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Railway infrastructure — Rail mounted construction, maintenance and inspection machines — Explanation of machine type

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Railway infrastructure — Rail mounted construction, maintenance and inspection machines — Explanation of machine type

Infrastructure ferroviaire — Machines de construction, de maintenance et d'inspection montées sur rail — Explication du type de machine

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Foreword

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This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 1, *Infrastructure*.

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Introduction

This document is intended to provide information on machines that are fitted with rail wheels. The purpose of this document is to clarify the complex variety of machines that are used for the construction, maintenance, inspection, repair and renewal of railway infrastructure. It is intended to be used as an introduction to the various types of rail mounted maintenance and infrastructure inspection machines. It is also intended as an aid to clarify the complexity caused by machines which are designed and intended for a specific working purpose but also have the ability to operate as a railway vehicle as an additional function.

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Railway infrastructure — Rail mounted construction, maintenance and inspection machines — Explanation of machine type

1 Scope

This document describes the different modes of operation and the classification of machine types.

This document covers machines fitted with rail wheels that are used for the construction, maintenance, inspection, repair and renewal of railway infrastructure. These include:

— on-track machines (OTMs), which are specially designed for construction and maintenance of the track and infrastructure;

— infrastructure inspection vehicles, which are utilised to monitor the condition of the infrastructure;

NOTE Inspection of the infrastructure includes measurement.

— environment vehicles, which are designed for clearance of the track from environmental conditions such as snow clearance machines;

— emergency vehicles, which are designed for a specific emergency use such as evacuation, firefighting and recovery of trains (including breakdown cranes);

— road-rail machines, which are able to move on railway track and on the ground;

— trolleys and portable machines that are manually moved along the railway track.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Machine type

3.1.1
rail mounted machine
generic term for the collection of all machines which have wheels suitable for running on railway tracks and are intended for the construction, maintenance, inspection, repair and renewal of railway infrastructure

Note 1 to entry: It is also applicable to machines used for emergency rescue purposes on railway infrastructure.

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3.1.2
railbound machine with running mode
machine intended to operate track signalling and control systems which only has wheels suitable for running on railway tracks and is intended for the construction, maintenance, inspection, repair and renewal of railway infrastructure

3.1.3
on-track machine
OTM
railbound machine with running mode specially designed for construction and maintenance of the track and infrastructure, running on its own rail wheels and designed and intended to operate signalling systems

Note 1 to entry: Such machines have running mode and travelling and working modes.

Note 2 to entry: Such machines are either self-propelled in running mode or hauled in running mode (hauled machines are permitted to have a self-propelled option in working/travelling mode).

3.1.4
infrastructure inspection machine
self-propelled or hauled railbound machine with running mode used to monitor the condition of the infrastructure, running on its own rail wheels, and designed and intended to operate signalling systems

Note 1 to entry: These machines are considered to be OTM unless they are intended to be incorporated in passenger or freight trains.

3.1.5
railbound machine without running mode
machine that can travel and work only on rail and which is not intended to operate track signalling and control systems, but is not able to travel on the ground

Note 1 to entry: Such a machine is permitted to work on the railway only under special operating conditions and travel under special conditions, i.e. it does not have a running mode.

3.1.6
non-demountable machine
self-propelled railbound machine without running mode that is not designed to get on and off track by its own means nor by other lifting equipment

3.1.7
demountable machine
self-propelled railbound machine without running mode that is designed to get on and off track by its own means or by other lifting equipment

Note 1 to entry: In the case of demounting by its own means, these are not intended for operating on the ground.

3.1.8
trailer
non-self-propelled railbound machine without running mode that can be towed on rail wheels and is not intended to operate track signalling and control systems

Note 1 to entry: Trailers are not designed to have a running mode.

Note 2 to entry: Trailers are hauled by *railbound machine without running mode* (3.1.5), *non-demountable machine* (3.1.6) or *road-rail machine* (3.1.9).

3.1.9
road-rail machine
self-propelled machine that can move on railway track and ground

Note 1 to entry: It is normally a road vehicle adapted for moving on rail also but can also be a specially designed rail vehicle for moving on the ground.

Note 2 to entry: It does not imply that the machine is suitable for use on the public road.

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3.1.10
road-rail trailer
trailer that can be towed on railway track and ground

3.1.11
lightweight demountable machine
machine with rail wheels which is designed so that it can be manually placed on or off the track and is either self-propelled or towed along the railway track

3.1.12
trolley
equipment moved along track on wheels or runners by human force only, which is designed so that it can be manually placed on or off the track; uses include transport of materials, tools and/or various equipment

3.1.13
portable machine
machine designed or adapted for use on the track which is propelled by manual effort (i.e. no powered drive system), but has a lifting capability and/or incorporates a power system (e.g. internal combustion, electro-mechanical, hydraulic, pneumatic energy sources or from an external supply) for specific work applications

3.2 Operational modes

3.2.1
running mode
configuration of a machine when it allows movement along the track, all moveable parts stowed within the applicable gauge, with the machine interacting with the signalling and control systems

Note 1 to entry: A fuller explanation is given in 4.4.

3.2.2
travelling mode
configuration of a machine when it allows movement along the working track, all moveable parts stowed (but not secured) within the applicable gauge, and when the machine does not require to interact with the signalling and control systems (in this condition, there is no need to ensure operation of signalling systems or for cab-based signalling equipment)

Note 1 to entry: A fuller explanation is given in 4.3.

Note 2 to entry: A machine in travelling mode does not need to meet the operational requirements for the movement of trains on the railway network.

3.2.3
working mode
mode when the machine is used to perform any of its permitted designed working tasks

Note 1 to entry: A fuller explanation is given in 4.2.

3.3 General

3.3.1
infrastructure manager
body or undertaking responsible for establishing and maintaining railway infrastructure, as well as for operating the railway control and safety systems

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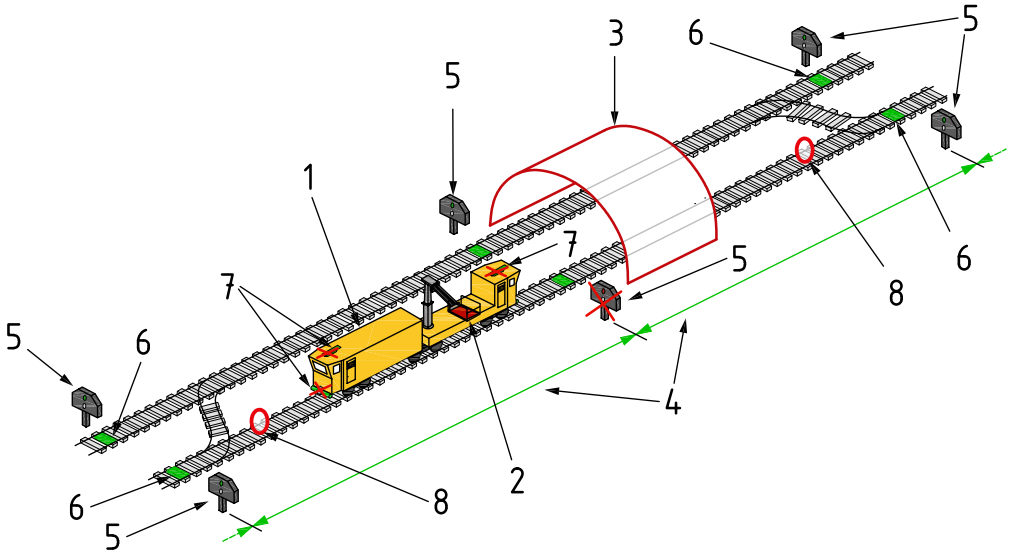
4 Modes of operation

4.1 General

Before explaining the various generic types of machines, it is useful to understand the three basic operating modes of a machine on the railway as described in this report, as they have a significant effect on the type of machine and its compliance process.

4.2 Working mode

When in working mode, the machine is protected from interference with passenger and freight trains by operational controls applied to the rules of the infrastructure manager. It is possible, but not always the case, that signalling systems will not be operational.



Key

1	machine	5	signal (with a cross means it can be isolated)
2	moveable component outside machine gauge	6	track mounted signalling equipment
3	limiting infrastructure gauge (tunnel, etc.)	7	vehicle mounted signalling equipment (off)
4	signalling block sections	8	train stop for passenger and freight trains

Figure 1 — Schematic representation of working mode

In working mode, as shown diagrammatically in Figure 1, a machine is permitted to exceed the vehicle gauge of the track it is on. Planning will be undertaken to avoid damage to the infrastructure by the machine which can need devices to limit its movement and/or other operational controls. Another area of planning is whether passenger and freight trains will be allowed to pass the work site on the adjacent track.

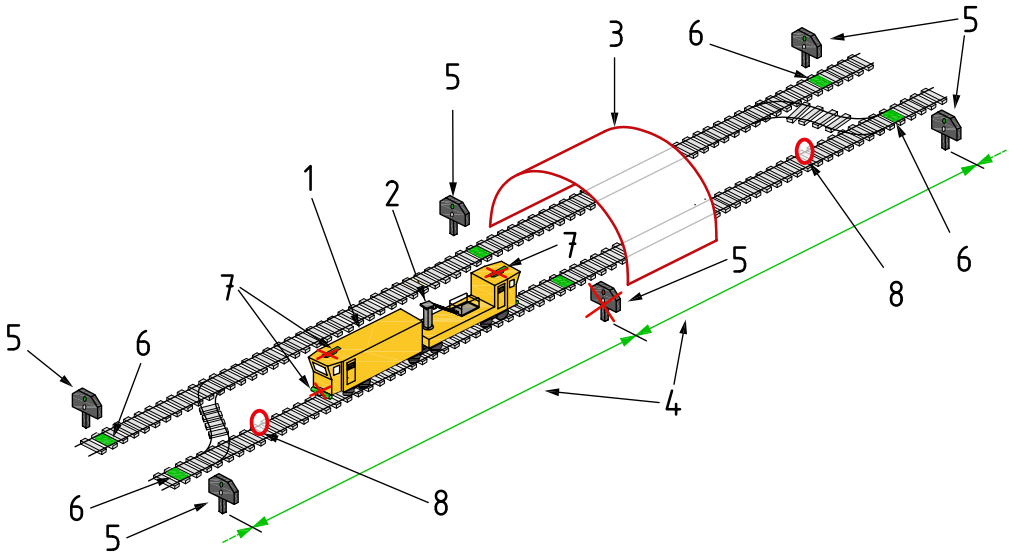
When self-propelled, a machine is operated by a driver/operator who fulfils the infrastructure manager's requirements for the line it is on.

4.3 Travelling mode

Where the machine needs to move from one site to another site, but only on the line that is protected from interference with passenger and freight trains by operational controls applied to the rules of the infrastructure manager, then the machine needs to be within gauge for the line but does not necessarily need to react with signals. This is called travelling mode, as shown diagrammatically in Figure 2. Where the machine is self-propelled, it is operated by a driver/operator who fulfils the infrastructure manager's requirements and the driver/operator needs to be able to see far enough ahead of the machine to enable the machine to stop within the sighting distance.

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Key

1	machine	5	signal (with a cross means it can be isolated)
2	moveable component within machine gauge	6	track mounted signalling equipment
3	limiting infrastructure gauge (tunnel, etc.)	7	vehicle mounted signalling equipment (off)
4	signalling block sections	8	train stop for passenger and freight trains

Figure 2 — Schematic representation of travelling mode

4.4 Running mode

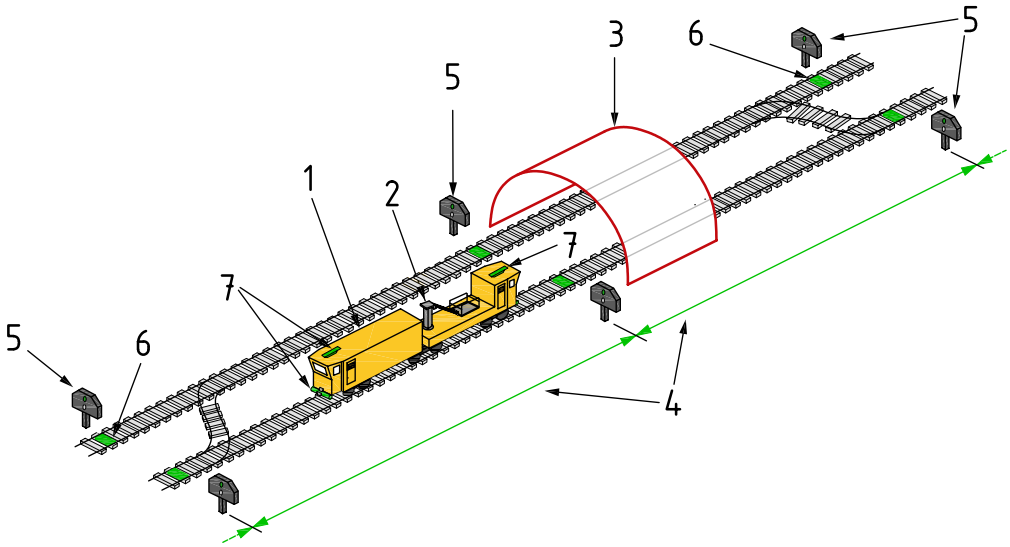
Running mode is shown diagrammatically in Figure 3. This is where the machine is operated under the same rules as a comparable standard railway vehicle.

Not every machine has a running mode. A machine in running mode will be expected to behave and react to the railway signalling and control systems on the track it is running on in the same way that a passenger or freight train would be scheduled for operational service.

In running mode, a machine can either be self-propelled or towed. When self-propelled, it will be driven by a train driver who complies with the signalling systems on the line it is running on, e.g. the driver has to be able to see signals, machine is fitted with in cab signalling etc. When a machine is not self-propelled in running mode, it will be towed and needs to behave with the signalling system in the same way that is expected for a railway wagon.

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Key

1	machine	5	signal
2	moveable component locked in machine gauge	6	track mounted signalling equipment (includes detection of the machine)
3	limiting infrastructure gauge (tunnel, etc.)	7	vehicle mounted signalling equipment (working)
4	signalling block sections		

Figure 3 — Schematic representation of running mode

In addition to signalling, machines also need to comply with other infrastructure-based control and detection systems. The machine when in running mode has to be within, and remain within, the gauge of the line it is running on to avoid collision with infrastructure or trains/machines on adjacent tracks.

Machines that have a running mode will have similar features to conventional rolling stock (e.g. locomotives, wagons or multiple units). When a machine is in running mode, it will have to be compatible with the interfaces of the railway it is running on. There will always be differences between machines and railway vehicles, which are discussed in this document. The primary purpose of a machine are the working processes which are different to vehicles for the transportation of passengers and freight.

5 Generic types of machine

5.1 General

5.1.1 Classification

The range of machines that are used for railway infrastructure work is extremely varied. Some examples are shown in Annex A, but these are a small selection and new models are continuously created. However, there are a few basic principles that can be used to decide what generic type of machine any particular machine falls into. Principally there are five generic types of machines, and each machine will ultimately be one of these:

a) railbound machines with running mode;

b) railbound machines without running mode (including trailers);

c) road-rail machines (including road rail trailers);

d) lightweight demountable machines;

e) trolleys and portable machines.

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By a relatively simple series of decisions, it is possible to clarify which generic type the machine belongs to, see 5.2.5.

5.1.2 Railbound machines with running mode

5.1.2.1 General

Railbound machines with running mode tend to be the larger machines and, as the name suggests, remain on the railway line, i.e. they are delivered to their place of work by use of the railway line. Operationally, railbound machines with running mode are railway vehicles in running mode and machines in working and travelling modes.

5.1.2.2 On-track machine (OTM)

Railbound machines with running mode are built to be able to interact with the signalling and control system for the railway line they are being used on. If the railbound machine is self-propelled in running mode then it will need to be fitted with all the in-cab signalling systems that a passenger or freight train is fitted with on that line (e.g. Indusi, TVM300, AWS, ERTMS). If the machine is hauled in running mode, then it still needs to react with the signalling and control systems in the way that a freight wagon is expected to; for example, the axle weights and wheel spacing will need to be compatible with the signalling system, the axle bearings need to be in a position to be monitored by the hot box detection systems, etc.

Railbound machines with running mode can be self-propelled in running and travelling/working modes, or hauled in running mode and self-propelled in travelling/working modes, or hauled in both running and travelling/working modes. Railbound machines with running mode are usually capable of being incorporated into trains or hauled by locomotives, but some are only able to run under their own power or be towed by specially dedicated machines. The machines which are capable of integration with trains are normally characterised for example by having standardised railway wheelsets and couplings.

The various categories of railbound machines with running mode are shown in Table 1.

Table 1 — Railbound machines with running mode categories

	Self-propelled in running mode	Towed in running mode [b]
Can be incorporated into a train [a]	Category A	Category B
Cannot be incorporated into a train	Category C	Category D

[a] Some machines can have restrictions for their position within the train.

[b] These machines are permitted to have a self-propelling function in travelling or working mode.

5.1.2.3 Infrastructure inspection machines

The status of infrastructure inspection machines can be ambiguous, but for clarity:

— most infrastructure inspection machines, including those that are self-propelled infrastructure inspection machines are considered as railbound machines and comply with the standards written for railbound machines with running mode;

— infrastructure inspection machines that are designed to be incorporated into passenger trains are considered as railway vehicles rather than machines and comply with the standards applicable to passenger vehicle(s) concerned;

— infrastructure inspection machines that are designed to be incorporated into freight trains are considered as railway vehicles rather than machines and comply with the standards applicable to wagons.

Additionally, there is equipment that is attached to railway vehicles which is used to monitor the condition of the infrastructure, such as unattended measurement systems. This monitoring equipment is not considered within this document.

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5.1.2.4 Converted railway vehicles

Converted railway vehicles, where this involves components moving out of vehicle gauge or generating asymmetric/abnormal wheel loads, are now considered as machines and will need to be reassessed as machines. This is applicable to wagons and coaches that are modified with equipment or machines to carry out work on the railway infrastructure.

5.1.2.5 Environmental and emergency vehicles

These special vehicles are designed to move on railway tracks for a specific purpose, i.e. for clearance of the track from environmental conditions such as snow clearance machines or emergency use such as evacuation, firefighting, and recovery of trains (including breakdown cranes). These vehicles are normally very similar to machines shown above and will need to comply with the same rules and requirements.

5.1.3 Railbound machines without running mode

This generic type of machine is always used in an area separated from passenger or freight trains by operational means as specified for the railway line it is on and therefore does not have a running mode. They do not therefore need to interact with all the signalling and control systems.

Railbound machines without running mode have to be brought to near the intended railway worksite and then lifted onto the railway track, or stored in local sidings until needed. Once on the railway track, infrastructure maintenance machines are self-propelled, and trailers are hauled along the track.

Railbound machines without running mode which are designed and intended to be regularly lifted on and off track, or have the ability to lift themselves on and off track, are known as demountable machines.

Non self-propelled railbound machines without running mode, which are towed by other machines, are known as trailers.

5.1.4 Road-rail machines

A road-rail machine has the ability to move on its own power on railway track and on the ground. In general, they approach the railway track by land-based means and then are used on the track to fulfil their function. These machines move on the ground by means of either road wheels or crawler tracks. Machines which use only sliding rams to get onto the track are not considered road-rail (and would normally be a railbound machine without running mode). There are examples of machines with road wheels that get near to the track and then use sliding rams to position themselves onto the railway track, these are road-rail machines because of the fitment of road wheels (or crawler tracks).

The ability of the machines to move on the ground does not automatically mean the machines have the ability (or necessity) to be used on a public road. Therefore, in some respects, the name road-rail is slightly confusing because it does not confer rights or ability to use a “road”.

Some road-rail machines are designed, intended and permitted to be used on the railway line without special protection for them, i.e. they have a running mode; these will need to react with the signalling and control systems as explained in 5.1.2.

Road-rail machines have three basic means of propulsion along the railway track, known as Type A, B or C. Their drive and braking arrangements are described below and summarised in Table 2. Examples are shown in Annex A.

Type A machines are where the power is applied directly from the rail wheels, this is usually from an axle mounted hydraulic or electric motor, the braking on Type A machines is also directly on the rail wheels.

Type B machines have the road wheel squeezed against the rail wheel (or sometimes on a knurled extension of the rail wheels). The power to move along the track comes from the road wheels, which turn the rail wheels and move along the track. Braking is provided from the road wheel and can also have independent brakes acting directly onto the rail wheels.

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Type C machines have the rail wheels directly bearing on the rail head, with the rail wheels providing guidance only for the machine.

Table 2 — Road-rail machine drive types

	Type A	Type B	Type C
Power from rail wheel	✓		
Power from road wheel		✓	✓
Braking from rail wheel	✓	✓	
Braking from road wheel		✓	✓
Guidance from rail wheel	✓	✓	✓

NOTE Road-rail machines Type A, B and C have no relation to railbound machines category A, B, C and D.

Non self-propelled machines which have the ability to be moved on railway track and on the ground are road-rail trailers because of the fitment of road wheels (or crawler tracks). A road-rail trailer can be self-propelled on the ground but not on railway track.

5.1.5 Lightweight demountable machines

Lightweight demountable machines are self-propelled for movement along the track but are small enough to be lifted on and off the track manually.

5.1.6 Trolleys and portable machines

Manual propulsion is the only permitted form of movement along the railway track for trolleys and portable machines with rail wheels, which characterizes this specific generic type of machines. Any machine which is intended to be towed at any stage, belongs to one of the previous generic types. If there is any form of powered movement along the track, even if very slow, then it is not a trolley (and will probably be a lightweight demountable machine).

5.1.7 Demountable modules

Demountable modules are removable units which are capable of being attached with dedicated fastening system to a machine or wagon, to perform a specific function. A demountable module will need to be checked for conformity as part of the machine to all relevant clauses in all parts of the relevant machine standard when any of the following apply:

a) it has been manufactured or modified to suit the particular machine or type of machine;

b) it is used to carry personnel during travelling mode;

c) it is positioned on the machine by other than gravity or twist locks;

d) it has electrical, pneumatic or hydraulic connections to the machine;

e) it is connected to the machine by twist locks and is used for lifting any load whilst on the machine;

f) it is connected to the machine by twist locks and has moveable components which are able to exceed the gauge profile of the machine.

5.1.8 Attachments

Attachments can be fitted to machines that are described in this document. Any equipment that is mechanically fixed to and/or powered or controlled from the host machine is considered as an attachment (this can be a lifting accessory). Mechanically fixed is normally taken to indicate that the attaching point is semi-permanent (very often a quick hitch type device, twist lock or plug and play mechanism). Equipment which requires a workshop and skilled fitting staff to assemble/remove is considered to be a part of the host machine, and its addition is a modification to the machine.

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The use of attachments needs to be carefully described by the manufacturer of the attachment because they can have detrimental effects on the host machine. The effect on stability is more serious for railway use. For safe operation, the instruction handbook for the attachment will need to specify the minimum characteristics of the host machine.

5.1.9 Machines without rail wheels

There are many machines which do not have rail wheels, i.e. they have the ability to move on ground only, these are generally referred to as “civil engineering machines”, e.g. excavators, loaders, mobile elevating work platforms (MEWPs), mobile cranes. These machines are outside the scope of rail mounted machine standards. These machines will have their own specific regulations and can be subject to the infrastructure manager’s specific conditions when working on or adjacent to the railway.

There are machines that are specifically designed and intended for use on the railway infrastructure that are not guided by the railway track. These machines are not covered in this document, see A.9 for example.

5.1.10 Locomotives and wagons

There are railway vehicles (locomotives and wagons) that are specifically designed and intended for use with railbound machines, for example wagons for carrying ballast. Where the wagon carries a load only, and the loading and unloading activities are undertaken by other machines, then these vehicles are not covered in this document.

If during infrastructure maintenance activities these vehicles have any of the following characteristics:

— are capable of generating asymmetric and/or abnormal wheel loads,

— have parts of the ‘vehicle’ that can exceed the loading gauge,

— power operated mechanisms (i.e. not manually operated),

then, they are actually machines and considered to belong to machines in 5.1.2 to 5.1.4.

5.2 Classification of rail mounted machines

5.2.1 Classification method

There is an almost infinite variety of machines. However, with relatively few questions, it is possible to ascertain which family the machine belongs to, see Figure 4.

5.2.2 Machines with a running mode

Running mode means the ability to run on the railway track in a manner similar to passenger and freight trains, i.e. to interact with the signalling and control systems. Railbound machines and road-rail machines can have a running mode.

5.2.3 Machines with a road mode

Road-rail machines are able to move on the ground as well as on rail – all the machines have the ability to move along the railway line. Machines that have wheels or crawler tracks for use of movement on the ground are said to have a ‘road mode’. The use of the term road mode does not confer any ability of the machine to be used on a public road.

There are machines that in their working mode have the ability to move on ground; if these are railbound machines that only travel on the ground in working mode then they are not road-rail machines and are considered as OTMs that turn into civil engineering machines when on site, normally when the track is missing during the working process.

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