ExTAG/326/Inf
July 2014

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) SYSTEM FOR CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR USE IN EXPLOSIVE ATMOSPHERES (IECEx SYSTEM)

Title: ExTAG Industry Discussion Request – Application of IEC 60079-0 Ed 6 2011 Section 16.6 "Selection of suitable cable"

Circulation: ExTAG Members

INTRODUCTION

The following Industry discussion request item, concerning, *Application of IEC 60079-0 Ed 6 2011 Section 16.6"Selection of suitable cable"* has been requested by, Thermal Electric Elements Pty Ltd, and is for discussion during the ExTAG The Hague Meeting.

Mr. Julien Gauthier

ExTAG Secretary

Address: **IECEx Secretariat** **Level 33 Australia Square** **264 George Street** **Sydney NSW 2000** **Australia** **Web: www.iecex.com**	**ExTAG Secretary** **Mr Julien Gauthier** **LCIE S.A.** **33 Avenue du General Leclerc** **92260 Fontenay-aux-Roses** **FRANCE** **Tel: +33 1 40 95 55 26** **Fax: +33 1 40 95 89 37** **Email : julien.gauthier@fr.bureauveritas.com**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) SYSTEM FOR CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR USE IN EXPLOSIVE ATMOSPHERES (IECEx SYSTEM)

ExTAG Meeting - Industry Discussion Request - Form
ExTAG Meeting: The Hague, the Netherlands 26th August 2014

Organisation	Thermal Electric Elements Pty Ltd
Name of representative	Nigel Kruger
Title of topic for discussion	Application of IEC60079-0 Ed 6 2011 Section 16.6 "Selection of suitable cable"
Brief Description/Synopsis	Application of this section of the standard varies between ExCB's (Please see attached appeal letter and response letters for further details). The section provides vague guidance to the ExCB on the application for the requirement for suitably rated cable when branch point return readings in excess of 70 degree C, during certification testing. Additionally the test methods employed do not truly reflect real life heat rise conditions, please refer to supporting letters.
Standards/Documents ***(if applicable)***	IEC60079-0 Ed 6 2011
Please indicate if an attachment is included and number of pages	Appeal Letter 05.03.2014 – 3 Pages Investigation Response Letter – 3 Pages Initial Report TEE Appeal April 2014 v1 – 3 Pages Silicon Multicore - 2 Pages

Approved for discussion by ExTAG Chairman and Secretary	**YES** ☑ **NO** ☐
Related ExTAG agenda item	10.5

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05th March 2014

Addressee:

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For Information:

Mr Chris Agius
Secretary IECEx
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Sydney NSW 2000

REF: APPEAL THE APPLICATION OF SECTION 16.6 OF IEC60079-0 Ed 6 2011

This letter is to formally appeal the requirements for cable temperature ratings applied to Thermal Electrical Elements Pty Ltd under the following IECEx certificates:

IECEx SIM 13.0013X – TWIH Range of Flameproof Heating Assemblies
IECEx SIM 11.0004X – TIH Range of Flameproof Heating Assemblies

This requires the marking of the temperature rating of the cable to meet the temperature setting of the enclosure T-Rating protection device up to and including 130°C. The requirements are as a result of the temperature reading recorded under testing in the following ExTR:

AU/SIM/ExTR11.004/00 (Results transcribed into AU/SIM/ExTR13.0015/00)

Thermal Electric Elements has been advised by the ExCB that this is as a result of the high temperature reading taken at the branch point and as such in accordance with IEC60079-0 Ed 6 2011 Section 16.6 Temperature at branching point and entry point, temperatures recorded exceeded the 70°C noted in this section.

Thermal Electric Elements is appealing the requirements of specific temperature rated cable for the following reasons:

1. The test methods employed by the ExCB did not represent the true function of the equipment,
2. The requirements imposed go beyond that which the standard intends,
3. The requirements exceed commercially available cable.

Thermal Electric Elements supports its appeal through the following results from an internal investigation, conclusions drawn are outlined below:

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1. Due to the communication regarding the test methods and subsequent results, it is the conclusion of our investigation that the test methods employed by ExCB's potentially do not truly simulate the operation of an electrical heater. Thus potentially creating inconsistent temperature rise and transfer results.

Due to the ExCB not having the capability to power the complete working sample provided, a current was passing through the busbar arrangement to simulated voltage being applied to the equipment. It is the view of Thermal Electric Elements that this would create an unrealistic rise in temperature as no resistance is passing through the heated section of the equipment. In order to create a more realistic simulation placing a heat source through the mounting flange of the enclosure and not the busbar would more effectively simulate heat rise and transfer.

At the time of testing Thermal Electric Elements was reliant upon ExCB to provide guidance on the testing conducted, results recorded and the requirements of Thermal Electric Elements as a manufacturer. Whilst the ExCB has noted that we agreed to 1, the test method used and 2, the requirements for the cable, time as a manufacturer, industry experience gained and feedback from the market has contributed to the knowledge and product range of Thermal Electric Elements.

2. In accordance with Section 16.6 of IEC 60079 Ed 6 2011, the equipment is required to be marked to provide guidance the user on proper selection of cable when temperature is higher than 70°C at the entry point.

Thermal Electric Elements has researched this on other manufacturer's certification and can find evidence of only one other certificate where any note is made. Certificate IECEx LCI 06.006X, enclosed, under the marking section has the following requirement; WARNING – IF THE TEMPERATURE AT CABLE ENTRY EXCEEDS 70°C HIGH TEMPERATURE CABLE SHALL BE USED. It is assumed therefore that this manufacturer recorded high results during testing and hence "guidance to the user on the proper selection of cable" is marked on the equipment.

Thermal Electric Elements is required to include within Schedule Drawing No's. EXdCERT-TSPEC001.03 and EXdTWIH-TSPEC001.03, enclosed, a table depicting the mains cable temperature rating in accordance with the T-Rating of the individual models. Additionally, Schedule Drawing no's ExdCERT-RPLAT001.01 and EXdTWIH-RP02-GAD001.01, enclosed, a section within the rating plate for the marking of the mains cable temperature rating.

It is the view of Thermal Electric Elements that the application of the section in the standard has not been evenly applied between us and the holder of certificate number IECEx LCI 06.006X.

3. Our research and feedback received from industry has shown that typical mains cable utilised by the industry is multicore V90 rated cable and as such to meet the requirements of Thermal Electric Elements certification of up to 130°C is difficult as multicore mains cable above 90°C is not available on the market. Additionally, as this information is not noted on our certificates and only within the rating plate considerable confusion is being caused within industry as end user are unable to prepare suitably for the install and commissioning of the equipment.

Feedback from industry has indicated that Thermal Electric Element electric heaters are the only heaters on the market with these requirements. This is resulting in delays in the commissioning of equipment and hence the start up of some project. Additionally, it results in additionally end user infrastructure costs to accommodate the restrictions on Mains cable selection and installation.

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To conclude as a result of the above points Thermal Electric Elements is appealing the requirements of main cable temperature rating be reviewed and request that reevaluation of the application of the standard in this instance. As demonstrated there are inconsistencies between manufacturer's certifications and between ExCB's in the application of this standard and as such we request that a warning similar to that required by others be applied to Thermal Electric Elements current certifications.

Finally, Thermal Electric Elements will be submitting an Industry Decision Request Form to the ExTAG Committee for discussion and review on the application of this section of the standard and any subsequent testing methods and requirements to assist in the accurate simulation of the function of electric heaters for hazardous locations.

We would like to thank you in advance for assistance in this matter and if you have any question regarding this letter please do not hesitate to contact us.

Kind Regards,

Julie Jardine
Managing Director.

Darren Taylor
Design Manager

Nigel Kruger
Quality Assurance Manager

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18th June 2014

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For Information:

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Secretary IECEx
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REF: RESPONSE TO SIMTARS INVESTIGATION OF APPEAL TO THE APPLICATION OF SECTION 16.6 OF IEC60079-0 Ed 6 2011

This letter is to formally respond to the investigation report provided by Simtars to the Appeal lodged by Thermal Electric Elements (TEE) on 5th March 2014.

TEE has conducted a complete review of the report provided by Simtars, and has concluded that the response, whilst providing evidence of Simtars methods and reasoning, does not provide any reasonable solutions to the issues raised by TEE in the appeal.

With regards to the test methods utilised by Simtars, this has been reviewed by our Design team with the following response:

The test method discussed in the response to our appeal varies from what was verbally discussed with TEE however we have no paper trail to reference that. This being said the test method used by Simtars does not reflect the actual field process. The heater used is a ceramic *infrared* heater. Infrared heating is very different from the *convection* heating which would occur in the field. The units are designed so that there is no heat generated from within the internal of the enclosure. Eg. Busbar, cable, etc. The temperature that is developed will be due to transfer from the temperature of the process we are heating through the steel flange/base plate into the enclosure, not directly emitted from a source within. Also a ceramic infrared heater does not heat the air within the enclosure. Infrared heating will heat the solids within the enclosure only giving a very different result than what would be achieved in the field.

The over temperature device is designed to measure the temperature within the enclosure. By using an infrared style heater the temperature of the enclosure does not rise anywhere near as rapidly as the temperatures of the branch points as infrared heating doesn't heat air only solid objects. This is why the branch points and therefore the cable rating needs to be as high as they have been noted. We did not dispute this requirement at the time of testing as we were under the impression that this was standard practice for a certified heater in this field. However we have found over the last few years that we are the only company to have these restrictions placed upon us.

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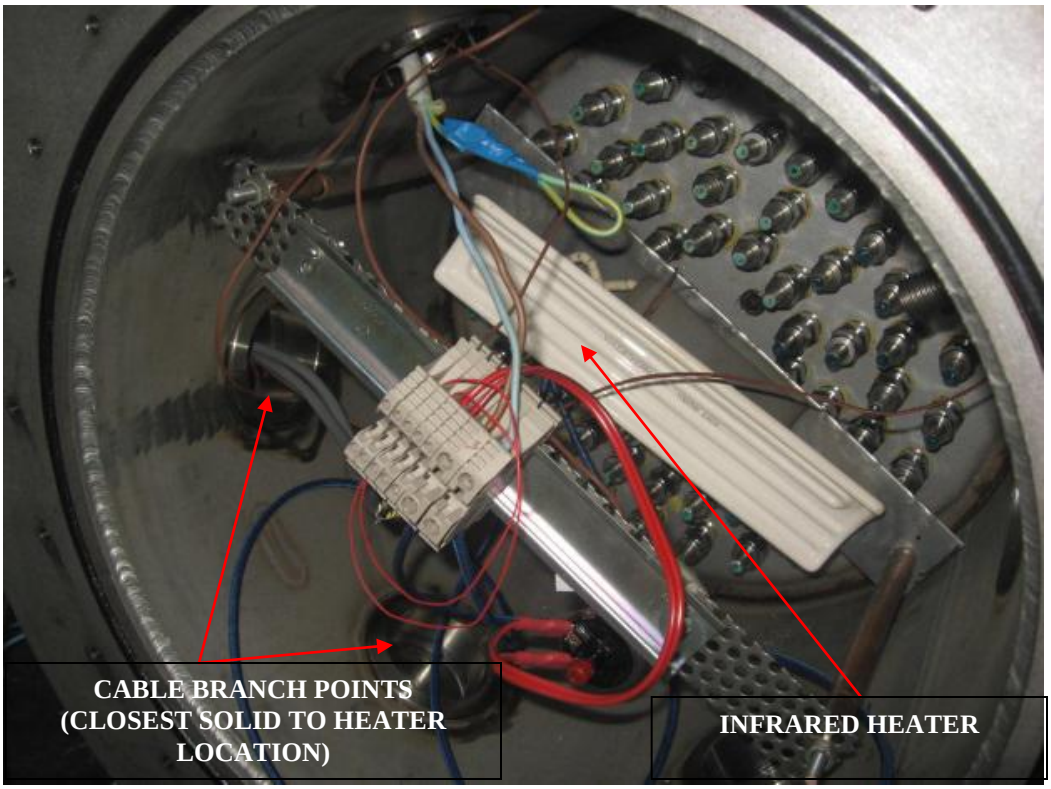
Conclusion – the employment of an infrared heater is highly likely to have resulted in higher than realistic temperature readings at the cable branch point. As depicted within the investigation report by Simtars the infrared heater is in close proximity to these points and the operation of the heater would heat these solid parts as described above. Refer to image below.



With regards to the availability of cable suitable to be utilised to achieve the requirements of certification, we refer to the attached specification sheet for the cable recommended by Simtars. As is displayed this cable is not available in sizes above 2.5mm2, which makes it an unviable option for use within the industry.

As TEE previously stated, we have conducted extensive research into the availability of this cable and it is not commercially available. We draw your attention to the attached email correspondence regarding the matter from one of Australia's leading energy companies, Enerflex. This company has currently installed a number of our heaters and is also an industry leader within their field.

Conclusion – from the research conducted by TEE and the industry feedback we have received the continued application of this requirement is seriously impeding TEE's ability to remain competitive within the domestic and international hazardous area equipment market. The continued application of this requirement is likely to see clients sourcing their equipment from offshore manufacturer's resulting in a loss of market share by an Australian based company.

We would like to resolve this matter as simply as possible. We have discussed this issue with many people within the IECEx umbrella and gained many different opinions and suggestions. We would like to propose that we provide an instruction for our customers to install high temperature sleeving over the incoming cable which will act as the high temperature barrier required to fulfill our T-rating requirements as they

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stand. If we provide the sleeving, the installation instruction and the additional note in our registered IOM, we could ensure that all cable has high temperature sleeving and we simply satisfy both the certification and our customer base. If this is the case we would suggest that an amendment is made to our rating plates to reflect this.

We would like to thank you in advance for assistance in this matter and if you have any questions regarding this letter please do not hesitate to contact us.

Kind Regards,

Julie Jardine
Managing Director.

Darren Taylor
Design Manager

Nigel Kruger
Quality Assurance Manager

Preliminary Report

Certification Appeal by Thermal Electric Elements Pty Ltd

Background

The Simtars Certification Governance Board received the certification appeal lodged by Thermal Electric Elements Australia (TEE) in relation to the application and interpretation of temperature rise testing on Wednesday 26 March 2014. The letter of Appeal is attached for information.

The appeal is based on three grounds:

1. The test methods employed by the ExCB did not represent the true function of the equipment,
2. The requirements imposed go beyond that which the standard intends,
3. The requirements exceed commercially available cable.

Simtars Certification Governance Board requested Bipin Parmar to conduct the initial investigation as an expert in the field and as someone not involved in the current testing and certification process and make recommendations as to appropriate course of actions attempting to resolve the dispute. The Job file 10/0146 was reviewed as it was linked with the two certificates of conformity mentioned in the letter of appeal.

1. Simtars Test Methods

The test methods under discussion relate to the temperature rise tests which determined the maximum operating temperatures within and on the surface of the heater enclosures. The purpose of the temperature rise testing is to:

- To determine temperature classification (T-Rating) for known heating element arrangements
- To determine the branch and cable temperatures to enable correct selection of cable gland and cable
- To determine maximum allowable power dissipation for a set arrangement of heating element

To fully satisfy the first purpose it is agreed that testing of the fully assembled equipment as used in service would be required. In the case of the thermal insertion heaters, it is not practicable as a vessel to house the enclosure with process fluid would be required. Furthermore the range of wattage from 10 kW to 430 kW with the length of elements varying from 300 mm to 6000 mm with varying enclosure size would require substantial amount of thermal testing would be required for each T-Rating.

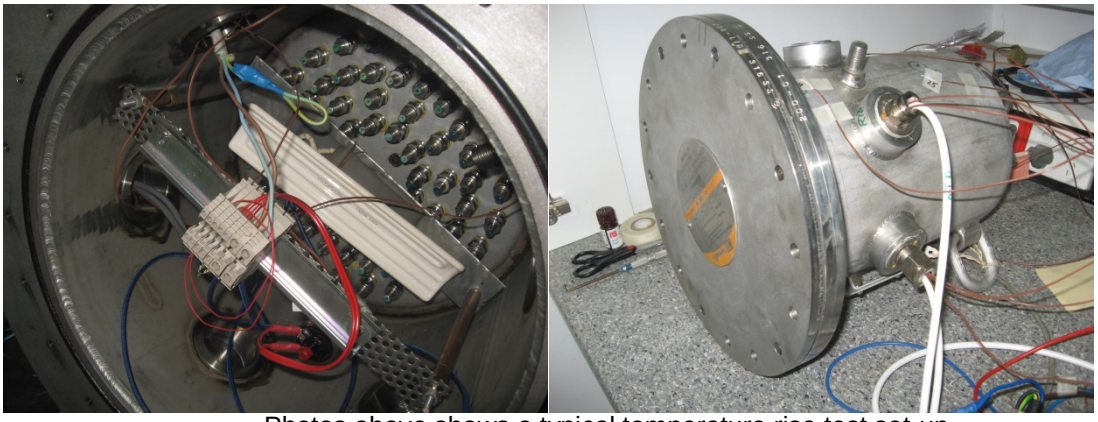
Based on this, it had been agreed with TEE that it was not practicable for the manufacturer nor the Ex CB to test every configuration of heating element (Wattage & element length), hence the utilisation of a thermostat to limit surface temperature of the termination enclosure by TEE. A thermostat is used as a control mechanism for the various T-Ratings.

The purpose of the testing now is not to simulate the equipment in service but to simulate the thermal conditions inside the enclosure at the time that the thermostat operates so that the surface temperatures satisfy the T-Rating requirements. It is normal practice to test the operation of the thermostat by placing a heat source mounted centrally within the termination enclosure and monitor temperatures at various points inside and outside the enclosure. It is the temperature within the enclosure that activates the thermostat that is important not the location of the source of heat producing these thermal conditions.

The thermal tests to determine maximum surface temperature for each T-Rating were conducted and the results presented to TEE which included the temperatures measured at various points including cable branch at the cable gland.

The heat source used was a ceramic heater using variable voltage supply to controlled power dissipated. The following temperatures were monitored:

- at the cable branch
- on cable gland
- inside wall of enclosure
- at the thermostat
- external side wall - top
- external wall near elements
- external ambient temperature
- external top of enclosure



Photos above shows a typical temperature rise test set-up

The results of temperature rise tests were included in the ExTR – NE11/0025 and specified the conductor insulation temperature as measured for each thermostat setting. The information on the conductor and internal wall temperature is required to inform the end users on correct selection of appropriate cable gland (elastomeric seal) and cable thermal insulation rating. It should be noted that the temperatures recorded are based on the maximum allowable power dissipation permitted for the T-Rating and NOT on the amount of power dissipated and or radiated by the heating element or the temperature of the process vessel to which it is fitted.

The surface temperatures for various T-Ratings were determined and it should be noted that the internal temperatures measured at various locations varied by around 5°C. The most critical aspect of the test was the thermostat trip point and it should be noted that the cable thermal insulation would be based on the thermostat trip value as it is set to 'limit' the surface temperature.

The thermostat setting can be reduced to accommodate the use of lower thermal rated cable insulation. Additional testing would be required to establish these set points.

2. Requirements of the Standard

The purpose of certification is to assess and test the product so that it is safe for use in potentially explosive atmospheres and to provide sufficient information to the end user as required by IEC 60079 series of standards. The requirements of IEC 60079-0 Ed 6 2011 clause 16.6 is as follows:

"When the temperature under rated conditions is higher than 70 °C at the entry point or 80 °C at the branching point of the conductors, information shall be marked on the equipment exterior to provide guidance to the user on the proper selection of cable and cable gland or conductors in conduit."

It is believed that the testing used reflects the temperatures in the enclosure at the time the thermostat operates to isolate the supply. The test results indicated that temperatures exceeded the limits specified in clause 16.6 and hence clause 16.6 applies requiring marking on the equipment exterior to provide guidance to the user on the proper selection of cables.

The reason why this is important is that when cable temperatures exceed their rating, the cable insulation softens and flows and the flameproof properties of the cable gland are compromised.

Simtars is unable to comment on certificates issued for like products because alternative methods may have been used to limit the temperatures in the enclosure such as:

- Establishing the set points of the thermostat to limit internal temperatures rather than external T-rating temperatures
- Different location of the thermostats.

There is a note after clause 16.6 of IEC 60079-0 as follows, "In cases where the information for the proper selection of cables, cable glands, and conductors in conduit is extensive, the marking need only be a reference to detailed information in the equipment instructions."

A possible alternative approach for TEE would be for the marking label to reference their user manual for guidance on the selection of cables and place the information in the user manual.

3. Commercially Available Cable

A search on available cables by Simtars indicated that the multicore cable supplier, Olex have a silicon multicore cable 300/500V, silicone insulated, silicone sheathed, -60°C to 180°C (peak 220°C), halogen free to IEC 60754-2.

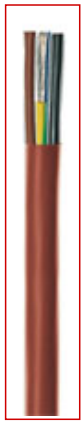
Bipin Parmar
11 April 2014

Contact
Aerospace & Military Customer Service
olexmktmgr.aerospace@nexans.com

Silicone multicore

300/500V cables, silicone insulated, silicone sheathed

Description



- 300/500V cables,
- Silicone insulated
- Silicone sheathed,
- Halogen free to IEC 60754-2,
- Tinned copper conductors, fixed –60°C to 180°C (peak: 220°C)
- Min. bending radius 7.5 x cable o.d.

Standards

International IEC 60754-2

Characteristics

Construction characteristics	
Halogen free	IEC 60754-2
Conductor material	Tinned copper
Outer sheath	Silicon elastomer
Insulation	Silicone
Electrical characteristics	
Rated Voltage Uo/U (Um)	300 / 500 V
Usage characteristics	
Operating temperature, fixed, range	-60 .. 180 °C
Bending factor when laying	7.5 (xD)

Halogen free
IEC 60754-2


Rated Voltage Uo/U (Um)
300 / 500 V


Bending factor when laying
7.5 (xD)

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Silicone multicore

Silicone multicore

Nb. of cores	Cross section [mm²]	Green/ Yellow core	Nom. outer diam. [mm]	Approx. weight [kg/km]	Nexans ref.
12	1	Yes	11.5	231	SF12G1
2	1	No	6.6	59	SF2X1
3	1	Yes	7.4	77	SF3G1
3	1.5	Yes	8.0	98	SF3G1.5
3	2.5	Yes	9.7	152	SF3G2.5
4	1	Yes	8.0	94	SF4G1
4	1.5	Yes	8.8	122	SF4G1.5
4	2.5	Yes	10.6	188	SF4G2.5
5	1	Yes	8.8	115	SF5G1
5	1.5	Yes	9.6	147	SF5G1.5
5	2.5	Yes	11.6	228	SF5G2.5
7	1	Yes	9.5	144	SF7G1

Halogen free
IEC 60754-2


Rated Voltage Uo/U (Um)
300 / 500 V


Bending factor when laying
7.5 (xD)