RAIL

TESTING AND ANALYSIS
OF PARTS AND MATERIALS
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SGS testing laboratories approve and determine all the mechanical properties of dry films of paint and varnish intended for railway applications. They draw on their skills in approving organic coatings, technical specifications (TS) and the French standards established by the SNCF and RATP amongst others, such as the standard NF F19-201 Railway rolling stock – Paintwork, markings and inscriptions – General requirements and testing methods.

**BEHAVIOUR WHEN CROSS-CUT (F330)**

The ISO2409 testing method evaluates the resistance of a coating of paint to being separated from its substrate after being cut with a cross-cut tester.

**PERSOZ HARDNESS (F370)**

The Persoz pendulum damping test as per the ISO1522 (NFT30-016) testing method specifies the use of a pendulum resting on a coated surface and set into oscillation.

The time it takes for the amplitude of the oscillation to decrease is measured. The shorter the damping time, the softer the coating.

**RESISTANCE TO ABRASION (F380)**

The NFT30-015 testing method, replaced by the ISO7784 method, provides a means of determining the resistance of a dry film of paint to the abrasion of a wheel covered in abrasive paper. The grade of abrasive paper and load applied to the test specimen determine the expected quality requirement level.

**PENCIL HARDNESS (F344)**

In the EN13523-4 method, the paint is intentionally scratched using pencils of increasing hardness. The hardest lead that does not remove paint over a length of at least 3 mm determines the degree of hardness.

**RESISTANCE TO CHIPPING DAMAGE (F360)**

The purpose of this method is to evaluate the protection's resistance to repeated shocks by standard nuts dropped from a height of 5 metres onto a painted test specimen tilted at 45°.

**RESISTANCE TO ALTERNATING IMMERSIONS / EMERSIONS (F407)**

The ISO15710 method describes a test operating procedure to evaluate the resistance of coatings when a coated panel undergoes a test of alternating immersions and emersions in a diluted saline solution.
BUCHHOLZ HARDNESS (F371)

Buchholz hardness tester

The ISO2815 method describes indentation on a coating of paint, varnish or related product using a Buchholz indenter. The length of the indentation obtained gives an indication of the residual deformation of the coating.

RESISTANCE TO CORROSION AND ENVIRONMENTAL AGEING (F400 TO F404, F408, F415)

Corrosion laboratory

Corrosion resistance tests, as per the ISO9227 testing method, whether under NSS (Neutral Salt Spray) or ASS (Acetic Salt Spray) conditions, are conducted by the SGS corrosion laboratory. Other types of ageing, such as resistance to humidity as per the testing method ISO6270 (NFT30-077) or resistance to ageing by poultice, provide a means of qualifying the resistance of coatings of paint and varnish in extreme weather conditions.

RESISTANCE TO DEFORMATION BY INDENTATION AND TO SHOCKS BY A FALLING WEIGHT (F343/350)

Tubular impact tester

The ISO1520 (NFT30-019) testing method determines the resistance of a dry film of paint to cracking using gradual deformation by indentation. The ISO6272 method analyses the same properties, but caused by a falling weight dropped under standard conditions.

RESISTANCE TO DEFORMATION BY BENDING ON CYLINDRICAL AND CONICAL MANDRELS (F340/341/342)

Cylindrical & conical mandrels

The ISO1519 (NFT30-040) testing methods describe resistance to deformation by bending on a cylindrical mandrel and ISO6860 (NFT30-078) on a conical mandrel, to evaluate the resistance of a coat of paint or varnish on a metal substrate to cracking and peeling when subjected to bending around a mandrel. These are usually supplemented by ISO1520 and ISO6272.

TENSILE STRENGTH (F331)

Block glued to a film of dry paint

Unlike the ISO2409 method, the ISO4624 method is specified for measuring the adhesion force of a painted or varnished coating by exerting a pulling force perpendicular to the substrate.

RESISTANCE TO CHEMICALS AND LIQUIDS (F405/406)

The ISO2812-1 testing method determines the resistance of paints and varnishes to different liquids such as fuel, motor oils, brake fluid, ethanol, sulphuric acid solution, hydrochloric acid solution and sodium hydroxide solution.

RESISTANCE TO ARTIFICIAL UV AGEING (F420/421/422)

QUV test chamber

All artificial UV ageing methods, as per ISO11507 (T30-036), ISO4892-2 (T51-to 56) or T30-049, approve the colour fastness and hold of coatings on their substrates, simulating artificial solar radiation and weather conditions.
INTERNATIONAL RUBBER HARDNESS DEGREES

International rubber hardness degrees (IRHD) as per NF T46-003 (ISO48) describe one of the basic properties of rubber and elastomers. They are defined by the degree of penetration of a ball into the material as measured by a durometer.

RESISTANCE TO ABRASION

The testing methods NF T46-012 (ISO4649) – Vulcanised or thermoplastic rubber – Determining resistance to abrasion using a rotating drum system involves determining the loss of volume from a test specimen of rubber subjected to an abrasive action by friction on a specific quality of abrasive cloth. Method A uses a fixed test specimen and Method B uses a rotating test specimen.

RESISTANCE TO OZONE

The French standard NF T46-019, replaced by an international version ISO1431-1, describes the action of an ozone concentration given in ppcm, at a temperature of 40°C on rubber-based products. This type of ageing promotes the appearance of defects and highlights the phenomenon of cracking in the material.
TENSILE STRENGTH AND TEAR RESISTANCE

The mechanical testing laboratory approves all the mechanical properties of rubber under tensile loading as per NF T46-002 (ISO37), and when subjected to tearing as per NF T46-007, before and after various types of ageing such as described in the standard NF T46-004 (ISO188).

RESISTANCE TO CLEANING PRODUCTS AND OXALIC ACID

The purpose is to determine and evaluate degradation and staining after application of certain fluids that could potentially come into contact with the flooring. The final ratings are provided according to the standards ISO105-A02 and ISO105-A03.

COLOUR FASTNESS UNDER ARTIFICIAL LIGHT

The UV light ageing laboratory comprises over 30 ageing test chambers. Rating of deterioration changes compared to the grey scale as per ISO105A-02 and ISO105-A03.

Measurement of gloss or specular gloss as per NFT30-064 (ISO2813)

The standard NF T51-056, replaced by the standard ISO4892-2 Plastics – Methods of exposure to laboratory light sources – Xenon arc lamps, describes how to reproduce the weathering effects that occur when materials are exposed to daylight or daylight filtered through window glass, in actual end-use environments.
SGS’s testing laboratories approve the material and mechanical properties and appearance retention of thermosetting plastics intended for railway applications. These tests are conducted in accordance with the French and international normative documents established by the main stakeholders in the sector. The programme of tests is primarily based on the standard NF F01-281. Railway rolling stock – Fibre-reinforced thermosetting plastics

This standard classifies plastic parts according to their use, positioning and exposure to users and environmental conditions. Depending on the type of part, a number of required parameters must be analysed through laboratory tests.

COATING ADHESION

Cross-cut tester

Cross-cut adhesion test as per ISO 2409

This test, conducted according to the testing method ISO2409 Paints and varnishes – Cross-cut test (NFT30-038), involves plastic parts covered in paint (pad printed). Cross-cutting is performed using a standard tester whose cuts are spaced 1 mm apart.

DSC – GLASS TRANSITION TEMPERATURE

Thermal analyses

Glass transition temperature is one of the main material properties of plastics measured by differential scanning calorimetry testing (DSC) as per the testing method: NFT51-223 or ISO11357-2. Differential scanning calorimetry (DSC) – Determination of glass transition temperature
SALT SPRAY

Metallic materials used for reinforcement components must undergo a neutral or acetic acid salt spray test as per the standard ISO9227 over a period of 400 to 1,200 hours.

BARCOL HARDNESS

The purpose of the NF T57-106 method is to determine hardness by penetration of textile-glass-reinforced plastics using a Barcol durometer.

RESISTANCE TO ABRASION

The standard NF T30-016 described in specification NF F31-812 has been cancelled and replaced by the standard ISO 9352 – Determination of resistance to wear by abrasive wheels. Depending on the material type and its application, the load applied during the test, the number of cycles and the grain of the wheel, may be variable parameters.

RESISTANCE TO BENDING

The testing method ISO14125 Determination of bending properties (NF T57-105) describes the mechanical bending properties of fibre-reinforced plastic composites using three-point or four-point loading methods.

RESISTANCE TO SCRATCHING

The purpose of the testing method NF T51-113 Determination of resistance to scratching is to define the load under which a standard-shaped diamond tip causes a scratch on a test specimen in plastic representative of the part to be approved.

RESISTANCE TO WEATHER

Resistance to weather of plastic parts intended for outdoor use is approved according to the standard NFT30-049 Artificial ageing test by the artificial UV (ultraviolet) ageing laboratory, simulating four consecutive phases of rain, cold, damp heat and UV.

COLOUR FASTNESS UNDER LIGHT

The UV light ageing laboratory comprises over 30 ageing test chambers.

Rating in D65 light box

Rating of deterioration changes compared to the grey scale as per ISO105A-02 and ISO105-A03.
TESTS ON TEXTILES
(SNCF ST-051)

SGS’s testing laboratories conduct a wide range of tests focusing on appearance retention and determination of the mechanical properties of threads, fabrics, non-wovens and rubber- and plastic-coated textiles. These tests are conducted according to the recommendations of rail industry suppliers and from the technical specifications (ST051) established by the SNCF.

DETERMINATION OF THE THICKNESS OF TEXTILES

Digital micrometer

The ISO5084 method describes the procedure to follow to determine the thickness of textiles and textile products at a specific pressure.

For determining the thickness of flooring, non-wovens or geotextiles, other standards are applicable.

RESISTANCE TO WEAR – MIE ABRASION

Four-station MIE abrasion tester

Schematic diagram

The purpose of resistance to wear is to simulate the regular contact of the seat’s textile with passenger clothing. The textile to be tested is stretched and secure throughout the test, and a pressure pad wrapped in a standard wear fabric generates the abrasive friction.

COLOUR FASTNESS WITH UV AGEING

Xenotest 150S: Resistance to artificial light (ISO105-B02 and ISO105-B04)

The standard ISO105-B02 describes a method to determine the colour fastness of textiles under the effect of an artificial light, representative of natural daylight (D65).

ISO105-A02 describes the grey scale rating used to evaluate deteriorations in the colouring of textiles caused by resistance tests.
COLOUR FASTNESS WITH FLUIDS

The testing methods ISO105-E01, ISO105-E04 and ISO105-E07 provide a means of qualifying the colour fastness of textiles under the effect of water and perspiration (acid or alkaline).

COLOUR FASTNESS WITH FRICTION

The methods ISO105-X12 and ISO105-D02 describe the resistance to rubbing and crocking of colours when they come in contact with other materials. It applies to textiles of any kind, including floor coverings and other velvet-like fabrics.

MECHANICAL RESISTANCE (TENSILE STRENGTH, TEARING)

The mechanical testing laboratory characterises the main properties of woven fabrics, stretch fabrics geotextiles and threads, such as the properties of tensile strength of fabrics and stitching, the properties of resistance to tearing ISO4674-2 and seam slippage.

The ISO13934-1 method determines maximum force and elongation at maximum force of textile fabrics using the strip test.

SGS also conducts fatigue tests on fabrics up to 30 Hz, which can be simultaneously combined with environmental ageing tests.
TESTS ON ELECTRICAL AND ELECTRONIC EQUIPMENT
(NF F67-155/EN50155)

SGS conducts environmental testing on electrical, electronic and electrotechnical components and equipment on the basis of national and international standards – NF, EN, ISO and CEI – described by the CENELEC (European Committee for Electrotechnical Standardisation).

The equipment tested may be subjected to mechanical and/or electrical analyses, before and after ageing, as recommended by the particular specifications of the equipment, especially in accordance with NF F67-155 or NF EN50155, and the standards EN60721- xx-x.

LOW AIR PRESSURE

Vacuum chamber (-50°C/+140°C)

Dielectric strength tester – Megohmmeter – Measuring insulation resistance

The purpose of this test is to determine the ability of components or materials to be stored and used under low air pressure conditions similar to those that may be encountered at high altitude.

- NF-EN-CEI60068-2-13: Test M: Low air pressure
- NF-EN-CEI60068-2-40: Test Z/AM: Combined cold/low air pressure test

GAS CORROSION

Four gas corrosion test chambers

The standard NF-EN-CEI60068-2-60: Test Ke: Flowing mixed gas corrosion test establishes the corrosive influence of the environment on electrical and electrotechnical components, on equipment and materials in operation or storage.

Four mixtures of gas are used according to the applied method, mixed in variable but generally quite weak concentrations (H2S, SO2, Cl2 and NO2).

These ageing tests are generally combined with measurements of insulation resistance and contact resistance as per the standard NF-EN-CEI60068-2-60:
- NF-EN-CEI60068-2-42: Test Kc: Sulphur dioxide test for contacts and connections (SO2)
- NF-EN-CEI60068-2-43: Test Kd: Hydrogen sulphide test for contacts and connections (H2S)

A few gas corrosion ageing standards complement the standard NF-EN-CEI60068-2-60:
- NF-EN-CEI60068-2-42: Test Kc: Sulphur dioxide test for contacts and connections (SO2)
- NF-EN-CEI60068-2-43: Test Kd: Hydrogen sulphide test for contacts and connections (H2S)
SALT CORROSION

+ 20 salt spray test chambers in the Corrosion laboratory

Salt spray test as per NF-EN-CEI60068-2-11: Test Ka: The purpose of neutral salt spray testing is to compare resistance to deterioration due to salt spray on specimens from similar constructions. It provides a means of evaluating the quality and uniformity of protective coatings in particular.

Test specified in the standard NF-EN-CEI60068-2-52: Test Kb: Salt spray cyclic test combines salt spray (35°C / 5% NaCl) with phases of dry heat that can generate different corrosion phenomena from those observed in salt corrosion alone.

TIGHTNESS

Dust chambers (IP5X)

Rain spray chamber (IPX4)

Drip box (IPX2)

The standard EN-ISO60529 describes a classification system for the degrees of protection afforded by electrical equipment enclosures. The degrees are defined according to two main classifications and are encoded with two letters, IP, standing for ‘ingress protection’ and two numbers, the first describing the level of protection against the ingress of solid foreign objects, the second against the harmful effects caused by water ingress.

SGS is able to conduct the full range of ingress protection tests in these laboratories as per the method CEI-EN-ISO60529, as well as for its equivalent as per the standard DIN40050-9. These ingress tests can also be conducted according to the standard NF-EN-CEI60068-2-18: Test R and guide: water for electronic or electrotechnical products subjected to falling water, splashing or immersions.

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<th>DEGREES OF PROTECTION AGAINST THE EFFECTS OF WATER INGRESS</th>
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<td>IP0X No protection</td>
<td>IPX0 No protection</td>
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<tr>
<td>IP1X Protected against solid foreign objects greater than or equal to 50 mm in diameter</td>
<td>IPX1 Protected against drops of water falling vertically</td>
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<tr>
<td>IP2X Protected against solid foreign objects greater than or equal to 12.5 mm in diameter</td>
<td>IPX2 Protected against drops of water falling vertically with an enclosure tilted up to 15° from vertical</td>
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<td>IP3X Protected against solid foreign objects greater than or equal to 2.5 mm in diameter</td>
<td>IPX3 Protected against rain</td>
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<td>IP4X Protected against solid foreign objects greater than or equal to 1.90 mm in diameter</td>
<td>IPX4 Protected against splashing water</td>
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<td>IP5X Protected against dust</td>
<td>IPX5 Protected against water jets</td>
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<tr>
<td>IP6X Dust tight</td>
<td>IPX6 Protected against powerful water jets</td>
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<tr>
<td>IPX7 Protected against the effects of temporary immersion in water</td>
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<tr>
<td>IPX8 Protected against the effects of continuous immersion in water</td>
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<tr>
<td>IPX9K Protected against powerful water jets from several angles of projection</td>
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RESISTANCE TO FLUIDS

Resistance of electrical or electrotechnical equipment and its compatibility with fluids and chemicals it may regularly, occasionally or accidentally come into contact with.

- **NF-EN-CEI60068-2-45**: Test Xa: Immersion in cleaning solvents
- **NF-EN-CEI60068-2-74**: Test Xc: Fluid contamination

ENVIRONMENTAL AGEING

Over 100 environmental chambers ranging from 10 L to 30 m³

The fundamental environmental tests vary between a number of different methods and environmental conditions, depending on the environment to be simulated or the type of equipment to be tested (whether energy is dissipated or not for example):

- **NF-EN-CEI60068-2-1** – Test A: Cold
- **NF-EN-CEI60068-2-2** – Test B: Dry heat
- **NF-EN-CEI60068-2-78** – Test Cab: Damp heat, steady state test
- **NF-EN-CEI60068-2-14** – Test N: Change of temperature
- **NF-EN-CEI60068-2-30** – Test Db: Damp heat, cyclic test
- **NF-EN-CEI60068-2-38** – Test Z/AD: Composite temperature and humidity cyclic test
- **NF-EN-CEI60068-2-61** – Test Z/ABDM: Climatic sequences

VIBRATIONS, SHOCKS, BUMPS (NFF01-373/EN61373)

SGS’s vibration laboratory is equipped with seven vibrators coupled with vibrating tables to be able to test parts under operating conditions.

This can be coupled with an environmental ageing test conducted simultaneously to the vibration test.

- Signal types: sine, random, sine on noise
- Strength: from 10 to 35 kN
- Frequency range: 10 to 2,000 Hz

Example of standards:

- **NF-EN-CEI60068-2-6** – Test Fc: Vibration (random)
- **NF-EN-CEI60068-2-34** – Test Fd: Random broadband vibrations

General requirements

The half sine shock machine enables the test **NF-EN-CEI60068-2-27** to be conducted under certain weight and volume conditions: Test Ea: shocks testing products’ ability to withstand the stress resulting from the application of non-repetitive shocks.

- Acceleration: 10 G to 1,500 G

Bump test as per the standard **NF-EN-CEI60068-2-29** – Test Eb: Bumps is applicable to components, materials and other electronic or electrotechnical products that may be subjected to repeated shocks during their transport or use. These shocks have a standard pulse shape with specific peak acceleration and duration.
TESTS ON LAMINATE SHEETS WITH DECORATIVE SURFACE MADE FROM THERMOSETTING RESINS (NF F31-447)

This standard applies to the supply of ‘high-pressure’ laminate sheets with a decorative surface, made from fibrous materials impregnated with thermosetting resins, intended for use as trim or interior fittings in passenger vehicles. This standard is primarily based on the standard EN438-2 (formerly NF T54-301).

RESISTANCE TO ABRASION

Sample tested Taber abrasion tester

Resistance to abrasion conducted according to the standard EN438-2 enables the resistance of a laminate coating surface to be evaluated when subjected to wearing by an abrasive wheel over a number of specific cycles.

DIMENSIONAL STABILITY

Dimensional measurement with a slide caliper

The purpose of this test is to assess a laminate’s ability to maintain its dimensional properties in a warm, humid environment. The sample tested on a gauge at 40°C and 90% RH is measured on exit using a slide caliper.

BEHAVIOUR IN BOILING WATER

The effect of immersing a test specimen in boiling water for two hours is determined by the increase in weight and thickness, and by noting any changes in appearance.

The test is generally compliant with EN ISO 62, except in the case of a longer duration of immersion in boiling water and different thickness measurement requirements.
RESISTANCE TO STEAM

A test specimen taken from the laminate to be tested is held above the neck of a flask containing boiling water, in such a way that the decorative surface of the test specimen is exposed to the steam. After one hour, the test specimen is removed and left to rest for 24 hours under normal ambient conditions and is then examined to identify any changes in appearance.

RESISTANCE TO IMPACT

Resistance to impact as per the standard EN438-2 is conducted by dropping an object of a specific shape and weight. The impact must not leave an imprint in the surface.

COLOUR FASTNESS UNDER ARTIFICIAL LIGHT

Colour fastness under artificial light is conducted according to the standard NF T51-058. A sample of the material is exposed to ultraviolet radiation for a specific period of time under xenon arc lamps. On completion of the test, the aged sample is compared to a sample of the same material that was kept in the dark for the same length of time. The evaluation is done using a contrast scale known as the ‘grey scale’ in a light booth.

RESISTANCE TO SCRATCHING

Resistance to scratching is conducted according to the standard EN438-2. The purpose is to determine the load needed to be applied to a diamond tip to obtain a permanent scratch on the decorative surface.
TESTS ON MOULDED OR EXTRUDED PARTS MADE FROM COMPACT RUBBER (NF F00-071 AND NF F00-072)

These two standards describe the tests required to qualify the properties of compact rubber materials intended for railway applications used between -20 and 100°C.

These standards are not applicable to O-rings, elastic joints and elastic suspension parts.

**IRHD HARDNESS**

*Durometer*

The IRHD hardness testing as per the standard NF T46-003 has been replaced by the standard ISO48. This property is inherent to processed elastomer materials. It allows for a quick measurement of the rubber’s stiffness. This hardness is proportional to the indentation of a hemispherical punch under a given specific force. This test may be conducted on the original state or after environmental ageing.

**RESISTANCE TO BREAKAGE**

*Tensile testing machine*

The tensile test to breaking point as per the standard NF T46-002 has been replaced by the standard ISO37. Elongation and tensile strength are measured at room temperature, but depending on the categories also at 70 and 100°C.

**RESISTANCE TO COLD**

The cold resistance test as per the standard NF T46-018 has been replaced by the standard ISO812. This standard, conducted by one of SGS’s partner laboratories, describes a method to determine the minimal temperature at which rubber materials show no signs of fragility when subjected to an impact under specific conditions. This test is conducted at -25°C for normal resistance and at -40°C for high resistance.
RESISTANCE TO OZONE

The ozone resistance test as per the standard NF T46-019 has been replaced by the standard ISO 1431-1. This standard and its ageing test provide a means of determining the resistance of vulcanised or thermoplastic rubber to cracking, when exposed under static tensile strain of 20% to air containing a specific concentration of ozone at a specific temperature, under conditions that exclude the effects of direct light.

RESISTANCE TO THE EFFECT OF LIQUIDS

The resistance to the effect of liquids test as per the standard NF T46-013 has been replaced by the standard ISO1817. The purpose of this test is to assess the behaviour of rubber immersed in a fluid at a specific temperature. Any variations in hardness or volume are measured after immersion. The duration of immersion is generally 70 hours. The fluids are generally oils, diesel, glycol-water solution, etc.

STAINING

The resistance to staining test as per the standard NF T46-031 has been replaced by the standard ISO 3865. This standard is a testing method to determine the degree to which rubber is stained when it comes in contact with organic matter. Various types of staining are achievable (contact and migration, extraction and penetration staining). Depending on the method used, the stain can be revealed or aged, either in an environmental test chamber or Xenotest UV chamber. On completion of the test, the stain is then given a rating using a grey scale as per the standard ISO105-A02.

RESISTANCE TO COMPRESSION

The compression resistance test as per the standard NF T46-011 has been replaced by the standard ISO815-1. This standard specifies the methods for determining persistent deformation properties of vulcanised and thermoplastic rubber after compression at ambient or elevated temperatures. Depending on the category, these temperatures can range from 70°C to 150°C. Materials are compressed at a constant strain of 25% for 24 hours.
TESTS ON FRONT WINDSCREENS FOR TRAIN CABS
(EN15152)

SGS laboratories test train windows wholly or partially, as per the standard EN15152 in particular. The integrity, environmental behaviour and functional performances of the glass are assessed according to the standards described. The standard NF F31-129 on toughened safety glass supplements this type of test on glass products for railway applications, including through impact tests with hard and soft objects.

RESISTANCE TO ABRASION

The resistance to abrasion for glass is conducted according to the standard ISO3537, which is specific to safety glass and describes a more comprehensive list of mechanical tests. External surfaces are abraded over 1,000 cycles and internal surfaces over 100 cycles.

HUMIDITY TEST

The purpose of this test is to determine to what extent laminated front windscreens withstand the effects of prolonged exposure to conditions of 55°C and 95% constant relative humidity over 240 hours, without significant deterioration.

WEATHERING TESTS (QUV)

For accelerated weathering tests, exposed materials are compared to non-exposed samples, and their deterioration is observed over eight-hour cycles under UV-A lamps, then four hours of condensation at 50°C and 100% RH. These cycles are repeated over 500 hours.

HEATING TEST

This test involves supplying power to the front windscreen’s heating systems at its nominal voltage for 1,000 hours at room temperature. The test is preferably conducted on the whole windscreen, and once complete, the product should have maintained its main functional properties, including defrosting time.

THERMAL CYCLING

Two samples measuring 500 x 500 mm are subjected to cyclical environmental exposures, alternating between a hot temperature of 80°C and 80% relative humidity and a cold temperature of -40°C. This ageing process lasts 240 hours. After 10 days of ageing, no significant changes such as bubbling, delamination or bleaching should be observed.
ELECTRICAL CONNECTORS
(NF F61-030)

The standard NF F61-030 defines the minimum design and analysis characteristics of electrical connectors intended for use in railway rolling stock. It is applicable to the types of cylindrical and rectangular connectors used for circuitry subjected to rated operating voltages of less than or equal to 500V for direct current and 380V for alternating current. This standard is partly based on the standard NF C93-400.

RESISTANCE OF MARKINGS
Connector markings
The permanence of the markings, connectors and their insulators is assessed by attempting to erase the inscription. Ten movements need to be performed while applying a force of 5 N on a surface area of approximately 1 cm² at a rate of two movements per second. This should be done using cotton wool soaked in demineralised water.

WITHSTAND VOLTAGE TEST
Dielectric strength tester
This test assesses the ability of a component to withstand specific test voltages.

A direct or alternating test voltage as indicated in the product specification is applied for 60 seconds. The voltage application speed must not exceed 500/s. There should be no breakdown or arcing event, and the leakage current should not exceed the value indicated in the special specifications.

CORROSION
Corrosion laboratory (overview)
The neutral salt spray corrosion test is conducted according to the 11f test specifications of the standard NF C93-400 and as per the operating procedure of the standard EN60068-2-11. After 96 hours of exposure to salt spray, appearance, markings and insulation resistance are assessed.
**INSULATION RESISTANCE TEST**

*Megohmmeter*

Insulation resistance is conducted according to Test 3a, Method A and B of the standard NF C93-400. Insulation resistance is measured at a voltage of 100 or 500V depending on the rated operating voltage. The resistance value should be greater than the value specified in Table 5 of the standard NF F61-030, in line with the rated operating voltage.

**DAMP HEAT CYCLIC TEST**

*Environmental test chamber*

This test is conducted according to Test 11c from the standard NF C93-400 with special procedures. The operating procedure is the one described in the standard NF C20-703. The purpose of this test is to determine the suitability of connectors.

**FLUID RESISTANCE TEST**

Mounted, wired and uncoupled connectors are fully immersed in diesel fuel or a mineral oil at 50°C for 5 minutes. They are then coupled for at least 24 hours at room temperature. The cycle is repeated three times. On completion of the test, and without being cleaned or dried, the overall appearance and markings are assessed. After 4 hours of stoving at 70°C, the withstand voltage and insulation resistance of the uncoupled assembly are also assessed. A similar test but at room temperature is conducted in an acid bath (hydrochloric acid solution) or an alkaline bath (sodium hydroxide solution).

**RESISTANCE TO VIBRATIONS**

*Test chamber for rapid temperature changes on shaker*

Test 6d described in the standard NF C93-400 assesses the ability of a connector to withstand vibrations of a specific severity. The vibrations are performed along each of the three perpendicular axes.

**COUPLING / UNCOUPLING FORCE**

*Coupled connector*

This test is conducted in accordance with Test 13a or 13b (insertion/removal) from the standard NF C93-400. One of the two connectors is secured in the fixed jaw of a tensile tester, the second in the movable jaw. The speed of the cross head must not exceed 5 mm/s. A tool tailored to the specific connection system may be produced to simulate a dual action in the case of models with locking systems other than screw coupling).
The standard NE45545-2 was developed based on existing regulations on fire safety for rail vehicles.

Depending on the final use of the product to be tested, various testing methods are applicable, whether it involves an interior wall, a light diffuser, a tray table, an air filter, a joint, seats or seat components, cables for the interior or exterior, for example.

The following is a non-exhaustive list of the testing methods used:

- **ISO5658-2**: Reaction to fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration
- **ISO5660-1**: Reaction to fire tests – Caloric value, smoke production rate and mass loss rate – Part 1: caloric value (Cone calorimeter method)
- **ISO5659-2**: Plastics – Smoke production – Part 2: Determination of optical density via a test in a single chamber – Caloric value, smoke production rate and mass loss rate
- **ISO9239-1**: Reaction to fire tests for flooring – Part 1: determination of the burning behaviour using a radiant heat source
- **ISO11925-2**: Reaction to fire tests: Ignitability of building products subjected to direct impingement of flame
- **NF X70-100-1**: Fire behaviour tests Analysis of gaseous effluents Part 1: Methods for analysing gases stemming from thermal degradation
- **NF X70-100-2**: Fire behaviour tests – Analysis of gaseous effluents – Part 2: Tubular furnace thermal degradation method

SGS has all the necessary equipment, and SGS Anji is approved by the organisation CERTIFER to conduct these tests.

**ANTI-GRAFFITI PROTECTION**
*(NF F31-112 & SNCF STM-N-812)*

The purpose of this test is to classify materials (excluding textiles) in terms of their resistance to graffiti. Two tests are described in this standard: the aggressiveness test and the effectiveness test.

Several types of graffiti may be used. These products are listed by SNCF (i.e. ink, paint and permanent marker).

Several removal products are also available depending on the use of the graffitied material. The sample of the test material is marked then cleaned several times. The test material is given a classification according to the aggressiveness of the removal product required to remove the graffito.