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**Agrément
Certificate
No 06/4319**

Designated by Government
to issue
European Technical
Approvals

GRACE ADPRUFE SYSTEM

Additif pour béton imperméable
Beimischung zur Beton Wasserdichtung

Product



• THIS CERTIFICATE RELATES TO THE GRACE ADPRUFE⁽¹⁾ SYSTEM, A TWO-COMPONENT SYSTEM COMPRISING A PORE BLOCKING ADMIXTURE AND A HIGH RANGE WATER-REDUCING ADMIXTURE TO PROVIDE WATERTIGHT CONCRETE.

- The system gives concrete enhanced durability and improved protection against reinforcement corrosion
- When used in accordance with this Certificate the system has no detrimental effects on the properties of the concrete.
- The system can provide watertight concrete for basement, swimming pool, tunnel, culvert and similar structures not subject to conditions of freeze/thaw cycling.

(1) The component products, Adprufe and Adva are registered trademarks of W R Grace Co – Conn.

Regulations

1 Building Regulations 2000 (as amended) (England and Wales)



In the opinion of the British Board of Agrément the use of this system is not subject to these Regulations.

2 The Building (Scotland) Regulations 2004



In the opinion of the BBA, the use of this system is not subject to these Regulations.

3 Building Regulations (Northern Ireland) 2000



In the opinion of the BBA, the use of this system is not subject to these Regulations.

4 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See sections: 6 Delivery and site handling (6.1, 6.3 and 6.4), and 13 Placing (13.4).

5 Description

5.1 The Grace Adprufe System comprises two components:

- Adprufe 100 — a liquid admixture that provides water resisting, pore blocking and enhanced durability when incorporated in concrete
- Adva — a range of synthetic carboxylated polymer high range water-reducing admixtures⁽¹⁾, enabling a significant reduction in the water/cement ratio of the mix while enhancing the workability of the concrete during placement.

(1) Conforming to the requirements BS EN 934-2 : 2001 Table 3.1 and 3.2.

5.2 Both components are produced by a blending process. Quality control is exercised over raw materials, during production and on the final product.

6 Delivery and site handling

6.1 The system components are supplied direct to site in 25, 205 and 1000 litre labelled containers or delivered in bulk by tanker. The label bears the company and product details, the batch number and a hazard label.

6.2 The system components must be stored in sealed containers and protected from frost. The components have a 12 month shelf-life when stored under these conditions.

6.3 Health and Safety Data Sheets and the Control of Substances Hazardous to Health Regulations 2002 (COSHH) risk assessments for the works should be available to the purchaser and maintained on site.

6.4 The components of the system are not classified as hazardous. However, overalls, gloves and safety glasses should be worn when handling the components.

Design Data

7 General

7.1 Concrete containing the Grace Adprufe System should be designed in accordance with BS EN 206-1 : 2000 and BS 8500-2 : 2002 for use as all normal types, including precast, pre-stressed, post-tensioned, ready-mixed, reinforced, slip formed, sprayed and pumped concrete.

7.2 The system produces concrete with enhanced durability and improved protection against reinforcement corrosion by providing a physical pore-blocking action that protects the resulting concrete against water ingress via hydrostatic pressure.

7.3 The use of the system will produce a concrete with the following properties relative to a control:

- reduced porosity
- reduced permeability
- increased water resistance
- increased corrosion resistance.

7.4 The concrete can be used in basement, swimming pool, tunnel, culvert, and similar structures, not subject to conditions of freeze/thaw cycling, without the requirement for additional applied protection.

7.5 Where exposure to aggressive soil conditions or chemicals is anticipated, a full assessment of the site should be made. In these situations the Certificate holder should be consulted on the suitability of the system.

7.6 The system is compatible with cement blends containing pulverized-fuel ash, ground granulated blastfurnace slag and silica fume as defined in BS EN 197-1 : 2000.

7.7 Use of the system with an air-entraining agent is not covered by this Certificate.

8 Construction

8.1 Structures built incorporating the system should be designed to the relevant sections of BS 8007 : 1987, BS 8102 : 1990, BS 8110-1 : 1997, BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004.

8.2 Concrete containing the system is suitable for Type B construction as described in BS 8102 : 1990, and it will be suitable for all grades defined in Table 1 of this Standard. For Grades 3 and 4 (where control of water vapour is required), it will be necessary to provide a mix with a sufficiently low vapour permeability in combination with an adequate section thickness (see sections 10.11 and 10.12).

8.3 Basements for dwellings should be designed in accordance with the guidance given in the Approved Document *Basement for dwellings*⁽¹⁾.

(1) Published by the British Cement Association, Document No 48.062.

9 Mix design

9.1 Concrete containing the system is normally supplied as ready-mixed concrete but may be prepared on sites where there is adequate mix control. Concrete prepared on site should be carried out in accordance with BS 8000-2.1 : 1990, the Certificate holder's instructions and this Certificate.

9.2 The system components should be added to the concrete mix at the rate of:

- Adva — 0.50% by weight of cement⁽¹⁾
- Adprufe 100 — 2.50 to 3.75 lm^{-3} concrete.

(1) The dose may be varied with the Certificate holder's agreement to obtain the appropriate slump and ensuring the maximum water/cement ratio given in section 9.3 is maintained.

9.3 The concrete is typically designed with a cement content of 360 kgm^{-3} . It must have a minimum cement content of 325 kgm^{-3} and be batched with a maximum water/cement ratio of 0.40. Further details of suitable mixes can be obtained from the Certificate holder or their approved representatives.

9.4 The workability of concrete is adjusted using the Avda superplasticising admixture to ensure the maximum water/cement ratio given in section 9.3 is not exceeded.

10 Concrete properties

10.1 The effect of the product on the properties of concrete designed to BS EN 480-1 : 1998 Reference concrete 1, are given in Tables 1 to 3.

Table 1 Sample details

Component	Control concrete	Grace Adprufe System	
		Mix A	Mix B
Adprufe 100 (lm^{-3})	—	2.50	3.75
Avda (% wt/wt PC)	—	0.50	0.50
Water/cement ratio	0.50	0.40	0.41

Table 2 Effects of Grace Adprufe System on the properties of fresh wet concrete

Property	Test reference	Control concrete	Grace Adprufe System	
			Mix A	Mix B
Slump (mm)	BS 12350-2	70	135	135
0 min			55	45
30 min		60		
Plastic density (kgm^{-3})	BS EN 12350-6	2400	2420	—
Air content (%)	BS EN 12350-7	0.8	0.9	—
Setting time (min)	BS 5075-1	265	315	—
Initial set			390	—
Final set			—	—

Setting and hardening characteristics

10.2 The effect of the system on these properties, for a specific mix and site conditions may be evaluated through site trials prior to use.

10.3 The setting time of concrete mixes containing the Grace Adprufe System will be similar when compared to an equivalent plain concrete. The amount of retardation will also depend on the concrete mix design used and ambient temperature during placing and curing.

Drying shrinkage and wetting expansion

10.4 The drying shrinkage and wetting expansion of concrete containing the system shows a reduction compared to that of an equivalent plain concrete.

Table 3 Effects of Grace Adprufe System on the hardened properties of concrete

Property	Test reference	Control concrete	Grace Adprufe System	
			Mix A	Mix B
Water permeability (ms^{-1})	Taywood/Valenta	6.90×10^{-14}	1.28×10^{-14}	—
Water vapour permeability ($\text{gm} [\text{NS}]^{-1}$)	BS 3177	660×10^{-12}	290×10^{-12}	—
Water absorption (%)	BS 1881-122		1.7	0.6
10 min			2.8	1.1
30 min			3.7	1.6
60 min			4.8	2.1
120 min				
Initial surface absorption test ($\text{mlm}^{-2}\text{sec}^{-1}$)	BS 1881-208		0.246	0.094
10 min			0.125	0.051
30 min			0.117	0.048
60 min				
Capillary absorption (% by mass of control)	BS EN 480-5		100	20
7 day			100	26
90 day				
Drying shrinkage (%)		0.050	0.040	0.022
Wetting expansion (%)	BS 1881-5	0.030	0.020	0.016
Compressive strength (Nmm^{-2})	BS EN 12390-3		11.0	19.2
24 hrs			47.0	64.5
28 days				64.0
Flexural strength (Nmm^{-2})	BS EN 12390-5		1.52	2.47
24 hrs			5.69	6.45
28 days				
Modulus of elasticity (Nmm^{-2})	BS 1881-121		36500	39500
28 days				

Mechanical properties

10.5 The compressive strength of concrete containing the system will be higher than the equivalent plain concrete with the same slump.

10.6 The flexural strength of concrete containing the system will be higher than the equivalent plain concrete with the same slump.

10.7 The static modulus of elasticity of concrete containing the system is higher than the equivalent plain concrete.

Resistance to leaching

10.8 Use of the system will reduce the leaching of lime from the hydrated cement in the concrete.

Water penetration

10.9 Concrete containing the system has significantly greater resistance to water penetration than equivalent plain concretes.

Water vapour permeability

10.10 Concrete containing the system has a significantly lower permeability to water vapour than the equivalent plain concrete.

10.11 Concrete made with a high water/cement ratio can have a water vapour permeability above $3000 \times 10^{-12} \text{ gm(Ns)}^{-1}$. The permeability of concrete is strongly dependent on the exact mix design and the figures given in Table 3 indicate the levels that can be obtained with the Grace Adprufe System.

10.12 The appropriate thickness for concrete with a specific permeability to achieve a water vapour resistance of 200 MNsg^{-1} or 550 MNsg^{-1} (suitable for grades 3 and 4 respectively of BS 8102 : 1990) is given by:

For 200 MNsg^{-1}

$$t = 0.2 \times 10^{12} \times p$$

For 550 MNsg^{-1}

$$t = 0.55 \times 10^{12} \times p$$

where t = concrete thickness (mm)

and p = water vapour permeability in gm(Ns)^{-1} (from BS 3177 : 1959 test).

Water absorption

10.13 Concrete containing the system has greater resistance to water absorption than equivalent plain concrete.

Reinforcement protection

10.14 The high alkalinity ($\text{pH} > 13$) of concrete necessary to prevent corrosion of the reinforcement is maintained in concrete containing the system.

10.15 Corrosion of reinforcement is normally caused by the ingress of chloride to the steel or by the reduction in alkalinity of the concrete by the diffusion of carbon dioxide. These processes lead to the breakdown of the steel's corrosion-protective passive layer. Reduced permeability of concrete containing the system slows down diffusion of aggressive agents into the concrete and confers improved protection against corrosion.

Carbonation resistance

10.16 Concrete containing the system has a greater resistance to carbon dioxide diffusion than an equivalent plain concrete due to its reduced permeability.

Sulphate resistance

10.17 The lower permeability of concrete containing the system will reduce the ingress of sulphates. However, if sulphate-resistant concrete is required the advice of the Certificate holder should be sought.

Alkali silica reaction (ASR)

10.18 Concrete containing the system should be designed according to BS EN 206-1 : 2000,

Section 5.2.3.4 and BS 8500-2 : 2002, Section 5.2.1.

10.19 The sodium oxide equivalent of Adprufe 100 when measured in accordance with BS EN 480-12 : 1998 was 0.01% by mass of admixture.

10.20 This figure should be used when calculating the contribution of the system to the total alkali content of a given concrete mix. In turn, this can be used to assess the susceptibility of the concrete to alkali-silica reaction.

11 Durability

Concrete containing the system is more durable than equivalent plain concrete due to its reduced permeability.

Installation

12 Site mixing

The components of the Grace Adprufe System are added to the concrete at the dosages given in sections 9.2 to 9.3 by automatic dispensing equipment. Between 50% to 75% of the total water is added first, followed by the Adprufe 100, then finally the Adva and the rest of the required mix water. The components must always be added separately and should never be mixed together prior to addition.

13 Placing

13.1 All aspects of placing must be carried out in accordance with BS 8000-2.2 : 1990, the Certificate holder's instructions and this Certificate.

13.2 Concrete containing the system should not be placed at temperatures of 5°C or below.

13.3 Once mixed, further materials must not be added to the fresh concrete.

13.4 Concrete containing the system should be placed in the same way as normal concrete, in accordance with the normal routine precautions for handling concrete.

13.5 Concrete containing the system should be fully compacted.

14 Curing

The concrete should be cured strictly in accordance with BS 8110-1 : 1997 and the Certificate holder's recommendations where site specific information exists.

15 Joints

15.1 Joints should be designed with waterstops as recommended in BS 8102 : 1990, to maintain watertightness of the whole structure. The advice of the Certificate holder should be sought on particular applications.

15.2 Penetrations of the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The advice of the Certificate holder should be sought on suitable systems.

16 Finishes

When water-based products are used to coat the concrete containing the system, a bonding agent may be needed. For specific cases, advice should be sought from the Certificate holder.

Technical Investigations

The following is a summary of the technical investigations carried out on the Grace Adprufe System.

17 Tests

Tests were carried out by the BBA to determine:

- characteristics of the Adprufe 100 including:
 - conventional dry material content
 - pH
 - setting time in cement-blended mortars
 - total chlorine
 - water soluble chloride
 - IR trace
 - alkali content
- fresh concrete
 - setting time
 - workability
- hardened concrete
 - compressive strength
 - flexural strength
 - modulus of elasticity
 - bond to steel
 - freeze/thaw resistance
 - drying shrinkage
 - wetting expansion
 - water vapour permeability
 - liquid water permeability
 - efflorescence
 - water absorption
 - capillary absorption
 - initial surface absorption.

18 Investigations

The manufacturing process was examined including methods for quality control, details of quality and composition of the materials used.

Additional information

The management systems of Grace Construction Products Ltd have been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2000 by BSI (Certificate No Q05912).

Bibliography

- BS 1881-5 : 1970 *Testing concrete — Methods of testing hardened concrete for other than strength*
- BS 1881-121 : 1983 *Testing concrete — Method of determination of static modulus of elasticity in compression*
- BS 1881-122 : 1983 *Testing concrete — Method for determination of water absorption*
- BS 1881-208 : 1996 *Testing concrete — Recommendations for the determination of the initial surface absorption of concrete*
- BS 3177 : 1959 *Method for determining the permeability to water vapour of flexible sheet materials used for packaging*
- BS 5075-1 : 1982 *Concrete admixtures — Specification for accelerating and retarding water reducing admixtures*
- BS 8000-2.1 : 1990 *Workmanship on building sites — Code of practice for concrete work — Mixing and transporting concrete*
- BS 8000-2.2 : 1990 *Workmanship on building sites — Code of practice for concrete work — Sitework with in-situ and precast concrete*
- BS 8007 : 1987 *Code of practice for design of concrete structures for retaining aqueous liquids*
- BS 8102 : 1990 *Code of practice for protection of structures against water from the ground*
- BS 8110-1 : 1997 *Structural use of concrete — Code of practice for design and construction*
- BS 8500-2 : 2002 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*
- BS EN 197-1 : 2000 *Cement — Composition, specifications and conformity criteria for common cements*
- BS EN 206-1 : 2000 *Concrete — Specification, performance, production and conformity*
- BS EN 480-1 : 1998 *Admixtures for concrete, mortar and grout — Test methods — Reference concrete and reference mortar for testing*
- BS EN 480-5 : 1997 *Admixtures for concrete, mortar and grout — Test methods — Determination of capillary absorption*
- BS EN 480-12 : 1998 *Admixtures for concrete, mortar and grout — Test methods — Determination of the alkali content of admixtures*
- BS EN 934-2 : 2001 *Admixtures for concrete, mortar and grout — Concrete admixtures — Definitions, requirements, conformity, marking and labelling*
- BS EN 1992-1-1 : 2004 *Eurocode 2 : Design of concrete structures. General rules and rules for buildings*
- BS EN 1992-1-2 : 2004 *Eurocode 2 : Design of concrete structures. General rules and rules for buildings. General rules. Structural fire design*
- BS EN 12350-2 : 2000 *Testing fresh concrete — Slump test*
- BS EN 12350-6 : 2000 *Testing fresh concrete — Density*
- BS EN 12350-7 : 2000 *Testing fresh concrete — Air content — Pressure methods*
- BS EN 12390-3 : 2002 *Testing hardened concrete — Compressive strength of test specimens*
- BS EN 12390-5 : 2002 *Testing hardened concrete — Flexural strength of test specimens*
- BS EN ISO 9001 : 2000 *Quality management systems — Requirements*

Conditions of Certification

19 Conditions

19.1 This Certificate:

- (a) relates only to the product that is named, described, installed, used and maintained as set out in this Certificate;
- (b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;
- (c) is valid only within the UK;
- (d) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;
- (e) is copyright of the BBA;
- (f) is subject to English law.

19.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

19.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabrication including all related and relevant processes thereof:

- (a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine; and

(c) are reviewed by the BBA as and when it considers appropriate.

19.4 In granting this Certificate, the BBA is not responsible for:

- (a) the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product;
- (b) the right of the Certificate holder to market, supply, install or maintain the product; and
- (c) the actual works in which the product is installed, used and maintained, including the nature, design, methods and workmanship of such works.

19.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.



In the opinion of the British Board of Agrément, the Grace Adprufe System is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 06/4319 is accordingly awarded to Grace Construction Products Ltd.

On behalf of the British Board of Agrément

Date of issue: 24th March 2006

A handwritten signature in black ink, appearing to read 'G. A. Cooper', is written over a light grey background.

Chief Executive

British Board of Agrément

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For technical or additional information,
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Certificate, including validity and
scope, tel: Hotline 01923 665400,
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