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CoCo LOCO PROJECT Fire Classification

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ACRONYMS & ABBREVIATIONS

HL	Hazard Level
TCMS	Train Control Monitoring System
HVAC	Heating, Ventilation and Air Conditioning
AC	Alternate Current

1 INTRODUCTION

1.1 SUBJECT

This document provides the fire classification and the fire safety requirements for the CoCo Loco project. The project includes two types of locomotives: Electric and Diesel Electric.

1.2 DOCUMENTS AND STANDARDS

In accordance to CoCo General Technical specification (ref. 1 [Table 2]), the locomotives shall be designed, assembled and tested according to more recently published versions of EN, IEC, UIC, TSI as other international standards required by [Table 1], respected in the order of priority.

Table 1 reports the reference standards to the matter of the present document.

Standard	Title
TSI Loc/Pass	Technical Specifications for Interoperability relating to “rolling stock - Locomotives and Passenger Rolling Stock” sub-system of the Trans-European rail system
TSI SRT	TSI SRT on the technical specification for interoperability relating to ‘safety in railway tunnels’ of the rail system of the European Union
EN 45545-1	Railway applications. Fire protection on railway vehicles. General
EN 45545-2	Railway applications. Fire protection on railway vehicles. Requirements for fire behaviour of materials and components
EN 50553	Railway applications - Requirements for running capability in case of fire on board of rolling stock
EN 1363-1	Fire resistance tests - Part 1: General Requirements
EN 1364-2	Fire resistance tests for non-loadbearing elements — Part 2: Ceilings
EN 13272-1	Railway applications - Electrical lighting for rolling stock in public transport systems - Part 1: Heavy rail
EN 3-7	Portable fire extinguishers - Part 7: Characteristics, performance requirements and test methods
EN 3-8	Portable fire extinguishers - Part 8: Requirements for the construction, pressure resistance and mechanical tests for extinguishers with a maximum allowable pressure equal to or lower than 30 bar, which comply with the requirements of EN 3-7
EN 3-10	Portable fire extinguishers - Part 10: Provisions for evaluating the conformity of a portable fire extinguisher to EN 3-7
ISO 11014	Safety data sheet for chemical products

Table 1 – Reference Standards

Table 2 reports the reference documents to the matter of the present document.

Document	Title
TS400048	GENERAL TECHNICAL SPECIFICATION OF ELECTRIC CoCo LOCO
TS400049	GENERAL TECHNICAL SPECIFICATION OF DIESEL CoCo LOCO

Table 2 – Reference Documents

2 VEHICLE CONFIGURATION

Within the project, two types of locomotives with different drive systems will be designed:

- Electric Locomotive
- Diesel Electric Locomotive

Both these configurations will be used as freight wagons locomotive.

3 FIRE BEHAVIOUR CLASSIFICATION

3.1 Regulatory framework

The locomotives will generally comply with fire safety requirements imposed by:

- TSI Loc&Pas & SRT "Safety in Railway tunnels"

3.2 Vehicle classification

3.2.1 Electric locomotive

The vehicle classification refers to the categories defined by the TSI (paragraph 4.1.4).

The locomotive must be classified as **freight locomotive** and according to TSI in paragraph 4.2.10.2.1, it can be considered as

- Standard vehicle: N
- Operation category: 2

So, the vehicle results to be classified as 2N, and this implies a hazard level equal to **HL2**.

3.2.2 Diesel Electric Locomotive

The vehicle classification refers to the categories defined by the TSI.

The locomotive must be classified as freight locomotive. It can be considered as

- Standard vehicle: N
- Operation category: 2

and this implies a hazard level equal to **HL2**.

3.3 Running capability

There are no requirements for running capability of freight locomotives in the TSI.

4 MATERIALS REQUIREMENTS FOR FIRE RESISTANCE BEHAVIOUR

4.1 Fire resistance behaviour

According to TSI LOC&PAS, materials requirements for fire resistance behaviour in freight locomotives, which are to be considered 'OC 2', are expressed through the index R(n) described in the standard EN 45545-2, "Table 5". To correctly define the requirements, it is necessary to know the hazard level of the locomotive that, in this case, is for all the configurations **HL2**.

These requirements for materials depend not only on the component intrinsic nature, but also on the position, shape and layout, surface exposure, relative mass and thickness of the material considered. To identify the relevant R (n) requirements, in "Table 2" of the standard EN 45545-2 several products and their position on the locomotive are listed.

Any material used, must meet the requirements specified in chapter 4 of the EN 45545-2 standard.

4.2 Smoke opacity and toxicity

All the materials used do not emit toxic gases in such quantities as to be harmful.

The parameters taken as reference for the selection of materials, and the requirements they must meet, are described in "Table 5" of the EN 45545-2 standard, paragraph 4.8. with reference to the classification of the hazard level of the locomotive and the set of requirements R(n) to which the material is associated.

4.3 Specific measures for flammable liquids

According to TSI Loc&Pas (paragraph 4.2.10.2.2), for all the configurations, flammable liquids used as cooling medium in high voltage equipment shall be compliant to the requirement R14 according to the standard EN 45545-2.

5 FIRE BARRIERS

5.1 Requirement criteria

Fire barriers in railway vehicles are necessary for the protection of staff in the event of a fire on board. The requirements are expressed in TSI Loc&Pas. As a freight locomotive, the fire barriers are required only for the driver's cab protection.

The requirements refer to the criteria:

- "E" integrity criterion.
- "W" radiation criterion.
- "I" insulation criterion.

5.2 Minimum requirements for fire barriers

Experimental tests must be carried out for the barriers to verify that they meet the minimum requirements described in TSI Loc&Pas.

5.3 Preliminary definition of fire barriers

The fire barriers that must be guaranteed and the minimum requirements for the aforementioned will be reported here.

The list refers to all configurations of the project.

The number indicates the time, expressed in minutes, the experimental tests of the barriers must show that they possess the requirement expressed.

According to TSI Loc & Pas (paragraph 4.2.10.3.5) the barriers need to protect the driver from fire spreading, that can be achieved by positioning the fire barriers in the following configuration:

- Fire barriers between the underfloor and the driver cab, to ensure safety for staff in the event of a fire being placed in the components below the floor. Requirement: **E15, I15**.
- Fire barriers between the driver cab and the rear compartment, to ensure safety for staff in the event of a fire being placed in the rear compartment. Requirement: **E15, I15**.

The fire barriers should be tested according to EN 1363-1 and EN 1364-2.

6 FIRE CONTROL AND MANAGEMENT SYSTEM

6.1 Fixed firefighting system

The locomotives will be provided with an automatic firefighting system in order to detect a fire starting in the high-risk areas, and to take the necessary action to reduce the risk of spreading it.

The vehicles will be provided with a fire detection system.

For the TSI it is not required a fire extinction system for freight locomotives, but it is advisable in critical areas where fire may spread at high speed.

6.1.1 Fire detection system

The standard taken into consideration for identifying which areas must be protected by the fire detection system are TSI Loc&Pas (paragraph 4.2.10.3.2).

According to the requirements, a fire detection system will be provided in:

- Electric Locomotive
 - Traction + Auxiliary converters
 - Main electrical cabinets
- Diesel Electric Locomotive
 - Traction + Auxiliary converters
 - Main electrical cabinets
 - Diesel Engine + Generator

Additionally, it is considered appropriate even if not directly asked in the TSI Loc&Pas for freight locomotive, to insert a detection system also in

- Driver's cabs

Each driver's cab shall be equipped with an audial and visual fire alarm system integrated with Train Monitoring System (TCMS).

The system must indicate to the driver the detection of a possible fire and the place where this has been detected.

6.1.2 Fire extinction system

The paragraph 4.2.10.3.2 of the TSI requires that appropriate automatic actions shall be initiated to minimize the subsequent risk to locomotive staff.

In order to protect the locomotive staff, it is advisable to have a fire extinction system.

In all the configurations, a fire extinction system may be provided in:

- Traction + Auxiliary converters

In Diesel Electric Locomotive, it is considered appropriate to have an extinction system also in:

- Diesel Engine + Generator

Summary of Detection and Extinction:

Area	Detection	Extinction
Traction + Auxiliary Converters	x	x
EC 41	x	
EC 42	x	
EC MV	x	
Diesel Engine + Generator	x	x
Driver's Cab	x	

6.2 Selective shut down of energy supply

According to the previous point (6.1.2), in order to protect the locomotive staff, a shut down of energy supply of the affected area shall be expected, if it belongs to the following list:

- Traction + Auxiliary converters
- Main Electrical Cabinets

6.3 Diesel engine shut down

According to TSI Loc&Pas (paragraph 4.2.10.3.3), in Diesel Electric Locomotive the firefighting system, in case of fire in diesel engine or the generator, must be able to shut down all relevant equipment and cutting off the fuel supply.

6.4 Ventilation Control

The Ventilation system must comply with TSI Loc&Pas.

In case of fire, the distribution of smoke shall be minimised in areas occupied by locomotive staff.

In particular, in case of external smoke, HVAC system must be shutdown, manually or automatically, to avoid smoke in driver's cabs.

6.5 Portable firefighting equipment

According to TSI Loc&Pas (paragraph 4.2.10.3.1), the vehicle shall be equipped with adequate and sufficient portable fire extinguishers, in staff areas.

For all the configurations the portable fire extinguisher foreseen for the vehicles are:

- a fire extinguisher (powder type) in each driver cab.

For fires of class A and B (solid and liquid sources) the most adequate fire extinguishers are powder types. Fire extinguishers must comply with the standard EN 3-7, EN 3-8, EN 3-10.

7 EMERGENCY REQUIREMENTS

7.1 Emergency lighting

To provide protection and safety on board in the event of emergency the locomotive shall be equipped with an emergency lighting system.

The requirements for the system will be the same for all the configurations: the system shall provide a suitable lighting level in staff areas during a minimum operating time of 90 minutes after the main energy supply has failed and must have a minimum of 5 lux at floor level.

Additionally, according to TSI Loc&Pas, the emergency lighting system in all areas must be compliant to EN 13272-1.

In the event of fire, the emergency lighting system shall continue to sustain at least 50 % of the emergency lighting in the vehicles not affected by fire for a minimum of 20 minutes. This requirement shall be deemed to be fulfilled by a satisfactory failure mode analysis.

7.2 Driver cab emergency exit

In emergency conditions, to ensure the driver's safety, emergency exits shall be present.

The requirements are specified in the TSI Loc&Pas, paragraph 4.2.9.1.2.2, which are the following:

- There shall be at least one emergency exit on each vehicle side
- Staff emergency exits shall provide **a minimum clearance of 2000 cm² with a minimum inner dimension of 400 mm;**
- The emergency exit in the driver cab can be the external door or the emergency window: in both cases, the emergency exit shall be located on both sides of the vehicle.
- Front position driver's cabs shall have at least an interior exit; this exit shall give access to an area of a minimum length of 2 metres, of a minimum clearance of 1700 x 430 mm, and this area (including its floor) shall be free of any obstruction to the escape of the driver; the above area shall be located on-board the unit, and can be an interior area or an area opened to the outside.

END of DOCUMENT