



European Technical Approval ETA-13/0253

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung
Trade name

Nikkalite Crystal Grade Serie 92000 digital bedruckt mit Mutoh Zephyr
TS UV-Colour MJUVTS-100 Serie und mit Schutzlaminat Nikkalite
Acrylic Cal 142 Transparent

*Nikkalite Crystal Grade series 92000 digitally printed with Mutoh Zephyr
TS UV-Colour MJUVTS-100 series and with protecting laminate
Nikkalite Acrylic Cal 142 transparent*

Zulassungsinhaber
Holder of approval

Nippon Carbide Industries
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Zulassungsgegenstand
und Verwendungszweck
*Generic type and use
of construction product*

Mikroprismatisches retroreflektierendes Folienmaterial
Microprismatic Retro-reflective Sheetting

Geltungsdauer:
Validity: vom
from
bis
to

14 June 2013

14 June 2018

Herstellwerke
Manufacturing plants

Nippon Carbide Industries Co., Inc. (Hayatsuki Factory)
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Diese Zulassung umfasst
This Approval contains

16 Seiten
16 pages

I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³;
 - *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998⁴, as amended by Article 2 of the law of 8 November 2011⁵;*
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC⁶.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
- 3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5 (1) of Council Directive 89/106/EEC.
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- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities L 40, 11 February 1989, p. 12
² Official Journal of the European Communities L 220, 30 August 1993, p. 1
³ Official Journal of the European Union L 284, 31 October 2003, p. 25
⁴ *Bundesgesetzblatt Teil I 1998*, p. 812
⁵ *Bundesgesetzblatt Teil I 2011*, p. 2178
⁶ Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of the product and intended use

1.1 Definition of the construction product

The product consists of retro-reflective sheeting on the basis of microprisms, which consist of optical elements, where the retro-reflection is created by total internal reflection on prisms. The microprisms are moulded in a transparent polymer enclosed in air capsules and provided with an adhesive, which can connect the sheeting with a substrate. The sheeting has a smooth surface and a regular structure visible on the surface forming the air capsules and serving to identify the orientation.

The product is delivered as reflective sheeting, the types of which are stated in Table 1.

Trade name	Component	Colour/Code	Properties
Nikkalite Crystal Grade (CRG) series 92000	Self-adhesive retro-reflective sheeting on the basis of microprisms	White 92802	Sheeting thickness: 300 – 600 µm Dimension of the roll: 1220 mm x 45.7 m or customized dimensions
Muthoh Zephyr TS UV-Colour MJUVTS-100	Digital printing ink	Yellow Mixture* of separate inks: Red MJUVTS-100-BK (Black) Blue MJUVTS-100-RD (Red) Green MJUVTS-100-BL (Blue) MJUVTS-100-YE (Yellow)	Consumption: 12-16 ml/m ² Printer: Zephyr TS
Nikkalite Acryl-Cal A-Cal 100 series	Transparent self-adhesive colour film	Transparent	Sheeting thickness: 50 – 150 µm Dimension of the roll: 1220 mm x 45.7 m or customized dimensions

Table 1: Types of reflective sheeting "Nikkalite Crystal Grade series 92000" digitally printed with "Muthoh Zephyr TS UV-Colour MJUVTS-100" and with "Nikkalite Acrylic Cal 142 Transparent"

*Mixing ratios have been deposited with the German Federal Highway Research Institute (Bundesanstalt für Straßenwesen).

1.2 Intended use

The construction product described here is used to manufacture signal aspects of fixed, vertical traffic signs (see also EN 12899-1). The further intended applications are all other traffic signs and traffic installations, route guidance with retro-reflective elements and variable message signs.

However, the intended application excludes the manufacture of road marking elements according to EN 1436. The intended sign support material is aluminium.

Within the framework of this approval the following product properties were assessed in consultation with the manufacturer:

- Chromaticity coordinates and luminance factor
- Coefficient of retro-reflection (Case A)
- Impact resistance
- Durability: Visibility after artificial weathering

The provisions made in this European technical approval are based on an assumed intended working life of the reflective sheeting of 10 years, provided that the conditions laid down in sections 4.1, 4.2, and 5.1 as well as in the related product data sheets for the manufacture, packaging, transport and storage are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of product and methods of verification

2.1 General

The identification of the product and the judgement of the qualification for the intended use of the reflective sheeting were performed on the basis of the assessment procedures agreed within EOTA.

The European technical approval for the product was evaluated and issued on the basis of the information/data and test results specifying the product in detail which are deposited with Deutsches Institut für Bautechnik. Changes during the production process of the product or its components which could include considerable modifications in the information/data deposited have to be communicated to Deutsches Institut für Bautechnik in advance. The notification has to be made before changes in the properties are made on the product so that Deutsches Institut für Bautechnik can check to what extent the planned modification has effects on the properties tested in this European technical approval and thus, can decide whether further assessment and/or alterations shall be carried out.

The properties of the product, which are not described in the European technical approval shall correspond to the relevant values laid down in the documentation to the European technical approval, examined by Deutsches Institut für Bautechnik.

2.2 Properties of the Product "Nikkalite Crystal Grade series 92000" digitally printed with "Mutoh Zephyr TS UV-Colour MJUVTS-100" and with "Nikkalite Acrylic Cal 142 Transparent"

2.2.1 Release of dangerous substances

The product complies with the provisions of Guidance Paper H ("A Harmonized Approach to Dangerous Substances Under the Construction Products Directive", edition 2002) about dangerous substances. A letter of confirmation by the manufacturer is available.

Note: In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

2.2.2 Visibility of "Nikkalite Crystal Grade series 92000" digitally printed with "Mutoh Zephyr TS UV-Colour MJUVTS-100" and with "Nikkalite Acrylic Cal 142 Transparent"

The properties of the product set out in clause 1.2 were tested for the granting of this European technical approval.

Detailed information on the test results are deposited with Deutsches Institut für Bautechnik.

For the preparation of the specimens, the test pieces of the reflective sheeting were applied by the manufacturer on a plane aluminium plate with a thickness of 2.0 mm (± 0.05 mm).

2.2.2.1 Chromaticity coordinates and luminance factors

The determination of the chromaticity coordinates and the luminance factors (see Table 2) was based on the following conditions:

The chromaticity coordinates (x , y) and the luminance factor (β) were measured according to CIE Publication 15.2 "Colorimetry", edition 1986, by using the 45/0 geometry and calculated for the spectral radiance of the illuminant D65 as well as for the colorimetric standard observer according to CIE 1931 (2°).

The orientation of the sample in the measuring system was shown by an orientation mark, with the orientation mark being at 90° to the optical plane of incidence. In doing so, the optical plane of incidence was formed from the right angle between the surface of the sample and the incident ray of light from the source of light on the sample surface.

Colour		Chromaticity coordinates				met / not met	Luminance factor Class
		1	2	3	4		
White & A-Cal 142	x	0.305	0.335	0.325	0.295	met	B2 ≥ 0.40
	y	0.315	0.345	0.355	0.325		
Yellow onto White & A-Cal 142	x	0.494	0.470	0.513	0.545	met	B2 ≥ 0.24
	y	0.505	0.480	0.437	0.454		
Red onto White & A-Cal 142	x	0.735	0.700	0.610	0.660	met	B2 ≥ 0.03
	y	0.265	0.250	0.340	0.340		
Blue onto White & A-Cal 142	x	0.130	0.160	0.160	0.130	met	B2 ≥ 0.01
	y	0.090	0.090	0.140	0.140		
Green onto White & A-Cal 142	x	0.110	0.170	0.170	0.110	met	B2 ≥ 0.03
	y	0.415	0.415	0.500	0.500		

Table 2: Chromaticity coordinates and luminance factors

2.2.2.2 Coefficient of retro-reflection (Case A)

The determination of the coefficient of retro-reflection R_A – Case A (see Table 3) was based on the following conditions:

The coefficient of retro-reflection R_A was measured according to the CIE Publication N° 54.2 "Retro-reflection by using the CIE illuminant A". During the measurement any of the recommended apertures could be used. The measurements were carried out at a specific observation angle α , entrance angle β , rotation angle ϵ and orientation angle ω_s . In doing so, the entrance angle β was determined via its component β_1 with $\beta_2 = 0^\circ$. The rotation angle ϵ and the orientation angle ω_s were to be set also equal to zero.

Geometry of measurements		Colours				
α	β_1 ($\beta_2 = 0$)	White & A-Cal 142	Yellow onto White & A-Cal 142	Red onto White & A-Cal 142	Green onto White & A-Cal 142	Blue onto White & A-Cal 142
0.33°	+ 5°	300	195	60	30	19
	+20°	240	155	48	24	16
	+30°	165	110	33	17	11
	+40°	30	20	6	3	2
1.0°	+ 5°	35	23	7	3.5	2.5
	+20°	30	20	6	3	2
	+30°	20	13	4	2	1.5
	+40°	3.5	2	1	#	#
1.5°	+ 5°	15	10	3	1.5	1
	+20°	13	8	2.5	1	#
	+30°	9	6	2	#	#
	+40°	1.5	1	#	#	#
met/ not met		met	met	met	met	met

Table 3: Minimum coefficient of retro-reflection; class R3B Germany
means value exceeding zero, but not clearly measurable and therefore not applicable for evaluation

2.2.2.3 Rotational symmetry

The rotational symmetry of the coefficient of retro-reflection was determined under the same conditions as the coefficient of retro-reflection (Case A, see 2.2.2.2). With an observation angle $\alpha = 0.33^\circ$ and an entrance angle $\beta_1 = 5^\circ$ ($\beta_2 = 0^\circ$) the ratio between the minimum and the maximum coefficient of retro-reflection during rotation of ε was determined in 25° steps from -75° to $+25^\circ$. The ratio shall not be greater than 2.5:1. The product satisfies this requirement.

Coefficient of retro-reflection ($\text{cd}\cdot\text{lx}^{-1}\cdot\text{m}^{-2}$) - rotational symmetry		
Colour	Ratio	met / not met
White & A-Cal 142	2.1	met
Yellow onto White & A-Cal 142	1.7	met
Red onto White & A-Cal 142	2.1	met
Blue onto White & A-Cal 142	1.9	met
Green onto White & A-Cal 142	1.7	met

Table 4: Rotational symmetry

2.2.3 Impact resistance

The determination of the impact resistance was based on the following conditions:
 The test was performed according to EN 12899-1:2001. For this purpose a weight of 450 g with a contact radius of 50 mm falls from a height of 220 mm onto the specimen. The specimen shall be reinforced such that the open surface is 100 mm x 100 mm.

Product	Colour		met / not met
Microprismatic reflective sheeting "Nikkalite Crystal Grade series 92000" digitally printed with "Mutoh Zephyr TS UV-Colour MJUVTS-100" and with "Nikkalite Acrylic Cal 142 Transparent"	White	92802 & A-Cal 142	met: There were no damages.
	Yellow	92802 & MJUVTS-100 & A-Cal 142	
	Red	92802 & MJUVTS-100 & A-Cal 142	
	Blue	92802 & MJUVTS-100 & A-Cal 142	
	Green	92802 & MJUVTS-100 & A-Cal 142	

Table 5: Impact resistance

2.2.4 Durability of "Nikkalite Crystal Grade series 92000" digitally printed with "Mutoh Zephyr TS UV-Colour MJUVTS-100" and with "Nikkalite Acrylic Cal 142 Transparent"

For the assessment of the durability an artificial weathering was carried out.
 The artificial weathering was performed according to ISO 4892-2:1994. For that purpose the specimens were weathered for a period of 2000 hours using the following parameters:

Weathering parameters	Air-cooled lamp	Water-cooled lamp
Irradiation cycle/dark phase cycle/spray cycle	Continuous light with spray on the test specimens for 18 min every 2 h	Continuous light with spray on the test specimens for 18 min every 2 h
Black standard temperature only during irradiation	(65 ± 3) °C with blackpanel thermometer	(65 ± 3) °C with blackpanel thermometer
Relative humidity	(50 ± 5) %	(50 ± 5) %
Irradiance (W/m ²) controlled in the		
- Range over 300 nm to 400 nm	60	60
- Range over 300 nm to 800 nm	550	630
NOTE: 1 - The water used for spraying the test pieces should not contain more than 1 ppm silica. Higher proportions of silica can leave residues on the test specimens and cause different results. Water with the required purity can be obtained by distillation or by a combination of deionization and osmosis. NOTE 2 - During irradiation, the aforementioned values should be reached. Changes in the age of the filter and the transmissivity, and changes in the calibration generally mean that the irradiation defect is of the order of 10 %.		

Table 6: Artificial weathering test parameters

After the artificial weathering the following tests were carried out:

- Determination of the chromaticity coordinates
- Determination of the luminance factors
- Determination of the coefficients of retro-reflection

After the artificial weathering the coefficients of retro-reflection with an observation angle of $\alpha = 0.33^\circ$ (or $\alpha = 0.2^\circ$) and of $\alpha = 1.0^\circ$ (if specified for new material) and the illumination angles $\beta_1 = 5^\circ$ and 30° ($\beta_2 = 0^\circ$) must not be less than 80 % of the required coefficients of retro-reflection in new condition.

2.2.4.1 Chromaticity coordinates and luminance factors after artificial weathering

Colour		Chromaticity coordinates				met / not met	Luminance factor Class
		1	2	3	4		
White & A-Cal 142	x	0.355	0.305	0.285	0.335	met	B2
	y	0.355	0.305	0.325	0.375		≥ 0.40
Yellow onto White & A-Cal 142	x	0.545	0.487	0.427	0.465	met	B2
	y	0.454	0.423	0.483	0.534		≥ 0.24
Red onto White & A-Cal 142	x	0.735	0.674	0.569	0.655	met	B2
	y	0.265	0.236	0.341	0.345		≥ 0.03
Blue onto White & A-Cal 142	x	0.078	0.150	0.210	0.137	met	B2
	y	0.171	0.220	0.160	0.038		≥ 0.01
Green onto White & A-Cal 142	x	0.007	0.248	0.177	0.026	met	B2
	y	0.703	0.409	0.362	0.399		≥ 0.03

Table 7: Chromaticity coordinates and luminance factors after artificial weathering

2.2.4.2 Coefficients of retro-reflection after artificial weathering

Colour	met/not met* (met: ≥ 80 % of the values required in mint condition)
White & A-Cal 142	met
Yellow onto White & A-Cal 142	met
Red onto White & A-Cal 142	met
Blue onto White & A-Cal 142	met
Green onto White & A-Cal 142	met

Table 8: Coefficient of retro-reflection (Case A) after artificial weathering
* assessment was made for the classes which were met in mint condition

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 96/579/EC of 24.06.1996⁷, amended by the Decision 1999/453/EC⁸, system 1 of the attestation of conformity shall apply. This system of attestation of conformity is described in the following:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- (a) Tasks for the manufacturer:
 - (1) factory production control;
 - (2) further testing of specimens taken at the factory by the manufacturer in accordance with a prescribed test and control plan;
- (b) Tasks for the approved body:
 - (3) initial type-testing of the product;
 - (4) initial inspection of factory and of factory production control;
 - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

⁷ Official Journal of the European Communities L 254 of 08.10.1996
⁸ Official Journal of the European Communities L 178 of 14.07.1999

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production (production of the retro-reflective sheeting on the basis of microprisms, transparent colour laminate, screen printing ink). All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall ensure that the product is in conformity with this European technical approval.

The manufacturer may only use components stated in the technical documentation of this European technical approval. A quality control on the incoming materials and material components bought will be conducted before these can be used. The manufacturer shall only use materials and/or material components which are entered in the relevant documents of the receiving control according to the test and control plan.

The factory production control shall be in accordance with the test and control plan of 17.02.2012 relating to the European technical approval ETA-13/0253 issued on 14.06.2013 which is part of the technical documentation of this European technical approval. The test and control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.⁹

The results of the production control are recorded and evaluated. The records include, inter alia, the following information:

- designation of the product, of the basic materials and of the components,
- type of surveillance and check,
- information on the production time frame of the products and time for testing the products and the materials and material components,
- results of the surveillance and of the control and, if necessary, details for comparison with the requirements demanded,
- signatures of the persons responsible for the factory production control.

The records shall be made available to the responsible inspection bodies during the continuous examination. On demand these shall be made available to Deutsches Institut für Bautechnik.

Details concerning extension, type and frequency of the controls and surveillance which are necessary in the context of factory production control shall be in conformity with the test and control plan which is part of the technical documentation of this European technical approval.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve bodies which are approved for the tasks referred to in section 3.1 in the field of the microprismatic retro-reflective sheeting for traffic signs in order to undertake the actions laid down in section 3.2.2. For this purpose the test and control plan according to sections 3.2.1.1 and 3.2.2 shall be handed over to the approved body by the manufacturer.

⁹ The test and control plan is a confidential part of the European technical approval and only handed over to the approved bodies involved in the procedure of attestation of conformity. See section 3.2.2.

3.2.2 Tasks for the approved bodies

The approved bodies shall perform the following tasks in accordance with the provisions laid down in the test and control plan:

- initial type-testing of the product,
- initial inspection of factory and factory production control,
- continuous surveillance, assessment and approval of factory production control.

The approved bodies shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its test and control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on the packaging or on the papers enclosed when delivering the product. The letters "CE" shall be followed by the identification number of the approved certification body and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- product description "Nikkalite Crystal Grade series 92000" digitally printed with "Mutoh Zephyr TS UV-Colour MJUVTS-100" and with "Nikkalite Acrylic Cal 142 Transparent",
- information on the product characteristics stated in section 1.2.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, shall be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Installation

It is the task of the manufacturer to see to it that all persons involved will be informed about the Specific Conditions of this European technical approval.

The sign bases foreseen shall consist of aluminium or polycarbonate.

The use of the products is subject to national provisions.

The choice and the preparation of the sign support materials as well as the generally applicable rules on the bonding of the products "Nikkalite Crystal Grade CRG series 92000" which are fully described in the current versions of the publications and the technical documentation by the holder of the European technical approval, shall be observed taking account of the national provisions on the use of the product.

4.3 Application

4.3.1 "Nikkalite Crystal Grade CRG Series 92000"

"Nikkalite Crystal Grade CRG series 92000" is equipped with a self-adhesive coating so that the sheeting can be glued on the sign support material which, at a room temperature of ($20\text{ °C} \pm 2\text{ °C}$), can be done with one of the following methods: mechanically driven roller applicator, manually operated roller applicator, application with a hand roller. If a heater assembly is used the sign support surface should be adjusted to a minimum temperature of 18 °C .

The users are instructed to carefully check the qualification of the sign support material used as to its bonding property as well as to the durability qualification. "Nikkalite Crystal Grade CRG series 92000" was in particular developed for the bonding on flat surfaces. Processing defects which were caused by the choice of an unsuitable substrate or by an improper preparation, are not the responsibility of the holder of the ETA.

4.3.2 Digital printing with UV light cured ink

The sheeting makes use of a digital printing technology based on UV light-cured inks as a colouring process. Colour is applied by means of a piezoelectric process in which ink drops are squeezed together via a piezo crystal that becomes deformed when electrical voltage is applied. The overpressure that is thus created causes the ink to burst out of the jet nozzle onto the printing substrate.

UV inkjet inks for the piezo drop-on-demand process are normally 100 percent solid formulations that do without the use of solvents. The radically cured UV inkjet ink contains a mixture of acrylic monomers and oligomers, photoinitiator packages, various additives, colour pigments and pigmentation agents that is adjusted to attain the final viscosity required.

As UV inkjet inks do without the use of solvents, the process translates into significant benefits with regard to requirements of environmental protection. The process also results in virtually no offensive odours, making especially large extraction systems required for health protection unnecessary.

A printing machine developed especially for this method of production is used for digital printing. Compliance with the settings specified in the operating instructions for the printing machine is necessary in order to meet process requirements. Details on operating the system can be found in the user guide.

The printing machine comes with a special printing mode, called HighGloss in the parameter list, that was developed for the process. This method uses a printing process developed specifically for this purpose to apply printing ink to the sheeting surface. Ink is cured by means of UV light sources that match the beam power expected by the process, allowing the ink to be cured during the printing process.

Printing speed, lamp power parameters, curing process speed and ink volumes for drop-on-demand technology are specified via the parameters in the software used to control the printing machine.

It is absolutely necessary that the machine uses a special temperature management system in order to cure the UV cured ink. This system serves to protect the reflective sheeting from too high thermal loading applied by the UV lamps and also to thermally condition the sheeting appropriately for the printing process. The instructions in the user guide for the digital printing machine should be followed in order to achieve correct results.

Only "UVIJ-100" series digital printing inks should be used for printing. Manufacturer instructions regarding the use of inks should also be followed in this area. Digital printing ink should not be stored at high temperatures, nor should they be stored at temperatures that are too low. The ink should be filled into the machine by the use-by date indicated on the packaging.

Digital printing ink is composed of blue, red, yellow and black components that are filled into the storage containers provided in the machine. The ink is applied to the sheeting surface by means of special print heads that generate the colours that are required by specifications. This process is controlled by special computer software. Manufacturer specification with regard to ink quantities should be followed in order to achieve the proper colours. A special colour formula has been provided for this purpose and should be used appropriately when preparing digital prints. Since the print heads of the digital printing machine have tolerances, precise adjustments should be made to the machine when it is commissioned.

The digital printing system can print sheeting from the roll, from sheets, or already laminated on panels.

After sheeting is printed with the digital printing machine, it should be laminated with transparent protective film over the printed surface. This special protective sheeting has a special filtering characteristic that filters out the UV light component of sunlight so it does not reach the print surface. If sheeting printed with UV-cured ink is exposed to UV light, the ink undergoes an accelerated aging process. The ETA holder is not liable if products without adequate UV protection are used for an intended use listed in the ETA.

Both Acrylic Cal 142 laminate and F-Cal 40801 protective laminate can be used as transparent protective laminates.

4.3.3 "Acrylic Cal Series 100 Transparent Colour Laminate"

This colour laminate has a protective liner made of either sheeting material or paper, and was developed so the laminate is easy to cut and trimming is facilitated. Rolls have their edges trimmed in order to prevent adhesive from squeezing out onto roll holders.

The sheeting shall be provided with transparent protective laminates after the digital printing process is completed. A roll laminator system is used for this purpose, with which the sheeting is laminated from roll to roll onto the printed reflective sheeting.

After the transparent protective laminate is applied to the printed reflective sheeting, the sheeting can be processed further with other plotter systems, allowing characters or symbols to be cut out according to pre-defined forms. A cutting process that makes use of hand knives is also possible, but in this case manufacturer recommendations should be followed.

When cutting out symbols, it is recommended that their inner edges be provided with small radii. In addition, the ETA holder recommends the following procedure:

- The plotter knife should be set according to the thickness of the sheeting so that it does not cut through the protective liner or protective paper. A 30° blade is best suited for this purpose. The distance between letters or symbols should be selected according to aesthetic considerations. The operating instructions provided by the plotter manufacturer should be followed when setting these distances. High speeds should not be used for cutting when using plotters with adjustable cutting speeds.
- Kinks in sheeting should be avoided both during the cutting process and also when handling sheeting. These can cause the protective liner to come loose from the sheeting.
- After the cutting process is finished, pieces of sheeting should be laid flat, with front sheeting sides laid on top of back sides. Sheetting should always be stored in this manner until they are trimmed and transfer sheeting is applied.
- A suitable tool with a blunted tip (not pointed) should be used to trim sheeting.
- After the trimming is finished, sheeting should be stored flat, with front sheeting sides laid on top of back sides.
- Transfer paper can then be applied, either by using a plastic squeegee or a manual roll applicator. If the transfer paper is applied by hand, care should be taken to move the squeegee from the centre of the sheet to the outside.
- Acryl Cal series 142 colour laminate may be applied before or after sheeting is bonded to the sign support material. At a minimum, the use of a manual roll applicator is recommended to achieve satisfactory results. Larger sheets should be processed as follows: First the protective liner is peeled off up to the centre, and the sheeting applied. The application is then completed from the other side. This method prevents the large sheet from running.
- After the Acryl Cal series 142 colour laminate is applied, the transfer sheeting can be carefully peeled off. The peeling angle should be kept as flat as possible.
- After the transfer sheeting is peeled off, the character or symbol should be run through the laminator once more in order to ensure sufficient adhesion.
- A clean knife is required in order to remove any adhesive residue. Residue can also be cleaned using a soft cloth soaked with spirit or isopropyl alcohol.

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5 Indications to the manufacturer

5.1 Packaging, transport and storage

Sheeting should be stored in a cool, dry room at approximately $22\text{ °C} \pm 2\text{ °C}$ and $40\% \pm 10\%$ relative air humidity and should be processed within one year after the delivery. The rolls should be stored horizontally in the packaging carton on the roller supports. Rolls partially used should be replaced in the packaging and continued to be stored horizontally on the roller supports. In order to avoid an independent unwinding of the sheeting from the roll the sheeting should be fastened with adhesive tape. Precutted sheeting sheets should be stored flat only. Prepared signs should be stored indoors, standing on the edge. Finished signs should always be kept dry during storage and transport. Should these get wet, it shall be made sure that the signs will be dried as soon as possible. Colour laminates should be stored in a cool, dry room at approximately $22\text{ °C} \pm 2\text{ °C}$ and $40\% \pm 10\%$ relative air humidity and should be processed within one year after the delivery.

Dr.-Ing. Karsten Kathage
Vice-President

beglaubigt:
Sterling