UL 60730-2-7

STANDARD FOR SAFETY

Automatic Electrical Controls – Part 2-7: Particular Requirements for Timers and Time Switches

UL Standard for Safety for Automatic Electrical Controls – Part 2-7: Particular Requirements for Timers and Time Switches, UL 60730-2-7

Third Edition, Dated November 16, 2020

Summary of Topics

This new third edition of ANSI/UL 60730-2-7 dated November 16, 2020 is an adoption of IEC 60730-2-7, Automatic Electrical Controls – Part 2-7: Particular Requirements for Timers and Time Switches (Edition 3.0, Issued by the IEC March 2015) as an IEC-based UL standard with US National Differences.

The requirements are substantially in accordance with Proposal(s) on this subject dated July 10, 2020.

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UL 60730-2-7

Standard for Automatic Electrical Controls – Part 2-7: Particular Requirements for Timers and Time Switches

First Edition – February, 2002
Second Edition – March, 2014

Third Edition

November 16, 2020

This ANSI/UL Standard for Safety consists of the Third Edition.

The most recent designation of ANSI/UL 60730-2-7 as an American National Standard (ANSI) occurred on October 29, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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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Preface (UL)

This UL Standard is based on IEC Publication 60730-2-7: 3.0 edition Automatic electrical controls – Part 2-7: Particular requirements for timers and time switches. IEC publication 60730-2-7 is copyrighted by the IEC.

This UL Standard 60730-2-7 Standard for Safety for Automatic Electrical Controls – Part 2-7: Particular Requirements for Timers and Time Switches, is to be used in conjunction with the fifth edition of UL 60730-1. The requirements for timers and time switches are contained in this Part 2 Standard and UL 60730-1.

Requirements of this Part 2 Standard, where stated, amend the requirements of UL 60730-1.

Where a particular subclause of UL 60730-1 is not mentioned in UL 60730-2-7, the UL 60730-1 subclause applies.

Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-2-7, Automatic Electrical Controls – Part 2-7: Particular Requirements for Timers and Time Switches, copyright 2015, are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUTOMATIC ELECTRICAL CONTROLS – Part 2-7: Particular Requirements for Timers and Time Switches

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60730-2-7 has been prepared by IEC technical committee 72: Automatic electrical controls.

This third edition cancels and replaces the second edition published in 2008. This third edition constitutes a technical revision. This new edition revises the compliance criteria of type 1.S and 2.S action, revises the requirements for filament lamp loads, adds requirements for abnormal operation in Annex H, removes some special requirements for single countries as well as updates the standard to IEC 60730-1:2010, fourth edition.

This Part 2-7 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the fourth edition (2010) of that publication. IEC 60730-1 Ed. 5 is available, and this part 2-7 will be aligned with that edition in the future. Consideration may be given to future editions of, or amendments to, IEC 60730-1.

The title of IEC 60730-2-7 Ed.3 has been updated to the title of IEC 60730-1 Ed.5.0. However, IEC 60730-2-7 Ed. 3.0 has not been updated in accordance with the technical requirements in IEC 60730-1 Ed. 5.0.

This Part 2-7 supplements or modifies the corresponding clauses in IEC 60730-1 so as to convert that publication into the IEC standard: Particular requirements for timers and time switches.

Where this Part 2-7 states "addition", "modification" or "replacement", the relevant requirement, test specification or explanatory matter in Part 1 should be adapted accordingly.

Where no change is necessary, this Part 2-7 indicates that the relevant clause or subclause applies.

In the development of a fully international standard, it has been necessary to take into consideration the differing requirements resulting from practical experience in various parts of the world and to recognize the variation in national electrical systems and wiring rules.

The “in some countries” notes regarding differing national practice are contained in the following clauses and subclauses:

– 6.3.6.101

– Table 1, Notes 101 and 103

– 7.2.9

– 11.4.104

– 17.16.101.1

– 17.16.101.3

– 17.16.103.1

– Table 15, Notes 101 and 102

– Table 16, Notes 101 and 102

– 21.101

– Annex D

– H.26.11

In this publication:

1) The following print types are used:

– Requirements proper: in roman type.

– *Test specifications: in italic type.*

– Explanatory matter: in smaller roman type

2) Subclauses, notes, tables or figures which are additional to those in Part 1 are numbered starting from 101, additional annexes are lettered AA, BB, etc.

The text of this standard is based on the following documents:

CDV	Report on voting
72/926/CDV	72/959/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60730 series, under the general title: *Automatic electrical controls*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under □http://webstore. iec. ch□ in the data related to the specific publication. At this date, the publication will be

• reconfirmed,

• withdrawn,

• replaced by a revised edition, or

• amended.

A bilingual version of this publication may be issued at a later date.

101DV DE *Addition to the part 2:*

The numbering system in the Standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

102DV DE *Modification of the paragraph starting with, "In this publication"*

– words in SMALL ROMAN CAPITALS in the text are defined in clause 2.

103DV D2 *Modification of the of the 6th paragraph after item (9) by replacing it with the following paragraph:*

This Part 2-7 is intended to be used in conjunction with UL 60730-1, edition 5.

1.101DV DE *Addition of the following to the part 2:*

In IEC terminology, "safety" is defined as an acceptable level of risk. This is consistent with the intention of UL requirements to reduce the risk of fire, shock or injury to persons.

AUTOMATIC ELECTRICAL CONTROLS – Part 2-7: Particular requirements for timers and time switches

1 Scope and normative references

This clause of Part 1 is applicable except as follows:

1.1 *Replacement:*

In general, this part of IEC 60730 applies to timers and time switches that may use electricity, gas, oil, solid fuel, solar thermal energy, etc. or a combination thereof, including heating, air conditioning and similar applications.

This standard is also applicable to individual timers utilized as part of a control system or timers which are mechanically integral with multifunctional controls having non-electrical outputs. This standard does not apply to time-delay switches (TDS) within the scope of IEC 60669-2-3.

NOTE 1 Throughout this standard, the word “timers” means timers and time switches, unless the type is specifically mentioned.

NOTE 2 Devices which only indicate time or passage of time are not included.

NOTE 3 This standard does not apply to multi-functional controls having an integrated timing function which is not capable of being tested as a separate timing device.

1.1.1 *Replacement:*

This standard applies to the inherent safety, to the operating characteristics where such are associated with equipment protection and to the testing of timers used in appliances and other apparatus, electrical and non-electrical, for household and similar purposes, but also extended to industrial purposes when no dedicated product standards exist, such as that for central heating, air conditioning, process heating, etc.

Timers for equipment not intended for normal household use, but which nevertheless may be used by the public, such as equipment intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

This standard is also applicable to timers for appliances within the scope of IEC 60335-1.

1.1.2 *Replacement:*

This standard applies to manual controls when such are electrically and/or mechanically integral with timers.

1.4 *Replacement:*

This standard applies also to timers incorporating electronic devices, requirements for which are contained in Annex H.

This standard applies also to timers using NTC or PTC thermistors, requirements for which are contained in Part 1, Annex J.

1.5 Normative references

This subclause of Part 1 applies except as follows:

Addition:

IEC 60669-1:1998, *Switches for household and similar fixed-electrical installations – Part 1: General requirements*[1]
IEC 60669-1:1998/AMD1:1999
IEC 60669-1:1998/AMD2:2006

[1] There exists a consolidated edition 3.2 (2007) that includes IEC 60669-1:2008 and its Amendments 1 and 2.

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

2 Definitions

This clause of Part 1 is applicable except as follows:

2.3 Definitions relating to the function of controls

Additional definition:

2.3.101
TIMING CYCLE
program including all the switching activities involved in a start-to-finish operation of a controlled appliance

2.5 Definitions of types of control according to construction

Additional definitions:

2.5.101
PLUG-IN TIMER
timer or time switch designed for direct plug-in to a socket-outlet

Note 1 to entry: The plug-in timer is equipped with conductor blades, pins or other means, protruding from the enclosure of the control or the control body itself, to match the dimensional parameters of the socket-outlet to which the control will be connected.

2.5.102
TV TIMER
control for television equipment that can be set by the user, switching very high inrush currents of a very short duration generated by electrical power supply components and associated electronic component parts with various electrical characteristics

Note 1 to entry: Examples are power transformers, electronic tube filaments, large electric capacitors and others in television receivers, radio and video products.

2.5.103
SYNCHRONOUS TIMER
timer or a time switch in which the transmission is effected by a device that is time-based on the frequency of the power supply for the prime mover or the load

2.5.104

HAND-WOUND TIMER
timer or time switch in which the transmission is provided by actuation

2.1.101DV D2 *Addition to the Part 2:*

CURRENT INRUSH FACTOR
CURRENT INRUSH FACTOR denotes the number by which the normal (steady-state) peak current through a load is multiplied to obtain the peak value of the inrush current through the load.

Such as for TV, tungsten and PILOT DUTY loads.

3 General requirements

This clause of Part 1 is applicable.

4 General notes on tests

This clause of Part 1 is applicable.

4.3.2.101DV D2 *Addition to the part 2:*

A permanently connected TIMER that has been tested for an ampere or horsepower rating, or both, may have a tungsten-filament load rating, even though it has not been tested for a tungsten-filament lamp load rating, provided the tungsten-filament lamp load rating does not exceed one-tenth the value of the ampere rating or the full-load motor-running current, whichever is greater.

4.3.2.102DV D2 *Addition to the part 2:*

An in-line cord or plug-in TIME SWITCH that operates on and off a minimum of once in 24 h shall have a tungsten-filament lamp load rating.

5 Rating

This clause of Part 1 is applicable.

6 Classification

This clause of Part 1 is applicable except as follows:

6.3 According to their purpose

6.3.6 *Additional subclause:*

6.3.6.101 – TV timer;

NOTE In Canada and the USA, timers for use on televisions have to be declared and tested as indicated in this standard.

6.4 According to features of automatic action

6.4.3 *Additional subclauses:*

6.4.3.101 – a timing action which automatically resets upon loss of the electrical supply (Type 1.Q or 2.Q);

6.4.3.102 – a timing action which is interrupted upon loss of the electrical supply and resumes at the point of interruption upon restoration of the electrical supply (Type 1.R or 2.R);

6.4.3.103 – a timing action of a time switch which, after interruption of the electrical supply for any interval up to the declared period of power reserve, resumes its intended operating sequence as if no interruption of the supply has occurred (Type 1.S or 2.S);

6.4.3.104 – a timing action with a declared running accuracy in an ambient temperature of 20 °C to 25 °C (Type 1.T or 2.T);

6.4.3.105 – a timing action in which the difference between set time and actual switching time does not exceed the declared amount (Type 1.U or 2.U).

6.10 According to number of cycles of actuation (M) of each manual actuation

Additional subclauses:

6.10.101 – 500 cycles;

6.10.102 – 2 500 cycles;

6.10.103 – 5 000 cycles.

6.15 According to construction

Additional subclause:

6.15.101 – plug-in timer.

7 Information

This clause of Part 1 is applicable except as follows:

7.2 Methods of providing information

7.2.9 *Addition:*

NOTE In Germany, for Type 1.S or 2.S actions, the power reserve is to be marked on the timer by the letter "R", followed by the duration of the power reserve, followed by the symbol indicating the time unit as follows:

minutes min

hours h

days d

years a

Table 1

Modification:

Replace the lines corresponding to items 7, 26, 27 and 28 by the following:

	Information	Clause or subclause	Method
7	The type of load controlled by each circuit [7) 101)]	6.2 14 17	C
26	Number of cycles of actuation (M) for each manual action [102)]	6.10	X
27	Number of automatic cycles (A) for each automatic action [102)]	6.11	X
28	Ageing period (Y) for Type 1.M or 2.M action [102)]	6.16	X

Add the following additional items:

	Information	Clause or subclause	Method
10-1	TV timer [103)]	2.5.102	C
10-2	Power reserve duration	6.4.3.103	D
10-3	Running time for manually wound switches	11.4.103	D
10-4	Running accuracy and setting accuracy	6.4.3.104 6.4.3.105 11.4.104	X

Add the following additional notes:

[101)] In Canada and the USA, timers with a tungsten-filament lamp load rating or direct current as well as alternating current, in addition to the regular electrical information shall be marked to indicate the type of load, type of current and rated voltage.

The marking shall be "T" for controls used with direct as well as alternating current and "L" for controls used on alternating current only. The marking shall follow the unique type reference or the electrical rating of the control.

[102)] Values for in-line cord, free-standing and independently mounted controls are given in Annex AA (see also 17.1.3.101).

[103)] In Canada and the USA, a timer with a TV rating shall be marked with the manufacturer's name or trademark, load type designation and electrical rating. The marking shall consist of "TV" followed by the ampere rating. This rating shall follow any other electrical rating the control may have or can be a single, stand-alone marking if the control has no additional ratings

Table 1DV D2 *Replacement of Table 1 of the part 2:*

Table 1DV

Information	Clause or subclause	Method
Modification: ***Replace the lines corresponding to items 7, 26, 27 and 28 by the following:***		
7 The type of load controlled by each circuit[7), 101), 101A)]	**14, 17, 6.2**	**C**
26 Number of cycles of ACTUATION (M) for each MANUAL ACTION[102)]	**6.10**	**X**

Table 1DV Continued on Next Page

Table 1DV Continued

	Information	Clause or subclause	Method
27	Number of automatic cycles (A) for each AUTOMATIC ACTION[102)]	6.11	X
28	Ageing period (Y) for Type 1.M or 2.M action[102)]	6.16	X

Addition to note 7:

[7] "High inductive" or "H" if intended for the control of high inductive loads such as gas-tube-sign transformers, fluorescent lamp loads, and the like.

Additional notes:

[101A)] Unless an in-line or plug-in TIME SWITCH is acceptable for use with a full-load of tungsten-filament lamps, it shall be marked to indicate the maximum connected incandescent lamp load in watts. The value of lamp wattage is to be not less than that equivalent to one-tenth of the full-load rating.

[102A)] A switch is to be operated by means of its ACTUATING MEMBER either manually or by an acceptable machine for a minimum of 6 000 cycles unless a particular application requires a higher number of cycles to be declared.

Switch cycles for in-line cord, free-standing and INDEPENDENTLY MOUNTED CONTROLS, see Annex AA.

[103A)] Change "TV" to "TV-". Change "ampere" to "ampere rating expressed in an integer value". Example: TV-8/240.

8 Protection against electric shock

This clause of Part 1 is applicable.

9 Provision for protective earthing

This clause of Part 1 is applicable.

9.5.101DV D2 *Addition of 9.5.101DV.1 to 9.5.101DV.4 to the part 2:*

9.5.101DV.1 A permanently connected clock-operated switch or one with a polarized or grounded attachment plug shall not disconnect the grounded conductor of a circuit unless one of the following conditions occur:

a) The switch simultaneously disconnects all the conductors of the circuit, or

b) The switch is so arranged that the grounded conductor cannot be disconnected until all the ungrounded conductors of the circuit have been disconnected.

9.5.101DV.2 OPERATION of a permanently connected clock-operated switch, with a marked OFF POSITION that disconnects any conductor of an output circuit, shall disconnect all ungrounded conductors of the same circuit simultaneously.

9.5.101DV.3 A cord-connected switch that has a polarized or grounded attachment plug shall comply with 9.5.101DV.2.

9.5.101DV.4 In determining compliance with 9.5.101DV.2 and 9.5.101DV.3, overcurrent and other protective devices are considered to provide OPERATION. In addition, all poles of a multiple switching device are considered to operate simultaneously.

10 Terminals and terminations

This clause of Part 1 is applicable.

11 Constructional requirements

This clause of Part 1 is applicable except as follows:

11.4 Actions

Additional subclauses:

11.4.101 Type 1.Q or 2.Q action

A Type 1.Q or 2.Q action shall be so designed that it resets automatically upon loss of the electrical supply.

Compliance is checked by inspection and by test.

11.4.102 Type 1.R or 2.R action

A Type 1.R or 2.R action shall be so designed that it is interrupted upon loss of the electrical supply and resumes at the point of interruption upon restoration of the electrical supply.

Compliance is checked by inspection and by test.

11.4.103 Type 1.S or 2.S action

A Type 1.S or 2.S action shall be so designed that, after interruption of the electrical supply for any interval up to the declared period of power reserve, it resumes its intended operating sequence as if no interruption of the supply has occurred.

If the energy store is charged by the supply voltage, then compliance is checked by a functional test, carried out immediately after the operation of the timer switches into power reserve. The previous operation in power reserve shall be the declared period of power reserve. Charging is carried out at rated voltage for 48 h, if no other charging period is declared.

If the running reserve is provided by a primary battery, compliance shall be verified by calculation of the power reserve by means of the battery capacity and the measured discharge current.

11.4.104 Type 1.T or 2.T action

A Type 1.T or 2.T action shall be so designed that its running accuracy in an ambient temperature of 20 °C to 25 °C is as declared.

NOTE 1 In Germany, the running accuracy for time switches shall be within ±60 s per day. For the power reserve period of synchronous time switches (Type S.T), the running accuracy shall be within ±500 s per day.

NOTE 2 In Germany, the deviation from the calculated elapsed time shall be less than 30 min per year, relative to actual elapsed time under fluctuations of 0,85 times to 1,1 times rated voltage and ±2 % rated frequency.

Compliance is checked by inspection and by test.

11.4.105 Type 1.U or 2.U action

A Type 1.U or 2.U action shall be so designed that its setting means, dial assembly, indicating devices and switch operating means function so that the difference between set time and actual time shall not be more than the declared amount.

This deviation shall not be more than:

±1 min for time switches with "hour" dial;

±30 min for time switches with "24 hour" dial;

±3,5 h for time switches with "7 day" dial;

±14 h for time switches with "month" dial;

±7 days for time switches with "12 month" dial.

Compliance is checked only on time switches with hour, 24 hour and 7 day dial by three consecutive measurements.

11.9DV D2 *Modification to 11.9 of the UL part 1 by adding the following:*

11.9.DV.1 INDEPENDENTLY mounted

11.9.DV.1.1 The flexible cord is to be of jacketed construction not lighter than Type SJ; except that a device having a maximum rating of 2 000 VA, 1 hp, or 300 V, may be provided with a cord not lighter than Type SP-2.

11.9.DV.1.2 The flexible cord shall have a minimum length of 6 inch (152 mm) and shall not exceed 10 ft (3,05 m).

11.101DV D2 *Addition to the part 2:*

11.101DV.1 Plug-in devices

11.101DV.1.1 A clock-operated switch having attachment-plug blades for plug-in connection to a receptacle outlet rated 15 A, 125 V, and having the ANSI/NEMA WD6-1988 slot configuration shall have a mass of 28 oz (0.79 kg) or less. The moment, center of gravity, and dimensions shall not exceed the limits specified in 11.101DV.1.2.

11.101DV.1.2 The moment, center of gravity, and dimensions of a clock-operated switch, see Figure 11.101DV.1, shall comply with each of the following:

a) The quotient of WY/Z shall not exceed 48 oz (1.36 kg).

b) The quotient of WY/S shall not exceed 48 oz.

c) The product of WX shall not exceed 80 oz-inch (0.56 N·m).

d) The dimension Z_3 shall not exceed 3-1/4 inches (82.6 mm).

e) The dimensions S_1, S_2, Z_1, and Z_2 shall not exceed 5 inches (127 mm).

11.101DV.1.3 Definitions for the symbols used in 11.101DV.1.2 are as follows:

W is the weight of the switch in ounces (kg),

Y is in inches (mm),

Z is the smaller of Z_1 or Z_2 in inches (mm),

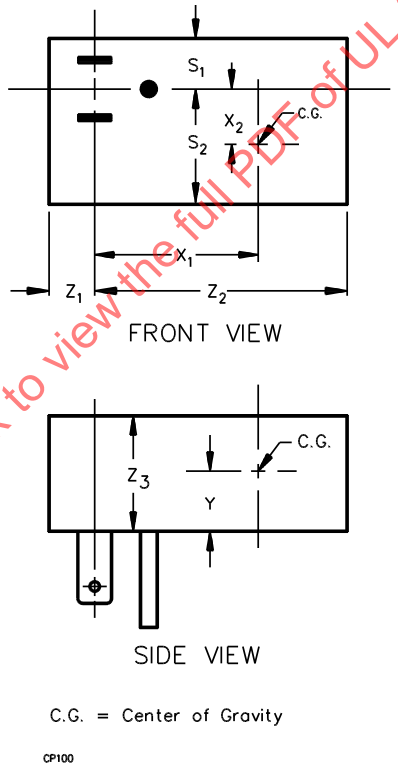
S is the smaller of S_1 or S_2 in inches (mm), and

X is the larger of X_1 or X_2 in inches (mm).

Figure 11.101DV.1 D2 *Addition:*

Figure 11.101DV.1

Plug-in device limits of dimensions



12 Moisture and dust resistance

This clause of Part 1 is applicable.

13 Electric strength and insulation resistance

This clause of Part 1 is applicable.

14 Heating

This clause of Part 1 is applicable.

15 Manufacturing deviation and drift

This clause of Part 1 is applicable.

16 Environmental stress

This clause of Part 1 is applicable.

17 Endurance

This clause of Part 1 is applicable except as follows:

17.1.3 Test sequence and conditions

17.1.3.3 *Addition:*

For manual actions which have been tested during the tests of 17.7 and 17.8, the number of cycles of actuation is reduced by the number of cycles carried out during those tests.

If a clutch is used during the tests of 17.10 to 17.13 inclusive, care should be taken to ensure that it does not fail due to the acceleration. If it fails or is considered liable to fail, the speeds of actuation shall be as specified, but rest periods shall be introduced between cycles to allow the heat dissipation which would occur during normal use.

Additional subclause:

17.1.3.101 At the end of each cycle, for timers only, an appropriate actuation shall be performed to initiate the next cycle.

If a timer or time switch has different programs, that program which utilizes the maximum number of contact operations shall be chosen, unless a timer with a special test program has been submitted by the manufacturer.

If the program does not cause all the contacts to be operated, the test shall be repeated on a new set or sets of samples operating on other programs to ensure that all contacts are tested. These extra samples need not be tested where the design is such that the results can be reasonably predicted from the result of the first set of samples, as could be done if the design of all contacts were identical.

If a timer with a special test program is used, it shall be so designed that it is possible, by carrying out the special program, to reasonably predict the test results for all specific application programs of the timer.

In-line cord, free-standing and independently mounted controls shall be tested as follows:

– For timers declared for resistive load, the number of cycles of contact operation for each contact of the time switch shall be A = 5 000.

The number of cycles of actuation (M) for each manual action of the time switch shall be M = 500 (inducing 500 cycles of contact operation).

– For timers declared for resistive or inductive load, the number of cycles of contact operation for each contact so rated shall be 5000, consisting of a first number of cycles *A* = 2500, to be tested with a substantially resistive load as specified in Tables 14, 15 or 16 followed by a second number of cycles, *A* = 2 500, which shall be conducted at the conditions specified in Tables 14, 15 or 16 for resistive or inductive load.

The number of cycles of actuation (*M*) for each manual action of these timers shall be *M* = 500 (inducing 500 cycles of contact operation, tested under resistive load conditions).

– If the timer requires an external electrical or mechanical signal to move it from a rest position this shall be simulated, if necessary in the manner declared by the manufacturer.

– For timers and time switches with Type 2 actions, any electrically driven prime mover shall for at least 50 % of the test, be connected to a supply of 0,9 V_R, all other loads and connections remaining as in 17.7.

– For timers and time switches with Type 1 actions, if there is any failure attributable to the acceleration (such as the excessive use of a clutch), then the test is held to be invalid and should be repeated in another manner.

17.2 Electrical conditions for the tests

Table 14 – Electrical conditions for the overvoltage test

Modification:

In the line "Declared specific load (classified 6.2.3)", in the column "Type of circuit as classified in 6.2", add a reference to note 101).

Additional footnote to Table 14:

[101)] For the tests of filament lamp load, the load and test of 18.2 of IEC 60669-1:1998, and for fluorescent lamp load, the load of 19.2 of IEC 60669-1:1998 and IEC 60669-1:1998/AMD2:2006, shall be used, under the conditions as specified in 17.6.

Table 15 – Electrical conditions for the overload tests of 17.7 and 17.10

Table 16 – Electrical conditions for the overload tests of 17.8, 17.9, 17.11, 17.12 and 17.13

Addition to the existing text of the notes to Tables 15 and 16:

For integrated and incorporated timers, except timers for filament lamp loads (17.16.101) with declared ratings of more than 10 A, the test current for a.c. circuits and d.c. circuits shall be 1,25 I_R or 1,25 I_x for substantially resistive and inductive (non-motor) type circuits, respectively.

The substantially resistive load may consist of any convenient combination of carbon-filament lamps or resistors or both that will cause the required current to flow through the test circuit with a power factor of 0,98 to 1,0 on a.c.

For a timer classified for substantially resistive load and tested under Tables 15 and 16, the tests of Table 16 may be waived for an additional motor load classification if I_R is not less than twice I_m. However, the tests under Table 15 for declared motor load shall be performed.

17.2DV D2 *Modification of 17.2.4 of the UL part 1 by adding the following:*

On d.c., the dead metal parts will be positive with respect to the nearest arcing point in the switch.

Additional subclause:

17.2.101 A two- or more pole timer shall be tested on a single-phase or d.c. circuit according to switch rating. In a more than two-pole timer intended to control a two-phase circuit, adjacent poles shall be used, one pole being that nearest metal that may be grounded in service. If the pole spacing varies, an additional test shall be made between the poles with the smallest spacing to cover use on two-phase interconnected systems.

17.15 Not applicable.

17.16 Test for particular purpose controls

Additional subclauses:

17.16.101 Filament lamp loads

17.16.101.1 Timers classified by the manufacturer under 6.2.3, declared specific load, for a halogen or tungsten-filament lamp load with a rating as declared according to Table 1, requirement 7, are subjected to the test tungsten-filament lamp test of 18.2 of IEC 60669-1:1998, with the number of contact cycles as declared by the manufacturer.

Alternatively, tungsten and halogen lamp load is possible. The operating cycle shall be such that the lamps are off for at least 55 s of each test cycle.

Timers classified for use with halogen or tungsten-filament lamp loads are tested at rated voltage and at no less than 1,2 times the rated current.

The test is carried out by using a number of halogen or tungsten-filament lamps. If such lamps with rated voltage equal to the rated voltage of the timer are not available, lamps with the nearest lower voltage can be used but should not be lower than 90 % of the rated voltage of the timer, if possible.

The test voltage shall be the rated voltage of the lamps.

The selection of the number of lamps shall be carried out giving a test current not less than 1,2 times the rated current of the timer. Number of lamps = test voltage x 1,2 x rated current / rated power of each lamp.

The operating cycle shall be such that the lamps are off for at least 55 s of each test cycle.

The number of operations shall be as declared.

The available short-circuit current of the supply shall be at least 1 500 A.

During the test, no sustained arcing shall occur at the contacts of the samples and after the test they shall show no damage which may impair their further use.

17.16.101.1.2 In Canada and the USA, halogen or tungsten-filament lamp load timers shall comply with the following requirements.

17.16.101.1.2.1 A timer with a halogen or tungsten-filament lamp rating shall be tested with a halogen or tungsten lamp load so adjusted that the normal current flow is the rated current of the timer. The test circuit, including the generator or other source of supply for testing a timer for a halogen or tungsten lamp rating shall have sufficient capacity to permit a current inrush through the timer and load as follows:

– for d.c. not less than 8 times the normal current, when the circuit is closed on a 20 A load.

– for a.c. not less than 10 times the normal current, when the circuit is closed on a 20 A load.

17.16.101.1.2.2 A halogen or tungsten-filament lamp and the supply circuit need not be sufficient to result in the inrush current required for a 20 A load if, when tested for a lower current rating, the available inrush current is adequate for the lower rating and testing is limited to the lower rating as a maximum.

17.16.101.1.2.3 With reference to the requirements in 17.16.101.2.1, the circuit shall be such that the peak value of the inrush current shall be reached within a quarter of a cycle of the rated frequency, after the circuit is closed.

17.16.101.1.2.4 The requirements for inductive (non-motor) circuits in Tables 15 and 16 also apply to tests for halogen or tungsten-filament lamp type circuit ratings.

17.16.101.1.2.5 If halogen or tungsten-filament lamps are used as the load for a switch designed for use with such lamps, the load shall be made up of the smallest possible number of lamps having standard ratings. In determining the smallest possible number of lamps necessary, the maximum lamp size required to be used is 500 W. Lamps of higher wattage may be used if desired. The operating cycle shall be such that the lamps are off for at least 55 s of each test cycle.

17.16.101.1.2.6 The suitability of a test circuit, including the generator or another source of supply, for testing with halogen or tungsten-filament lamps shall be determined by means of oscillograph studies. With reference to a rated frequency timing wave, the peak values of inrush current as shown by oscillograms shall be reached with one quarter of a cycle.

17.16.101.1.2.7 The characteristics of a d.c. test circuit shall be judged from a number of oscillograms (12 or more), and test equipment is acceptable if at least half the oscillograms show the minimum acceptable or a greater current inrush factor.

17.16.101.1.2.8 The characteristics of an a. c. test circuit shall also be judged from a number of oscillograms (12 or more). Those which indicate that the current is decreasing (that the part of the sine wave in question is approaching the 0 point) should be sufficient to show whether or not the capacity of the test circuit is adequate to produce the minimum acceptable current inrush factor based on observed peak values.

17.16.101.2 Fluorescent lamp loads

Timers classified by the manufacturer under 6.2.3 for fluorescent lamp loads with a rating as declared according to Table 1, requirement 7 are submitted to the fluorescent lamp test of 19.2 of IEC 60669-1:1998 and IEC 60669-1:1998/AMD2:2006, with the number of contact cycles as declared by the manufacturer.

17.16.101.3 At the request of the manufacturer, synthetic loads as described in 17.16.102 may be used.

17.16.102 Synthetic loads (alternative to 17.16.101)

17.16.102.1 A synthetic load used for testing shall be investigated as described in 17.16.102.2 to 17.16.102.5 inclusive.

17.16.102.2 The suitability of a test circuit (including the generator or other source of supply) for testing with a synthetic load shall be determined by means of oscillograph studies. With reference to a rated frequency timing wave, the peak values of inrush current as shown by oscillograms shall be reached with one quarter of a cycle.

17.16.102.2.1 The characteristics of a d.c. test circuit shall be judged from a number of oscillograms (12 or more), and test equipment is acceptable if at least half the oscillograms show the minimum acceptable or a greater current-inrush factor.

17.16.102.2.2 The characteristics of an a. c. test circuit shall also be judged from a number of oscillograms (12 or more). Those which indicate that the current is decreasing (that the part of the sine wave in question is approaching the 0 point) should be sufficient to show whether or not the capacity of the test circuit is adequate to produce the minimum acceptable current inrush factor based on observed peak values.

17.16.102.3 A synthetic load may consist of non-inductive resistors if they are connected and controlled so that a portion of the resistance is shunted during the closing of the circuit under test or if a portion of the load is cut out prior to opening the circuit. A synthetic load may also consist of a non-inductive resistor or resistors and a capacitor in parallel, in which case the load shall be calibrated immediately after the capacitor has been charged and discharged in the normal manner. A combination load consisting of tungsten-filament lamps and resistors and/or capacitors shall be considered as a synthetic load.

17.16.102.4 A synthetic load shall be calibrated against the intended load rating of the timer. The calibration of a synthetic load shall be checked at appropriate intervals to ensure that none of the constants of the circuit or load change with time or use.

17.16.102.5 The characteristics of a synthetic load shall be such that:

– for d.c. not less than 9 with a 15 A load, 10 with a 10 A load, and 11 with a 5 A load;

– for a.c. not less than 8 times the normal current, when the circuit is closed on a 20 A load.

In addition, the current in the capacitor/resistance load or the combination load mentioned in 17.16.102.3 shall be at least half the required inrush current at one cycle at rated frequency and no less than twice the steady-state current at 3,5 cycles at rated frequency after the circuit is closed. The current in a straight resistance load shall be the full inrush value for a minimum of 90 % of a cycle of the rated frequency after the switch is closed.

17.16.103 TV timers

17.16.103.1 In Canada and the USA, TV timers shall comply with the requirements of 17.16.103.1.1 to 17.16.103.1.5 inclusive.

17.16.103.1.1 A TV timer having more than one load pole shall be tested with each pole controlling a separate load, with opposite polarity between poles.

17.16.103.1.2 The tests indicated in Table 15 and Table 16 shall be conducted with the appropriate test current shown in Table 101 that is consistent with the switch rating or a load as described in 17.16.102.1 to 17.16.102.5 inclusive.

The preferred rate of OPERATION is 45°/s.

Table 101
Electrical conditions for overload and endurance testing

Electrical overload conditions for TV timers (a.c. circuits) for 17.2, 17.16.103.1.2, 17.7, 17.10, 17.12			Electrical conditions for TV timers (a.c. circuits) endurance testing	
Switch rating (A)	Minimum inrush current (peak) (A)	Steady-state current (r.m.s.) (A)	Steady-state current (r.m.s.) (A)	Minimum inrush current (peak) (A)
1	27	1,5	1	18
2	51	3,0	2	35
3	71	4,5	3	51
4	91	6,0	4	65
5	111	7,5	5	78
8	163	12,0	8	117
10	191	15,0	10	141
15	215	18,75	15	191
20	247	25,0	20	226

17.16.103.1.3 For tests described under Tables 15 and 16, the test circuit shall be in accordance with 17.16.101.2.3, 17.16.101.2.6 and 17.16.101.2.8 and the load shall be as described in 17.16.101.2.5.

17.16.103.1.4 A TV timer shall perform acceptably when subjected to the initial test of automatic action of 17.8 for 10 000 cycles by means of its actuating member, either manually or by a suitable machine, at a preferred rate of 45°/s, making and breaking its rated current. The rate of operation may be greater than 60°/s if agreed with the test authority.

The timer shall be electrically and mechanically operable at the conclusion of the test, at which time the control shall be capable of performing its normal function and shall show no wear, loosening of parts or defects of any other description which would diminish appreciably the usefulness and reliability of the timer.

17.16.103.1.5 The timer shall perform acceptably when subjected to an additional 15 000 cycles during the repeat test for automatic action of 17.2. At the conclusion of this test, the control shall be capable of making and breaking the test load.

17.101DV D2 *Addition of Clause 17.101DV, Electronic ballast loads as follows:*

17.101DV.1 A timer or time switch intended for use with electronic ballasts, self-ballasted LED and Compact Fluorescent Lamps, LED drivers and similar loads with capacitive load characteristics shall be tested in accordance with Table 17.101DV.1 – Table 17.101DV.3.

17.101DV.2 The synthetic load described in Figure 17.101DV.1 shall be used as the load for testing

17.101DV.3 The series coil values must be adjusted based on the input line characteristics to achieve the peak currents listed in Table 17.101DV.1 – Table 17.101DV.3. The series coil shall be sized such that it does not saturate during testing and shall be able to handle the resulting power dissipation with less than 10°C temperature rise. Peak current and pulse width are illustrated in Figure 17.101DV.2.

17.101DV.4 The circuit shall provide a method to discharge the capacitor bank in between test cycles without influencing the performance of the device under test. This is

accomplished by S2 and R2 in Figure 17.101DV.1. S2 should be switched alternately with S1 and R2 should be sized to allow for complete discharge of C during the period that S1 is open.

Table 17.101DV.1
Endurance Test – Peak Current Requirements for Timers and Time Switches – Rated 120 VAC

Steady state current (A), I_s	Peak current (A), 120 VAC	Pulse Width 120 VAC (mS)	I^2t (A2 sec) 120 VAC See Note 1
0.5	75	0.34	11
1	107	0.48	24
2	144	0.70	41
3	166	0.89	51
5	192	1.20	74
8	221	1.25	98
10	230	1.50	106
12	235	1.80	110
15	239	2.00	114
16	242	2.10	117
Note 1 – The values used to calculate I^2t are the peak current shown in the table above and pulse duration of 2 mS (t). Note 2 – Linear interpolation of test parameters for intermediate values of steady state currents is acceptable.			

Table 17.101DV.2
Endurance Test – Peak Current Requirements for Timers and Time Switches – Rated 277 VAC

Steady state current (A), I_s	Peak current (A), 277 VAC	Pulse Width 277 VAC (mS)	I^2t (A2 sec) 277 VAC See Note 1
0.5	77	0.07	11
1	131	0.71	27
2	205	0.85	76
3	258	0.98	111
5	320	1.20	205
8	370	1.25	274
10	430	1.50	370
12	440	1.80	387
15	458	2.00	420
16	480	2.10	461
Note 1 – The values used to calculate I^2t are the peak current shown in the table above and pulse duration of 2 mS (t). Note 2 – Linear interpolation of test parameters for intermediate values of steady state currents is acceptable			

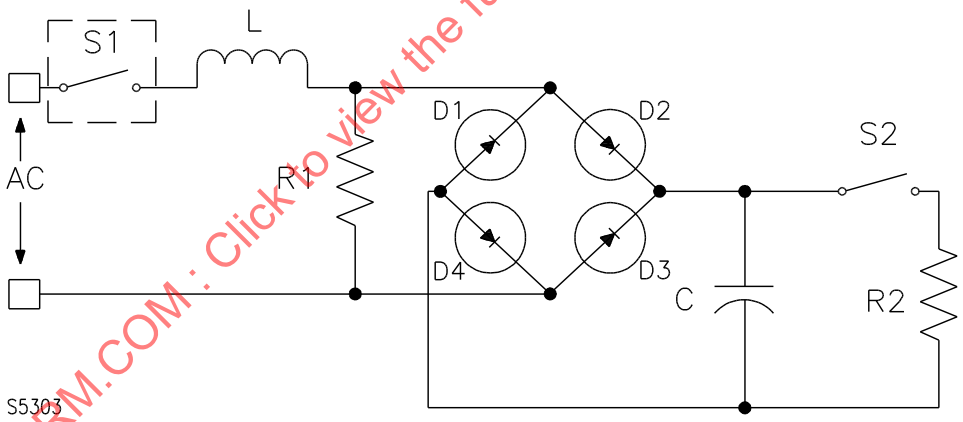
Table 17.101DV.3
Endurance Test – Peak Current Requirements for Timers and Time Switches – Rated 347 VAC

Steady state current (A), I_s	Peak current (A), 347 VAC	Pulse Width 347 VAC (mS)	I^2t (A2 sec) 347 VAC See Note 1
0.5	198	0.34	92
1	270	0.47	173
2	354	0.70	294
3	396	0.86	369
5	450	1.15	476
8	492	1.50	569
10	508	1.67	606
12	529	1.66	658
15	550	2.05	711
16	552	2.10	716

Note 1 – The values used to calculate I^2t are the peak current shown in the table above and pulse duration of 2.35 mS (t).

Note 2 – Linear interpolation of test parameters for intermediate values of steady state currents is acceptable

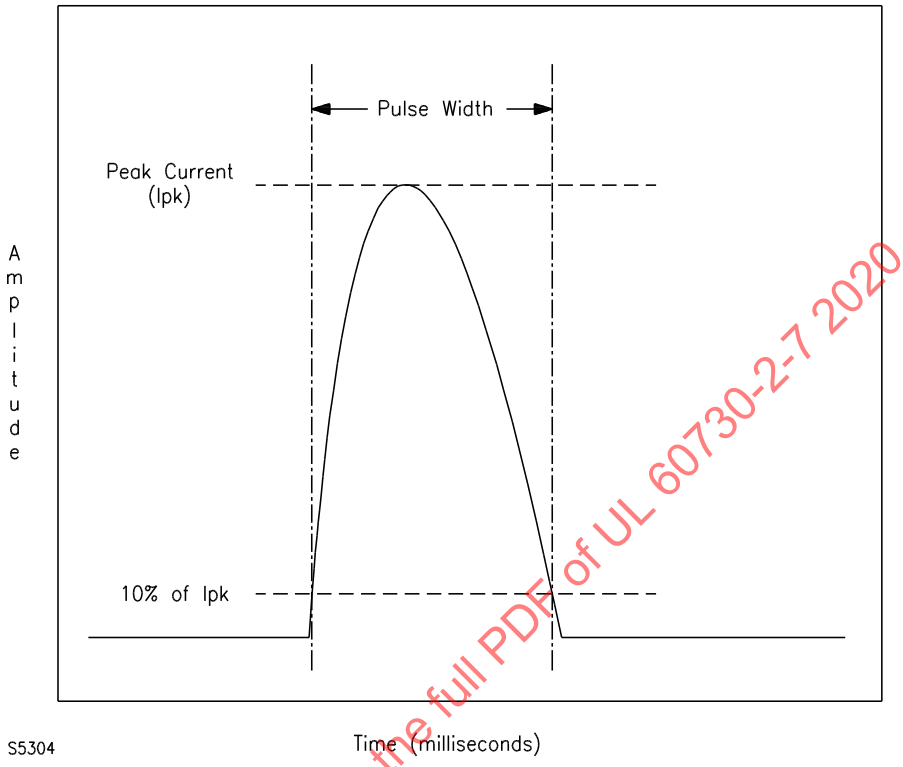
Figure 17.101DV.1
Typical test circuit diagram



Reference	Description
AC	Test voltage is either 277 Vac, 347 Vac, or 120 Vac
S1	Device Under Test
L	Series Inductor, its value of inductance (L) and resistance © are selected. When combined with the AC line source impedance it provides the specified Reference Waveforms
R1	AC synthetic load resistor, value to provide desired continuous current. (e.g., 5A, 8A... 16A)
D1 – D4	Bridge rectifier
C	Capacitor load bank, design value to provide 125 µF for each continuous amp of load current at a test voltage of 277 Vac or 347 Vac, and 175 µF for each continuous amp of load current at a test voltage of 120 Vac.
S2	Capacitor discharge switch
R2	Bleeder resistor, value to provide appropriate capacitor load bank discharge rate

Figure 17.101DV.2

Waveform per synthetic measurement of pulse width and peak current



18 Mechanical strength

This clause of Part 1 is applicable except as follows:

18.6.1 Not applicable to plug-in time switches.

18.9DV D2 *Deletion of 18.9 of the part 1:*

Delete 18.9.

19 Threaded parts and connections

This clause of Part 1 is applicable.

20 Creepage distances, clearances and distances through solid insulation

This clause of Part 1 is applicable.

21 Resistance to heat, fire and tracking

This clause of Part 1 is applicable except as follows:

21.2.4 *Addition:*

Other small parts (gears, cams, levers and the like) which are not in direct contact with live parts or current-carrying parts are not submitted to the glow-wire test.

Additional subclause:

21.101 In the USA, insulating material used on a TV timer as any part of the enclosure shall have a flammability classification of FV-0 as determined by IEC 60695-11-10 and shall comply with the requirements of Annex D of Part 1.

In addition, the proof tracking index (PTI) shall have a minimum performance level characteristic according to the TV timer voltage rating.

Other insulating materials used within the enclosure shall comply with the applicable requirements of Annex D of Part 1 based on its application. Wire leads, if provided with TV timers, shall be suitable for the purpose and have flame-resistant properties.

21.101DV D2 *Modification of 21.101 of the part 2 by adding the following:*

An actuator on a TV-TIMER made of an insulating material need not comply with the requirement in 21.101 if:

a) The area occupied by the actuator, where it passes through the plain of the enclosure plus the area of all other openings in the enclosure does not exceed 0,05 in^2 (32 mm^2), and

b) The actuator complies with the requirement in Annex D, FV-0 Flammability.

22 Resistance to corrosion

This clause of Part 1 is applicable.

23 Electromagnetic compatibility (EMC) requirements – emission

This clause of Part 1 is applicable.

24 Components

This clause of Part 1 is applicable.

25 Normal operation

This clause of Part 1 is applicable.

26 Electromagnetic compatibility (EMC) requirements – immunity

This clause of Part 1 is applicable.

27 Abnormal operation

This clause of Part 1 is applicable.

28 Guidance on the use of electronic disconnection

This clause of Part 1 is applicable.

FIGURES

The figures of Part 1 are applicable.