

INSTITUT GRAĐEVINARSTVA HRVATSKE

**GENERAL TECHNICAL REQUIREMENTS  
FOR ROAD WORKS**

**VOLUME VI**

**ROAD FURNITURE**

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## Foreword

### 0-00 INTRODUCTION

General Technical Requirements for Road Works (GTR) contain requirements for the realization of individual works necessary for the completion of road construction projects, and they form an integral part of the corresponding contracts. If the technical documentation calls for realization of works not comprised in these GTR, the Designer will prepare Special Technical Requirements (STR) for these works, and the STR will constitute an addendum to these General Technical Requirements.

This is the third revised edition of the General Technical Requirements (GTR). The first edition was published in 1976, and the second in 1989. Experience gained in practical work has been incorporated as appropriate in these General Technical Requirements for Road Works.

These GTR 2001 are composed of the following volumes:

- Volume I General Provisions and Preliminary Work
- Volume II Earthwork, Drainage, Retaining and Facing Walls,
- Volume III Pavement Structure,
- Volume IV Concrete Work,
- Volume V Road Tunnels, and
- Volume VI Road Furniture.

This 2001 edition of GTR consists of six Volumes which together form a single entity. When it is specified in a contract, technical document or cost estimate that a work is to be carried out in accordance with any provision contained in any one of these Volumes, the Contractor will be required to perform such work in accordance with all relevant provisions of these GTR.

These General Technical Requirements were prepared by Institut građevinarstva Hrvatske (Civil Engineering Institute of Croatia).

### 0-00.1 ABBREVIATIONS

Appropriate abbreviations of terms used in these GTR are explained as follows:

GTR	General Technical Requirements for Road Works
CMD	Construction Management Design
STR	Special Technical Requirements
GRCC	General Requirements for Construction Contracts
SRCC	Special Requirements for Construction Contracts
QCQAP	Quality Control and Quality Assurance Program
SOS-NCS	State Office for Standardization – National Certification Service
BL	Building Law of the Republic of Croatia
SL	Standardization Law of the Republic of Croatia
HRN	Croatian standard
ISO	International Organization of Standardization
EN	European Standard
DIN	German standard (Deutsches Institut für Normung)
ASTM	American Society for Testing and Materials

## **0-00.2 GENERAL NOTES**

These GTR set minimum quality requirements for materials, products and works. The GTR are written in such a way that they can form a part of a contract while requirements relating to special works will be included in the contract as Special Technical Requirements (STR). The GTR take into account all applicable Croatian regulations and technical standards (HRN).

## **0-00.3 USE OF THESE GENERAL TECHNICAL REQUIREMENTS**

These GTR contain technical requirements for the performance of works, methods for quality assurance and quality assessment, and methods for calculation of completed work. The GTR are applicable to works contained in cost estimates of projects, but also to works subsequently defined on the site to ensure full completion of the work specified in the contract. On some projects, special requirements may also be specified to take into account various additional requirements, i.e. particular features of the project. The use of GTR is mandatory when they form an integral part of technical documents of the contract.

**9**  
**ROAD FURNITURE**

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## 9-00 GENERAL REMARKS

This section sets general requirements for the realization of works and specifies minimum quality requirements for materials, products and works as applied during realization of works relating to road furniture. The GTR are written in such a way that they form a part of the contract while requirements relating to special works are included in the contract as Special Technical Requirements (STR).

Materials, products, equipment and works must comply with the standards and technical regulations specified in the design documentation. If no standard is specified, then an appropriate EN (European standard) must be applied. If a standard or regulation becomes invalid during realization of the project, it will be substituted by an appropriate replacement standard or regulation.

The Contractor may propose application of generally recognized technical rules (standards) issued by a foreign standardization body (such as ISO, EN, DIN, ASTM, etc.), subject to written explanation and approval of the Supervising Engineer. This change may be accepted by the Supervising Engineer if approved by the Designer. The Contractor is required to register this change in the working design.

### 9-00.1 DEFINITIONS

General terms and expressions, with the meanings they have in these General Technical Requirements, are presented in section 0. The following terms are additional terms that are especially relevant to this section.

**Automatic traffic counter** is a device for constant traffic information collection.

**Road weather station** is a device for constant information collection on weather conditions relevant for traffic.

**Road markings across the carriageway** are lines marked vertical or sloped to the carriageway centreline.

**Traffic signs** are elements of horizontal and vertical signalization which guide and inform the drivers about the manner of behaviour on roads.

**Marker post** is a post which indicates the nearness of carriageway edge.

**Noise protection device** is a construction – engineering structure which decreases the traffic noise to an insignificant level.

**Anti -glare screen** is a construction – engineering structure which prevents the blinding of drivers by traffic from the opposite direction.

**Road markings along the carriageway** are lines marked parallel to the carriageway centreline.

**Safety barrier** is an engineering safety structure that prevents the skidding of vehicles from the carriageway surface, i.e. catches and holds the vehicles turned aside.

**Safety chain-link fence** is an element which protects the motorway surface (carriageway area) from unwanted entries and enables safe traffic flow.

## 9-01 TRAFFIC SIGNS (HORIZONTAL SIGNALIZATION)

### Description of work

This work includes the supply and installation of all types of traffic signs, all in compliance with the traffic road furniture design.

The work shall be executed in accordance with the design, the Book of Rules, regulations, the quality assurance and control programme (QAACP), the construction-management design (CMD), the supervising engineer's requests and these General Technical Conditions.

### Shape and dimensions of traffic signs

Traffic signs, according to type, meaning, shape, colour, size and manner of installation must be in compliance with the Book of Rules, the Croatian and European standards:

ES 12899-1,  
ES 12899-2,  
ES 12996,  
ES 12352,  
ES 12368,  
ES 12675,  
ES 1436,  
ES 1463,  
ES 1790,  
ES 1871.

Larger size traffic signs, whose surface area is greater than  $2\text{m}^2$ , shall be made of several parts assembled in a unique whole at the place of installation.

The traffic signs shall be placed into position in such a manner that there is no visible connection from the front side. Elements for fixing shall be of such performance which prevents the turning of the traffic sign around the post axis. The screws shall be protected against unscrewing.

Traffic signs shall be placed on posts made of Fe pipes, corrosion protected by means of hot galvanization, or on aluminium posts.

Larger size traffic signs, e.g. direction boards, shall be fixed on aluminium "I" girders by means of pre-fabricated elements. Number of girders depends on the surface area of the traffic sign as given below:

- surface area of the sign up to  $8\text{ m}^2$  – 2 girders IPA1.180 mm
- surface area of the sign from  $8\text{ m}^2$  to  $15\text{ m}^2$ , 3 girders IPA1, 180 mm or 2 girders IPA1 240 mm

During installation the traffic sign should be turned  $3-5^\circ$  in relation to the carriageway centreline in order to avoid bright reflection and decrease the contrast of marks, signs and the illuminated background. More than two traffic signs shall not be installed on one post.



The traffic sign posts are placed into concrete foundations, minimum concrete class C 20/25 (MB 25), of a truncated pyramid shape, whose lower square sides are 30 cm and upper square sides are 20 cm.

### **Quality control**

Materials for production of signs and posts are defined by standards. For all materials used, the Contractor shall at his expense provide certificates of adequate material quality before installation. Original copies of the certificates shall be given to the supervising engineer.

Material quality control and corrosion protection of steel elements shall be carried out in accordance with relevant provisions of these General Technical Conditions.

Protection of electrical and electronic elements of the fire protection system is defined by separate legal provisions relevant for electrical and electronic installations, thus the quality control is performed according to these provisions. The Contractor shall, at his expense, ensure the quality control of material and works and original copies of the certificates shall be given to the supervising engineer.

### **Calculation of work**

Installation of traffic signs shall be calculated per piece of installed sign, with post and foundation included. The price also covers manufacture and painting of signs and posts, pasting of sheet, excavation and concreting of foundations, fixing of signs and posts, transport of signs and other material and other work relating to installation of traffic signs, including all works and materials incorporated into the sign in order that the sign can perform the planned and remote controlled change.

For works relating to the placement of installations and devices of the fire protection system, calculation shall be done according to a separate design and details from the Bill of Quantities of that design.

## **9-01.1 WARNING SIGNS**

Warning signs (equilateral triangle) are fixed on posts of square or circular cross-section.

Dimensions of the signs are defined by the Book of Rules and relevant standards.

The work includes supply, transport and installation of traffic sign with post and foundation included. The price is calculated according to the number of installed signs of particular size, including posts and foundations, taking into consideration the differences of locations according to the number of signs on one post (post with one sign – post with two signs).

## **9-01.2 REGULATORY SIGNS**

Regulatory signs are mostly circular shaped (exceptionally octagon or equilateral triangle shaped) and are fixed on posts of square or circular shaped cross-section.

The work includes supply, transport and installation of traffic sign with post and foundation included. The price is calculated according to the number of installed signs of particular size, including posts and foundations, taking into consideration the

difference of locations according to the number of signs on one post (post with one signs – post with two signs).

### 9-01.3 INFORMATION SIGNS

Information signs are circular, square or rectangular shaped, fixed on posts of square or circular cross-section. Large rectangular shaped signs are fixed on to posts and the exceptionally large ones are fixed on structures that demand special calculation and measurements. During calculation, local weather conditions must be considered (the frequency, force and direction of the wind).

Sign measurements are regulated by the Book of Rules and Standards. Measurements of large and exceptionally large information signs depend on the content, thus they are calculated separately in accordance with the guidelines of the competent road management authorities.

These can be:

- Signs: one way vehicles from opposite direction, pedestrian crossing sign, children on the road, underground or overhead pedestrian crossing, one way traffic signs,
- Signs: overtaking allowed, priority passage road, pedal cyclist route crossing marked,
- Signs: end of overtaking restriction, end of speed restriction, end of horn signal restrictions, end of all restrictions sign,
- Signs: Speed restriction zone and end of restriction, pedestrian zone and end of pedestrian zone, restricted parking duration zone and end of that zone,
- Signs: recommended speed and end of that speed, lights-on sign, lights-off sign, motor off sign,
- Signs: school patrol, hospital, ambulance station, police, parking, garage, telephone, information, petrol station, hotel or motel, restaurant, potable water, taxi, bus station, airport, tram station, port, marina, coffee-shop, picnic area, camp, climbers' lodging, fire-fighters, road service vehicle, car workshop, car-wash, toilet, radio-station, river, water-protected area, rest-area, detour for certain type vehicles, traffic sign for certain type of vehicles, traffic lane for certain type of vehicles, traffic lane for closing and detour of traffic.
- Signs: road structure (tunnel, viaduct etc.)
- Signs: mountain pass, highway – beginning and end, road for motor vehicles only and end of road for motor vehicles only, board indicating exit.
- Sign: name of settlement and end of settlement,
- Sign: traffic direction sign,
- Sign: blind alley / dead end lane
- Sign: traffic flow direction, change of lanes, intersection, primary traffic direction sign, primary exit direction board, direction confirmation sign, rest area, toll gate, no entry on highway for certain vehicle categories,
- Signs: Direction sign on gantry, traffic allotment sign on gantry,
- Signs: detour direction
- Signs: Traffic lane for public transport vehicles and end of lane, traffic sign for speed restriction and end of that speed restriction,
- Signs: traffic direction board
- Signs: number of international road, highway, state and county road, state and county road mark, kilometre mark.

The work includes supply, transport and installation of traffic sign with posts and foundations included. The price is calculated according to the number of installed signs

of particular size, including posts and foundations, taking into consideration the differences of locations according to the number of signs on one post (post with one sign – post with two signs), locations of one sign on two posts and locations with a bearing structure.

#### **9-01.4 CHANGEABLE SIGNS**

Changeable traffic signs (CTS) are signs whose content can, according to need, be changed or turned off during the traffic flow. With the use of respective applicable warnings, orders or prohibitions for specific traffic or weather situations, as well as information signs on traffic detour, traffic safety and traffic flow should be increased. Special attention shall be given to the construction conditioned dangerous spots. Changeable traffic signs are defined by type, meaning, shape, colour, size and manner of installation and are installed according to the Book of Rules, Croatian and European standards (HRN EN 12966).

Content of an individual sign can be expressed in four states:

- Zero state – changeable traffic sign without any information
- Basic (initial) state – previously defined, traffic – wise and legal wise single meaning information state of the sign (including the zero state),
- Static state, non-changeable sign,
- Changeable state – content of the sign indicates one of the defined changes.

Changeable traffic signs, according to the provisions of the Book of Rules, shall not differ greatly from the standard traffic signs by their content or measurements. There shall be no competition between the static signs or the changeable traffic signs with respect to the content and the level of recognition.

The speed limits, indicated on one information board, are basically intended for all traffic lanes. At interchanges, a difference in speed limits of 20 km/h is allowed between different traffic lanes on one information cross section.

During speed limits due to weather conditions, a warning sign shall be pointed out even after the initial warning sign. In the area of traffic jams only information sign 125 (traffic jam) is needed. When the visibility is less than 50 m, a change in the speed limit is possible to 40 km/h.

#### **9-02 CARRIAGEWAY MARKINGS (HORIZONTAL SIGNALIZATION)**

##### **Description of work**

This work includes placing of carriageway markings for traffic control which are defined in the Book of Rules and these General Technical Conditions.

The work must be carried out in accordance with the design, appropriate regulations, Quality Control and Quality Assurance Program (QCQAP), Construction Management Design (CMD), Supervising Engineer's requirements, and these GTR.

##### **Classification of markings**

Carriageway markings are divided in the following groups:

- Road markings along the carriageway

- Road markings across the carriageway
- Other markings

Colours and measurements are defined by the Book of Rules and respective standards.

### **Quality control**

It is the responsibility of the Contractor to submit relevant certificates on the adequacy of materials for road markings to the supervising engineer

Quality control consists of:

- Preliminary testing of material
- Audit testing during work
- Audit testing

### **Preliminary testing**

Testing of the adequacy of material is performed according to the HRN Z.S2.240 requirements (paint for thin layer carriageway markings)

### **Control testing**

This testing is carried out by the Contractor in order to prove the obtained quality of material.

The control testing consists of:

- Testing of the thickness of wet and dry film – without glass globules - by sample taking at every 5 000 m ( separately for central, border and other markings), all in conformity with the HRN Z.S2.240 and HRN C.A6.030 standards,
- Testing of markings with regard to traffic and technical characteristics (durability, day and night visibility, slipperiness) and adequate material properties , all in conformity with HRN Z.S2.240 standards,
- Testing of resistance of material used for markings with regard to freezing, salt and temperatures of 80 °C.

### **Audit testing**

This testing is carried out by the Employer in order to prove the obtained quality of material. Audit testing consists of:

- Testing of thickness of dry film (without the glass globules) by sample taking at sample plates at every 20 000 m (separately for central, border and other markings) all in conformity with HRN Z.S2.240 and HRN C.A6.030 standards,
- Testing of resistance to slipperiness of dry film markings at every 10 000 m, in conformity with HRN U.C4.018 standards,
- Testing of day and night visibility and the position of colour co-ordinates in the dry film spectral diagram of markings at every 5 000 m, in conformity with EN 1436/97 and HRN EN 1436:2001 en, standards,
- Visual check of the dry film state of the marking and possible faults (damage, wrinkling, cracking, peeling, stickiness and dirt).

### **Calculation of work**

Carriageway markings are calculated as follows:

- solid and broken white and yellow lines, per length of markings (m),
- stop line, inclined and border lines, per length of markings (m),
- pedestrian crossing, arrows per piece of marking ( pc),
- traffic direction surfaces, per surface area of marking (m<sup>2</sup>),
- parking surfaces and special purpose surfaces, as well as longitudinal markings on structures along the carriageway edge, per length of executed marking (m)..

The price includes work, material, transport and all other needed for completion of work, including necessary quality control testing of material and executed work.

#### **9-02.1 ROAD MARKINGS ALONG THE CARRIAGEWAY**

Road markings along the carriageway are lines marked parallel to the carriageway centreline and thoroughly define the manner in which the carriageway surfaces are used.

Road markings along the carriageway are:

- solid line,
- broken line
- double line

#### **9-02.2 ROAD MARKINGS ACROSS THE CARRIAGEWAY**

These markings are:

- Stop lines,
- Inclined and border lines,
- Pedestrian crossings
- Pedal - cyclist route crossing,

#### **9-02.3 OTHER CARRIAGEWAY MARKINGS**

Other carriageway markings include arrows, traffic directing surfaces, direction lines, signboards, marking of special purpose traffic surfaces, marking of parking places and longitudinal markings on objects along the carriageway edge.

Paint or material used for carriageway markings shall be of quality that does not significantly change the adhesion of the carriageway.

Carriageway markings shall not be higher than 0,6 cm above the carriageway level, and if metallic heads are used as carriageway marking, they shall not be higher than 1,5 cm above the carriageway level.

## **9-03 ROAD FURNITURE FOR MARKING OF CARRIAGEWAY EDGE**

### **9-03.1 MARKER POSTS AND OTHER MARKINGS**

#### **Description of work**

The work includes supply of marker posts and other carriageway edge markings according to the accepted type, placing of posts into concrete, digging into ground, fixing on structures, transport of material and fixing of carriageway shoulder or central reserve, i.e. structure on which the marking is placed after installation, all in accordance with the HRN Z.S2.235 standard, the Book of Rules on traffic signs, road furniture and road markings”, and other standards.

The work must be carried out in accordance with the design, appropriate regulations, Quality Control and Quality Assurance Program (QCQAP), Construction Management Design (CMD), Supervising Engineer's requirements, and these GTR.

#### **Manufacture**

Marker posts and other carriageway shoulder markings shall be made of material with such characteristics that, in case of collision with a vehicle, damage to the vehicle shall be minimum and it will not effect the vehicle stability.

Certificates on the quality of used material for marker posts and other markings shall be provided by the Contractor and original documents shall be given to the supervising engineer.

#### **Calculation of work**

Placing of marker posts shall be calculated per piece of installed post. Payment shall be done according to the contracted unit prices which include supply and installation of marker posts, concrete foundation included, other markings, transport of material and fixing of carriageway shoulders.

#### **9-03.1.1 Marker posts on open road sections**

Marker posts shall be placed in concrete foundation, minimum C20/25 (MB 25), or dug into ground, fixed by anchors which are supplied with the marker posts. Distance of the marker post from the carriageway edge is at least 50 cm, at most 90 cm, marker post height is 90 cm from the carriageway surface.

Roads where the shoulder is only 50 cm wide, marker posts are placed on the external shoulder edge. In order to reach the visual continuity, marker posts are placed in cuts, along the external gutter edge.

Distance between the marker posts along the road depends primarily on local visibility conditions and the road ground plan elements. It is defined by the design according to the conditions from HRN Z.S2.235. On straight road sections, the maximum distance between marker posts is 50 cm.

#### **9-03.1.2 Marker posts in tunnels**

Marker posts for tunnels mark the carriageway edge in the tunnel. They are placed immediately along the internal shoulder edge and fixed by anchors (screw anchors) which are supplied with marker posts.

Maximum distance between marker posts in the tunnel is 25 m.

### **9-03.1.3 Other carriageway edge markings**

At places where installation of marker posts is not possible, other reflecting markings are placed (catadiopters, reflecting foil etc.).

## **9-04 TRAFFIC BARRIERS**

### **9-04.1 STEEL BARRIERS**

#### **Description of work**

Steel barrier is a technical safety device whose purpose is to prevent sliding out of vehicles from the carriageway, i.e. holding the vehicles that have strayed of the carriageway.

The work includes supply, transport, mounting of traffic barrier according to design and according to authorized classification.

The work must be carried out in accordance with the design, appropriate regulations, Quality Control and Quality Assurance Program (QCQAP), Construction Management Design (CMD), Supervising Engineer's requirements, and these GTR.

#### **Manufacture**

Steel barrier shall be of such construction that a vehicle can not smash through it or run over it. Upon collision into the traffic barrier, the vehicle must not be bounced back onto the traffic lane. The transverse displacement of the traffic barrier must be as large as possible, depending on the free space between the railing and the danger zone. The damage on the vehicle upon collision into the traffic barrier must be minimal. The structure of the traffic barrier shall be such that its elements can be quickly and easily replaced upon damage.

Steel barrier according to type can be:

- Single barrier (SGR)
- Double barrier (DGR)
- Single spaced barrier (SSGR)
- Double spaced barrier (DSGR)
- Single spaced barrier on structure (SSGRS)
- Double spaced barrier on structure (DSGRS)

The steel barrier shields are fixed directly on the posts by screws, or by means of spacer elements.

The posts are driven into the ground up to the necessary depth or screwed on the already concreted anchors with a foundation slab, i.e. fastened into the concrete by screws and screw anchors.

The shields are installed in such a manner that, looking in the direction of traffic, the end of the previous shield is covered by the beginning of the following shield.

When the steel barrier crosses the structure, the installation of posts and shields starts from the centre of the structure forward and backward, in order to avoid cutting the

edges of the shields and boring new holes in the shield, i.e. in order keep the defined distance between the posts.

If there is insufficient space for installation of posts, the spacer is fixed into the vertical walls on the already placed anchors by means of screws, i.e. by screws and screw anchors.

Parts of the diagonal ends which shall be placed into the ground – are coated by adequate bitumen insulation coating.

Parts of the barrier shall be transported in such a manner that will avoid damage to the anti-corrosive coating. Shields shall be transported in bands and protection shall be placed between each part. Posts and spacers shall be bulked.

### **Quality control**

Materials for barriers and its component parts are defined by standards, and the manufacturer shall, at his expense, provide certificates of quality for all materials. The original certificates of quality shall be submitted to the supervising engineer.

Quality control of material and anti-corrosion protection (galvanizing) of the structure steel elements shall be according to the respective GTC provisions.

### **Calculation of work**

Installation of barriers shall be calculated according to type and length (m) of railing, completely finished and according to the contracted price, all works, supply, excavation, concreting and other material included, as well as all other works relating to the installation of barriers.

## **9-04.2 CONCRETE PARAPET**

### **Description of work**

Concrete parapet implies a type of technical safety road equipment for prevention of sliding out of vehicles from the carriageway, i.e. holding the vehicles that have strayed of the carriageway.

Structure and shape of the parapet shall be such that it prevents smashing through or running over it and that it holds and gradually stops the vehicle in the area outside the danger zone. Damage to the vehicle due to collision into the parapet shall be minimal.

Structure of the parapet shall be such that the damage incurred can be easily and quickly repaired.

The parapet shall be constructed exactly according to given geometrical elements since the safety factor of the railing directly depends on the shape and its own mass. Shape of the concrete parapet must be tested.

The work includes all necessary preliminary works, e.g. base preparation, foundation excavation, supply, transport and installation of material as well as Manufacture and mounting of the parapet, all in accordance with the valid Croatian standards for this kind of work, while, in case of prefabricated elements, according to the GTC, this also includes certificates on quality of cement, aggregates and ready mixed concrete as well



as all quality control testing. Concrete parapets shall be made of concrete class C40/45 (min. MB 40).

The work shall be performed in accordance with the design, regulations and quality assurance and control program (QAACP), the construction – management design (CMD), the supervising engineer's requirements and these GTC.

### **Manufacture**

There are several ways to make a guard rail.

Mechanical means of concrete parapet construction in situ.

For this kind of construction a special electronic controlled machine is used.

The guard rail is constructed on a previously prepared foundation or stabilised base, cross-fall 0.0%

If planned according to design, the reinforcement is placed according to valid standards and regulations for that kind of work. .

*Prefabricated construction of concrete parapet from industrially made, or prefabricated elements.*

Concrete elements are produced in specialized plants. Guard rail elements are 2 m, 3 m long, or more, and are reinforced due to transport, loading and mounting efficiency. Quantity and means of reinforcement must be proven by structural analysis for individual lengths of elements.

The connection of elements must be simple, by means of gouge and wedge, at least at two places on each connection.

Prefabricated guard rails shall be placed at places along the road where a temporary need exists for such road furniture. Prefabricated elements shall be placed on previously precisely levelled and prepared concrete base (foundation).

Irrespective of the means of manufacture of concrete railing, concrete prepared in concrete production plants must be used, and transported to the place of pouring in a special vehicle. The quality of concrete must be in accordance with the conditions and standards for concrete used in road construction. This means that the concrete shall have the strength defined by the design, resistance to salt as well as resistance to the mutual influence of salt and freezing, all according to the GTC.

### **Quality control**

Materials used for production of concrete parapets are defined by standards, and for all materials used, the contractor shall provide quality certificates at his expense. Original certificates shall be given to the supervising engineer.

### **Calculation of work**

Production and installation of concrete parapets is calculated per length (m) of completed railing and according to the contracted price which includes all work and material, e.g. preparation of base, foundation concreting, supply and transport of all needed material, placing of concrete or prefabricated elements, finishing works e.g.

curing and protection of concrete, as well as all other work connected to the production and installation of guard railing.

### **9-04.3 SAFETY CHAIN-LINK FENCES**

#### **Description of work**

This includes supply, transport and installation of complete safety chain link fences of different types, according to the design. The fence consist of posts, wire net, wire hooks for anchoring bolts for securing the railing against falling.

The work shall be done according to the design, regulations, quality assurance and control program (QAACP), the construction-management program (CMP), requirements of the supervising engineer, respective Croatian standards and these GTC.

#### **Manufacture**

Excavation of foundations for posts is done by drills, depth up to 85 cm. After installation of posts, the remaining hole is filled by concrete and the use of the excavated earth material is already planned.

Wire net is fixed to the posts by wire, and by hooks into the soil. At places where the fence changes direction and where danger of collapse exists, it should be secured by anchors and struts.

According to height, the fence can be:

- low - up to 1,6 m height
- high – from 1,6 to 2 m height

According to material used, the fence can be:

- steel – galvanized or plastic coated
- made of polymer fibres

After installation of safety fences, the contractor shall remove from the construction site all waste material, according to the agreement with the supervising engineer.

#### **Quality control**

The contractor shall provide certificates of quality for all materials used for the safety fence and submit the originals to the supervising engineer. The anti corrosion quality control is done according to the respective regulations of these GTC.

#### **Calculation of work**

This work is measured per meter (m) of installed safety fence measured from the farthest edges of the poles, and is paid per unit price for one meter of installed fence according to type and height.

Unit price includes supply and installation of material, transport and all other work and material needed to complete the work.

#### 9-04.4 HEDGE

##### **Description of work**

This work includes supply and transport of seedlings and fertilisers, excavation of trenches, removal of unfertile soil, filling of trenches with fertile soil and fertiliser, cutting of roots and seedling branches, planting and landscaping after planting. Works are done according to design, instructions of the seedling grower and these GTC.

##### **Manufacture**

At places planed according to the landscaping design, a trench 60 cm wide and 50 cm deep is excavated. Excavated material, if fertile, shall be used for back-filling after planting. If the material is not fertile, it shall be removed to the dumping site or spread along the trench (in agreement with the supervising engineer). For back-filling of trenches, fertile soil shall be used.

Ten litres of stable manure is used for one meter of trench. Roots and branches shall be cut before planting.

For a high quality hedge two rows of seedlings are planted, according to the design and manufacturer's instructions.

The work includes cutting to shape and single watering. After planting all waste material shall be removed and surface around the hedge improved.

##### **Calculation of work**

The work is measured according to the length (m) of planted hedge. The price includes supply, transport and cultivation of seedlings, all necessary work, supply and transport of material (manure, soil) as well as everything else needed for completion of the job.

#### 9-05 NOISE PROTECTION STRUCTURES

##### **Description of work**

The work includes supply, transport and installation of the designed protection structure. The work shall be done in accordance with the design, regulations, quality assurance and control program (QAACP), the construction-management design (CMD) the supervising engineers' requirements and these GTC.

##### **Manufacture**

The noise protection structures represent the engineering – technical protection measures, which decrease the traffic noise to an insignificant level or to the level which does not extend the allowed values of noise emission in protected areas, i.e. structures.

The noise emission is expressed by the A – tested energy equivalent in dBA, and is determined from the noise emission depending on the conditions of sound spreading – distance, absorption, protection, reflection and length of the road section in question.

The highest allowed values of noise emission are given in “The Book of Rules on the highest allowed noise levels in areas where people live and work”, of the Ministry of Health and social welfare” on the basis of Article 1, Item 2 of the Law on Noise protection (O.G., 17/90).

The higher and longer the noise protection structures along the roads and the nearer to the road, the more efficient they will be.

The noise protection structures can be:

- hedges or planted trees
- noise protection embankments
- noise protection embankments with a built in wall
- steep embankments
- noise protection walls

### **Quality control**

Quality control of Manufacture includes the control of materials used with respect to the design requirements, including structural analysis, erosion due to precipitation and the influence of wind, all in accordance with the provisions, laws and these GTC for used materials and structures.

The contractor shall provide certificates of quality for all materials used and for allowed noise level and submit the originals to the supervising engineer. Quality control of used materials (concrete, stone, plastic, aluminium) shall be done according to respective GTC provisions.

### **Calculation of work**

The work shall be calculated according to the length (m) of planted seedling pieces (trees and shrubbery), embankment and concrete, stone or other material walls of the designed structure.

#### **9-05.1 PLANTED TREES AND SHRUBBERY**

The acoustic decrease of noise pressure is significantly decreased only when the planted land strip is wider than 50 m.

#### **9-05.2 EMBANKMENTS**

Embankments are long, greened noise protection earth-fill or rubble dams. Embankment slope gradient on the side of the road shall be 2:3, while the other embankment side shall be so shaped to adjust to the terrain. Width of the embankment crown shall be 1,0 m.

#### **9-05.3 EMBANKMENTS WITH BUILT - IN WALLS**

Embankments with built-in walls are planned for cases when there is lack of available space for a real earth embankment. Embankment crown width of 2,0 m is needed for construction and maintenance of these embankments.

#### **9-05.4 STEEP EMBANKMENTS**

Steep embankments have concrete or stone retaining structures (truss girders) filled with humus and planted. Such a retaining structure enables a much steeper execution of the earth, i.e. humus embankment slope, therefore these embankments are planned in cases when there is not enough available space for a real earth-fill embankment.

### **9-05.5 WALLS**

Walls are long structures whose cross section corresponds to an upright narrow rectangle. Walls are planned when there is no sufficient space available for a real earth-fill embankment or a steep embankment, and on bridges.

Displacement of the protection wall from the carriageway shall be such to enable the necessary width of the stopping sight distance and respective free road width. Apart from this, sufficient space must be planned for maintenance services and winter road services as well as space for road furniture. In very long walls, the necessary emergency exits shall be planned.

The protection walls shall be so constructed to enable sound absorption, irrespective of the wall age or weather influence, for which an A-test is needed.

The minimum influence of protection walls, i.e. minimal decrease of noise stress shall be 20 dBA.

The aesthetics of the protection walls is also important, as well as their incorporation into the landscape or settlement, which is solved by the design..

### **9-06 ANTI - GLARE SCREENS**

#### **Description of work**

The work includes supply, transport and installation of the designed protective structure.

The work must be carried out in accordance with the design, appropriate regulations, Quality Control and Quality Assurance Program (QCQAP), Construction Management Design (CMD), Supervising Engineer's requirements, and these GTR.

#### **Manufacture**

Anti-glare screens are an engineering – technical measure which prevent the influence of traffic lights from the opposite direction.

The screens are placed in the central reserve area of the road with two separate carriageways, mounted on specially designed girders or on steel guard rail posts.

A separate analysis of the dynamic wind influence is needed for the girders and the barrier, which takes into consideration local weather conditions.

#### **Quality control**

Quality control of Manufacture includes the control of materials used with respect to the design requirements, including structural analysis, erosion due to precipitation and the influence of wind, all in accordance with the provisions, laws and these GTC for used materials and structures.

The contractor shall provide certificates of quality for all materials used and for allowed noise level and submit the originals to the supervising engineer. Quality control of used materials (concrete, stone, plastic, aluminium) shall be done according to respective GTC provisions.

**Calculation of work**

The work shall be measured and calculated per meter of the screen installed.

**9-07 OTHER ROAD FURNITURE**

**Description of work**

The work includes supply, transport and installation of the designed equipment for traffic regulation and road mirrors.

The work shall be in accordance with the design, regulations, quality assurance and control program (QAACP), construction -management design (CMD) supervising engineers' requirements and these GTC.

**Manufacture**

Traffic mirrors are mounted on posts with concrete foundation, or are placed on already constructed structures by means of cantilever beams (buildings, fences, walls etc.) on places where the visibility at intersections is inadequate.

**Quality control**

Quality control of Manufacture includes the control of materials used with respect to the design requirements, in accordance with the provisions, laws and these GTC for used materials and structures.

The contractor shall provide certificates of quality for all materials used and submit the originals to the supervising engineer. Quality control of used materials (concrete, stone, plastic, aluminium) shall be done according to respective GTC provisions.

**Calculation of work**

The work is calculated and measured per piece of mounted mirrors, i.e. per piece of element for traffic regulation.

**9-08 AUTOMATIC TRAFFIC COUNTERS**

**Description of work**

The work includes supply, transport and installation of traffic counters, including all equipment and electrical installations.

The work must be carried out in accordance with the design, appropriate regulations, Quality Control and Quality Assurance Program (QCQAP), Construction Management Design (CMD), Supervising Engineer's requirements, and these GTR.

**Manufacture**

The traffic counters constantly gather data on the significant features of traffic flows. Automatic traffic counters with inductive technology are preferred because they enable quick and exact measurement of road traffic and belong to the most modern solutions that can satisfy all main and additional needs on data gathering concerning the road traffic. It is especially important to mention that the automatic traffic counter has the option to classify vehicles in at least 8 groups (according to European standard).

The traffic counters are installed on roads according to the design. The traffic flow counters (traffic counters) measure and memorise all relevant traffic data:

- counting of vehicles per traffic lane and direction
- speed per type of vehicle
- frequency
- distance between vehicles

The data is gathered by measuring devices on characteristic measuring places on the roads. The data gathering interval is usually one minute, which corresponds to the time needed to process the gathered data.

The measuring system can be based on the inductive loop or other sensors including "video imaging" system. The inductive vehicle detection system is used as a rule, with two inductive loops per one traffic lane. Inductive loops for vehicle detection are installed into the carriageway with two supply lines to the counting device.

The position of the inductive loops shall be determined in a manner that the distance between the loops and the supply of adjacent loops is a minimum of 50 cm.

The in-coming and out-going sides of the adjacent loops of the same traffic direction (e.g. on high-speed roads and highways with multiple one-way traffic lanes) shall be positioned in the same level.

The carriageway groove width, for placement of loops, is 5-8 cm, but when the supply lines to the connecting cubicle are in question (telecommunication his 5 cm in concrete pavement).

For loop supply lines the Cu/Si Li5Y AWD 16/19 are used, whose casing remains undamaged during groove grouting process (180°-240°C). The type of cable with glass fibres strengthened casing is SiFGI 1,5 mm<sup>2</sup> Cu.

Loop supplies outside the carriageway are placed in plastic pipes. The loop wires are connected outside the carriageway area, protected with thermo-shrinking plastic joint.

The loop cable placed in grooves and protected against displacement with plastic wedges– at each 50 cm and grouted with hot bitumen emulsion type "elastin". Placing is done at temperature above 10°C and during dry weather conditions.

The traffic counters are placed in PVC cubicles, with quality protection IP 54, RAL 2009, painted and ultra-violet radiation protected.

The device is protected by means of a short steel fence.

General technical data of the traffic counters:

- weight about 5 kg
- easy to install, move and maintain
- 220 V feeding, AC/12V battery and solar plate
- high performance at working temperature from -40°C to +70°C
- modular performance for possible extensions
- at least c4 inductive loops
- error indicator in the loop for every registration for the complete registration period
- automatic adjustment during inductive loop error

- registration of total number of vehicles
- registration of vehicles in the free flow, slow and stopped vehicles
- registration of vehicles according to direction of movement
- classification of vehicles into at least 8+1 categories (E standard for inductive loops)
- registration of vehicle speed
- measurement of vehicle distribution according to time
- measurement of carriageway temperature (advantage)
- data registration intervals (1-60 minutes, 1-24 hours)
- counting speed 25 vehicles/channel/sec
- exactness – number of vehicles in free flow:>99%±1
- number of slow/stopped vehicles:>95
- gathering and storing for local surveillance
- memory module capacity >512 Kb
- communication: serial connection RS 232 and serial net connection RS 485
- GSM module
- Overload protection
- Parameter adjustment for software on the basis of specific needs
- Software for data processing, analysis and reports, according to the latest technology.

#### **Calculation of work**

The work is calculated and measured per piece of installed traffic counter unit.

### **9-09 WEATHER STATIONS ON ROADS**

#### **Description of work**

The work includes supply, transport and installation of weather station, all equipment and electrical installations included.

The work must be carried out in accordance with the design, appropriate regulations, Quality Control and Quality Assurance Program (QCQAP), Construction Management Design (CMD), Supervising Engineer's requirements, and these GTR.

#### **Manufacture**

Road weather stations discover and analyse potentially dangerous situations on the road and transmit the necessary warning signals to the changeable signs or other information devices. The gathered data helps the roads maintenance services, especially during the winter period.

Road weather stations are installed according to the design and instructions of the manufacturer. They serve to gather data on weather conditions on the road and surrounding area. The weather measuring station consists of a micro-processing device and sensors in the carriageway and atmosphere.

The carriageway sensors measure:

- Internal pavement surface temperature
- carriageway surface moisture
- Salt concentration of the carriageway surface
- Presence of frost, ice and frozen snow



Atmospheric sensors measure:

- Air moisture and temperature
- Type of precipitation (optical)
- Presence and intensity of precipitation
- Wind direction and intensity
- Visibility
- Snow height

The central micro-processing device gathers and processes data from the measuring electrodes, and on the basis of this, gives the following signals:

- Calculated freezing point on the carriageway
- Necessary amount of products for de-frosting of the carriageway
- Warning and alarm for increased risk of frost, ice and frozen snow presence.

The central device shall be connected with the traffic control centre and shall have the option to control the changeable traffic signs.

The measuring station must satisfy the following requirements:

- Simple mounting/de-mounting and maintenance
- 220V AC feeding, 24V, 12V backup feeding or by solar energy
- high performance and measuring exactness
- data registration intervals (1-60 minutes, 1-24 hours)
- error indicator
- data storage and possibility of communication with PC and remote station (back-up)
- possibility of network connection
- Software for data processing, analysis and data report in the centre
- high performance at working temperature from -40°C to +60°C
- moisture and rain resistant
- overload protection

The measuring station cubicle shall be water resistant, IP 54 level of protection.

Atmospheric sensors are installed on a pole 4 to 5 m height (e.g. wind speed and direction sensors, air temperature sensors).

Measuring device for determining the presence, intensity and type of precipitation is made of an optical and capacity sensor. On the basis of the measuring signals from the sensors and the given algorithms, the device recognises the following states: no precipitation, presence of precipitation (rain, snow, hail) and gives information on the precipitation intensity. An algorithm is installed to determine the approximate snow height. The same device gives a constant signal which serves as a visibility measure (expressed by measure from 50 – 2000 m). The device operates on the basis of the ultra-red radiation reflection.

The wind speed measuring device measures the wind speed in the range from 0,5 to 75 m/s, and wind direction from 0-360°. The device is equipped with a heater for winter operating conditions.

### **Calculation of work**

The work is measured and calculated per piece of completely installed weather station according to the design.

## **9-10 TELEPHONE ALERT SYSTEMS**

### **Description of work**

The work includes supply, transport and installation of telephone poles, all equipment and electrical installations included.

The work shall be performed in accordance with the design, regulations, quality assurance and control programme (QAACP), construction-management programme (CMP) , supervising engineer's requirements and these GTC.

### **Manufacture**

Telephone alert system (TAS) is installed on both sides of the highway, in the tunnel and other structures according to the design. It is installed on both sides of the highway at intervals of 2 km, and 3m distance from the carriageway edge, i.e. emergency lane.

The TAS is installed in tunnels longer than 500 m and distance between the telephone poles is usually 250m.

The telephone shall also be positioned immediately before the tunnel entrance. Each parking area and turning area shall also be furnished with a telephone alert system.

TAS is installed only on one side of the carriageway, except in cases when parking and turning areas are planned on both sides of the carriageway.

Tunnels constructed to be one way tunnels, shall be furnished with telephones on the side of the carriageway which will in the final version of the tunnel be the right carriageway side.

The TAS consists of:

- Telephone post
- Telecommunication links (wire and optical cables)
- Switchboard

Standard cables capacity 15 x 4 x 0,8 are used in telecommunications, i.e. 6 x 2 of mono-mode fibres.

Protection against electromagnetic fields and electromagnetic influence is done by increased reduction factor of the wire cable shield, i.e. with a completely non-metal optical cable structure.

According to international telephone transmission standards (ITU) maximum distance between the telephone posts and the switchboard is 30 km.

The work is measured and calculated per piece of installed telephone post according to the design.

## 9-11 TRAFFIC SIGNS BEARING STRUCTURES

### Description of work

The load – bearing structures are mounted over multiple lane highways for installation of traffic signs for traffic re-direction or classification, or other information signs important for safe and uninterrupted traffic flow.

### Classification of load - bearing structures

The traffic signs structures are divided according to their function, performance and span length, i.e. length of structure leg.

- Direction signs gantry type “PP 1550”
- Traffic lights gantry type “PP 1400”
- Cantilever – direction post type “KPS 900”
- Cantilever-traffic lights post type “KSS 600”
- Traffic lights post type “SS 300”

### Manufacture

Traffic signs load bearing structures shall be anti-corrosion protected by hot galvanizing. Anti – corrosion protection shall be done in accordance with the “Book of Rules on technical measures and requirements for anti-corrosion protection of steel structures (O.G. no: 32/70).

Traffic signs bearing structures consist of steel posts and steel transverse bars.

The overhead clearance of the gantry with traffic sign boards is minimum 5,0 m above the carriageway.

Gantry posts are rectangular pipes, dimension as follows:

- For type “PP 1550” 350Δ250Δ8 mm
- For type “PP 1400” 350Δ250Δ8 mm
- For type “KPS 900” 250Δ350Δ8 mm

Anchor bolts, connecting the post with the foundation pole for type “PP 1550”, type “PP 1400” and type “PP 900” are M 30.

Steel material used for poles and bars is hot rolled tin material ČN24-B1-Č.0361. The gantry steel structure shall be done according to the “Book of Rules on technical standards for load-bearing steel structures” (O.G. no: 42/68).

The mounting of the structure shall be according to the “Book of Rules on technical measures and requirements for steel structure mounting” (O.G. no: 29/70) and according to the “Technical regulations for welded steel structures in load-bearing steel structures” (O.G. no: 17/87)

Foundation excavation for traffic signs bearing structures (gantries and posts) shall be done according to the design, i.e. according to the geo-technical report. Foundations are bearing concrete blocks that transfer all structural influences to the ground through their own weight.

Excavation of foundation is 1,5 m deep for all posts except for type “SS 300”, where the depth is 1,0 m. The concrete grade for gantry and post foundations is MB 30 (minimum 350 kg of cement per 1 m<sup>3</sup> of concrete).

All gantries shall have an inspection passage for maintenance of signs and lighting.

Changeable roadside signals of larger size shall be mounted on steel hot rolled profiles.

The number and the profile dimension shall be defined by structural analysis.

All structures shall be designed for II. and III. climatic zone according to valid laws, Book of Rules and standards.

Mounting and Manufacture of load bearing structured for traffic signs shall be done in accordance with European standard HRN EN 12 8991.

Material for signs and posts is defined by standards or the “Book of Rules on traffic signs, road furniture and road markings”.

### **Calculation of work**

The work is measured and calculated per piece and type of mounted structure – gantry or post.

## **9-12 STANDARDS AND TECHNICAL REGULATIONS**

HRN U S4.102/87	Technical furniture of public roads. Safety chain–link fence. Technical conditions.
HRN U S4.104/84	Technical furniture of public roads. Safety chain–link fences. Terms and definitions. Classification.
HRN U S4.106/87	Technical furniture of public roads. Safety chain–link fences. Terms and definitions. Classification.
HRN U S4.110/84	Technical furniture of public roads. Guard rails, steel. Technical conditions for installation.
HRN U S4.112/87	Technical furniture of public roads. Safety chain–link fences. Technical conditions for installation.
HRN U S4.201/80	Road markings. Latinic script of normal width for traffic signs. Shape and size.
HRN U S4.202/80	Road markings. Latinic script narrow, for traffic signs. Shape and size.
HRN U S4.221/80	Road markings, along the carriageway. Definition and Classification.
HRN U S4.222/80	Road markings , along the carriageway. Solid lines.
HRN U S4.223/80	Road markings, along the carriageway. Broken lines.
HRN U S4.224/80	Road markings, along the carriageway. Double lines.
HRN U S4.225/80	Road markings, across the carriageway. Stop lines.
HRN U S4.226/80	Road markings, across the carriageway. Diagonal and border lines.
HRN U S4.227/80	Road markings, across the carriageway. Pedestrian crossings.
HRN U S4.228/80	Road markings, across the carriageway. Pedal cyclist route crossings.

HRN U S4.229/80	Road markings. Other markings. Arrows.
HRN U S4.230/80	Road markings. Other markings Traffic direction surfaces.
HRN U S4.231/80	Road markings. Other markings. Direction lines.
HRN U S4.232/80	Road markings. Other markings. Signboards.
HRN U S4.233/80	Road markings. Other markings. Special purpose traffic surfaces markings.
HRN U S4.234/80	Road markings. Other markings. Marking of parking area.
HRN Z.SO.001/82	Safety colour markings and signs. General provisions.
HRN Z.SO.002/82	Safety signs. Signs giving orders.
HRN Z.SO.003/82	Safety signs. Obligatory signs.
HRN Z.SO.004/82	Safety signs. Warning signs.
HRN Z.SO.005/82	Safety signs. Information signs for protection and safety.
HRN Z.SO.010/82	Safety colour markings and signs. Colour-metric and photo-metric properties of material.
HRN Z.S2.235/82	Technical furniture of public roads. Direction signs.
HRN Z.S2.236/82	Technical furniture of public roads. Directioning furniture. Vertical marking.
HRN Z.S2.240/83	Carriageway markings. Colours for thin-layer carriageway markings. Technical conditions.
HRN Z.S2.301/83	Traffic signs on roads. Warning signs. Graphical introduction.
HRN Z.S2.302/83	Traffic signs on roads. Right of way signs. Graphical introduction.
HRN Z.S2.303/83	Traffic signs on roads. Level crossing signs. Graphical introduction.
HRN Z.S2.304/83	Traffic signs on roads. Signs giving orders i.e. restriction signs. Graphical introduction.
HRN Z.S2.305/83	Traffic signs on roads. Warning signs. Graphical introduction.
HRN Z.S2.306/83	Traffic signs on roads. Information signs. Graphical introduction.
HRN Z.S2.307/83	Traffic signs on roads. Stop signs and parking zones. Graphical introduction.
HRN Z.S52.313/82	Traffic signs on roads. Information signs for traffic in the junction zone.
HRN Z.S52.314/82	Traffic signs on roads. Marker posts and direction boards. Shape and size.
HRN Z.S52.315/82	Traffic signs on roads. Traffic signs for traffic on highways and roads with multiple level crossings. Shape and size.
HRN Z.52.316/82	Traffic signs on roads. Confirmation of direction. Shape and size.
HRN Z.52.322/82	Traffic signs on roads. Street name boards. Graphical introduction.
HRN U.C4.018/84	Testing the resistance to slipperiness of the pavement structure wearing course. Method of measurement.
HRN EN 12352:2000 en	Traffic control equipment. Warning and safety light devices.
HRN EN 12368:2001 en	Traffic control equipment. Signal heads.

HRN EN 12675:2001 en	Traffic signal controllers. Functional safety requirements.
HRN EN 12676-1:2000en	Anti-glare system for roads. Part 1: Performance and characteristics.
HRN EN 12676-2:2000 en	Anti-glare system for roads. Part 2. Testing methods.
HRN EN 1317-1:2001 en	Road restraint system. Part 1. Terminology and general criteria for test methods.
HRN EN 1317-2:2001 en	Road restraint system. Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers.
HRN EN 1317-3:2001 en	Road restraint system: Part 3. Performance classes, impact test acceptance criteria and test methods for crash cushions
HRN EN 1436:2001 en	Road marking materials. Performance characteristics for road users.
HRN EN 1436-1:2001 en	Road marking materials. Retro-reflecting road studs. Part 1: Initial performance requirements
HRN EN 1436-2:2001 en	Road marking materials. Retro-reflecting road studs. Part 2: Road test performance specifications
HRN EN 1790:2000 en	Road marking materials. Pre-formed road markings.
HRN EN 1794-1:2001 en	Road traffic noise reduction devices. Non-acoustic performance. Part 1. Mechanical performance and stability requirements.
HRN EN 1794-2:2001 en	Road traffic noise reduction devices. Non-acoustic performance. Part 2 General safety requirements and environmental protection requirements.
HRN EN 1824:2000 en	Road marking materials. Road trials.
HRN EN 1871:2000 en	Road marking materials. Physical properties.
HRN ENV 13563:2000 en	Traffic control equipment – vehicle detectors.
HRN 1114	Traffic signs – technical requirements
HRN 1118	Traffic signs – additional boards. Appearance of signs.
HRN 1119	Traffic signs. Road traffic furniture. Appearance of road traffic furniture.
HRN 1120	
HRN 1121	
HRN 1122	
HRN 1123	
HRN 1124	
HRN 1125	
HRN 1126	Traffic signs. Traffic guidance information signs. Appearance of signs.
HRN 1127	Traffic signs. Visual signs for railway line crossing. Appearance of sign.
HRN EN 12899-1	Traffic signs – fixed, vertical. Part 1: Fixed signs.
HRN EN 12899-2	Road furniture. Fixed, vertical traffic signs. Part 2: Illuminated traffic bollards.
HRN EN 13422	Vertical road furniture. Portable traffic signs. Cones and cylinders.
HRN 1115	Traffic signs. Warning signs. Appearance of signs.
HRN 1116	Traffic signs. Regulatory signs. Appearance of signs.
HRN 1117	Traffic signs. Information signs. Appearance of signs.