## Technical Report

Brussels, June 2022

# Rear end signals

**CER aisbl** – **COMMUNITY OF EUROPEAN RAILWAY AND INFRASTRUCTURE COMPANIES**
Avenue des Arts 53 – 1000 Bruxelles | T: +32 (0)2 213 08 70 | F: +32 (0)2 512 52 31 | @CER_railways | E: contact@cer.be | www.cer.be

# Rear end signals

## Summary

**This CER Technical Report summarises the findings of the discussions carried out at experts level on rear end signals in 2022.**

- CER OPE experts
- CER Safety experts

**This CER Technical Report gives an overview about feasible options for rear end signals (reflective plates) and finally recommends the use of a single rear end signal (reflective plate as defined in the OPE TSI) under certain conditions.**



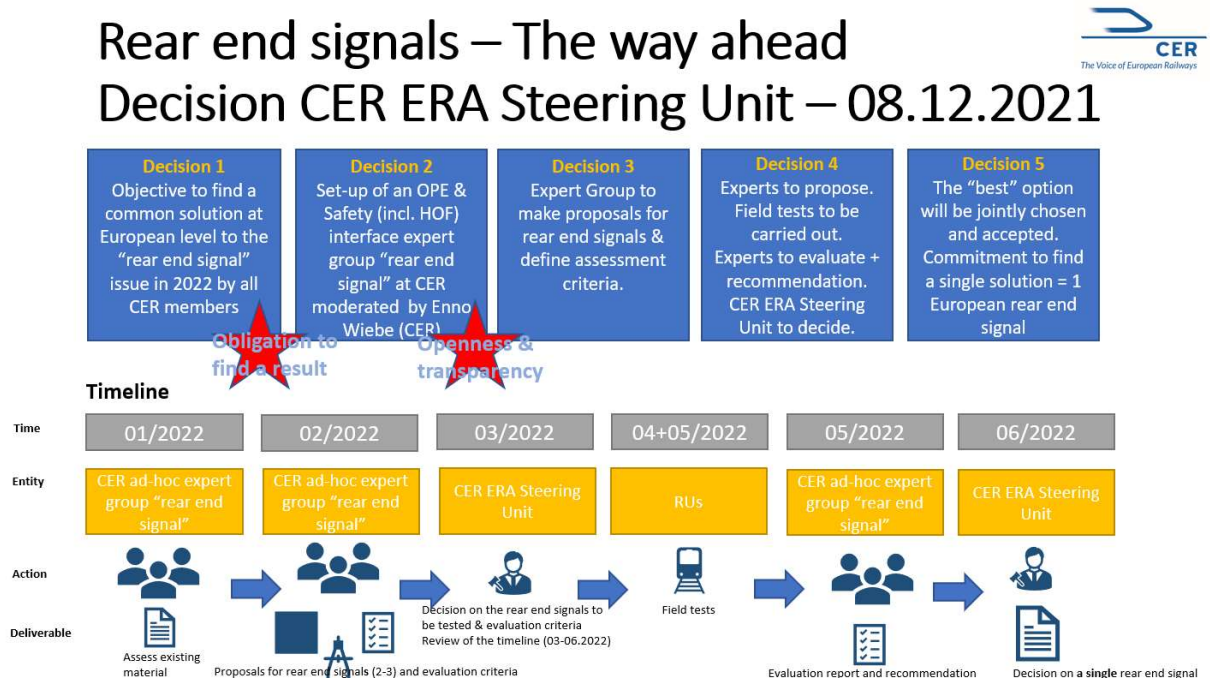
# Contents

1. The mandate given to CER by its members ..... 3
2. The legal background & legal requirements ..... 3
3. Return of experience with rear end signals from the CER members ..... 7
4. Intermediate findings of the OPE experts regarding the interoperability aspects of rear end signals ..... 13
5. Intermediate findings of the CER safety experts regarding the safety aspects of rear end signals ..... 13
6. Costs – Fact & Figures ..... 15
7. Analysed options ..... 15
8. Field tests carried out by SNCF ..... 16
   8.1. TSI OPE reflective plate versus a new design of reflective plates ..... 16
   8.2. TSI OPE reflective plate versus steady lights ..... 18
   8.3. SNCF findings ..... 19
9. CER Conclusion ..... 20
10. References ..... 20

11. Abbreviations ..... 20
12. CER proposal for a change request (OPE TSI – front end signals) ..... 21

## 1. The mandate given to CER by its members

The following mandate was given to CER by the CER ERA Steering Unit at the 70th meeting of the CER ERA Steering Unit on 08.12.2021:



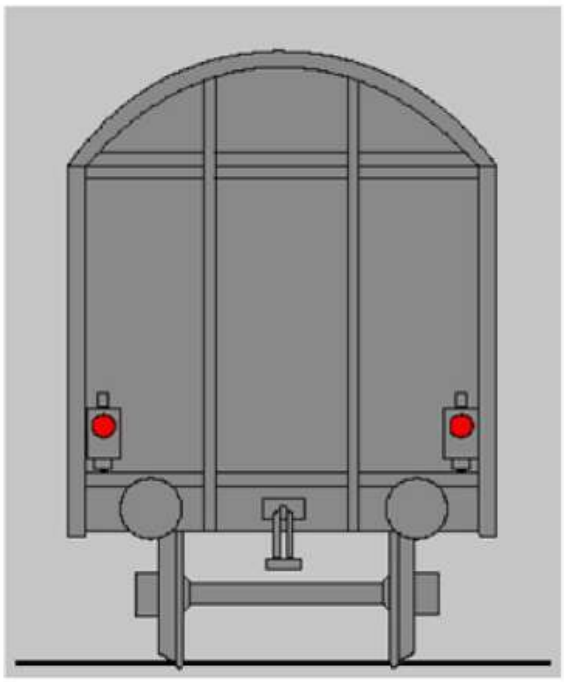

Reference: 70th meeting of the CER ERA Steering Unit on 08.12.2021 – Minutes of the Meeting

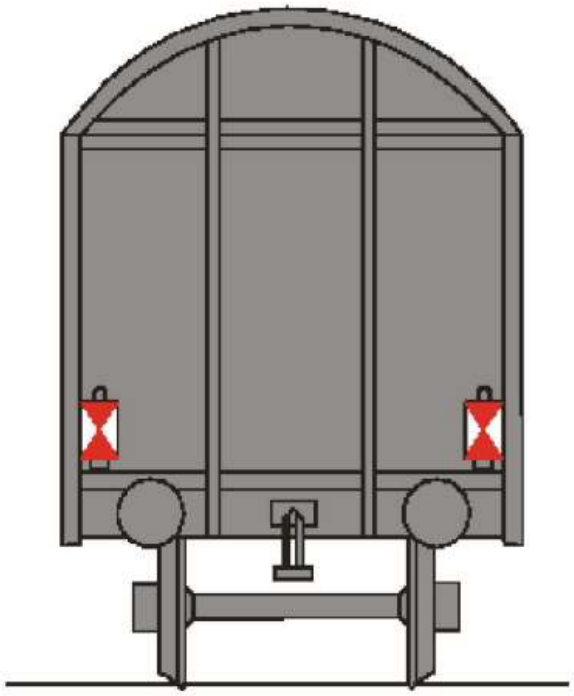
## 2. The legal background & legal requirements

Commission Implementing Regulation (EU) 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management subsystem of the rail system within the European Union - *OJ L 139I , 27.5.2019, p. 5–88 (BG, ES, CS, DA, DE, ET, EL, EN, FR, HR, IT, LV, LT, HU, MT, NL, PL, PT, RO, SK, SL, FI, SV)*

https://eur-lex.europa.eu/eli/reg_impl/2019/773/oj

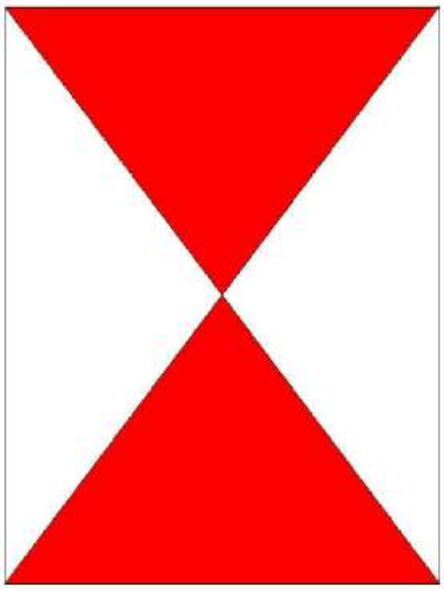
4.2.2.1.3. Rear end The railway undertaking shall provide the required means of indicating the rear of a train. The rear end signal shall only be exhibited on the rear of the last vehicle of the train. It shall be displayed as shown below.





4.2.2.1.3.1. Passenger trains The rear end signal of a passenger train shall consist of 2 steady red lights at the same height above buffer on the transversal axis.

4.2.2.1.3.2. Freight trains The rear end signal of a freight train shall consist of 2 reflective plates at the same height above buffer on the transversal axis. Any train equipped with 2 steady red lights shall also be considered to comply with this obligation. Reflective plates shall comply with Appendix E to Wagon TSI and have the following shape with white side triangles and red top and bottom triangle:



The plates shall be on the same height above buffer on the transversal axis

Specific cases:
Belgium, France, Italy, Portugal, Spain and UK may continue to apply notified national rules that require freight trains to be equipped with 2 steady red lights as a condition to run on sections of their network, where this is justified by operating practices already in place and/or national rules notified before end of January 2019.

Reports:
At the latest by 30 September 2020, the concerned Member States shall deliver to the Commission reports on their use of reflective plates, identifying any serious obstacles to the planned elimination of national rules.

Cooperation with neighbouring countries:
In the meantime, Member States concerned, in particular at the request of the railway undertakings, shall perform an assessment with a view to accept the use of 2 reflective plates in one or more sections of their network if the result of the assessment is positive and define appropriate conditions, which shall be based upon an assessment of the risks and operational requirements. This assessment shall be completed within a maximum period of 6 months after receiving the railway undertaking's request. The acceptance of reflective plates shall be granted, unless the Member State can duly justify the refusal based on the negative result of the assessment. Member States shall in particular endeavour to permit the use of reflective plates on rail freight corridors, with a view to prioritise the current bottlenecks. These sections and details of any conditions pertaining to them shall be recorded in the RINF. Until the information is encoded in RINF, the infrastructure manager shall ensure the information is communicated to railway undertakings by other appropriate means. The infrastructure manager shall identify the sections of lines on which 2 steady red lights are required in the RINF.

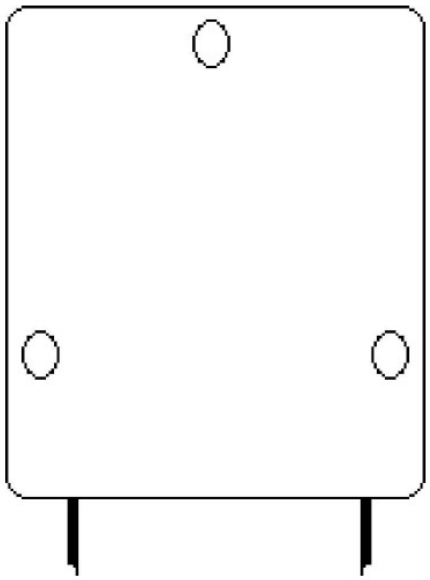
Phasing out:
By 31 March 2021, the Commission shall, on the basis of a recommendation from the Agency and taking into account the findings in the reports delivered by Member States, review the dates and specifications with a view of harmonising the rear end signal to have reflective plates accepted for the whole Union, bearing in mind the safety and capacity concerns as well as cost impact during the transition. Unless such revision provides otherwise the following deadlines shall apply for accepting freight trains equipped with 2 reflective plates:

(1) From 1 January 2022, along the rail freight corridors specified in accordance with Regulation (EU) No 913/2010 of the European Parliament and of the Council (5).

(2) From 1 January 2026, in the whole European Union rail network. The Commission shall report to the committee referred to in Article 51 of Directive (EU) 2016/797 on the implementation progress of section 4.2.2.1.

4.2.2.1.2. Front-end
The railway undertaking shall ensure that an approaching train is clearly visible and recognisable as such, by the presence and layout of its lit white front-end lights.

The forward facing front-end of the leading vehicle of a train shall be fitted with three lights in an isosceles triangle, as shown below. These lights shall always be lit when the train is being driven from that end.



The front-end lights shall optimise train detectability (marker lights), provide sufficient visibility for the train driver (head lights) by night and during low light conditions and shall not dazzle the drivers of oncoming trains.

The spacing, the height above rails, the diameter, the intensity of the lights, the dimensions and shape of the emitted beam in both day and night time operation are defined in the 'rolling stock — locomotives and passenger rolling stock' TSI ('LOC&PAS TSI').

By the dates mentioned below for the harmonisation of the rear end signal as per section 4.2.2.1.3.2, the luminous intensity of vehicle headlamps shall be in accordance with point (5) of section 4.2.7.1.1 of the Annex to Commission Regulation (EU) No 1302/2014 (Loc&Pas TSI) in order to access the lines identified in RINF where permissive driving is used.

# 3. Return of experience with rear end signals from the CER members

The following chapter compiles the input from the following CER members. In order to make the results clear and easy to compare, they are presented in a standardised tabular form

- SNCF – France
- DB – Germany
- ÖBB – Austria
- CD – Czeck Republic / Czechia
- RFI – Italy
- SBB – Switzerland
- RDG – United Kingdom
- PKP – Poland
- ZSR – Slovakia

## SNCF -France

| | |
|---|---|
| **Current rear end signals for freight trains** | **Steady Light** |
| **Use of reflective plate** | No |
| **Use of permissive driving on the network** | Yes |
| **Safety issues reported on permissive driving with reflective plates** | Not applicable |
| **Safety issues expected on permissive driving with reflective plates** | Yes<br>• reflectivity of the white part of the plate – driver does not see the red part but the white part only<br>• Driver needs to detect the right message – red vs. white |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | No |
| **Concerns** | Safety issues |
| **Recommendation** | Different plate with different pattern |

## DB – Germany

| Current rear end signals for freight trains | Reflective plate |
|---|---|
| Use of reflective plate | Yes |
| Use of permissive driving on the network | No |
| Safety issues reported on permissive driving with reflective plates | No |
| Safety issues expected on permissive driving with reflective plates | No |
| In favour of implementing the TSI requirements 4.2.2.1.3. | Yes |
| Concerns | No |
| Recommendation | No changes |

## ÖBB – Austria

| Current rear end signals for freight trains | Reflective plate |
|---|---|
| Use of reflective plate | Yes |
| Use of permissive driving on the network | No |
| Safety issues reported on permissive driving with reflective plates | No |
| Safety issues expected on permissive driving with reflective plates | No |

| | |
|---|---|
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | Yes |
| **Concerns** | No |
| **Recommendation** | No changes; we still question the argumentation, a driver has to distinguish if he detects a red or a white reflection on his track. A white "light" could also be another train upcoming, so a driver should stop in both situations, red and white. |

## CD – Czeck Republic /Czechia

| | |
|---|---|
| **Current rear end signals for freight trains** | **Reflective plate** |
| **Use of reflective plate** | Yes |
| **Use of permissive driving on the network** | Yes |
| **Safety issues reported on permissive driving with reflective plates** | No |
| **Safety issues expected on permissive driving with reflective plates** | No |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | Yes |
| **Concerns** | No |
| **Recommendation** | No changes |

## RFI – Italy

| | |
|---|---|
| **Current rear end signals for freight trains** | **Reflective plate** |
| **Use of reflective plate** | Yes |

| | |
|---|---|
| **Use of permissive driving on the network** | No |
| **Safety issues reported on permissive driving with reflective plates** | No |
| **Safety issues expected on permissive driving with reflective plates** | No |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | Yes |
| **Concerns** | No concerns as Italy changes from lights to reflective plates and made good experience. No safety concerns detected. |
| **Recommendation** | No changes |

## SBB – Switzerland

| | |
|---|---|
| **Current rear end signals for freight trains** | **Reflective plate** |
| **Use of reflective plate** | Yes |
| **Use of permissive driving on the network** | No |
| **Safety issues reported on permissive driving with reflective plates** | No |
| **Safety issues expected on permissive driving with reflective plates** | No |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | Yes |
| **Concerns** | No |

| | |
|---|---|
| **Recommendation** | No changes |

## RDG – United Kingdom

| | |
|---|---|
| **Current rear end signals for freight trains** | **Lights - flashing taillamp** |
| **Use of reflective plate** | No |
| **Use of permissive driving on the network** | Permissive freight only lines and lines signalled by 19th Century mechanical signal boxes, however, these lines only represent a relatively small percentage of the network. |
| **Safety issues reported on permissive driving with reflective plates** | Yes |
| **Safety issues expected on permissive driving with reflective plates** | Main concern, if we were to change to reflective plates, is that we would be required to achieve safety acceptance. This is foreseen as problematical with the existing reflective plates.<br>In a discussion with the author of the ERA report, he stated that "washout" was a significant issue and that if the scope of the report had been to recommend a reflective board it would have been to recommend a large Red one!<br>The argument that a driver seeing what appears to be a white light will enable the driver to stop is not supported by GB. The shock of what appears to be a train coming towards the driven train would result in drivers going sick leading to cancellations and delay. |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | No |
| **Concerns** | Yes |
| **Recommendation** | Sympathy for those countries that use existing reflective plates and seem to have few, if any, operational incidents. We are, like SNCF, slightly surprised by this as we, in the past, have experienced incidents and we use lamps!<br>GB would support the French proposals whilst accepting a very long implementation period for existing boards to be kept by those countries that use them. We believe all new reflective plates after an agreed date should be of the "new" type. |

| | |
|---|---|
| | We do wish to move to a position where our freight trains can be operated with reflective plates only |

## PKP – Poland

| | |
|---|---|
| **Current rear end signals for freight trains** | **Lights & reflective plates** |
| **Use of reflective plate** | Yes |
| **Use of permissive driving on the network** | Yes |
| **Safety issues reported on permissive driving with reflective plates** | No |
| **Safety issues expected on permissive driving with reflective plates** | No |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | Yes |
| **Concerns** | No |
| **Recommendation** | No changes |

## ZSR – Slovakia

| | |
|---|---|
| **Current rear end signals for freight trains** | **Using reflect plates of rear end for freight trains** |
| **Use of reflective plate** | yes |
| **Use of permissive driving on the network** | yes |
| **Safety issues reported on permissive driving** | No |

| | |
|---|---|
| **with reflective plates** | Permissive driving with reflective plates on rear end for freight trains is safety way used on Slovak railway network x-tens years. |
| **Safety issues expected on permissive driving with reflective plates** | No, not expected |
| **In favour of implementing the TSI requirements 4.2.2.1.3.** | yes |
| **Concerns** | No |
| **Recommendation** | Preservation of reflect plates on rear end for freight trains while continuing the operating status of permissive driving. |

## 4. Intermediate findings of the OPE experts regarding the interoperability aspects of rear end signals

No interoperability problems were identified in most countries except France. No safety related problem reported in most countries, except in the United Kingdom. SNCF has expressed its doubts. No problems with permissive driving were reported in the participating countries except France SNCF reports this as major issue.

Two issues need to be further elaborated

- Decommissioning class B systems and deployment ERTMS – how does permissive driving fit into that
- Issue of safety culture and train drivers perception of rear end signals (different cultural background)

## 5. Intermediate findings of the CER safety experts regarding the safety aspects of rear end signals

Definition from the OPE TSI

RUNNING ON SIGHT
When a driver has to run on sight, the driver shall:
— Proceed with caution, controlling the speed having regard to the visibility of the line ahead, so that it is possible within the free visible part to stop short of any vehicle, stop aspect or obstacle on the infrastructure; and
— Not exceed the maximum speed for running on sight.
This does not apply to unexpected obstacle entering the track zone within the stopping distance.

- SNCF – France
  - Permissive driving with the reflective plates as rear end signals would decrease the high level of safety in France

- Need for a risk assessment – allowing permissive driving and rear end signals

- DB – Germany
  - No safety or interoperability problem with the existing TSI OPE rules; not interested in a change
  - Need for FR risk assessment for a better understanding of SNCF concerns
  - Not possible to carry out a European risk assessment as some operational and safety rules are fundamentally different in the MS
- ÖBB – Austria
  - Austria changed to reflective plat and abandoned all other solution
  - Reflective plate as described in the TSI is a safe solution
  - Reflective plate is the best compromise chosen from all possible solutions – Reference: technical report on rear end signals for ERA
  - No need and willingness to change
- Mercitalia – Italy
  - Changed from lights to reflective plates
  - No problems when training the train drivers
  - No safety problems encountered
  - Prefers to stay with the TSI solution
- SBB – Switzerland
  - SBB has no safety (and no interoperability) problem with the existing reflective plates and does not see any need to change it. It will only cause unnecessary costs.
- PLK – Poland
  - Poland is a friendly country, so PLK allows both reflective plates and lamps. Despite the fact that in permissive driving in automatic block PLK's regulations recommend using lamps rather than plates, it should be noted that it is only a recommendation and not the obligation. That is why, in practice all freight trains in Poland are equipped with reflective plates only, because reflective plates are found as safe as lamps and they are cheaper. Furthermore, PLK has no safety and no interoperability problem with the existing reflective plates and does not see any need to change it. It will only cause unnecessary costs.

Common commitment: It must be ensured that permissive driving with reflective rear end signals as already applied in some member states of the European Union (area of operation) is not endangered or made impossible.

## 6. Costs – Fact & Figures

Cost, facts & figures for the reflective plate (rear end signal) as defined in the OPE TSI

| Rear end signal as defined in the WAG TSI | ÖBB | SBB | DB |
|---|---|---|---|
| Price per unit (purchase) [€/piece] | 6,35 €/piece | 36,26 CHF ~ 35 € | 12,80€ |
| Life cycle of a rear end signals [a] | 4 years | 5-8 years | 10-15 years |
| Number of rear end signals purchased per year [pieces/a] | 14 000 pieces/year | 10.000 pieces / year | 24.000 pieces / year |
| Total number of rear end signals used [pieces/company] | 55 000 pieces | 60.000 – 80.000 pieces | 300.000 pieces |

## 7. Analysed options

**Option 1**: **Application** of Commission Implementing Regulation (EU) 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management subsystem of the rail system within the European Union, in particular chapter 4.2.2.1.3.2., in all Member States (areas of operation).

**Option 2: Change** of the chapter 4.2.2.1.3.2. of Commission Implementing Regulation (EU) 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management subsystem of the rail system within the European Union an integration of a new rear end signal.

**Option 3**: **Specific case** for the areas of operation on the French territory. Special provisions in the TSIs for rear end signals, either temporary or permanent, because of constraints affecting compatibility with the existing system.

**Assessment**

| | Advantages | Disadvantages |
|---|---|---|
| **Option 1: Application** | Keeping the TSI current TSI requirement<br>Keeping common practice in the majority of the European areas of operation | Requires changes in the areas of operation on the French territory (change / impact on safety culture, potential loss of the operational concept of permissive driving), potential cost increase |
| **Option 2: Change** | Common solution facilitating interoperability on the Union's railway network | Huge impact on the majority of stakeholders (safety culture, potential cost increase (potential mitigation by a sound transition scheme) |
| **Option 3: Specific case for FR** | "easy" compromise among European railway stakeholders | Negative impact on interoperability in Europe |

Option 3 is the less favourable solution.

# 8. Field tests carried out by SNCF

## 8.1. TSI OPE reflective plate versus a new design of reflective plates

**Test environment**

- 2021/2022
- 12 different plates tested
- 7 professional drivers participating
- Tests by night, in a shunting yard in a Parisian suburb
- Locomotive equipped with full beam and dimmed lights (TSI compliant)
- The following distances between the locomotive and the plates have been tested: 400, 300, 200, 100m[1]
- Objective and subjective perception requested from the drivers

[1] During the second night, and because of fog conditions, the perception of the plate is not possible over 100m

### The tested plates

TSI plate (left)
Red circle plate,
little (centre) and
medium (right)

Rectangular plate
medium (centre),
little (centre), TSI
plate (right)

STI shape plates,
white non reflective
(far left), little
(centre left),
medium and big

When available, both retro-reflective microprism film and retro-reflective microbead film have been tested

In all cases, the TSI plate was tested and used as a reference

### First outcomes

- Microprism technology is far more efficient
- The circle shape is preferred (similarity with the red lights of the passenger trains)
- An important improvement of the perception of the plate can be obtained with a slightly larger dimension

### Ranking o the plates

- The ongoing analysis shall be completed by experts and ergonomists
- A first ranking is as follows:
  1. Red circle plates (and especially the medium sized one) are preferred
  2. Then the rectangular red plates
  3. After come the TSI shape plates (7th rank)

### SNCF initial conclusions after the field test

- The results are consistent with the 2012 ERA key findings e.g.:
  - The larger plate, the most efficient in terms of perception
  - Plates with red and white patterns: colours tend to be merged, altering their perception
  - Micro prismatic technology seems to be the most visible
- The TSI plates are less visible than the full red plates (circle or rectangular)

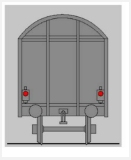
## 8.2. TSI OPE reflective plate versus steady lights

The SNCF undertook field tests to check the visibility of the current plates versus possible new rear end signals as well **as steady lights versus the OPE TSI rear end signal (reflective plate)**.

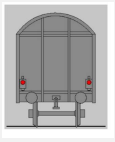
For these field test, SNCF has chosen four representative lines of the French railway network. Steady lights (rear end) were compared to the reflective plates (rear end) as described in the OPE TSI.

**The following return of experience (driver's behaviours) can be summarised:**

| | |
|---|---|
|  |  |
| Clear weather | The driver will proceed and enter in the presumed occupied section |
| Reduced visibility | The driver will wait for the signal to become green |
| Degraded visibility | The driver will wait for the signal to become green |

| | |
|---|---|
|  |  |
| Clear weather | The driver will proceed and enter in the presumed occupied section |
| Reduced visibility | Depends on the driver's experience, knowledge of the route, shape |
| Degraded visibility | The driver will wait for the signal to become green |

| | |
|---|---|
|  |  |
| Clear weather | Depends on the driver's experience, knowledge of the route, shape |
| Reduced visibility | The driver will wait for the signal to become green |
| Degraded visibility | The driver will wait for the signal to become green |

| | |
|---|---|
|  |  |
| Clear weather | The driver will proceed and enter in the presumed occupied section |
| Reduced visibility | The driver will wait for the signal to become green |
| Degraded visibility | The driver will wait for the signal to become green |

**The following analysis was provided by the French infrastructure manager:**

- Human behaviour depends on the conditions in place
- When facing a new condition (TSI plates), the drivers will be more careful
- From the data SNCF analysed, the number of trains running in an occupied section will be reduced due to the precautionary principle; SNCF estimates a 25% reduction of this operational practice
- When the changes are integrated by the drivers, the drivers' behaviour will return more or less to the previous practices; this transitional period will have to be managed by the drivers' leaders
- Furthermore, in normal situations, the drivers will ask the signallers before entering in a presumed occupied section, which will help to take the right decision (to enter or not to enter) depending on the operational conditions
- In any case, the safety is based on the "Running on sight" rule

## 8.3. SNCF findings

| | Current system | Target System |
|---|---|---|
| **Read-end** | Steady light | |
| **Front-end** | 12 000 cd max | |
| **Read-end** | | TSI plate |
| **Front-end** | | 40 000 cd |

- *SI base unit: candela (cd)*

  *The candela, symbol cd, is the SI unit of luminous intensity in a given direction.*

- The two systems are equivalent, advantages and disadvantages compensate each other
- In the majority of cases, the drivers are informed by the signaller by radio
- There in no impact on the network capacity because the paths are built with "green signals"
- The impact on the network resilience in degraded situation will be real with a 25% reduction of the "permissive driving" occurrences, and will be less over time
- Even if the current TSI plate is not regraded as the best plate for the target system by SNCF, SNCF finally considers that a new plate will not radically change the change management SNCF will have to deal with; then, it is now time to move forward with the current TSI plate, and to prepare the 2026 major evolution.
- It is now important to make sure that all drivers intending to run in France will be properly informed and trained on this major evolution (permissive driving with plates according to the TSI OPE)

## 9. CER Conclusion

The identified obstacle for the Union-wide application of the rear end signal as defined in chapter 4.2.2.1.3.2. of the OPE TSI was the satisfactory visibility of the rear end signal and hence the sufficient and correct recognition of the above-mentioned signal as rear end signal by the train driver whilst applying the operational concept of "permissive driving" in certain areas of operation. [interface rear end signal and front-end light].CER concludes that for all areas of operation across the European Union where the OPE TSI and WAG TSI apply, including those areas of operation where permissive driving is a practiced operational concept, the rear end signal as defined in chapter 4.2.2.1.3.2. of the OPE TSI shall be used. In order to ensure the safe interface between front end light and rear end signal and hence its sufficient recognition as the rear end of a train and in order to access the lines identified in RINF where permissive driving is used, the luminous intensity of vehicle headlamps shall be in accordance with ***the level defined for the full-beam headlamps*** in the point (5) of section 4.2.7.1.1 of the Annex to Commission Regulation (EU) No 1302/2014 ( 4 ) (Loc&Pas TSI).

The respective CER change request proposal for the TSI OPE for the TSI 2022 revision is defined in chapter 12 of this report.

**Under the abovementioned conditions, the reflective plates complying with Appendix E to Wagon TSI shall be the single rear end signal for freight trains in all European areas of operation without respective specific cases.**

## 10. References

Commission Implementing Regulation (EU) 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management subsystem of the rail system within the European Union

Commission Regulation (EU) No 321/2013 of 13 March 2013 concerning the technical specification for interoperability relating to the subsystem rolling stock — freight wagons of the rail system in the European Union

Study on freight train rear end signals: field tests, Booz & Company, December 2012, study carried out for the European Union Agency for Railways (ERA)

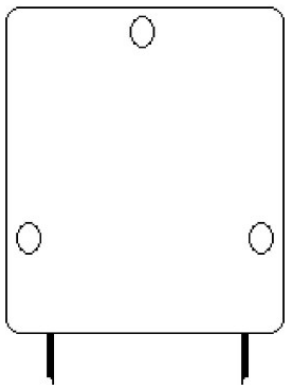
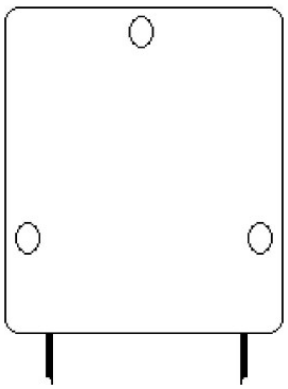
## 11. Abbreviations

| | |
|---|---|
| ERA | European Union Agency for Railways |
| ERTMS | European Rail Traffic Management System |
| OJ | Official Journal |
| OPE | Operation and traffic management subsystem |
| RINF | Register of Infrastructure |
| TSI | Technical Specifications for Interoperability |

# 12. CER proposal for a change request (OPE TSI – front end signals)

**CR:TSI_C00000552**
Luminous intensity of vehicle headlamps

**Text proposal**

| **Commission Implementing Regulation (EU) 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management subsystem of the rail system Current consolidated version: 05/01/2022** | **CER change request** |
|---|---|
| **4.2.2.1.2. Front-end** | |
| The railway undertaking shall ensure that an approaching train is clearly visible and recognisable as such,<br>by the presence and layout of its lit white front-end lights.<br><br>The forward facing front-end of the leading vehicle of a train shall be fitted with three lights in an isosceles<br>triangle, as shown below. These lights shall always be lit when the train is being driven from that end.<br><br>  <br><br>The front-end lights shall optimise train detectability (marker lights), provide sufficient visibility for the train<br>driver (head lights) by night and during low light conditions and shall not dazzle the drivers of oncoming<br>trains. | The railway undertaking shall ensure that an approaching train is clearly visible and recognisable as such,<br>by the presence and layout of its lit white front-end lights.<br><br>The forward facing front-end of the leading vehicle of a train shall be fitted with three lights in an isosceles<br>triangle, as shown below. These lights shall always be lit when the train is being driven from that end.<br><br>  <br><br>The front-end lights shall optimise train detectability (marker lights), provide sufficient visibility for the train<br>driver (head lights) by night and during low light conditions and shall not dazzle the drivers of oncoming<br>trains. |

| | |
|---|---|
| The spacing, the height above rails, the diameter, the intensity of the lights, the dimensions and shape of the emitted beam in both day and night time operation are defined in the 'rolling stock — locomotives and passenger rolling stock' TSI ('LOC&PAS TSI').<br><br>By the dates mentioned below for the harmonisation of the rear end signal as per section 4.2.2.1.3.2, the luminous intensity of vehicle headlamps shall be in accordance with point (5) of section 4.2.7.1.1 of the Annex to Commission Regulation (EU) No 1302/2014 ( 4 ) (Loc&Pas TSI) in order to access the lines identified in RINF where permissive driving is used. | The spacing, the height above rails, the diameter, the intensity of the lights, the dimensions and shape of the emitted beam in both day and night time operation are defined in the 'rolling stock — locomotives and passenger rolling stock' TSI ('LOC&PAS TSI').<br><br>By the dates mentioned below for the harmonisation of the rear end signal as per section 4.2.2.1.3.2, the luminous intensity of vehicle headlamps shall be in accordance with ***the level defined for the full-beam headlamps*** in the point (5) of section 4.2.7.1.1 of the Annex to Commission Regulation (EU) No 1302/2014 ( 4 ) (Loc&Pas TSI) in order to access the lines identified in RINF where permissive driving is used. |

## Suggested improvement by CER

"On lines identified in RINF where permissive driving is used, by the dates mentioned below for the harmonisation of the rear end signal as per section 4.2.2.1.3.2, the luminous intensity of vehicle headlamps shall be in accordance with the level defined for the full-beam headlamps in the point (5) of section 4.2.7.1.1 of the Annex to Commission Regulation (EU) No 1302/2014 ( 4 ) (Loc&Pas TSI)."