

Nikkalite®

Retroreflective Products

PB NO.90000

**Nikkalite® MICROPRISMATIC RETROREFLECTIVE SHEETING
CRYSTAL GRADE 90000 SERIES**



Introduction

Nikkalite® "Crystal Grade" (CRG) is a retroreflective sheeting that uses the principle of the retroreflection of micro-prisms. In the case of a prism-type reflection element, the light reflects efficiently without diminishing, as the three reflection planes that constitute the element and are positioned at right angles in relation to each other, completely reflect within the element. As the specialty

prisms designed to provide optimum reflection are densely arranged within the sheeting, excellent brightness characteristics and wide-angle reflection can be obtained. The traffic signs and traffic-safety devices made of the reflective sheeting provide far better visibility and withstand a longer service period compared with those that utilize glass beads.

Color and Product Specification

White, yellow, red, blue, and green colors are available for CRG, as shown in Table 1, and applicable in traffic signs. These colors are within the chromaticity ranges shown in Table 2 and Fig. 1.

Product width: Nominal 610 mm (24"), actual ca. 620 mm
 Nominal 1220 mm (48"), actual ca. 1240 mm
 Product length: Nominal 45.7 m (50 yards), actual ca. 46.0 m
 Package specification: Rolled on 3-inch paper core and hung with suspension in carton boxes.

Note: The actual width and length are not guaranteed values.

Table 1

Color	Item Number
	CW Type
White	92002
Yellow	92004
Red	92005
Blue	92006
Green	92008
Dark Green	92028

Optical properties

Daylight color (x, y, Y %)

Each color of CRG measured using a spectro- colorimeter in accordance with ASTM D 4956-01, EN 12899-1, or JIS Z 9117 is in the ranges shown in Table 2 and Fig. 1.

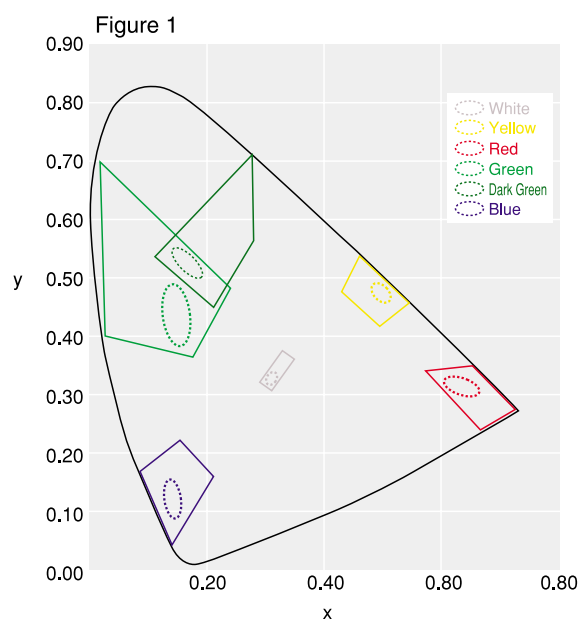
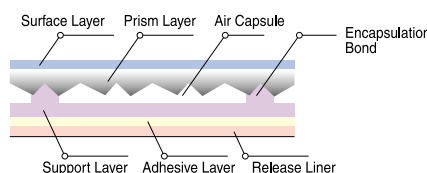


Table 2

Color		Color Specification Limits (Daytime)							Luminance Factor(Y%)	
		1		2		3		4		
		x	y	x	y	x	y	x	y	Min.
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375	40	—
Yellow	0.545	0.454	0.487	0.423	0.427	0.483	0.465	0.534	16	45
Red	0.735	0.265	0.674	0.238	0.569	0.341	0.655	0.345	3	15
Blue	0.078	0.171	0.150	0.220	0.210	0.160	0.137	0.038	1	10
Green	0.007	0.703	0.248	0.490	0.177	0.362	0.026	0.399	3	9
Dark Green	0.313	0.682	0.313	0.453	0.248	0.409	0.127	0.557	1	7

*: The four pairs of chromaticity coordinates were determined in accordance with CIE 1931 by means of a light source D₆₅.

Reflection performance

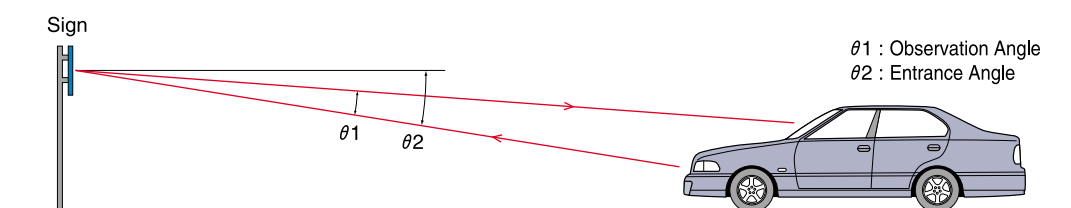
The values shown in Table 3 are average typical values determined by our own measurement method using the entrance angle α and with the arrow marks of the CW

types indicating the directions parallel to the observation angle.

Table 3 (cd/lux/m²)

CW Type		92002	92004	92005	92006	92008	92028
O.A.	E.A.	White	Yellow	Red	Blue	Green	Dark Green
0.2	−4/5	700	525	105	42	70	50
	30	325	245	49	20	33	26
0.5	−4/5	250	190	38	15	25	20
	30	115	86	17	7.0	12	8

O.A.: Observation Angle, E.A.: Entrance Angle



Brightness after ink printing and affixing using the overlay films

When Nikkalite® inks or the PA100 series overlay films are applied to the white sheets of CRG92002, the reflection performance of the corresponding colors at an

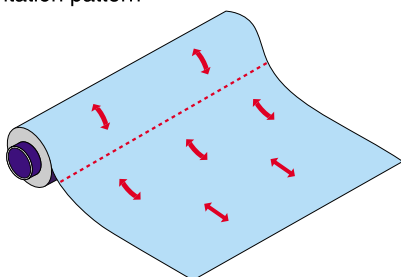
observation angle of 0.2 degrees and an entrance angle −4 or 5 degrees can be expected to be greater than 70% of the values shown in Table 3.

Directional property of the sheetings

The prisms that are the reflective elements of CRG have a slight directional property, the orientation of the prisms change gradually when the sheets are rotated. This also gradually changes the reflectivity, depending on the orientation of the sheets. In order to avoid difference in

brightness and provide the most effective visibility, the sheets are provided with arrow marks indicating directional property. Make sure the arrow marks on the base of signs, cutout letters, border lines, and symbol marks are all horizontal.

Orientation pattern



Cell pattern



Adhesive

The adhesive coated on CRG 92000 series is pressure-sensitive material, the optimum application temperature is

between 18°C to 35°C (64°F to 95°F).

Preparation of test pieces and Standard Curing Time

When testing the sheets by laminating them on aluminum substrates in accordance with the requirement for the test items, laminate the sheets on aluminum substrates of the specified quality and thickness that are degreased and acid-treated to prevent bubbles and foreign substances from getting in between the sheets and substrates. No

matter sheet test alone or sheet test after laminated on aluminum substrates, cure them under the standard conditions of $23 \pm 1^\circ\text{C}$ ($73 \pm 2^\circ\text{F}$) and $50\% \pm 4\%$ R.H. for 24 hours. Conduct the tests under the standard conditions unless specifically required.

1. Adhesion test

Apply a 25.4 mm x 152 mm (1" x 6") sheet on an aluminum substrate, leaving 50 mm (2") in the longitudinal direction, and cure it under the standard conditions. Hold

the test piece horizontally, and hang an 800 g (1-3/4 lbs.) weight at the end of the free sheet for 5 minutes.

* Requirement: The sheet shall not be peeled off by more than 50 mm (2") in 5 minutes.

2. Impact resistance

After a test piece applied on a 76 mm x 152 mm (3" x 6") aluminum plate is cured, and an impact of 127 cm 0.45

Kg (50 inches pounds), 5.65 N is applied in accordance with ASTM D 2794.

* Requirement: There shall be no cracking around the mark of impact.

3. Shrinkage

Cure a 230 mm x 230 mm (9" x 9") sheet with liner, remove the liner and leave the sheet on a table with the adhesive surface facing up.

* Requirement: There shall be no shrinkage in either direction of over 0.8 mm (1/32") after 10 minutes, and of over 3.2 mm (1/8") after 24 hours.

4. Flexibility

Cure a 25 mm x 152 mm (1" x 6") sheet with liner, remove the liner and spread talcum powder on the adhesive surface. Roll it on a mandrel with a diameter of 3.2 mm

(1/8") and with the surface of adhesion inside in one second.

* Requirement: No cracking, peeling off, or de-lamination.

5. Gloss

Measured using a 85° gloss meter in accordance with ASTM D523.

Requirement: It shall not be below 50.

Nikkalite® CRG satisfies all aforementioned requirements.

Processing method for signs

All CRG sheeting application should be in the room temperature above 18°C (64°F). It is desirable to process them below 35°C (95°F), although the upper limit of the

temperature varies depending on sites. Also refer to the CRG Application Manual for details.

Cutting and trimming

Cut CRG sheets individually from the front side, as they are far harder than the sheeting with glass beads. CRG can be cut with scissors and paper cutters, however. When hand-cutting or trimming the sheets, use a large retractable knife, as significant force is required, making a

small retractable knife very dangerous to use. Although as many as 100 cut sheets can be piled on a flat worktable, it is recommended that they be piled with the front sides facing each other. Do not touch the front sides of the sheets to be printed; rather, hold them at the ends.

Color matching

When applying multiple cut sheets to a sign board, place them with the directional property arrow marks the horizontal direction, and remember to carry out color matching. Color matching is easy when cut sheets are cut from the same roll. In addition, take each of the cutout letters, border lines, and symbol marks from the same roll

or same cut sheet. It is recommended that color matching be conducted in daylight from north-facing windows in the northern hemisphere, from south-facing windows in the southern hemisphere (windows without direct sunlight), and in the color of reflected light in the dark.

Printing process

CRG can be both pre-screened (sheets alone) and post-screened (with substrates) using the two-component inks of the Nikkalite® N3600 and N3800 series. These two-component inks have good transparency and durability, and provide high reflectivity even after printing; also, it excels in adhesion, anti-scratch and solvent resistance. For applications that do not require solvent resistance, both the N3600 and N3800 series can also be used as one-component inks without the addition of hardener. Use plainly-woven polyester mono-filament screen with 61-71

mesh/cm (157-180 mesh/inch). Use the off-contact method for printing, and be sure to carry out fill-pass. Do not apply a large amount of ink to the screen at one time; apply it frequently in small amounts. In this way, ink can be prevented from clogging and a uniform color concentration can be obtained throughout printing. Nippon Carbide Industries Co., Inc. (NCI) is not responsible for any defects partial or whole, in the signs caused by the use of inks, solvents, auxiliary agents, or the like that are not recommended by NCI.

Drying process

Immediately place printed sheets with or without substrates in a drying rack, and air-dry them using electric fans. At least an electric-fan stand consisting of three levels each having three electric fans is required to dry the entire rack. Although tack free drying to the touch can be fully achieved in 20~30 minutes, continue to blow air for a further 2~3 hours before storing. Oven and tunnel driers can also be employed, but driers that circulate or blow hot

air of 60°C~80°C (140°F~176°F) should be used. Avoid drying by heating using infrared rays or gas unaccompanied by hot air. Stack the sheets up to a limit of 50 and vertically place the sheets with substrates in exclusive-use racks, after confirming that printed sheets are completely dried. It is recommended that each printed sheet be provided with a slip sheet on the printed side.

Substrate treatment

CRG is provided with a strong pressure-sensitive adhesive with good durability, and it is recommended that it be laminated on a flat substrate. Use aluminum plates properly treated with degreasing, sanding, or acid-cleaning for traffic signs that require long-term durability. When laminating on coated steel or plastic substrates, particularly on new type of substrates, confirm there is no trouble in adhesion, peel-off, swelling, discoloration and reflectivity degradation of sheeting, before starting mass

production. Although the adhesion of any substrate material can be expected to be improved by wiping with solvents or sanding, confirm it by testing in advance. While CRG cannot be laminated to rounded surface, consult NCI salespersons when laminating it to curved or new material surface. NCI is not responsible for defects caused by inappropriate substrates, inappropriate surface treatment, or inappropriate lamination.

Application process

CRG can be applied using a hand roller in the case of small signs, cut letters, borderlines, and legends, and can be applied on substrates through the use of a hand or motor-driven roller applicator. When applying more than two CRG sheets on a sign, laminate them with the directions indicated by the arrow marks horizontal in the butt joint. The maximum gaps of the butt joints shall be up

to 1.5 mm (1/16"). When applying using a roller applicator, adjust the nip pressure in accordance with the process technology guidebook. Excessive pressure will degrade the reflection performance. Draw positioning lines for cutout letters and symbol marks using water-soluble ink, and then wipe it off using a wet cloth.

Storage

Store CRG sheets and other Nikkalite® products in a room temperature of 15°C~27°C (59°F~81°F) and relative humidity of 30%~60%, out of direct sunlight, and use them within a year after purchase. Avoid stacking the carton boxes in an irregular manner, and stack no more than four carton boxes of the same size in the same direction for storage. Store half-used sheet rolls with the ends of the sheeting tightly fastened to the roll with adhesive tape, either hung with plastic supporters fixed in the original carton boxes, or similarly hung horizontally

with iron rods inserted through the paper core. Do not leave the sheeting rolls directly on the table or floor for an extended period. Pile no more than 50 printed sheets of the same size, with a slip sheet for each of them with its smooth side facing the printed side, and store them in a location free from dust. Store CRG products applied on substrates by standing them on square timbers or the like, so that the front sides face each other. It is recommended that a soft material such as a rubber sponge be placed between them to prevent direct contact of the sheets.

Packaging and transportation of sign faces and finished products

Package up to 50 sign faces of the same size in an exclusive-use box with slip sheets, in the same manner as for storage. When an exclusive-use box is not available, package them with thin plates or hard cardboard of the same size at the top and bottom. It is recommended that sign boards be packaged with their front sides facing each other, with slip sheets or cushioning materials such as foam sheets inserted between them, and placed in a

wooden skeleton case. In either case, packages shall be air-permeable, with no strapping or plastic sheets that cause air-tightness. Do not apply excessive weight to the products during transportation, and do not wet the products until they are set up. In the event that the products get wet, immediately open the package and dry the products.

Cleaning of signs

In order to maintain the reflectivity and visibility of the signs and provide them with long-term durability, remove dust from the signs and tar, oil, and soot from the road, and keep the signs clean. Neutral cleaning solutions are recommended for the cleaning of signs. Use chemically

neutral cleansers that do not contain abrasives, strong solvents, or alcohols. Rinse them with water after cleaning them using neutral detergent. Refer to CRG's processing technology guidebook for details.

Standard Limited Warranty

Nippon Carbide Industries Co., Inc. (NCI) warrants that its Nikkalite® "Crystal Grade" retroreflective sheeting (hereinafter "Product") shall be free from defects in design, workmanship and material for a period of ten (10) years from the date of initial sale when processed and utilized in accordance with the directions of NCI on aluminum substrates specified by NCI. NCI further warrants that when standard signs containing the Product are maintained in accordance with procedures specified

In the event of a defect in the Product during the first seven (7) years following initial sale, NCI shall re-fabricate and re-install the standard signs containing the Product. In the event of a defect in the Product during years eight (8) through ten (10) following initial sale, NCI shall supply

All reports of an alleged defect in the Product must be reported to NCI within a reasonable time of failure in order

The foregoing warranty shall not apply when failure arises from a cause or condition other than a defect in the Product, including, but not limited to: inadequate

THE FOREGOING EXPRESS WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY FOR THE PRODUCT. NCI DOES NOT AUTHORIZE ANY PERSON OR ENTITY TO CREATE ANY OBLIGATION OR LIABILITY WITH RESPECT TO THE PRODUCT OTHER THAN THAT STATED IN THE FOREGOING LIMITED WARRANTY.

by NCI, the Products shall have a minimum retention rate of 70% and 50%, respectively, during years one (1) through seven (7), and eight (8) through ten (10), respectively, of use following initial sale. Such minimum retention rate shall be determined by observing the standard signs containing the Product at an observation angle of 0.2 degrees and an angle of entrance of — 4 or 5 degrees as specified in Tables 3 and 4.

replacement Product for sign re-fabrication. Under no circumstances shall the furnishing of a replacement Product extend the warranty period beyond the stated ten (10) year period.

for warranty to be provided.

maintenance, adverse weather or climactic conditions of any type, or improper substrate treatment, printing or lamination.

THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. UNDER NO CIRCUMSTANCES SHALL NCI BE LIABLE TO ANY PERSON OR ENTITY FOR ANY CONSEQUENTIAL, INCIDENTAL OR INDIRECT DAMAGES ARISING FROM THE PRODUCT.

Reliability

All recommendations and technical information contained herein are based on experience and tests, which the manufacturer believes to be reliable; however, their accuracy and completeness are not warranted. The

user is requested to conduct their own test/tests to determine the fitness of this product for the intended application.

Safety and Health Information

Read carefully in advance the labels, instruction manuals, material safety data sheets (MSDS), and first aid measures of the retroreflective sheetings supplied by Nippon Carbide Industries Co., Inc. (hereinafter referred

to as "NCI"), the auxiliary materials such as inks and solvents used for NCI's products, and proprietarily used chemicals such as substrate cleansers.

Warning

Failure to comply with the explicit instructions in this bulletin will result in voiding all warranties express or implied for use of this product. If retroreflective sheeting is to be applied to a surface other than conventional sign

blank materials, prospective users should contact technical representatives of Nippon Carbide Industries Co., Inc. for advice before such application.



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