

Nikkalite

CRG 92000 Series Crystal Grade

1. INTRODUCTION

Nikkalite™ "Crystal Grade" (hereinafter "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.

2. COLOR AND PRODUCT SPECIFICATION

White, yellow, red, blue, green, and dark 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 1.

Product width: 24", 30", 36", 48"

Product length: 50 yards

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

| ITEM NUMBER | COLOR | COLOR SPECIFICATION LIMITS (DAYTIME) | | | | | | | | LUMINANCE FACTOR (Y %) | |
|-------------|--------------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|------------------------|------|
| | | 1 | | 2 | | 3 | | 4 | | MIN. | MAX. |
| | | X | Y | X | Y | X | Y | X | Y | | |
| 92802 | White | 0.303 | 0.300 | 0.368 | 0.366 | 0.340 | 0.393 | 0.274 | 0.329 | 15 | - |
| 92804 | Yellow | 0.498 | 0.412 | 0.557 | 0.442 | 0.479 | 0.520 | 0.438 | 0.472 | 12 | 30 |
| 92805 | Red | 0.648 | 0.351 | 0.735 | 0.265 | 0.629 | 0.281 | 0.565 | 0.346 | 2.5 | 11 |
| 92806 | Blue | 0.140 | 0.035 | 0.244 | 0.210 | 0.190 | 0.255 | 0.065 | 0.216 | 1 | 10 |
| 92844 | Fluorescent Yellow Green | 0.387 | 0.610 | 0.369 | 0.546 | 0.428 | 0.496 | 0.460 | 0.540 | 60 | - |
| 92847 | Fluorescent Orange | 0.583 | 0.416 | 0.535 | 0.400 | 0.595 | 0.351 | 0.645 | 0.355 | 25 | - |
| 92894 | Fluorescent Yellow | 0.479 | 0.520 | 0.446 | 0.483 | 0.512 | 0.421 | 0.557 | 0.442 | 40 | - |

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 1.

3. REFLECTION PERFORMANCE

The values shown in Table 2 are average typical values determined by our own measurement method using the entrance angle and with the arrow marks of the CW types indicating the directions parallel to the observation angle.

| CW TYPE | | 92802 | 92804 | 92805 | 92806 | 92844 | 92847 | 92894 |
|---------------|----------------|-------|--------|-------|-------|----------------|---------------|---------------|
| OBSERV. ANGLE | ENTRANCE ANGLE | WHITE | YELLOW | RED | BLUE | FLUOR. YLW/GRN | FLUOR. ORANGE | FLUOR. YELLOW |
| 0.2 | -0.4 | 700 | 525 | 105 | 42 | 560 | 210 | 420 |
| | 30.0 | 325 | 245 | 49 | 20 | 260 | 95 | 200 |
| 0.5 | -0.4 | 250 | 190 | 38 | 15 | 200 | 75 | 150 |
| | 30.0 | 115 | 86 | 17 | 7 | 92 | 35 | 69 |

(cd/lux/m²)

Nikkalite

CRG 92000 Series Crystal Grade

4. BRIGHTNESS AFTER AFFIXING OVERLAY FILMS

When Nikkalite™ A100 series overlay films are applied to the white sheets of CRG 92802, 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 2.

5. DIRECTIONAL PROPERTY OF THE SHEETING

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.

6. 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).

7. 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 +/- 1°C (73 +/- 2°F) and 50% +/- 4% R.H. for 24 hours. Conduct the tests under the standard conditions unless specifically required.

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

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 (1-3/4lbs.) weight at the end of the free sheet for 5 minutes.

B. IMPACT RESISTANCE: Requirement: There shall be no cracking around the mark of impact.

After a test piece applied on a 76 mm x 152 mm (3" x 6") aluminum plate has cured, and an impact of 127 cm 0.45 Kg (50 lbs/in), 5.65 N is applied in accordance with ASTM D 2794.

C. SHRINKAGE: 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.

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.

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

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.

E. GLOSS: Requirement: It shall not be below 50.

This measurement should be made using an 85° gloss meter in accordance with ASTM D523.

Nikkalite

CRG 92000 Series Crystal Grade

8. PROCESSING METHOD FOR SIGNS

All CRG sheeting application should be at 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.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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

Nikkalite

CRG 92000 Series Crystal Grade

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.

14. PACKAGING AND TRANSPORTATION OF SIGN FACES AND FINISHED PRODUCTS

50 CRG sign faces can be packaged in an exclusive use box with slip sheets if the sheets are the same size and the storage directions are followed. 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.

15. CLEANING OF SIGNS

In order to maintain the reflectivity and visibility of signs while maintaining 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.

16. 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 test/tests to determine the fitness of this product for the intended application.

17. SAFETY AND HEALTH INFORMATION

Read carefully in advance the labels, instruction manuals, material safety data sheets (MSDS), and first aid measures of the retroreflective sheeting 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.

18. 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.

19. STANDARD LIMITED WARRANTY

10-year warranty for items 92802, 92804, 92805, 92806, with 7 years being 100% full replacement and the final 3 years covering 100% sheeting replacement. 3-year warranty for 92847 with first year being full replacement and the final 2 years covering 100% sheeting replacement.

All reports of an alleged defect in CRG must be reported to NCI within a reasonable time of failure in order for warranty to be provided.

Nikkalite

CRG 92000 Series Crystal Grade

The foregoing warranty shall not apply when failure arises from a cause or condition other than a defect in CRG, including, but not limited to: inadequate maintenance, adverse weather or climactic conditions of any type, or improper substrate treatment, printing or lamination.

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