

ALSTOM	PROJECT SPECIFICATION	Rev. 01	12.05.153
SHOE FUSE			
ELABORATED By: R. Ohta	CHECKED By: L. Juns	APPROVED By: P. Decottignies	PAGE: 1/13

<h1>SHOE FUSE SPECIFICATION</h1>

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REVISION HISTORY

REV.	DESCRIPTION	DATE	RESPONSIBLE	
			ELAB.	APPROV.
00	First issue	10/09/2007	R.OHTA	P.DECOTT.
01	Update in some chapter, and added appendix	03/08/2009	M.CHAGAS	P.DECOTT.

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1 INTRODUCTION

This document contains the third rail collector shoe fuse specification for the Train unit. The shoe fuse to be provided shall follow all specific existing ABNT norms. In the case of non-existence of ABNT norm, it shall be follow the IEC 60269-1, IEC 60269-4 or newer standard that replaces these ones.

2 VALIDATED FUSES

The fuse ref. 8001000 manufactured by “THS Indústria e Comércio Ltda” was validated in 2008 according to this specification.

3 FUSE CHARACTERISTICS

3.1 General

- Limiter current fuse with high capacity of interruption
- Cartridge format with fixation by screws
- High-speed action
- Nominal Voltage/Current 1000 V/800 A
- Peak voltage during interruption 4000 V
- Maximum time for arc breaking 70 ms

Characteristic curve of the fuse, see [APPENDIX C](#).

3.2 Environment Conditions

Maximum Ambient Temperature	40 °C
Minimum Ambient Temperature	-10 °C
Maximum Tunnel Temperature	40 °C
Maximum Parking Temperature	70 °C
Average Maximum Humidity	95 %

3.3 Car High Voltage System Details

HT Power Supply	750 Vdc (500-900) Third rail
Nominal Current	800 A
Peak Current	1560 A during 5s;
Peak Current	1352 A during 40s;
Peak Current	1343 A during 30s;
Peak Current	3120 A during 3s;
Regime	715A - 800A;
(CE) Exceptional case	1100A during 1000s;
(CE) Exceptional case	1650A during 400s (*);

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These values were based on the simulations and results, see [\(APPENDIX A\)](#) and the table [\(APPENDIX B\)](#)

(*) Condition where the train has lost 3 shoes, and only one shoe and fuse has touch with third rail.

In this condition the train should be removed from service in a time less than 400s.

3.4 Fuse Identification And Dimensions

All fuses must have marked in its body, in undeletable way, the following information:

- Manufacturer name
- Nominal values of voltage/current
- Ohmic resistance
- Type of fuse
- Date and lot of manufacturing

The letter size must be larger than 3 mm.

See [APPENDIX D](#) - Dimensions and Tolerances of the fuse.

The manufacturer shall propose a configuration that must be analyzed and approved previously by costumer.

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4 DESCRIPTION OF TESTS

The following tests shall be performed in order to approve the fuse. The detailed procedures of the test and homologation are described in Chapter 5.

4.1 Current interruption characteristics

The fuse shall be capable of interrupting the circuit with the following characteristics:

Current (kA)	Voltage (Vcc)	L/R (ms)
14±1	1000±50	37±3
16±1	1000±50	42±3
27±2	1000±50	49±3
57±4	1000±50	30±3
100±10	1150±50	15 to 20

After the current interruption, it shall be applied reestablishment voltage during 30s, in which no arc shall appear. This test shall be done after the vibration test, described (item 4.4)

4.2 Maximum heat temperature

The fuse shall be tested using IEC 269-1 – items 7.3 and 8.3 – to obtain the maximum heating temperature, that must be lower than the maximum operation temperature of the material that is used to construct the fuse body.

4.3 Electrical resistance measurement

The dispersion (regarding to the theoretical nominal value) on the electrical resistance values of the fuse shall not be more than ±5%, when measured in room temperature (24 ± 2°C). This measurement will be carried out, positioning the instrument probes in the terminals as near as possible of the center of the fixing holes.

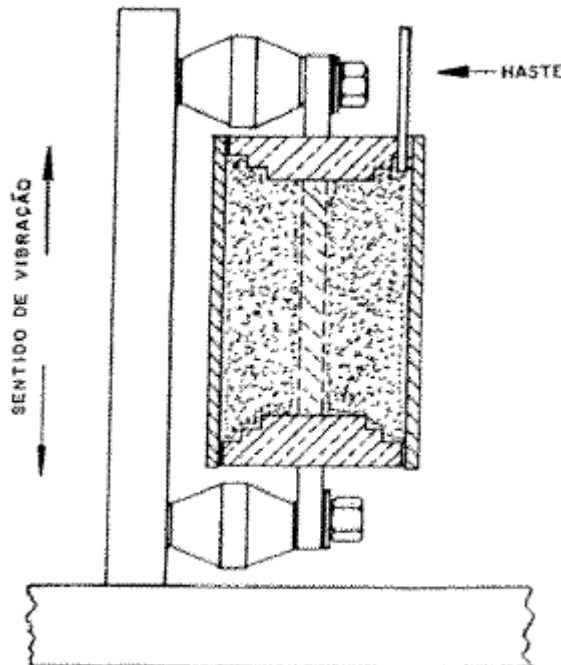
4.4 Vibration test

The fuse shall withstand vibration (harmonic sinusoidal) at a frequency chosen in the range between 25 and 35Hz, in 12G of acceleration, during 15 minutes. This test shall be made with the fuse in horizontal position. After the vibration test, the fuse shall be kept in the same position, repeating the electrical resistance test (item 4.3) and the current interruption test (item 4.1).

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4.5 Sand compacting test

The sand compacting test shall be made with the fuse in vertical position with vibrations of 25Hz to 35Hz in 12G of acceleration during 15 minutes. After this test, there must not have empty spaces inside the fuse, as shown in the figure below. Also, the little stick of 3 mm of diameter shall not penetrate more than 20 mm in the sand after the fuse is vibrated. This stick shall test the penetration in 3 equidistant points.



5 ACCEPTANCE CRITERIAS

All lot of fuses supplied shall be tested with acceptance tests that will have the supervision of the costumer. These tests have the objective to keep the repeatability of the properties of the fuse. If the lot is divided in several delivery parcels, each parcel shall be tested. The lot will be rejected, partially or totally, if is verified any kind of abnormality.

5.1 Dimensional and finishing check

The fuse body shall be fabricated with material self-extinguishable and fire resistance, as described in ASTM D-635, and must be mechanically resistance to the efforts and vibrations that the fuse is submitted. The exposed metal parts shall have anticorrosive treatment. There will be dimensional and finishing verification in 100% of the test samples and in 10% in the delivery parcels. In case of the abnormality, 100% of the fuses will be checked and, if 15% of the lot have abnormality, all fuses will be rejected, not only the affected parts.

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5.2 Sand compacting test

This test shall be applied in all test samples. In the case of several delivery parcels, this test shall be applied in 10% of the fuses of each parcel. In case of abnormally, 100% of the parts will be inspected and if the problem affects 10% of the supply, all parts will be rejected, not only the defectives parts.

5.3 Electrical resistance check

This test shall be applied in 100% of the test samples and 100% of the supplied parts. The manufacturer shall provide a report with all results together with the supplied parts. In case of variations above 5% in more than 15% of the total number of fuses supplied lot, all fuses will be rejected, not only the abnormal fuses.

5.4 Rising Temperature test

The rise temperature test shall be executed in 3 fuses of each parcel. If any abnormally with the temperature values among these three tested fuses, others samples shall be tested. If the problem is detected in these complementary samples, all supplied parts will be rejected.

5.5 Fusibility test

The test shall be in 3 points (2 kA, 3.5 kA and 10kA) with at least two fuses in each point. For this test, utilize the 3 samples submitted in the rising temperature test. In case of several delivery parcels, apply each test in all parcels. If any abnormally is observed in the results, the test shall be made with new samples. Confirming the problem, all lots will be rejected.

5.6 Vibration test

The vibration test shall be done in 100% of the test samples to be used in the current interruption test. In case of several delivery parcels, apply the test in three parts of each delivery parcel.

After the vibration test, verify the electrical resistance in all vibrated samples.

Any abnormality with the electrical resistance in one of the vibrated samples, others samples shall be tested. If the problem persists, all parts will be rejected.

5.7 Current interruption test

The current interruption test shall be done with the circuit shown below with 3 samples previously tested in the vibration test. In the case of delivery in several parcels, this test shall be done only in the first parcel.

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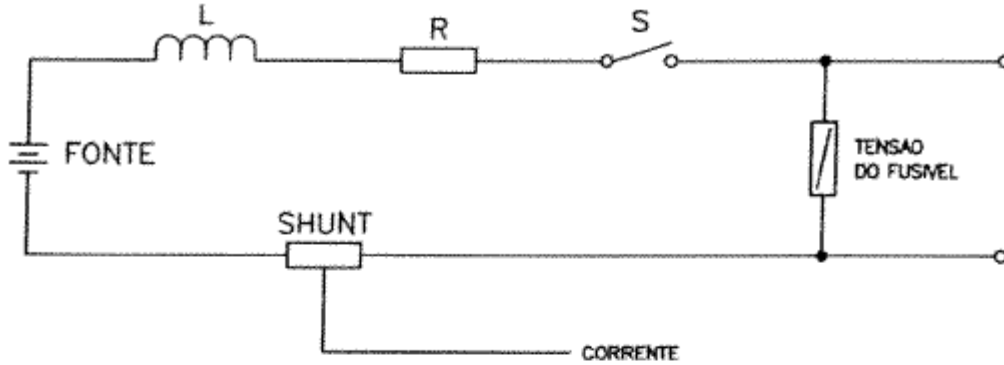


FIGURA 2: Circuito para teste de capacidade de interrupção dos fusíveis.

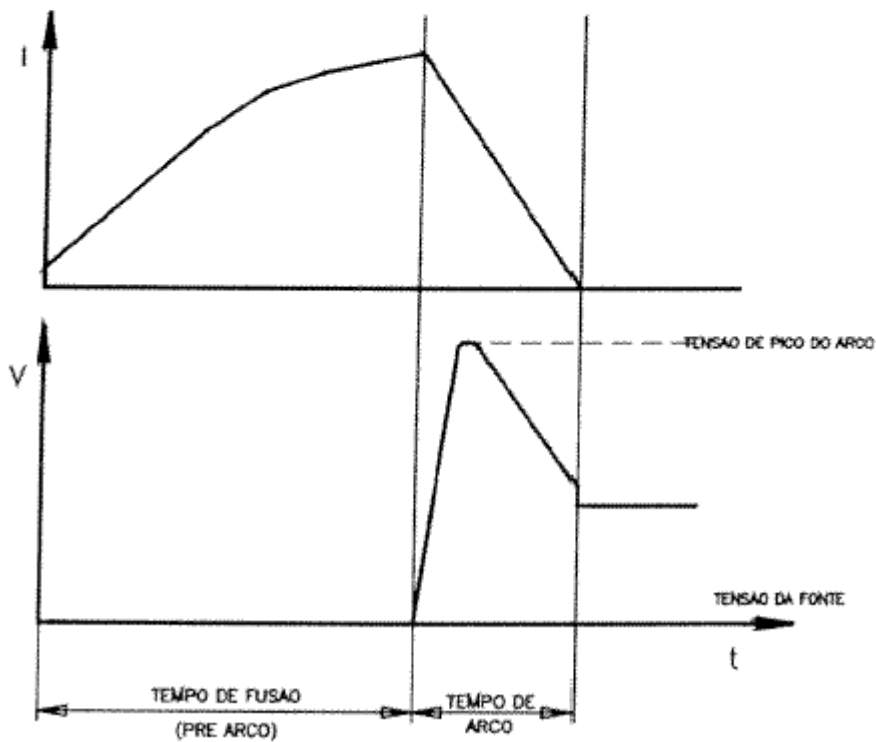



FIGURA 3: Curvas $I \times t$ e $V \times t$ para os testes de capacidade de interrupção.

The results will be verified using the IEC 269-1 and will be approved if:

- Voltage peak during interruption is less than 4000V
- Fuse resistance at room temperature, after the interruption, is more than $1M\Omega$, measured in a Megger with 1000V.
- The fuse does not show perforated terminals, loss of structural resin due to external carbonization or loss of mechanical integrity of the fuse body, after the interruption.

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All samples will be opened and an inspection will be made in all elements that compose the fuse (sand, terminals, body, etc.).

If the fuses do not pass in all these inspections, more samples shall be tested, according to the customer decision, to confirm if the problems verified are project or fabrication defects.

Also, the customer might procedure inspections in all fuses provided, in order to verify the accomplishment of the specifications described in this document. Eventually, the customer might demand additional inspections or tests due to the nature of the materials used in the fabrication of the fuses or to nullify doubts that might appear.

The fuses destroyed in the acceptance test must be replaced without cost to the customer.

5.8 Fuses burned during train operation

The fuses burned during train operation will be analyzed internally and externally, as decided by customer.

If any irregularity of fabrication or employed material is verified, the supplier shall correct the problems and replace partially or totally the fuse lot, as decided by customer, without any cost.


The customer might also request the procedure of the test in its presence, in the supplier facilities.

6 DOCUMENTATION

The manufacturer shall provide to customer the dimensional drawings of the fuses and all information about electrical and mechanical characteristics. A chemical composition certification of the metal alloy of the fuse elements used shall also be provided (quantitative and qualitative values).

7 WARRANTY

If any fuse shows defects, the supplier shall replace the defective components and/or correct the problems without cost to the customer.

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8 APPENDIX

8.1 APPENDIX A



Corrente_sapata_MS
PL2.xls

8.2 APPENDIX B

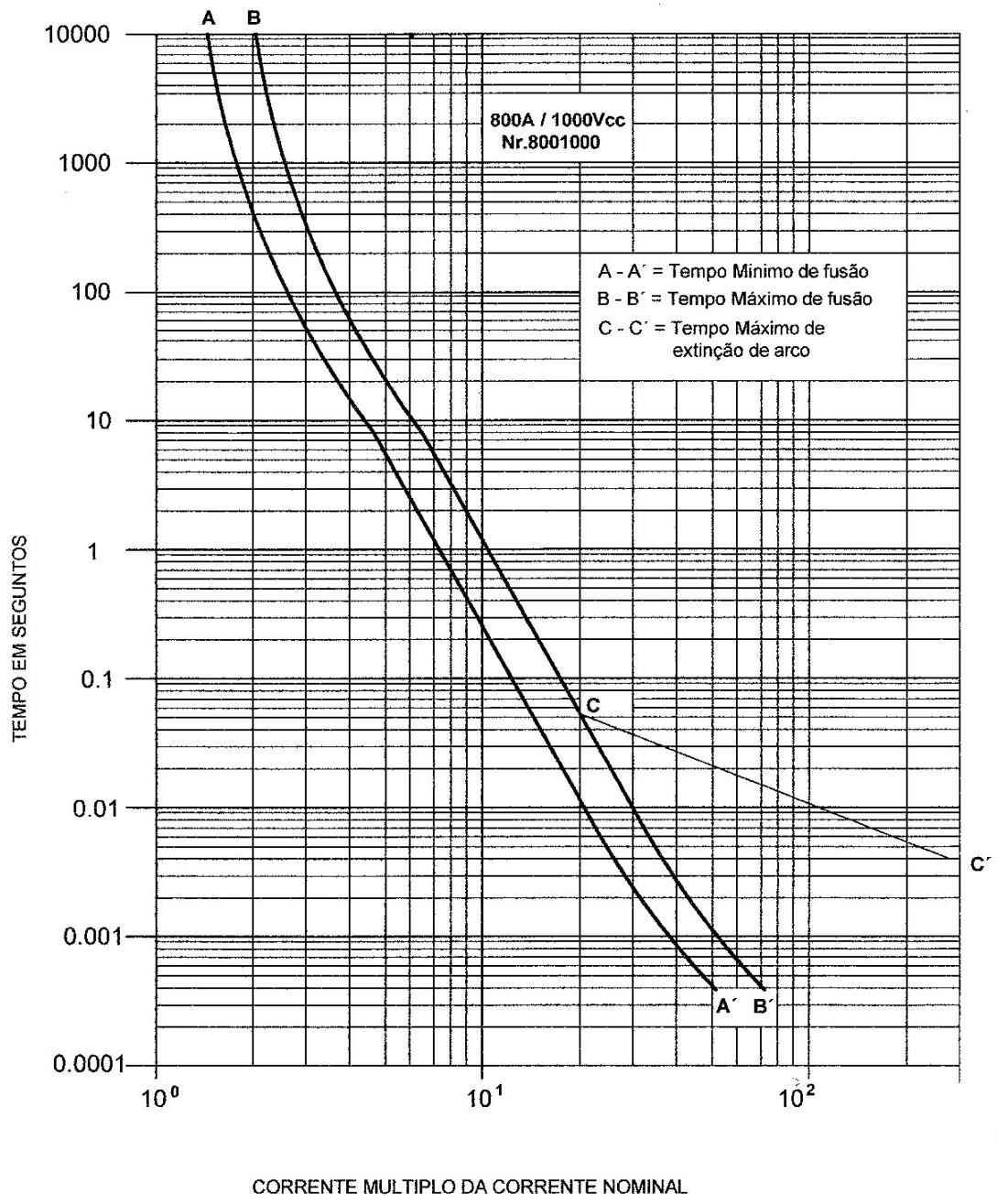


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utilização coletor coi

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8.3 APPENDIX C

CURVA DE FUSÃO DO FUSÍVEL DE SAPATA COLETORA



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8.4 APPENDIX D

Características Técnicas para Fusível 1000VCC / 800A

DADOS DO FUSIVEL
Corrente: 800A
Tensão: 1000VCC
Tensão de arco: 1860V
I^t fusão: 1532000A²s.
I^t Total: 2765000 A²s.
Corpo: Epoxi com fibra de vidro Classe: "H"
Perda: 136 W
Elev.de temp. do corpo: 82°C
Elev.de temp.do terminal: 88°C

ENSAIOS APLICADAS
Elevação de temperatura
Ensaio de perda em watts
Elevação Tempo/Corrente
Ensaio de comp. de areia
Teste de resistencia ohmica
Dimensional mecanico
Isolamento
Corrente de nao fusao
Corrente de fusao

CURVA DE FUSÃO DO FUSÍVEL DE SAPATA COLETORA THS

TOLERANCIAS ONDE NÃO INDICADO CONF. NBR 6371 grau medio

Acima de... até...	Tolerância
0,5 - 6	± 0,1
6 - 30	± 0,2
31 - 120	± 0,3
121 - 400	± 0,5

R = 0.129 ± 5% mOhm
Potencia dissipada = 136 W

Elev.Temp.	Corpo Fusivel = 82°C
	Terminal = 88°C

6	Conjunto Disparador	1	---	
5	Elemento	32	129x5,5x0,25x0,7	151282
4	Heat Wrap - Material	128	14x6x0,8	151282
3	Corpo em fibra de vidro Classe "F"	1	86ØX3"ØX155	151280
2	Terminais de ligação - prateado	2	3"X15X47,5X9,5	151281
1	Areia H31	---	---	---

THS Industria e Comercio Ltda	
FUSIVEL DE TRAÇÃO METRO RIO	
Data	28.01.05
Proj.	SAULO
Des.	HERMANN
Esc.	1:1
DESCRIÇÃO	Nr. de Ref.
	Nr. Des. 8001000