isolator. Housing or Case material that provides isolation over the surface and through the material would be considered an insulating material.

4.7 MAXIMUM JUNCTION TEMPERATURE – The maximum allowable temperature of the optical isolator semiconductor junction as specified by the manufacturer.

4.8 MAXIMUM OPERATING AMBIENT TEMPERATURE – The maximum temperature of the air surrounding the optical isolator when power is applied, as specified by the manufacturer.

4.9 MAXIMUM STORAGE TEMPERATURE – The maximum temperature at which the optical isolator can be stored without any power applied, as specified by the manufacturer.

4.10 PHOTO-EMITTER – A device internal to the optical isolator that generates electromagnetic radiation, such as a light-emitting diode (LED), used to transmit signals to the photo sensor.

4.11 PHOTO-SENSOR – A device internal to the optical isolator that generates an electrical current due to incident light, such as a photo diode or a photo-conductive transducer, used to receive signals from the photo-emitter.

CONSTRUCTION

5 General

5.1 An optical isolator shall be constructed in compliance with Corrosion Protection, Section 6, Insulating Materials, Section 7, Live Parts, Section 8, and Spacings, Section 9.

6 Corrosion Protection

6.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

Exception: Encapsulated parts and stainless steel parts need not be provided with plating.

7 Insulating Materials

7.1 Insulating materials employed as part of an optical isolator shall be subjected to the Dielectric Voltage-Withstand Test, Section 11, and the Overload Test, Section 12.

7.2 Additionally, insulating materials, other than the case or housing, that are not encapsulated or hermetically sealed, shall also be investigated in accordance with the applicable requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.3 Insulating materials shall have a relative thermal index or generic thermal index equal to or greater than the maximum junction temperature or maximum storage temperature of the optical isolator. whichever is greater. Insulating materials where the relative thermal index or the generic thermal index of the material is exceeded shall be subjected to the Limited Thermal Aging Test, Section 13.

7.4 Materials used to encapsulate devices, such as a case or housing, shall operate within the generic temperature limitations as specified in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, or shall be tested as outlined in Limited Thermal Aging Test, Section 13.

8 Live Parts

8.1 Metal employed for current-carrying parts shall be of stainless steel, plated steel, copper, silver, gold, nickel, aluminum, an alloy of the same, or an equivalent material.

9 Spacings

9.1 The optical isolator's external spacings between input and output circuits shall be based on the end product spacing requirements.

PERFORMANCE

10 General

10.1 Optical isolators shall be tested as described in the Dielectric Voltage-Withstand Test, Section 11 and the Limited Thermal Aging Test, Section 13.

11 Dielectric Voltage-Withstand Test

11.1 Immediately following each of the conditionings indicated in 11.5 – 11.8, each representative optical isolator shall be capable of withstanding without breakdown for 60 seconds a potential equal to the rated dielectric isolation voltage, as specified by the manufacturer, applied between the input and output terminals of the optical isolator. A dc test potential shall be applied to a device having a dc rated dielectric isolation voltage. The value of the potential applied to an ac rated device shall be in volts rms.

11.2 To determine whether a representative optical isolator complies with the requirements in 11.1, the test potential is to be applied as described in 11.4 by means of test equipment having the characteristics outlined in 11.3.

11.3 The test equipment for conducting the Dielectric Voltage-Withstand Test is to have the following features and characteristics:

a) A means of indicating the test potential.

b) For an ac rated device, a 40 – 70 Hz test potential that has a sinusoidal waveform.

11.4 The test potential is to be obtained from any convenient source either:

a) Having a capacity of at least 500 VA, or

b) If of a lower capacity with the voltmeter connected in the output circuit.

The voltage is to be steadily increased until the required test level is reached and is to be held at that value for one minute. The increase in the applied potential is to be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

11.5 Six representative optical isolators are to be tested in the as-received condition.

11.6 Six representative optical isolators are to be exposed to the maximum rated junction temperature for 7 hours, before testing.

11.7 Six representative optical isolators are to be exposed to 85 percent relative humidity at 32.0 ±2.0°C (89.6 ±3.6°F) for 24 hours, before testing.

11.8 Six representative optical isolators are to be exposed to 0.0 ±2.0°C (32.0 ±3.6°F) for 7 hours, before testing.

11.9 Separate sets of representative optical isolators are to be used for each of the various conditions in 11.5 – 11.8.

12 Overload Test

12.1 Three representative optical isolators shall be connected to the rated electrical supply such that the photo-sensor (output) is caused to operate at 150 percent of maximum rated power while the photo-emitter (input) is operated at rated power until temperatures stabilize.

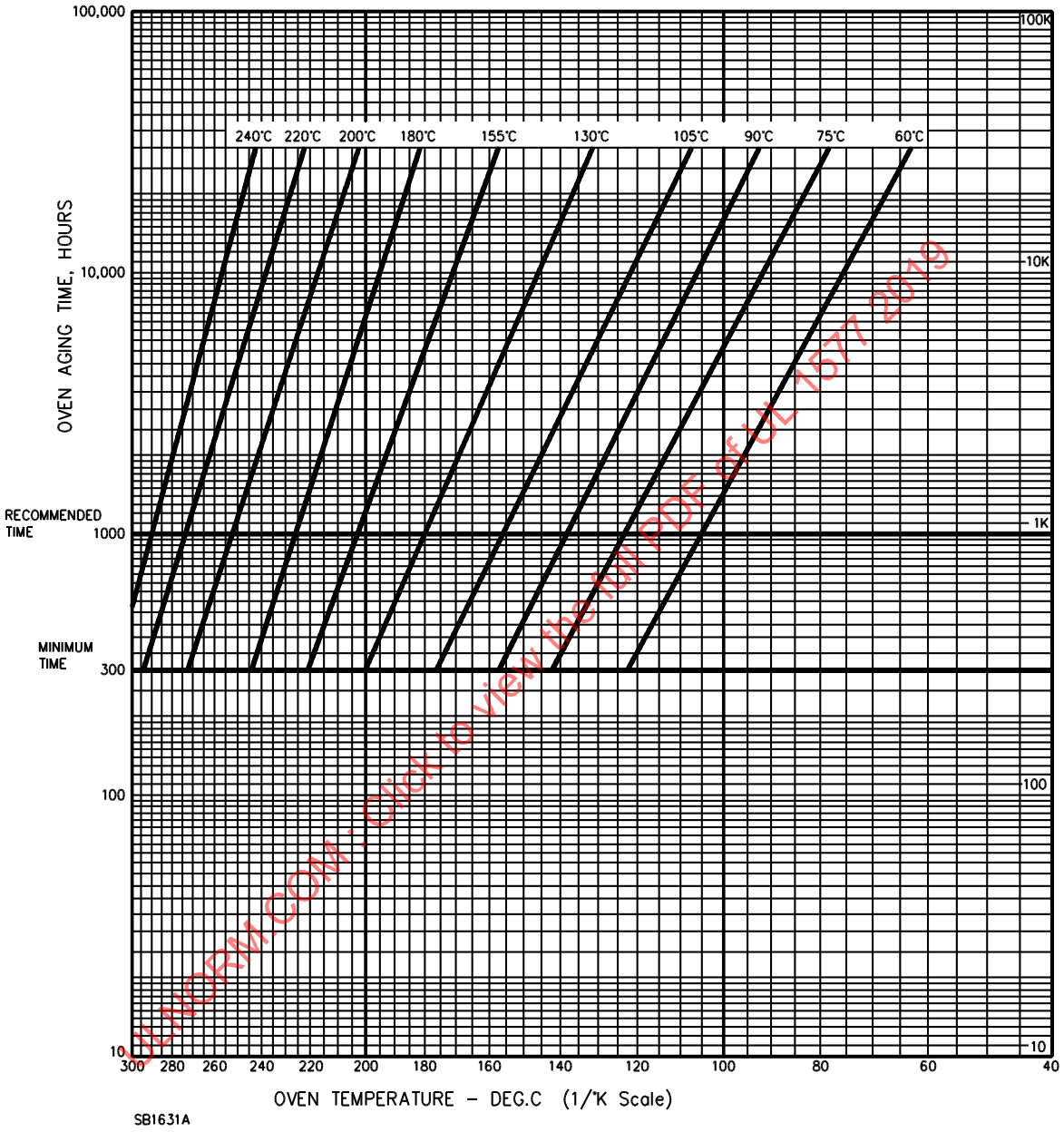
12.2 Immediately after the overload conditioning, as described in 12.1, each of the three representative optical isolators shall withstand the rated isolation voltage as described in 11.1 and 11.4.

13 Limited Thermal Aging Test

13.1 An insulating or encapsulating material, as described in the Insulating Materials Section 7, shall not crack or warp in any of three representative optical isolators when the optical isolators are aged in a full-draft oven at a temperature and time chosen from the graph in Figure 13.1 using the index line that corresponds to the greater of the maximum junction temperature or the maximum storage temperature of the device. All samples shall be conditioned for 1000 hours unless otherwise agreed by all concerned. Optical isolators shall not be subjected to conditioning less than 300 hours. Immediately after this oven conditioning, all three representative optical isolators shall withstand the rated isolation voltage as described in 11.1 and 11.4.

13.2 The air oven is to be essentially as indicated in the Standard Test Methods for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation, ASTM D5374. A portion of the air may be recirculated, but a substantial amount of air is to be admitted continuously to maintain an essentially normal air content surrounding the representative optical isolators. The oven is to be adjusted to achieve 100 – 200 complete fresh-air changes per hour.

Figure 13.1
Oven conditioning time versus oven temperature for temperature index for insulating or encapsulating materials



DOUBLE-PROTECTION OPTICAL ISOLATORS

14 General

14.1 At least 20 representative double-protection optical isolators are required for the tests described in the Discharge Test, Section 15 and the Optical Isolator Life Test, Section 16.

15 Discharge Test

15.1 Ten representative optical isolators are to be tested as described in 15.2 and 15.3. As a result of this test:

a) There shall be no visible evidence of damage to the optical isolator. Discoloration of the optical isolator is not considered to be evidence of damage.

b) The optical isolator shall comply with the dielectric voltage-withstand tests described in 15.4.

15.2 To determine whether an optical isolator complies with the requirements in 15.1, it is to be subjected to 50 discharges from a 0.0005 microfarad capacitor that has been charged to a potential of 20 kV between the short-circuited input and short circuited output terminals. The interval between successive discharges is to be 5 seconds. The optical isolator may be submerged in an oil bath if arcing occurs over the surface or through air during the test.

15.3 The circuit to be used in performing the discharge test is illustrated in Figure 15.1.

15.4 To determine whether an optical isolator complies with 15.1(b), the optical isolator shall withstand without breakdown for not less than 1 minute a potential at the greater of the rated isolation voltage or 3500 V rms having a frequency of 60 Hz, applied between:

a) The input and output terminals of the optical isolator, and

b) The input and output terminals of the optical isolator connected together and metal foil wrapped closely around the body of the optical isolator. The foil is to be kept at least 1/16 inch (1.6 mm) from the terminals.