## Description of the Challenge

The challenge posed by the Infrastructure Section of the Conservation Service of the Department of Infrastructure and Territorial Development of the Bizkaia Provincial Council is entitled: ***"How can the visibility of road markings be improved in rainy and adverse weather conditions?"***

This challenge addresses the needs described below:

- How could the level of retroreflection of road markings be maintained in rainy conditions, in areas without lighting and with low visibility?
- How could the user's visibility of road markings be guaranteed in adverse weather conditions and at any time?
- How could the solution meet the technical requirements demanded by the nature of the infrastructure in an economically sustainable way?

**Background**

The Bizkaia Provincial Council, as the owner of the road network of the Historical Territory of Bizkaia, is responsible for its conservation and maintenance. This road network is made up of a total of 1,241.4 km, with a traffic volume of 4,592.8 million vehicle km per year. [1].

One of the elements of the infrastructure of road networks is road markings. These markings are defined as markings made on the pavement to separate traffic lanes, continuous no-overtaking lines, lines separating the hard shoulder from the carriageway and any other type of lines, words or symbols applied on the pavement to regulate vehicle and pedestrian traffic.

It is an essential component for channelling traffic, indicating the presence of possible obstacles and providing visual information throughout the journey in all weather conditions. It is therefore a key element for improving visibility on the road and promoting road safety as, in addition to defining lanes, it signals priorities and warns of possible hazards.

In order to maintain these road markings, the Department of Infrastructure and Territorial Development invests a total of €1,500,000 in its conservation each year.

These maintenance and conservation actions are carried out in accordance with the provisions of Standard 8.2-IC on Road markings [2], PG-3/75 of the Ministry of Public Works [3], subsequent updates and other applicable regulations.

The need for annual investment is related both to the need to address wear and tear and the need to maintain the necessary level of retroreflection. This is usually done by repainting road markings with paint and reflective microspheres in accordance with PG-3/75 for these work units.

However, retroreflective performance in heavy rain is significantly reduced. The accumulation of water on the roads and the formation of a film of water reduces the reflectivity of the glass microspheres. This film can cover the surface of the microspheres, reducing the amount of reflected light and therefore the visibility of the road markings. In turn, the angle of light reflection may be affected in heavy rain.

Despite the maintenance efforts and investment made, in adverse weather conditions, users do not have good visibility while driving.

**Additional information:**

Inspection of the lines is carried out both through visual inspection and through measurement of retroreflection using a digital retroreflectometer.

Globally, particularly in Nordic countries, there are various regions dealing with this issue and work is being carried out on different lines of innovation. These range from phosphorescent paints, heat-sensitive paints or even other types of peripheral systems that contribute to improving road visibility through the installation of various devices, sensors and systems that help guide drivers and generate alerts.

However, in tackling this challenge the aim is for the solution to be compatible with current regulations and economically sustainable in line with available annual investment budgets.

**Interested parties**

The main stakeholders involved in this challenge, and which therefore represent all of the interested parties to be taken into account when presenting the solution, are:

- The owner of the road network: Bizkaia Provincial Council
- The manufacturer of the paint or visual element
- The company responsible for applying or installing the solution.
- The inspection companies and laboratories: they will be responsible for validating compliance control of the characteristics of the solution once deployed on the road network.
- The road maintenance companies: once the pilot test has been validated, when proceeding with the final application of the solution, the companies awarded the road maintenance contracts will be responsible for its implementation.
- The inspection companies and laboratories: they are responsible for inspecting and validating the condition of these road markings, ensuring the safety of the infrastructure and regulatory compliance.
- Users: the ultimate beneficiaries of the solution, who will experience improved visual perception while driving.

**Needs**

The proposed solution must ensure that road markings remain retroreflective in rainy conditions and ensure that roads may also incorporate instruments or systems that assist driving in adverse weather conditions.

This must be achieved on any type of road and in any situation. For example, on a dual carriageway, at night, during heavy rain, the driver must be able to see the lane separation marking without difficulty, or on a mountain road, when dense fog appears, the driver must be able to perceive the edges of the road.

**Objectives**

As a guideline, the following table includes the functional needs required, classified as a requirement or weighted according to their level of importance, with three being the lowest level and nine the highest:

| Variable | Functional need | Weighting |
|---|---|---|
| 1. Optical characteristics | 1.1 The solution must maintain its optical characteristics in any weather conditions, mainly rain | Requirement |
| | 1.2. The initial retroreflection value, measured between 48 and 96 hours after application of the paint, must be at least 300 millicandelas per lux and square metre | Requirement |
| | 1.3. The retroreflection value six months after application of the paint must be at least 160 millicandelas per lux and square metre | Requirement |
| | 1.4. The surface must achieve a minimum wet slip-resistance value of 45, as measured using the TRRL (Transport Road Research Laboratory) Pendulum Tester | Requirement |
| 2. Regulatory compliance and safety | 2.1. The solution must comply with the provisions set out in Standard 8.2 - IC. Road markings [2] | Requirement |
| | 2.2 It must be possible to install road markings on the elements of the road infrastructure without resulting in a loss of functionality or posing a hazard for user safety | Requirement |
| 3. Applicability and installation | 3.1 The solution must be easy to apply or install | Requirement |
| | 3.2. Along with the description of the solution and its characteristics, information will be required on the application and installation method | Requirement |
| | 3.3 In the case of road markings, it will be necessary to avoid the appearance of irregularities, alignment deviations and any defects in application that contribute to a poor finish of the marking | 9 |
| | 3.4 For road markings, thicknesses of 1.5 mm are considered suitable in automatic applications of sprayed material and thicknesses of 3 mm when using continuous extrusion units | 9 |
| | 3.5 The appropriate application system shall be selected to ensure that the glass microspheres remain properly attached to the paint film for road markings For hot thermoplastic materials, the combined method (pre-mixed and post-mixed) will preferably be used | 9 |
| 4. Compatibility | 4.1 The solution must be compatible with all the materials used to produce the road surface layers | Requirement |
| | 4.2 The solution must be compatible with road maintenance activities, such as sweeping, winter maintenance, etc. | Requirement |
| | 4.3 The solution must be usable on all types of roads, from motorways and dual carriageways to mountain roads | 9 |

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|---|---|---|
| 5. Durability | 5.1. The durability of the solution must range between one and two years, depending on traffic levels | 9 |
| 6. Cost | 6.1 The cost of the solution must allow for its widespread implementation, replacing the materials currently used<br>Reference: annual investment of €1,500,000, with an approximate cost of €2-8 per linear metre | Requirement |
| | 6.2 A higher cost will be considered provided that the expenditure cycle is longer than the current one (see point 6.1) | 6 |
| 7. Solution maturity level | 7.1. The solution must allow it to be applied in a pilot test in a relevant environment (realistic environment conditions) TRL5-6<br>Note: the Department of Infrastructure and Territorial Development will provide the means to carry out a full-scale test in a controlled environment | 9 |
| | 7.2. The solution must allow it to be applied in a pilot test in a laboratory environment (controlled environment) TRL4 | Requirement |
| 8. Pilot test: aspects to be met in the validation process | 8.1. In the case of road markings, to proceed with validation, samples of paint and glass microspheres applied on the pavement will be taken by placing metal plates measuring 30 by 15 centimetres (30 x 15 cm) and a thickness between one and two millimetres (1 to 2 mm) on the road surface along the line | 9 |
| | 8.2. To carry out the pilot test and comply with current health and safety regulations, it will be necessary:<br>A) To comply with the provisions of RD 1627/1997, which establishes the minimum health and safety requirements applicable to construction works in Spain. [4]<br>B) To have a preventive management document as outlined by the National Institute of Occupational Health and Safety in the note published in November 2014 [5] | Requirement |

## Scope of the pilot and scalability of implementation

By means of the pilot project developed between the winning company and the Department of Infrastructure and Territorial Development, the viability of the proposed solution will be validated in a realistic controlled environment. The option of carrying out functional tests on sections in different environments, such as motorways, conventional roads and mountain roads, will be assessed.

This validation, the result of a collaboration between user entities and the winning company in designing a solution, will also enable said company to tackle a problem that occurs on roads in any other national or international territory.

## References


[1] Bizkaia Provincial Council, "Evolución del tráfico en las carreteras de Bizkaia, 2024"(Traffic trends on the roads of Bizkaia, 2024), p18.

[2] Standard 8.2 -IC. Road markings (Order of 16 July 1987). MINISTERIAL ORDER OF 16 JULY 1987 APPROVING STANDARD 8.2 - IC ON ROAD MARKINGS (BOE OF 4 AUGUST and 29 SEPTEMBER)

[3] PG-3/75 of the Ministry of Public Works Part 2. PG-3

[4] BOE-A-1997-22614 Royal Decree 1627/1997 of 24 October, establishing minimum health and safety provisions in construction works.

[5] Basic guidelines for integrating occupational risk prevention into construction works. National Institute for Health and Safety at Work.