



Traceability: Test Sieves

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1 Introduction

- 1.1 The requirements for equipment calibration and measurement traceability are given in ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*. Several guidance publications on the application of these requirements in the case of particular items of equipment and forms of measurement are listed in *UKAS Publications, M4*.
- 1.2 This publication (LAB 22) is a revision of UKAS (NAMAS) publication NIS 8 and provides guidance for laboratories needing to meet these requirements as applied to construction and other materials testing. By following this guidance laboratories will be able to demonstrate at assessment that they meet these requirements. Alternative methods may be used provided they are shown to give an equivalent outcome.

2 General

- 2.1 The measurement of particle size using test sieves is required by a number of standard test procedures e.g.:

BS 598: *Sampling and examination of bituminous mixtures for roads and other paved areas*

BS 812: *Testing aggregates*

BS 1377: *Methods of test for Soils for civil engineering purposes*

- 2.2 Each of these standards calls for the use of test sieves as specified in BS 410 (*Specification for test sieves*). This standard specifies the requirements for woven wire cloth and perforated plate test sieves for the size distribution of granular products in the range 32 μm to 125 mm. Future construction-related European and International Standards will require compliance with ISO 3310-1 (*Test sieves - Technical requirements and testing - Test sieves of metal wire cloth*) and ISO 3310-2 (*Test sieves - Technical requirements and testing - Test sieves of perforated metal plate*). All references to BS 410 in this publication shall be substituted to read ISO 3310-1 and/or ISO 3310-2 where appropriate, when testing to these European and International Standards.

3 New sieves

- 3.1 The laboratory should use test sieves that comply with BS 410, have been permanently labelled by the manufacturer as conforming to BS 410 and have been supplied with an appropriate compliance record card. The record card should be retained throughout the working life of the sieve and may be used to maintain in-house records of sieve examinations.
- 3.2 BS 410 provides detailed procedures for the inspection and calibration of new test sieves. It is the responsibility of the manufacturer to supply sieves complying with BS 410.

4 Sieve marking

- 4.1 The laboratory should have procedures to ensure that where more than one set of sieves is available for use, all sieve sets are colour coded or otherwise marked as a means of set identification.

5 Working sieves

5.1 EXAMINATION - GENERAL

- 5.1.1 It is the user's responsibility to ensure that working sieves are checked with a frequency appropriate to the degree of use. All sieves should be checked visually as in para 5.2 and, depending upon their aperture size and use, should be measured or checked by an appropriate method. The procedure used to measure or check sieves should be documented or otherwise referred to in the laboratory's quality system.
- 5.1.2 Measurement methods, eg, co-ordinate measurement or light projection, that ensure measurements are traceable to national standards of measurement may be used.
- 5.1.3 UKAS accredited calibration laboratories are available to provide calibration services for test sieves. Details of these laboratories are available from UKAS. Testing laboratories should consider the use of these laboratories for the calibration of master sieves.
- 5.1.4 A method of measurement of perforated plate sieves is described in para 5.3.
- 5.1.5 The procedure described in para 5.4 is the recommended method for checking woven wire mesh sieves. However, procedures specified in test methods may also be used.

5.2 VISUAL INSPECTIONS

- 5.2.1 All sieves should be checked visually by the operator before each use. A record that this check has been made should be recorded with the appropriate test data or as a part of the laboratory's record system. Additionally, a detailed check shall be made of the condition of every sieve at regular intervals, depending on use. This check should be recorded (see Section 6). The visual checks should identify any damage, scoring, blinding or contamination, likely to affect the performance of the sieve. It is important that the condition of any gaskets (particularly where a solvent such as dichloromethane is used as a washing medium) and the fitting of nests of sieves are checked. Fitting checks include lids and receivers to ensure no loss of material occurs during operation either from gaps in loosely fitting sieves or from possible accidental spillage when separating tightly fitting sieves. If any doubt exists, a measurement or performance check, as appropriate, should be carried out before further use.

5.3 PERFORATED PLATE SIEVE MEASUREMENTS

- 5.3.1 The apertures of perforated plate test sieves should be measured and recorded in accordance with Appendix D4 of BS 410: 1986, at a frequency as specified in the test method or at least once every two years (see Section 6), whichever is more frequent. Bridge width, plate thickness and pitch should be checked only if the sieve is not accompanied by a manufacturer's certificate of conformance (which may be the case with newly acquired/commissioned **used** working sieves). In this instance measurements would be carried out only once before initial use of the sieve. All measurements should be made using appropriately calibrated reference equipment.

5.4 WOVEN WIRE SIEVE PERFORMANCE CHECKS

- 5.4.1 The performance check procedure monitors the change in condition due to wear of the test sieve. The performance check ensures that a working sieve is consistent with the manufacturing tolerances for the test sieve and the requirements of the tests in which it is used. Only optical projection, co-ordinate measuring machines or similar equipment can achieve true calibration.

- 5.4.2 The apertures of woven wire test sieves should be checked at regular intervals, depending on the frequency of usage (see para 5.4.4.4 Note 2). Checking procedures are outlined in paras 5.4.3 or 5.4.4, using either a suitable certified reference sample (Appendix F4 of BS 410 lists organisations from where reference samples can be obtained), or by comparison with a master set of sieves using performance check samples. The working sieve should be cleaned in accordance with the guidelines in BS 410 Appendix G before any performance check. Appropriate records should be maintained of all checks made (Section 6).

5.4.3 PROCEDURE USING CERTIFIED REFERENCE SAMPLES

- 5.4.3.1 Certified reference samples, consisting of uniformly graded rounded or sub-rounded particles of known grading, should be used to check each working sieve. The grading of the certified reference sample should be such that 40 to 60% is retained on the sieve being checked. A certified reference sample shall not normally be used for more than one check determination. However, multiple use is acceptable where the supplying organisation provides written affirmation that multiple use will not alter the reference samples' certified grading.

5.4.4 PROCEDURE USING PERFORMANCE CHECK SAMPLES

- 5.4.4.1 Performance check samples consisting preferably of uniformly graded, rounded or sub-rounded particles should be created for each sieve size to be checked (see 5.4.4.1 Note). The mass of the performance check sample should be selected so as not to exceed, but be at least 50% of, the maximum retained mass recommended in any relevant test procedure or specification. The performance check sample should be uniformly graded, ie continuous, not gap or step graded, and should comply with Table 1.

Table 1 Grading of the performance check sample for test sieve of aperture size d mm

Test sieve aperture size (mm)	% passing
The nearest size at or above $2d$	100
d	40 to 60
The nearest size to $0.5d$	0 to 5

NOTE: The requirement for test sieve size $0.5d$ shall not apply if $0.5d$ is less than $63\mu\text{m}$

The oversize and undersize figures of $2d$ and $0.5d$ are only approximate values. Table 2 provides practical interpretation of these values.

To ensure that the check sample is uniformly graded, sieve sizes in between the above sizes should be used in its preparation.

Table 2 Practical over and undersize sieve apertures for sieve performance checks

	Nominal sieve aperture								
	d	$2d$	$0.5d$						
d	3.35mm	2.36mm	1.18mm	600 μm	300 μm	150 μm	75 μm	63 μm	
$2d$	6.3mm	5.0mm	2.36mm	1.18mm	600 μm	300 μm	150 μm	150 μm	
$0.5d$	1.18mm	1.18mm	600 μm	300 μm	150 μm	75 μm	none	none	

BS 410 Table 4 lists a number of sieves, many of which are not routinely used in construction materials testing laboratories. It is advisable to use the nearest sieve above ($2d$) and below ($0.5d$) from the range of sieves in routine use in the laboratory where these are available.

Note: Particles of similar shape to those normally sieved may be used to create performance check samples, provided no significant attrition of the particles occurs during the sieving procedure. Glass spheres, quartz, feldspathic particles, etc. are the commonly accepted medium to use for performance check samples. Care must be exercised when using glass spheres to ensure they are truly uniformly graded and not gap or step graded.

- 5.4.4.2 Each size working sieve needs to have a corresponding master sieve of the same nominal aperture to serve as a reference standard. A master sieve should have been used for no other purpose previously and should be retained exclusively for use as a master sieve until it is replaced. This should be after no more than 200 uses or 8 years from first use, depending on which is reached first (see Section 6), or if visual inspection detects damage that is likely to affect its performance as a master sieve.

5.4.4.3 The performance check procedure involves dry sieving the performance check sample consecutively on both the master sieve and the working sieve being checked, by identical methods. Sieving should be considered complete when not more than 0.1% by mass of the total check sample passes the sieve during one minute of continuous hand sieving. Sieving techniques are described in ISO 2591-1: 1988 (*Test Sieving - Methods using test sieves of woven wire cloth and perforated metal plate* [identical to BS 1796: Part 1 : 1989]).

- (a) For each check, establish the mass retained on each size increment after sieving, to the nearest 0.1% of the total mass of the check sample determined prior to placing on the sieve. The total mass of the check sample after sieving should differ by no more than 0.3% of the mass prior to sieving. If there is no agreement the results should be disregarded and the whole check procedure repeated. The performance check sample may be retained for further use provided it continues to be fit for purpose (see para 5.4.4.1).
- (b) The 'offset' difference between the percentage passing the working sieve and master sieve in the performance check is established i.e. percentage passing working sieve minus percentage passing master sieve.

Note: The nominal frame diameter of both master and working sieves should, wherever possible, be the same. However, instances may occur where the performance check procedure is carried out on master and working sieve which have different frame diameters. In such instances it may be necessary to sieve the check sample in two or more portions to avoid overloading a particular sieve. The sieved portions can afterwards be combined for weighing.

5.4.4.4 The performance check needs to be carried out before the first use of a working sieve to establish the 'reference offset' for that sieve. For a working sieve, the 'reference offset' should not be greater than 5%. This applies equally to both **new** and newly acquired/commissioned **used** working sieves (para 5.4.4.4 Note 1).

The performance check procedure is repeated at appropriate intervals (para 5.4.4.4 Note 2). A sieve shall be considered as having failed the performance check if the 'current offset' is more than 5% after subtracting the 'reference offset' (para 5.4.4.4 Note 3). For example, the result of the check before first use was:

	Test sieve nominal aperture size	Percentage passing	
		Working sieve check	Master sieve check
The nearest size at or above $2d$	2.36mm	100	100
d	1.18mm	52	54
The nearest size to $0.5d$	600 μ m	2	2

In the example the 1.18mm working sieve 'reference offset' is established as -2% i.e. 52% subtract 54%. The same 1.18mm working sieve at a subsequent performance check gave the following results:

	Test sieve nominal aperture size	Percentage passing	
		Working sieve check	Master sieve check
The nearest size at or above $2d$	2.36mm	100	100
d	1.18mm	56	56
The nearest size to $0.5d$	600 μ m	3	3

The 'current offset' is calculated as:

(percentage passing working sieve subtract percentage passing master sieve)
subtract the 'reference offset'

for the example:

(56% subtract 56%) subtract - 2% = + 2%

Therefore, the 1.18mm sieve in the example passes the performance check on this occasion.

Note 1: Because of allowable tolerances, a **new** working sieve complying with BS 410 may not give the same result as the master sieve for the first performance check, but would be expected to be within the 5% tolerance stated above. The laboratory must take action to investigate and confirm (e.g. optical means or certified reference check samples) the validity of the master sieve where new or certified reconditioned sieves show a reference offset difference greater than 5%. When a new master sieve is put into use to replace an existing master, a first use check of the old master against the new master shall be performed. The resultant offset is used as a correction to be taken into account when evaluating **existing** sieves against the new master. If however, the old master is being replaced because it is suspected of being in error, then a 'first use' check will need to be made on **all** working sieves against the **new master** sieve, and appropriate action taken according to the results of this investigation.

Note 2: Wear and tear on sieves is dependant on the manner of use and the abrasiveness of the material being tested. Until such time that the laboratory has sufficient records to indicate rates of wear and is thus able to assign rational check periods, performance checks should be carried out at intervals of not more than three months. It should be noted that where test methods specify mandatory calibration/check frequencies for test sieves, these should take precedence over the frequencies recommended in this publication. In order to comply with the grading requirements of para 5.4.4.1, sieves should ideally be checked individually.

Note 3: Where standard test methods define mandatory offset limits for sieve checks these should be used in preference to the 5% offset.

5.5 IDENTIFICATION OF FAILURES

- 5.5.1 Test sieves which fail visual, measurement or performance checks should be clearly identified as such and either discarded or used for protection sieves as appropriate.

6 Procedures and records

- 6.1 Laboratories should have a written procedure for inspecting, measuring and checking test sieves and should maintain records of all inspections, measurements and checks. To be able to demonstrate that they have followed the recommendations of this publication, laboratories should maintain the following records:

- (a) *All sieves* Records of all routine inspections, including nesting, labelling, and general condition (see para 5.2). Copies of compliance record cards supplied by the manufacturer.
- (b) *Perforated plate sieves* (apertures larger than 4mm) Records of measurements using calibrated (traceable to national standards) calipers, tapered plate gauges, optical projection, three-axis co-ordinate measuring machines or plug gauges (see para 5.3).
- (c) *Woven wire sieves* (apertures 4mm and smaller) Records of any measurements carried out using calibrated (traceable to national standards) optical projection, coordinate measuring machines or similar equipment in accordance with BS 410.

or

records of any performance checks made using certified reference samples or performance check samples with master sieves (see para 5.4).

- (d) *Master sieves* Records of number of uses and date of first use (see para 5.4.4.2).

7 Sieve maintenance

- 7.1 Before each use, the sieving medium (mesh) and frame should be examined against an illuminated background for defects, blinding or contamination. If it is necessary to clean the sieve, cleaning should be carried out with great care to avoid damage to the sieving medium. BS 410: 1986, Appendix G provides guidance on the maintenance of test sieves.