USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

TECHNICAL DATA SHEET • TEST REPORT

12 MIL CLEAR SAFETY FILM

Abrasion-resistant safety & solar control window film

BS EN 410 | ASTM | UV < 1% | CLEAR

Document	Technical Data Sheet – Test Report	**Ref.**	GHTF/TDS/SF12-CL-TR
Product	12 MIL Clear Safety Film	**Layers**	Two
Colour	Clear	**Application**	Interior surface of glazing

88%	< 1%	12 Mil	Class A
Visible Light Transmittance	UV Transmission	Two-Layer Safety Film	ASTM E84 Fire Rating

01 GENERAL – SUMMARY

This test report covers the tested properties of the **12 MIL Clear Safety Film**, an abrasion-resistant safety window film applied to the interior surface of window glass. The film imparts safety and solar-control performance, including solar heat and UV reduction, glare reduction and other characteristics.

02 DEFINITIONS

TERM	DEFINITION
Visible Light Transmittance (VLT)	Ratio of visible solar energy (380 – 750 nm) passing through a glazing system to the total visible solar energy falling on it.
Visible Light Reflectance	Total percentage of visible light reflected by a glazing system that can be seen visually.
Ultraviolet Light Transmittance	Ratio of solar ultraviolet energy (300 – 380 nm) transmitted by the glazing system to the total solar UV energy falling on it.
Solar Energy Transmitted	Ratio of total solar energy passing through a glazing system to the total solar energy falling on it.
Solar Energy Reflected	Ratio of total solar energy directly reflected by the glazing system to the total solar energy falling on it.
Solar Energy Absorbed	Ratio of total solar energy directly absorbed by the glazing system to the total solar energy falling on it.
Total Solar Energy Rejected (TSER)	Sum of incident solar energy rejected by a glazing system (solar reflectance plus the part of solar absorption re-radiated outward).
Shading Coefficient (SC)	Ratio of solar heat gain through a given glazing system to that of standard 3 mm (1/8 in) clear glass under the same test conditions. The lower the SC, the better the sun-control capability.
U-Factor	Rate of heat conductivity of a glazing system, independent of solar radiation. Multiplied by the indoor–outdoor temperature difference (°F) it gives heat flow in BTU/hr/ft² of glazing.

USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

TERM	DEFINITION
Emissivity	Ability of a surface to absorb far-infrared heat and to reflect it. Lower emissivity means lower far-infrared absorption and greater far-infrared reflectance.
Luminous Efficacy	Ratio of visible light transmission to shading coefficient for a glazing system.
Solar Heat Gain Coefficient (SHGC)	Fraction of incident solar radiation that passes through the window, both directly transmitted and absorbed then released inward. Expressed between 0 and 1; lower SHGC means less solar heat transmitted. SHGC is the complement of TSER: **SHGC = 1 – TSER**.

03 THERMAL & OPTICAL PERFORMANCE

Measured and calculated performance values on 1/8 inch (3 mm) clear glass, determined according to procedures indicated in BS EN and ASTM standards.

#	PROPERTY	UNIT	VALUE
01	Thickness	Mil	**12.0**
02	Visible Light Transmittance	%	**88**
03	Visible Light Reflectance – Exterior	%	**10**
04	Visible Light Reflectance – Interior	%	**9**
05	Solar Transmittance	%	**80**
06	Solar Reflectance	%	**9**
07	Solar Absorptance	%	**11**
08	Ultraviolet Transmission	%	**< 1**
09	Total Solar Energy Rejected	%	**17**
10	Shading Coefficient	–	**0.96**
11	Emissivity	–	**0.89**
12	U-Value (Day Winter)	–	**1.12**
13	Solar Heat Gain Coefficient	–	**0.84**
14	Luminous Efficacy	–	**0.92**
15	Glare Reduction	–	**3**

04 UV, SCRATCH & MECHANICAL PERFORMANCE

A. **UV Transmission:** less than 1 percent when measured in accordance with BS EN 410.

B. **Scratch Resistance:** difference in haze value after the abrasion resistance test is **3.10**, tested as per ASTM D1044 using 100 revolutions, CS-10F wheel and 500 g weight.

C. **Mechanical Performance:** values based on the manufacturer's published test data, determined according to procedures indicated in ASTM standards.

USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

#	PROPERTY	UNIT	VALUE
01	Thickness	Mil	**12.0**
02	Number of Layers	–	**Two**
03	Tensile Strength	PSI	**28,446**
04	Break Strength	lbs/in	**340**
05	Elongation at Break	%	**160**
06	Peel Strength	g/in	**2,000**
07	Abrasion Resistance	Haze increase	**5 %**

SUMMARY — 12 MIL Clear Safety Film combines a high 88% visible light transmittance with < 1% UV transmission and a robust two-layer, 28,446 PSI construction — delivering glass-retention safety with a virtually invisible, clear appearance.

Performance values are based on manufacturer's published test data on 3 mm (1/8 in) clear glass and are subject to normal manufacturing tolerances. Actual performance may vary with glass type, thickness and installation conditions. Specifications are subject to change without notice.

USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

TECHNICAL DATA SHEET • SPECIFICATION

12 MIL CLEAR SAFETY FILM

Specification section for abrasion-resistant safety & solar control film

ASTM E84 CLASS A | BS EN 410 | ISO 9001 | CLEAR

Document	Technical Data Sheet – Specification	**Ref.**	GHTF/TDS/SF12-CL-SPEC
Product	12 MIL Clear Safety Film	**Layers**	Two
Colour	Clear	**Application**	Interior surface of glazing

88%	< 1%	12 Mil	Class A
Visible Light Transmittance	UV Transmission	Two-Layer Safety Film	ASTM E84 Fire Rating

PART 1 – GENERAL

1.01 SUMMARY

Section includes properties of an abrasion-resistant safety window film applied to the interior surface of window glass to impart safety and solar-control performance for solar heat, UV reduction, glare reduction, impact performance and other characteristics. The film is called **12 MIL Clear Safety Film**.

1.02 DEFINITIONS

TERM	DEFINITION
Visible Light Transmittance (VLT)	Ratio of visible solar energy (380 – 750 nm) passing through a glazing system to the total visible solar energy falling on it.
Visible Light Reflectance	Total percentage of visible light reflected by a glazing system that can be seen visually.
Ultraviolet Light Transmittance	Ratio of solar ultraviolet energy (300 – 380 nm) transmitted by the glazing system to the total solar UV energy falling on it.
Solar Energy Transmitted	Ratio of total solar energy passing through a glazing system to the total solar energy falling on it.
Solar Energy Reflected	Ratio of total solar energy directly reflected by the glazing system to the total solar energy falling on it.
Solar Energy Absorbed	Ratio of total solar energy directly absorbed by the glazing system to the total solar energy falling on it.
Total Solar Energy Rejected (TSER)	Sum of incident solar energy rejected by a glazing system (solar reflectance plus the part of solar absorption re-radiated outward).
Shading Coefficient (SC)	Ratio of solar heat gain through a given glazing system to that of standard 3 mm (1/8 in) clear glass under the same test conditions. The lower the SC, the better the sun-control capability.

TERM	DEFINITION
U-Factor	Rate of heat conductivity of a glazing system, independent of solar radiation. Multiplied by the indoor–outdoor temperature difference (°F) it gives heat flow in BTU/hr/ft² of glazing.
Emissivity	Ability of a surface to absorb far-infrared heat and to reflect it. Lower emissivity means lower far-infrared absorption and greater far-infrared reflectance.
Luminous Efficacy	Ratio of visible light transmission to shading coefficient for a glazing system.
Solar Heat Gain Coefficient (SHGC)	Fraction of incident solar radiation that passes through the window, both directly transmitted and absorbed then released inward. Expressed between 0 and 1; lower SHGC means less solar heat transmitted. SHGC is the complement of TSER: **SHGC = 1** – **TSER**.

1.03 REFERENCES

Section makes reference to the following standards:

1. **ASTM E903** – Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres
2. **BS EN 410** – Determination of Luminous and Solar Characteristics of Glazing
3. **ASTM D1044** – Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test)
4. **ASTM G26** – Accelerated Outdoor Weathering for Non-metallic Materials Using Concentrated Natural Sunlight
5. **ASTM E84** – Surface Burning Characteristics of Building Materials
6. **WINDOW 7.8** – Computer Tool for Analysing Window Thermal Performance, Lawrence Berkeley Laboratory
7. **ASTM D882** – Tensile Properties of Thin Plastic Sheeting
8. **ASTM D3330** – Peel Adhesion of Pressure-Sensitive Adhesive Tapes
9. **ASTM D6988** – Determination of Thickness of Plastic Film

USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

1.04 PERFORMANCE REQUIREMENTS

A. Thermal and Optical Performance Properties: Provide glazing films with performance properties specified (on 1/8 inch clear glass) based on manufacturer's published test data, as determined according to procedures indicated in ASHRAE, ASTM and AIMCAL standards.

#	PROPERTY	UNIT	VALUE
01	Thickness	Mil	**12.0**
02	Visible Light Transmittance	%	**88**
03	Visible Light Reflectance – Exterior	%	**10**
04	Visible Light Reflectance – Interior	%	**9**
05	Solar Transmittance	%	**80**
06	Solar Reflectance	%	**9**
07	Solar Absorptance	%	**11**
08	Ultraviolet Transmission	%	**< 1**
09	Total Solar Energy Rejected	%	**17**
10	Shading Coefficient	–	**0.96**
11	Emissivity	–	**0.89**
12	U-Value (Day Winter)	–	**1.12**
13	Solar Heat Gain Coefficient	–	**0.84**
14	Luminous Efficacy	–	**0.92**
15	Glare Reduction	–	**3**
	Visible Light Transmittance Tolerance	%	**89 ± 2.0**

B. UV: Provide films with UV-absorbing materials that limit the weighted UV transmission to less than 1 percent when measured in accordance with BS EN 410.

C. Scratch Resistance: Provide films with a surface coating resistant to abrasion such that there is less than 5.0 percent increase in haze when tested as per ASTM D1044, using 100 revolutions, CS-10F wheel and 500 g weights.

D. Surface Burning Characteristics: Provide films that meet the requirements of Class A interior finish for building materials for both flame spread index and smoke development values as per ASTM E84.

E. Mechanical Performance Properties: Provide glazing films with mechanical performance properties specified below, based on manufacturer's published test data, as determined according to procedures indicated in ASTM standards.

#	PROPERTY	UNIT	VALUE
01	Thickness	Mil	**12.0**
02	Number of Layers	–	**Two**
03	Tensile Strength	PSI	**28,446**
04	Break Strength	lbs/in	**340**
05	Elongation at Break	%	**160**
06	Peel Strength	g/in	**2,000**
07	Abrasion Resistance	Haze increase	**5 %**

USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

1.05 QUALITY ASSURANCE

A. **Manufacturer Qualifications:** Engage a firm experienced in manufacturing systems similar to those indicated for this project and meeting ISO 9001 Quality Assurance in Production. The manufacturer shall ensure proper quality control during production, shipping and inventory, and clearly identify and label each film core with the product designation and run number.

B. **Installer Qualifications:** Engage an experienced installer certified, licensed or otherwise qualified by the film manufacturer as having the necessary experience, staff and training to install the manufacturer's products according to specified requirements.

C. **Mock-ups:** Apply glazing films in locations as directed to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Obtain approval of field samples before continuing with remainder of installation.
2. Maintain field samples during remainder of installation in an undisturbed condition as a standard for judging the completed work.
3. Approved field samples may become part of the completed work.

D. **Pre-installation Conference:** Before installing glazing films, conduct a conference at the project site in conjunction with installation of the mock-up.

1. Meet with Owner, Architect, glazing film Installer and glazing film manufacturer's representative.
2. Review methods and procedures related to installation, including manufacturer's written instructions.
3. Examine substrate conditions for compliance with requirements.
4. Review temporary protection measures required during and after installation.
5. Document proceedings, including corrective measures or actions required, and furnish a copy of the record to each participant.

1.06 DELIVERY, STORAGE & HANDLING

Protect glazing films according to manufacturer's written instructions and as needed to prevent damage from condensation, temperature changes, direct exposure to sun or other causes.

1.07 PROJECT CONDITIONS

Environmental Limitations: Do not proceed with film installation when ambient and substrate temperature conditions are outside limits permitted by the manufacturer, or when glass substrates are wet from frost, condensation or other causes.

USA OFFICE
Global Hi-Tech Films, Inc.
101 Lakeforest Blvd, Suite 410
Gaithersburg, MD 20877, United States
+1 954 499 7990 | www.globalhitechfilms.com

PART 2 – PRODUCTS

2.01 MANUFACTURERS / PRODUCTS

Provide the following product: **12 MIL Clear Safety Film** — Colour: **Clear**.

2.02 GLAZING FILM ACCESSORIES

A. **General:** Provide products complying with requirements of the glazing film manufacturer for the application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. **Adhesive:** Optically clear, pressure-sensitive adhesive system that forms a molecular bond between film and glass.

C. **Cleaners, Primers and Sealers:** Types recommended by the glazing film manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine glass and surrounding adjacent surfaces for conditions affecting installation. Report conditions that may adversely affect installation, including a description of any glass that is broken, chipped, cracked, abraded or damaged in any way.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Immediately before beginning installation, clean glass surfaces of substances that could impair the film's bond, including mould, mildew, oil, grease, dirt and other foreign materials.

C. Protect window frames and surrounding conditions from damage during installation.

3.03 INSTALLATION

A. **General:** Comply with the glazing film manufacturer's written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Install film continuously, but not necessarily in one continuous length, with no gaps or overlaps. If seamed, install seams vertical and plumb with no gaps or overlaps. No horizontal seams allowed.
2. Do not remove the release liner until just before each piece of film is cut and ready for installation.
3. Install film with mounting solution and custom-cut to the glass with neat, square corners and edges to within 1/8 inch of the window frame.
4. Remove air bubbles, wrinkles, blisters and other defects.
5. Upon completion, the film may have a dimpled appearance from residual moisture. Under reasonable weather conditions this shall dry flat with no moisture dimples within 30 calendar days when viewed under normal viewing conditions.
6. Remove excess mounting solution at finished seams, perimeter edges and adjacent surfaces.

B. **Inspection:** After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform with no visible streaks, banding, thin spots, pinholes or other optical defects. If installed film does not meet these criteria, remove and replace with new film.

3.04 CLEANING

A. The film may be cleaned using common window cleaning solutions 30 days after application. Abrasive cleaning agents and bristle brushes that could scratch the film must not be used; synthetic sponges or soft cloths are recommended.

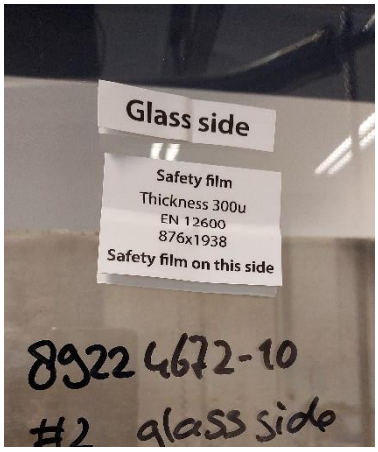
B. Use cleaning methods recommended by the glazing film manufacturer. Replace films that cannot be cleaned.

SPECIFIER NOTE — 12 MIL Clear Safety Film is a two-layer, optically clear safety film rated Class A to ASTM E84, blocking over 99% of UV while preserving 88% visible light — ideal for façades, storefronts, schools, hospitals and government buildings requiring glass-retention safety.

Performance values are based on manufacturer's published test data on 3 mm (1/8 in) clear glass and are subject to normal manufacturing tolerances. Actual performance may vary with glass type, thickness and installation conditions. Specifications are subject to change without notice.

Test report no.: *Testrapport nr.:*	**89224672-25**	**Order No.:** *Opdracht nr.:*	89224672 24.A160	
Client Reference No.: *Klantreferentie nr.:*	-	**Order date:** *Opdrachtdatum:*	2024-07-22	
Client: *Klant:*	Garware Hi Tech Films Limited Naigaon, P.O. Waluj, Aurangabad – 431 133, Maharashtra, India.			
Test item: *Testvoorwerp:*	4mm Glass + 12mil Safety Film			
Identification/ Type No.: *Benaming / Type nr.:*	4mm Glass + 12mil Safety Film			
Order content: *Inhoud opdracht:*	Samples for testing against EN 12600, as given in the standard			
Test specification: *Testomschrijving:*	EN 12600:2002[a] Impact test method and classification for flat glass *Laminated safety glass*			

Date of sample receipt: *Ontvangstdatum monster:*	2024-08-01
Test sample No: *Testproefstuk nr.:*	89224672-01/04
Testing period: *Testperiode:*	2024-11-26 - 2024-11-26
Place of testing: *Testlocatie:*	Arnhem, the Netherlands
Testing laboratory: *Testlaboratorium:*	TÜV Rheinland Nederland B.V. (NoBo 0336)
Test result*: *Testresultaat*:*	Pass



tested by: *getest door:*	X Ondertekend door: Salah El Bardai	**authorized by:** *geautoriseerd door:*	X Signed by: Sef Hovens
Date: 2025-01-21 *Datum:*		**Issue Date:** 2025-01-21 *Datum uitgave:*	
Position / *functie*:	Expert	**Position** / *functie*:	Expert

Others /
Andere:

Condition of the test item at delivery:
Toestand van het test voorwerp bij ontvangst: Test item complete and undamaged

* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
** Legenda:*	*P(ass) = voldoet aan test omschrijving*	*F(ail) = voldoet niet aan test omschrijving*	*N/A = niet van toepassing*	*N/T = niet getest*

This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.
Dit testrapport heeft alleen betrekking op het voorgenoemde test voorwerp. Zonder toestemming van het testcentrum mag dit testrapport niet in delen worden vermenigvuldigd. Dit keuringsrapport geeft geen recht op het dragen van enig keurmerk.
VO5

Test report no.: 89224672-25
Testrapport nr.:

Remarks
Opmerkingen

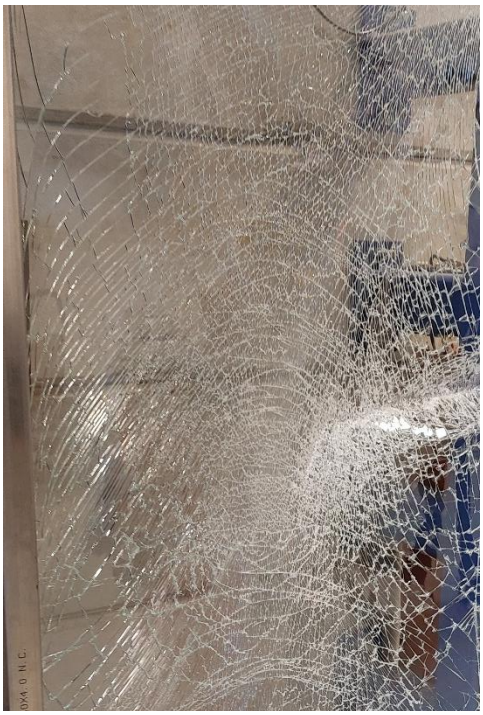
1	The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. For the influence of the measuring uncertainties on the results, reference is made to the validation of the respective methods. *De apparatuur welke tijdens de gespecificeerde testperiode is gebruikt, is gekalibreerd volgens ons kalibratieprogramma. De apparatuur voldoet aan de eisen welke zijn opgenomen in de relevante normen. De traceerbaarheid van de gebruikte testapparatuurs is gewaarborgd door naleving van de voorschriften in ons kwaliteitsmanagementsysteem. Gedetailleerde informatie over testomstandigheden, apparatuur en meetonzekerheid is beschikbaar in het testlaboratorium en kan op verzoek worden verstrekt. Voor de invloed van de meetonzekerheden op de resultaten wordt verwezen naar de validatie van de respectievelijke methode c.q. verrichting*
2	As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged. *Zoals contractueel overeengekomen is dit document enkel digitaal ondertekend. TÜV Rheinland heeft niet geverifieerd en kan niet verifiëren welke wettelijke of andere vereisten van toepassing zijn op dit document. Een dergelijke verificatie valt onder de verantwoordelijkheid van de gebruiker van het document. Op verzoek van de opdrachtgever kan TÜV Rheinland de geldigheid van de digitale handtekening bevestigen door een apart document. Een dergelijk verzoek moet worden gericht aan onze verkoopafdeling. Voor een dergelijke extra service zal een milieutoeslag in rekening worden gebracht.*
3	Test clauses with remark of * are subcontracted to qualified subcontractors and descripted under the respective test clause in the report. Tests clauses marked with [a] are performed under ISO 17025 accreditation. Deviations of testing specification(s), test locations or customer requirements are listed in specific test clause in the report. This report is only to be read is a whole. No opinions or interpretation are included in this report. This test report consists of multiple pages and is only to be read is a whole. The number of pages can be seen in the header on the top right of each page, the report ends when the last page is reached. TÜV Rheinland Nederland B.V. is solely responsible for the content. *Test onderdelen welke met * zijn gemarkeerd zijn uitbesteed aan gekwalificeerde onderaannemers en zijn beschreven in het respectievelijke test onderdeel van dit rapport. Test onderdelen welke met [a] zijn gemarkeerd zijn onder ISO 17025 accreditatie uitgevoerd. Afwijkingen van testspecificatie(s), testlocaties of klant eisen zijn vermeld in het van toepassing zijnde onderdeel in het rapport. Het rapport dient als geheel te worden gelezen. Er zijn geen opinies en interpretaties opgenomen binnen het rapport. Dit rapport bestaat uit meerdere pagina's en dient al geheel gelezen te worden. Het aantal pagina's is rechtsboven in de koptekst van dit rapport vermeld en eindigt wanneer de laatste pagina is bereikt. TÜV Rheinland Nederland is als enige verantwoordelijk voor de inhoud van het rapport.*
4	All rights reserved. No part of this report may be reproduced, provided to and/or examined by third parties, and/or published by print, photoprint, microfilm, in electronic form or any other means without the explicit previous written consent of TÜV Rheinland Nederland B.V. In case this report was drafted within the context of an assignment to TÜV Rheinland Nederland B.V., the rights and obligations of contracting parties are subject to the General Terms & Conditions for Advisory, Research and Certification assignments to TÜV Rheinland Nederland B.V. and/or the relevant agreement concluded between the contracting parties. © 2010 TÜV Rheinland Nederland. *Alle rechten voorbehouden. Niets uit dit rapport mag worden verveelvoudigd, aan derden ter beschikking gesteld en/of door derden onderzocht en/of openbaar gemaakt door middel van druk, fotokopie, microfilm, in elektronische vorm of op welke andere wijze dan ook, zonder uitdrukkelijke voorafgaande schriftelijke toestemming van TÜV Rheinland Nederland B.V.* *Indien dit rapport is opgesteld in het kader van een opdracht aan TÜV Rheinland Nederland B.V., zijn de rechten en verplichtingen van contractpartijen onderworpen aan de Algemene Voorwaarden voor Advies-, Onderzoeks- en Certificeringsopdrachten aan TÜV Rheinland Nederland B.V. en/of de betreffende overeenkomst tussen de contractpartijen. © 2010 TÜV Rheinland Nederland*

Test report no.: 89224672-25
Testrapport nr.:

Product description
Product omschrijving

1	**Product details:** *Product details:*	Name of the manufacturer : Garware Hi Tech Films Limited Address of the manufacturer : Naigaon, P.O. Waluj, Aurangabad – 431 133, Maharashtra, India. Production plant of the samples : - Line ID where the samples are made : - Production date : - Sampling date : - The product was marked as : 4 mm Glass + 12mil Safety Film Kind of glass : Clear float glass Nominal thickness : 4.2 mm Composition : 4 mm float + 12mil Safety Film Intermediate layer, name, type : 12 mil Safety Film
2	**Other:** *Andere:*	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
3	**Test sample obtaining:** *Selectie van het proefstuk:*	☒ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

Product description
Product omschrijving

Picture 1. Sample 1 After impact	Picture 2. Sample 2 After impact
	
Picture 3. Sample 3 After impact	**Picture 4. Sample 4 After impact**
	

Test method
Test methode

EN 12600:2002[a]	**Impact test method and classification for flat glass**	
Scope:	EN 12600 specifies a pendulum impact test method for single flat glass for use in buildings. The test is intended to classify flat glass products in three principal classes by performance under impact and by mode of breakage. The standard does not specify requirements for applications, nor does it specify requirements for durability.	
Test requirements of clause 4 :	When tested by the method given in clause 5 of the standard, each test piece shall either not break or shall break as defined in one of the following ways : a) Numerous cracks appear, but no shear or opening is allowed within the test piece through which a 76mm diameter sphere can pass when a maximum force of 25 N is applied. Additionally, if particles are detached from the test piece up to 3 minutes after impact, they shall - in total – weigh no more than a mass equivalent to 10.000 mm² of the original test piece. The largest single particle shall weigh less than the mass equivalent to 4.400 mm² of the original test piece; b) Disintegration occurs and the 10 largest crack-free particles collected within 3 minutes after impact and weighed, all together, within 5 minutes of impact shall weigh no more than the mass equivalent to 6.500 mm² of the original test piece. The particles shall be selected only from the portion of the original test piece exposed in the test frame. Only the exposed area of any particle retained in the test frame shall be taken into account in determining the mass equivalent.	Applicable clause : (a) ☒ (b) ☐
Test method:	The test temperature shall be (20 ± 5) °C. **Clause 5.** Each test piece shall comprise a single pane of glass product and be representative of the normal production of the type of product submitted for test. Results obtained with test pieces of dimensions (876 ± 2) x (1938 ± 2) mm are valid for classification purposes of the glass product, whatever the service dimensions. The test shall be carried out at each drop height on four pieces of identical structure and the same nominal thickness. In case of symmetrical samples, the classification obtained can be used for both sides of the product. For asymmetrical samples, the classification obtained, are intended solely for installation in situations where the risk of impact is from one side only. Inspect the test piece after impact and note whether ; - It remains unbroken; or - It broke in accordance with either the requirements a) or b) of clause 4; or - It broke and failed to conform to the requirements of clause 4. If any of the initial four test pieces fails to conform to the requirements of clause 4, the procedure is terminated. If all four test pieces either do not break or else break according to the criteria given in clause 4, and it is required to test the material to a higher impact level, increase the drop height to the next impact level. Repeat the test on four more samples of the same material (If the material remained unbroken, the same sample(s) may be used.)	

Test method
Test methode

	Impact levels Classification: 3 — Drop height (mm): 190 Classification: 2 — Drop height (mm): 450 Classification: 1 — Drop height (mm): 1200
Measuring uncertainty:	Caused by the destructive nature of the test and pass/fail result no measurement uncertainty can be determined. Based on the validation of the test procedure, measurement set-up and the associated parts (test frame / drop height, etc.) there is a presumption of conformity established which is approved with ISO 17025 accreditation.
Sphere penetration test :	The probe assembly shall consist of a sphere of diameter (76 ± 1) mm connected to an arm with a device for measuring when a maximum force of 25 N has been applied. The probe assembly shall be held horizontal. It shall then be pushed in any opening formed in the test piece. The weakest point of resistance shall be selected. A horizontal force shall be applied until : - A maximum force of 25 N has been achieved without penetration by the sphere. The test piece shall be deemed to have passed the test; or - The maximum diameter of the sphere has passed through the plan of the test piece without a force of 25 N being achieved. The test piece shall be deemed to have failed the test.
Classification :	**General** Glazing conforming to this European standard is classified as follows : - Its performance under the impact test; - The drop height at which breakage occurred; - The drop height at which the product passed in accordance with a) of clause 4; - The drop height at which the product passed in accordance with b) of clause 4; - The mode of breakage of the material if it remains unbroken after the impact test.
	Drop height class Glazing shall be classified as follows : - Class 3: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm; - Class 2: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm and 450 mm; - Class 1: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm 450 mm and 1200 mm.

Test method
Test methode

Mode of breakage

If all test pieces remain unbroken at the drop height appropriate to its intended drop height class, the mode of breakage shall be determined as per Annex C of this standard. The mode of breakage shall be described as follows :

- Type A : numerous cracks appear forming separate fragments with sharp edges, some of which are large (typical of annealed glass);
- Type B : numerous cracks appear, but the fragments hold together and do not separate (typical of laminated glass);
- Type C : disintegration occurs, leading to a large number of small particles that are relatively harmless (typical of toughened glass).

Performance classification

The performance classification of a glass product shall be given as follows :

α (β) ϕ , where

- α : is the highest drop height class at which the product either did not break or broke in accordance with a) or b) of clause 4;
- β : is the mode of breakage;
- ϕ : is the highest drop height class at which the product either did not break or when broke, broke in accordance with a) clause.

When a glass product breaks at a drop height of 190 mm and the breakage is not in accordance with a) of clause 4 then the value of ϕ quoted shall be zero.

Test results
Test resultaten

Expression of test results				
Performance under impact test	**Composition (from the attack side) : 4mm Glass + 12mil Safety Film**			
	Sample number			
	89224672 #1	89224672 #2	89224672 #3	89224672 #4
Asymmetrical yes/no	Yes			
Attack face?	Glass side			
Dimensions	876 x 1938 mm			
Nominal thickness	4.2 mm			
Tyre pressure (0,35 ± 0,02) MPa ? yes/no	yes			
In case of applied films, film clamped in frame ? yes/no	n.a.			
Behaviour at each drop height	- did the test piece broke or not - if broken, the mode of breakage - was it broken in accordance with clause 4, a) or b)			
Class 1 (drop height 1200mm)	Breakage, A / **B** / C Clause a)	Breakage, A / **B** / C Clause a)	Breakage, A / **B** / C Clause a)	Breakage, A / **B** / C Clause a)

Based on EN 12600:2002 [a], Clause 6

Glazing conforming to this European Standard is classified by the performance of four consecutive samples under impact.

Trade name	**: 4mm Glass + 12mil Safety Film**	Pass ☒
Composition	**: 4mm Glass + 12mil Safety Film**	Fail ☐
Classification EN 12600	**: 1 (B) 1 Glass side**	Not applicable ☐

Remarks

The test results exclusively relate to the tested objects.

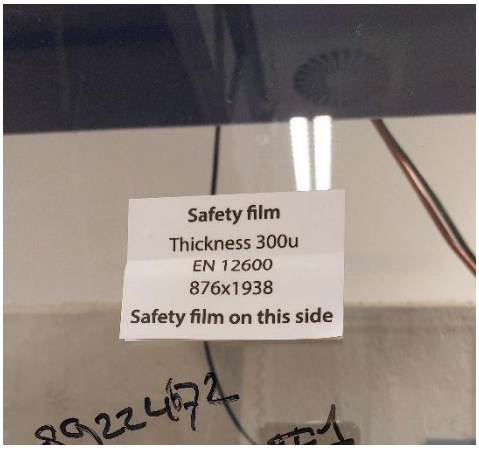
When and if changes are made in production method and/or equipment, assessment according to this standard shall be reconsidered and re-tests shall be performed when the changes can lead to different specifications of the glass. The decision and responsibility lies at the manufacturer.

If no reference of the product description was supplied by the manufacturer, than that document shall be added to this test report by the manufacturer. It was to the manufacturer's responsibility that the samples delivered for initial type test are representative to the production and deviations from perfection were included in the delivered test samples.

- End of report -

Test report no.: *Testrapport nr.:*	**89224672-26**	**Order No.:** *Opdracht nr.:*	89224672 24.A160	
Client Reference No.: *Klantreferentie nr.:*	-	**Order date:** *Opdrachtdatum:*	2024-07-22	
Client: *Klant:*	Garware Hi Tech Films Limited Naigaon, P.O. Waluj, Aurangabad – 431 133, Maharashtra, India.			
Test item: *Testvoorwerp:*	4mm Glass + 12mil Safety Film			
Identification/ Type No.: *Benaming / Type nr.:*	4mm Glass + 12mil Safety Film			
Order content: *Inhoud opdracht:*	Samples for testing against EN 12600, as given in the standard			
Test specification: *Testomschrijving:*	EN 12600:2002[a] Impact test method and classification for flat glass *Laminated safety glass*			

Date of sample receipt: *Ontvangstdatum monster:*	2024-08-01
Test sample No: *Testproefstuk nr.:*	89224672-01/04
Testing period: *Testperiode:*	2024-11-26 - 2024-11-26
Place of testing: *Testlocatie:*	Arnhem, the Netherlands
Testing laboratory: *Testlaboratorium:*	TÜV Rheinland Nederland B.V. (NoBo 0336)
Test result*: *Testresultaat*:*	Pass



tested by: *getest door:*	X Ondertekend door: Salah El Bardai	**authorized by:** *geautoriseerd door:*	X Signed by: Sef Hovens
Date: 2025-01-21 *Datum:*		**Issue Date:** 2025-01-21 *Datum uitgave:*	
Position / *functie*:	Expert	**Position** / *functie*:	Expert

Others /
Andere:

Condition of the test item at delivery:
Toestand van het test voorwerp bij ontvangst: Test item complete and undamaged

* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
** Legenda:*	*P(ass) = voldoet aan test omschrijving*	*F(ail) = voldoet niet aan test omschrijving*	*N/A = niet van toepassing*	*N/T = niet getest*

This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.
Dit testrapport heeft alleen betrekking op het voorgenoemde test voorwerp. Zonder toestemming van het testcentrum mag dit testrapport niet in delen worden vermenigvuldigd. Dit keuringsrapport geeft geen recht op het dragen van enig keurmerk.
V05

Test report no.: 89224672-26
Testrapport nr.:

Remarks
Opmerkingen

1	The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. For the influence of the measuring uncertainties on the results, reference is made to the validation of the respective methods. *De apparatuur welke tijdens de gespecificeerde testperiode is gebruikt, is gekalibreerd volgens ons kalibratieprogramma. De apparatuur voldoet aan de eisen welke zijn opgenomen in de relevante normen. De traceerbaarheid van de gebruikte testapparatuurs is gewaarborgd door naleving van de voorschriften in ons kwaliteitsmanagementsysteem. Gedetailleerde informatie over testomstandigheden, apparatuur en meetonzekerheid is beschikbaar in het testlaboratorium en kan op verzoek worden verstrekt. Voor de invloed van de meetonzekerheden op de resultaten wordt verwezen naar de validatie van de respectievelijke methode c.q. verrichting*
2	As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged. *Zoals contractueel overeengekomen is dit document enkel digitaal ondertekend. TÜV Rheinland heeft niet geverifieerd en kan niet verifiëren welke wettelijke of andere vereisten van toepassing zijn op dit document. Een dergelijke verificatie valt onder de verantwoordelijkheid van de gebruiker van het document. Op verzoek van de opdrachtgever kan TÜV Rheinland de geldigheid van de digitale handtekening bevestigen door een apart document. Een dergelijk verzoek moet worden gericht aan onze verkoopafdeling. Voor een dergelijke extra service zal een milieutoeslag in rekening worden gebracht.*
3	Test clauses with remark of * are subcontracted to qualified subcontractors and descripted under the respective test clause in the report. Tests clauses marked with [a] are performed under ISO 17025 accreditation. Deviations of testing specification(s), test locations or customer requirements are listed in specific test clause in the report. This report is only to be read is a whole. No opinions or interpretation are included in this report. This test report consists of multiple pages and is only to be read is a whole. The number of pages can be seen in the header on the top right of each page, the report ends when the last page is reached. TÜV Rheinland Nederland B.V. is solely responsible for the content. *Test onderdelen welke met * zijn gemarkeerd zijn uitbesteed aan gekwalificeerde onderaannemers en zijn beschreven in het respectievelijke test onderdeel van dit rapport. Test onderdelen welke met [a] zijn gemarkeerd zijn onder ISO 17025 accreditatie uitgevoerd. Afwijkingen van testspecificatie(s), testlocaties of klant eisen zijn vermeld in het van toepassing zijnde onderdeel in het rapport. Het rapport dient als geheel te worden gelezen. Er zijn geen opinies en interpretaties opgenomen binnen het rapport. Dit rapport bestaat uit meerdere pagina's en dient al geheel gelezen te worden. Het aantal pagina's is rechtsboven in de koptekst van dit rapport vermeld en eindigt wanneer de laatste pagina is bereikt. TÜV Rheinland Nederland is als enige verantwoordelijk voor de inhoud van het rapport.*
4	All rights reserved. No part of this report may be reproduced, provided to and/or examined by third parties, and/or published by print, photoprint, microfilm, in electronic form or any other means without the explicit previous written consent of TÜV Rheinland Nederland B.V. In case this report was drafted within the context of an assignment to TÜV Rheinland Nederland B.V., the rights and obligations of contracting parties are subject to the General Terms & Conditions for Advisory, Research and Certification assignments to TÜV Rheinland Nederland B.V. and/or the relevant agreement concluded between the contracting parties. © 2010 TÜV Rheinland Nederland. *Alle rechten voorbehouden. Niets uit dit rapport mag worden verveelvoudigd, aan derden ter beschikking gesteld en/of door derden onderzocht en/of openbaar gemaakt door middel van druk, fotokopie, microfilm, in elektronische vorm of op welke andere wijze dan ook, zonder uitdrukkelijke voorafgaande schriftelijke toestemming van TÜV Rheinland Nederland B.V.* *Indien dit rapport is opgesteld in het kader van een opdracht aan TÜV Rheinland Nederland B.V., zijn de rechten en verplichtingen van contractpartijen onderworpen aan de Algemene Voorwaarden voor Advies-, Onderzoeks- en Certificeringsopdrachten aan TÜV Rheinland Nederland B.V. en/of de betreffende overeenkomst tussen de contractpartijen. © 2010 TÜV Rheinland Nederland*

Test report no.: 89224672-26
Testrapport nr.:

Product description
Product omschrijving

1	**Product details:** *Product details:*	Name of the manufacturer : Garware Hi Tech Films Limited Address of the manufacturer : Naigaon, P.O. Waluj, Aurangabad – 431 133, Maharashtra, India. Production plant of the samples : - Line ID where the samples are made : - Production date : - Sampling date : - The product was marked as : 4 mm Glass + 12mil Safety Film Kind of glass : Clear float glass Nominal thickness : 4.2 mm Composition : 4 mm float + 12mil Safety Film Intermediate layer, name, type : 12 mil Safety Film
2	**Other:** *Andere:*	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
3	**Test sample obtaining:** *Selectie van het proefstuk:*	☒ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

Product description
Product omschrijving

Picture 1. Sample 1 After impact	Picture 2. Sample 2 After impact
	
Picture 3. Sample 3 After impact	**Picture 4. Sample 4 After impact**
	

Test method
Test methode

EN 12600:2002[a]	**Impact test method and classification for flat glass**	
Scope:	EN 12600 specifies a pendulum impact test method for single flat glass for use in buildings. The test is intended to classify flat glass products in three principal classes by performance under impact and by mode of breakage. The standard does not specify requirements for applications, nor does it specify requirements for durability.	
Test requirements of clause 4 :	When tested by the method given in clause 5 of the standard, each test piece shall either not break or shall break as defined in one of the following ways : a) Numerous cracks appear, but no shear or opening is allowed within the test piece through which a 76mm diameter sphere can pass when a maximum force of 25 N is applied. Additionally, if particles are detached from the test piece up to 3 minutes after impact, they shall - in total – weigh no more than a mass equivalent to 10.000 mm² of the original test piece. The largest single particle shall weigh less than the mass equivalent to 4.400 mm² of the original test piece; b) Disintegration occurs and the 10 largest crack-free particles collected within 3 minutes after impact and weighed, all together, within 5 minutes of impact shall weigh no more than the mass equivalent to 6.500 mm² of the original test piece. The particles shall be selected only from the portion of the original test piece exposed in the test frame. Only the exposed area of any particle retained in the test frame shall be taken into account in determining the mass equivalent.	Applicable clause : (a) ☒ (b) ☐
Test method:	The test temperature shall be (20 ± 5) °C. **Clause 5.** Each test piece shall comprise a single pane of glass product and be representative of the normal production of the type of product submitted for test. Results obtained with test pieces of dimensions (876 ± 2) x (1938 ± 2) mm are valid for classification purposes of the glass product, whatever the service dimensions. The test shall be carried out at each drop height on four pieces of identical structure and the same nominal thickness. In case of symmetrical samples, the classification obtained can be used for both sides of the product. For asymmetrical samples, the classification obtained, are intended solely for installation in situations where the risk of impact is from one side only. Inspect the test piece after impact and note whether ; - It remains unbroken; or - It broke in accordance with either the requirements a) or b) of clause 4; or - It broke and failed to conform to the requirements of clause 4. If any of the initial four test pieces fails to conform to the requirements of clause 4, the procedure is terminated. If all four test pieces either do not break or else break according to the criteria given in clause 4, and it is required to test the material to a higher impact level, increase the drop height to the next impact level. Repeat the test on four more samples of the same material (If the material remained unbroken, the same sample(s) may be used.)	

Test method
Test methode

	Impact levels Classification: 3 — Drop height (mm): 190 Classification: 2 — Drop height (mm): 450 Classification: 1 — Drop height (mm): 1200
Measuring uncertainty:	Caused by the destructive nature of the test and pass/fail result no measurement uncertainty can be determined. Based on the validation of the test procedure, measurement set-up and the associated parts (test frame / drop height, etc.) there is a presumption of conformity established which is approved with ISO 17025 accreditation.
Sphere penetration test :	The probe assembly shall consist of a sphere of diameter (76 ± 1) mm connected to an arm with a device for measuring when a maximum force of 25 N has been applied. The probe assembly shall be held horizontal. It shall then be pushed in any opening formed in the test piece. The weakest point of resistance shall be selected. A horizontal force shall be applied until : - A maximum force of 25 N has been achieved without penetration by the sphere. The test piece shall be deemed to have passed the test; or - The maximum diameter of the sphere has passed through the plan of the test piece without a force of 25 N being achieved. The test piece shall be deemed to have failed the test.
Classification :	**General** Glazing conforming to this European standard is classified as follows : - Its performance under the impact test; - The drop height at which breakage occurred; - The drop height at which the product passed in accordance with a) of clause 4; - The drop height at which the product passed in accordance with b) of clause 4; - The mode of breakage of the material if it remains unbroken after the impact test.
	Drop height class Glazing shall be classified as follows : - Class 3: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm; - Class 2: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm and 450 mm; - Class 1: material that conforms the requirements of clause 4 when tested by the method given in clause 5 at a drop height of 190 mm 450 mm and 1200 mm.

Test method
Test methode

Mode of breakage

If all test pieces remain unbroken at the drop height appropriate to its intended drop height class, the mode of breakage shall be determined as per Annex C of this standard. The mode of breakage shall be described as follows :

- Type A : numerous cracks appear forming separate fragments with sharp edges, some of which are large (typical of annealed glass);
- Type B : numerous cracks appear, but the fragments hold together and do not separate (typical of laminated glass);
- Type C : disintegration occurs, leading to a large number of small particles that are relatively harmless (typical of toughened glass).

Performance classification

The performance classification of a glass product shall be given as follows :

α (β) ϕ , where

- α : is the highest drop height class at which the product either did not break or broke in accordance with a) or b) of clause 4;
- β : is the mode of breakage;
- ϕ : is the highest drop height class at which the product either did not break or when broke, broke in accordance with a) clause.

When a glass product breaks at a drop height of 190 mm and the breakage is not in accordance with a) of clause 4 then the value of ϕ quoted shall be zero.

Test results
Test resultaten

Expression of test results				
Performance under impact test	**Composition (from the attack side) : 12mil Safety Film + 4mm Glass**			
	Sample number			
	89224672 #1	89224672 #2	89224672 #3	89224672 #4
Asymmetrical yes/no	Yes			
Attack face?	Foil side			
Dimensions	876 x 1938 mm			
Nominal thickness	4.2 mm			
Tyre pressure (0,35 ± 0,02) MPa ? yes/no	yes			
In case of applied films, film clamped in frame ? yes/no	n.a.			
Behaviour at each drop height	- did the test piece broke or not - if broken, the mode of breakage - was it broken in accordance with clause 4, a) or b)			
Class 1 (drop height 1200mm)	Breakage, A / **B** / C Clause a)	Breakage, A / **B** / C Clause a)	Breakage, A / **B** / C Clause a)	Breakage, A / **B** / C Clause a)

Based on EN 12600:2002 [a], Clause 6

Glazing conforming to this European Standard is classified by the performance of four consecutive samples under impact.

Trade name	**: 4mm Glass + 12mil Safety Film**	Pass ☒
Composition	**: 12mil Safety Film + 4mm Glass**	Fail ☐
Classification EN 12600	**: 1 (B) 1 Foil side**	Not applicable ☐

Remarks

The test results exclusively relate to the tested objects.

When and if changes are made in production method and/or equipment, assessment according to this standard shall be reconsidered and re-tests shall be performed when the changes can lead to different specifications of the glass. The decision and responsibility lies at the manufacturer.

If no reference of the product description was supplied by the manufacturer, than that document shall be added to this test report by the manufacturer. It was to the manufacturer's responsibility that the samples delivered for initial type test are representative to the production and deviations from perfection were included in the delivered test samples.

- End of report -