

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Electrical resistance trace heating systems for industrial and commercial applications –  
Part 2: Application guide for system design, installation and maintenance**

**IEC 62395-2:2013**  
**Systemes de traçage par résistance électrique pour applications industrielles et  
commerciales –  
Partie 2: Guide d'application pour la conception, l'installation et la maintenance  
du système**



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3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Electrical resistance trace heating systems for industrial and commercial applications –  
Part 2: Application guide for system design, installation and maintenance**

**Systèmes de traçage par résistance électrique pour applications industrielles et commerciales –  
Partie 2: Guide d'application pour la conception, l'installation et la maintenance du système**

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## CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references .....	11
3 Terms and definitions .....	11
4 Surface heating of vessels and piping systems.....	11
4.1 Application description .....	11
4.1.1 General .....	11
4.1.2 Environmental conditions.....	11
4.1.3 Trace heating systems considerations .....	12
4.2 Design information – General .....	12
4.2.1 General .....	12
4.2.2 Electrical system design .....	12
4.2.3 Control and monitoring .....	12
4.2.4 Trace heating system design .....	13
4.2.5 Design information documentation.....	13
4.3 Thermal system design.....	14
4.3.1 General .....	14
4.3.2 Design conditions .....	14
4.3.3 Thermal insulation.....	15
4.3.4 Heat loss determination .....	19
4.3.5 Design safety factor .....	20
4.3.6 Heat-up considerations.....	20
4.3.7 Selection of trace heater.....	21
4.3.8 Design calculations.....	23
4.3.9 Theoretical sheath temperature calculations – Metallic pipe applications .....	24
4.3.10 Theoretical sheath temperature calculations – Non-metallic pipe applications .....	25
4.3.11 Design documentation .....	26
4.3.12 Start-up at low ambient temperatures .....	26
4.3.13 Long trace heater circuits .....	27
4.3.14 Chimney effect .....	27
4.4 Electrical design.....	27
4.5 Control and monitoring system design .....	27
4.5.1 General .....	27
4.5.2 Mechanical controllers .....	28
4.5.3 Electronic controllers .....	28
4.5.4 Application suitability.....	28
4.5.5 Location of controllers .....	29
4.5.6 Location of sensors .....	29
4.5.7 Alarm considerations .....	30
4.5.8 Integrated control .....	31
4.5.9 Flow pattern analysis.....	31
4.5.10 Dead-leg control technique.....	33
4.6 Special design considerations .....	33
4.6.1 General .....	33

4.6.2	Freeze protection systems	33
4.6.3	Sprinkler systems, fire suppression	33
4.6.4	Hot water services/tempered water	35
4.6.5	Safety shower design requirements	36
4.6.6	Specialty lines	36
4.7	Installation	38
4.7.1	General	38
4.7.2	Personnel aspects	38
4.7.3	Preparatory work	38
4.7.4	Preliminary installation of trace heating circuits	39
4.7.5	Insulation resistance test	39
4.7.6	Installation of trace heater systems	39
4.7.7	Installation of control and monitoring equipment	42
4.7.8	Necessary modifications	43
4.7.9	Installation of the thermal insulation system	43
4.7.10	Installation of electrical power	44
4.7.11	Commissioning	45
4.8	Maintenance	46
4.8.1	General	46
4.8.2	Training of maintenance personnel	46
4.8.3	Frequency of inspection	46
4.8.4	Maintenance program documentation	46
4.8.5	Visual evaluation	47
4.8.6	Electrical evaluation	47
4.8.7	Review of the electrical protection system	47
4.9	Repair	48
4.9.1	General	48
4.9.2	Fault location	48
4.9.3	Practicability of repair to electric trace heaters	48
4.9.4	Repair techniques for electrical trace heaters	49
5	Roof and gutter de-icing	49
5.1	Application description	49
5.2	Design information – General	50
5.3	Thermal design	51
5.4	Electrical design	51
5.5	Control and monitoring system design	51
5.6	Special design considerations	51
5.7	Installation	51
5.7.1	General	51
5.7.2	Trace heaters and component mounting	52
5.8	Maintenance	55
5.9	Repair	55
6	Rail heating	55
6.1	Application description	55
6.1.1	General	55
6.1.2	Switch point heating	56
6.1.3	Contact/live rail heating	56
6.1.4	Track heating	56
6.1.5	Catenary/pantograph shoe heating	56

6.2	Design information .....	57
6.2.1	General .....	57
6.2.2	Weather data .....	57
6.2.3	Rail system description .....	57
6.2.4	System design .....	57
6.3	Thermal design .....	57
6.3.1	Heating load determination .....	57
6.3.2	Typical heating load .....	58
6.4	Electrical design .....	58
6.5	Control and monitoring system design .....	58
6.6	Special design considerations .....	58
6.6.1	Electrical considerations .....	58
6.6.2	Finite element analysis .....	59
6.7	Installation .....	59
6.7.1	General .....	59
6.7.2	Point heating .....	60
6.7.3	Swing nose crossing .....	60
6.7.4	Clamp lock heating .....	61
6.7.5	Contact/live rail heating and track heating .....	61
6.7.6	Catenary/pantograph shoe heating .....	62
6.8	Maintenance .....	62
6.9	Repair .....	62
7	Snow melting .....	62
7.1	Application description .....	62
7.2	Design information .....	63
7.2.1	General .....	63
7.2.2	Weather data .....	63
7.2.3	Construction details of workpiece .....	63
7.2.4	Electrical considerations .....	63
7.2.5	System performance level .....	63
7.2.6	Trace heater layout and component mounting .....	64
7.3	Thermal design – Power output (heat load) determination .....	68
7.4	Electrical design .....	68
7.5	Control and monitoring system design .....	68
7.6	Special design considerations .....	68
7.7	Installation .....	69
7.8	Maintenance .....	69
7.9	Repair .....	70
8	Floor warming .....	70
8.1	Application description .....	70
8.2	Design information .....	70
8.2.1	General .....	70
8.2.2	Environmental data .....	70
8.2.3	Construction details of workpiece .....	70
8.2.4	Electrical considerations .....	70
8.2.5	Trace heater layout and component mounting .....	71
8.3	Thermal design – Heat load determination .....	72
8.4	Electrical design .....	73
8.5	Control and monitoring system design .....	73

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8.6	Special design consideration .....	73
8.7	Installation.....	74
8.8	Maintenance.....	74
8.9	Repair .....	74
9	Frost heave prevention .....	74
9.1	Application description .....	74
9.2	Design information .....	75
9.2.1	General .....	75
9.2.2	Construction details of the floor .....	75
9.2.3	Electrical considerations.....	75
9.3	Heat load determination .....	75
9.3.1	General .....	75
9.3.2	Trace heater layout and component mounting.....	77
9.4	Electrical design.....	77
9.5	Control and monitoring system design .....	77
9.5.1	Control options .....	77
9.5.2	Monitoring .....	77
9.6	Special design considerations .....	77
9.7	Installation.....	78
9.8	Maintenance.....	78
9.9	Repair .....	78
10	Underground thermal energy storage systems .....	78
10.1	Application description .....	78
10.2	Design information .....	79
10.2.1	General .....	79
10.2.2	Environmental data .....	79
10.2.3	Construction details of building .....	79
10.2.4	Electrical considerations.....	79
10.2.5	Trace heater layout and component mounting.....	79
10.3	Thermal design – Heat-loss determination.....	80
10.4	Electrical design.....	80
10.5	Control and monitoring system design .....	81
10.6	Special design considerations when trace heaters are located in sand layer.....	81
10.7	Installation.....	81
10.7.1	General .....	81
10.7.2	Installation in sand .....	81
10.7.3	Installation in concrete.....	81
10.8	Maintenance.....	82
10.9	Repair .....	82
Annex A (informative)	Pre-installation checks .....	83
Annex B (informative)	Trace heater commissioning record .....	84
Annex C (informative)	Maintenance schedule and log record .....	85
Bibliography.....		86
Figure 1 – Thermal insulation – Weather-barrier installation.....		17
Figure 2 – Typical temperature profile.....		18
Figure 3 – Equilibrium conditions for workpiece maintenance.....		22
Figure 4 – Equilibrium conditions for upper limit evaluation.....		23

Figure 5 – Heated tank example .....	32
Figure 6 – Bypass example.....	32
Figure 7 – Fire sprinkler sprig: tapered thermal insulation .....	35
Figure 8 – Double containment system .....	37
Figure 9 – Gravity flow piping systems.....	38
Figure 10 – Ice dam formation .....	50
Figure 11 – Downspout to underground drain.....	50
Figure 12 – Roof and gutter trace heater arrangement.....	52
Figure 13 – Gutter detail .....	53
Figure 14 – Typical roof mounting methods.....	54
Figure 15 – Drain detail for flat roof .....	55
Figure 16 – Typical positioning of point trace heater on stock rail and switch rail .....	60
Figure 17 – Typical positioning of trace heater on swing nose crossing.....	60
Figure 18 – Typical clamp lock trace heater .....	61
Figure 19 – Typical positioning of trace heater on steel and aluminium clad contact rails .....	61
Figure 20 – Typical positioning of trace heater in pantograph shoe .....	62
Figure 21 – Snow melting trace heater embedded in concrete .....	65
Figure 22 – Snow melting trace heater located in conduit.....	66
Figure 23 – Expansion joint detail.....	67
Figure 24 – Snow melting junction box location.....	67
Figure 25 – Typical floor warming trace heater mounting .....	72
Figure 26 – Typical floor heating power requirements.....	73
Figure 27 – Typical frost heave prevention substructure .....	75
Figure 28 – Frost heave prevention power requirements.....	76
Figure 29 – Typical underground thermal energy storage system installation .....	80
Table 1 – Application types.....	13
Table 2 – Recommendations for monitoring and control – Type II and III control.....	29
Table 3 – Recommendations for hot water services and tempered water temperatures .....	35
Table 4 – Typical snow melting heat loads .....	64

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**ELECTRICAL RESISTANCE TRACE HEATING SYSTEMS  
FOR INDUSTRIAL AND COMMERCIAL APPLICATIONS –****Part 2: Application guide for system design,  
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International Standard IEC 62395-2 has been prepared by IEC technical committee 27: Industrial electroheating and electromagnetic processing.

This standard cancels and replaces IEC/TS 62395-2:2008.

This standard includes the following significant technical changes with respect to IEC/TS 62395-2:2008:

- This document has been changed from a Technical Specification to an International Standard.
- Design considerations for trace heating on sprinkler systems have been expanded and a figure has been added to illustrate how to avoid undue shadowing of spray patterns from insulated sprigs close to sprinkler heads;

- Specific details of design considerations for trace heating for emergency eyewash units and safety showers have been added.

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

FDIS	Report on voting
27/927/FDIS	27/936/RVD

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 in the IEC 62395 series, under the general title *Electrical resistance trace heating systems for industrial and commercial applications*, can be found on the IEC website.

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## INTRODUCTION

IEC 62395-1 provides the essential requirements and testing appropriate to electrical resistance trace heating equipment used in industrial and commercial applications. While some of this work already exists in national or international standards, this standard has collated much of this existing work and added considerably to it.

IEC 62395-2 provides detailed recommendations for the system design, installation, maintenance and repair of electrical resistance trace heating systems in industrial and commercial applications which can include piping, vessels, roofs and concrete slab heating applications.

It is the objective of IEC 62395 that, when in normal use, electrical trace heating systems operate safely under their defined conditions of use, by

- a) employing heaters of the appropriate construction so as to meet the test criteria and requirements detailed in IEC 62395-1. The construction includes a metallic sheath, braid, screen or equivalent electrically conductive covering;
- b) operating at safe temperatures when designed, installed, and maintained in accordance with IEC 62395-2;
- c) having at least the minimum levels of overcurrent and earth-fault protection required in IEC 62395-1 and IEC 62395-2.

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# ELECTRICAL RESISTANCE TRACE HEATING SYSTEMS FOR INDUSTRIAL AND COMMERCIAL APPLICATIONS —

## Part 2: Application guide for system design, installation and maintenance

### 1 Scope

This part of IEC 62395 provides detailed recommendations for the system design, installation, maintenance and repair of electrical resistance trace heating systems in industrial and commercial applications. This standard does not include or provide for any applications in potentially explosive atmospheres.

This standard pertains to trace heating systems that may comprise either factory fabricated or field-assembled (work-site) units, and which may be series or parallel trace heaters, or surface heaters (heater pads or heater panels) that have been assembled and/or terminated in accordance with the manufacturer's instructions.

The products covered by this standard are intended to be installed by persons who are suitably trained in the techniques required and that only trained personnel carry out especially critical work, such as the installation of connections and terminations. Installations are intended to be carried out under the supervision of a qualified person who has undergone supplementary training in electric trace heating systems.

This standard does not cover induction, impedance or skin effect heating.

Trace heating systems can be grouped into different types of installations. These are characterized by different requirements for testing and are usually certified for a specific type of installation or application. Typical applications for the different types of installation are as follows:

- a) Installations of trace heating on pipes, vessels and associated equipment. Applications include:
  - freeze protection and temperature maintenance;
  - hot water lines;
  - oil and chemical lines;
  - sprinkler systems.
- b) Outdoor exposed area installations of trace heating. Applications include:
  - roof de-icing;
  - gutter and downspout de-icing;
  - catch basins and drains;
  - rail heating.
- c) Installation with embedded trace heating. Applications include:
  - snow melting;
  - floor warming;
  - frost heave prevention;
  - underground thermal energy storage systems;
  - door frames.

d) Installations of trace heating internal to conduit or piping. Applications include:

- snow melting – in conduit;
- floor warming – in conduit;
- frost heave prevention – in conduit;
- underground thermal energy storage systems – in conduit;
- internal trace heating of potable water lines;
- enclosed drains and culverts.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60519-1, *Safety in electroheating installations – Part 1: General requirements*

IEC 62395-1:2013, *Electrical resistance trace heating systems for industrial and commercial applications – Part 1: General and testing requirements*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60519-1 and IEC 62395-1:2013 apply.

NOTE General definitions are given in the International Electrotechnical Vocabulary, IEC 60050. Terms relating to industrial electroheat are defined in IEC 60050-841.

## 4 Surface heating of vessels and piping systems

### 4.1 Application description

#### 4.1.1 General

Piping and vessels often utilise surface-mounted trace heating systems to maintain water above freezing-point and to maintain process fluids and gases at given temperature levels. The trace heaters compensate for heat losses to the environment that are reduced but not eliminated by thermal insulation.

#### 4.1.2 Environmental conditions

Attention should be directed to the surrounding environmental conditions, especially for systems that are exposed to sunlight (ultraviolet exposure), coastal atmospheres (corrosive salt spray and high humidity), and chemical atmospheres such as oil refineries and chemical plants.

Equipment subject to ultraviolet exposure may degrade due to surface oxidation, which can possibly lead to surface embrittlement and cracking. Corrosive atmospheres can affect the same exposed surfaces and can accelerate degradation of surfaces that are also susceptible to ultraviolet exposure. Chemical exposure can affect all equipment, whether covered by thermal insulation or not.

The trace heating equipment for piping and vessels is often protected from corrosion and ultraviolet exposure to some degree by the thermal insulation. However, these systems can have components that are exposed to the environment such as electrical connection

components and weather barrier around the thermal insulation. The selection of trace heating equipment shall include a review of the suitability of equipment to the expected environmental conditions.

#### **4.1.3 Trace heating systems considerations**

Trace heating systems can range from simple pipe freeze protection in commercial buildings to process temperature maintenance and heat-up applications in large complex piping/vessel systems in industrial facilities. The details required for design can vary based on the complexity of the application. Control systems and requirements for monitoring can also vary depending on the control and design requirements.

Trace heating equipment should be chosen that is suitable for the application. For example, plastic piping has a much lower maximum exposure temperature than metallic piping. The trace heating and control system shall keep the piping temperature within the allowed range.

Higher temperature processes shall utilize trace heating and thermal insulation equipment that are suitable for the maximum exposure temperatures.

### **4.2 Design information – General**

#### **4.2.1 General**

The requirements for system design include the development of basic heat loss (load) requirements, installation instructions for electrical, control and monitoring requirements, and trace heating system layouts for large, detailed, complex installations such as industrial facilities. While each design component requires individual treatment, the final system shall be evaluated as an integration of these component parts.

Trace heating system design shall conform to all IEC requirements for the use of electrical equipment and to the requirements of this standard. Consideration should be given to the maintenance of the trace heating systems to maintain energy efficiency and to routine testing of the installed systems for safe and proper operation.

Persons involved in the design and planning of electric trace heating systems should be suitably trained in all techniques required.

#### **4.2.2 Electrical system design**

The evaluation of electrical resistance heating systems includes an initial assessment of energy requirements and the associated electrical distribution equipment. The selection of the type of trace heating equipment and the control equipment affects the requirements of the electrical system design. Additional information is given in 4.4.

#### **4.2.3 Control and monitoring**

##### **4.2.3.1 General**

Controls for trace heating systems are often specified to reduce total energy usage and/or to maintain particular processes within a narrow band. Monitoring systems are used to verify correct system operation and in many cases to provide an indication of electrical problems or temperatures that are out of range. Subclause 4.2.3.2 describes the basic types of controls and monitoring and 4.2.3.3 defines critical applications relative to the control systems. Specific design of control systems is given in 4.5.

##### **4.2.3.2 Recommendations for control**

The recommendations for control and monitoring are defined by the type of application.

a) Type I

A Type I control is for applications where the temperature is maintained above a minimum point. Large blocks of power may be controlled by means of a single control device, such as ambient sensing, and an electrical distribution panel board. Heat input may be provided unnecessarily at times and wide temperature excursions should be tolerable. Energy efficiency may be improved through the use of dead-leg control techniques (see 4.5.10).

b) Type II

A Type II control is for applications where the temperature should be maintained within a moderate band. Control by pipe-sensing mechanical thermostats is typical.

c) Type III

A Type III control is for applications where the temperature should be controlled within a narrow band. Electronic pipe-sensing controllers using thermocouple or resistance-temperature detector (RTD) units facilitate field (work site) calibration and provide maximum flexibility in the selection of temperature alarm and monitoring functions. Heat input capability may be provided to preheat an empty pipe or raise the fluid temperature, or both, within a specified range and time interval. Type III systems require strict adherence to flow patterns and thermal insulation systems.

#### 4.2.3.3 Control and monitoring for critical applications

If failure of any part of the trace heating system can result in a safety or operability problem, then the trace heating system may be considered to be critical to the application. The temperature control and circuit monitoring requirements of an application may be defined according to the temperature control types described in 4.2.3.2, together with the control level as described in Table 1.

**Table 1 – Application types**

Is trace heating a critical component for the application?	Desired accuracy of temperature control		
	Above a minimum point Type I	Within a moderate band Type II	Within a narrow band Type III
Yes = Critical (C–)	C – I	C – II	C – III
No = Non-critical (NC–)	NC – I	NC – II	NC – III

When trace heating is critical to the application, circuit monitoring for correct operation, malfunction alarms, and back-up (redundant) trace heaters should be considered. Redundant trace heaters may allow maintenance or repairs to be performed without a process shutdown and may be used to enhance reliability. Redundant controllers can be specified to be automatically activated in the event of a fault being indicated by the monitoring/alarm system.

#### 4.2.4 Trace heating system design

Trace heaters should be selected to provide sufficient power for

- a) compensation of heat loss when maintaining a specified temperature of an application, see the calculation method in 4.3.4; and/or
- b) raising the temperature of a workpiece and its contents when specified, within a specified time period, see the calculation method in 4.3.6.

The evaluation should provide an electrical system with sufficient capacity to deliver the required power at the specified minimum ambient temperature. The system heat requirements should be multiplied by a safety factor as determined on the basis of 4.3.5. Additional specific design recommendations are described in 4.6.

#### 4.2.5 Design information documentation

Design information may be compiled and provided in the form of specifications, layouts, and other system documentation and drawings. Any or all of the following may be applicable: