SLOVENSKI STANDARD
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Varovanje sluha - Varnostne zahteve in preskuġanje - 3. del: Nauġniki za pritrditev na industrijsko varnostno ļelado

Hearing protectors - Safety requirements and testing - Part 3: Ear-muffs attached to an industrial safety helmet

Gehörschützer - Sicherheitstechnische Anforderungen und Prüfungen - Teil 3: An Industrieschutzhelmen befestigte Kapselgehörschützer

Protecteurs individuels contre le bruit - Exigences de sécurité, essais - Partie 3: Serre-tete monté sur casque de protection pour l'industrie

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CEN

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FOREWORD

This European Standard has been prepared by Technical Committee CEN/TC 159 "Hearing protectors", the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

Part 1 of this standard deals with ear-muffs and Part 2 with ear plugs. An associated standard, EN 458, covers selection, use, care and maintenance of hearing protectors.

The particular requirement for hearing protectors in relation to their ability to reduce noise to below daily limit levels is addressed in the standard by means of a requirement for attenuation performance, tested to EN 24869 -1:1992, and by the setting of a minimum level of attenuation, enabling selection of suitable protectors for individual circumstances to be undertaken according to established practice.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU-Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

INTRODUCTION

This part of the standard is primarily concerned with ear-muffs when fitted as an accessory to an industrial safety helmet which complies with EN 397:1995, Industrial safety helmets, both before and after fitting (including any necessary modifications to the helmet).

The sizing requirements in the standard enable the great majority of the industrial population to be fitted satisfactorily by 'Medium size range' ear-muffs. Populations of other sizes can be accommodated by 'Small size range' or 'Large size range' ear-muffs, which are meant to be accompanied by information regarding the range of sizes which they are designed to fit.

The requirements and tests of the standard are concerned primarily with specifying mechanical characteristics. However, the standard also calls for the values of sound attenuation afforded by the ear-muffs, as measured in accordance with EN 24869 -1:1992, provided in order to assist purchasers in selecting the most appropriate type of ear-muffs for their needs, and minimum values of sound attenuation are specified. A maximum variability in insertion loss, measured objectively after a series of performance tests, is specified.

The objective method is defined in EN 24869-3:1993. It only facilitates the making of comparative measurements and insertion loss values obtained from its use will differ from the sound attenuation values measured using the procedures given in EN 24869 -1:1992. The latter, which require the ear-muffs to be tested whilst being worn by human test subjects, is regarded as providing the reference test method for the measurement of the acoustic performance of ear-muffs.

This part of the standard is a specification intended for type examination purposes, for which a number of specimen ear-muffs is tested.

1 SCOPE

This part of the standard specifies constructional, design and performance requirements, test methods, marking requirements and user information for ear-muffs when fitted to an industrial safety helmet. It calls for information to be made available concerning the sound attenuation characteristics of the ear-muffs measured in

accordance with EN 24869 -1:1992, and defines a minimum level of attenuation required for compliance with this specification.
Because one model of ear-muffs designed to be attached to an industrial safety helmet can be fitted to a number of helmet models and sizes, this part of the standard sets out a series of mechanical and acoustic tests intended to assess performance of the ear-muffs when fitted to the specified model(s) or sizes of helmet.

All tests are performed on the ear-muffs fitted to one of the specified models or sizes of helmet (the basic combination), and an abbreviated set of tests is performed on the same model of ear-muffs when fitted to the other specified models or sizes of helmet (the supplementary combinations).

An alternative protocol is specified which can be applied when a single model of ear-muffs is submitted for testing in combination with a model of safety helmet supplied in more than one size.

For type tests in accordance with this standard, the industrial safety helmets specified by the ear-muffs manufacturer comply with EN 397:1995. Information on the range of industrial safety helmet types tested with the ear-muffs, and for which the combination satisfied this standard, is supposed to be made available.

This part of the standard does not deal with the performance of electronic devices which can be incorporated within ear-muffs, or of amplitude sensitive ear-muffs.

2 NORMATIVE REFERENCES

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 352-1:1993	Hearing protectors - Safety requirements and testing - Part 1: Ear muffs
EN 397:1995	Industrial safety helmets
EN 960:1994	Headforms for use in the testing of protective helmets
EN 24869-1:1992	Acoustics - Hearing protectors - Subjective method for the measurement of sound attenuation (ISO 4869-1:1990)
EN 24869-3:1993	Acoustics - Hearing protectors - Part 3: Simplified method for the measurement of insertion loss of ear-muff type protectors for quality inspection purposes (ISO/TR 4869-3:1989)
ISO 4869-2:1994	Acoustics - Hearing protectors - Part 2: Estimation of effective A- weighted sound pressure levels when hearing protectors are worn

3 DEFINITIONS

For the purposes of this standard, the following definitions apply:

3.1 **acoustic test fixture (ATF):** A device that approximates certain dimensions of an average adult human head and is used for measuring the insertion loss of ear-muffs, as defined in EN 24869-3:1993.

3.2 **cup:** A hollow component which is mounted on the equivalent headband and to which a cushion and a liner are usually fitted.

3.3 **cup supporting arm:** An arm attached to the safety helmet shell and designed to enable the ear-muffs' cup to fit securely around the ear by exerting pressure through the cushion. It includes the means of attachment to the safety helmet shell.

3.4 **cushion:** A deformable component, usually containing a foam plastic or liquid filling, fitted to the rim of the cup to improve the comfort and fit of the ear-muffs on the head.

3.5 **ear-muff:** A hearing protector consisting of a cup to be pressed against each pinna or of a circumaural cup to be pressed against the head around the pinna. The cups can be pressed against the head with a special headband or neckband or by means of a device attached to a safety helmet or other equipment.

3.6 **equivalent headband:** That part of the ear-muffs/safety helmet combination which supports the cups. It comprises the safety helmet shell and the cup support arms, and is intended to be functionally equivalent to the headband, as defined in EN 352-1:1993.

3.7 **external vertical distance:** The vertical distance between the top of the test headform on which the safety helmet is mounted and the highest point on the outside surface of the safety helmet shell.

3.8 **test height**[1]**:** Vertical distance between an axis through the centres of the mounting holes for the pinna simulators in the test headform shown in figure 2 and the top of the headform.

3.9 **test width**[1]**:** Horizontal distance between the vertical axes through the centres of the mounting holes for the pinna simulators in the test headform shown in figure 2.

3.10 **wearing height:** The vertical distance from the lower edge of the headband of the safety helmet to the highest point of the test headform on which the helmet is mounted

NOTE: The headband of the safety helmet is defined in EN 397:1995 as "The part of the harness completely or partly surrounding the head above the eyes at approximately the largest horizontal circumference of the head".

3.11 **industrial safety helmet:** Headgear, hereinafter referred to as "safety helmet", intended primarily to protect the upper part of a wearer's head against injury from falling objects, and which complies with EN 397:1995.

3.12 **insertion loss:** The mean algebraic difference in decibels between the one-third octave band sound pressure level, measured by the microphone of the acoustic test fixture in a specified sound field under specified conditions, with the ear-muffs/safety helmet combination absent, and the sound pressure level with the ear-muffs/safety helmet combination on, with other conditions identical.

3.13 **liner:** Acoustically absorptive material contained within the ear-muffs cup which is intended to increase the attenuation of the ear-muffs at certain frequencies.

3.14 **parking position:** Position of the ear-muffs in which the cups are located above the level of the lower edge of the safety helmet shell, as specified by the ear-muffs manufacturer in accordance with 8.1(h) (see also 3.16)

3.15 **sound attenuation:** For a given test signal, the mean difference in decibels between the threshold of hearing, with and without the ear-muffs/safety helmet combination in place, for a panel of test subjects.

3.16 **stand-by position:** Position of the ear-muffs in which the cups are located below the level of the lower edge of the safety helmet shell and in which the cushions are held away from the side of the head or pinna (see also 3.14).

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[1] The dimensions given in table 2 correspond with the definitions given in 3.8 and 3.9.

3.17 **basic combination:** The ear-muffs/safety helmet combination which includes the first or only model or size of helmet to which a given model of ear-muffs is fitted, and which will undergo all the tests in the standard (see also 3.18).

3.18 **supplementary combination:** An ear-muffs/safety helmet combination which includes a model or size of helmet, other than the basic helmet, to which is fitted the same model of ear-muffs as for the basic combination, and which will undergo an abbreviated set of tests (see also 3.17).

4 SIZING

The requirements of 6.2 give rise to the classification of ear-muffs into three size ranges, 'Medium size range', 'Small size range' and 'Large size range'. Ear-muffs can be classified into more than one size range.

For any given ear-muffs, this classification will be dependent upon the safety helmet to which they are fitted.

'Medium size range' ear-muffs are so classified if their adjustability complies with 6.2.1, when assessed at the test dimensions specified in table 2.

'Small size range' ear-muffs are so classified if their adjustability complies with 6.2.2, when assessed at the test dimensions specified in table 2.

'Large size range' ear-muffs are so classified if their adjustability complies with 6.2.3, when assessed at the test dimensions specified in table 2.

'Small size range' and 'Large size range' ear-muffs shall be accompanied by the information specified in 8.1l).

5 MATERIALS AND CONSTRUCTION

5.1 **Materials**

5.1.1 Those parts of the ear-muffs that can come into contact with the skin shall be not known to be likely to cause skin irritation, allergic reaction or any other adverse effect on health.

5.1.2 Cushions shall be soft and pliable and shall comply with 5.1.1.

5.1.3 All materials shall be visibly unimpaired after cleaning by the method specified by the manufacturer.

5.2 **Construction**

5.2.1 All parts of the ear-muffs assembly that may be exposed during use and maintenance shall be radiused, finished smooth and be free from sharp edges as might reasonably be expected to cause injury.

5.2.2 Ear-muffs whose cushions and/or liners are intended, by the ear-muffs manufacturer, to be replaced by the wearer, shall not require the use of tools for this purpose.

6 REQUIREMENTS

6.1 **General**

6.1.1 The requirements specified in 6.2 - 6.12 shall be satisfied, as appropriate, by all designated specimens when tested in accordance with 7.

6.1.2 Specimens of ear-muffs shall be conditioned and tested as specified in 7.1.1 and 7.1.2. The scheme of testing shall be as specified in 7.1.3.

6.2 **Adjustability**

When tested in accordance with 7.2:

6.2.1 **'Medium size range' ear-muffs**

For each of the combinations of test dimensions shown by the letter 'M' in table 2, the range of adjustment of the cups/support arms and of the width between the cushions shall enable the ear-muffs/safety helmet combination to be fitted to the test headforms, in accordance with 7.2.3.5.

6.2.2 **'Small size range' ear-muffs**

For each of the combinations of test dimensions shown by the letter 'S' in table 2, the range of adjustment of the cups/support arms and of the width between the cushions shall enable the ear-muffs/safety helmet combination to be fitted to the test headform, in accordance with 7.2.3.5.

6.2.3 **'Large size range' ear-muffs**

For the combination of test dimensions shown by the letter 'L' in table 2, the range of adjustment of the cups/support arms and of the width between the cushions shall enable the ear-muffs/safety helmet combination to be fitted to the test headform, in accordance with 7.2.3.5.

NOTE: Ear-muffs can be classified into more than one size range.

6.3 **Cup rotation**

When tested in accordance with 7.3, the contact between the cushions and the plates of the fixture shall be continuous insofar as it provides an unbroken barrier between the inside and outside perimeter of the cushions.

NOTE: Discontinuity in contact between the cushions and the plates is acceptable in the region where the pinna simulator mounting area (46 mm x 10 mm) lies on the plates.

6.4 **Equivalent headband force**

6.4.1 When tested in accordance with 7.4, the equivalent headband force shall be not greater than 14 N. In the case of ear-muffs/safety helmet combinations incorporating means to adjust this force, it shall be possible to adjust the force to 14 N or less.

6.4.2 For each supplementary combination set, if either of the following conditions are **not** met, the supplementary combination set shall be additionally tested for sound attenuation in accordance with 7.15.2:

a) The mean value of equivalent headband force of the specimens of the supplementary combination set as reported in 7.4.4, shall be not less than 8N.

b) Equation (1) below shall be satisfied.

$$-L \leq T \leq L \qquad (1)$$

where, for each supplementary combination set, the values T and L are calculated in accordance with equations (2) and (3) below respectively:

$$T = \frac{F_{m;basic} - F_{m;supp}}{F_{m;basic}} \times 100, \text{ in percentage} \qquad (2)$$

where:

$F_{m;basic}$ is the mean value of equivalent headband force of the specimens of the basic set as reported in 7.4.4 in newtons, and

$F_{m;supp}$ is the mean value of equivalent headband force of the specimens of the supplementary set as reported in 7.4.4 in newtons.

NOTE: The value T (in percentage) becomes a tolerance, related to $F_{m;supp.}$

for $F_{m;basic} < 8$ N ; L = 10%

for $8\ N \leq F_{m;basic} \leq 11$ N ; $L = 10 + \frac{(F_{m;basic} - 8) \times 10}{3}$ % (3)

for $F_{m;basic} > 11$ N ; L = 20%

NOTE: The value L (in percentage) becomes a limit related to $F_{m;supp}$.

6.5 **Cushion pressure**

When tested in accordance with 7.5, the cushion pressure shall be not greater than 4500 Pa. In the case of ear- muffs/safety helmet combinations incorporating means to adjust the equivalent headband force, this requirement shall apply to the maximum force setting or 14 N, whichever is the lower.

6.6 **Resistance to damage when dropped**

Unless 6.7 is to be satisfied:
when tested in accordance with 7.6, the ear-muffs/safety helmet combination (except for replaceable cushions) shall not crack, neither shall any part of the ear-muffs become detached, such that correct re-assembly requires the use of either a tool or a replacement part.

6.7 **Resistance to low temperature (optional)**

When tested in accordance with 7.7, the ear-muffs/safety helmet combination (except for replaceable cushions) shall not crack, neither shall any part of the ear-muffs become detached, such that correct re-assembly requires the use of either a tool or a replacement part.

6.8 **Change in equivalent headband force (including optional water immersion - combination under stress)**

The mean equivalent headband force of the six specimens tested shall not change by more than ± 20% from the mean of those measured in accordance with 7.4, after the ear-muffs/safety helmet combinations have been subjected to the appropriate conditioning and tests specified in 7.1.3.6 to 7.1.3.13, neither shall the helmet shell, the cups or the cup supporting arms break or crack.

6.9 **Insertion loss**

The standard deviations for basic combination specimens 1 to 10 (20 cups), reported in accordance with 7.12.3.4, shall be not greater than 4,0 dB in four or more adjacent one-third octave bands, and not greater than 7,0 dB in any individual one-third octave band.

6.10 **Resistance to leakage**

In the case of liquid filled cushions, they shall not leak when the ear-muffs are tested in accordance with 7.13.

6.11 **Ignitability**

When tested in accordance with 7.14 no part of the ear-muffs or cup supporting arms shall ignite or continue to glow after the removal of the heated rod.

6.12 **Minimum attenuation**

When tested in accordance with 7.15 the values

$(M_f - s_f)$

of the ear-muffs/safety helmet combination shall be not less than those given in table 1.

M_f are the mean attenuation data and s_f the standard deviations according to EN 24869 -1:1992.

Table 1: **Attenuation requirement for ear-muffs/safety helmet combinations**

f in Hz	125	250	500	1000	2000	4000	8000
$(M_f - s_f)$ in dB	5	8	10	12	12	12	12

7 TESTING

7.1 **Specimens, Conditioning and Scheme of Testing**

7.1.1 **Specimens**

Ear-muffs and safety helmets shall be submitted for testing in the condition in which they are offered for sale.

For a given model of ear-muffs, 10 basic combination specimens (ear-muffs and safety helmets) shall be submitted and they shall be numbered 1 to 10 (basic).

If the same model of ear-muffs is to be tested with another model or size of safety helmet, 6 further supplementary combination specimens (ear-muffs and safety helmets) for each model or size of safety helmet shall be submitted. These shall be numbered (in sets) 1 to 6 (supplementary).

7.1.2 **Conditioning and testing atmosphere**

All specimens shall be conditioned and tested in an atmosphere having a temperature of (22 ±5) °C and a relative humidity of not more than 85%, unless required otherwise by the test procedure.

7.1.3 **Scheme of testing**

Except as specified in the following paragraph, the scheme of testing for the 10 basic combination specimens and, if applicable, the sets of 6 supplementary combination specimens shall be as follows (see figure 1):

In the case of safety helmets supplied in more than one size, one selected size is used for testing in a basic combination (except for sound attenuation testing). All other safety helmet sizes are tested in a supplementary combination (except for sound attenuation testing). Sound attenuation testing is performed using the complete range of available safety helmet sizes - see 7.15.2 e).

If the ear-muffs/safety helmet combination incorporates a means to adjust the equivalent headband force, adjust the force to its minimum setting for all stages of conditioning and testing, unless otherwise specified.

NOTE: Testing can be discontinued in the event of a specimen failing to satisfy the respective requirement.

7.1.3.1 Unpack all ear-muffs/safety helmet combinations completely, and, if appropriate, assemble the ear-muffs to the safety helmets in accordance with the ear-muffs manufacturer's instructions.

7.1.3.2 Set the cups/support arms to the mid-point of the range of their adjustment and condition all specimens, set in the position (in-use, stand-by, parking etc) as received from the manufacturer, for not less than 4 h in the atmosphere specified in 7.1.2.

The scheme of testing for specimens 1 to 6 of the basic and supplementary sets shall be as follows:

7.1.3.3 Check each specimen for compliance with the requirements of 6.2 Adjustability, 6.3 Cup rotation, then, after a period of not less than 4 hours, 6.4 Equivalent headband force and 6.5 Cushion pressure.

7.1.3.4 Unless the optional low temperature performance requirement of 6.7 is to be tested, check each specimen for compliance with the requirements of 6.6 Resistance to damage when dropped.

7.1.3.5 Optionally, check each specimen for compliance with the requirements of 6.7 Resistance to low temperature.

7.1.3.6 Subject each specimen to 7.8 Support arm flexing, or, if appropriate, to 7.9 Stand-by mechanism durability test (which is deemed to include support arm flexing).

7.1.3.7 Remove the cups (if possible) or the cushions and liners from each of the cups of each specimen, identifying the cups or liners to enable subsequent identical re-assembly. If the cups are not removable and cushions or liners are not removable and/or replaceable, the cushions and liners shall be protected during the water immersion testing.

7.1.3.8 Unless the optional water immersion - combination under stress conditioning of 7.1.3.9 is to be performed, subject each specimen ear-muffs/safety helmet combination to 7.10 water immersion.

7.1.3.9 Optionally, subject each specimen to 7.11 water immersion - combination under stress.

7.1.3.10 Remove each specimen from the water bath noting the time of removal and re-fit the cups (if removed). Remove excess water. If the liners were removed, re-fit them, and for all specimens with replaceable cushions fit new cushions to each of the cups in accordance with the manufacturer's instructions.

7.1.3.11 Condition each specimen for (60 ±5) min, measured from the time of removal from the water bath in 7.1.3.10, under the conditions specified in 7.1.2, and then immediately measure the equivalent headband force in accordance with 7.4.

NOTE: For multiple size range models, use the settings of width and height which gave the lowest equivalent headband force in 7.1.3.3.

7.1.3.12 Set the cups/support arms to the mid-point of the range of their adjustment and condition all specimens, set in the position (in-use, stand-by, parking etc) as received from the manufacturer, for not less than 16 hours under the conditions specified in 7.1.2.