The driver's activity shall be monitored when the machine is in running mode and is moving. This monitoring is permitted to be done by noting the action of the driver on dedicated devices (pedal, push buttons, sensitive touches) and/or the driver's action on the Train Control and Monitoring System and/or the driver's vigilance by indirect means. When no action is monitored for more than 5 s, the vigilance monitoring shall start.

After a time not longer than 60 s without detecting driver's activity the lack of driver's activity shall be triggered.

Before triggering a lack of driver's activity, a warning shall be given to the driver, in order for him to have the possibility to react and reset the system.

The system should have the information "lack of driver's activity triggered" available for being interfaced to other systems (e.g. the radio system).

The detection of the lack of the driver's activity is a function that shall be subject to a reliability study considering the failure mode of components, redundancies, software, periodic checks and other provisions, and the estimated failure rate of the function (lack of driver's activity as specified above not detected) shall be provided in the technical documentation. When existing systems with known service experience are used, it is permissible that this study is not necessary.

Specification of actions triggered at machine level when a lack of driver's activity is detected:

— a lack of driver's activity when the machine is in running mode and is moving (criterion for movement detection is at a low speed threshold) shall lead to a full service brake or an emergency brake application on the machine;

— in case of application of a full service brake, its effective application shall be automatically controlled and in case of non-application, it shall be followed by an emergency brake.

It is permitted to have the function described in this clause fulfilled by the in-cab signalling and control systems.

15 Safety design features

15.1 Electrical protection measures

All metallic parts of the machine shall be equipotentially bonded. Parts which are not electrically connected, i.e. separated by means of elastic supports, rubber springs, intermediate mountings made of plastic material, etc., shall be connected by means of bonding consisting of flexible copper wires of a size according to EN 50153. The electrical resistance from the highest place on the machine to the running rails shall not be more than 0,05 Ω and shall be demonstrated by measurement according to the requirements of EN 50153:2014, 6.4.4.

The installation of antennae shall comply with either of the following two conditions:

— conducting parts of the antennae shall be completely protected from voltage from the overhead line by a protective device made of impact proof insulating material and the antennae system shall form a unit connected to earth at a single point (aerial with static earthing) earth at rail potential;

or

— antennae fitted to the outside of the machine and not complying with the conditions above shall be separated from parts connected to the inside of the vehicle by means of high voltage capacitors combined with surge absorbers.

15.2 Mechanical protection measures

The cab shall be secured to the frame and all fixed objects in the cab, so that they are able to withstand a longitudinal acceleration of 30 m/s^2.

The floor shall be insulated against noise and made of non-slip material. The floor shall be insulated against heat where a heat source is present under the floor.

Secondary equipment shall be provided to prevent components, e.g. cardan shafts, transmission shafts, falling onto the track.

All the equipment which requires regular maintenance, control, clearing or filling shall be accessible.

15.3 Fire protection

15.3.1 Material requirements

The selection of materials and components for use in driver's and staff's compartments in running mode shall take into account their fire behaviour properties and shall comply with EN 45545-2. Machines shall correspond to operational category 1. The certificate to prove compliance of a material with the standard, which shall be issued immediately after testing of this material, shall not be older than five years or where the material consistence and the standards defining the material requirements have not changed it is not necessary to require new certificates.

An assessment of the material used in compliance with EN 45545-2:2013+A1:2015, 4.6, shall include:

— specific location of each component that does not have a stated fire performance to the standard shown in EN 45545-2;

— the response of alternative suppliers of components contacted who could not provide sufficient detail of the standard of fire performance;

— statement of which standard the material does comply where possible;

— mitigation for use of any non-compliant material.

15.3.2 Specific measures for flammable liquids

Specific measures for flammable liquids shall be according to EN 14033-3:2017, 5.22.

15.3.3 Portable fire extinguishers

Provision of portable fire extinguishers shall be according to EN 14033-3:2017, 5.25.4.

15.3.4 Fire detection and suppression systems

Requirements for fire detection systems shall be according to EN 14033-3:2017, 5.25.2 and 5.25.3.

15.3.5 Driver’s cab emergency exit

Emergency exits from driver’s cabs shall be provided and be in accordance with 14.2.3.2.

15.3.6 Floors

Flammable floors located above wheels where cast iron brake blocks are fitted, shall be protected by spark guards.

15.4 Personnel protection

At least the front part of the machines above buffer level shall be painted yellow and shall be free of non-safety related information.

NOTE This colour corresponds, for example, to:

— RAL 1004;

— or to the NCS (Natural Colour System) target value 1080-Y10 R;

— or to the NCS exact value 1475-Y 11R;

— or to EC 222.69.79 in the Eurocolour table.

The following colours are also acceptable RAL 1003, 1018, 1021 and 1023.

15.5 Electromagnetic compatibility

The machine shall comply with the requirements of EN 50121-3-1 and additional apparatus to EN 50121-3-2.

16 Environmental conditions

16.1 General

In the design process for the machines and equipment on board, it shall be taken into account that machines shall be operational and function normally under the conditions and the climate zones for which the equipment is designed and where it is likely to be in operation. Guidance on the environmental requirements is given in EN 50125-1. Demonstration of compliance shall be required where the manufacturer states that the machine is intended for running in conditions without a relevant experience for the machine or component concerned.

16.2 Carriage and storage of fuel and oil

All precautions shall be taken on the machine to prevent loss or overflow of fuel and oil onto the track.

The carriage of fuel in barrels is not allowed. Oil for use on the machine shall only be carried in specified places, which are equipped for safe storage and where any leakage can be collected.

The filling points shall identify the fluids to be used.

16.3 Tanks and equipment

16.3.1 Fuel tanks and pipework

The fuel tanks shall be fitted with venting equipment, which shall contain any overflow and prevent excessive pressure. Except for sealed drain cocks and inspection covers, all openings in the fuel tank shall be situated above the maximum fuel level.

For filling the machine with diesel fuel there shall either be an opening on each side of the vehicle, at a maximum height of 1 500 mm above rail level or where the fuel filling is unable to comply, the method of refuelling shall be described in the technical documentation.

The opening shall:

— either be directly on top of the fuel tank, or lead directly to the fuel tank by pipework, in all cases the opening shall be higher than the top of the fuel tank;

— be circular with a minimum diameter of 70 mm.

There shall be a marking located beside each diesel refuelling opening compliant with EN 15877-2:2013, 4.5.31.

The diesel refuelling opening shall be covered by a cover which seals the opening against fuel spillage. Except where an anti-theft device is fitted, the cover shall be able to be opened by hand without the requirement for specialist tools.

No fuel shall come out of the venting equipment of the machine even in the case of overflow or extreme inclination or tipping of the machine.

Fuel tanks with a capacity greater than 500 l shall be equipped with inspection hatches.

Each fuel tank shall have a level indicator to indicate the maximum and minimum level. The level indicator shall not show the level directly, e.g. by a sight glass or transparent tube.

Fuel tanks shall not be fitted at a distance of less than 300 mm from the extremity of the machine frame. Fuel tanks mounted on or under the machine frame shall either be equipped with additional safety devices to prevent a detached tank falling on to the track or the design shall ensure a detached tank cannot fall on to the track. The underside of fuel tanks shall not be less than 200 mm above rail level.

NOTE Further requirements are shown in EN 14033–3.

16.3.2 Hydraulic oil circuit

The hydraulic equipment shall be constructed for the use of biodegradable hydraulic oils.

16.4 Power equipment

Exhaust gases shall be directed towards the top of the machine, clear of the overhead line equipment, except for machines designed to be used for inspection, maintenance and construction of the higher parts of the infrastructure, e.g. overhead line equipment, bridges, tunnels.

Exhaust system(s) shall be designed in such a manner as to avoid exhaust gases being drawn into the cab(s).

NOTE 1 For emission of gas and particles, see EN 14033–3:2017, 5.20.

NOTE 2 European legislation, see Annex ZA, prescribes limit values for noise emissions of railbound construction and maintenance machines in running mode. These values concern stationary noise, starting noise, pass-by noise and interior noise in the driver's cab.

17 Aerodynamic effects

17.1 Cross wind

For machines with a maximum design speed higher than 140 km/h the characteristic wind curve (CWC) of the most sensitive vehicle shall be determined in accordance with the specification set out in EN 14067-6:2010, Clause 5, and subsequently recorded in the technical documentation as shown in Clause 20.

17.2 Slipstream effect of machines with maximum speed greater than 160 km/h

Machines with a maximum design speed greater than 160 km/h, running in the open air at a reference speed specified in Table 7, shall not cause the air speed to exceed the value $u_{2\sigma}$ as indicated in the Table 7 as measured at a height of 0,2 m and 1,4 m above top of rail at a distance of 3,0 m from the track centre, during the passage of the machine.

Table 7 — Limit criteria for slipstream effects on passengers on platform and on workers trackside

Maximum design speed (km/h)	Measurement performed at height above the top of rail (m)	Trackside maximum permissible air speed, [limit values for $u_{2\sigma}$ (m/s)]	Reference speed (km/h)
> 160 < 250	0,2	20	Maximum design speed
	1,4	15,5	200 km/h or the maximum design speed, whichever is lower
≥ 250	0,2	22	300 km/h or the maximum design speed, whichever is lower
	1,4	15,5	200 km/h

17.3 Head pressure pulse

Machines with a maximum design speed higher than 160 km/h and lower than 250 km/h, running in the open air at their maximum speed shall not cause the maximum peak-to-peak pressure of changes to exceed a value of 800 Pa as assessed over the range of height between 1,5 m and 3,0 m above the top of rail, and at a distance of 2,5 m from the track centre, during the passage of the head.

Machines with a maximum design speed higher or equal to 250 km/h running in the open air at the given reference speed 250 km/h shall not cause the maximum peak-to-peak pressure of changes to exceed a value of 800 Pa as assessed over the range of height between 1,5 m and 3,0 m above the top of rail, and at a distance of 2,5 m from the track centre, during the passage of the head.

These values shall be verified using the methodology set out in EN 14067-4:2013, 5.5.2.

18 Design for recovery purposes

Failed on-track machines shall be capable of being coupled to a locomotive fitted with a draw hook that complies with EN 15566:2016, 5.2, to enable the safe removal of the on-track machine clear of the line.

It shall be possible (where not prevented by damage to the brake system) to release and apply the brakes of the combined train when the assisted on-track machine is coupled to the assisting train or locomotive. The brake system shall be designed to apply the brakes on both parts of the train in the event of the combined train parting.

Where the on-track machine is designed to be recovered by use of an emergency tow bar, then the emergency tow bar shall:

— be carried on the on-track machine;

— either be designed to be fitted by one person or indicate how many people are required for its use;

— accept the forces and movements involved in the recovery of the on-track machine, without significant permanent deformation or damage.

The fitting instructions and any limitations on movement of the on-track machine and operation arising from the use of the emergency tow bar shall be stated in the instruction handbook.

Where the on-track machine is designed to be recovered involving the use of special brake hoses, then the special brake hoses shall:

— be carried on the on-track machine;

— be designed to be fitted by one person.

The fitting instructions and any limitations on movement and operation of the on-track machine arising from the use of the special brake hoses or other connections shall be stated in the instruction handbook.

It shall be possible to return the on-track machine to travelling mode in the event of failure of the primary power source. All equipment required for emergency stowage shall be supplied as part of the on-track machine's tool kit, together with suitable provision for it to be carried on the on-track machine.

The instructions and any limitations on movement and operation of the on-track machine arising from the failure of the primary power source shall be stated in the instruction handbook.

19 Machine marking

19.1 Lettering on the machine

All lettering and markings, which are specified in EN 15877-2 shall be applied to the machine in the places as specified in Annex G.

NOTE Machines transporting dangerous materials will be marked as described in RID.

19.2 Machine identification number

To identify the machines they shall carry a European Vehicle Number (EVN). The format of the EVN is specified in the relevant European legislation, see Annex ZA.

19.3 Details of the railway infrastructure where the machine is allowed to run

Additional markings to 19.1 could be required by the infrastructure manager.

NOTE An example is described in Annex F.

20 User information

20.1 General

In addition to the user information required in EN 14033-3:2017, 8.1, the manufacturer and/or owner of the machine shall provide technical documentation for type testing and the granting of working authorization.

This documentation shall be provided in one of the official CEN languages accepted by the authorized body. The presentation of drawings and units used shall comply with European Standards and shall contain assumptions for calculations used.

As a minimum the documents shown in 20.2, 20.3 and 20.4 shall be provided.

20.2 Data for inclusion in National Vehicle Register

The following information shall be provided in the technical documentation as a separate list within the instruction handbook. This is the information nominated by the Loc&Pas TSI to be reported to the National Vehicle Register:

TSI clause number	Information to be provided
4	**General technical characteristics**
4.1.1	Number of driving cabs
4.1.2	**Speed**
4.1.2.1	Maximum design speed
4.1.3	Wheel set gauge
4.1.4	Conditions of use regarding train formation
4.1.8	Validity of vehicle authorization
4.1.10	Structural category
4.2	**Vehicle kinematic gauge**
4.2.1	Vehicle kinematic gauge (interoperable gauge)
4.3	**Environmental conditions**
4.3.1	Temperature range
4.3.2	Altitude Range
4.3.3	Snow, ice and hail conditions
4.4	**Fire safety**
4.4.1	Fire safety category
4.5.2	**Design Mass**
4.5.2.1	Design mass in working order
4.5.2.2	Design mass under normal payload
4.5.2.3	Design mass under exceptional payload
4.5.3	**Static axle load**
4.5.3.1	Static axle load in working order
4.5.3.2	Static axle load under normal payload
4.5.3.3	Static axle load under exceptional payload
4.5.4	Quasi-static guiding force
4.6	**Rolling stock dynamic behaviour**
4.6.1	Cant deficiency
4.6.2	Vehicle equipped with a cant def compensation system ?
4.7	**Braking**
4.7.1	Maximum train deceleration
4.7.2	**Service Braking**

4.7.2.1	**Brake performance (steep gradients normal payload)**
4.7.2.1.1	Reference case of TSI
4.7.2.1.2	Speed
4.7.2.1.3	Gradient
4.7.2.1.4	Distance
4.7.2.1.5	Time
4.7.3	**Parking brake**
4.7.3.1	Is there a parking brake?
4.7.3.2	Type
4.7.3.3	Max gradient with parking brake alone
4.7.4	**Braking system**
4.7.4.1.1	Eddy current brake?
4.7.4.1.2	Possibility of preventing the use of eddy brake
4.7.4.2	**Magnetic brake**
4.7.4.2.1	Magnetic brake fitted?
4.7.4.2.2	Possibility of preventing magnetic brake?
4.7.4.3	**Regen brakes (only elec traction vehicles)**
4.7.4.3.1	Fitted?
4.7.4.3.2	Possibility of preventing regenerative brakes?
4.8	**Geometrical Characteristics**
4.8.1	Vehicle Length
4.8.2	Minimum in-service wheel diameter
4.8.4	Minimum curve radius capability
4.8.8	Suitability for transport on ferries
4.9	**Equipment**
4.9.1	Type of end coupling (with tensile/compressive forces)
4.9.2	Axle bearing condition monitoring (hot axles box detection)
4.9.3	**Flange Lubrication**
4.9.3.1	Flange lubrication fitted
4.9.3.2	Possibly of preventing the use of the lubrication device?
4.10	**Energy Supply**
4.10.1	Energy supply system
4.10.3	Maximum related current from the overhead line equipment
4.10.4	Maximum current at standstill per pantograph
4.10.5	Height of interaction of pantograph with contact wires

4.10.6	Pantograph head
4.10.7	Number of pantographs in contact with OCL
4.10.8	Shortest distance between two pantographs in contact with OCL
4.10.9	Type of OCL used
4.10.10	Material of pantograph contact strip
4.10.11	ADD fitted?
4.10.12	TSI conform energy meter installed?
4.11	**Noise related characteristics**
4.11.2	Pass-by noise level measured?
4.13.1	**Signalling**
4.13.1.1	ETCS Equipment on board and its level
4.13.1.2	ETCS baseline version
4.13.1.3	ETCS on-board equipment
4.13.1.4	ETCS national applications implemented
4.13.1.5	Class B/ train protection/ warning systems installed
4.13.1.6	Special conditions implemented on-board to switch over
4.13.2	**Radio**
4.13.2.1	GSM-R equipment on board/ version
4.13.2.2	Number of GSM-R mobile sets
4.13.2.3	Class B or other radio types installed
4.13.2.4	Special conditions to implemented to switch over
4.14	**Compatibility with train detection systems**
4.14.1	Type of train protection system
4.14.2	Machine characteristics regarding compatibility
4.14.2.1	Maximum distance between consecutive axles
4.14.2.2	Minimum distance between consecutive axles
4.14.2.3	Distance between first and last axle
4.14.2.4	Maximum length of vehicle nose
4.14.2.5	Minimum wheel rim width
4.14.2.6	Minimum wheel diameter
4.14.2.7	Minimum flange thickness
4.14.2.8	Minimum flange height
4.14.2.9	Maximum flange height
4.14.2.10	Minimum axle load
4.14.2.12	Wheel material is ferromagnetic?

4.14.2.13	Maximum sanding output
4.14.2.14	Possibility of preventing the use of sanding
4.14.2.16	Maximum impedance between opposite wheels of a wheelset
4.14.2.17	Minimum vehicle impedance (between wheels and pantograph)

20.3 Instruction Handbook

20.3.1 Technical documentation

For determining the conformity of a machine with the requirements of this standard's technical documentation should be given by the manufacturer to the organization confirming conformity. This documentation should be presented in one of the three official CEN languages and if specified by contract in the language of the organization. Drawings and units should conform to European Standards. Details should be given of assumptions used for calculations.

The documentation required is as follows:

a) Summary of the delivered documents.

b) Outline diagram showing:

1) Principal dimensions;

2) Position of the centres of gravity;

3) Position of the marker lights;

4) Maximum machine mass without payload (as shown in 7.7.3);

5) Maximum permitted load;

6) Maximum machine mass with payload (as shown in 7.7.4);

7) Minimum radius of curvature in vertical and horizontal planes that can be negotiated;

8) Lifting and jacking points;

9) Indication of exhaust position;

10) Position of buffing and draw gear.

c) Running gauge details including calculation of the reductions at critical points. All critical points shown shall be detailed and dimensioned, according to the example given in Annex C.

d) Axle loads and wheel loads of the machine both empty and loaded (in running mode).

e) Drawings of the suspension together with the characteristics of the springs, dampers and guides including those which are part of the body.

f) Details of bogie rotational clearance.