PRODUCT STANDARDS THEIR STRENGTHS AND WEAKNESSES

Bill Walters

Ceram Research
Queens Road, Penkhull; Stoke-on Trent; STA LQ England.
E-mail: bill. walter@ceram.co.uk

In this presentation I shall be giving an overview of the current international standards position for the adhesives and installation and how the standards work in the practice asking some questions. The situation is quite complex at present particularly within Europe. I hope that my comments will promote some discussion and comment from the meeting.

Firstly, I want to look at the current standards situation.

Slide 1 shows the three topics that I shall review. We have the tiles themselves. Tiles have been subject to a variety of tests and requirements in many countries for many years. There has been for instance a well-established European standard and this has been used as a basis for many other national standards.

It is well known that high quality tiles will not perform satisfactorily if they are not installed properly. For this, there are two other topics which again are covered by standards. They are adhesives and grouts and design and installation. As with tiles, adhesives have standards in some countries and others are being developed. Grout tests are also being developed.

The best materials available are of little use if design and installation is not good. Many countries again have codes of best practice for design and installation. This normally includes selection of the correct tiles and other materials, how to incorporate movement joints, the nature and preparation of the background and the actual installation techniques.

This lecture was initially prepared in December 1999 and the latest information available was contained in the papers for the TC67 meeting held in Brussels on 19th November. Perhaps I can start by indicating the committees which are working on international tile standards in both ISO and CEN. Firstly, the technical committees are as shown in slide 2. In CEN we have TC67 with the secretariat held by Italy. At ISO level we have TC189, secretariat held by USA. In the case of ISO documents, they are usually published and sent to CEN where TC67 gives approval for their publication in Europe after which all European member states are obliged to publish them through their own national standards institutes.

Both TC67 and TC189 develop their standards using working groups (WG's) as shown in slide 3. In both cases they are as follows. WG1 is responsible for tile tests, the actual tests to be used. WG2 sets any requirements for those tests. For instance, a minimum strength or modulus of rupture value. WG2 has also defined the various tile categories by water absorption level and forming process.

TC67 and TC189 are both concerned with tiled installation as well as the tiles themselves and so WG3 is set up to develop tests and requirements for adhesives and grouts. Finally, design and installation is covered in WG4.

WG1 and 2 of TC67 have now largely finished their work and the business of these two groups is, therefore, covered by the full technical committee (TC).

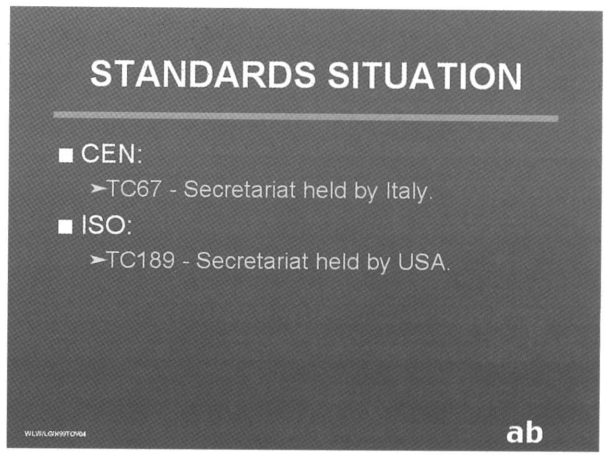
Coming, therefore, to the current tile standard situation. There is at present a transitional situation in existence in Europe at least. The EN standards are still officially current, but the ISO standards will soon replace them. This transition arises because the new ISO standard 13006 on the definition, classification characteristics and marking of tiles is not yet published by CEN (slide 4). So we have the situation in Europe of published ISO test documents, but only draft ISO requirement documents. This does not prevent tests being performed to the ISO system, but the ISO requirements (ISO 13006) will only be published in September 2000 and at that time this will supercede the current EN 87 : 1991.

We all know very well the EN series of tests and requirements documents and they are listed here for the reference of delegates.

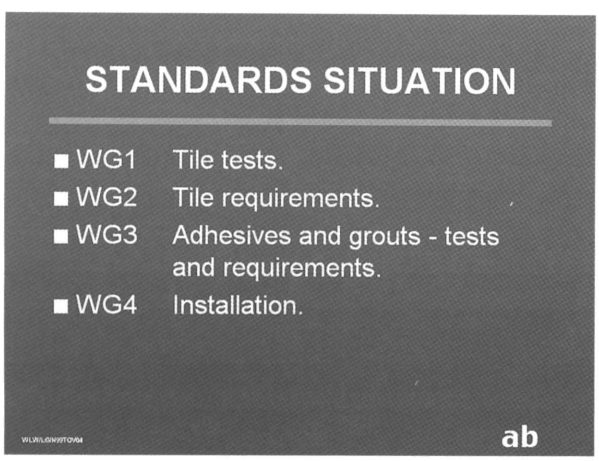
EN EUROPEAN STANDARD FOR CERAMIC FLOOR AND WALL TILES

EN Number	Title
87	Ceramic floor and wall tiles - Definitions, Classification, Characteristics and Marking.
121	Extruded ceramic tiles with a low water absorption E # 3%. Group A1.
186 (Parts 1 & 2)	Extruded ceramic tiles with water absorption 3% < E # 6%. Group A11a. Parts 1 and 2.
187 (Parts 1 & 2)	Extruded ceramic tiles with water absorption 6% < E # 10%. Group A11b. Parts 1 and 2.
188	Extruded ceramic tiles with water absorption E > 10%. Group A111.
176	Dust pressed ceramic tiles with a low water absorption E # 3%. Group B1.
177	Dust pressed ceramic tiles with absorption 3% < E # 6%. Group B11a.
178	Dust pressed ceramic tiles with a water absorption 6 < E # 10%. Group B11b.
159	Dust pressed ceramic tiles with a water absorption > 10%. Group B111.
98	Determination of dimensions and surface quality.
99	Determination of water absorption.
100	Determination of modulus of rupture.
101	Determination of scratch hardness of surface according to Mohs.
102	Determination of resistance to deep abrasion. Unglazed tiles.
103	Determination of linear thermal expansion.
104	Determination of resistance to thermal shock.
105	Determination of crazing resistance.
106	Determination of chemical resistance. Unglazed tiles.
122	Determination of chemical resistance. Glazed tiles.
154	Determination of surface abrasion. Glazed tiles.
155	Determination of moisture expansion using boiling water. Unglazed tiles.
202	Determination of frost resistance.
163	Sampling and basis for acceptance.

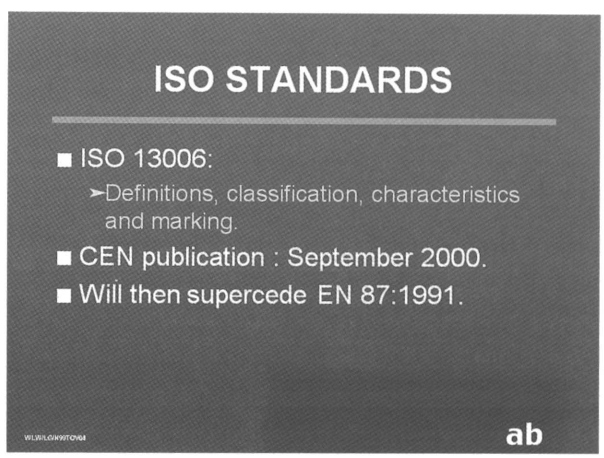
Slide 1.



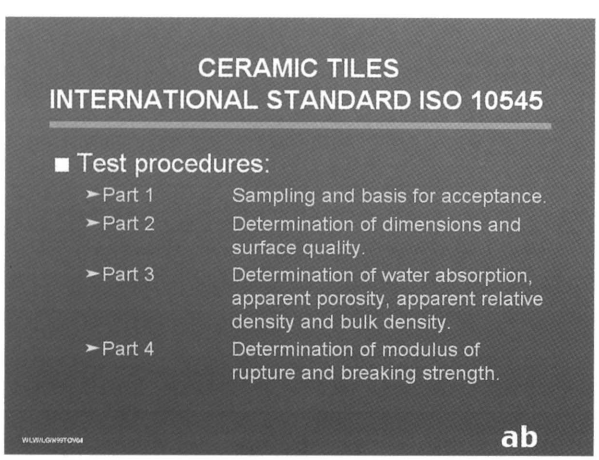
Slide 2.



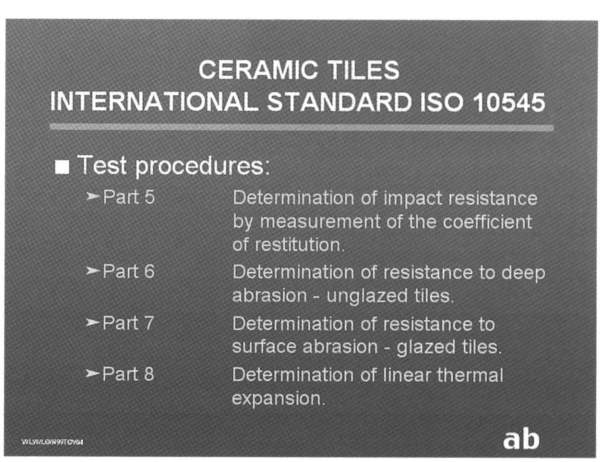
Slide 3.



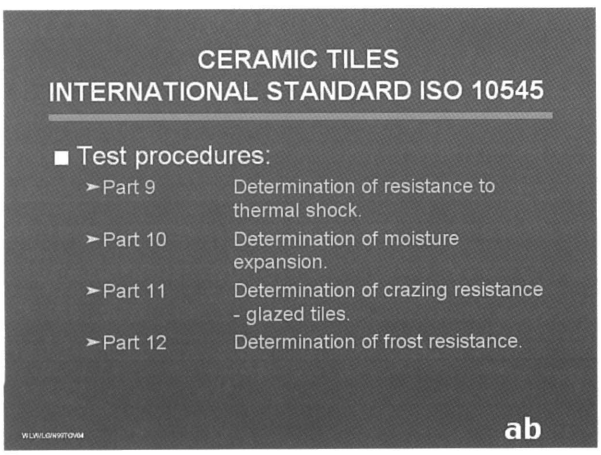
Slide 4.



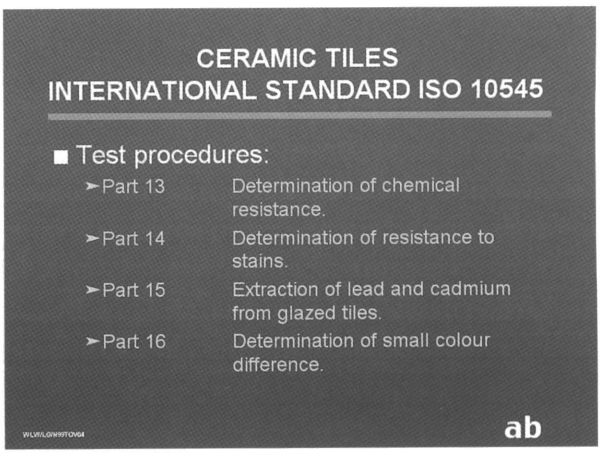
Slide 5.



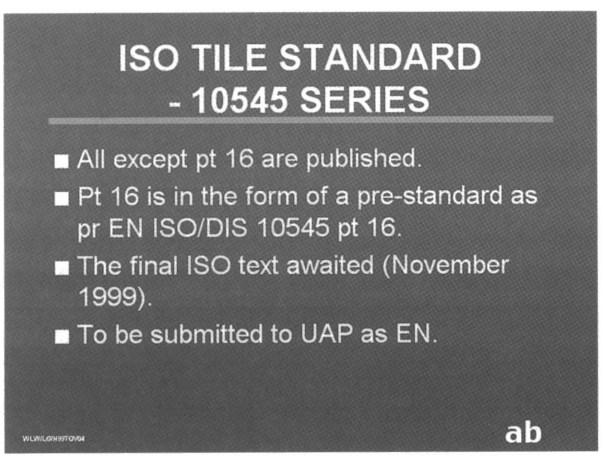
Slide 6.



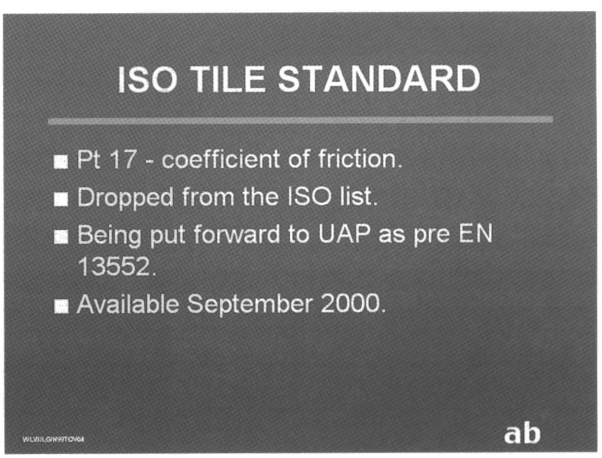
Slide 7.



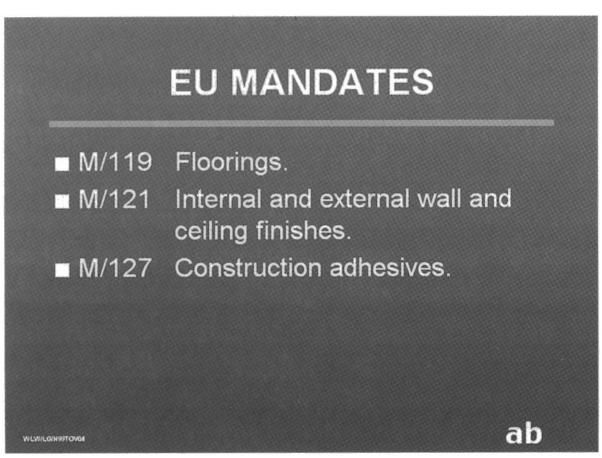
Slide 8.



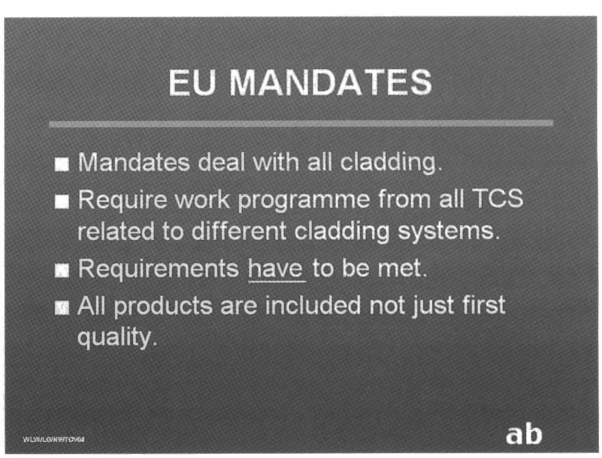
Slide 9.



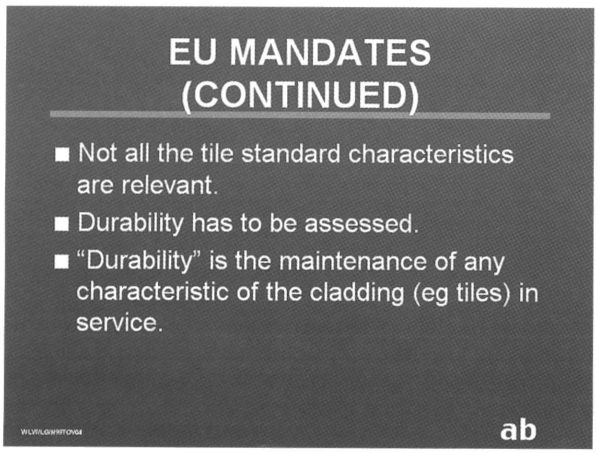
Slide 10.



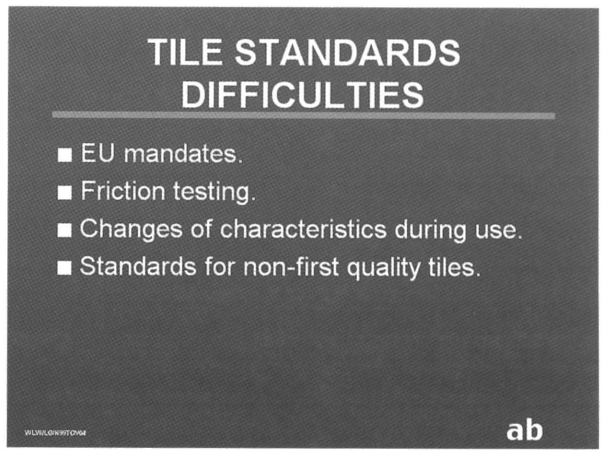
Slide 11.



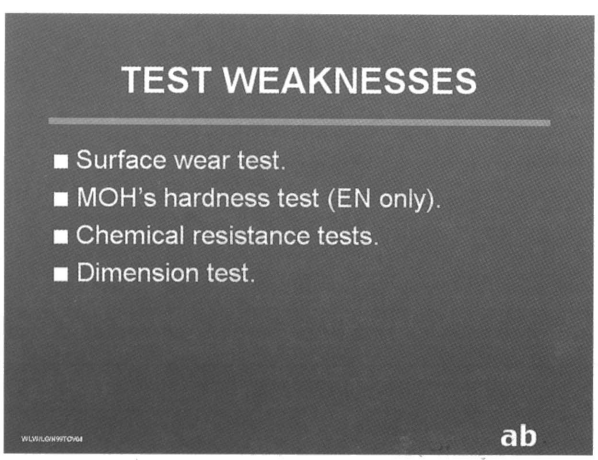
Slide 12.



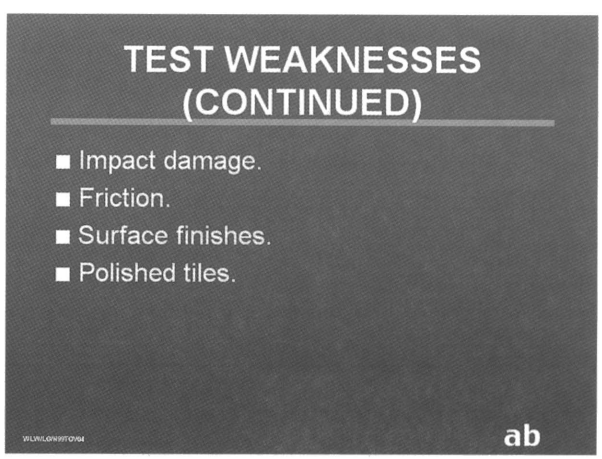
Slide 13.



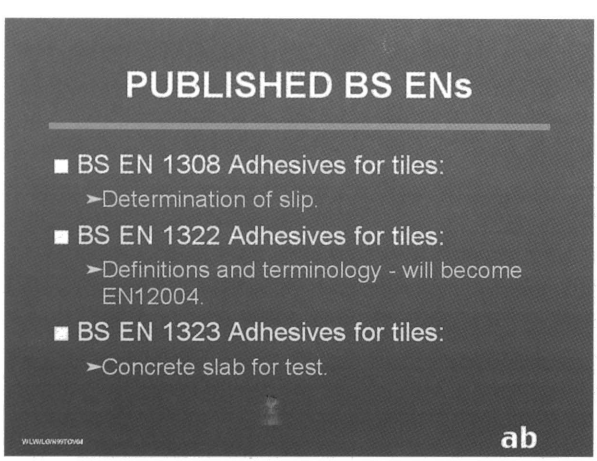
Slide 14.



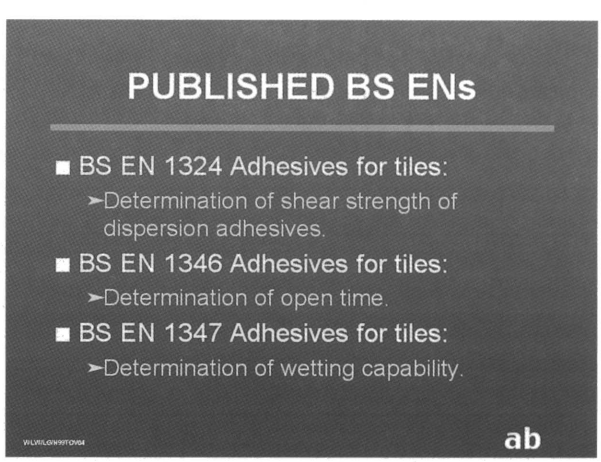
Slide 15.



Slide 16.



Slide 17.



Slide 18.

I am not showing these well-known standards, but want to go on to the ISO tests.

These ISO tests shown in slides 5, 6, 7 and 8 Parts 5, 15 and 16 are new tests and many of the others have modifications, but there is a general similarity to the EN series. It is not proposed to discuss the differences in the two systems of test in this presentation although some aspects will come up later. Pt 16 is the only part not yet published in Europe and this should be brought forward in year 2000 (slide ten).

The one part of ISO 10545 which has caused most argument was the part 17 on measurement of coefficient of friction of floor tiles (slide 10). This has now been dropped from the ISO list of tests as at November 1999. It is now being pursued within CEN with a new number pr EN 13552, with the same text as before. As with ISO 10545 pt 16 it is being put forward to the unique acceptance procedure (UAP).

That, ladies and gentlemen is the tile situation and it is largely in place except for two tests and the requirements document in Europe. There are, however, some complications which will require much continued discussion particularly in Europe in the next few years.

The complication arise from EU mandates arising from the construction products directive. They are listed in the next slide 11 and are:

- M/119 Floorings.
- M/121 Internal and external wall and ceiling finishes.
- M/127 Construction adhesives.

The requirements within these documents will have to be achieved and work programmes are being proposed by all technical committees concerned in order to develop tests and be in a position to comply with these mandates. Some key points are shown in slides 12 and 13.

The mandates refer to all forms of cladding and floors not just ceramics. Hence, about 12 technical committees are all putting forward work programmes independently. The fact that compliance is required from all material used means that products not of first quality must be included for the first time in terms of tile standards.

The concept of durability has been introduced with the following definition. The maintenance of any characteristic at the same level during use as when new. Guarantees of this type will be difficult to assess by testing.

In short then, there are some real difficulties to be addressed by the technical committees. These are listed in slide 14.

We have the EU mandates. These are making some new demands on the standard tests. In the key tests are in the measurement of friction or slip resistance. Another very difficult characteristic to test for is durability and how key characteristics change with use.

Finally, the mandates demand that the key test are performed on all products not just products of first quality. This again is a subject which has not been resolved as the current standard system only refers to first quality products.

PUBLISHED BS ENs

- BS EN 1348 Adhesives for tiles:
  - ➢Determination of tensile adhesion strength of cementitious adhesives.
- BS EN 12002 Adhesives for tiles:
  - ➢Determination of transverse deformation for cementitious adhesives.

ab

Slide 19.

PUBLISHED BS ENs

- BS EN 12003 Adhesives for tiles:
  - ➢Determination of shear strength of reaction resin adhesives.
- BS EN 12808-1 Adhesive and grouts for tiles:
  - ➢Determination of chemical resistance of reaction resin mortars.

ab

Slide 20.

ADHESIVE CLASSIFICATION

- Type C Cementitious.
- Class 2TE Improved performance with additional characteristics, reduced slip and extended open time.

ab

Slide 21.

prENs UNDER ENQUIRY

- prEN 12808-2 Grouts for tiles:
  - ➢Determination of resistance to abrasion.
- prEN 12808-3 Grouts for tiles:
  - ➢Determination of flexural and compressive strength.
- prEN 12808-4 Grouts for tiles:
  - ➢Determination of shrinkage.
- prEN 12808-5 Grouts for tiles:
  - ➢Determination of water absorption:
    - – Currently submitted to enquiry. Deadline: 17-12-99.

ab

Slide 22.

SPECIFICATION DOCUMENTS

- prEN submitted to formal vote:
  - ➢prEN 12004 Adhesives for tiles:
    - – Definitions and specifications.
- prEN before enquiry:
  - ➢prEN .... Grouts for tiles:
    - – Determinations and specifications.

ab

Slide 23.

DESIGN AND INSTALLATION OF CERAMIC TILES

- prEN 13548.
- Very general.
- Voted on late 1999.
- Not accepted.

ab

Slide 24.

Before leaving the tile tests, I would like to list some areas in the tests which can lead to problems. I'm calling these, "Test Weaknesses", as seen in slide 15. The way some of the tests are written, in the English version at least, make visual assessment and characterisation difficult. Visual assessment is difficult anyway as can be deduced by the different results sometimes seen in the surface abrasion test. The MOH's hardness test is even more difficult to assess and this is the reason for its removal from the ISO list of tests. In both these tests some of the claimed performance results are very high - far higher than the real results. It is interesting to note that companies never claim performance results that are poorer than the real results. Whenever there is a difference the company result is always better than the independent results.

In the chemical resistance test the guidelines for assessment are not really clear in the English version at least. Quite obvious changes to the glaze can fall into the category B are thus are deemed to have passed the test.

This seems quite wrong. Despite removal of the surface which would constitute a failure, the colour change itself should also constitute a failure since it is so obvious. The standard does not give this as an option to fail a tile.

In the dimension test, tolerances are given in % terms, but as tiles get larger the variations get so large that grout lines vary enormously between say 1 and 10 mm. This would give any tiled area a poor look. Companies get round this by having a range of up to ten different calibres for tiles of the same nominal (pressed) size. The problem with this arrangement, in UK at least, s that customers do not realise that tiles of the same nominal size can vary so much because of the calibre. It is possible, therefore, to buy a variety of sizes which cannot be used together.

Some other weaknesses are shown in slide 16. Some factors are not really tested at all. Impact is assessed using the new ISO 10545 pt 5, but this test only reports on the coefficient of restitution. No reference is made to any surface damage to the tile which might be imparted by the ball bearing. In fact, this test on glazed tiles in particular can damage the surface. Such damage is often seen in normal use, but at present this problem is outside the scope of the standard tests.

I've already mentioned friction testing and in my opinion this remains a problem for many reasons. Firstly, there are four vastly different method of measurement in the draft standard all giving results which do not necessarily correlate. There is no guidance - and this is crucial to specifiers and architects - on limits although there is information available outside the standard. The different methods can give different results as to suitability when reference to the guidance information is made. Most commonly, wet tortus results can suggest a tile is suitable whereas the wet pendulum results will say the opposite. This is an impossible situation for a specifier.

All the proposed tests are for shod conditions only - no barefoot test is included. For this latter condition the German bare foot ramp test has to be used.

Finally, I am a firm believer that none of the tests so far advocated can cope equally with all types of surface texture and profiling and all types of footware and that anomolies arise because of this.

The mention of different surfaces leads me to my last area of tile test weaknesses. There are many innovative processes now in use in tile production which modify the surface in any number of ways. The tile standard only recognises glazed and unglazed and it is quite difficult in many instances to decide which category the tile falls into. This of course is very important to the different wear tests for each category. We at CERAM have sometimes performed the wrong test. This is usually the surface test because our feeling is that the surface layer is different from the rest of the tile when the manufacturer claims that this is not the case and, therefore, the deep abrasion test should be done.

Perhaps the most obvious instance of tiles with a modified surface is the polished tile. This is regarded at present as unglazed, but in fact this surface is far more like a glazed surface. So should the surface wear test be performed? It is also a fact that polished tiles can be less stain resistant. This is because micropores are opened up in the polishing process.

Moving onto adhesives and grouts, I shall briefly report on the situation. WG3 in CEN has now largely finished its work on both these materials having spent some 10 years and 35 meetings on the project! WG3 in ISO is using the CEN work as a blueprint in the expectation that this will speed up its work.

Only CEN documents are published or drafted at present and these are listed in slides 17 to 24. ISO documents for adhesives and grouts are numbered ISO 13007 parts 1-4.

In slides 17 to 20 we have the published adhesive test methods and associated tests (eg on the concrete slab). Adhesives will be described as per the following table in your notes. I cannot put this on the screen as there is so much information. If I take just one category as an example in slide 21. I can take an adhesive characterised as C-2TE. The full text is in the table.

CLASSIFICATION AND DESIGNATION

Symbol		Description
Type	Class	
C	1	Normal cementitious adhesive.
C	1F	Fast setting cementitious adhesive.
C	1T	Normal cementitious adhesive with reduced slip.
C	1FT	Fast setting cementitious adhesive with reduced slip.
C	2	Improved cementitious adhesive with additional characteristics
C	2E	Cementitious adhesive with extended open time.
C	2F	Improved fast setting cementitious adhesive with additional characteristics.
C	2T	Improved cementitious adhesive with additional characteristics and reduced slip.
C	2TE	Improved cementitious adhesive with additional characteristics, reduced slip and extended open time.
C	2FT	Improved fast setting cementitious adhesive with additional characteristics and reduced slip.
D	1	Normal dispersion adhesive.
D	1T	Normal dispersion adhesive with reduced slip.
D	2	Improved dispersion adhesive with additional characteristics.
D	2T	Improved dispersion adhesive with additional characteristics and reduced slip.
D	2TE	Improved dispersion adhesive with additional characteristics, reduced slip and extended open time.
R	1	Normal reaction resin adhesive.
R	1T	Normal reaction resin adhesive with reduced slip.
R	2	Improved reaction resin adhesive with additional characteristics.
R	2T	Improved reaction resin adhesive with additional characteristics and reduced slip.

Note: *Additional designations can be inserted according to the combination of the different characteristics.*

The grout tests are listed in slide 22. These should be published in year 2000. Finally, there are two documents on definitions and specifications, one for adhesives and one for grouts as shown here in slide 23.

The third aspect of good tiling is the installation and again many countries have best practice guidance documents. An attempt to get a Europe-wide document was made by WG4 of TC67 and a document pr EN 13548 was circulated for public comment. This is seen in my last slide. Many compromises had to be made to this document as many countries in Europe had very set ideas of best practice. As a result, a very general document was produced and a statement added in the scope states that it does not seek to supercede more detailed national documents of the subject.

Nevertheless, in voting which took place in late 1999 the document was not voted for acceptance by the TC67 members and a further attempt to draft a suitable document is to be undertaken by a recommended WG4 committee. The ISO based WG4 committee is yet to meet and is viewing the problems experienced in Europe with some trepidation - I think!

This has been a very brief resume of the standards situation. It does not indicate the huge amount of hard work put in by all the delegates from so many countries. To get as far as we have shows a good measure of international co-operation. In particular I would like to highlight the amount of work done by the various committee chairmen and secretariates. In particular TC67 is chaired by the Italian delegation and TC189 by the American delegations.

There are still some serious problems to confront not least in Europe where the EU mandates have to be resolved. I'm sure they can be resolved and hopefully by the next QUALICER in 2002 someone will be able to stand here and report the outcome.

WLW/LG/N99NOT02
13.12.99