
Fungal Resistance Testing to BS 3900: G6 and
Antimicrobial Testing to ISO 22196

For

Aspartus PLC

Final Report

Work Carried Out By

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Final Report

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Work Requested Fungal Resistance Testing to BS 3900:
G6 and Antimicrobial Testing to ISO
22196
Samples Submitted 2 paint systems

Work Carried out by A.C. Smith

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Authorised Signatory

1 Materials Submitted For Testing

1 sample of each of the following was submitted:

- Elastomeric primer
- Elastomeric finish
- Water based primer
- Water based finish

Each primer/finish pair was to be tested as one system for fungal resistance to BS 3900: G6 and for antimicrobial activity to ISO 22196: 2007.

2 Test Procedure

2.1 Fungal Resistance Testing to BS 3900: G6

One full brush coated of each primer was applied to duplicate calcium silicate Masterboard panels, followed by two full brush coats of the appropriate finish. Duplicate blank control panels were prepared by applying 3 full brush coats of a paint known to be susceptible to fungal growth. The panels were allowed to air dry for 24 hours between coats and for 7 days at room temperature prior to testing

Fungal testing was carried out according to the procedure described in BS 3900: G6, in which the paint films are inoculated with a spore suspension containing the following mixture of mould and yeast fungi:

<i>Alternaria alternata</i>	IMI	342924
<i>Aspergillus versicolor</i>	IMI	45554
<i>Aureobasidium pullulans</i>	IMI	45533
<i>Cladosporium cladosporioides</i>	IMI	178517
<i>Penicillium purpurogenum</i>	IMI	178519
<i>Phoma violacea</i>	IMI	49948ii
<i>Rhodotorula rubra</i>	NCYC	1695
<i>Sporobolomyces roseus</i>	NCYC	717
<i>Stachybotrys chartarum</i>	IMI	82021
<i>Ulocladium atrum</i>	IMI	79906
<i>Cladosporium herbarum</i>	IMI	378363
<i>Cladosporium sphaerospermum</i>	IMI	170353
<i>Paecilomyces variotii</i>	IMI	114930

Note 1: The IMI Number is a strain prefix used by the International Mycological Institute (now CABI-Bioscience)

Note 2: The NCYC Number is the catalogue number of the National Collection of Yeast Cultures.

Each species was present in the spore suspension at a level of not less than 10^4 spores per ml.

The test and control panels were spray inoculated with the spore suspension and placed in fungal test cabinets (i.e. humidity chambers operating on a time cycle to give 2 hours in every 12 hours at 4 °C above ambient). After 7 days incubation, the panels were re-inoculated as above and incubation was continued for a total of 56 days.

Growth of fungi on the panels was monitored after 28 and 42 days, with a final growth assessment being made 56 days after inoculation.

2.2 Testing for Antimicrobial Activity to ISO 22196: 2007

Test samples for each paint system were prepared by applying 1 full brush coat of primer followed by 2 full brush coats of finish to a sheet of polypropylene film (known to have no antimicrobial activity). The test samples were allowed to air dry at room temperature for 24 hours between coats, and for 7 days prior to testing.

The prepared paint films were tested for antibacterial activity using a procedure based on ISO 22196: 2007. This procedure was modified to allow for the porosity of the paint films.

As described in the standard the test was carried out twice using 2 different test organisms - *Staphylococcus aureus* ATCC6538P and *Escherichia coli* ATCC8739.

For each test organism and each paint, 3 samples, 2 cm by 2 cm, were cut from the coated film to provide three replicates. The paint films were then detached from the polypropylene film and placed in the base of a 5 cm diameter Petri dish.

0.1 ml of a suspension of the test organism (containing approx. 5×10^5 cells) was placed on the detached films which absorbed the inoculum (the Petri dish base ensured that it was retained within or in contact with the film). Similarly 0.1 ml of a suspension of the test organism was placed on triplicate samples of uncoated polypropylene film (used as the PRA control). The suspension was held in intimate contact with the test surface using a polyethylene film rectangle, 20 mm x 20 mm in size. (This ensured that the test area for both the paint films and the PRA control was the same).

To provide a time zero inoculation level, an additional triplicate set of PRA control samples were inoculated and washed off immediately, each into 10 ml of sterile neutralizer solution, shaken with glass beads, and bacterial counts determined to give a time zero count.

The paint film samples and the remaining control samples were incubated at 21°C and relative humidity of not less than 90%. After 24 hours incubation these were washed off as described previously, and bacterial counts determined.

3 Results and Observations

3.1 Fungal Resistance testing to BS 3900: G6

Fungal growth assessments on the test and control systems are given in Table 1. Sample condition was rated according to the following numerical scale:

- 0 = no growth
- 1 = trace of growth
- 2 = growth on 1-10% of test face
- 3 = growth on 10-30% of test face
- 4 = growth on 30-70% of test face
- 5 = growth on 70-100% of test face

A photographic record was made and plates are included in Section 5.

Table 1: Fungal Resistance Testing to BS 3900: G6

Test System	Fungal Growth Rating		
	28 days	42 days	56 days
PRA control	5, 5	5, 5	5, 5
Water based paint	1, 1	1, 1	1, 1
Elastomeric paint	1, 1	1, 1	1, 1

3.2 Antimicrobial Testing to ISO 22196: 2007

The microbial counts obtained (shown as a geometric mean), together with the antimicrobial activity (shown as a Log10 reduction) and % kill, are given in Tables 1 and 2.

The antimicrobial activity was calculated as follows:

$$R = [\log (B/A) - \log (C/A) = [\log (B/C)]$$

where, R = antimicrobial activity

A = mean microbial count on PRA control sample at time zero

B = mean microbial count on PRA control sample after 24 hours

C = mean microbial count on test piece after 24 hours

Table 2: Antimicrobial Activity against *S. aureus*

Test System	Mean Bacterial Count		Antibacterial Activity	% Kill
	Initial count	24 hr count		
PRA control	4.3×10^5	2.0×10^5	-	-
Water based paint	-	< 10	> 4.3	>99.99
Elastomeric paint	-	3.9×10^3	1.7	98.05

Table 3: Antimicrobial Activity against *E. coli*

Test System	Mean Bacterial Count		Antibacterial Activity	% Kill
	Initial count	24 hr count		
PRA Control	5.1×10^5	2.4×10^5	-	-
Water-based paint	-	5.3×10^1	> 3.7	>99.98%
Elastomeric paint	-	1.4×10^3	2.2	99.42

4 Conclusions

4.1 Fungal Resistance Testing

Using the BS 3900: G6 test, ratings 0, 1 and 2 are considered by PRA to represent 'pass' levels since, at most, only very slight growth will have occurred on the test face (up to a maximum of 10%). The higher ratings of 3, 4 and 5 are considered by PRA to represent 'fail' levels since a noticeable increase in biomass from the initial level will have occurred, usually accompanied by darkening and spreading of hyphal strands across the surface.

Referring to Table 1, after 56 days the PRA control paint had developed extensive fungal growth (rated 5, 5), whereas only a trace of growth had developed on the films prepared from both the water based and elastomeric paint systems (rated 1, 1). It is concluded therefore that the two paint systems demonstrated excellent resistance to fungal growth.

4.2 Antimicrobial Testing

ISO standard 22196: 2007 specifies a method of evaluating the antimicrobial activity of antimicrobial-treated materials which includes paint films.

The predecessor to this ISO standard, JIS Z 2801: 2000, stated that for a coating to demonstrate antimicrobial efficacy the value of the antimicrobial activity shall not be less than 2.0 (equivalent to a kill rate of 99%). The new ISO standard provides a means of quantifying the antimicrobial effectiveness of a surface in terms of antimicrobial activity but no longer specifies a value for determining antimicrobial efficacy.

Referring to Tables 2 and 3, the antibacterial activity of films prepared from the water based paint was shown to exceed a level of 3 (*E. coli*) and 4 (*S. aureus*) giving a kill rate greater than 99.9%. It is concluded therefore that this paint demonstrated excellent antimicrobial activity against the two bacteria used in the test.

Again referring to Tables 2 and 3, the antibacterial activity of films prepared from the elastomeric paint was shown to exceed a level of 2 against *E. coli* (kill rate greater than 99%) however against *S. aureus* the antibacterial activity was only 1.7 (kill rate less than 99%). It is concluded therefore that although this paint demonstrated good activity against *E. coli*, against *S. aureus* the activity was considered borderline.

5 Appendix: Photographic Plates



Plate 1: PRA Control Paint at 56 days

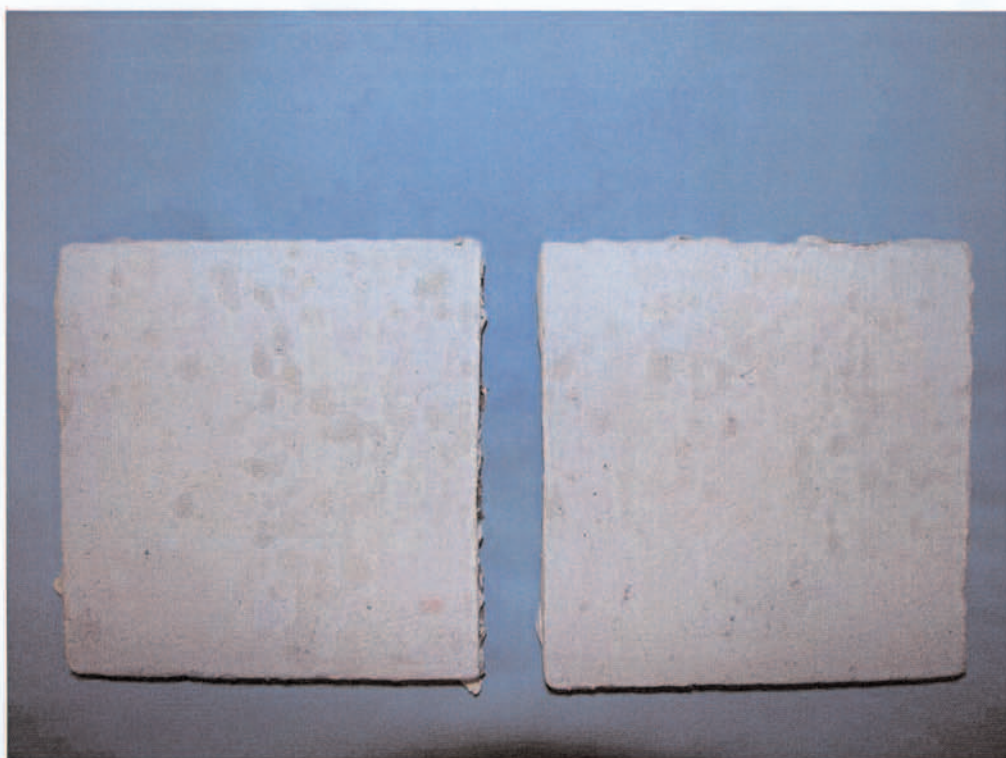


Plate 2: Water-based Paint at 56 days

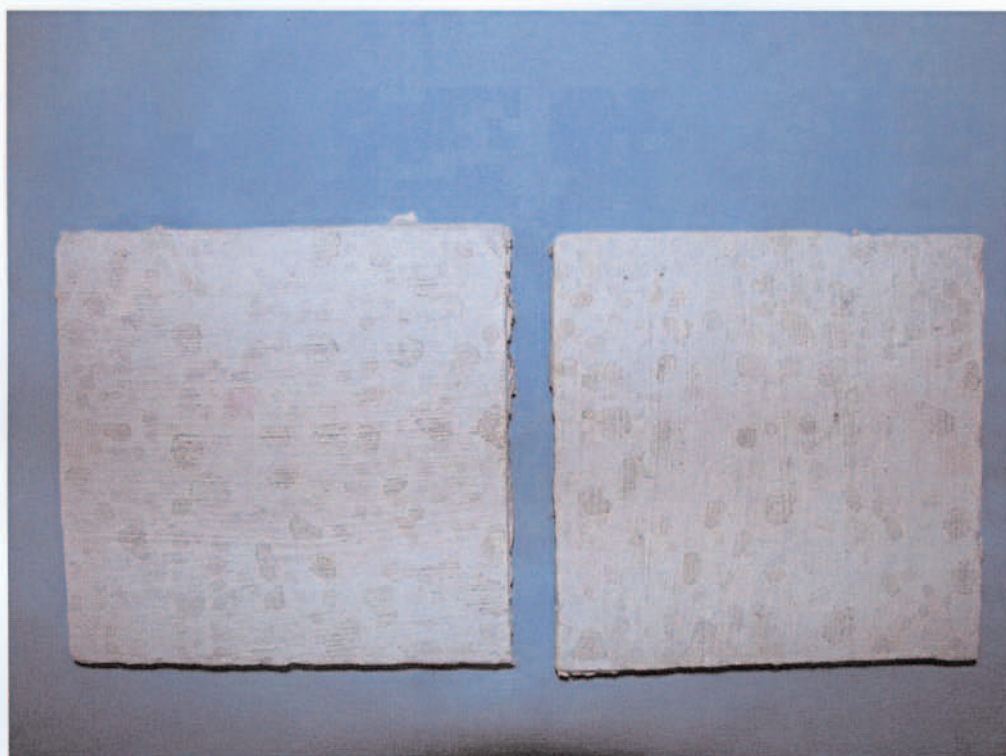


Plate 3: Elastomeric Paint at 56 days

End of Report

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Paint Testing

For

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Date Received 03 September 2008
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Work Requested Paint Testing

Samples Submitted Two Water Based Paint Systems and a Glass Coating

Work Carried out by

P. Lee

Approved by
T.J. Glazier

J. Bourne, P. Collins, T. Glazier

Authorised Signatory

1 Materials Submitted For Testing

- 2 x 1 litre Nano Water Base Primer
- 2 x 1 litre Nano Water Base Finish
- 2 x 1 litre Nano Elastomeric Primer
- 2 x 1 litre Nano Elastomeric Matt Finish White
- 2 x 125 ml Nano Glass Coating

2 Test Procedure

Tests For Elastomeric Primer and Elastomeric Finish as a complete system

1000 Hours Artificial Weathering BS EN ISO 11507

Application Details

One coat of Primer was brushed out over Master Board .The primer coat was then over coated seven hours later with the first coat of topcoat .

The second coat of topcoat was brushed on 16 hours later.

The panels were then allowed to age for one week before being put on test.

The panels were monitored for gloss and colour changes during the duration of the test period.

Elongation ASTM D2370

Application details:

The primer was drawn down using a 100 micron spiral applicator over a polythene panel. The primer coat was allowed to dry overnight before over coating with the elastomeric finish. The elastomeric finish was also applied using a 100 micron spiral applicator.

The complete system was then allowed to age for 1 week before removing the coating from the substrate to obtain a free film. The coating was then cut into strips for the elongation test, using a Instron tensile tester which stretched the film at a rate of 20mm/minute. The reported result is the percentage elongation of the film at the time of breakage.

Contact Angle Using Camtel CDCA 100 Tensiometer

The contact angle was done using the Wilhelmy plate method using a tensiometer. This consists of immersing and withdrawing a microscope cover slide coated on both sides with paint into a container of deionised water while recording the force in mN. A plot of the immersion depth vs force is made and the contact angle is calculated from the slope of the best fit straight line made by extrapolation of this graph to the intercept on the force axis.

Tests For Water Based Primer**VOC Content**

Samples were prepared and analysed to a methodology based on ISO /DIS 11890-2(2nd Edition 2006-11-15).

The VOC calculation was made using EN ISO 11890 Method 2.

Water Based Finish**VOC Content**

As per method and calculation used for the water based primer.

Tests For Water Based Primer /Water Based Finish as a complete system**1000 Hours Artificial Weathering BS EN ISO 11507****Application Details**

As used for the elastomeric primer and finish

Contact Angle Using Camtel CDCA 100 Tensiometer

Method Used: As used for the elastomeric primer and finish

Tests For Nano Glass Coating

Application details for Use of the Glass Coating

The glass panels were smeared with the glass coating, (ensuring that the surface was saturated with the coating solution) using a soft tissue.

The coating was allowed to dry for about 3 hours and was then polished with a soft tissue.

Before being put on test, the roll off behaviour of water over the glass was checked. If correctly done, the water will form droplets (and thus not spread out) and should roll off quickly/easily from the glass panel.

1000 Hours Artificial Weathering BS EN ISO 11507

Two glass panels coated with Glass Coating were put on test. Light transmission through the panels before and after the test was measured to see the effect of the artificial weathering on the coating.

Contact Angle Using Camtel CDCA 100 Tensiometer

Method Used: As used for the elastomeric primer and finish

Light Transmission Test.

The transmission of light through glass coated with Nano Glass Coating was compared to the transmission of light through a uncoated pane of glass.

3 Results and Observations

Results For Elastomeric Primer and Elastomeric Finish as a complete system

1000 Hours Artificial Weathering BS EN ISO 11507

At 1000 hours the panels were slightly yellower than unexposed panel, but not significantly so.

No blistering or any other breakdown (eg cracking) of the paint film was seen.

No changes in gloss were seen.

Elongation ASTM D2370

Sample	Elongation Results(%)	Mean Elongation Results(%)
	Min-Max	
Elastomeric Primer/Finish	199% - 400%	311%

Contact Angle Using Wilhelmy Method (2 results taken)

Sample	Results	Average contact angle
Elastomeric Primer/ Finish	76.80°,81.54°	79.17°

VOC Content Results For Water Based Primer

This was found to be 7.07 grams per litre.

VOC Content Results For Water Based Finish

This was found to be 8.69 grams per litre.

Results For Water Based Primer and Water Based Finish as a complete system

1000 Hours Artificial Weathering BS EN ISO 11507

At 1000 hours the panels were slightly yellower than unexposed panel, but not significantly so.

No blistering or any other breakdown (eg cracking) of the paint film was seen.

No changes in gloss were seen.

Contact Angle Using Wilhelmy Method (2 results taken)

Sample	Results	Average contact angle
Water based primer/Water based Finish	69.43°,66.23°	67.83°

Results For Nano Glass Coating

1000 Hours Artificial Weathering BS EN ISO 11507

No change was noted in the transmission of light through the glass panels after the 1000 hours of artificial weathering. (ie There was no hazing or obvious degradation of the glass coating.)

Contact Angle Using Wilhelmy Method (2 results taken)

Sample	Results	Average contact angle
Nano Glass Coating	97.76°,98.84°	98.30°

Light Transmission Test.

The light transmission results showed that differences in light transmission through an uncoated and coated glass panels were of an extremely minor nature. (ie The glass coating does not impede the transmission of light).

End of Report



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