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EIM

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EIM POSITION PAPER ON THE USE OF EDDY CURRENT TRACK BRAKES

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Introduction:

With respect to the several Rolling Stock TSIs, the EIM position on the use of eddy current brakes and their influence on the infrastructure is as follows.

EIM recognises that the use of brake systems, such as eddy current brakes, that are independent of adhesion between wheel and rail improve rail safety by enabling:

- shorter stopping distances when applied
- reduced dependency between stopping distance and rail wheel adhesion, particularly during adverse adhesion conditions (for example caused by moisture, ice, leaves or other pollution on the rail head).

Furthermore, with increasing train speeds there is a need to enhance both service and emergency braking performance and eddy current brakes offer braking power which is difficult to achieve with other methods of enhancing braking performance such as dynamic braking.

Eddy current brakes also have desirable secondary effects in that their use:

- mitigates the thermal capacity problems of brake pads and discs associated with conventional friction braking systems
- avoids harder application of conventional friction brakes leading to excessive wear of the pads/discs.

However, eddy current brakes have compatibility issues with infrastructure that can potentially impair both safety and technical reliability

Because of these compatibility issues the unrestricted use of eddy current brakes cannot be allowed in the rolling stock TSIs and their use shall be accepted by the IM on a site specific basis. Where their use is permitted this shall be published in the Infrastructure Register.

EIM explains:

The overall technical background and working principle influencing the track design:

- The working principle behind the eddy current track brake leads to a revision of the requirements for the design of track and line side equipment to ensure compatibility and applying these new requirements to existing infrastructure may prove cost prohibitive or not technically feasible, and for new infrastructure may lead to increased initial investment and higher ongoing maintenance costs.

Why do infrastructure managers need to be able to restrict the use of eddy current track brakes?

- The use of eddy current track brakes raises issues of compatibility between the braking system and the infrastructure. These include:

- electromagnetic compatibility with train detection installations (for example track circuits and axle counters)
- electromagnetic and physical compatibility with line side equipment for train condition monitoring (for example hot wheel detection)
- elevated temperatures in the rail head, which can lead to track buckling.

Background:

While air brakes of the various standardised designs remain in general use the need for supplementary braking systems on trains increases with speed. In Europe the UIC air brake is the most common type and forms the basis for the braking performance considerations needed in the running of trains. The performance of the UIC air brake system has well understood limitations related to train speed, weight and length. These limitations have driven a series of improvements to increase deceleration rates over the years.

With the introduction of electric traction motors, the use of dynamic braking - that is the use of the traction motors as generators - was introduced, allowing higher train loads. The dynamic braking system also reduces wear on brake pads/shoes and discs thereby prolonging the life of these components and reducing maintenance costs.

For speeds over 200km/h it becomes necessary to supplement the service air brake function further and the eddy current track brake is a means for achieving this. The eddy current track brake works with a magnetic field across an air gap between the train mounted “brake head” and the rail head making it a contact and adhesion free form of braking. The high braking forces that are possible with this type of brake have advantages for the rolling stock in reducing the maintenance costs of the braking system and increasing the safety margins for achieving brake performance curves in line with the requirements for high speed working. The braking force can be controlled by regulation of the magnetic field and the kinetic energy dissipated during deceleration is absorbed as heat in the rail.

The eddy current brake installation is similar in configuration to the magnetic track brake as the braking heads are usually attached to the bogie frames between the wheels on either side and are only lowered to the to give the specified air gap (for example 6 – 7 mm for the German ICE 3 train) when the brake is activated. This means that the eddy current brake, even if it is not in contact with the rail, will be in close proximity to the rail and line side and track mounted equipment and can not only influence these electromagnetically but also physically. It is thus important that they are geometrically compatible and in correct adjustment.

When the eddy current brake is used for service braking, the heating of the rail becomes an important factor. The issue being that the regulating of the speed of trains is done in specific areas and towards fixed features (for example on the approach to signals, speed restrictions, junctions and stations) and therefore trains will use the service brake

repeatedly in the same areas. This has led to restriction of the use of eddy current brakes in Germany to slab track only. It is not only the heating of the rail head and the longitudinal force that is of importance but also the uplift of the track panel leading to a reduction in lateral stability and increased risk of track distortion or buckling.

In Germany there are currently no additional restrictions placed on the use of eddy current track brakes at times when rail temperatures are elevated due to solar radiation.

Apart from the effect of heating the rail, other components are potentially adversely affected and in need of modification prior to service. For example axle counters and hot-wheel detectors (dragging brake detectors) were an issue during the introduction of eddy current brakes in Germany in conjunction with the operation of the ICE 3 trains and were resolved by addressing the various system influences.

Considerations and impact on the rail infrastructure:

From the above it may be deduced that:

- eddy current brakes are an effective means of regulating train speed at higher line speeds
- the brake effort can be regulated and varied to provide both service and emergency braking modes
- the infrastructure will need to be adapted for the use of eddy current brakes
- physical clearance must exist between track structure and the eddy current brake head
- electromagnetic compatibility issues with track mounted and lineside equipment must be addressed
- the track resistance to longitudinal, vertical and lateral forces must be considered and that this will place additional requirements on the design and construction of the track

Conclusion:

The unrestricted use of eddy current brakes cannot be allowed in the Rolling Stock TSIs.

The Infrastructure Manager may allow the use of eddy current brakes to the extent that the brakes are considered compatible with specific infrastructure installations and the track construction is adequate.

If the use of eddy current brakes is permitted by the IM the location and any particular restrictions on use shall be published in the Infrastructure Register.