

# Transition to UL 60730: From UL 353 and UL 372 to IEC-Based Standards

2020-10-08

Presented by:  
Kent Nelson, UL Staff Engineer

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## Agenda

|          |                                                                      |          |                                     |
|----------|----------------------------------------------------------------------|----------|-------------------------------------|
| <b>1</b> | International Harmonization of Standards                             | <b>5</b> | Field Inspection of Safety Controls |
| <b>2</b> | Transition Timeline for Legacy Standards to IEC Harmonized Standards | <b>6</b> | Introduction to UL Product iQ       |
| <b>3</b> | Updates in Field Codes (e.g., CSD-1, NFPA 85 & 87)                   | <b>7</b> | Questions and Answers               |
| <b>4</b> | Differences between UL 353/372 and UL 60730                          |          |                                     |



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## Speaker

**Kent Nelson**  
Staff Engineer

**Background**

**Kent Nelson** is a Staff Engineer at UL Northbrook with over 13 years of experience in HVAC-R product safety certification. His diverse competencies in control and end product requirements bridge the gap between the component evaluations and their applications in the field.

As a member of the IEC Technical Committee 72 Working Group 1, he has participated in the development of combustion control requirements in IEC 60730-2-5. He serves as an Alternate on the ASME CSD-1 Standards Committee, and currently is a Regional Lead Reviewer for Combustion Controls in UL's HVAC-R, Controls, and Gas Appliances group.

**Kent Nelson**  
Staff Engineer

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## Relevance of Safety Standards

**Specific example – New York Telephone Company Boiler Explosion October 3<sup>rd</sup>, 1962.**

**... accidental grounding of control circuit may prove to be**

### N.Y. TELEPHONE CO BOILER EXPLOSION:

#### Control circuitry and safety devices get complete study

By J. J. O'CONNOR, Managing Editor  
JANUARY 1963

As this is written, more than two months since the October 3<sup>rd</sup> explosion of a boiler in the New York Telephone Co. building (Power Eng 1962, p 136) months of intense probing by many questions raised, the ones dealing with pressure switch to shut down the burner at least one interesting theory.

The pressure switch (a Bourdon-tube mercury-tube combination) did operate, according to some who examined the switch after the explosion. They base their thinking on the fact that the Bourdon tube was found overextended, on overpressure. The Bourdon tube had not ruptured "operate" position. But if the pressure switch tripped, why didn't the burner shut down?

There is a lingering question: why didn't the pressure-switch failure in the boiler Dept. in the past? The pressure-switch failure is traceable to human error—a mistake in connecting up a new automatic-sequencing device for the control of all three boilers.

Neutral grounding is generally regarded as a blessing since it effectively serves to keep transient overvoltages from getting out of bounds should one phase accidentally ground. Also, it offers a degree of general safety. The neutral grounded at the building's service entrance serves to hold line-to-ground voltage at 120—this was a 3-phase 4-wire supply with a 208-line-to-line voltage.

No neutral was carried into the controls since their normal operating voltage was 208. This meant the potential to ground from most control points was 208—phase voltage divided by square root of 2.

Installing an isolating transformer between the control circuitry and incoming supply will negate the effect of any accidental ground. Backup would be similar to that shown below for 120-voltage transformer with one secondary side grounded as used in the 208-v line. Live side of line would go through safety contacts while grounded side of transformer secondary goes to coils, relays.

**TWO ANSWERS TO GROUNDING**—as indicated by burner of a 120-v control circuit—use one being safe.

**Article Source:** Power Magazine, January 1963  
**Photo Source:** Nine Boiler Accidents, National Board Bulletin, Summer 2003

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## Revision to UL 353 and UL 372

Standard for Limit Controls (UL 353) and Primary Safety Controls (UL 372) updated to address this hazard.

Historically → UL wrote Standards.

Until recently → UL managed Standards Technical Panels to write Standards specific for the United States...

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>SEPTEMBER 23, 1984      LIMIT CONTROLS - UL 353      7</p> <p>[...]</p> <p><b>CONSTRUCTION</b></p> <p><b>4 General</b></p> <p>4.1 A component of a control shall comply with the requirements for that component, except that such requirements may be modified if appropriate for the particular application.</p> <p>4.2 A safety control incorporating a transformer, relay, or the like, shall be supplied by a circuit consisting of a two-wire, one-side grounded system having a voltage rating of not more than a nominal 120 volts. A switch or protective device shall be in the circuit electrically connected to the ungrounded supply conductor.</p> | <p>SEPTEMBER 1, 2000      PRIMARY SAFETY CONTROLS FOR GAS- AND OIL-FIRED APPLIANCES - UL 372      11</p> <p><b>CONSTRUCTION</b></p> <p><b>4 General</b></p> <p>4.1 The primary input circuit of a safety control shall be a two-wire, one-side-grounded system, having a voltage rating of not more than a nominal 120 volts. A switch or protective device shall be in the circuit electrically connected to the ungrounded supply conductor.</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



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## International Standard Development

Today → Standards are developed globally, where requested by the manufacturers (e.g., the burner standards are not being harmonized at this point (UL 295, UL 296, etc.), nor are the boiler standards (UL 834, ANSI Z21.13, etc.).

International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO) are independent, non-governmental organizations.

- Leading global organizations that prepare and publish international standards for electrical, electronic and related technologies
- Worldwide organization for standardization
- Objective is to promote international co-operation
- Members are National Committees
- Do not, themselves, provide attestation of conformity



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## IEC Technical Committees and Standards

### Relevant Committees:

- IEC Technical Committee 72 – Automatic Electrical Controls
  - ▶ **Working Group 1** – Burner controls and maintenance of 60730-2-5
    - 60730-2-5 (replaces UL 372, CSA C22.2 No. 199, and ANSI Z21.20)
  - ▶ **Working Group 6** – Temperature and pressure sensing controls
    - Includes 60730-2-6, -2-9, and -2-15 (replaces UL 353 and CSA C22.2 No. 24)
  - ▶ **Working Group 12** -- Electrical sensors
    - Developing new “Part 2” Standard which could be used for advanced sensors, e.g., O2 Sensors for Fuel/Air Ratio
  - ▶ **Working Group 13** – Expanded use of intelligence in products, and the linking of products by information technology & wireless solutions (“internet of things” (IoT))
    - Developing requirements for the “Internet of Things” (IoT)
    - Covers topics inclusive of Standards such as UL 5500 (Remote Software Download), UL 2900 (Cybersecurity), etc.
  - ▶ Burner and Boiler Control and Component Standards are harmonizing with IEC-Based Standards
  - ▶ End Product Standards (e.g., UL 295, UL 296, etc.) are not harmonizing with IEC-Based Standards and continue to develop the Legacy regional Standards



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## ISO Technical Committees and Standards

- ISO Technical Committee 161 – Controls and protective devices for gas and/or oil
  - ▶ ISO 23550:2018, Safety and control devices for gas and/or oil burners and appliances — General requirements (**typically covered in the US by UL 353 for electronic controls and/or ANSI Z21 Series for electronic, electromechanical, and mechanical controls**)
  - ▶ ISO 23551-1:2012 and ISO 23553-1:2014, Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 1: Automatic and semi-automatic valves (**currently covered in the US by, e.g., ANSI Z21.21**)
  - ▶ ISO 23551-6:2014, Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 6: Thermoelectric flame supervision controls (**Currently covered in the US by ANSI Z21.78 and UL 60730-2-5 Annex DVKK**)
  - ▶ ISO 23552-1:2007, Safety and control devices for gas and/or oil burners and gas and/or oil appliances — Particular requirements — Part 1: Fuel/air ratio controls, electronic type (**Currently required for Field Erected Boilers in Canada per B149.3-15, Cl. 5.4.3 and Annex D; typically covered in the US by UL 353**)



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## 120V Example - UL 372 vs. UL 60730-2-5

Today, the IEC prepares the requirements from a Global perspective (for the 60730 Series of Standards, it is with Technical Committee (TC) 72.

Each National Committee publishes a document for particular countries; for the US and Canada, this document is Bi-National.

UL publishes the US National Standard, CSA publishes the Canadian Standard, and both Harmonize together

SEPTEMBER 1, 2000 PRIMARY SAFETY CONTROLS FOR GAS- AND OIL-FIRED APPLIANCES - UL 372

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JANUARY 30, 2014

ANSI Z21.20:2014 • CAN/CSA-C22.2 NO. 60730-2-5-14 • UL 60730-2-5

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### CONSTRUCTION

#### 4 General

4.1 The primary input circuit of a safety control shall be a two-wire, one-side-grounded system, having a voltage rating of not more than a nominal 120 volts. A switch or protective device shall be in the circuit electrically connected to the ungrounded supply conductor.

[...]

#### 1 Scope and normative references

This clause of part 1 is applicable except as follows:

[...]

#### 1.2 Replacement:

This part 2-5 applies to systems with a rated voltage not exceeding 660 V and with a rated current not exceeding 63 A.

#### 1.2DV DR Modification of 1.2 by adding the following text:

The maximum control output voltage is 600 V. The maximum current is unlimited.

The primary input circuit of a system shall be a two-wire, one-side-grounded system, having a voltage rating of not more than a nominal 120 volts. A switch or protective device shall be in the circuit electrically connected to the ungrounded supply conductor.



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## Structure of Certifications

### BUILDING LEVEL

Regulations and Codes

e.g., International Building Code, ASHRAE 15, ASME, NFPA, etc.

Require that 'Listed and Labeled equipment' is used



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## Structure of Certifications

**END PRODUCT LEVEL**

Codes and Standards  
 e.g., ANSI Z21.13, UL 795,  
 ASME BPVC, ASME CSD-1

Require that 'Listed and Labeled equipment' is used; equipment which is Listed contains Recognized components







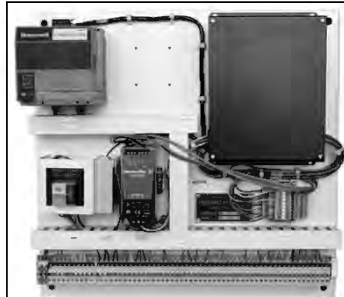
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## Structure of Certifications

**PANEL/COMPONENT LEVEL**

Safety Standards  
 e.g., UL 372, UL 353,  
 UL 60730 Series

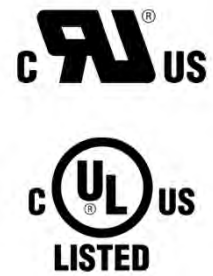
Require that 'Listed' or 'Recognized' components are used




MCCZ2 CONTROLS, PRIMARY SAFETY - COMPONENT

e.g., MCCZ2 Recognized /  
 MCCZ8 Canadian Recognized

e.g., MCCZ Listed / MCCZ7 Canadian Listed

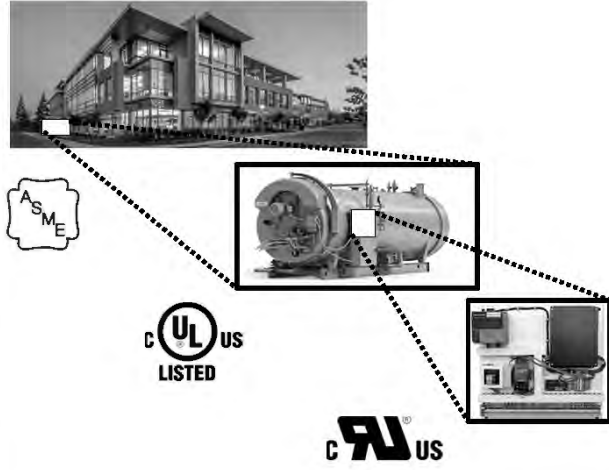




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## Structure of Certifications

- Overlap exists
- Boilers can be Listed Packages **or** Field Erected / Inspected
- Components within panel can be evaluated using field requirements **or** evaluated as part of Listed equipment
- Generally, what applies at the larger level can also be carried to the component level, but not the reverse
  - ▶ e.g., ASME stamped component *Can be inspected in the field*
  - ▶ e.g., Primary Safety Control **CANNOT** be evaluated only by the field



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## New Category “Burner Management Systems”

The new category enables complex systems containing Safety Controls like Primary Safety Controls, Temperature and Pressure Limiters, Fuel/Air Ratio Controls, and also non-safety Controls like PLCs, lead-lag sequencing, etc.

XAAF:GuideInfo - BURNER MANAGEMENT SYSTEMS

DETAILS

UL Category (CCN): XAAA/C

Document Type: Guide Info

Parent Category (CCN): XAAA/C

RESOURCES

- View UL Certified Products
- Guide Info (XAAA)

TAGS

Add Tag

[Automatic Electrical Controls for Household and Similar Use] Burner Management Systems

See General Information for Automatic Electrical Controls for Household and Similar Use.

**GENERAL**

This category covers burner management systems (BMS) intended for heating, air conditioning, ventilating, and similar applications. The equipment may use electricity, gas, oil, solid fuel, solar thermal energy, etc., or a combination thereof. They are intended for household, commercial or industrial applications (where no other standard covers the product) in accordance with ANSI/NFPA 70, "National Electrical Code" (NEC).

This category does not cover products intended exclusively for industrial process applications. Such products are investigated to ANSI/UL 61010-1, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements."

The BMS system typically consists of a base control unit and several peripheral devices or modules that may be connected individually or a combination thereof to form a system of components in a modular manner. The peripheral components/modules may be burner controls, flame sensors, temperature limit controls, fuel/air ratio controls, O<sub>2</sub>s, etc. The system is generally dry-rail mounted in an electrical panel complying with the appropriate requirements for installation and field wiring of the NEC.

The peripheral devices are individual controls utilized as part of a control system with or without non-electrical outputs or controls that are mechanically integrated with multifunctional controls having non-electrical outputs.

The BMS system is investigated to the inherent electrical safety and to the operating values, operating times and operating sequence where such are associated with equipment safety (functional safety).

Each module of the BMS may be individually investigated to the respective component standards as noted below or investigated as part of the overall system, if a particular component standard does not exist.

**Class 2 Output Circuits**

A Class 2 output circuit is a device that incorporates a Class 2 transformer or a Class 2 power source with provision for field wiring of the output circuit that is marked to permit wiring as specified in Article 725 of the NEC for the Class 2 circuit.

**Ratings**

These automatic electrical controls have a voltage rating not exceeding 600 V. The input, output, and other environmental ratings of each module and the system are based on the manufacturer's declarations and verified through testing. An input/output circuit that fulfills the requirements for both SELV and Limited-energy not exceeding 15 W is considered to address the risk of fire and electric shock. An input/output circuit is marked "Class 2" when the electrical characteristics of the circuit meet the requirements in Article 725 of the NEC, specifically Table 11(A) or 11(B) in Chapter 9, under normal and single-component fault operating condition.

**Classification per ANSI/UL 60730 Series of Standards**

Controls are classified based on their unique features, intended applications and environment, level of reliability, etc. These classifications are noted in ANSI/UL 60730-1, "Automatic Electrical Controls for Household and Similar Use - Part 1: General Requirements," and the respective Part 2 standards. Two of the more common classifications are:

**Type 1 action** — Automatic action for which the manufacturing deviation and the drift (calibration) of its operating value, operating time, or operating sequence have not been declared and tested under this standard.



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## Standards Chart

Table of Standards and Editions (last updated 2020-10)

| 60730                                                                                               |                     | Legacy |                   | Control Types        | Notes                                       |
|-----------------------------------------------------------------------------------------------------|---------------------|--------|-------------------|----------------------|---------------------------------------------|
| UL                                                                                                  | CSA                 | UL     | CSA               |                      |                                             |
| 60730-1, 5 <sup>th</sup> Ed.                                                                        | E60730-1:15+A1:2017 | n/a    | n/a               | General Requirements | Latest Edition                              |
| 60730-1, 4 <sup>th</sup> Ed.                                                                        | E60730-1:2013       |        |                   |                      | Previous Edition; used with -2-5            |
| UL 60730-2-5, 3 <sup>rd</sup> Ed.<br>ANSI Z21.20:2014 - C22.2 No. 60730-2-5-14, 1 <sup>st</sup> Ed. |                     | UL 372 | CSA C22.2 No. 199 | Oil/Gas Burner       | Used with 4 <sup>th</sup> Edition of Part 1 |
| 60730-2-6, 3 <sup>rd</sup> Ed.                                                                      | E60730-2-6:17       | UL 353 | CSA C22.2 No. 24  | Pressure             | Based on IEC 5.0 Edition of Part 1          |
| 60730-2-9, 4 <sup>th</sup> Ed.                                                                      | E60730-2-9:2018     |        |                   | Temperature          | Based on IEC 5.0 Edition of Part 1          |
| 60730-2-15, 2 <sup>nd</sup> Ed.                                                                     | E60730-2-15:2014    |        |                   | Water Level          | Based on IEC 3.2 Edition of Part 1          |
| 60730-2-15, 3 <sup>rd</sup> Ed.                                                                     | Not yet published   |        |                   |                      | Based on IEC 5.0 Edition of Part 1          |



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## Requirement Alignment

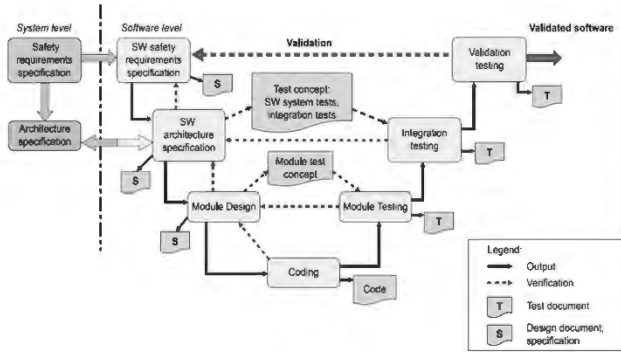
| Subject                       | UL 353 / 372                   | CSA C22.2 No. 24  | CSA C22.2 No. 199 | UL/CSA 60730-X                  |
|-------------------------------|--------------------------------|-------------------|-------------------|---------------------------------|
| Spacings                      | UL 840                         | CSA C22.2 No. 0.8 | TIL-H18A          | 20<br>(based on 60664)          |
| Safety Software               | UL 1998                        |                   |                   | H.11.12                         |
| Thermal Cycling               | 31C / 30C                      |                   |                   | H.17.1.4                        |
| Electromagnetic Compatibility | UL 991                         |                   |                   | H.26<br>(based on 61000 Series) |
| Component Faults              | 31A / 30A                      |                   |                   | H.27                            |
| Fire Hazard                   | NEC Class 2<br>3.6(b) / 3.9(b) | CEC Class 2       |                   | > 15W (H.27)                    |
| Shock Hazard                  |                                |                   |                   | > 30V (H.27)                    |



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## A Note on Safety Software

- Very similar concepts between UL 1998 and 60730 Series
- UL 60730 adds "informative" references to IEC 61508 e.g. V-Model



| UL 1998 Clause | Document Requirement                                                                                                       | IEC 60730-1 Clause  | Document Requirement                                             |
|----------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------|
| 3, 8.3, 12.3   | Risk Analysis Approach and Results                                                                                         | H.7, Table 1, 66    | Software sequence document                                       |
| 4, 12.2        | Software Development Plan                                                                                                  | H.7, Table 1, 68-72 | Software Fault Analysis (Risk Analysis)                          |
| 12.5           | System Architecture                                                                                                        | Figure H.1          | Software Development Life Cycle                                  |
| 12.6           | Programmable Component and Software Requirements Specification                                                             | H.11.12.3.2.1       | Software Safety Requirements Specification                       |
| 6, 7, 12.7     | Software Design                                                                                                            | H.11.12.3.2.2       | Software Architecture Specification                              |
| 11.1           | Software Design and Code Analysis                                                                                          | H.11.12.3.2.3       | Software Module Design Specification                             |
| 5              | Tool Documentation (V & V, Calibration, Bug List and Bug Fixes, or Third-Party Certification)                              | H.11.12.3.2.4       | Design and Coding Standards                                      |
| 13             | OTS Software Documentation (Description, Version, Usage, Interface; Verification & Validation, or Certification; Bug List) | H.11.12.3.3.1       | Software Module Testing                                          |
| 12.8           | Test Documentation (Test Plan, Test Methods, Test Procedures, and Test Results)                                            | H.11.12.3.3.2       | Software Integration Testing                                     |
| 11.2           | Software Development and Post-Release Tests                                                                                | H.11.12.3.3.3       | Software Validation Testing                                      |
| 11.3           | Operational Tests (Failure Mode and Stress)                                                                                | H.11.12.3.4.1       | Tools and Programming Languages                                  |
| 12.1           | User Documentation                                                                                                         | H.11.12.3.4.2       | Software Version Management (i.e. Configuration Management) Plan |
| 12.4           | Configuration Management Plan                                                                                              |                     |                                                                  |
| 14             | Software Change and Document Control                                                                                       | H.11.12.3.4.3       | Software Modification Plan                                       |
| 15             | Software Identification                                                                                                    |                     |                                                                  |

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**Transition  
Timeline for  
Legacy Standards  
to IEC Harmonized  
Standards**



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## Transition Timeline for Legacy Standards to IEC Harmonized Standards

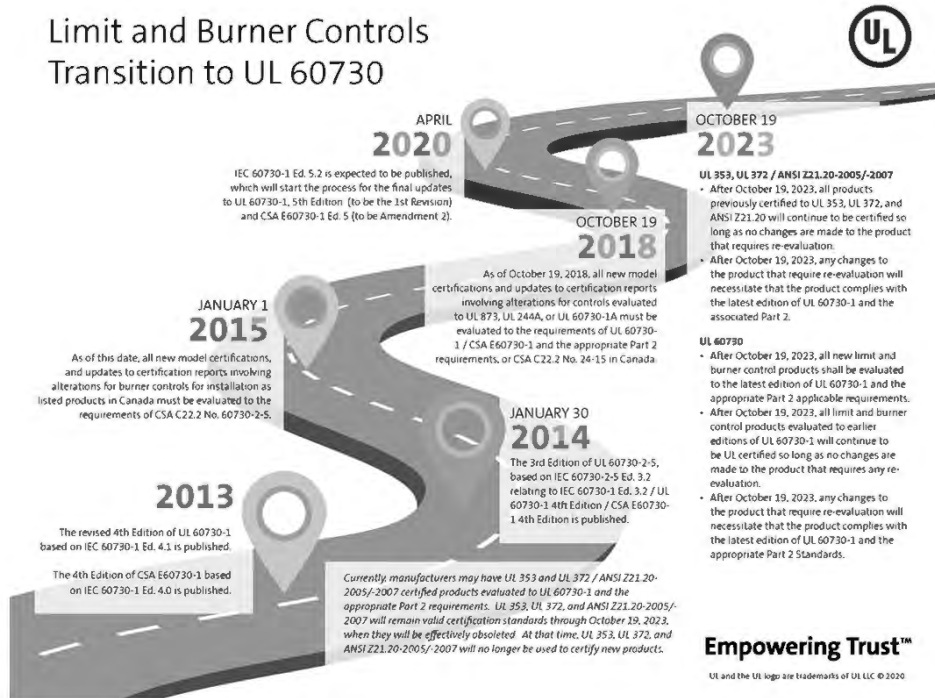
- For Product certified to US Standards (e.g., UL 353) or Bi-National US/Canadian Standards (e.g. UL 372/ANSI Z21.20/CSA C22.2 No. 199), certifications can continue to Legacy Standard until 2023-10-19.
- Products updated before the 2023-10-19 date can remain certified to Legacy Standard after this date (noted on Product iQ).
  - The Standard Technical Panel (STP) voted that the change in requirements does not warrant existing products certified to the previous requirements to be recertified to the recently adopted requirements. Manufacturers have the option of continuing their certifications to the standard in effect at the time of the original certification if no changes requiring a certification decision are made to the product after the Effective Date.*
- Unlisted Components may be certified to Legacy standards after this date, if permitted by the End Product Standard.
- For Product certified to Canadian Standards (e.g., CSA C22.2 No. 24), as of today they must be evaluated to the latest published Standard (either CSA C22.2 No. 24-15 or CSA E60730-1:15 and the relevant Part 2 (as of April 2018)).
- Documented on <http://ifr.ul.com/>

| Bulletin/Letter Date | TITLE                                                               |
|----------------------|---------------------------------------------------------------------|
| 03/28/2019           | UL 1995 (UL60335-2-40) Change of Effective Date to January 1, 2024  |
| 03/26/2019           | UL 62275 Effective Date Extension to 2019-11-30                     |
| 02/18/2019           | 1995 Proposed Effective Date Change                                 |
| 02/04/2019           | UL 218 Effective Date change to 2019-09-01                          |
| 01/22/2019           | UL 508 Certification Requirement Changes Announcement               |
| 12/21/2018           | UL 218 Extension Proposal                                           |
| 07/16/2018           | Subject 2251 Proposal to change Effective Date to November 20, 2022 |
| 04/25/2018           | Industry File Review FAQs                                           |
| 04/23/2018           | Transition of UL 353                                                |



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## Limit and Burner Controls Transition to UL 60730



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## Proposal for Updates to CSD-1 for Transition

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>CW-110 General Requirements for Water Level Controls for All Boilers</b></p> <p><i>(a)</i> Each low-water fuel cutoff or combined feeder/cutoff device shall be a safety control which conforms to UL 353 and/or UL 60730-2-15 and shall be accepted by a nationally recognized testing agency.</p> <p><b>CW-210 Requirements for Flow or Temperature Sensing Devices for Forced Circulation Boilers</b></p> <p>In lieu of the requirements for low-water fuel cutoffs in CW-100, a boiler requiring forced circulation to prevent overheating and failure of the heat exchanger (tubes, coils, etc.) shall have one or more of the following means to protect the boiler unit against overheating at all allowable firing rates:</p> <p><i>(a)</i> a flow sensing device labeled and listed by a recognized testing agency as a safety control complying with the requirements of UL 353 and/or UL 60730-2-15 as a protective control. This safety control shall be independent of any other operating controls and may be automatically reset when adequate flow is restored.</p> | <p><b>CW-310 Requirements for Pressure Controls for Steam Boilers</b></p> <p><i>(a)</i> Each boiler pressure control shall conform to UL 353, Standard for Limit Controls and/or UL 60730-2-6 as a protective control, and shall be accepted by a nationally recognized testing agency.</p> <p><b>CW-410 Requirements for Temperature Controls for Hot-Water Boilers</b></p> <p><i>(a)</i> Each automatically fired hot-water boiler or each system of commonly connected hot-water boilers shall have at least two temperature-control devices that conform to UL 353 and/or UL 60730-2-9 as a protective control and shall be labeled and listed by a nationally recognized testing agency. This requirement does not preclude the use of additional temperature control devices that are not labeled and listed to UL 353 and/or UL 60730-2-9 as a protective control.</p> | <p><b>CW-710 Requirements for Vacuum Boilers</b></p> <p>Vacuum boilers complying with ASME Boiler and Pressure Vessel Code, Section IV, Mandatory Appendix 5 shall be permitted to have the safety limit controls meeting the requirements identified in (a), (b), (c), and (d) in lieu of all other requirements in Part CW.</p> <p><i>(a)</i> Each boiler pressure control shall conform with UL 353 and/or UL 60730-2-6 as a protective control and each boiler temperature control shall conform to UL 353, Standard for Limit Controls and/or UL 60730-2-9 as a protective control, and shall be accepted by a nationally recognized testing agency.</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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## Recent Updates to NFPA 85

- From, 'Origin and Development of NFPA 85:'
  - ▶ *The 2015 edition recognized the use of safety-rated programmable logic controllers for use with single burner boilers where they are certified as at least **SIL 3 capable according to IEC 61508, Functional Safety of Electrical/Electronic Programmable Electronic Safety-Related Systems.***
- Controls developed to IEC 61508 are **not acceptable for Listed Burners and Boilers** unless also certified to UL 372 or UL 60730-2-5
- Approach between the Standards is essentially different
  - ▶ UL 372 / 60730-2-5: **Deterministic** Functional Safety
  - ▶ IEC 61508: **Probabilistic** Functional Safety



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## Requirements in NFPA 87

- Similar statement to NPFA 85, except allowing the lower SIL 2 capability

### 8.3\* Burner Management System Logic.

#### 8.3.1 General.

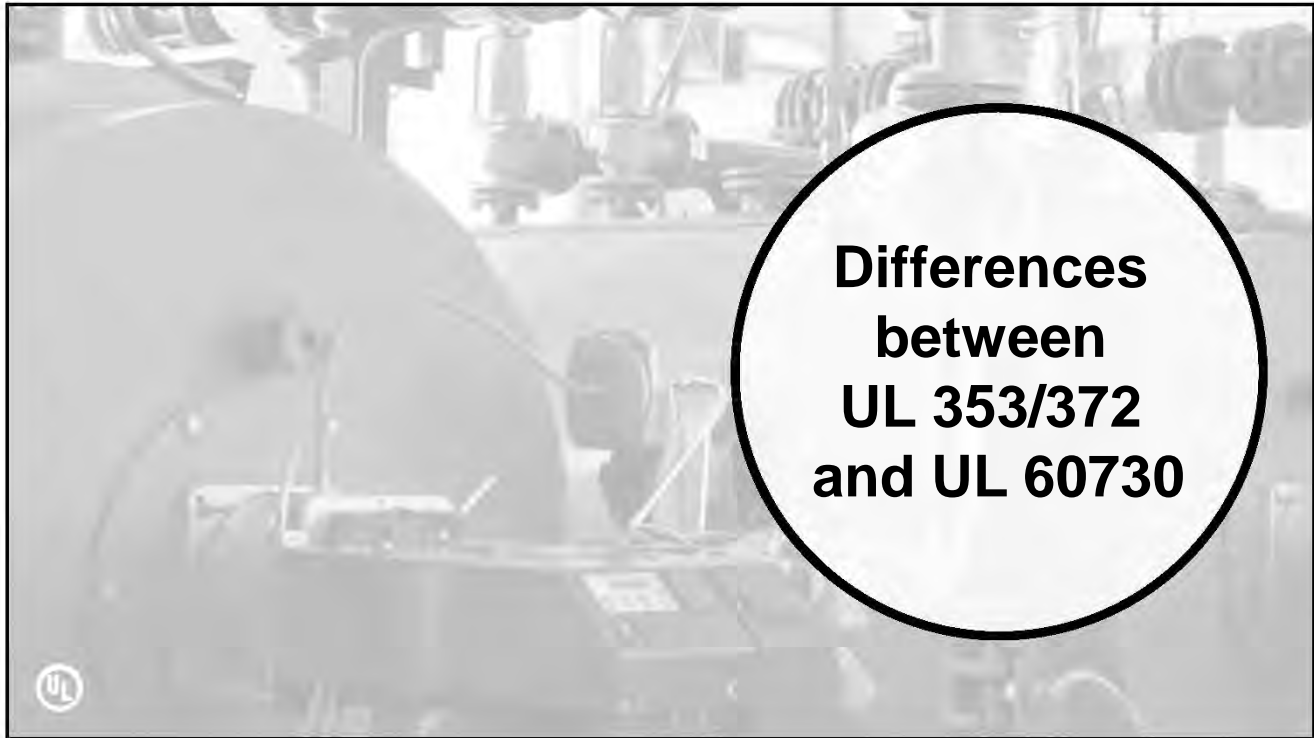
8.3.1.1 Purge, ignition trials, and other burner safety sequencing shall be performed using either devices listed for such service or programmable controllers used in accordance with Section 8.4.

Δ 8.4.2\* Where PLCs are not listed for combustion safety service or as a combustion safeguard, the PLC and its associated input and output (I/O) used to perform safety functions shall be as follows:

- (1) Third-party certified to IEC 61508, *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems*, safety integrity level (SIL) 2 or greater
- (2) Applied to achieve at least a SIL 2 capability per the manufacturer's safety manual



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### Differences between UL 353/372 and UL 60730

**Spacings**

- Functional/Operational (FI)
- Basic/(Supplementary) (BI)
- Reinforced/(Double) (RI)

**Different Extra Low Voltage Concepts**

- SELV – Safety/Separated Extra Low Voltage
- PELV – Protected Extra Low Voltage
- Functional Earth (ISO 60417:5018) (FE)
- Protective Earth (ISO 60417-5019) (PE)

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## Differences between UL 353/372 and UL 60730

### Relay Requirements

- Require 'disconnection type:'
  - ▶ Full Disconnection (e.g., for cases of "Marked Off" position)  
(Basic Insulation Spacing and Electric Strength)
  - ▶ Micro Disconnection (Electric Strength)
  - ▶ Micro Interruption (No Added Quantitative Criteria)



### Extra Low Voltage Power Supply Changes (15W vs. Class 2)

- Legacy → "NEC Class 2"
- Modern → 15W Power Limit / 30V Voltage Limit



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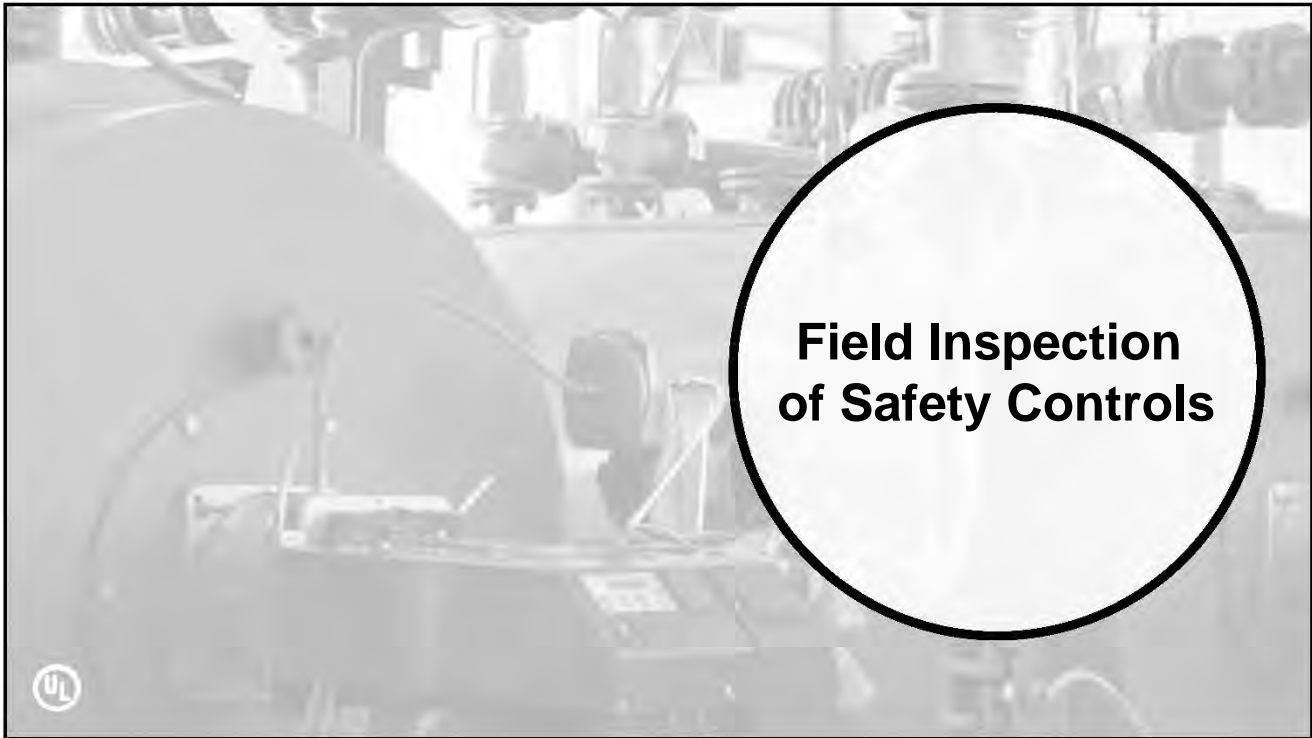
## Transition to the Future State of Controls

### Transition from separate Functional Safety Standards to embedded requirements in the IEC-based Standards:

- UL 1998 – Standard for Safety for Software in Programmable Components
    - ▶ Replaced by UL 60730 Clause H.11.12
  - UL 991 – Standard For Safety For Tests for Safety-Related Controls Employing Solid-State Devices
    - ▶ Replaced by UL 60730 such as Clauses H.17.1.4.2 (Thermal Cycling), H.26 (EMC Tests), H.27 (FMEA), etc.
- New Requirements must consider the 'Internet of Things;' Smart Controls; Data Security; etc.
- IEC 61508 – Functional Safety
    - ▶ Probabilistic Analysis as compared to Deterministic Functional Safety Analysis of 60730, 1998, 991, etc.
  - UL 2900 – Standards for Software Cybersecurity
  - UL 5500 – Standard for Safety for Remote Software Updates
    - ▶ Also represented by UL 60730 Clause H.11.12.4



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### Inspecting Controls in the Field

New Category for **Burner Management Systems**  
(Category Code XAAF)

'Four Elements' to the 'Traditional' UL Listing Mark

Note: First characters of File Number Indicate Certification Type, e.g.:

- MH = Miscellaneous Hazard
- MP = Miscellaneous Petroleum
- E = Electrical
- SA = Safety Appliance

UL in a Circle

The word 'Listed'

Product Category

File / Control Number

C **UL** US

**LISTED**

**BURNER**

**MANAGEMENT SYSTEM**

**MHxxxxx**

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## Inspecting Controls in the Field

'Enhanced' UL Certification Mark has a new format

Allows integration of QR Code to directly link to Product iQ Web Page

Customers can build marks at: <https://markshub.ul.com/>



### ADD A MARK

The Enhanced UL Certification Mark has been created to deliver greater transparency and efficiency in the market today.

Promotes multiple-market acceptance and faster deployment  
Allows for bundling of current and future Certifications

ADD A MARK



### ADD A BADGE

The UL Certification Badge communicates product compliance for buyer confidence at point-of-sale or in marketing materials.

Optimized for online, advertising and packaging materials  
Provides flexibility in packaging placement and design options

ADD A BADGE



### MAKE SMART

Advance your UL Certification Marks and Badges with the addition of a unique product Web page for audiences activated through a QR code.

Automatically generates a Web page as part of the build process  
Provides mobile, in-market access to compliance information

MAKE SMART



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## New: Product iQ

- Replaces “Online Certification Directory”
- Requires Login
- Significantly more powerful and easier to use
- As always, available at the bottom of the [UL.com](http://UL.com) homepage



UL Product iQ™ Features

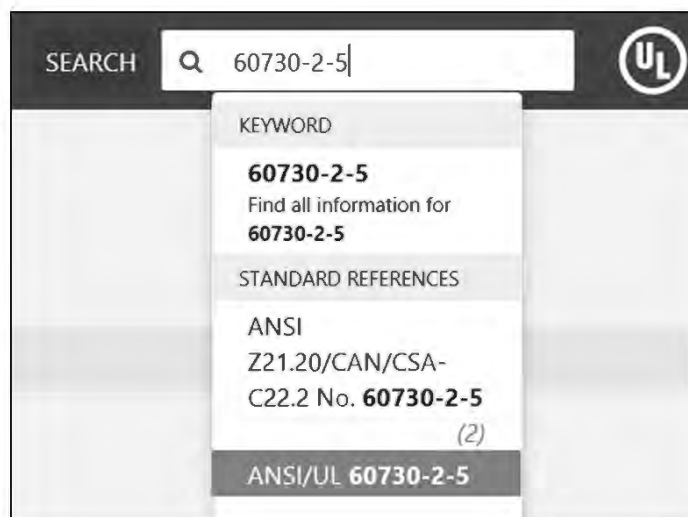
### Featured tools



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## Product iQ Searching

Can search directly by product Standard, e.g. “60730-2-5:”



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## Product iQ Searching

This exposes all Category Code Numbers (CCNs) which contain this in the Guide Information:

The screenshot shows a search interface with the following components:

- REFINE RESULTS**: Build or filter your results by keyword and/or adding criteria like document type, file number and country name.
- Keyword**: Filter by Keyword (empty) with a Search button.
- Standard References**: A list containing 'ANS/UL 60730-2-5'.
- Add Filter**: A section with Cancel, Reset, and Save Search buttons.
- Results**: 6 Results :: Standard References: ANS/UL 60730-2-5. Display: General, Rows: 15.
- Table of Results**:
 

| Document Name    | Company Name | UL CCN Description                                                  |
|------------------|--------------|---------------------------------------------------------------------|
| JHYR.GuidelInfo  |              | GAS APPLIANCE ACCESSORIES                                           |
| JHYR2.GuidelInfo |              | GAS APPLIANCE ACCESSORIES - COMPONENT                               |
| LZZG2.GuidelInfo |              | CONTROLS, PRIMARY SAFETY FOR USE IN HAZARDOUS LOCATIONS - COMPONENT |
| MCCZ.GuidelInfo  |              | CONTROLS, PRIMARY SAFETY                                            |
| MCCZ2.GuidelInfo |              | CONTROLS, PRIMARY SAFETY - COMPONENT                                |
| XAAF.GuidelInfo  |              | BURNER MANAGEMENT SYSTEMS                                           |



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## Protective vs. Operating; Type 1 vs. Type 2

*Legacy* → Limiting controls are 'safety'  
Regulating or Ancillary/Auxiliary Controls are 'non-safety'

*Modern* → Type 2, Protective Controls are 'safety'  
Type 2, Operating Controls are 'safety'  
Type 1, Protective Controls do not exist (all are safety by definition)  
Type 1, Operating Controls are 'non-safety'

### 60730

2.2.19 OPERATING CONTROL: CONTROL which starts or regulates the equipment during normal OPERATION

2.2.20 PROTECTIVE CONTROL: CONTROL, the OPERATION of which is intended to prevent a hazardous situation during abnormal OPERATION of the equipment  
[...]

2.6.1 TYPE 1 ACTION: AUTOMATIC ACTION for which the MANUFACTURING DEVIATION and the DRIFT of its OPERATING VALUE, OPERATING TIME OF OPERATING SEQUENCE have not been declared and tested under this standard

A TYPE 1 ACTION is subclassified as specified in 6.4.

2.6.2 TYPE 2 ACTION: AUTOMATIC CONTROL for which the MANUFACTURING DEVIATION and the DRIFT of its OPERATING VALUE, OPERATING TIME OF OPERATING SEQUENCE have been declared and tested under this standard

A TYPE 2 ACTION is subclassified as specified in 6.4.



### CSD-1

#### CG-700 DEFINITIONS

*control*: a device designated to regulate the fuel, air, water, steam, or electrical supply to the controlled equipment. It may be automatic, semiautomatic, or manual.

*control, operating*: an automatic control, other than a safety control, to start or regulate input according to demand and to stop or regulate input on satisfaction of demand.

*control, primary safety*: a control directly responsive to flame properties, sensing the presence of flame and, in event of ignition failure or loss of flame, causing safety shutdown.

*control, safety (also known as limit)*: a control responsive to changes in liquid level, pressure, or temperature and set beyond the operating range to prevent the operation beyond designed limits.

*control, protective*: a safety control investigated to 60730 Standards as a Protective (Type 2 Action) Control with Class C Safety Function.

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## Applying Types to Inspection: Example

**BURNER CONTROL COMPANY**  
123 Main Street  
Anytown, USA

MH00000

| Model                                                      | Control Function Class | Operating Ambient, °C | Optional or Required | Notes |
|------------------------------------------------------------|------------------------|-----------------------|----------------------|-------|
| <b>Burner Management System, Model XYZ, consisting of:</b> |                        |                       |                      |       |
| XYZ, Master Control Component with or without:             | C                      | -30 to +70            | Required             | (1)   |
| XYZ1, Flame Scanner or                                     | C                      | -20 to +60            | Optional             | (2)   |
| XYZ2, Flame Detector                                       | C                      | -20 to +60            | Optional             | (2)   |
| XYZ3, Actuator Module                                      | C                      | 30 to +70             | Optional             | (1)   |
| XYZ4, Input / Output Module                                | C                      | 30 to +70             | Optional             | (1)   |
| XYZ5, User Interface                                       | A                      | 30 to +70             | Optional             | (1)   |
| XYZ6, Flue Gas Analyzer                                    | A                      | -20 to +60            | Optional             | (3)   |
| XYZ7, Actuator                                             | C                      | -30 to +60            | Optional             | (4)   |

Notes: Standards used for Certification:

(1) -UL 60730-1 Ed. 4 dated 2014-05-21, CAN/CSA E60730-1 Ed. 4 dated 2013-03-01, UL 60730-2-5 Ed. 3 dated 2014-01-30, CAN/CSA-C22.2 No. 60730-2-5 Ed. 1 dated 2014-01-30, ANSI Z21.20 Ed. 1 dated 2014-01-30

(2) -UL 372, 5th Ed., Dated 2000-09-01.

(3) -UL 353, 5th Ed., Dated 2001-04-30.



### SUMMARY:

Class A is non-safety (ancillary control)  
Class B includes some safety  
Class C is safety (2<sup>nd</sup> order fault tolerant)

UL 372/UL 353 may be prescribed by an End Product Standard; suitability varies by usage.

Various jurisdictions may adopt different codes e.g., in Canada C22.1-2015 **requires** 60730-2-5

*Canadian Electrical Code, Part I*

### **Appendix A — Safety standards for electrical equipment, Canadian Electrical Code, Part II**

Notes:  
(1) This Appendix is a normative (mandatory) part of this Standard.

ANSI Z21.20-2014/CAN/CSA-C22.2 No. 60730-2-5-14

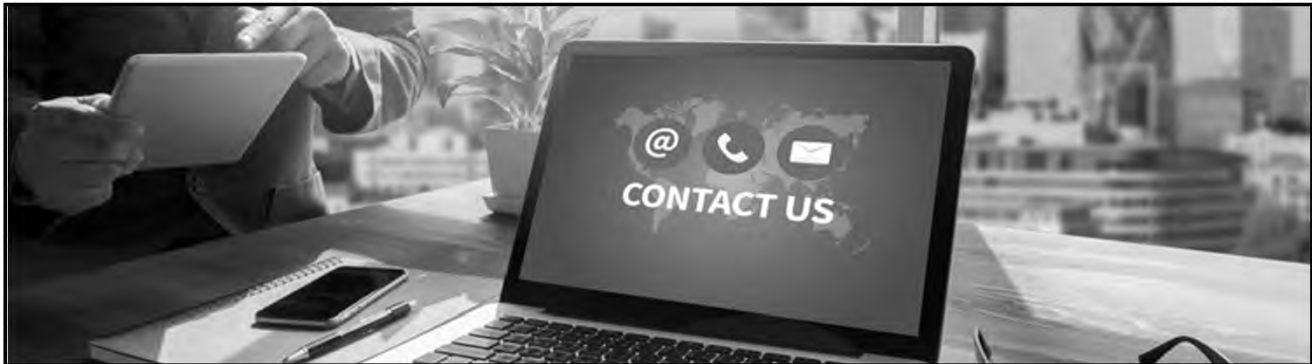
Automatic Electrical Controls for Household and Similar Use — Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems

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## Questions?

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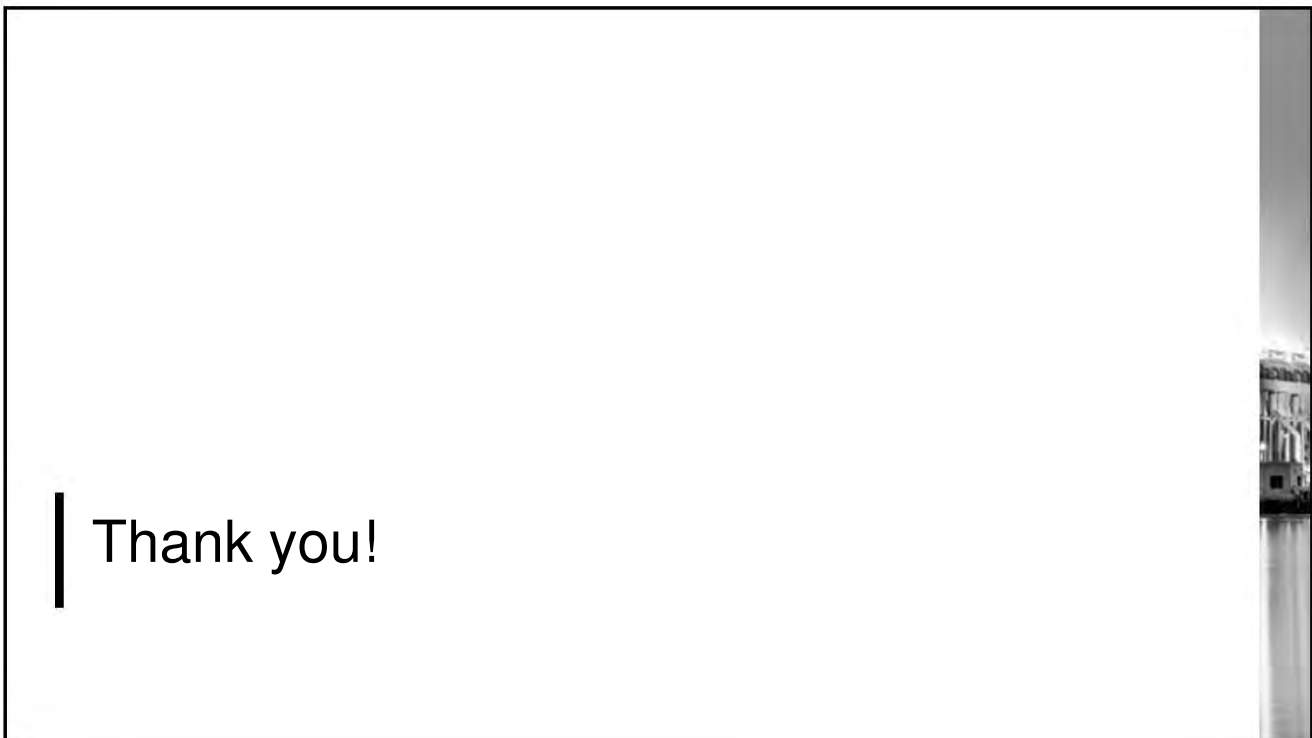
For more information regarding:  
**Transition to UL 60730: From UL 353 and UL 372 to IEC-Based Standards**

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Thank you!

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