

Avery Dennison® T-1000B Series Engineering Grade Beaded Retroreflective Film

Issued: April 2019

Avery Dennison® T-1500-B Series beaded Engineering Grade Retroreflective Film for permanent and temporary traffic signage, is a high-quality, durable, enclosed lens retroreflective material with a pressure sensitive adhesive.

T-1500-B Series sheeting is an Omni-Directional beaded film. This feature benefits agencies by providing confidence that all signs will perform with uniform visual reflectivity at all sign face orientations.

Features:

- Omni-Directionality provides consistent performance when mounted in different orientations¹
- Designed for long term durability on safety devices worldwide
- Pattern free face allows for clean graphic imaging
- Economical choice for non-critical signs
- Uniform daytime and nighttime visual appearance

Conversion:

- Screen printing
- Thermal transfer printing
- TrafficJet digital printing
- Steel rule sign-cut
- Drum roller sign-cut
- Steel rule sign-cut
- Thermal die-cut

Applications:

- Rigid permanent and temporary outdoor signage
- Nonessential signage where retro-reflection is necessary

¹ See Sheeting Orientation section for explanation on directional sensitivity

² See Page 5 for Nomenclature.



Performance:
ASTM D4956 Type I,
EN-12899 RA1
See Page 2 for complete list.



Orientation: Omni-Directional



Durability: 7 years
Vertical Exposure Only



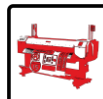
Face: PVC with Glass Microspheres



Adhesive: Permanent Pressure Sensitive



Liner: White Polyethylene Coated Paper



Printable with: TrafficJet™ Print System

Product Availability²:

| Traffic Products | |
|------------------|-------|
| T-1500-B | White |

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Retroreflectivity:

Table A:
Min. coefficients of retroreflection (R_A)¹ per ASTM D4956² Type I

| Observation Angle | Color | Entrance Angle | |
|-------------------|--------|----------------|-------|
| | | - 4° | + 30° |
| 0.2° | White | 70 | 30 |
| | Yellow | 50 | 22 |
| | Orange | 25 | 7 |
| | Blue | 4 | 1.7 |
| | Green | 9 | 3.5 |
| | Red | 14 | 6 |
| | Brown | 1.0 | 0.3 |
| 0.5° | White | 30 | 15 |
| | Yellow | 25 | 13 |
| | Orange | 13 | 4 |
| | Blue | 2.0 | 0.8 |
| | Green | 4.5 | 2.2 |
| | Red | 7.5 | 3.0 |
| | Brown | 0.3 | 0.2 |

Table B:
Min. coefficients of retroreflection (R_A)¹ EN 12899 Table 3

| α Observation Angle | Color | β_1 ($\beta_2=0^\circ$) Entrance Angle | | |
|-------------------------------|--------|--|-------|-------|
| | | + 5° | + 30° | + 40° |
| 12' (0.2°) | White | 70 | 30 | 10 |
| | Yellow | 50 | 22 | 7 |
| | Orange | 25 | 10 | 2.2 |
| | Blue | 4 | 1.7 | 0.5 |
| | Green | 9 | 3.5 | 1.5 |
| | Red | 14.5 | 6 | 2 |
| | Brown | 1 | 0.3 | -- |
| 20' (0.33°) | White | 50 | 24 | 9 |
| | Yellow | 35 | 16 | 6 |
| | Orange | 20 | 8 | 2.2 |
| | Blue | 2 | 1 | -- |
| | Green | 7 | 3 | 1.2 |
| | Red | 10 | 4 | 1.8 |
| | Brown | 0.6 | 0.2 | -- |
| 2° | White | 5 | 2.5 | 1.5 |
| | Yellow | 3 | 1.5 | 1.0 |
| | Orange | 1.2 | 0.5 | -- |
| | Blue | -- | -- | -- |
| | Green | 0.5 | 0.3 | 0.2 |
| | Red | 1 | 0.5 | 0.5 |
| | Brown | -- | -- | -- |

T-1500-B Series **exceeds** all values listed in **Table A** and **Table B**.

T-1500B Series also **exceeds** the current applicable requirements for the following specifications:

| | |
|---------------|--------------------------|
| ASTM D4956 | International |
| EN-12899 | EU |
| GB/T 18833 | China |
| JIS Z9117 | Japan |
| SANS 1519-1 | South Africa |
| AS/NZS 1906.1 | Australia New Zealand |

Avery Dennison suggests you obtain the current requirements from your local agency and ensure product conformance with such requirements. Your Avery Dennison Representative can assist you in this regard.

¹ R_A =
candelas per foot-candle per
square foot($cd/ft \cdot ft^2$) OR
Candelas per lux per square meter
($cd/lx \cdot m^2$)

² Measured according to ASTM E810

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Colors and Specification Limits:

Figure A: Daytime Color – CIE Color Diagram

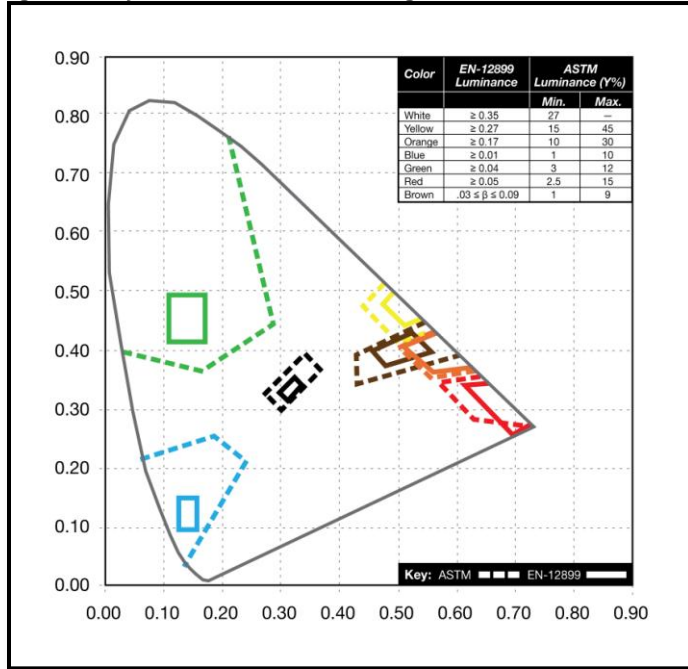
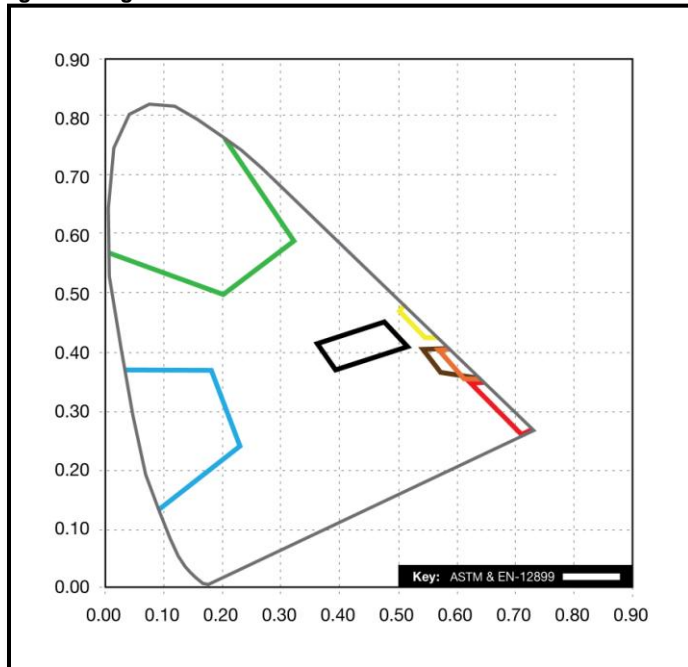


Figure B: Nighttime Color



T-1500-B Series meets the current applicable daytime and nighttime color requirements for ASTM D4956 and EN-12899 as well as standards listed on Page 2.

Chromaticity Coordinate Limits

Figures A & B show the four pairs of chromaticity coordinates from ASTM D4956 and EN-12899 on the color grid.

Daytime Color

The four pairs of chromaticity coordinates in Figure A determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with Standard Illuminant D65 and CIE Publication no. 15 using CIE Standard Illuminant D65 and CIE 45/0 geometry. Luminance factor shall comply with table in Figure A.

Note: The saturation limit of green and blue may extend to the border of the CIE chromaticity locus for spectral colors

Nighttime Color

The four pairs of chromaticity coordinates in Figure B determine the acceptable color measured using CIE Illuminant A, observation angle of 0.33 degrees, entrance angle of +5 degrees, source and receiver apertures not to exceed 10 minutes of arc, and CIE 1930 (2 degree) standard observer per ASTM D4956.

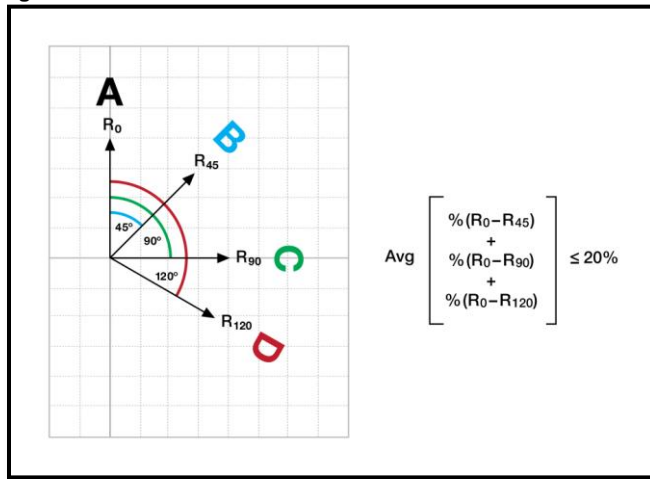
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Sheeting Orientation:

The American Association of State Highway Transportation Officials (AASHTO) has recognized that some retroreflective films are rotationally (orientation) sensitive. Because this impacts sign luminance, AASHTO has defined a specification to measure orientation performance. **Figure C** shows how the orientation sensitivity is measured. In order for a film to be considered rotationally insensitive, the average percent difference (shown in **Figure C**) must be less than or equal to 20%.

Figure C



When measured for orientation sensitivity as described in AASHTO M 268-10, all Avery Dennison sheeting, both beaded and prismatic, **pass** the specification as **rotationally insensitive**. Therefore, no special identification marks or other features (such as a datum mark, or distinctive seal pattern) are required to denote optimum orientation for sheeting. Because the user can expect visual uniformity regardless of orientation, no costly and cumbersome fabrication techniques are required to orient sheets, cut sign legend or border tape during sign fabrication.

Specifying agencies and sign fabricators are cautioned that some retroreflective sheetings, even of the same ASTM "Type" may not provide consistent luminance for desired night visibility if the sheeting is not applied in the optimal, or in uniform orientation. Agencies and fabricators should be aware of this concern and discuss the potential effects of rotation on luminance of specific sheetings with their material supplier before beginning installation and/or fabrication.

T-1500-B Series is Omni-Directional and **passes** the AASHTO specification as being **rotationally insensitive**.

Retroreflectivity R_A values taken per ASTM E810 at 0.5° Observation angle and -4° or 5° Entrance angle

As a datum for laboratory measurements R_0 is identified in the crossweb direction.

*Watermark*¹: T-1500-B Series does not have a watermark.

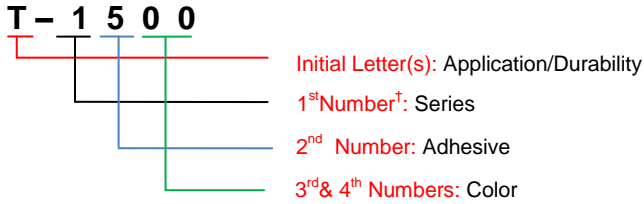
¹ May vary by region.

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Nomenclature:



| Initial Letter | Application | Durability* |
|----------------|----------------------------|-------------|
| T | Traffic/Permanent Sheeting | 7 year |
| W | Work Zone Sheeting | 3 year |
| WR | Work Zone Reboundable | 3 year |

* See your local representative for complete details.

| Series | 1000 |
|--------|------|
|--------|------|

| 2 nd Number | Substrate |
|------------------------|--|
| 1 | Pressure Sensitive for Plastic Substrates |
| 2 | Pressure Sensitive for Wood Substrates |
| 5 | Pressure Sensitive for Aluminum Substrates |

| 3 rd & 4 th Numbers | Color |
|---|---------------------------------------|
| 00 | White |
| 01 | Yellow |
| 04 | Orange |
| 05 | Blue |
| 07 | Green |
| 08 | Red |
| 09 | Brown |
| 11 | Fluorescent Yellow |
| 13 | Fluorescent Yellow-Green |
| 14 | Fluorescent Orange |
| 42 | 4" LEFT Orange Pre-Striped Barricade |
| 43 | 4" RIGHT Orange Pre-Striped Barricade |
| 44 | 6" LEFT Orange Pre-Striped Barricade |
| 45 | 6" RIGHT Orange Pre-Striped Barricade |

[†]OmniCube is the exception and leads with the number 11

WARRANTY

Avery Dennison T-1500-B beaded retroreflective sheeting ("Product(s)") are warranted to be free from defects in material and workmanship for one (1) year from date of purchase (or the period stated on the specific product information literature in effect at time of delivery, if longer). It is expressly agreed and understood that Avery Dennison's sole obligation and Purchaser's exclusive remedy under this warranty, under any other warranty, express or implied, or otherwise, shall be limited to repair or replacement of defective Product without charge at Avery Dennison's plant or at the location of Product (at Avery Dennison's election), or in the event replacement or repairs is not commercially practical, to Avery Dennison's issuing Purchaser a credit reasonable in light of the defect in the Product.

CONDITIONS:

This warranty shall be effective only if all of the following conditions are met:

Fabrication and/or installation must occur within one (1) year from the date of purchase.

The failure must have resulted solely from a manufacturing defect or deterioration of the Product due to natural causes under the Performance Warranty. Without limiting the generality of the foregoing, there is no warranty for the failure of the sheeting due to improper sign fabrication, storage, handling, installation, maintenance, failure of the sign substrate, vandalism or mischief. Slight color fading, cracking, chalking, edge lifting, or slight reduction in gloss or reflectivity will not materially detract from appearance and does not constitute a breach of warranty.

Avery Dennison has published instructional bulletins pertaining to the storage, handling, and cleaning of Product, approved substrates, and application procedures (collectively, the "Procedures"). The Product must have been processed and applied to blank, clean material in accordance with the Procedures, as such may be amended from time to time. Avery Dennison reserves the right to reject any warranty claim where the fabricator or installer cannot satisfactorily prove or demonstrate that the Avery Dennison procedures were utilized. The date of installation, warranty registration, and claim procedures established by Avery Dennison must be followed, and failure to follow such procedures shall void this warranty. Replacement Product carries only the unexpired warranty portion of the Product it replaces. The Product must be properly stored and applied within the shelf-life as stated in the applicable Avery Dennison Product Data Sheet including adhesive and other material product data sheets.



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Characteristics:

| <i>Property</i> | <i>Value</i> | <i>Instructional Bulletins</i> |
|------------------------------|--|--------------------------------|
| Shelf-Life | 1 year from date of purchase when stored at the following conditions; 65°-75°F (18°-24°C) 50% ± 5% R.H. | #8.00 |
| Typical film Caliper | 5.5 – 6.5 mils (140 – 165 µm) | NA |
| Min. Application Temperature | 65° F (18° C) | #8.10 |
| Service Temperature | -10°F to +150°F (-23°C to + 65°C) | #8.00 |
| Screen Printing | Long term durability of screen printing in combination with T-1500-B is warranted when used with approved inks and overlays. See Page 7. | #8.30 #8.55 |
| TrafficJet Digital Printing | Long term durability of TrafficJet digital printing in combination of T-1500-B is warranted when used with approved overlay. See Page 7. | NA |
| Thermal Transfer Printing | Long term durability of thermal transfer printing in combination with T-1500-B is warranted when used with approved ribbons and printer systems. See Page 7. | #8.60 |

ADDITIONAL LIMITATIONS

Unintended Use: This warranty only applies to Product that is used by professional converters and installers for the defined end uses and in the combinations described in the applicable Avery Dennison Product Data Sheets and Instructional Bulletins. For any other use, the user is responsible for determining the suitability of the Product, and for any and all risk or liability associated with that use or application, and the user agrees to indemnify, defend and hold harmless Avery Dennison for any claims, losses, damages, judgments, expenses and/or expenses, including attorneys fees, resulting from such use or application. This warranty is expressly conditioned on the Product being processed by professional converters or installers in accordance with the Avery Dennison recommended written processing instructions, and being applied to properly prepared surfaces and cleaned and maintained in accordance with recommended Avery Dennison procedures. It is the converters, installers or other users responsibility to perform incoming raw material quality inspections, to assure proper surface preparation and that approved application procedures are followed, to retain converted samples, and to immediately cease using and notify Avery Dennison and/or its authorized agent or distributor of any Product, Materials and/or finished Product discovered to be (or reasonably capable of being discovered to be) defective.

Misuse and Force Majeure: Avery Dennison has no obligations or liability under this warranty with respect to Product that has been altered, modified, damaged, misused, abused, subject to accident, neglected or otherwise mishandled or improperly processed or installed. Product is not warranted against premature failure caused by chemical, environmental or mechanical means such as, but not limited to, vandalism, cleaning solutions, paints, solvents, moisture, temperature, mechanical washing equipment, engine fuel spills, engine exhaust, steam, organic solvents or other spilled chemicals pollutants, including industrial and volcanic ash. Damage from fire, structural failure, lightning, accidents, and other force majeure events are not covered by this warranty.

Third Party Product: Avery Dennison assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where installer or converter uses or reference is made to a commercially available product, made by another manufacturer, it shall be the responsibility of the user, installer or converter to ascertain the precautionary measures for its use outlined by the manufacturer.

The remedies provided under this warranty are exclusive. In no event shall Avery Dennison be responsible for any direct, indirect, incidental or consequential damages or specific relief whether foreseeable or not, caused by defects in such Product, whether such damage occurs or is discovered before or after replacement or credit, and whether or not such damage is caused by Avery Dennison's negligence. In no event shall Avery Dennison's liability hereunder exceed the remedies specifically set forth in this warranty. Avery Dennison's liability shall be limited, at Avery Dennison's option, to the purchase price, replacement of the defective Product and in some cases when authorized by Avery Dennison the repair and replacement of the defective Product.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHERS. ANY AND ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED. NO WAIVER, ALTERATION, ADDITION OR MODIFICATION OF THE FOREGOING CONDITIONS SHALL BE VALID UNLESS MADE IN WRITING AND MANUALLY SIGNED BY AN OFFICER OF AVERY DENNISON.

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Converting Information:

The following Avery Dennison literature will provide information to the user for proper application, storage, and other requirements. Find the latest information on the Avery Dennison website, www.reflectives.averydennison.com. We encourage you to check our website periodically for updates.

Approved screen printing inks, overlays, thermal transfer ribbons:

| Supplier | Series | System | Instructional Bulletins |
|----------------|-----------|------------------|-------------------------|
| Avery Dennison | 4930 Inks | 1 Part Solvent | #8.40 |
| Avery Dennison | 7TS | 1 Part Solvent | #8.37 |
| Avery Dennison | OL-2000 | Acrylic Overlay | #8.01, #8.10, #8.25 |
| Avery Dennison | OL-1000 | Anti-Graffiti | #8.01, #8.10 |
| Matan | DTS | Thermal Transfer | #8.60 |

Instructional Bulletins:

| | |
|---------------------------------------|-------|
| Film Care & Handling | #8.00 |
| Substrate Requirements | #8.01 |
| Application Techniques for PS Film | #8.10 |
| Cutting Methods | #8.20 |
| Computer Sign Cutting | #8.25 |
| Screen Preparation | #8.30 |
| Troubleshooting Printing & Processing | #8.34 |
| Ink Recommendations Guide | #8.55 |

Substrates:

The application of Avery Dennison T-1500-B Series sheeting is limited to properly prepared aluminum. Users are urged to carefully evaluate, under actual use conditions, any film application to other substrates. Failure of film caused by other substrates, materials, contamination, or improper surface preparation is not the responsibility of Avery Dennison. See Instructional Bulletin #8.01 for full details on substrate requirements.

DEFINITIONS

Durability: means that the Product in a finished graphic, panel or sign situated outdoors, subject to the limitations herein and Avery Dennison Product Data Sheets and Instructional Bulletins, and applied to recommended surfaces, will not deteriorate excessively such that the finished sign, panel or graphic is ineffective for its identification when viewed under normal conditions from the intended viewing distance.

Outdoor Durability: is based on normal middle European and central North American outdoor exposure conditions and application to recommended surfaces. Actual performance life will depend on a variety of factors, including but not limited to substrate preparation, exposure conditions and maintenance of the Product and finished graphic, panel or sign. In case the finished graphics, panel or sign is in areas of high temperatures or humidity, in industrially polluted areas or other areas with air laden particulate matter, and/or in high altitudes, Outdoor Durability may be reduced. Please see your local Avery Dennison representative for changes to warranties based on such localized conditions.

Vertical Exposure: means that the face of the finished graphic is $\pm 10^\circ$ from vertical.

Non-Vertical Exposure: means that the face of the finished graphic is greater than 10° from vertical and greater than 5° from horizontal. Retroreflective films are not warranted for this exposure.

Flat surfaces: means a two dimensional flat surface without protruding objects.

Weathering Effects: Some degradation of Product performance over time is considered normal wear. Slight color fading, chalking, edge lifting, or slight reduction in gloss or reflectivity due to normal wear exposure and other natural weathering, environmental or other conditions or damage caused by tornadoes, hurricanes, wind, excessive ice buildup or extraordinary frozen particulate conditions, large hail stones or other acts of God, do not constitute a breach of warranty or give rise to any liability by Avery Dennison.

Printing, Curing and Ink Defects: Ink contaminations, failures or other defects, or other failures due to improper printing conditions or settings including, but not limited to, unsuitable color calibration, incorrect ICC color profile or incompatible printing, do not constitute a breach of warranty. Product failure caused by ink over-saturation, excessive or under curing, failure of ink to render desired colors on Product, or other treatment or processing errors are not warranted.

Adhesion to Application Surfaces: This warranty does not cover the Product if the application surface is not properly prepared; nor does the warranty cover the Product or damage to the substrate because the layers of the substrate separate due to a lower bond between those layers than the bond between the Product and the top layer of the substrate, or surfaces which subsequently crack, peel, outgas, or become damaged beneath the Product

INDEPENDENT TESTING REQUIRED

All statements, technical information and recommendations about Avery Dennison products are based upon tests and information believed to be reliable but do not constitute a guarantee or warranty of any kind. All Avery Dennison products are sold with the understanding that Purchaser has independently determined the suitability of such products for its intended and other purposes.

If any court of competent jurisdiction or relevant government agency holds any provision of this warranty and limitation of liability to be illegal, void, invalid or unenforceable, whether in terms of any competition, legislation or otherwise, such provision shall be deleted and severable from this warranty and limitation of liability but deletion shall not affect the validity or enforceability of any other provisions hereof.

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