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New Protective Eyewear

Suite of Standards:
EN ISO 16321 Parts 1,2,3

White paper

Contents

Introduction

The main standard for eye protection in Europe, EN 166:2001, has been the norm for certification for over 20 years without any changes since its publication in 2001. This standard is still harmonised (EU) until November 2024 and designated (UK) with PPE Regulation legislation, thus it is still widely used for CE/UKCA marking of eyewear protection. The new EN ISO 16321 standard series are now harmonised and we expect it to be designated with the PPE Regulation (EU)2016/425 in due course, allowing the process of certification in Europe and in the United Kingdom.

A number of new Protective Eyewear standards have been published, including EN ISO 16321-1:2022, EN ISO 16321-2:2021 and EN ISO 16321-3:2022. The aim of the publications is to have a common international standard that would replace national or regional standards or specifications.

The new suite of standards EN ISO 16321:2022 Parts 1 to 3 replace BS EN 172:1995, BS EN 169:2002, BS EN 170:2002, BS EN 171:2002, BS EN 166:2002, BS EN 379:2003+A1:2009, which have been withdrawn.

There are significant differences between the old EN 166 requirements and test methods and those outlined in the new EN ISO 16321 series of standards. All eyewear manufacturers will need to familiarise themselves with these changes, so that their products can be designed and manufactured to meet the new criteria.

First and foremost, the scope of the standard has changed compared to what was covered by EN 166:2001. The EN ISO 16321 series apply only to plano and prescription glasses for occupational use or use in educational establishments. The standard now excludes face protectors intended for live-working to protect against short-circuit electric arcs, laser protectors, sports eyewear, protectors for use during medical applications, protectors for medically prescribed applications; protectors specifically intended for protection against solar radiation only or protectors intended to protect against ionizing radiation. There are separate standards to cover these specific use devices.

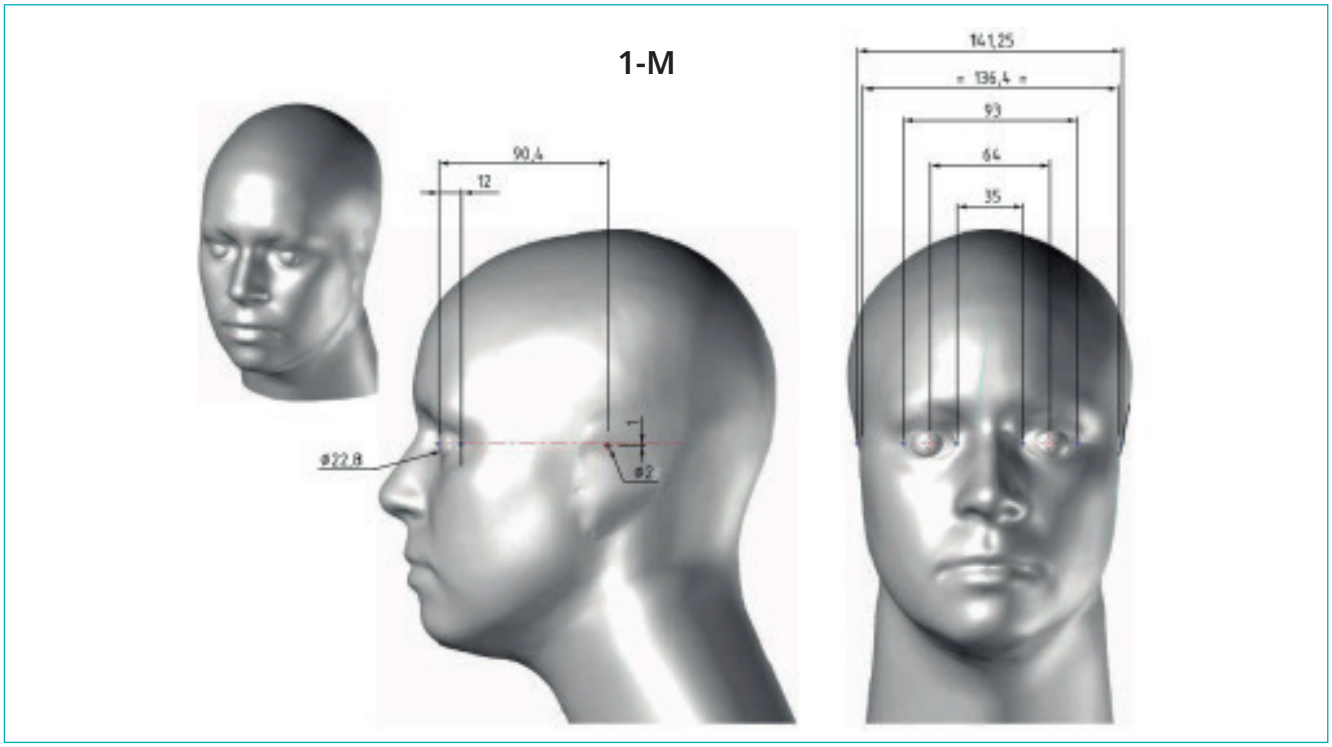
What is new in EN ISO 16321-1:2022 Eye and face protection for occupation use – Part 1 General requirements

Headforms

A new range of EN ISO 18526-4:2020 headforms have been introduced to the EN ISO 16321 series of eyewear standards. The change to new headforms has the biggest impact on the standard, as it affects every measurement, test and clause. There are six different size headforms available for testing, with 1-M being the default size. These six headforms represent approximately 95% of the world's population, following a great deal of intensive international research work precursing the development of the new headforms. The headform which is selected and used for testing under the new standard, will then be specified in the products' User Instructions providing end users with information and to allow a good fit. In comparison, the EN 166:2001 specified two headform sizes: 'medium' and 'small'; the majority of testing was performed on the medium size headform. The new standard's designated headform sizes are:

Small	Medium	Large
1-S	1-M	1-L
2-S	2-M	2-L

Example of EN ISO 18526-4:2020 Headform 1-M:



Optical requirements

Field of View

Field of view is the measurement of the required unobstructed vision in front of each eye. The test is one of the mandatory clauses, applicable to all eyewear. This is because any reduced distance vision, restricted field of view or peripheral blur would indicate the potential for safety issues with the product.

The new measurement of field of view uses the Stoll Apertometer method for assessment. This allows measurements to be taken from many more points of reference to ensure there is no restriction to the natural field of vision for the wearer. This method of assessing the field of view is commonly used as a reliable assessment method in other international standards, i.e. respiratory protective devices. The previous test method used for EN 166:2001 was ellipses placed in front of the eye on the headform, however the testing was very subjective as Test Engineers were judging pass/fail criteria by eye.

The field of view requirement also includes new specific criteria if the eye protectors are to be used for driving.

Luminous Transmittance

The luminous transmittance requirement for lenses without deliberate filter action in the new EN ISO 16321-1:2022 is for lense to allow above 80% transmitted light. For face shields with a lens thickness of more than 2 mm and for multiple glazed eye protectors, the luminous transmittance shall be not less than 75%. This is a change from the EN 166:2001 where the requirement for luminous transmittance was the same for all lenses and greater than 74.4 %.

Scattered Light

The requirement for all eye protectors is that they should be free of diffusely transmitted light as far as reasonably practicable. Many different lens materials used in safety eyewear may contain inhomogeneities, therefore the test requirement for scattered light is setting a minimum standard to ensure quality of vision. Previously in EN 166:2001 this feature was covered by measuring small-angle scatter, which is light diffusion. The new standard specifies a different measurement method which is a wide-angle scatter (haze). The requirement applies to all eye protections, except for welding filters, which are still tested using the small-angle scatter, as the haze method is unsuitable for dark filters.

There is not much correlation between the two methods, hence test results from EN 166:2001 cannot be considered valid for meeting the new standard requirement.

Physical requirements

Headbands and harnesses

The new requirement is only applicable to eye protectors that incorporate a headband or a harness.

The old standard requirement for a 10 mm wide headband has been replaced in the new standard by a 'sit and fit test', in other words a practical performance test. The fit test is intended to demonstrate that the protector, when using a headband or harness fits comfortably and securely through a number of physical movements including turning head left and right, tilting head back and forward and jumping on the spot

Basic impact

There is a requirement for all eye protectors to achieve at least the basic level of protection from impact. The impact requirements were detailed in the old EN 166:2001 standard as increased robustness, whereas the new ISO 163321-1 equivalent is the 'basic impact' test. The table below shows that there are significant differences in the steel ball characteristics in EN ISO 16321-1 compared to EN 166:2001.

EN 166:2001 Steel Ball Measurements	EN ISO 16321-1 Steel Ball Measurements
22 mm diameter	25 mm diameter
43 grams	66 grams

High-speed impact

A high speed impact resistance test is an optional requirement applicable to all protective eyewear. In EN 166:2001, test requirements were defined by the type of eye-protector – Spectacles, Goggles or Face shields, with Low (F), Medium (B) and High (A) energy impacts. In the new standards there has been a change to the velocity speeds and the introduction of three new impact levels namely C, D and E, see the below table for details.

In the new standard there is an additional requirement for minimum coverage areas called protection zones: OPZ, EOZ and FPZ; the higher the impact speed, the larger the area of coverage required.

Velocity of the ball	$(45^{+1,5}\%)$m/s	$(80^{+2,}\%)$m/s	$(120^{+3,}\%)$m/s
Impact level	C	D	E
Minimum area to be protected	Orbital protection zone (OPZ)	Extended orbital protection zone (EOZ)	Face protection zone (FPZ)

High Mass Impact

The high mass impact is an optional test for those eyewear devices that offer protection against high mass objects moving at a moderate speed. The requirement was taken from an American standard ANSI Z87.1, but as far as European standards are concerned this is a new requirement. The high mass impact test is conducted with two impact points, frontal left and frontal right, with a pointed steel projectile weighing 500g.

Resistance to Thermal Exposure

The resistance to thermal exposure is not a new test requirement, but it is an equivalent to the 'Stability at elevated temperature' test, as referenced in the EN 166:2001 standard. This requirement is for all eye protectors to withstand deformation of any part when being exposed to high temperature in the environment of their use. The main change is the duration of thermal exposure, which at 120 minutes is double that of the old standard.

Penetration of Vents and Gaps

The penetration test introduced within the EN ISO 16321-1:2022 is a brand-new test requirement, which applies to eye protectors that have ventilation or gaps between their components. The opening is tested with a rigid rod to ensure the opening is no larger than 1.5mm in diameter.

Optional Requirements

It is important to note that there are a number of new optional requirements within the EN ISO 16321-1:2022 standard, some of which were not included in the old standard EN166:2001. Optional requirements get assessed only if they are applicable to the type of protector or the special protection characteristics are claimed by the manufacturer.

Optional requirements include:

- resistance against fogging
- resistance to surface damage by fine particles
- protection against gases and fine dust particles
- protection against large dust particles
- protection against molten metals and hot solids
- high mass impact **NEW**
- protection against radiant heat **NEW**
- protection against streams of liquids **NEW**
- lens assessment for anti-reflective coatings **NEW**
- use in explosive atmospheres **NEW**
- chemical resistance **NEW**

Product Marking

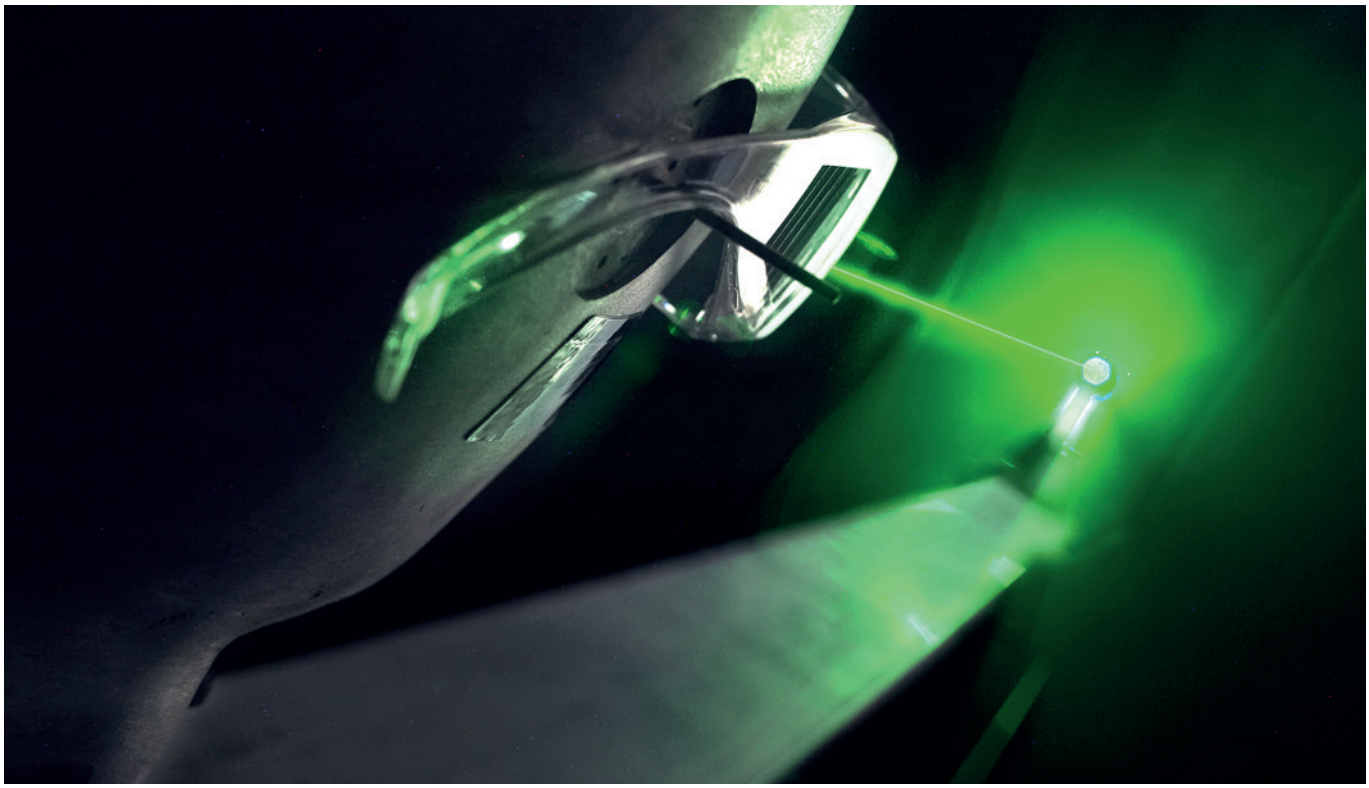
The below table presents and compares the new marking requirements as per EN ISO 16321-1:2022 and old EN 166:2001 standard.

Code letters EN ISO 16321-1:2022	Code letters EN 166:2001	Description
16321	EN 166	Basic use
1	1/2/3 -Optical class	Enhanced optical performance (marking optional)
3	3	Droplets
4	4	Large dust particles
5	5	Gas and fine dust particles
6	-	Streams of liquids
7	-	Radiant heat
9	9	Molten metals and hot solids
CH	-	Chemical resistance
K	K	Surface damage by fine particles
N	N	Resistance to fogging
-	S	EN 166 Increased robustness
C	F	Impact level C (45m/s)
D	-	Impact level D (80m/s)
E	B	Impact level E (120m/s)
-	A	EN 166 impact level A (190m/s)
HM	-	Impact level HM
CT	FT	Impact level C (45m/s) at extremes of temperature
DT	-	Impact level D (80m/s) at extremes of temperature
ET	BT	Impact level E (120m/s) at extremes of temperature
HMT	-	Impact level HM at extremes of temperature

EN ISO 16321-2:2021 – Eye and face protection for occupational use – Part 2 : Additional requirements for protectors used during welding and related techniques: In addition to EN ISO 16321-1:2022, this standard specifies material, design, performance and marking requirements for eye and face protectors designed to provide protection against occupational hazards, such as optical radiation, impacts from flying particles and fragments, and hot solids during welding and related techniques.

EN ISO 16321-3:2022 – Eye and face protection for occupational use – Part 3 Additional requirements for mesh protectors: This standard shall be used in conjunction with EN ISO 16321-1:2022 to outline the requirements for mesh protectors designed to provide protection for the eyes and faces of persons against mechanical hazards such as impacts from flying particles and fragments. It should be noted that one of the main differences of the new standard when compared to the old EN 1731:2006 standard, is the aperture count in mesh protectors.

ISO/DIS 16321-4 – Eye and face protection for occupational use: Part 4 of the new suite of standards is still in development and has not been published yet. This part will cover the additional requirements for protection against biological hazards.



Testing and Certification at BSI

BSI is currently working on ensuring our eyewear laboratory will be capable of carrying out the testing to the new requirements introduced by this fresh suite of standards. We are working towards being able to provide this service. Please contact BSI to register your interest for the testing, as we expect high demand for this service in future.

We, at BSI are actively helping our clients in getting CE and/or UKCA marked eyewear products tested and certified to the latest standards, and we work closely with manufacturers to ensure their products meet the latest Regulations to gain market access. In order to mark products in accordance with the new standard, a full testing covering the mandatory clauses as well as relevant optional requirements, would be necessary. BSI will work with each manufacturer to establish claims and work out a bespoke test program covering the full range of products, with the aim of transitioning certification according to the EN ISO 16321 set of standards. Any organisation placing Protective Eyewear onto the market in the EU or UK has a legal requirement to meet the PPE Regulation (EU) 2016/425 and/or Regulation 2016/425 on personal protective equipment, as amended to apply in GB. BSI can offer this in the form of Notified Body/Approved Body services to Module B under the PPE Regulation and Module C2 or Module D if the product falls into category III PPE.

To offer differentiation for the product in the market, the BSI Kitemark offers third party certification and can also be used to meet the requirements of Module B, C2 or D of the PPE Regulation simultaneously.

Support from BSI:

Still got questions? We have the expertise! Contact us to get started:
Kinga.Demetriou@bsigroup.com and Deborah.Savage@bsigroup.com

BSI Kitemark certification

BSI Kitemark certification is exclusive to BSI and cannot be awarded by any other UKAS-accredited certification body.

Our laboratories carry out safety and performance testing of a wide variety of health and safety PPE equipment and can help you achieve Kitemark certification.

Why apply for BSI Kitemark certification? A gold standard of safety, performance, and reliability, it can differentiate you from competition. It has far reach as a quality and safety symbol and is a recognized equivalent to many global counterparts.

About BSI

By Royal Charter

BSI has been developing world-leading standards for over 100 years and continues to break new ground. Our blend of heritage and newness makes us unique – we are the only organization that can offer such a powerful combination of innovation and international reach.

We work closely with leading manufacturers to ensure their products meet the latest regulations to gain market access. We focus to delivering a testing and certification partnership underpinned by quality, safety, reliability, and accuracy aligned to your product development requirements. That's why we're best placed to help you understand standards and to meet the requirements.

At BSI we share knowledge, innovation, and best practice to help people and organizations realize their potential. We are client-centric, agile, and collaborative.

BSI: Inspiring trust for a more resilient world.

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