

**Client Report :**

Scoping study: Service life  
estimation of PVC-U windows

**Prepared for :**

Dr Mercia Gick  
British Plastics federation

16 March 2006

**Prepared on behalf of BRE by**

Signature

Name

Mike Clift

Position

Associate Director

**Approved on behalf of BRE by**

Signature

Name

Dave Richardson

Position

Director Construction Consultancy

Date

BRE  
Construction Division  
Bucknalls Lane  
Garston  
Watford  
WD25 9XX

Tel : 01923 664200  
Fax : 01923 664096

Email : [construction@bre.co.uk](mailto:construction@bre.co.uk)  
Website : [www.bre.co.uk](http://www.bre.co.uk)

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## Executive Summary

PVC-U window suppliers have increasingly found that housing associations and registered social landlords are becoming reluctant to specify their products on the basis of their perceived capital and whole life costs, and environmental impacts. By and large this is as a direct result of the rating reflected in BRE publications such as the Green Guide to Specification<sup>1</sup> where the relative environmental performance of PVC-U products is compared against competing products and how this is used within schemes such as BREEAM<sup>2</sup> and EcoHomes.

Undertaking whole life costing<sup>3</sup> and environmental assessments<sup>4</sup> requires data on the service life of the product being considered. This information is fundamental in that it provides data on replacement intervals and instances of interventions such as maintenance and replacements of components. For whole life costing the replacement and other interventions trigger a cost when they happen. For environmental assessments, the replacements and maintenance actions trigger new environmental burdens.

The Green Guide uses 25 years as a typical service life for PVC-U windows which translates into the environmental burdens from initial installation and two further replacements during the 60 year life cycle assessment period. The service life was based on information available at the time of the publication of the guide.

The British Plastics Federation (BPF) commissioned BRE to examine new evidence and to review the service life of 25 years for PVC-U windows.

With the help of BPF, BRE identified a representative sample of PVC-U window manufacturers that together provide some 80% of the manufactured product in the UK. These were sent a questionnaire requesting evidence of the service lives of their products.

BRE has found strong evidence, provided by the BPF and its member manufacturers that PVC-U windows should now expect to have a (reference<sup>5</sup>) service life at least 35 years under normal urban and non-aggressive conditions. This conclusion has been supported by a desk analysis of common service life data sources.

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<sup>1</sup> See Appendix A for a description of the Green Guide

<sup>2</sup> See Appendix A for a description of BREEAM

<sup>3</sup> See Appendix A for definitions for whole life costing

<sup>4</sup> See Appendix A for a description of life cycle assessment

<sup>5</sup> *Reference Service Life is the service life that a building or parts of a building would expect (or is predicted to have) in a certain set (reference set) of in use conditions.* (ISO 15686-1 clause 3.1.2)

## Service life estimation of PVC-U windows

This service life data will be used in future Green Guide, a new web version of which is due in autumn 2006, and other BRE publications, as appropriate. It will also be used in whole life cost analyses undertaken by BRE in the future.

The double glazing units, gaskets, weatherstripping and the mastic seals may need to be replaced within the life of the window. Ironmongery should be cleaned and lubricated periodically.

General assumptions include installation should be in accordance with manufacturers' instructions and the use of good practice detailing and that the window has been manufactured in accordance with relevant BS including BS EN 12608, BS 7722 and BPF Selecting the Standard 2005.

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## Introduction

### Background

The objective of the study is to review the service life of PVC-U windows. The BPF and its members believe that current techniques will extend their service life beyond the 25 years used in BRE publications. It is anticipated that the assessment will be reflected in subsequent editions of BRE tools and publications (including The Green Guide to Specification and Invest2)

This project was initiated at a meeting on 19 November 2004 between BRE the British Plastics Federation (BPF) Window Group. PVC-U window suppliers have increasingly found that housing associations and registered social landlords are becoming reluctant to specify their products on the basis of their perceived capital and whole life costs, and sustainability and environmental impacts. This is largely due to the relatively poor environmental performance of PVC-U versus competing products in BRE publications such as the Green Guide to Specification and how this is used within schemes such as BREEAM, especially given what the BPF considers as an unacceptably low life-span of PVC-U currently used within the Green Guide.

This led to a proposal to undertake a whole life cost and environmental assessment dated 22 December 2004 ref 114-253.

The proposal was broken down into four tasks:

- Task 1 Assessment of service life;
- Task 2 Assessment of whole life costs;
- Task 3 Life cycle assessment in accordance with the BRE Environmental Profiles Methodology;
- Task 4 Assessment of existing and potential for recycled PVC-U in windows.

Task 1 Assessment of service life (durability) is fundamental in that it provides data on replacement cycles and instances of interventions such as inspections and maintenance activities for input to Tasks 2 and 3. For whole life costing the replacement and other interventions trigger a cost when they happen. For life cycle assessment, they trigger environmental burdens (measured in Ecopoints).

The Green Guide to Specification uses 25 years as a typical replacement interval for PVC-U (and timber) windows which translates into the initial installation and two replacements during the 60 year study period or building life considered by the current Green Guide. This replacement period was based on industry wide data available at the time the guide was being developed.

Task 3 requires BRE to undertake environmental life cycle assessment work of PVC-U window manufacture and develop Environmental Profiles representing generic industry performance. The first phase of this work is to identify the manufacturers who will be involved in providing data into the study. For representative-ness it is desirable that the project considers 80% of the UK PVC-U windows industry including coverage of raw material manufacturers, extruders and product fabricators. Both small and large companies should be

involved in this work. This ensures that the data gathered represents a statistically acceptable sample.

### **Objective of this scoping study**

The objective of this scoping study is to complete the service life assessment as defined in Task 1 above. It is also to scope out the actions necessary to complete Task 3 including identification of the companies that will participate in the creation of Environmental Profiles. For Task 1 the focus is on PVC-U windows only, for Task 3 both PVC-U windows and cellular products will be considered.

It was also noted that the scope of the full project would be better defined if BRE was able to identify the most relevant manufactures to contact about providing service life and then environmental data.

BPF has therefore requested that BRE undertakes a scoping study before it considers embarking on the full study. Tasks for this scoping study are:

- Task A) Service life of PVC-U windows;
- Task B) Identify appropriate window and cellular cladding manufacturers.

Task B) has been completed.

## Description of project

### Service life

The service life of a product, component or material used in construction is the

- *Period of time after installation during which a facility or its parts meets or exceeds the performance requirements<sup>6</sup>*

The estimation of service life of a product should be built up from estimates of its relevant components. When the service life of a product is being considered on an actual building and a known site, the relevant actions which will influence the performance and degradation which will likely modify the service life, should be taken into account. These will include:

- a) Quality of product;
- b) Design of the assembly or works;
- c) Standards of workmanship (or work execution levels);
- d) Indoor environment
- e) Outdoor environment;
- f) Conditions of use;
- g) Maintenance levels.

The product manufacturer only has direct influence over the first of these, but will be able to provide information on several of the others, such as:

- The manufacturer will be able to give data on product quality;
- Critical design requirements (eg may include minimum angle of slope, effect of environmental issues such a salt laden wind, action of chlorine laden air in swimming pools);
- The installation should be carried out by a suitably certified installer;
- Some products may be designed for particular level of use (eg security, fire rating);
- Maintenance requirements to help ensure a stated service life is achieved.

Manufacturers holds key data on the performance of their products, although they clearly do not fully influence and cannot always be held fully responsible for the actual design, environment, workmanship or use which the product will experience in practice.

### Estimating service life

Service life estimation takes as its starting point the *reference service life*. (RSL) ISO 15686 currently has a definition for this:

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<sup>6</sup> ISO 15686-1 Service Life Planning, General principles

- *Reference Service Life is the service life that a building or parts of a building would expect (or is predicted to have) in a certain set (reference set) of in use conditions. (ISO 15686-1 clause 3.1.2)*

The designer needs to start with the information on how long a component is expected to last under 'normal' circumstances. Manufacturers, accreditation bodies and research organisations such as and British Board of Agreement, and Building Life Plans/HAPM and BRE provide service life data based on defined (normal) circumstances. The designer's job is to then consider the affect that the intended use or location of the component is going to have on its RSL – and arrive at an estimated service life. For example a number of components being used for a house within an urban environment will have different estimated service lives from similarly specified components being used in a swimming pool on the coast.

The Green Guide and other BRE guides are not project or site specific and therefore can only consider *reference service lives* based the components and materials being confined to urban, inland sites. The reference service lives used in the Green Guide are solely for the purposes of undertaking life cycle assessments. Designers should use the data with caution when deriving estimated service lives for components on actual projects.

This project seeks to identify the **reference service life** of PVC-U windows.

### **What marks the end of service life?**

Buildings and their component parts deteriorate over time. The rate of deterioration depends on a number of factors such as the indoor and outdoor environment, design, quality of construction, the nature of use and the level of maintenance. The service life of a building will therefore depend on the amount of deterioration that is acceptable for it and its components and, ultimately, on regulatory factors (particularly safety).

The appropriate limit state may vary depending on a number of factors including the type of element or structure and the associated performance requirements, as well as on the maintenance regime that is to be adopted.

BRE has agreed with BPF the following definition for the end of service life for a PVC-U window

- *Failure of a PVC-U window occurs when it is no longer feasible to replace ironmongery or other components*

There are five materials that are used for the manufacture of windows in the UK – softwood, hardwood, galvanised steel, aluminium and PVC-U. The latter was little used before 1970, but since then its use for domestic replacements has grown rapidly and now has a majority share in the market.

In the mid 1980s, many Local Authorities were keen to specify alternatives to softwood windows and doors required each year as replacement for worn out windows in their council owned estates. Many carried out exhaustive evaluations of alternative window types - hardwood, galvanised steel, aluminium and PVC-U. Some more innovative councils, such as Blackburn BC, set up their own manufacturing plant for PVC-U windows and embarked on a 15 year replacement programme. However many LAs only replaced worn out windows with single glazed units, usually in PVC-U, which would soon become obsolete or unacceptable when new Part L Building Regulations were introduced and for stock transfer deals. They were then often replaced again before the end of their service lives with more efficient and customer acceptable high performance double glazed systems. This has presented a distorted view of the service lives of replacement PVC-U windows.

As a general rule, BRE has found that most defects arise from poor design and specification (around 40%), poor workmanship (around 40%) and around 20% due to poor manufacture. This is particularly true for the replacement of domestic window market where surveys have shown that customer dissatisfaction is more often to do with poor installation than with the product itself.

### Sources of data

BRE undertook an evaluation of the available evidence on the service lives of PVC-U windows using a range of specifications commonly used by the industry and provided by selected manufacturers. Specifications are based on UK construction practice to satisfy current UK building regulations and specifications provided by the BPF member organisations identified below.

ISO 15686-1 states that service life prediction should be based on exposure and performance evaluation and may be supported by the following sources:

- data provided by a manufacturer, a test house or an assessment regime (for innovative components it will normally be based on manufacturers' or suppliers' exposure results); this may be a single figure or a distribution of typical performance;
- previous experience or observation of similar construction or materials used in similar conditions;
- Boards of Agreement in the EC state assessments of durability in their certificates or reports of national product evaluation services;
- some books which are available and which include typical service lives;
- building codes which may give typical service lives for components.

The data considered for this project was that provided by the main manufacturers below, data from the Housing Association Property Mutual (HAPM)/Building Life Plans and the Building Maintenance Information (BMI) published by the RICS.

The following organisations have been identified from discussions with BPF and are considered to undertake the manufacture of some 80% of PVC-U windows in the UK :

- VEKA
- Kommerling
- Rehau
- Bowater
- Deceuninck
- Anglian

## 7 Service lives of PVC-U windows

Questionnaires<sup>7</sup> were compiled by BRE and sent by BPF to member organisations that together were considered to provide window products for around 80% of the UK market for PVC-U windows. The questionnaires were returned to BPF and forwarded to BRE.

The results are summarised in Table 1. A full set of returned data can be found in a separate report.

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<sup>7</sup> See Appendix B

## Findings

### Summary of results

Examples of PVC Window Systems still in use today provided from the questionnaires are summarised in Table 1

Source	Location	Manufacturer/spec	Date of installation	Still in use	Approximate age
VEKA	Saunders residence, Nelson	Frisoplast,	Sovereign Circa 1980	y	25
	Sovereign Factory, Nelson	VEKA Verbundfenster	Sovereign Circa 1981	y	25
	Sovereign Factory, Nelson UK	Twin Seal Tilt & Turn	Sovereign Circa 1981	y	25
	Kings St Blackburn UK	Kommerling	Circa 1982	y	25
	Frankenthal Germany	Kommerling	Circa 1982	y	25
Solvay/Solvin	Bubendorf Austria		1972	y	34
Greiner-Austria	Kremsmunster Austria		1976(copy of quote)	y	30
	Vienna, Austria (offices)		1976 (copy of quote)	y	30
Cincinnati Extrusions	West Midlands UK		1978	y	28
W H Smith Tools Ltd	Cheshire		1983	y	23
P Jervis BPF	House Oldham UK	Kommerling	1979	y	27
	Shop Oldham UK	Kommerling	1980	y	26
	Erlangen	Kommerling	1981/2	y	24
	Birch services M62 UK	Anglian	1985	y	21
Rehau	SW UK	Rehau	1968	y	38
Epwin	UK domestic	Epwin	1977	y	29
Anglian	Derby UK Office	Anglian	1978 (frame date stamped)	y	28
L B Plastics		L B Plastics	1980	y	26
Bowater xxxx	Ludwigshafen Germany commercial (ref 24)		1968	y	37
	Ludwigshafen Germany commercial (ref 22)		1971	y	34

Source	Location	Manufacturer/spec	Date of installation	Still in use	Approximate age
	Frankenthal, Germany domestic (ref 1)		1972	y	33
	Linz Austria domestic (ref 28)		1972	y	33
	Linz Austria, commercial (ref 26)		1973	y	32
	Ludwigshafen Germany commercial (ref 26)		1974	y	32
	Linz Austria, commercial/flats (ref 27)		1974	y	31
	Leverkusen, Germany domestic (ref 10)		1975		30
	Bubendorf-Kematen, Austria domestic (ref 2)		1976 (copy of quote)	y	29
	Kremensmunster, Austria (ref 3)		1976	y	29
	Vienna, Austria commercial (ref 4)		1978	y	27
	Linz Austria, domestic (ref 6)		1978	y	27
	Stockport UK domestic (ref 17)		1978	y	27
	Stockport UK domestic (ref 18)		1979	y	26
	Hamburg, Germany domestic (ref 22)		1969 (inspected 1994)	n/a	25 achieved
	Herten Germany		1969 (inspected 1994)	n/a	25 achieved
	Monheim am Rhein, Germany domestic (ref 16)		1980	y	25

**Table 1 Summary of evidence from BPF of 25+ years installed PVC-U windows**

Box 1 is an extract from a typical BBA certificate for a PVC-U window indicating a service life of at least 25 years.

BBA Agreement Certificate 04/4153 for Nolan UPVC Ltd for Profile 22 PVC-U window system

**Durability** Evidence is available on the performance in the UK and other Northern European countries of PVC-U similar to that for the system over a period 15 years for woodgrain windows and in excess of 20 years for white windows. Such evidence when compared with the results of tests on the Profile 22 PVC-U, indicates that the windows will have a life of at least 25

years. Any slight colour change or surface dulling that might occur will be uniform over surfaces of both white and woodgrain finish windows receiving equal exposure to solar radiation, assuming that for woodgrain finish the acrylic outer layer is undamaged.

Fittings, including the hinges, locking mechanism and operating handles, as described in the detail sheet will have similar durability except where the windows are installed in areas subject to particularly aggressive conditions. These conditions can prevail in coastal locations or near sources of pollutants and replacements of fittings may necessary within the life of the window.

The gaskets, weatherstripping and the mastic seal may need to be replaced within the life of the window.

**Box 1 Extract from BBA Agreement Certificate 04/4153**

Box 2 is an extract from A BRE digest that noted in 1995 that PVC-U windows have been around even then for over 30 years

BRE Digest 404 1995 on PVC-U windows noted that in terms of weathering, white PVC-U windows had been used in Germany for over 30 years, generally with satisfactory performance.

**Box 2 Extract from BRE Digest 404 1995**

Box 3 is an extract from a DETR report published in 2000 that assumes a service life of PVC-U windows of 30 years

DETR report Life Cycle Assessment of Polyvinyl Chloride and Alternatives 2000 by Entec UK stated that PVC and timber windows used for the assessment had an assumed life span of 30 years.

**Box 3 Extract from DETR report**

**Housing Association Property Mutual (HAPM)/Building Life Plans data**

HAPM was founded in 1990 to provide latent defect insurance for 35 years to tie in with long-term loans prevalent at that time. Data derived by HAPM was established to provide insurance cover to smaller housing associations and registered social landlords. The service life data provided is in fact insured life data and is hence expected to be on the conservative side. HAPM indicates an insured life for PVC-U windows as 25 years.

HAPM Technical Note Lifespans of Building Components June 1995 set out other uses of the component life data other than for insurance purposes. Independent research had indicated that insured lives of many longer life components could be increased by a factor of 1.2. This would imply a reference service life of  $24 \times 1.2 = 30$  years for PVC-U windows based on HAPM data.

When surveyors and engineers attempt to estimate the residual life of a component following an inspection at the time of its expected end of life, they will apply a rule of thumb assessment based on the condition of the component in question. A code is applied to the condition: A = as new, B = in good condition, C = some wear, but still serviceable, and D = no longer serviceable/time expired. For condition C, which is the 'worst' case, it is not uncommon to

estimate an additional 25% of its original estimated service life to arrive at a residual life and a revised service life, based on inspection.

Based on the photographic evidence provided by BPF members, the 30 year service life based on HAPM data can be conservatively extended by a further 25% giving a rounded service life of in excess of 35 years.

#### **Building Maintenance Information (BMI) data**

On behalf of the RICS, BMI undertook a questionnaire driven survey to gather information on the experience of life expectancies of common building components from surveyors who regularly inspect and report on buildings in use. The results are published by the RICS and do not take into account specific design, construction, location, positioning, local ground conditions, air quality, loading or mis-use that may occur. For each component data is provided giving, for PVC-U windows:

- Average typical life 35 years
- Average minimum life 25 years
- Average maximum life 50 years
- (Range 11 to over 100 years)

#### **Conclusions**

The data provided by BPF members included photographic evidence. All the windows illustrated were still in good condition and little or no signs of deterioration, with no indications from the building owners that they are intending an imminent replacement. The examples from the information provided were all 25 years old or more and ranged up to 38 years. A typical BBA certificate indicates a service life of at least 25 years.

HAPM indicates that PVC-U windows should have an insured life of 25 years, which equates to a service life of 30 years. Based on the photographic evidence, this can conservatively be extended to 35 years

BMI indicates a typical life of 35 years.

Based on this evidence, BRE would expect the service life of PVC-U windows to be at least 35 years. This is assuming a 'normal' urban location, domestic scale, good practice installation and maintenance and manufactured to the relevant standards.

BRE will use a 35 year service life for PVC-U windows in the forthcoming revision to the Green Guide to Specification. A web-based version is due for publication in autumn 2006. Users of BREEAM and Envest will be directed to the new Green Guide when completing a BREEAM assessment.

## Appendix A BRE tools

### Green Guide to Specification

The relative environmental performance of over 250 materials and components have been assessed in this Guide, using carefully researched, quantitative data derived from the BRE Environmental Database. A wide range of alternative specifications are provided for: walls, floor systems, floor finishes, roofs, windows, doors, ceilings, paints, insulation and landscaping.

The performance of each specification is measured against a range of environmental impacts. Environmental performance is indicated by a simple to use A-B-C rating system. To further aid specifiers, guidance on capital costs, typical replacement intervals and information on recycling is also provided for each material and component.

The Green Guide to Specification is an essential tool for architects, surveyors, building managers and property owners seeking to reduce the environmental impacts of building materials through informed choice and is an important part of BREEAM.

### Life Cycle Assessment (LCA)

Life Cycle Assessment is a method to measure and evaluate the environmental burdens associated with a product system or activity, by describing and assessing the energy and materials used and released to the environment over the life cycle. It is a cradle (extraction) to grave (disposal) assessment tool for environmental impacts of products and processes. LCA has developed into an instrument that enables comparison of the environmental performance of specific products used for the same purposes but made of different raw materials or by different processes. In this way, it parallels whole life cost assessment for products and processes. The International Organisation for Standardisation (ISO 14040) states:

- *LCA is a systematic identification and quantification of inputs and outputs for the whole life cycle for products used for the same purpose but made of different raw material or by different method.*

LCA is carried out to agreed rules and has been standardised. Further rules have been developed to apply LCA to building materials. A single LCA method should be used to compare different products. Across Europe, construction product manufacturers have begun to recognise the benefits of measuring and communicating their environmental performance.

### Whole Life Costs (WLC)

Some recent definitions of whole life costing follow – the list is considerable and each definition varies to some degree with even a difference between two parts of the same International Standard (ISO 15686 Service life planning). There has and probably always will be an issue about what to call the technique ranging from ‘through life costs’ to ‘life cycle costs’ to ‘costs-in-use’ to the more usual and current ‘whole life costs’. Definitions vary, for example, in whether demolition costs are included, and in whether costs born by stakeholders other than the owner are included.

Whilst there are any number of definitions which suggest what to consider, there is very little information on how to do it and few tools to help. There has until very recently been certainly no industry recognised standard methodology, but the draft ISO guidance is now published in the UK (BSI BIP 2048 in 2004), and will be adopted as a British and International Standard within the next few years.

#### **ISO/DIS 15686 Buildings and constructed assets – Service life planning Part 5 Whole life costing (BSI 2004)**

- *Whole life cost is the economic assessment considering all agreed projected significant cost flows over a period of analysis expressed in monetary value. The projected costs are those needed to achieve defined levels of performance, including reliability, safety and availability.*

#### **Achieving Excellence in Construction Procurement Guide 07 Whole Life Costing (OGC 2003)**

- *The whole-life costs of a facility (often referred to as through-life costs) are the costs of acquiring it (including consultancy, design and construction costs, and equipment), the costs of operating it and the costs of maintaining it over its whole life through to its disposal - that is, the total ownership costs. These costs include internal resources and departmental overheads, where relevant; they also include risk allowances as required; flexibility (predicted alterations for known change in business requirements, for example), refurbishment costs and the costs relating to sustainability and health and safety aspects.*

#### **EU TG4 Life Cycle Costs in Construction (2004)**

- *Life cycle costing – LCC is a technique which enables comparative cost assessments to be made over a specified period of time, taking into account all relevant economic factors both in terms of initial capital costs and future operational costs. In particular, it is an economic assessment considering all projected relevant cost flows over a period of analysis expressed in monetary value. Where the term uses initial capital letters it can be defined as the present value of the total cost of an asset over the period of analysis.*

#### **The Whole Life Cost Forum (2003)**

- *Whole life costing is the systematic consideration of all relevant cash flows associated with the acquisition and ownership of an asset.*

#### **Construction Research Industry Steering Panel (CRISP 1998)**

- *Whole life costing is defined as "the systematic consideration of all relevant costs and revenues associated with the acquisition and ownership of an asset". (CRISP 1998)*

### **BREEAM**

BREEAM is primarily an environmental assessment method for buildings. BREEAM is a consensus based standard. It was originally developed by BRE in 1990 for application to the design of new office buildings. Versions for other buildings quickly followed, and now BREEAM can be applied to any building type. BREEAM has also been adopted internationally in Australia, New Zealand, Hong Kong and Canada and forms the basis of environmental assessment methods in South Africa, Norway and the United States (LEED) (Yates et al, 2004).

The organisational and operating structures of BREEAM are designed to allow flexibility and wide participation. BRE is responsible for:

- developing BREEAM, taking account of new technical and legislative developments as they occur;
- training and licensing independent assessors;
- certifying assessments made by independent assessors; and
- maintaining quality control.

Developers and designers are encouraged to consider these issues at the earliest opportunity to maximise their chances of achieving a high BREEAM rating.

Credits are awarded in each area according to performance. A set of environmental weightings then enables the credits to be added together to produce a single overall score. The building is then rated on a scale of pass, good, very good, or excellent, and a certificate awarded that can be used for promotional purposes.

BREEAM covers a wide range of building types. Standard versions cover:

- offices
- homes (known as EcoHomes)
- industrial units
- retail units 2005

**Appendix B Questionnaire**

## **Questionnaire of service lives of PVC-U windows**

### **Background**

The British Plastics Federation (BPF) requires an authoritative report based on current existing data which records BRE's considered assessment of the performance of PVC-U windows over their life cycle – the service life or durability. It is anticipated that the assessment will be reflected in subsequent editions of BRE tools and publications (including The Green Guide to Specification and Envest2) and whole life cost studies.

Assessment of service life (durability) is fundamental in that it provides data on replacement cycles and instances of interventions such as inspections and maintenance activities. For whole life costing the replacement and other interventions trigger a cost when they happen. For life cycle assessment, they trigger environmental burdens (measured in Ecopoints).

The Green Guide to Specification uses 25 years as a typical replacement interval for PVC-U (and timber) windows which translates into the initial installation and two replacements during the 60 year study period considered by the guide. This replacement period was based on industry wide data available at the time the guide was being developed.

### **Objective of this study**

The objective of the study is to review the service life assessment for PVC-U windows. BPF feels that new techniques will extend the service life of PVC-U windows beyond 30 years.

### **Approach to the study**

#### **Service life of PVC-U windows**

This will undertake an evaluation of the available evidence on the service lives of PVC-U windows using a range of specifications commonly used by the industry and provided by selected manufacturers. Specifications will be based on UK construction practice to satisfy current UK building regulations and specifications provided by the organisations identified below.

*ISO 15686-1 Buildings and constructed assets: service life planning* states that service life prediction should be based on exposure and performance evaluation and may be supported by the following sources:

- data provided by a manufacturer, a test house or an assessment regime (for innovative components it will normally be based on the manufacturer's or supplier's exposure results); this may be a single figure or a distribution of typical performance;
- previous experience or observation of similar construction or materials or in similar conditions;
- Boards of Agreement in the EC state assessments of durability in their certificates or reports of national product evaluation services;
- some books which are available and which include typical service lives;
- building codes which may give typical service lives for components.

We have agreed with BPF the following definition for the failure of a PVC-U window

Failure of PVC-U window occurs when it is no longer feasible to replace ironmongery<sup>8</sup>

The following organisations have been identified from discussions with BPF and are considered to undertake the manufacture of some 80% of PVC-U windows in the UK :

- VEKA
- Kommerling
- Rehau
- Bowater
- Deceuninck
- Anglian

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<sup>8</sup> note this has been amended as follows *Failure of PVC-U window occurs when it is no longer feasible to replace ironmongery or other components*

**Questionnaire**

Before recommending a revised service life for PVC-U windows, BRE needs to consider all relevant supporting evidence from the industry.

Please answer the following questions

<b>Contact information</b>	
Name of organisation	
Address	
Completed by	
Job title	
Contact detail	
• telephone	
• email	

1. **How does your organisation fit into the supply chain?** For example

<b>Response to Q1</b>	
<b>Supply chain</b>	<b>Please tick/comment</b>
Raw material manufactures PVC-U mix	
Extrusion	
Window product manufacturer	
Other (please state)	

2. **What constitutes failure of a PVC-U window and or its components?**

(We are currently working on an assumption that failure of a window happens when it is no longer feasible to replace ironmongery)

<b>Response to Q 2</b>
Failure mode for PVC-U window

3. **Do you have evidence of service lives from actual installations?**

This should be in the form of statements from your organisation, preferably supported by photographs and evidence of installation dates.

<b>Response to Q 3</b>	<b>yes</b>
Please provide evidence of service lives	
Comment	

4. **Please provide specifications of sample windows identified in Q 3**

<b>Response to Q 4</b>	<b>yes</b>
Please provide specification	
Comment	

5. **Where this evidence has been provide from outside of the UK, please confirm that similar products with similar specifications have been installed in the UK.**

We recognise that examples from the European Continent, where the industry is more mature, are likely to have been installed for a longer time than in the UK.

<b>Response to Q 5</b>	<b>yes</b>	<b>no</b>
Similar specifications have been installed in the UK		

Comment
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**6. Do you have third party certification covering the service life of your product(if available/applicable).**

This would include Agreement type certificates

<b>Response to Q 6</b>	<b>yes</b>
Third party certificates enclosed	
Comment	

**7. Please provide evidence from long term site exposure testing and / or accelerated testing**

<b>Response to Q 7</b>	<b>yes</b>
Evidence attached	
Comment	

**8. Please confirm compliance with applicable standards and codes of practice for manufacture and installation eg impact testing, colour fastness.**

(Reference to BPF Selecting the Standard ref SEL/3 November 1996 and subsequent standards)

<b>Response to Q 8</b>	<b>yes</b>
Confirm compliance	
Comment	

Questionnaires were sent by BPF to the following organisations and responses back to BPF are indicated below

<b>Organisation</b>	<b>Responded</b>
VEKA	yes
Kommerling	
Rehau	yes
Bowater	yes
Deceuninck	yes
Epwin	yes
Anglian	yes
Spectus	yes (do not produce windows)
BPF	yes