

INSPECTION REPORT

Fire Safety Assessment according to EN 45545-2 SENSORswitch CHT9 series

Report-No.: CO 88365 T, Report Date: 10.05.2016
Revision: 1.0, Pages: 10

Customer:

CAPTRON Electronic GmbH
Johann-G.-Gutenberg-Str. 7
82140 Olching
Germany

Order Date: 04.01.2016

Project No.: 717510468

Inspector:

Dipl.-Ing. Sven Ehrenberg
Phone: +49 (89) 5791 3309, Fax: -2999
Mail: sven.ehrenberg@tuev-sued.de

Inspection body Rolling Stock:

TÜV SÜD Rail GmbH
Barthstr. 16
D - 80339 Munich

| Content | Page |
|---|-------------|
| 1. General | 3 |
| 1.1. Standards | 3 |
| 1.2. Abbreviations | 3 |
| 2. Equipment under inspection | 4 |
| 2.1. Description of equipment | 4 |
| 2.2. Installation Conditions | 4 |
| 3. Conformity assessment acc. to EN 45545 | 5 |
| 3.1. Classification according to EN 45545-1 | 5 |
| 3.2. Assessment according to EN 45545-2 | 5 |
| 3.2.1. Material requirements | 5 |
| 3.2.2. Material verification | 7 |
| 4. Fire risk analysis | 8 |
| 5. Summary | 9 |
| 6. Documents | 10 |

Revision history

| Revision | Status | Date | Author | Modified clauses | Modifications |
|----------|--------|------------|----------------|------------------|---------------|
| 1.0 | Final | 10.05.2016 | Sven Ehrenberg | all | Initial |

1. General

1.1. Standards

This document deals with the assessment of the CAPTRON Electronic GmbH, SENSORswitch CHT9 series in respect to compliance with the fire safety requirements as laid down in following standards:

| No. | Standard | Date | Title |
|-------|------------|------|---|
| [R01] | EN 45545-1 | 2013 | Railway applications – Fire protection on rail vehicles – Part 1: General |
| [R02] | EN 45545-2 | 2013 | Railway applications – Fire protection on rail vehicles – Part 2: Requirements for fire behavior of material and components |

Table 1: Standards

1.2. Abbreviations

| Abbreviation | Definition |
|--------------|-----------------------|
| HL | Hazard Level |
| PCB | Printed circuit board |
| N/A | Not Applicable |
| min. | Minimum |
| max. | Maximum |

Table 2: Abbreviations

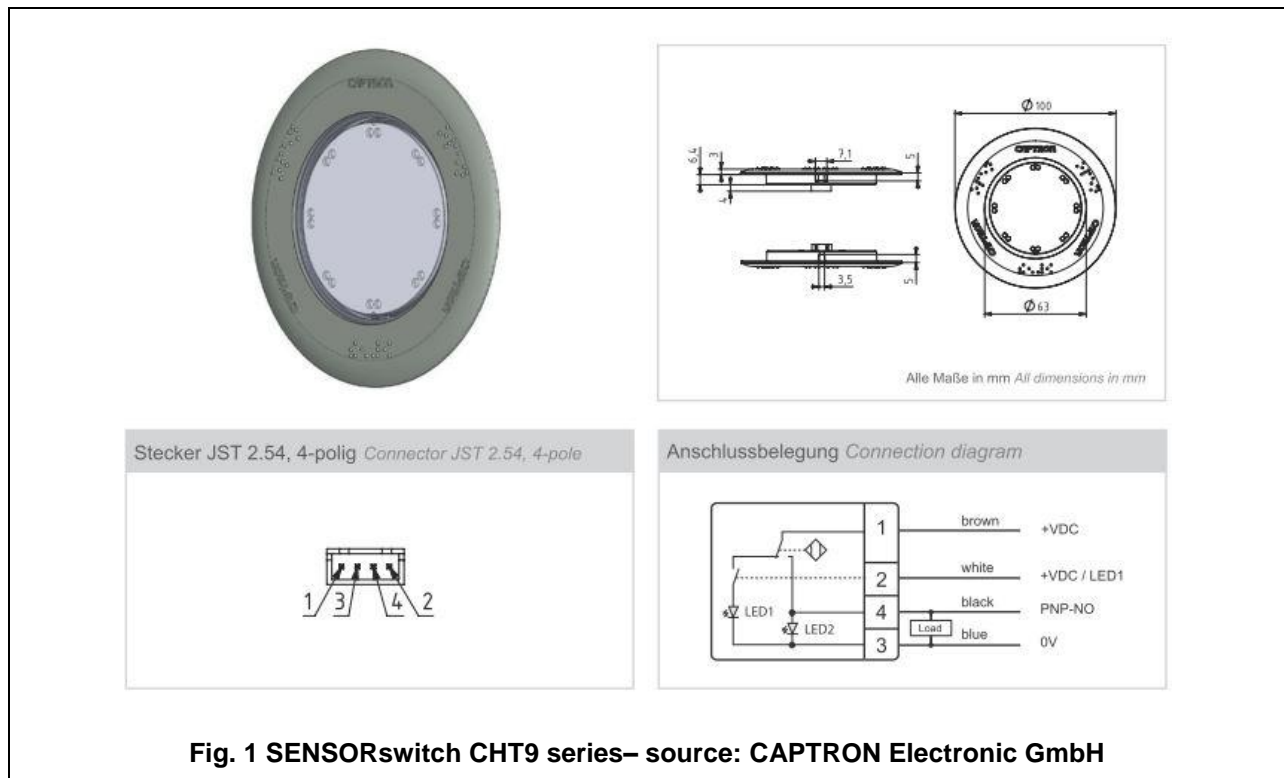
2. Equipment under inspection

2.1. Description of equipment

The SENSORswitch CHT9 series is developed and designed for application in rolling stock. The following components will be tested for fire safety regulations:

- Sensor Unit CHT9 series
- Fixation Flange
- Coloured Cover-Ring
- Seals

The Fixation Flange, Colored Cover-Ring and the Seals are made of plastic parts. The interior of the Sensor are electronic components, conductors and plugs, which are molded into a plastic cup.



Electrical Data:

- Nominal input voltage: 24 VDC
- Power Consumption: 30 mA
- Max. failure power: 0,72 W

2.2. Installation Conditions

The SENSORswitch CHT9 series are intended for use in passenger areas in rolling stock. The devices are accessible for passengers.

3. Conformity assessment acc. to EN 45545

3.1. Classification according to EN 45545-1

The SENSORswitch is to be used in vehicles of all design categories and for operations corresponding to operating classes 1 to 4.

The target protection requirement will be evaluated in a risk-oriented approach in accordance with EN 45545-1, Section 4.2 “Fire resulting from accidental ignition or arson” and Section 4.3 “Fires caused by technical defects”. The section 4.2 examines typical ignition models involving newspaper, matches, cigarettes and gas lighters. Those shall be taken into consideration in any position freely accessible to passengers and staff (ignition models 1 and 2 in accordance with Annex A, EN 45545-1). The section 4.3 examines ignition models comparable to electrical arcing or overheating and the spread of fire by any potentially flammable gases and liquids present (ignition models 3 and 4 in accordance with Annex A, EN 45545-1). According to section 4.4 larger ignition models (model 5 in accordance with Annex A, EN 45545-1) will be evaluated.

3.2. Assessment according to EN 45545-2

3.2.1. Material requirements

Based on the classification acc. to EN 45545-1, the materials/components shall meet the requirements of Hazard Level HL3. The devices are to be regarded as electro-technical equipment covered by the EN 45545-2 standard. Generally, the requirement sets are listed in section 4.4 “Listed products”. The applicable requirements are the following:

| No. | Name | Details | Requirement |
|------|---------------------------------|--|--|
| EL9 | Printed circuit boards | Printed circuit boards without any attached technical equipment | R25 EN 60695-2-11 Glow wire temperature 850 °C or R24 ISO 4589-2:OI min. 32% |
| EL10 | Small electrotechnical products | All electrotechnical equipment, including protection against contact and similar | R26 EN 60695-11-10 min. V0 |

Table 3: Requirement sets

Connecting cables are not part of the assessment.

In addition to requirements of listed products, the grouping rules acc. to clause 4.3. are applicable for components with low combustible mass and/or surfaces:

- No requirements apply to products with a combustible mass of < 10 g not in touching contact with another unclassified product. (EN 45545-2 clause 4.3.1)

| No. | Clause | Requirement | Remark |
|-----|-------------------------------|---------------------------------------|-----------------|
| 1-1 | 4.3.2. Grouping rule 1 | < 100 g for interior grouped products | No requirements |
| 1-2 | Products without requirements | < 400 g for exterior grouped products | No requirements |

Table 4: Grouping rule1

| No. | Clause | Requirement | Remark |
|-----|---|---|---------------------------|
| 2-1 | 4.3.3. Grouping rule 2 Products tested acc. to R24 | < 500 g for interior grouped products tested acc. to R24 | Proof R24 Oxygen index |
| 2-2 | | < 2000 g for exterior grouped products tested acc. to R24 | Proof R24 Oxygen index |

Table 5: Grouping rule2

The following general rules apply:

| Clause | Requirement | Remark |
|---|--|---------------------------------------|
| 4.2. a) General | Products which comply with the highest level of reaction to fire performance and therefore need no further testing are <ul style="list-style-type: none"> - products classified as A1 according to EN 13501-1 - all products described in commission decision 96/603/EC (as amended) | Metallic housing materials |
| 4.2. n) | If listed products are used in an application below the mass and area thresholds given in 4.3, they may be treated as non-listed products. | --- |
| 4.7 Products to be approved on functional necessity | If it can be shown that any of the requirements specified above are not technically achievable with functionally suitable products, then existing commercially available products can be used until and unless a suitable product is developed | digital and analogue circuit elements |

Table 6: general requirements EN 45545-2

3.2.2. Material verification

All used materials and those weights are listed in tables as described in D1. All other combustible materials can be treated according to grouping rules or have a mass below 10 g and are therefore not required for verification by test.

| Pos. | Description | Weight (ca.) | UL 94 | UL No.: |
|------|----------------------------|----------------|------------|---------------|
| 1 | Aufnahmehalter AH9-1X#-T6 | 23 g | V-0 | E41613 |
| 2 | Klebefolie AH9-1-KF | 0,9 g | --- | --- |
| 3 | O-Ring 60x2 | 0,7 g | --- | --- |
| 4 | O-Ring 54x2 | 0,6 g | --- | --- |
| 5 | Sensoreinheit CHT9 | 39,5 g | | |
| 6 | Befestigungsflansch BF9-95 | 12 g | V-0 | E41613 |
| 7 | Klebefolie BK9-95-68 | 0,8 g | --- | --- |
| 8 | O-Ring 86x2 | 1 g | --- | --- |
| 9 | Abdeckfarbring AR6 | 30 g | V-0 | E41613 |
| 10 | Total Weight | 108,5 g | | |

Table 7: Material CHT9 series

| Pos. | Description | Weight (ca.) | UL 94 | UL No.: |
|------|--------------------------|--------------|---------------|----------------|
| 5.1 | CHT9-Becher | 8,5 g | V-2/HB | E41613 |
| 5.2 | Elektrode | 8,5 g | V-0 | E322892 |
| 5.3 | Vergussmasse transparent | 5 g | --- | --- |
| 5.4 | Hauptplatine | 8 g | V-0 | E322892 |
| 5.5 | JST-Stecker | 0,5 g | V-0 | E60389 |
| 5.6 | Vergussmasse schwarz | 7 g | (HB) | --- |
| 5.7 | Bestückung | 2 g | --- | --- |

Table 8: Materials Sensor Unit CHT9 series

Material according to EL10:

According the requirements EL10, 4 materials with a combined weight of 65,5 g have the proof R26 (V-0)

Grouped Materials according to grouping rule 1 without requirements

Listed materials may, according to 4.2n), be considered as non-listed materials, if they are below the threshold value for weight and surface. Those values are defined in chapter 4.3 of EN 45545-2.

The circuit boards have a combined weight of 16,5 g. The other non-attested materials have a combined value of 26,5 g.

That implies a mass of $16,5 \text{ g} + 26,5 \text{ g} < 100 \text{ g}$. This group can be used without requirements.

Materials according to 4.7:

- Electronic components on the circuit boards
The compliance with the essential requirements of 4.1 EN 45545-2 is stated in section 4.

For installation of switches in railway vehicles the distance requirements according to grouping rules have to be considered.

The SENSORswitch, CHT9 series with their combustible materials fulfill the material requisitions according to EN 45545-2 for HL 3.

4. Fire risk analysis

A) Ignition and spread of fire starting from device – material and failure analysis

Fire on electronic devices cannot be excluded. Because of the small content of combustible materials and the low electrical power the fire keeps limited inside the housing. The value of power consumption is max. 0,72 W and is limited by an internal fuse or external circuit line breaker. Therefore in the case of a failure an ignition of combustible materials is unlikely and the spreading of fire is limited to a minimum.

B) Brand inclusion of the components through external/neighboring fire - material-technical and design considerations:

The combustible mass and surface are very small. Therefore, and due to the proven properties of fire promoting the spread of fire is severely limited.

5. Summary

The assessments result is that the CAPTRON Electronic GmbH SENSORswitch CHT9 series meet the requirements as laid down in the fire safety standards – considering the installation areas in railway vehicles:

- EN 45545-2 material: hazard levels HL1 to HL3

For regular (intended) operation the required level of personal safety is ensured.

The assessment is based on documents provided by the costumer (see documents table).

This inspection report was written under the specified accreditation.

TÜV SÜD Rail GmbH
Munich, 10.05.2016



Dr. Jürgen Heyn
Lead Inspector Fire safety



Sven Ehrenberg
Senior Inspector Fire safety

6. Documents

| ID | Document | Doc./File ID | Author | Rev. | Date |
|----|----------------|--------------|---------|------|------------|
| D1 | Material table | --- | Captron | --- | 2015-12-16 |
| D2 | Datasheet CHT9 | --- | Captron | --- | 2013-10-09 |

Table 9: Documents