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BS EN 771-1 and PAS 70 – Guide to the Standards

The purpose of this document is to give Specifiers a précis of the current manufacturing Standard BS EN 771-1: Specification for clay masonry units, and the Publicly Available Specification PAS 70: guide to appearance and site measured dimensions and tolerance.

The European Standard has been in operation in this Country since 2003 so we have condensed them down into one document for reference purposes.

Appearance

The appearance of brickwork isn't covered in BS EN 771-1 since it is not performance related. However, BSI has published PAS 70, A Publicly Available Specification which is intended to cover aesthetic aspects.

Prior to construction, the manufacturer should provide upon request a reference panel sufficiently representing the bricks in question. This should be built on site and should be to a size agreed by all parties but not less than 1m² in size, and be constructed using the intended mortar colour, joint profile and bond of the finished building.

Subsequent deliveries of bricks should have a sample panel built from bricks randomly chosen from the whole load (to check colour/texture consistency). Individual bricks should not be closely scrutinised.

Portable Sample boards should not be taken as the definitive guide to colour, they give an idea of colour and texture to aid decisions and a reference panel will show a broader perspective of the likely colour variations.

It should also be noted that facing bricks, chosen for their aesthetic appearance, are only finished to one stretcher and one header surface as is seen in normal cavity construction. The rear face of most products will be unsuitable for facing purposes.

- a) The reference panel should be built on a level firm foundation in a dry location with natural daylight.
- b) Construct sample panels representing subsequent deliveries in the same way allowing mortar sufficient time to dry out before viewing.
Or
Dry lay bricks sampled in the same manner but take no account of mortar or joint profile. But, in the case of a dispute, a mortared panel should be used for comparison purposes.
- c) Assessment of panels should be agreed by all parties.



- d) All panels, when viewed from approximately 3 metres away, should not differ significantly.
- e) Bricks should be reasonably free from deep or extensive cracks, damage to edges and corners, pebbles and expansive particles of lime.

To avoid many of the issues of colour variation of products built into structures, the following procedures are recommended either by PAS 70 or by Industry Associations.

- a) Inform the manufacturer in the first instance of the total amounts involved so deliveries from one batch can be arranged.
- b) Upon delivery, check each load against the reference panel.
- c) Always blend from AT LEAST 3 packs.

For small quantities involving 1 or 2 packs, work through packs 1 blade at a time rather than top layer down.

Compressive Strength

BS EN 771-1 states that the mean compressive strength of a product must be declared by the manufacturer. When tested, this must not fall below the strength stated by the manufacturer who must also categorise the unit into either:

Category I (the probability of failing to achieve the declared strength does not exceed 5%)

Or

Category II (the level of confidence as placed on category I does not apply)

The orientation of the unit as tested should be indicated, e.g. bed-face or stretcher face, etc. and whether voids are intended to be mortar filled.

If the units are intended to be exposed to concentrated loads or for use in seismic areas, any strength result from the batch tested that falls below 80% of the stated strength must be declared.

The test involves sampling 10 bricks at random and sending them to an approved laboratory where the surfaces will be ground smooth if they vary in height more than 1mm per 100mm from a level plane. Alternatively the unit can be bedded in mortar to achieve a flat plane if grinding would alter the contact area significantly.

The units are then placed in a testing machine, one at a time; a uniformly distributed load is applied and increased continually up to failure. The results are recorded in N/mm². The mean figure of the 10 is then calculated to ensure compliance with the declared figure. Note: The BS EN test method, in most instances, but not all, results in a higher strength than the BS 3921 method.

Durability

Unlike BS 3921, where durability designation incorporated both frost resistance and soluble salts content, BS EN 771-1 states that freeze-thaw resistance and active soluble salts content are separately categorized.

FREEZE/THAW RESISTANCE

This must be declared by the manufacturer with reference to suitability under passive, moderate or severe exposure to saturation and freezing.

Category	
F0	Passive Exposure
F1	Moderate Exposure
F2	Severe Exposure

F2 is deemed frost resistant in all normal building situations when used in accordance with the appropriate Codes of Practice.

F0 products should only be used for protected or internal walling.

ACTIVE SOLUBLE SALTS CONTENT

When sampled and tested in accordance with BS EN772-5 the content of water soluble salts should be no greater than tabled below.

Category	Total % by mass not greater than	
	Na ⁺ + K ⁺	Mg ²⁺
S0	No requirement	No requirement
S1	0,17	0,08
S2	0,06	0,03

((Na⁺ = Sodium) (K⁺ = Potassium) (Mg²⁺ = Magnesium))

The laboratory test is similar to that in BS 3921, but the results are categorised differently.

S2 products are suitable for brickwork subject to prolonged saturation; S1 is for normal exposure and S0 for completely protected walls (i.e. internal or rendered or clad).

E.g. bricks required for chimneys, parapets and walling exposed to wind driven rain should be specified as F2S2.

Internal walling can be specified as F0S0.

The use of Sulfate Resisting Portland cement is recommended when using S1 category products in exposed locations.

Engineering Bricks

Clay Engineering bricks are defined in BS 6100 'Glossary of building and civil engineering terms' as 'brick sized fired clay units having a dense and strong semi vitreous body, conforming to defined limits for water absorption and compressive strength.'

In BS 3921 Engineering Bricks were classified as A or B based on minimum compressive strength and maximum water absorption not falling below 70 N/mm² – 4.5% and 50 N/mm² – 7% respectively.

Engineering bricks are not included in EN 771-1, but are referenced for information in the UK National Annex that appears at the end of the Standard.

As the test method for compressive strength has changed, giving generally higher figures, the requirements have been upgraded accordingly as shown below.

		Compressive Strength N/mm ²	Water Absorption %	Freeze/thaw resistance category	Active soluble salts content category
BS 3921	Class A	≥70	≤4.5	na	na
	Class B	≥50	≤7	na	na
BS EN 771	Engineering A	≥125	≤4.5	F2	S2
	Engineering B	≥75	≤7	F2	S2

Water Absorption figures remain at 4.5% and 7%. This is because the test method for engineering bricks has not altered from the method in BS 3921.

The EN test method for units for use in Damp Proof Courses, which involves placing the bricks in boiling water for 5 hours, is used as the Engineering Brick test method.

Facing bricks undergo a different test method involving a 24 hour soak. The quoted water absorption for facing bricks should not be confused with the requirements for engineering bricks.

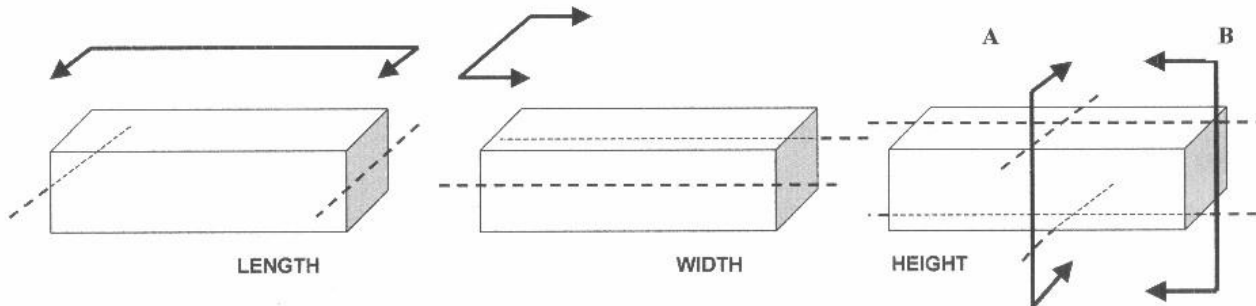
Clay engineering bricks must be frost resistant (categorised as F2).

Also, although it was not included as a requirement in BS 3921, UK clay engineering bricks must conform to the S2 category of soluble salts content.

Dimensions and Tolerances

BS EN771-1 requires that the dimensions of a clay masonry unit shall be declared by the manufacturer in millimetres for length, width and height, in that order. The manufacturer shall declare also which of the tolerance categories the mean values fulfil when measured to the test method detailed in BS EN 772-16.

10 bricks are randomly sampled, superfluous material removed and using long nosed callipers, or bespoke measuring device, measurements must be taken on individual bricks for length, width and height as shown.



(This should not be confused with PAS 70, which is a BSI Publicly Available Specification for measuring brick tolerances in the case of disputes on site, as the 771-1 reference method is impractical. In cases where there is an impasse, the test method below will have to be performed either at the nearest factory or at Ceram Research which will cause delays on site.)

TOLERANCE

MEAN VALUE

For each dimension in question, when 10 bricks have been measured, add the individual figures and then divide by 10, rounding to the nearest whole number (see separate procedure for height overleaf). Mean values should fall between the following limits:

The tolerance is the difference between the calculated mean size and the stated work size.

Declared size mm	T1 Lower & Upper limits	Tolerances mm	T2 Lower & Upper limits	Tolerances mm	Tm
40	37-43	±3	38-42	±2	Deviation in mm declared by the manufacturer (may be wider or closer than the other categories). Please refer to the product data sheet for quoted figure.
50	47-53	±3	48-52	±2	
65	62-68	±3	63-67	±2	
68	65-71	±3	66-70	±2	
73	70-76	±3	71-75	±2	
80	76-84	±4	78-82	±2	
90	86-94	±4	88-92	±2	
102	98-106	±4	99-105	±3	
190	184-196	±6	186-194	±4	
215	209-221	±6	211-219	±4	
225	219-231	±6	221-229	±4	
227	221-233	±6	223-231	±4	
290	283-297	±7	286-294	±4	

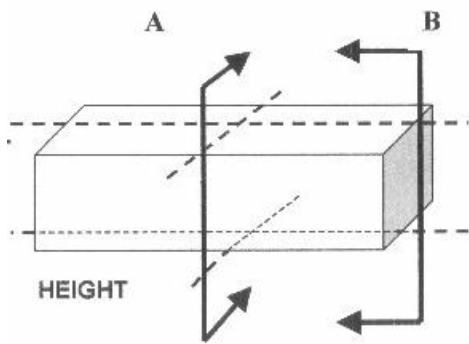
E.g. if measurements for the declared length of 215mm are recorded as:

216+217+215.5+217+214+217.5+217.5+218+215+218 =2165.5mm divide by 10 = 216.55

(figures of .5 or higher are rounded up) 217mm, this would fall within the tolerance T2 which indicates the limits of 211 to 219mm.

HEIGHT

Unlike length and width Height measurements have to be taken from 2 points (A and B) and averaged for each brick.



E.g. For a declared height of 65mm, if A measures 64+ B measures 65 =129 divided by 2= a mean figure of 64.5mm
 This has to be repeated for all 10 sampled bricks, the means added, divided by 10 and compared with the mean value table of tolerances. Therefore a T2 product mean must fall between 63-67mm for a declared size of 65mm

RANGE VALUE

The range tolerance covers the overall difference within a sample between the largest brick and the smallest and may be called upon to resolve problems with size variation.

From the 10 bricks measured (length, width or height), the highest and lowest figure for each declared dimension must not exceed a range as stated in the following table.

mm	40	50	65	68	73	80	90	102	140	190	215	227	290
R1	4	4	5	5	5	5	6	6	7	8	9	9	10
R2	2	2	2	3	3	3	3	3	4	4	4	5	5
Rm	A range in mm declared by the manufacturer (may be wider or closer than the other categories). Please refer to the product data sheet for quoted figure.												

E.g. if the length of the brick in question is 215mm and the lowest measurement recorded during the test is 211mm and the highest measurement recorded is 216mm there is a difference of 5mm. This safely falls within the Range of R1 (9mm) but would fail if it is an R2 product (4mm).