Tech INFO

Marabu

Production of Retroreflective Traffic Signs

Screen
2015
15.June

Requirements and Specifications

Numerous kinds of retro reflective and reflecting materials are used as aids to Traffic Safety. Differing standards, specifications, and laws must be observed. The reflective effect of traffic signs and traffic devices can be produced in different ways and with different retroreflective materials. To achieve such an effect, specifically developed transparent **screen printing inks** are used.
This TechINFO describes the correct use of Marabu screen printing ink for traffic signs in combination with approved retroreflective materials.

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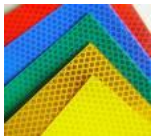

1.0 The construction of traffic signs

According to the German road traffic regulations StVO-VwV §§ 39 - 43 under III, paragraph 4 the manufacturing of road signs must meet the requirements of established standards. The requirements regarding colours and retroreflective sheets refer to DIN standards, which have recently been adapted to European Standards. The functionality of the road signs must be guaranteed on a long-term basis.
The aging process, as well as the visibility of road signs is naturally influenced by environmental factors like UV-radiation, dirt and moisture. For this reason the manufacturing of these products requires approved, high-grade sheeting and ink materials. Only materials (and combinations of materials) which have been approved by the Federal Highway Research Institute (Bundesanstalt für Straßenwesen (BASt)) and the Auditing Federation of Street Furniture Manufacturers (StrAus-Zert) must be used. Furthermore, the manufacturers must provide a sample for examination as well as a processing examination according to „RAL"-requirements.

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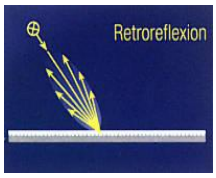
2.0 Retroreflection



Retroreflective sheets reflect the light of the vehicle's headlights back to the vehicle effectively.

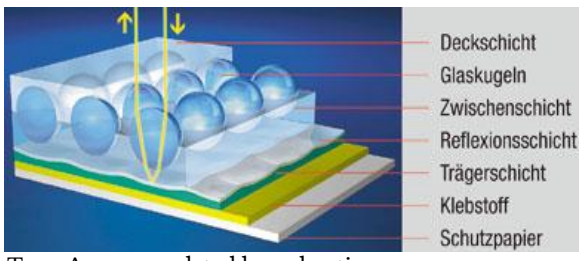
Only if drivers can see and understand the hazardous situation in good time by day or night, they can react accordingly. In the 1950´s the development of reflective materials for the making of traffic signs began. Nowadays, retroreflective sheeting is a high-tech product. The various types neither reflect the light like a mirror, nor do they diffuse it in multiple directions like a varnished area, but reflect the light back to the light source (i.e. the vehicle).

2.1 Different types of reflective sheeting

The functionality of traffic signs must be guaranteed during the day as well as in the night. DIN 67520 regulates the minimum luminous intensity of the sheeting while new. To meet these differing requirements various types of reflective sheets are available. Dependant upon the various constructions they are divided into type A, B, or C.

Type A / Encapsulated lens sheeting:

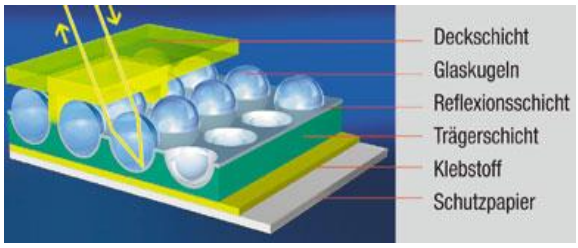
This technology was the first generation of retro-reflecting lens sheeting and is becoming less important. Nowadays it is mainly used for unfrequented country roads and for areas with low illumination at night (residential roads) and where traffic sign are mounted rather low (< 2,5 m).



Type A: encapsulated lens sheeting

Type B / Encapsulated lens sheeting

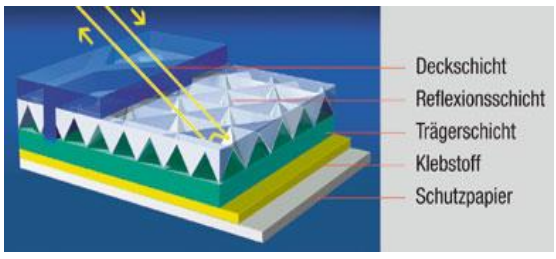
This is the ideal solution for traffic signs on country roads or for at night in dimly lit suburbs. These so called 'high intensity grade' sheeting materials achieve about triple the luminance density than the so called 'engineering' grade sheeting at wide angles. It features adequate reflective index even at a 40° degree angle.



Type B: encapsulated lens sheeting

Type C / Micro prismatic Type

The micro prismatic technology was especially developed for the use along highways, freeways, and country roads where high speeds require early information for the drivers. This technology offers the highest performance even at long distances and allows good contrast even in a bright and busy surrounding (distraction by other sources such as lights, signals, billboards, etc). This type of sheeting is available in the categories RA2 and RA3 by many manufacturers. This new technology features triple the luminous intensity compared to a high intensity sheeting type B, even at oblique angles.



Type C: Micro prismatic Type

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2.2 Retroreflection categories

With the revision of Standard DIN 67520 dated Nov. 2008 reflective materials are being divided into three reflection categories (RA1, RA2, und RA3). The classification depends upon their reflective characteristics which are typical for the requirements to the Coefficient of Retroreflection (R_A), being decisive for the choice of sheeting. The Coefficient of Retroreflection is not bound to the sheetings´ construction anymore. The retroreflection category describes the minimum requirements of a selected material. Previous classifications become void.

R. Refl. Category	Type
RA1	Type A
RA2	Type B
RA2	Type C
RA3A (long distance)	Type C
RA3B (shorter dist.)	Type C

2.3 Manufacturers of reflective sheetings

- Avery Dennison (USA)
- Autoadesivi (Italy)
- 3M (USA)
- LGChem (Korea)
- Nippon Carbide Industries (Japan)
- Orafol Europe GmbH (Germany)
- Sakai Trading (Japan)

3.0 Specifications / Regulations

Government authorities must use European standards for fixed, vertical traffic signs. The implementation of the adapted European standard (**hEN 12899-1:2007**) requires a change to the national standards in Germany. Only authorized manufacturers, approved materials, and material combinations (sheeting/ink), can be used. The finished signs must show the corresponding identification on the front side.

For example, specifications for reflecting materials are:

- hEN 12899-1 (European Regulation)
- DIN 67520 und DIN 6171-1 (D)
- BS 873: Part 6 (Great Britain)
- NFP 98-590-1 (France),
- SN 640879 (Switzerland)
- ASTM D 4956 (US)
- JIS Z 9117 (Japan)

3.1 CE marking of traffic signs

According to mandate 111 of the EC, which is based on the EC Construction Products Directive (89/106/EWG), all construction products must meet certain requirements for a verification of their technical suitability. If a building product's usability has been confirmed based on acceptable standards (hEN) or a European Technical Approval, the conformity with these standards or approvals must be verified by an authorized institution (PÜZ-Stelle) before it may carry the CE mark. The CE mark is the precondition for a permission to sell a construction product within the EC.
Other street sign products, including traffic signs, reflector posts, reflectors, variable message signs, and pavement markings are also subject to this procedure (mandate 111).

In Germany, the German Institute for Constructional Engineering (Deutsches Institut für Bautechnik (DIBt)) is responsible for applications for approval. With implementation of the harmonized European Standard hEN 12899-1:2007 construction products **without** the CE mark must not be distributed within the European Economic Area.

The combination of CE mark and RAL quality label proves the compliance and the fulfilment of operational requirements in Germany.

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CE marking

- shows that the product meets all relevant standards
- is evidence of conformity to harmonized European Standards

For Germany and the majority of members of the EC the CE mark is obligatory. Uniform procedures for quality assurance, the approximation of laws, and consumer protection are the advantages. There are two ways to obtain the CE mark:

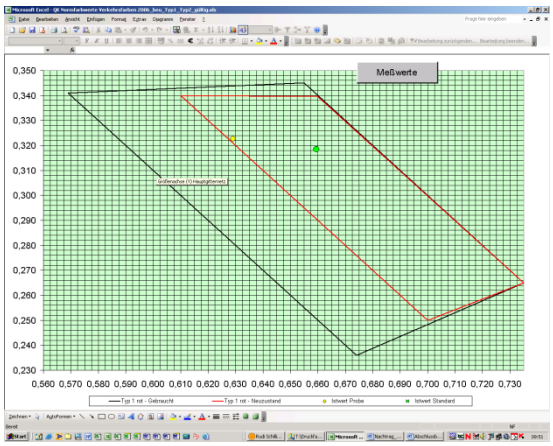
- weathering tests, duration 3 years
- accelerated weather tests (approx. 3 mths. with a certificate limited to 4 years)

During this time regular weather tests must be carried out or the certificate becomes invalid.

3.2 Standards of light engineering

Colour coordinates (Chromaticity Coordinates)

The visible colours´ chromaticity coordinates must comply with DIN 6171-1:2003-08 chart 4 and DIN hEN 12899-1. This characteristic is indicated by x, y-coordinates.



Coefficients of retro reflection R_A

Colours and retroreflection should have an even appearance. The revised DIN 67520:2008-11 defines the specific coefficients of luminous intensity R_A as well as the hEN 12899-1. Using the new terms, the standard DIN 67520:2008-11 combines DIN 67520 part 1, 2, and 4, as well as PAS 1038 and PAS 1060. The specific R_A value is measured in Candela ($cd \cdot m^{-2} \cdot lx^{-1}$).

Luminance (Brightness) Index

This index shows the ratio of brightness of the reflective sheeting to a blank white material and must meet the DIN 6171-1 and DIN hEN 12899-1 requirements.

3.3 GVZ and test phases

The Quality Auditing Commission for Traffic Signs & Transportation Facilities (Güteschutz-gemeinschaft Verkehrszeichen und Verkehrs-einrichtungen e.V.) located in Hagen, Germany is a Quality Auditing Commission approved by RAL. The mandatory specifications, which have been approved by the BMVBS, are described in the quality requirements and test regulations of the GVZ. The GVZ verifies the manufacturing of traffic signs according to the German road traffic regulations „StVO“ for the application range of the RAL quality mark in coordination with BMVBS and BASt, based on the above mentioned specifications.
The commission´s tasks include:

- to ensure that users of the quality mark obey the quality mark statute , the implementation of rules for the conformance and retention of the quality mark as well as fulfilling the quality conditions (quality and test regulations)
- to require quality mark users to warrant the quality of the marked products
- to accomplish joint actions for the promotion of quality-secured products using the quality mark

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The material admission examination and the processing examination are divided into three phases:

Examination		Test Criteria
1st Phase (mechanical tests, esp. R_A and colour coordinates)	New condition	surface adhesion visible colours abrasion resistance corrosion protection corrosion retr. F. R_A value colour coordinates
2nd Phase	Xenon-weather test 12 weeks acc. to DIN EN ISO 4892-2	surface adhesion corrosion retr. F. visible colours R_A value colour coordinates
3rd Phase	Natural weather test for 3 years acc. to DIN hEN 12899-1	surface adhesion corrosion retr. F. visible colours R_A value colour coordinates

3.4 Industrial Association IVSt

The Industrial Association for Street Furniture was founded as umbrella organization of the existing associations. The Industrial Association for Street Furniture is divided into four departments:

- Pavement marking
- Traffic safety on roads
- Traffic signs
- Restraint systems

Objectives and tasks:

- Development and advancement of technical standards
- assisting boards of FGSV, DIN, Straßenliga and DVR
- participating national and international standardizations

IVSt informs about current developments of standards, technical specifications, laws, and about special technical events. (www.ivst.de).

4.0 Marabu Traffic Sign Inks

For the manufacturing of traffic signs, Marabu provides the specifically formulated transparent Marabu **Mara® *Sign* TS** traffic sign inks as below:

TS 521 Transparent Yellow
TS 536 Transparent Red
TS 552 Transparent Blue
TS 563 Transparent Green
TS 573 Black (opaque)

Mara® *Sign* TS is a high quality, solvent based, weather resistant 2-component polyurethane based ink system. The light fastness of the pigments used is approx. 7-8 according to Blue wool scale. After addition of hardener and stirring homogeneously the ink is ready to print. Further additives must not be used.

Ratio Ink / Hardener:

Ink TS (800g) : Hardener H1 (200 g)
equals 4 : 1

4.1 Requisites for Screen Printing Inks

All Marabu Traffic Sign inks have internally been tested according to GVZ terms by the following standards in combination with different common reflective sheetings:

- DIN 6171-1:2003-08
- DIN 67520:2008-11
- DIN EN ISO 4892-2
- hEN 12899-1:2007

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The customary measuring devices of the manufacturers mentioned below were used to indicate the R_A value and colour coordinates:

- RetroChecker RC 2000 (R_A value)
- MiniScan XE Plus 5060 (Colour Coordinates)

Q-Sun Xenon Test Chamber (accelerated weather tests)

MiniScan XE Plus RetroChecker RC 2000

Quality of sheeting / Remark

The R_A values of the printed areas are affected by the quality and the base values of the blank type of sheeting, in particular the less reflective sheetings of the RA1 and RA 2 Category (encapsulated lens sheeting). The base value recommended by the Quality Auditing Commission (GVZ) for the blank RA1 sheeting is 85 Candela, RA 2 = 210 Candela and RA3.

Concerning the adhesion, the colours can be used on the below mentioned materials:

Description	RA Categ.	Manufacturer
Scotchlite EG Series 3290i	1	3M
Scotchlite HIP Series 3930	2 (micropr.)	3M
Scotchlite DG Series 4090	3A/3B (micropr.)	3M
Oralite Series 5710	1	Orafol
Oralite Series 5810	2	Orafol
Nikkalite ULS Series 800	2	Nippon Carbide
Nikkalite CRG Series 92000	3A (micropr.)	Nippon Carbide
Kiwalite EG Series 2000	1	Sakai Trading
Kiwalite EG Series 22000	2	Sakai Trading
Avery EG 1 Series T-1500	1	Avery Dennison
Avery HI Series T-5500	2	Avery Dennison
Avery HIP Series T-6500	2 (micropr.)	Avery Dennison
Avery MVP Series T-7500	3A/3B (micropr.)	Avery Dennison
Eurolux EG	1	Autoadesivi
Corelite HI	2	Autoadesivi
Luckylite EG LL 7100	1	LGChem
Luckylite WZ LL 8000	2	LGChem

4.2 Mesh recommendations and printing parameters

Height of ink deposit

The height of the ink deposit influences the specifications regarding the R_A value (lucency) and colour coordinates. Marabu recommends

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the following printing and processing parameters:

- Processing Temperature at 18° - 25°C
- mesh: PET 61-64 for Traffic Sign Inks
- Screen tension: > 15 N
- Print: mechanical (medium speed)
- Squeegee: 65-75 shore
- Squeegee angle: 75-80°

4.3 Outlook

The segment of Traffic Sign Inks has high priority at Marabu. We are constantly developing and researching optimizations and improvements for this application.

5.0 Remarks

The details of this TechINFO correspond to our current knowledge. You are nevertheless obliged to examine and approve details and recommendations before the start of production due to individually differing conditions regarding the printing process (printing, drying, and processing) and substrates. Additional important details are available from the Technical Data Sheet of the Mara® *Sign* TS.

6.0 Abbreviations

BAM	Bundesanstalt für Materialforschung *Federal Institute for Material Research and Testing*
BMVBS	Bundesministerium für Verkehr, Bau und Stadtentwicklung *Federal Ministry of Transport, Building and Urban Affairs*
BPR	Bauproduktenrichtlinie und –prüfung *Building Products Guideline*
BASt	Bundesanstalt für Straßenwesen *Federal Highway Research Institute*
CE	„Communaute´ Européenes“ *European Communities*
CEN	Comité Européen de Normalisation *European Commitee for Standardization*
CUAP	Common Understanding of Asssessment Procedure
DIBt	Deutsches Institut für Bautechnik *German Institute for constructional engineering*
EFTA	European Free Trade Association
EOTA	European Organisation for Technical Approvals
ETAG/ETA	European Technical Approval Guideline
EtZ	Europäische technische Zulassung *European Technical Approval*
FGSV	Forschungsgesellschaft für Straßen und Verkehrswesen *German Road and Transportation Research Association*
GVZ	Güteschutzgemeinschaft Verkehrszeichen und Verkehrseinrichtungen e.V. *Quality Auditing Commission for Traffic Signs & Transportation Facilities*
IVSt	Industrieverband Straßenausstattung e.V. *Industrial Association for Street Furniture*
PAS	Publicly Available Specification
RAL	Deutsches Institut für Gütesicherung und Kennzeichnung, ehemals Reichsausschuss für Lieferbedingungen *German Institute for Quality Auditing and Marking*
StrAus-Zert	Prüf-, Überwachungs- und Zertifizierungsgemeinschaft der Straßenausstatter e.V. *Testing, Surveilling and Auditing Federation of Street Furniture Manufacturers*

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