Ministry of Defence

de&S

DE&S SAFETY AND ENVIRONMENTAL PROTECTION LEAFLET 06/2013

NOISE MEASUREMENT TO FACILITATE ASSESSMENT OF EXPOSURE AND SELECTION OF HEARING PROTECTION		
Sponsor: **DES EngSfty-QSEP SSA TL**	**Version: Issue 3.0** Issue 3.0 supersedes all previous issues of SEP Leaflet 06/2013.	**Date of Issue:** **December 2024**
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1. INTRODUCTION

1.1 Issue 1 of this leaflet delivered protocols that were to be implemented throughout DE&S for the measurement of impulse noise to facilitate assessment of noise exposure in compliance with the Control of Noise at Work Regulations (CNAWR), Control of Noise at Work (Northern Ireland) Regulations (CNAW (NI)R) and the Merchant Shipping and Fishing Vessels (Control of Noise at Work) Regulations (MSFV(CNAR)R)).

1.2 The protocols in Defence Standard 00-027 Issue 4 follow HSE guidance where possible and included measurements needed to assess the level of attenuation required to support the selection of hearing protection.

1.3 The measurement methodology and protocols have been incorporated into Issue 4, Measurement of Impulse Noise from Military Weapons, Explosives and Pyrotechnics and Selection of Hearing Protection.

1.4 The primary purpose of this leaflet is to mandate the use of Issue 4 by the MOD and its Contractors, in the execution of MOD contracts for measurement of impulse noise and supporting selection of hearing protection.

1.5 This leaflet also provides background and guidance on the use of Issue 4.

2. BACKGROUND

2.1 MOD policy on compliance with CNAWR, CNAW(NI)R and MSFV(CNAR)R is delivered through JSP 375, Volume 1 Chapter 25, and requires Defence Procurement/Acquisition Teams to identify and provide information on risks to hearing from exposure to noise from the equipment that they procure and supply. Where such exposure requires the end user to wear PPE hearing protection, it is the procurement/acquisition team's responsibility to recommend the type of hearing protection or provide sufficient information to enable the selection of appropriate measures or hearing protection to reduce the noise exposure to the end user.

2.2 In order to fulfil these responsibilities, DE&S Project Teams task agencies both from within and external to the MOD to make appropriate measurements of the noise to facilitate assessment of risk and where necessary, determine the selection of suitable hearing protection.

3. COMPLIANCE

3.1 Def Stan 00-027 Issue 4 has now been published and shall be used for measurement of impulse noise and support for the selection of hearing protection.

3.2 This provides guidance on the methodology for measurement of the noise from Military Weapons, Explosives and Pyrotechnics (MWEP) to support the procurement process for such devices. This is particularly intended for the testing and development stage of the MWEPs to facilitate appropriate measurement of impulse noise that enables a suitable and sufficient risk assessment and the selection of appropriate control measures to reduce the risk to ALARP. The methodology recommended by the Def Stan represents current good practice.

3.3 Def Stan 00-027 supports compliance with the Control of Noise at Work Regulations 2005 (CNAWR 2005) and Control of Noise at Work (Northern Ireland) Regulations 2006 (CNAW(NI)R) apply European Union (EU) legislation in the United Kingdom (UK) and the protocols in the Standard follow current Health and Safety Executive (HSE) guidance on the Regulations as far as possible. However, as neither the HSE guidance on assessment of the sound attenuation of a hearing protector for impulsive sounds, nor the British Standard on which it is based, BS EN 458:2004, fully encompass the noise from military weapons, an adaptation of the HML method for determining attenuation is given in the Standard. The CNAWR/CNAW(NI)R applies in full throughout the MOD to all workplaces (including, ships, boats, vessels, aircraft and premises) with the exception of Royal Fleet Auxiliary operated vessels, which are covered by the Merchant Shipping and Fishing Vessels (Control of Noise at Work) Regulations (MSFV(CNAW)R) which has comparable requirements.

3.4 Def Stan 00-027 also supports compliance with current MOD Policy. As MWEPs can generate high levels of impulsive noise, there is a requirement for the provision of suitable and effective hearing protection for exposed personnel. The minimum requirements for measurements required by Def Stan 00-027 provide information to facilitate the estimation of the level of attenuation obtained from personal hearing protection.

3.5 As the measurements are to meet the requirements of the Regulations, the guidance given in Def Stan 00-027 follows that given in the HSE guidance to the Regulations as closely as possible.

4. SPECIALIST SUPPORT

4.1 Specialist support is available to teams within DE&S through:

a. N&V SME via QSEP (DESEngSfty-QSEPSEP-NoiseVib@mod.gov.uk)

b. Acoustics and Vibration Team, Institute of Naval Medicine (NAVYINM-AVS@mod.gov.uk)

c. Noise and Vibration Division, RAF Centre of Aviation Medicine (Air-Support-CAM-NVD@mod.gov.uk)

d. Scientific Advisor Acoustics, Field Army Environmental Monitoring Team (FdArmy-Sp-EMT@mod.gov.uk)

5. VALIDATION OF MOD ADAPTATION OF BS EN 458 METHOD

5.1 During the development of Issue 4, the validation work was completed by QinetiQ and agreed by a group of MOD N&V SMEs.

6. MEASUREMENT AND SCENARIOS

6.1 The Standard had to be generic and tries to capture all operating scenarios (defined as combination of the variables influencing the noise from MWEPs including transducer position and orientation, weapon type, ammunition type, charge level, weapon height and orientation, conditioning of weapon and or ammunition, etc. Safety issues may dictate some of the arrangements for measurements, e.g. testing to be carried out on a specified firing range.

6.2 Remote firing is usually mandated for MWEPs in the testing and development stage. Issue 4 assumes this as the norm and that the testing arrangements will reflect normal operating situations, e.g. height above ground, elevation etc. This will allow measurements to be made in accordance with HSE guidance; measurements should be made at the position occupied by the person's head, preferably with the person not present".

6.3 Issue 4 does not specify the number of firings but recommends an ideal of a minimum of five firings, this number has been assessed during validation and provides the minimum firings for a specified certainty that the maximum value will be reached within the set of firings, (firing may be single shot or bursts of known number of rounds) per operating scenario. Other factors such as cost, and availability may dictate the number of firings per operating scenario. Where the five-firing minimum cannot be met users shall discuss this with one of the MOD specialists at para 4.

7. SELECTION OF HEARING PROTECTION

7.1 The guidance on the selection of personal hearing protection given in the HSE Guidance on the Regulations is based on British Standard BS EN 458:2004. BS EN 458:2004 annex B, gives an informative method for selecting hearing protection for peak sound pressures. The method groups noise sources into one of three "Types" depending on their frequency content. A list of sources in each Type is provided. The categorisation is too coarse to be applied to MWEPS. For example, the term "rifle" used in the BS does not apply to the wider range of weapons termed "rifle" by the MOD. For this reason, the MOD has adapted the HML method to give a more refined approach.

7.2 The use of MIRE techniques had been considered but not used in the Standard for a number of reasons, including:

e. The Standard covers guidance on the measurement of noise from MWEPs not the measurement of attenuation.

f. Regulations require the use of BS EN 24869-1 attenuation data.

g. The BS 458 method and the MOD adaptation can be used for both over and in the ear hearing protection. The MIRE cannot be used for in-ear devices.

7.3 Like the method given in BS 458:2004, the MOD adaptation cannot be applied to all types of hearing protection. British Standards cover level dependent devices such as sound restoration and active noise cancellation devices. However, with these types of device, it is assumed that only the passive attenuation applies in high level impulsive noise. There are no current Standards covering devices that provide increased resistance to the passage to noise through a valve at

high sound pressures. Such devices are therefore outside the scope of Issue 4 and will be through future work.

7.4 See Appendix A for an example completing the calculations for the scenario where $L_{CFmax} - L_{Afmax} > 2dB$ and $L_{CFmax} - L_{Afmax} \leq 2dB$.

8. APPROVAL FOR USE

8.1 The Standard and its methodology have:

a. Utilised current good practice and followed British Standards, HSE Guidance and MOD policy where possible.

b. Captured the variation of operational scenarios so far as is reasonably practicable.

c. Provided guidance for using the measurements to assess the sound attenuation required, supporting the selection of appropriate hearing protection for impulse noise. Published consultation drafts both internally and publicly (through DStan) and addressed and sentenced all comments.

8.2 Issue 4 of the Standard has been reached following broad consensus amongst the authorities and SMEs concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc, and whenever practicable, by amendment to those already in existence.

8.3 Previous versions of the Standard were delivered in accordance with good practice at the time of their publication. Publishing of this Issue does not obligate re-measurement or re-evaluation work carried out using previous issues of the Standard, but it is recommended that guidance is sought from an appropriate subject matter expert and, where appropriate, a risk assessment is carried out to identify whether such action would be necessary.

8.4 Def Stan 00-027 Issue 4 shall be used by the MOD and its Contractors, in the execution of MOD contracts for the measurement of impulse noise and support for the selection of hearing protection.

EXAMPLE OF USING DEF STAN 00-027 ADAPTED HML METHOD

1. Method where $L_{CFmax} - L_{Afmax} > 2dB$:

A delivery team have received results from an impulse noise test on their weapon with the following parameters:

$$L_{p,Cpeak} = 154.5\ dB\ (C)$$
$$L_{CFmax} = 133.8\ dB\ (C)$$
$$L_{AFmax} = 130.7\ dB\ (A)$$

The hearing protection available has the following HML values:

$$H = 32\ dB$$
$$M = 24\ dB$$
$$L = 15\ dB$$

Using these values, we can work out the modified HML values:

$$M' = M - 5 = 24 - 5 = 19\ dB$$
$$L' = L - 5 = 15 - 5 = 10\ dB$$

The next step is to use the $L_{CFmax} - L_{Afmax}$ value to determine which equation should be used:

$$L_{CFmax} - L_{AFmax} = 133.8 - 130.7 = 3.1\ dB$$

Using this value the Predicted Peak Reduction (PPR) equation relating to $L_{CFmax} - L_{Afmax} > 2dB$ shall be used:

$$PPR = M' - \frac{M' - L'}{8}(L_{CFmax} - L_{AFmax} - 2)$$

$$PPR = 19 - \frac{19 - 10}{8}(3.1 - 2)$$

$$PPR = 19 - (1.125 \times 1.1) = 19 - 1.24$$

$$PPR = 17.8\ dB \text{ (rounding to 1d.p.)}$$

To calculate the effective peak sound pressure at the ear:

$$L'_{p,Cpeak} = L_{p,Cpeak} - PPR$$

$$L'_{p,Cpeak} = 154.5 - 17.8$$

Therefore, the peak sound pressure at the ear is: $\boldsymbol{L'_{p,Cpeak} = 136.7\ dB\ (C)}$

2. Method where $L_{CFmax} - L_{Afmax} \leq 2dB$:

A delivery team have received results from an impulse noise test on their weapon with the following parameters:

$$L_{p,Cpeak} = 136.0\ dB\ (C)$$
$$L_{CFmax} = 114.3\ dB\ (C)$$
$$L_{AFmax} = 113.7\ dB\ (A)$$

The hearing protection available has the following HML values:

$$H = 40$$
$$M = 32$$
$$L = 23$$

Using these values, we can work out the modified HML values:

$$M' = M - 5 = 32 - 5 = 27$$
$$L' = L - 5 = 23 - 5 = 18$$

The next step is to use the $L_{CFmax} - L_{AFmax}$ value to determine which equation should be used:

$$L_{CFmax} - L_{AFmax} = 114.3 - 113.7 = 0.6$$

Using this value the Predicted Peak Reduction (PPR) equation relating to $L_{CFmax} - L_{AFmax} \leq 2dB$ shall be used:

$$PPR = M' - \frac{H - M'}{4}(L_{CFmax} - L_{AFmax} - 2)$$

$$PPR = 27 - \frac{40 - 27}{4}(0.6 - 2)$$

$$PPR = 27 - (3.25 \times (-1.4))$$

$$PPR = 27 + 4.55$$

$$PPR = 31.5\ dB$$

To calculate the effective peak sound pressure at the ear:

$$L'_{p,Cpeak} = L_{p,Cpeak} - PPR$$

$$L'_{p,Cpeak} = 136 - 31.5$$

Therefore, the peak sound pressure at the ear is: $\boldsymbol{L'_{p,Cpeak} = 104.5\ dB\ (C)}$