



CAR Segnaletica Stradale srl

STEEL ROAD SAFETY BARRIER

MODEL: CARN2BL3-S

DESCRIPTION: ROAD SAFETY BARRIER CLASS N2

DRAWING: N° CARN2BL3-S REV. 0 DATE 10/06/2013

APPLICATION: SAFETY BARRIER FOR SIDE EDGE H1
- **CONFIGURATION A (Depth of infixing 800mm)**
- **CONFIGURATION B (Depth of infixing 1050mm)**

INSTALLATION AND MAINTENANCE MANUAL

REVISION NR.1

01/02/2018

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APPLICATION

The road safety barrier in galvanized steel according to EN ISO 1461 double wave beam, for embankments class N2, developed by *CAR - Segnaletica Stradale SRL*, designed for gradual and controlled containment of light and heavy impacting vehicles, according to table A of the annex to Ministry of Infrastructure and Transportation Decree dated 21/06/2004 –“Updating of the technical instructions for the design, approval and application of the road safety barriers and technical requirements for the tests”, can be used under the following design conditions (roads classification and traffic types established under art. 6 of the same annex, Decree 21/06/2004):

- Secondary roads (C) out of towns and main urban roads (D) with type traffic I;
- Urban roads in residential areas (E) and local roads (F) with type traffic II

CRASH TEST (UNI EN 1317 PARTI 1-2)

The road safety barrier in galvanized steel according to EN ISO 1461, 2double wave beam for embankment class N2, according with drawing no. CARN2BL3-S, has been designed to comply with the requirements laid down by the current legislation following

DM 223 del 18/02/1992

DM n° 2367 del 21/6/2004

UNI EN 1317 parti 1 e 2 del 05/2000

These requirements include the containment level, which is higher, a level of impact severity, type A, such as to allow an adequate containment system for traffic conditions and geometric characteristics of the road concerned.

The Company CAR Segnaletica Stradale SRL has therefore carried out the following impact tests at the Test Centre AISICO at Anagni (Frosinone - Italy), in accordance with to what is required by the Regulations which provides for a normal containment barrier class N2 the acceptance tests type TB 32 and TB 11:

- Test TB 11, n° 972, with test speed of the vehicle of 100 km / h, 20 ° impact angle and the total mass of 900 kg; performed with a car

- Test TB 32, n° 971, with test speed of the vehicle of 110 km / h, 20 ° impact angle and the total mass of 1.500 kg; performed with a car

The company CAR Segnaletica Stradale to develop an "optimal" double wave beam road barrier class N2, has conducted a series of crash tests on several prototypes testing them in different classes (light and heavy vehicles) at the aforementioned test track.

For the complete description and analysis of the test results, please refer to the Test Reports prepared by the official testing center AISICO of Anagni (Frosinone), in which the definitive crash tests have taken place, according to the requirements of current legislation (Decree 21/06 / 2004). We limit ourselves here to do a brief summary on the results:

Test n. 972

Test type: TB11
ASI value : 0,9<1,0
THIV value: 28,00<33
Normalized Working width: 0,7 m
Normalized Dynamic Reflection: 0,5 m
Crossing the barrier NO
The vehicle rolls over : NO
Vehicle trajectory within exit box: YES

As explained in "Design and tuning of the device", knowing that this barrier has been designed to ensure the "effective" safety of passengers and that all the required test parameters by current regulations had been met. The value of the ASI is undoubtedly good.

Test n. 971

Test type: TB32
Normalized Working width: 1,0 m with working width level W3
Normalized Dynamic Reflection: 0,9 m
Normalized vehicle intrusion: 1,0 m VI3
Crossing the barrier NO
The vehicle rolls over: NO
Vehicle trajectory within exit box: YES

All test parameters, required by current regulations, have therefore been respected; the vehicle does not cross the barrier and does not roll over during the impact phase. We must emphasize the excellent behavior of the barrier during the impact of the heavy vehicle, as evidenced by the photos of the sequence attached to the test report, creating the classic smooth and gradual "varix". The damages on the barrier are those expected. The bearing of the vehicles has been good, specially for the stability shown in all phases of impact.

MARGINAL VARIATIONS

The barrier has a standard geometry that provides a stake fixed for 800 mm in **ground A-1-according to the CNR - UNI 10006 Standards (see Fig. 1 - Barrier in configuration A)**. In the case in which the installation is made on an embankment narrower than the "standard" one, it is proposed the version with the post more infixed without changing the upper geometry (see Fig. 2 - Barrier in configuration B), in which case, the verification of the invariability of the results of crash tests are entrusted to a specific technical report, an integral part of the CE mark.

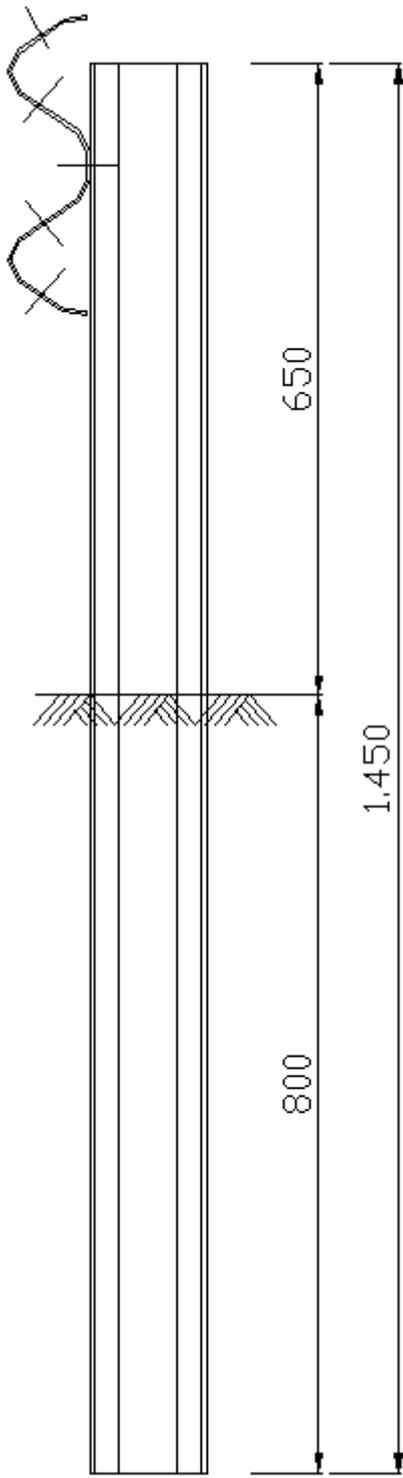


Fig. 1 - Configuration A

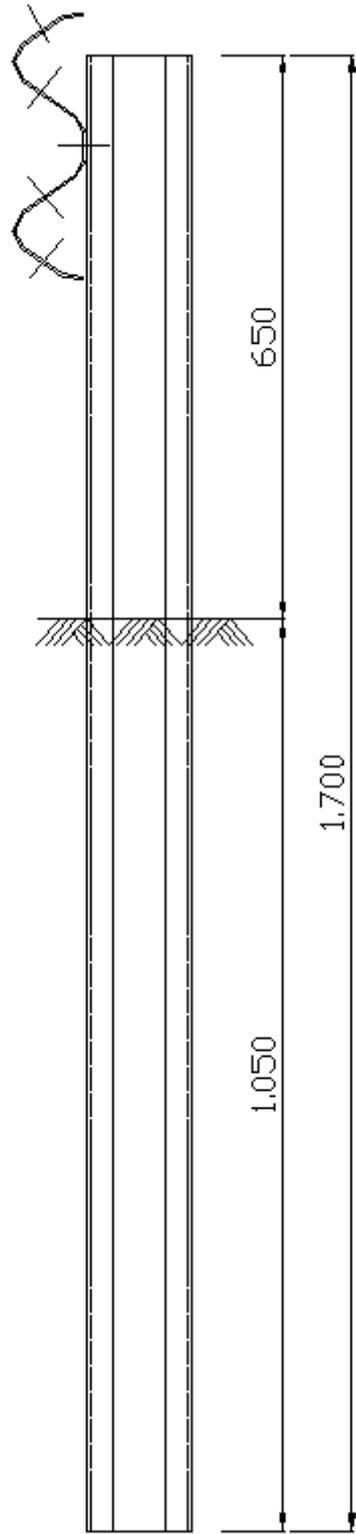


Fig. 2 - Configuration B

CE CERTIFICATE OF CONFORMITY OF THE BARRIER

For road safety barrier concerned, identified by the initials CARH1BL3, was released Certificate of Conformity.

This Certificate of Conformity was issued by SRAC CERTSERV, Notified Body "CE" No. 1835, with registered office at Str. Theodor Burada n° 6, Sector 1, Bucharest, 010215, ROMANIA, in accordance with Directive 89/106/EEC through checks of Initial type testing (I.T.T.), submitted by the manufacturer to the Factory Process Control (FPC), which ensured conformity to the type examined and the requirements of the standard according to the procedure of System 1 - Annex III of Directive 89/106 / EEC

The product is marketed by CAR Segnaletica Stradale SRL - ZI Contrada Piana Ponte (BN).

The product is manufactured by CAR Segnaletica Stradale SRL - ZI Contrada Piana Ponte (BN).

INSTALLATION

Assuming that we have to install the barrier in the presence of normal traffic, first we need to install all necessary road signalization for the reduction of the carriageway or traffic deviation to make a construction site protected from the flow of vehicles.

In compliance with safety standards, the staff should be provided with suitable equipment (overalls, shoes, gloves) and any other expected by statutory regulations on safety.



Making sure you start the work by the end of the section to be protected, to ascend to the beginning of the same section, regarding the traffic direction (the side where you work for roads with two-way traffic), the temporal and spatial sequence of operations, neglecting any non-specific operations like removal of existing barrier, restoration of the margin road, will be approximately the following:

1) drawing one or more lines or stringing wires suitable for the alignment of the posts and beams;

2) unloading and positioning on the ground of the 2-wave beams along the path taking into account the traffic direction, please note that the overlapping parts of the beams must be predispose, in relation to the traffic direction, in such way that the thickness exposed is not directed to the traffic that comes and in this way there is no pediment or coupling for the vehicle in derailment that must “slip away”;

3) positioning of the posts in correspondence to the slots of the beam aligned on the ground, so with the post spacing of 4000 mm. This operation must be done with the aid of pile driver driven by a specialized operator, while another operator is supporting the post to be driven into the ground. The piling operations are completed by control of the posts alignment, post spacing, post verticality and distance from the road paving and/or roadsides according to the amounts provided in the project drawing (once the installation is finished, the beam must be aligned with the roadside “thread”);

4) connecting the double wave overlapped beams, previously laid on the ground, to the post and between them , using a hexagonal head bolt TEDE M12x50 class 8.8;

5) completion of the double wave overlapped beams junctions through n°.8 round head bolts TTDE M16x30 class 8.8;

6) proceed with the appropriate pneumatic screwdrivers or torque wrench with the final tightening of all bolts necessary for the mutual connection of the various elements after checking all amounts and alignment of the 2-wave beam.

As for the proper tightening of the bolts the TEDE M12x50 class 8.8 must be apply a torque value of 20-50 Nm; for the proper bolt tightening TTDE M16x30 class 8.8 must be apply a torque value between 50 and 90 Nm

MINIMUM WORKING LENGHT

In accordance with the Article 6 of the Italian norm D.M. 21 June 2004: “safety barriers should have the minimum length like in Article 3 (the length stated in the certificates of approval or the designer technical report)” in this case is the length resulting from the tested installation.

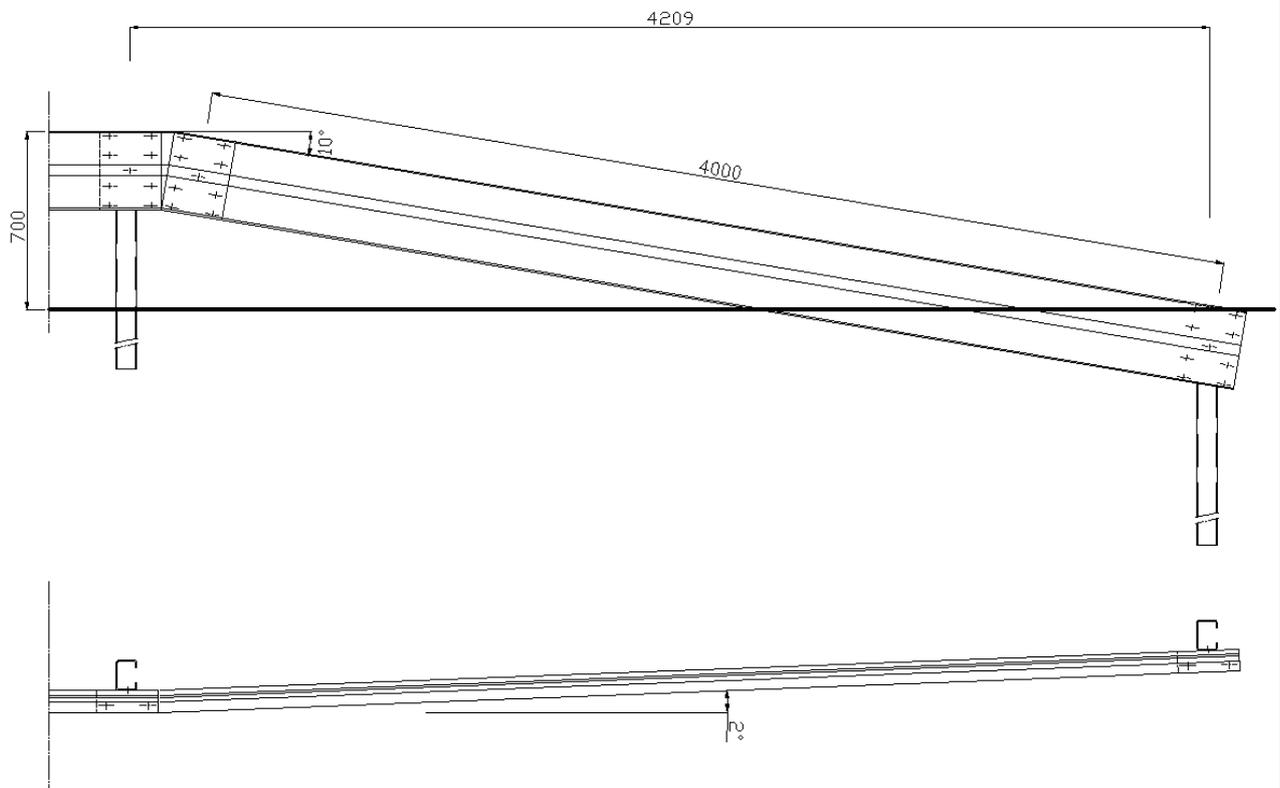
MATERIALS

Steel SR 235 JR. Galvanization in accordance with UNI EN ISO 1461. The tolerances in accordance with norms UNI.

ELEMENT IDENTIFICATION	N° DRAWING	MATERIAL		PROCESSING	
Post "C" shape dim. 120x80x25x4 mm H=1450 mm	Table 2/3	Steel SR 235 JR		Galvanizing	
Double wave beam Distance between the post 4000 mm Thickness 2 mm	Table 4	Steel SR 235 JR		Galvanizing	
Bolt TT M16x30	Table 5	CL 8.8		Galvanizing	
Bolt TE M12x50	Table 6	CL 8.8		Galvanizing	

TERMINALS

It is necessary that the barrier must be equipped in both areas of approach (initial and final) with the terminal element defined "mitred" to ensure an effective and functional behavior, with both beam before and after the extension of the barrier, facing the outside of the roadway with an angle of 2 °. However, different solutions are permitted in relation to motivated and clear choices of the designer in order to adapt to the actual situation of the road.



WATER DRAINAGE

The barrier in question does not constitute an obstacle to the disposal of rainwater because the drainage structure and "classics" capturing systems such as manholes, drains and downspouts ensures the dispose of the waters.

CHARACTERISTICS OF SOIL

The device under test was infix into the soil consisting of limestone gravel in a silty sandy matrix classified A-1- according to the Standards CNR - UNI 10006 with standard ambient temperatures (around 20 ° C) and dry soil.

In case of discrepancy on the composition of the soil and on the environmental temperature, it will be necessary to perform a geological and geotechnical survey and carefully evaluate the compliance of the geotechnical parameters of the support terrain with the crash test conditions according to the technical criteria; however, following the instructions given by the designer and reported by the Director of Works.

POSITIONING

The tests for the approval of side edge barriers are generally performed on flat land (with extension behind the barrier considered, compared to it size, indefinite) infix on land class A1).

Such conditions are clearly not achievable in practice in new constructions (particularly with the possibility to have a wide berm) , but, even more, when installing barriers on existing berm, in addition to have very small widths you have, generally, materials with inferior mechanical characteristics to those considered in the impact tests.

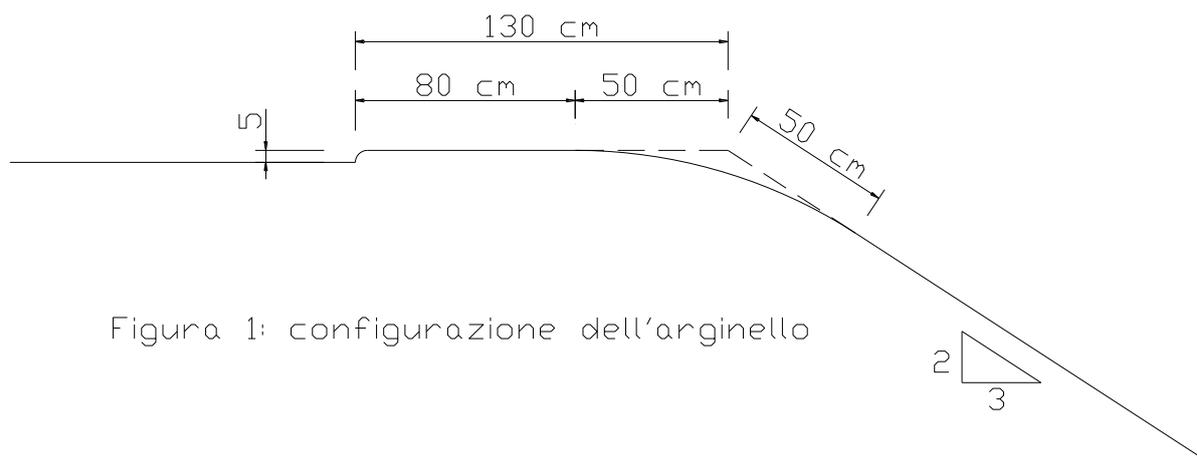
It is therefore a clear need, to adapt the support of the devices to the road where they should be installed, already called art. 7 DM 3.6.1998.

As previously mentioned side edge barriers are usually tested on a flat land of indefinite extension and essentially on land classified as A1. The adoption of these conditions as a reference implies that the barriers can never be installed without making any changes to the support.

For such a configuration has been defined as a "reference" the geometric characteristics compatible with the minimum requirements set out in MD 6792/2001 "Functional and geometric guidelines for road construction" for a section of the highway.

For the purposes of analysis of geotechnical character the margin is considered as two straight sections connected by the element does not move and it is therefore considered as "Arginello" the distance between the edge of the dock and the intersection between the top the "Arginello" and the top of the escarpment (which, in the scheme adopted as a reference, is equal to 130 cm).

Regarding the soil in which the posts are fixtures it is assumed that the same has geotechnical characteristics compatible with the slope of the escarpments (2/3) typical of road embankments.



Therefore, installation is recommended at the minimum distance of 1,30 m on the back of road barrier, as long as the front is clear of obstacles; otherwise appropriate technical evaluation will be made by the designer about the working space needed for the proper functioning of the barrier.

On the front road instead, the organs attenuators of the barrier should be placed according to the thread of the road edge, respecting, at least the minimum width of the road shoulder to avoid altering the geometry.

Finally, the altitude difference between the road surface and the mounting surface, it is also considered according to the instructions contained on the tolerances on the UNI EN 1317 Part 1 which is 5 cm maximum tolerable effectively and does not force the barrier to be changed.

In fact, in paragraph 5 of EN 1317, Part 1, from Table 1, shows that the position of the center of gravity of the impacting vehicle has a tolerance limit of 10% more or less, equivalent given altitude difference between of the parts of the barrier and the parts of the impacting vehicle, to a slip elevation in line with the methods of impact crash test.

INSTALLATION AND SAFETY EQUIPMENT



WHEELED OR TRACKED PILE DRIVER



TRUCK WITH CRANE



BLOWTORCH



GENERATOR



PNEUMATIC HAMMER



COMPRESSOR



OVERALLS WORKING CLOTHES



HELMET



SAFETY ROPES



HEADPHONES



GLOVES



SAFETY GLASSES



EAR PLUGS

MAINTENANCE

The staff proposed by the Road Management Body, will identify any possible imperfection of the installed barriers (presence of rust, deformation and/or damage of one or more components) and/or changes in performance characteristics (bolts tightening, damage).

Particular attention should be placed at parts of the barrier damaged by shocks that if not removed in time constitute a noncompliance barrier with the original performance and guaranteed by the supplying company.

As a result of its reports, as the repairs are not allowed, appropriate staff will replace the damaged parts (identified by a specific code marked on them), which will have the constitutive characteristics described in the documentation attached to the graphic design and crash testing.

The staff will arrange the restore operations in four phases, as best illustrated graphically below:

Stage 1: manual dismantling of the longitudinal / transversal elements of the damaged barrier as a result of impact;

Stage 2: slinging and extraction, with wagon crane of the posts fixtures, or cutting with cutting torch the support;

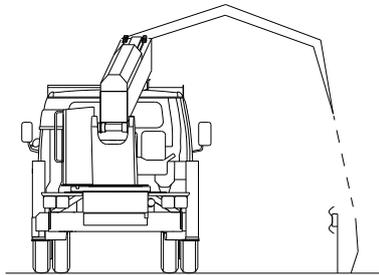
Stage 3: Fill voids and re-consolidation of the support with roller;

Stage 4: infixion of new posts with pile driver;

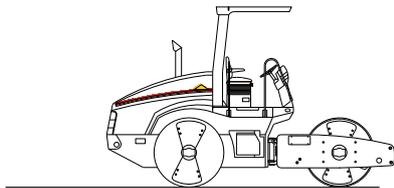
Stage 5: manual editing of the new longitudinal and transverse elements to the complete restoration of the barrier.



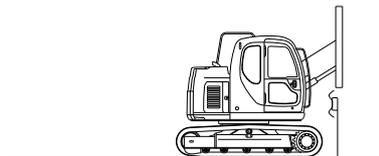
1° Fase: smontaggio manuale degli elementi longitudinali/trasversali e di facile removibilità della barriera danneggiati a seguito dell'urto;



2° Fase: imbragaggio e sfilamento con carro gru dei montanti infissi, oppure taglio con fiamma ossidrica a raso del supporto;



3° Fase: riempimento vuoti e ricompattamento del supporto con rullo;



4° Fase: infissione dei nuovi montanti con battipalo;



5° Fase: montaggio manuale dei nuovi elementi longitudinali e trasversali per il ripristino

Periodically, as determined by Road Management Body, it will be conducted a review sampling of tightening of the bolts with a wrench to 50-90 Nm. In case you find a lower clamp will proceed to tighten the bolts and/or anchor bolts.

If is noticed a frequent loosening of nuts and bolts due to various causes including the vibrations induced by the passage of vehicles, it is recommended to the Road Management Body to provide the clamping nuts of the appropriate type Grower washers.

DURABILITA'

The durability of the product is ensured by protective treatments performed on all surfaces of the components of the barriers. The processing is necessary to ensure efficiency over the years of single parts and complete device. In particular, the zinc coating is adopted as the best defense against environmental factors. The galvanizing process is done by immersion in molten zinc. The reference standard - EN ISO 1461 - settles the minimum thickness coverage for different thickness of artifact.

The duration of such work is 10 years since its installation.

TOLERANCES

The tolerances refer to the following standards:

- 1) UNI EN 10025 “Hot rolled products of non-alloys structural steel. Technical delivery conditions”;
- 2) UNI EN 10027-1 “Designation systems for steels. Steel names, principal symbols”;
- 3) UNI EN 10029 “Hot rolled steel plates 3 mm thick or above. Tolerances on dimensions shape and mass”;
- 4) UNI EN 10051 “Continuously hot-rolled uncoated plate, sheet and strip of non-alloy and alloy steels. Tolerances on dimensions and shape”;
- 5) UNI 10162 “Cold rolled steel sections - Technical delivery conditions - Dimensional and cross-sectional tolerances”;
- 6) UNI EN 10143 of 31/01/94 “Continuously hot-dip metal coated steel sheet and strip. Tolerances on dimensions and shape”;
- 7) UNI EN ISO 1461 of 30/09/99 “Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods”;
- 8) UNI EN 3740 “Steel fasteners - Technical requirements”.

1) UNI 10162 “Cold rolled steel sections. Technical delivery conditions. Dimensional tolerances and on the cross section. "It applies to the profiles obtained from the flat products, hot-rolled or cold-rolled, cold formed machine roll formers and commercial products in the forms usual. Definitions, requirements and features, dimensions, tolerances, supply conditions, testing, test procedures, designation, marking, documents. Appendix: Additional information relating to the restriction of the material

2) UNI EN 10143 of 31/01/94 "Strip and sheet steel with metallic coating applied by hot dipping continuously. Tolerances on dimensions and shape. "Specifies the requirements for tolerances on shape and dimensions of flat products (strip of all widths and expanded metal to cut them to length / strips) with a thickness of ≤ 3 mm, of steel with low carbon content for cold forming and of structural steels, with metallic coating applied by hot dipping continuously. The thickness is the thickness of the final product supplied, including the metallic coating.

3) UNI EN ISO 1461 of 30/09/99 "Dip galvanized coatings on fabricated iron and hot steel articles - Specifications and test methods". Specifies the general properties and test methods for coatings applied by immersion in molten zinc (hot dip galvanizing) (containing not more than 2% of other metals) on articles of iron and steel.

4) UNI EN 3740 "Connection elements threaded steel - the technical requirements."

For installation of the barrier, the following tolerances are allowed:

- Check the vertical piling of the posts: deviation in the upper part of the post $\max \pm \min$ mm 20;
- Check the placement of the posts respect to the road: tolerances according to the project;
- Check the height of the upper part of the post regard to the road level: height tolerance ± 20 mm;
- Installation of the beam: height in relation to the road level ± 20 mm, alignment ± 30 mm (unless other project indications);
- Bolts tightening ± 10 Nm.

APPENDIX: Installation of barriers - marking of the construction

site.

Legal framework:

Official Gazette N. 226 of 26th September 2002

MINISTRY OF INFRASTRUCTURE AND TRANSPORT DECREE July 10, 2002

TECHNICAL REGULATIONS CONCERNING THE DIFFERENTIAL SIGNALS SCHEMES, BY CATEGORY OF ROAD TO BE TAKEN FOR TEMPORARY SIGNALLING

The following diagrams, based on the requirements of the consolidated documentation - "Testo Unico della Strada", indicate the safety marking for works with the presence of traffic on highways and major streets with more lanes in each direction and separated carriageways.

Other adjustments can be taken from THE handbook "Autostrade" (below you can find a frontispiece). In the shown document there are all signs combined in 54 different ways.

The following tables show the most usual configurations.

The following table shows are the most frequent

To install the device in curve (with the exception of crash cushions and special terminals provided in the tests) and the minimum radius of curvature, it emphasizes the art. 33 of the said Ministerial Decree:

Art. 33. Special Guideposts

1. The special delineators are of the following types:

- a) Demarcation. It should be used in series to highlight the longitudinal edges and approach to the work areas. Must always be installed at right angles to the axis of the road which it is addressed. The interval between the posts should not be more than 15 m. The stake is colored bands on the face with alternating white and red. The red ones have a width equal to 1.2 times the white ones. The minimum size is 20x80 cm and the height of the support is to ensure the lower edge of at least 30 cm;
- b) Modular Delineator. It should be used in multiple elements to highlight the outer side of the deviations with provisional curves of radius less than or equal to 200 m and must always be installed at right angles to the axis of the road. The interval between the outlines temporary bulls must be in the following values:

Radius of the curve (in meters) / longitudinal spacing (in meters):

- up to 30 m / 5 m

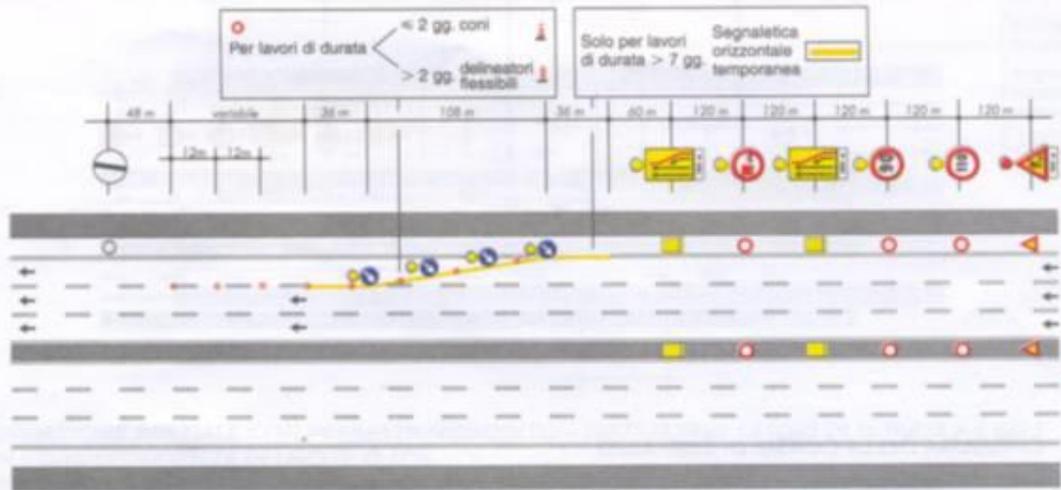
- from 30 to 50 m / 10 m - from 50 to 100 m / 15 m - from 100 to 200 m / 20 m

The delineator has a design on the face of a white arrow on red background. The "normal" size is 60x60 cm, the "big" one is 90x90 cm.

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CHIUSURA DELLA CORSIA DI DESTRA

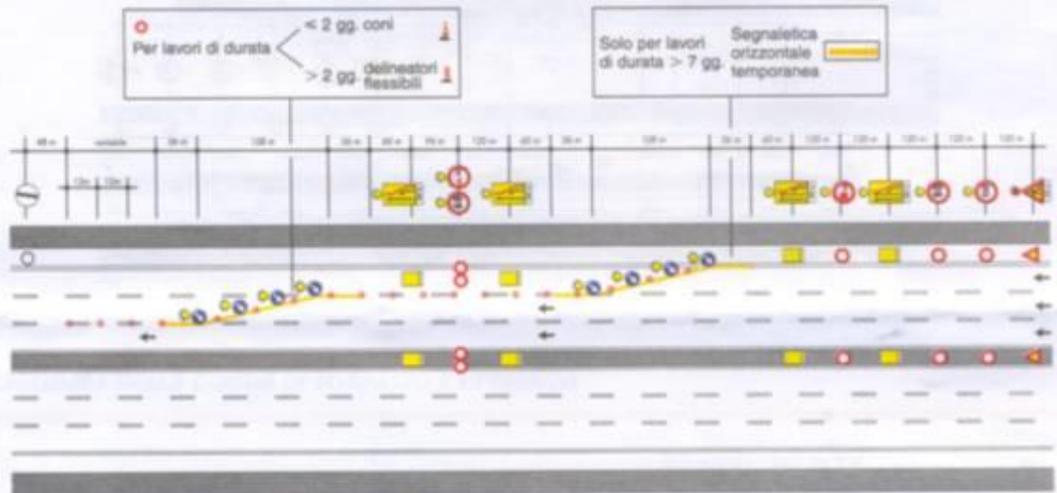
Schema



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CHIUSURA DELLE CORSIE DI DESTRA E CENTRALE

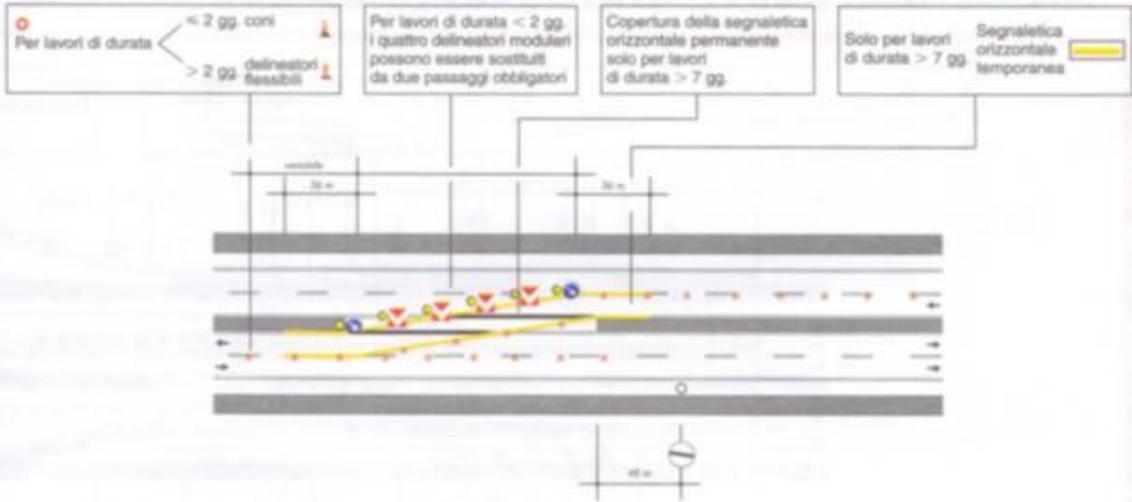
Schema



7

DEVIAZIONE – TESTATA

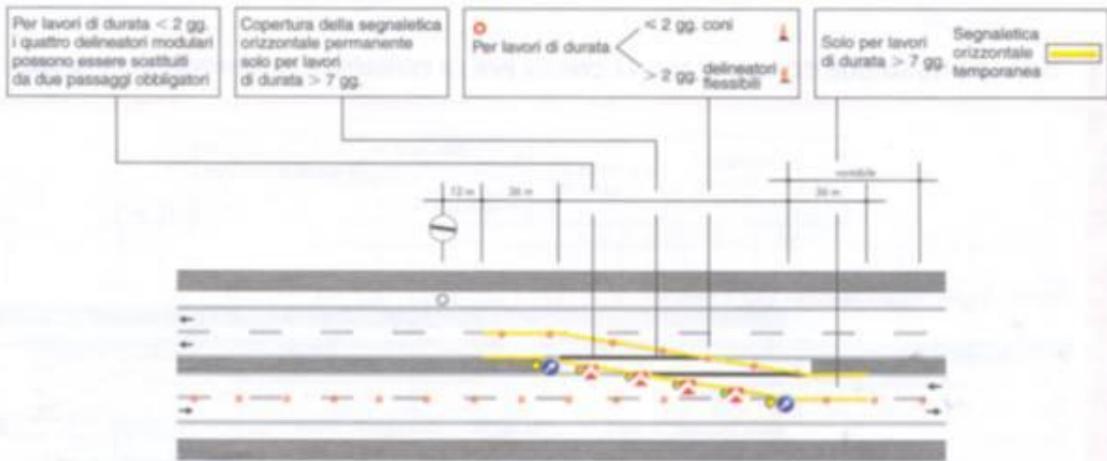
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DEVIAZIONE – RIENTRO

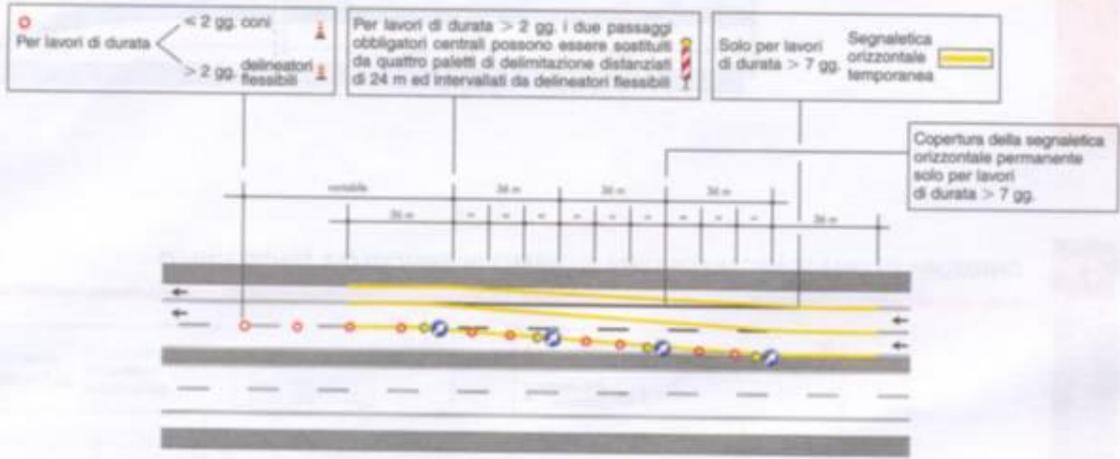
Schema



11

FLESSO – TESTATA

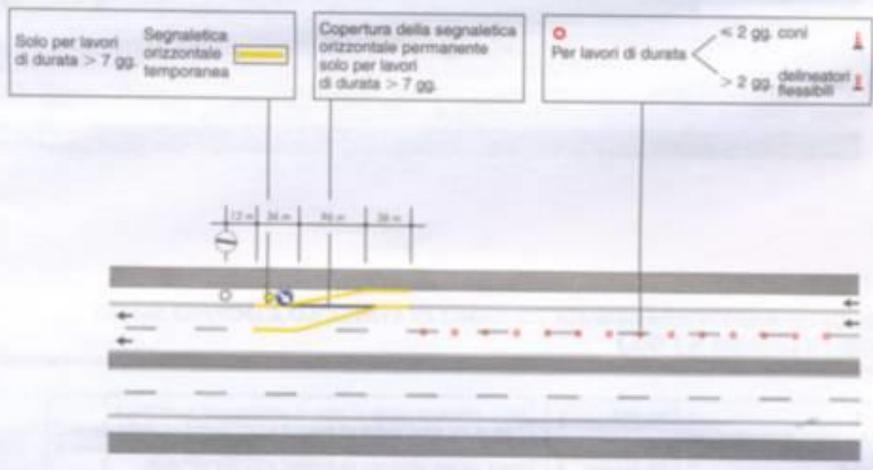
Schema



12

FLESSO – RIENTRO

Schema



DOCUMENTS

- Technical Report
- Technical Drawings
- Supply and installation tolerances:

DM 2367/2004

UNI EN 10025

UNI EN 10027-1

UNI EN 10029

UNI EN 10051

UNI 10162

UNI EN 10143

UNI EN ISO 1461

UNI EN 3740

D.M. MINISTERO INFRASTRUTTURE E TRASPORTI 28/06/2011 (G.U. n.233/2011)

DATE 10 JANUARY 2013

CAR SEGNALETICA STRADALE SRL
THE TECHNICIAN