Research into Construction Product Standards and Testing

Final Report

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for and on behalf of

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Executive Summary

1.1. Following the events surrounding Grenfell Tower fire in June 2017 and the subsequent publication of the "Building a Safer Future: Independent Review of Building Regulations and Fire Safety" in May 2018, the need to develop a more streamlined approach and greater transparency with regards to the way that construction products are tested, certified, labelled and marketed was identified.

1.2. In December 2018, an implementation plan was published that included the establishment of a Construction Products Standards Committee (the 'CPSC'). This Committee's remit will be to provide advice to the Secretary of State on new and existing standards for the testing of construction products, including how the conformity assessment for construction products (including both harmonised and non-harmonised) could be improved.

1.3. In order to support the CPSC's activities, this research has been commissioned by the MHCLG in order to provide the CPSC with an evidence base for decision-making. The key output was the development of a prioritisation framework which shall be used to help the CPSC identify construction product and test standards it should consider first. This research is also aimed at enabling the CPSC to further to understand the challenges faced by the construction industry with regards to construction products testing, and identify ways forward for the development of new construction product standards for products not sufficiently covered by the current testing regime.

1.4. This report summarises the methods and findings of this research and how the prioritisation tool was developed, from the identification, characterisation and scoring of the standards through to the stakeholder engagement activities and gap analysis of the current system.

Research Findings

1.5. It is clear from this work that the large body of standards governing the safety of construction products is an extremely complex ecosystem and, that while the identification of these standards has been quite a substantial task in itself, the challenge of ensuring consistency across all of these standards as per the remit of the CPSC is not going to be a trivial task.

1.6. The analysis of perceived vulnerabilities in the current fire and structural safety standards and testing regime showed that each product category faces its own

unique set of challenges in terms standards and testing. The following graph indicates that most product categories face challenges across the range of vulnerabilities, and that improving the testing regime for these products will require a comprehensive and holistic approach to improvement. (see Figure 1 – Risk and Vulnerability Dashboards (Fire and Structural Safety Testing) and Figure 2 – Risks and Vulnerabilities (Fire and Structural Safety Testing)

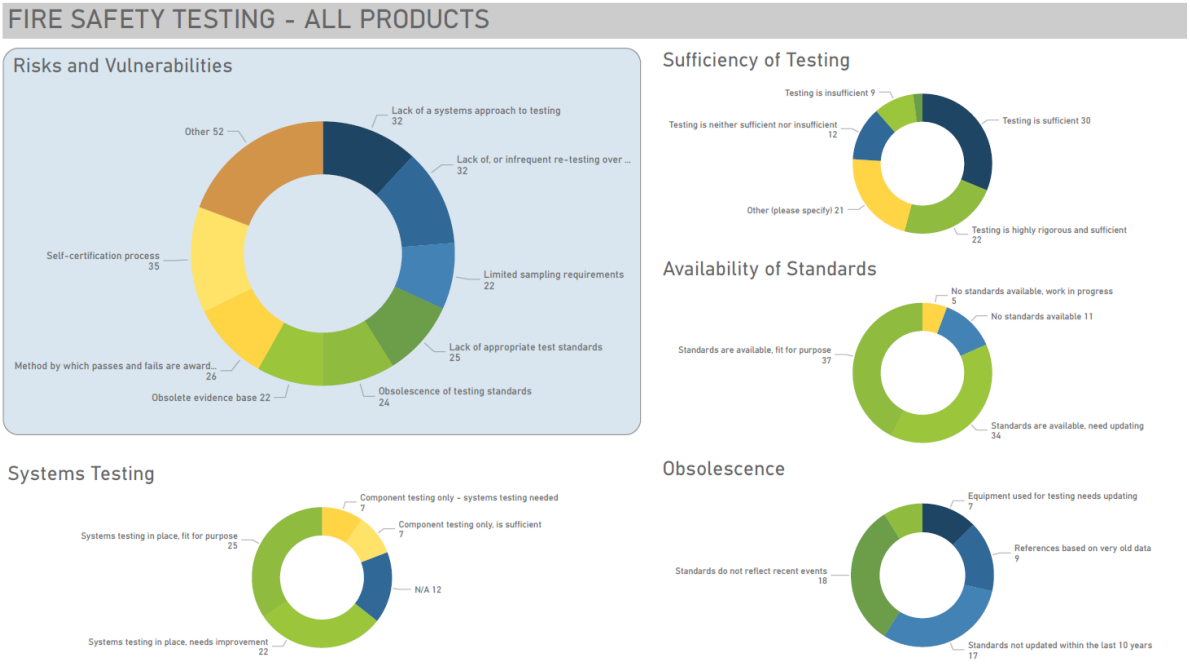

Figure 1 - Risks and Vulnerabilities Dashboard of the Current Fire Safety Standards and Testing Regime (All Products). Numbers represent the number of responses from the Construction Products Testing Survey.

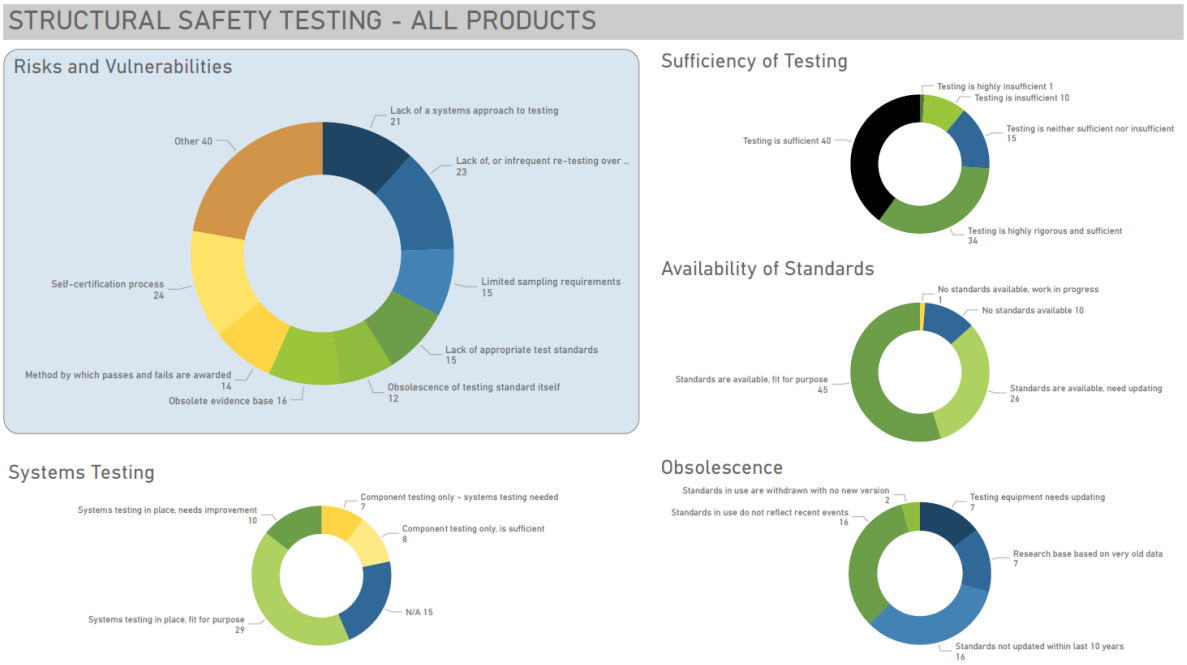

Figure 2 - Risks and Vulnerabilities Dashboard of the Current Structural Safety Standards and Testing Regime (All Products). Numbers represent the number of responses from the Construction Products Testing Survey.

1.7. In terms of areas that the CPSC need to focus on first, we have identified a number of key standards that the industry has raised issues with, and that pose a high risk in terms of their fire or structural safety aspects:

- BS 476 series
- BS 8414 series
- BS EN 1154
- BS EN 1155
- BS EN 1363 series
- BS 5839 series
- BS EN 13501 series
- BS EN 1366 series
- BS EN 1364 series
- TGD 019
- EN 13830
- BS EN 15882 series
- BS 9414

1.8. A gap analysis has been carried out combining findings from all of the research activities for the project and we have identified key standards and vulnerabilities for each family of products as well.

1.9. In terms of gaps in the availability of standards, feedback from the surveys and workshops indicate that the following product families may need standards to be developed:

- For fire safety, there are gaps in the availability of standards for fire stopping, fire sealing and fire protective systems, roof coverings, building kits, structural timber products, laminated glass, and thermal insulation products.
- Issues around the lack of standards for fully investigating reaction to fire, and smoke toxicity, were also raised at the workshops and in the survey.
- For structural safety, there are gaps in the availability of standards for gypsum products and roof coverings.

Recommendations

1.10. A number of product families have also cited the lack of a systems approach to testing as being an issue that needs to be addressed. In particular, a lack of/issues with standards for compartmentation, fire stopping and fire sealing has been cited. We hope that the prioritisation framework and the insights gathered during the course of this project will be useful to the CPSC in terms of clarifying its priorities and building an understanding of the challenges that the construction products industry face in terms of product testing standards.

1.11. We would highly recommend that the prioritisation tool database be maintained for it to retain its usefulness. We have sought to provide as much transparency as possible into how it was developed and structured and hope that after an initial period of discussion that a mechanism can be established for regular updates to be undertaken and for new standards to be regularly added to the database.

1.12. The community of experts we engaged with during the workshops could provide a valuable resource for further discussions on construction product standards specific to certain families of products – we have provided a good overview of the concerns for each product grouping but as we tried to cover as wide a range of products as possible, we believe there to be opportunities for further discussion and engagement with specifically targeted groups of product manufacturers, particularly those manufacturing 'higher risk' products, as well as those who are most in need of updated or improved standards.

1.13. Finally, there remain questions about the evidence base for the standards most commonly in use by the industry. The lack of academically rigorous referencing or references to primary scientific research in most of the standards we looked at is the result of the system under which these standards are written, and is largely based on consensus between a diverse group of experts as opposed to commissioned research for the purpose of standards development. We would suggest that this needs to be looked at more closely. Is a consensus between experts sufficient to ensure that our current set of standards considers the most recent academic and industrial research for the testing covered in the standard? Perhaps it is, but even if this is the case, should there be more transparency with regards to the rigour to which the underpinning knowledge and research that is used to make their decisions is referenced in the actual standards. Most official publications have a bibliography or list of references, and it is surprising that published standards are not held to the same level of transparency and scrutiny.

1. Introduction

1.1. Background and context

1.1.1. Following the Grenfell Tower fire in June 2017, the Government appointed Dame Judith Hackitt to conduct and independent review of the Building Regulations and Fire Safety. This work subsequently led to the publication of her final report, "Building a Safer Future: Independent Review of Building Regulations and Fire Safety" in May 2018.[1]

1.1.2. Chapter 7 of the Hackitt report examined the role of construction products in building safety, and included recommendations for the way that construction products are tested, certified, labelled and marketed. One aspect of this was the need for a significantly more streamlined approach and greater transparency with regards to test standards. The report mentioned that a more effective specification and testing regimes need to be developed to ensure that conflicting standards could be identified and reviewed.

1.1.3. These recommendations were accepted by Government in December 2018, and an implementation plan was published that included the establishment of a Construction Products Standards Committee (the 'CPSC'). This Committee's remit will be to provide advice to the Secretary of State on new and existing standards for the testing of construction products, including how the conformity assessment for construction products (including both harmonised and non-harmonised) could be improved.

1.1.4. In order to support the CPSC's activities, this research has been commissioned by the MHCLG in order to provide the CPSC with an evidence base for decision-making, through the production of a **prioritisation framework.** This framework shall be used to help the CPSC identify construction product and test standards. It should consider first, as well as allow it to further to understand the challenges faced by the construction industry, with regards to construction products testing, and identify ways forward for the development of new

[1] https://www.gov.uk/government/publications/independent-review-of-building-regulations-and-fire-safety-final-report

construction product standards for products not sufficiently covered by the current testing regime, through a **gap analysis** of the current system.

1.1.5. This report represents the final report and outputs of the project. It supersedes the draft report issued in June 2020.

2. Project Overview

2.1. Project objectives

2.1.1. The key objectives of this research are the following:

- To develop a prioritisation framework for review of test standards by the CPSC
- To identify construction product and test standards that should be the focus of the CPSC, based on risk and need
- To conduct a gap analysis of the current system, identify the challenges in the testing regime faced by the construction industry and the development of new product standards for those products that would benefit from having a standard

2.1.2. These objectives have been achieved using a range of research methods, including a desktop evidence review, internal workshops, external stakeholder engagement, document analysis, and a gap analysis.

2.2. Research Elements

2.2.1. The key research elements of this work are the following:

2.2.2. **Stage 1 - Identifying standards** – this task focuses on identifying the standards that would be within the remit of the CPSC, i.e. British Standards associated with the testing of construction products used in buildings, for both harmonised and non-harmonised products. More detail on this task can be found in *Section 3 – Stage 1 - Identifying Standards*

2.2.3. **Stage 2 – Screening** – this task focuses on establishing a process for rapidly looking at over 3,000 construction product standards to identify those which would be of key interest to the CPSC. The aim of this would be to create a basis for generating a shortlist of construction products and test standards that the CPSC would need to look at first. More detail on this screening can be found in *Section 4 – Stage 2 – Screening.*

2.2.4. **Stage 3 - Stakeholder Engagement** – which is aimed at enriching our evidence gathering with feedback from industry and academic experts with a keen understanding of construction products, the relevant tests and standards for these products, and the wider implications of the current testing regimes on the industry and the built environment. More detail on this task can be found in *Section 5 – Stage 3 - Stakeholder Engagement.*

2.2.5. **Stage 4 – Prioritisation Framework and Scoring** – the basis of the framework is a set of evaluation criteria that will be used to evaluate the fitness for purpose of the standards. This task focuses on the refinement of this criteria based on findings from the stakeholder engagement and scoring exercise, as a basis for informing the scoring exercise. The scoring exercise uses the shortlist generated using the Stage 1 – Screening exercise, and a set of draft prioritisation framework criteria, in order to take a detailed look at the most relevant standards in terms of their significance to the fire and structural safety testing standards in the construction products industry. In addition to identifying the most likely candidates for standards that the CPSC need to look at first, this stage also tests the fitness for purpose of the draft criteria as an effective decision-making tool for the CPSC. The key output of this task would be a prioritisation framework tool in the form of a working database, with scored metrics and usage guidelines. More information on this task can be found in *Section 6 – Stage 4 - Development of Prioritisation Criteria and Scoring*

2.2.6. **Stage 5 - Gap analysis** – to accompany the prioritisation tool for existing testing standards, this task gathers the evidence the stakeholder engagement exercise in order to analyse what the gaps are in the current testing regime. The discussion would be structured around product family groupings, identifying the relevant testing and classification standards for each product family and discussing any gaps in terms of the identification of existing products without any formal recognised test standards. Or products that have some standards in place, but that are missing testing standards such as particular, safety-critical aspects; missing standards for innovative new products; conflicts between standards; standards that need updating; and aspects of the testing regime that present known vulnerabilities. *Section 8 – Stage 5 – Gap Analysis*

3. Stage 1 - Identifying Standards

3.1. Introduction

3.1.1. Standards provide a technical basis for the assessment of the performance of construction products. In Construction Products Regulation (CPR) terms, these standards enable manufacturers to draw up the Declaration of Performance and affix CE marking.[2] Testing standards in particular, describe a process or a set of processes that can be replicated by different testing bodies, and that provide a reliable basis from which comparisons can be made. Standards can be either performance-based or prescriptive. A prescriptive standard specifies exactly how a product should be manufactured, while a performance-based standard sets out targets for how a product should perform, regardless of how it is manufactured.

3.1.2. Standardisation work is carried out by standardisation bodies for each "standards programme".[3] In the UK there are currently three main routes for the development of construction product standards. Standards are developed by national standards bodies (NSBs), European standards bodies (ESBs) and international standards organisations. The British Standards Institution (BSI) is the UK NSB. The European Committee for Standardisation (CEN) and the European Committee for Electrotechnical Standardisation (CENELEC) are the ESBs that are officially recognised by the EU and support standardisation activities in the Union. The BSI is one of the 34 member organisations of CEN/CENELEC and represents the UK on the Committee. The International Organization for Standardisation (ISO) and the International Electrotechnical Commission (IEC) are non-governmental independent organisations with a membership of 164 NSBs, one for each member country. The BSI is a member of ISO/IEC and represents the UK within these organisations.

[2] From https://ec.europa.eu/growth/sectors/construction/product-regulation/harmonised-standards_en

[3] Directive 98/34/EC of the European Parliament, available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31998L0034&from=EN

3.1.3. Whilst most standards are initiated by the industry, standardisation can also be initiated by consumers, SME's, associations or legislators.[4] Standards are developed by technical committees at an international, European and national level. The standardisation bodies are responsible for the maintenance of the existing standards, the development of new ones, and for investigating concerns about their contents and act upon these concerns.

3.1.4. Standards are routinely reviewed by their standardisation bodies at least every 5 years, but reviews can be instigated at any time. Standards can usually be withdrawn, but only after a full review. In addition to product standards, BSI, CEN and ISO produce other reference documents that are not to be technically regarded as standards, such as technical specifications (TSs), technical reports (TRs), published documents (PDs), publicly available specifications (PASs), European or international workshop agreements (CWAs/IWAs).

3.1.5. The majority of the British Standards have their origin in international standards developed by ISO and CEN/CENELEC and this is the preferred vehicle for voluntary standardisation in the UK.[5] Standards of UK origin can be initiated if there is a national demand and anyone, as an individual or as an organisation, can initiate the standardisation process of a product, or the revision of an existing one. Compliance with British Standards is non-mandatory; however, in the case of the single European market, standardisation can have a quasi-regulatory role because it provides presumption of conformity to European Directives. BSI as a member of CEN/CENELEC carries an obligation of adopting without change all standards ratified by these bodies, withdraw any conflicting pre-existing national standards and refrain from approving any new material conflicting with ratified standards.

3.1.6. Harmonised standards are harmonised technical specifications (HTSs) that set out the basic requirements for the construction products that circulate within the EU. For guaranteeing the free movement of goods within the Union, harmonised standards are ratified by CEN and

[4] CEN website, available at https://www.cen.eu/work/Pages/default.aspx

[5] BS 0: 2016, A standard for standards – Principles of standardisation, available at https://www.bsigroup.com/Documents/30342351.pdf

adopted by BSI. Harmonised Standards can be used to draw up the declaration of performance (DOP) of a particular construction product. According with the Construction Products Regulation (CPR) (EU) 305/2011, "When a construction product is covered by a Harmonised Standard or conforms to a European Technical Assessment the manufacturer shall draw up a Declaration of Performance when such a product is placed on the market".[6]

3.1.7. European Assessment Documents (EADs) cited in the CPR are another stream of harmonised technical specifications for construction products. Before the CPR came into force, European Technical Approval Guidelines (ETAGs) were established under the Construction Product Directive – 89/106/EED (CPD). Since 2014, the European Organization for Technical Assessments (EOTA) develops ETAGs into EADs following the requirements of the CPR.[7] Technical Assessment Bodies (TABs) adopt these documents for the purpose of issuing the ETAs. If a product is not fully covered by a harmonised standard, a manufacturer can address a request to the TAB for that product area to issue an ETA that can be used to draw up the Declaration of Performance (DoP) for the construction product and subsequently apply for CE marking. A CE mark indicates that the product has satisfied all the legal requirements to be placed on the market and that the product is consistent with its declared performance.

3.1.8. The full list of TABs is available from the European Organization for Technical Assessment (EOTA) website[8] for all 36 product areas defined in Annex IV of (EU) 305/2011. The organisation of TABs in the UK includes among others BBA, BRE, BM Trada and Warringtonfire. Notified bodies are third-party independent organisations that provide the manufacturers with the Assessment and Verification of Constancy of Performance that safeguards the reliability and accuracy of the DoP. Organisations can be registered as both TABs and notified bodies. Some notified bodies also conduct product testing.

[6] Construction Products Regulation (CPR) (EU) 305/2011, available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R0305&from=EN

[7] European Organization for technical assessments, 2019, Available at: https://www.eota.eu/en-GB/content/etags/26/

[8] Ibid.

3.1.9. In addition to these standards mentioned above, we also recognise that there may be a number of industry testing "standards" that may be widely used if there are no standards available that have been developed by a recognised standardisation body. These include guidance developed by the BRE, NHBC, and product-specific trade associations. Industry standards are documents that contain requirements that have been agreed on by groups of companies and people working in specific industries or on specific types of products. These standards typically address product performance, safety, reliability, and the methods for evaluating these aspects.[9]

3.1.10. Given the timing of this work and the end of the transition period at the end of the year, the impact of the UK leaving the EU on the CPR and the standards regime, including the future interaction between BSI and CEN, is still uncertain. Currently we believe that the BSI will remain a member of CEN, and as such will still be required to adopt HTSs as BS EN standards. As of June 2020, plans for the establishment of a new construction products regulator are also underway, who will be tasked with providing oversight of the new building safety regulatory regime, including strengthening the oversight and regulation of construction products.

3.2. Identifying the Standards

3.2.1. A three-pronged approach was used to identify the relevant standards:

- **Desktop review** – carried out by following a 'trail' of standards, starting from Approved Documents A, B, C, D, J and Regulation 7, and their subsequent normative and informative references; ISO standards gathered from the ISO website,[10] ETAGs[11] from the Nando website, and EADs[12] from the EOTA website. These standards form the bulk of the standards in the CPSC standards database.
- **Stakeholder Engagement** – a survey and series of online workshops have been used to identify two types of standards:

[9] Pfeifer, M. "Materials Enabled Designs: The materials engineering perspective to product design and manufacturing", Butterworth-Heinemann, 2009.

[10] ISO standards, available at https://www.iso.org/standards.html

[11] https://ec.europa.eu/growth/tools-databases/nando/ - ETAGs used as EADs according to Regulation (EU) No 305/2011 and related development of European Assessment Documents (EADs)

[12] https://www.eota.eu/en-GB/content/eads/56/

Standards commonly used by the industry, and standards that need updating. The list of standards generated through this exercise will be used to spot-check the completeness of the database and the correctness of the assigned materials categories, as well as provide additional scoring metrics related to their usage by industry and the need for them to be updated.

- **In-house expert consultation** – PRP's in-house experts, has developed list of the most relevant standards for testing fire safety, based on product categories that have been classified by how they function in terms of fire safety. This list will be used to provide an additional scoring metric in terms of identifying key standards for fire safety.

3.2.2. **Desktop Review.** The primary avenue for exploration was a desktop review of available standards. A 'trail' of standards was followed, starting with standards that are referenced in AD-A, AD-B, AD-C, AD-D, AD-J and Regulation 7. BSI and ISO and entered into a standards database created for this project. The standards database was built by following the links from the original set of standards gathered from the Approved Documents.

3.2.3. Progressive levels of priority were assigned to the data gathering, in order to help us track the origin of the standards in the database. Level 1 priority was assigned to the standards directly referenced in the ADs. A total of 277 Level 1 standards are currently referenced in AD-A, AD-B, AD-C, AD-D, AD-J and AD-7. Only 163 out of the 277 standards we gathered from the ADs were classed as "Current". According to the information we gathered from the BSI-shop, the statuses of the remaining 114 Level 1 standards as they are currently referenced in the ADs are either "withdrawn", "replaced" or "superseded". An intermediate Level 1.5 was subsequently created to accommodate standards that are currently referenced in the ADs but that have subsequently been withdrawn and replaced or superseded by a more recent version of the standard.

3.2.4. Level 2 was assigned to the normative reference which are required to achieve compliance with the Level 1 standards.

3.2.5. Level 3 was assigned to the standards that are not listed or cross-referenced in the ADs, including ISO standards gathered from the ISO

website,[13] ETAGs[14] from the Nando website, and EADs[15] from the EOTA website. The Level 3 standards also include international standards for construction products that were not gathered from the Level 1, Level 1.5 or Level 2 data sources. These standards are usually 'current' or 'under development'.

3.2.6. **Stakeholder engagement** – a small number of Industry standards and other harmonised and non-harmonised standards that were not captured in the desktop research exercise have been identified via the survey. These are designated as Level 4 standards in the database. This list is not extensive, and includes FM Approvals Standards, Intrinsic Safety, Centre for Window and Cladding Technology Technical Notes (CWCT TNs), a number of Regulations and Directives (e.g. Water Supply Regulations 1999, RoHS Directive, REACH Regulation, EU Directives), BuildCert, UL Standards, NIST Standards, NEMA Standards, LPCB Standards, NSSS Specifications, and ASFP Guidance. Some product manufacturers have also cited micro-certification installer schemes and manufacturer installation instructions as being 'standards' that they follow, but as these are more to do with installation rather than the actual products, we consider these to be out of scope. In terms of the online workshops, most of the discussion was centred around BS and BS EN standards that needed updating, as well as gaps in the coverage of standards, so no industry standards were highlighted during the discussions.

3.2.7. **In-house expert consultation** – in order to provide another approach towards the screening of the standards, and to ensure that no critical standards are missed, our in-house team pulled together a micro-study on product categories and standards critical to the design and management of fire safety, using a hazard-based approach to identify and characterise risks to building elements. This assessment was primarily based on the most prevalent current known fire risks in blocks of flats. Many risks are caused by matters outside of construction product selection and performance, such as human behaviour, white

[13] ISO standards, available at https://www.iso.org/standards.html

[14] https://ec.europa.eu/growth/tools-databases/nando/ - ETAGs used as EADs according to Regulation (EU) No 305/2011 and related development of European Assessment Documents (EADs)

[15] https://www.eota.eu/en-GB/content/eads/56/

goods and domestic contents. These have not been included. Electrical installations can pose a fire risk. Many aspects of these currently fall outside of the CPR and have therefore not been included in this analysis, however electrical installations that support life safety systems have been included.

3.2.8. The main current fire risks in flats are as follows: façade and cladding fires; fire in cavities and voids; compartmentation and penetrations; fire stopping and seals, etc.; smoke logging; ducts and shafts; combustible materials; toxicity; and balcony fires. We have identified key issues surrounding each of these hazard areas as well as the key standards that are aimed at addressing these hazards.

3.2.9. This analysis has fed into the gap analysis in Section 7 (*Section 7 – Stage 5 – Gap Analysis*).

4. Stage 2 - Screening

4.1. A database of standards was prepared to facilitate the screening process and serve as a repository for the data gathered during the desktop research and stakeholder engagement phases. This database will be developed as a working tool and key component of the Prioritisation Framework tool that will be produced as one of the final deliverables for this project.

4.2. Our objective for this stage was to develop a screening procedure that would extract as much categorisation information from the following information, without having to access the information contained within the standard itself.

4.2.1. **ID of the standard** – this provides an indication of whether the standard is harmonised or non-harmonised, or a national, international or European standard (BS vs BS EN vs EN vs ISO, for example), or an industry or bespoke standard, and the author/developer of the standard, which would also give an indication of the procedures involved with updating and maintaining the standard. The ID often also indicates the year of publication, revision or addition to the standard.

4.2.2. **Full name of the standard** – this indicates the type of standard (e.g. specification, method of test, classification, conformity assessment) by looking for key words in the title (see 5.3.1 for more details on Types of Standards). The full name of the standard would also indicate whether the standard applies to a specific product (see 5.3.2) or building element (see 5.3.3), or whether it relates directly to fire or structural safety.

4.3. From these two pieces of information, we were then able to research and extrapolate the following:

4.3.1. **Status** - for as many of the standards as possible, we cross referenced the standard ID with the information contained on the BSI shop website,[16] in order to gather information about the status of the standard (e.g. Withdrawn, Current, In progress)

4.3.2. **References** – the BSI shop website also provides a list of normative and informative references for each standard, which were then expanded and added to the database as Level 2 standards.

4.4. Classification Categories

[16] BSI-shop, available at: https://shop.bsigroup.com/

4.4.1. **Types of Standards** – we encountered the following types of standards, as defined in BS 0:2016, which is the main document by which BSI sets out how British Standards are developed and maintained.[17] The definitions in para. 9.4.1 of this document have been used to semi-automate the categorisation of the standards using a set of relevant search terms for each type of standard.

- **Specification** – provides a coherent set of verifiable, absolute criteria for products, services or systems. (search terms: specification, dimension)
- **Management System** – provides a model for setting up and operating a management system. (search terms: manage)
- **Code of Practice** – provides 'good practice' recommendations and supporting guidance, commonly used to support a claim of compliance. These codes can also be used to justify substitution of any of the recommendations with practices of equivalent or better outcome. (search terms: code, requirements)
- **Guide** – provides information and guidance, but generally not used to support claims of compliance. (search terms: guide, general, guidance, recommendation, design)
- **Method of Test** – sets out repeatable and reproducible procedures with consistent outcomes for the assessment of products, materials or processes. (search terms: test, determination, assess, exam)
- **Method of Specifying** – provides characteristics of a material, products, process or system. (search terms: specifying)
- **Vocabulary** – sets out terms and definitions in order to harmonise the use of language and terminology for a particular sector, field or discipline. (search terms: vocabulary, glossary)
- **Classification** – sets out a system for the ordering of items or a grading system for use across a range of products or materials. (search terms: class, designation)
- **Conformity Assessment** – sets out a set of criteria for demonstrating conformity for a particular material, product or process, including: standards and specifications; test methods or conformance clauses; test suite or test tools; procedures for testing,

[17] BS 0:2016, A standard for standards – Principles of standardization, The British Standards Institution, 2016. https://www.bsigroup.com/Documents/standards/guide-to-standards/BSI-BS-0-2016.pdf

and/or qualified bodies for carrying out testing. (not included in BS 0 but was a frequently recurring category of standards) (search terms: conformity)

- **Method of Calculation** – provides repeatable and reproducible procedures with consistent results for the calculation of metrics related to material, product or processes. (not included in BS 0 but was a frequently recurring category of standards) (search terms: calculation)

4.4.2. **Product Categories** – the next level of filtering was then to assign a primary building element to each standard, pertaining to the closest product family the standard was related to. These product categories are based on the CPR categories as defined in the New Approach Notified and Designated Organisations (Nando) information system.[18] In cases where there were two potential candidates for primary building element, the element that generally had a higher risk rating was selected. The list also includes non-specific categories, such as "General – Fire", "General – Structural", and "Other" for standards that related to products that made their way into the database that were not normally associated with building products, such as standards for earthquake resistance, soils, protective clothing and construction machinery.

4.5. Developing the risk rating factors

4.5.1. Using a series of discussions and workshops with our internal PRP experts and industry experts (CPA) we developed a risk rating scoring system based on the product categories.

4.5.2. A separate set of risk ratings were assigned to fire and structural safety, in order to clearly differentiate between the nature of the risks related to each aspect. Fire safety risk was evaluated by assigning a rating on a 10-point scale based on the severity of consequences (should combustion occur) and the likelihood of combustion occurring. Structural safety risk was evaluated based on the severity of consequences (should structural failure occur) and the likelihood of combustion occurring. These detailed risk ratings can be found on the "Risk Rating – by Product" tab of the database, including the qualitative descriptions used to assign the scores.

[18] https://ec.europa.eu/growth/tools-databases/nando/

4.5.3. Functionality was then built into the database to automatically populate the risk ratings for fire and structural safety based on the assigned product category and its corresponding risk rating factors.

4.6. Guide to the Standards Database

4.6.1. The guidance that follows refers to the latest issue of the standards database (Standards Database v11 as included with this report).

4.6.2. The intention is for this database to be maintained as a live and evolving document throughout the course of this research, and we have added detail to this database throughout the course of the project. This is being handed over as a live tool for the CPSC to use as an aid to decision making and modelling.

4.6.3. **Guide to Spreadsheet Tabs**

- **List of Standards** – this tab contains the main standards database. For more detailed information about the structure of this spreadsheet, please see 5.6.4
- Data validation (hidden) – this tab contains the data validation choices for the Standard Prefixes, the AD number, and the product type
- Scoring (hidden) – this tab contains the lookup tables for the risk rating scores and the obsolescence scores
- **Risk Rating – by Product** – this tab contains the risk ratings for structural safety and fire safety by product family, as well as a complete list of the product families used for the selection of Product Category (in List of Standards tab, column AN)
- **Types of Standards** – this tab contains descriptions for the Types of Standards referred to in the List of Standards tab

4.6.4. **Guide to List of Standards tab**

- A - **ID** – ID of the standard, which can be used to identify the prefix (and therefore the publishing organisation), and the year of publication
- B - INDEX (hidden) – a unique index number was assigned to each standard as it was added to the database. This column can be used to re-set the database to its original order
- C – **Level** – the level designation for the standard, as explained in paragraphs 4.2.2-4.2.4

- D – **Name of Standard** – the full name of the standard, where available. Note that not all of the Level 3 standards are complete at this stage, as we were focusing on the Level 1s, 1.5s and 2s
- E – **Referenced in** – where applicable, this standard lists the relevant Approved Document that the standard is referenced in
- F – **Prefix**
- G – **Year of Publication**
- H – **Type of Standard** – the type of standard, as discussed in paragraph 5.3.1. This column is semi-automatically populated using the information provided by word filtering columns L – T (TOS series)
- I – J Keyword filters (hidden)– word filtering columns that highlight standards containing the words "fire", "structural" and "safety" to ensure that these are not missed
- L – T – TOS series word filters (hidden) – word filtering columns that help to identify the Type of Standard, as discussed in paragraphs 5.3.1-5.3.4
- U – AM – BE series word filters (hidden) word filtering columns that help to identify the Primary Building Element, as discussed in paragraph 5.3.6
- AN – **Product Category** – product family, as discussed in paragraph 5.3.5. This column is semi-automatically populated using the information provided by word filtering columns U-AM (BE series)
- AO – **Risk Rating Structural** – H, M, L or 0 rating as referenced from the Risk Rating - by Product tab
- AP – **SCORE Structural** – the numerical risk rating as referenced from the Risk Rating – by Product tab
- AQ – **Risk Rating 2 Fire** – H, M, L or 0 rating as referenced from the Risk Rating-by Product tab
- AR – **SCORE Fire** – the numerical risk rating as referenced from the Risk Rating – by Product tab
- AS – **SCORE Obsolescence** – conversion of year of publication, combined with the Status of the standard, to an obsolescence score.

- AT – **FLAG Fire Safety Essential Standard** – flagged as an essential fire safety standard using the hazard-based approach (see 3.2.7-3.2.27) – *work in progress*
- AU – **FLAG Standard more than 20 years old** – calculated from the Year of Publication
- AV – **FLAG Commonly used by industry** – Flagged as a commonly used standard, by stakeholders (based on data from the Construction Products Testing Survey)
- AW – **FLAG Standard cited in BRegs** –flagged if the standard is cited in the Building Regulations
- AX – **FLAG Key standard for fire safety** – flagged as a key standard for fire safety by our internal expert consultant team
- AY – **FLAG Standard cited in BRegs but no longer current** – flagged if standard is cited in BRegs but whose status is not 'Current'
- AZ – **FLAG Standard covers products that have high structural risk** – flagged the product family covered by the standard has been designated as high structural risk (Column AQ)
- BA – **FLAG Standard covers products that have high fire risk** – flagged the product family covered by the standard has been designated as high fire risk (Column AS)
- BB – **FLAG Known issues** – flagged if the standard has been specifically cited as having known issues by stakeholders
- BC – **FLAG Standard is Current** – flagged if the standard has the status of "Current"

Columns BD to BG are the Scoring columns, and these will be discussed in *Section 6 – Stage 4 – Development of a Prioritisation Framework and Scoring.* Column BH is the final score which is the basis for the prioritisation of the standards.

4.6.5. The following filters have been used to organise the visibility of the data on the List of Standards tab:

- D – Name of Standard – all except blanks
- H – Type of Standard – only Classification, Method of Test, Method of Specification, Conformity Assessment and Specification

4.7. Summary

4.7.1. We have sufficiently populated the standards database in order to evidence the database's functionality as a tool and to implement a system for the scoring stage. We see this as a document that will evolve and be updated to serve as a live tool for the CPSC.

4.7.2. The database also includes standards that have been identified as most commonly used by the industry through the findings from the stakeholder engagement and survey work, as well as the key standards identified by our in-house experts.

5. Stage 3 - Stakeholder Engagement

5.1. Coronavirus Impacts

5.1.1. This component of the work has experienced the greatest impact from the coronavirus outbreak. The survey was originally planned to be short and succinct, helping to set the scene for a major stakeholder engagement workshop to be held in the Ideas Store at PRP. The main activity would have been the workshop, where with stakeholders would participate in an all-day workshop with speakers, plenary sessions, breakout groups and interactive reporting.

5.1.2. However, with the shift towards home working and the need for social distancing, the survey was redesigned into a longer questionnaire which will gather more detailed information, as well as generate discussion points for the online workshops.

5.1.3. The workshops were also reconfigured to adapt to a virtual online format as opposed to a physical workshop. In retrospect this probably allowed us to reach a wider range of stakeholders from across the country, and provided us with the opportunity to offer more workshop sessions than we would have been able to do in a physical format.

5.2. The Construction Products Testing Survey

5.2.1. The Construction Products Testing Survey was live from 23 April - 31 May 2020. In total, 464 respondents visited the survey link. Of these, we were able to gather 136 meaningful responses from product manufacturers and trade associations, and an additional 88 responses from other types of organisations. The survey covered responses from over 30 product categories.

5.2.2. The aim of the survey was to gather stakeholder feedback on the following:

- Whether the current testing regime for each product category is adequate, specifically for structural safety and fire safety
- Characterising the risks within the current testing regime
- Providing data for the gap analysis that will assist with the identification of areas where new product standards might have the potential to improve building safety

- Whether there is consensus on the relative importance of the proposed prioritisation criteria, in order to help inform the weightings for these criteria

5.3. Survey Structure

5.3.1. There are two main pathways for the survey:

- Product Manufacturers and Trade Associations are directed to a product-specific survey
- Test houses, Testing Laboratories, Notified Bodies, Standards Developers and other organisations are directed to a multi-product survey

5.3.2. Both survey pathways contain the following common question sets (asterisks indicate mandatory sections):

- Introduction
- Consent Form*
- About You – includes the name of the respondent's organisation and organisational category*
- What standards should the CPSC be looking at? * – these include the proposed prioritisation criteria and a ranking based on robustness, reliability and correctness
- Thank You and Comments – an open-ended form field for comments, questions and concerns

5.3.3. The product-specific survey contains the following question sets. Please note that there are separate but similar questions for both structural and fire safety (asterisks indicate mandatory sections):

- Information about the product
- Is the current structural safety testing regime sufficient? *
- Common testing standards for structural/fire safety
- Is the current structural/fire safety testing regime sufficient? *
- Weaknesses in the current structural/fire safety testing regime*
- Availability of appropriate test standards*
- Challenges to the development and improvement of testing standards
- Re-testing
- Self-certification
- Sampling
- Obsolescence

- Methodology
- Product vs Systems approach*
- On-going work

5.3.4. The multi-product pathway contains the following question sets (asterisks indicate mandatory sections):

- Challenges to ensuring that products used for buildings are safe and fit for purpose*
- Weaknesses in product testing*
- Sufficiency of testing for fire and structural safety*
- Availability of appropriate standards*
- Obsolescence*

5.3.5. For a copy of the full survey, please see Appendix D.

5.3.6. The analysis of perceived vulnerabilities in the current fire and structural safety standards and testing regime showed that each product category faces its own unique set of challenges in terms standards and testing. The following graph indicates that most product categories face challenges across the range of vulnerabilities, and that improving the testing regime for these products will require a comprehensive and holistic approach to improvement (see Figure 1 – Risk and Vulnerability Dashboards (Fire and Structural Safety Testing) and Figure 2 – Risks and Vulnerabilities (Fire and Structural Safety Testing).

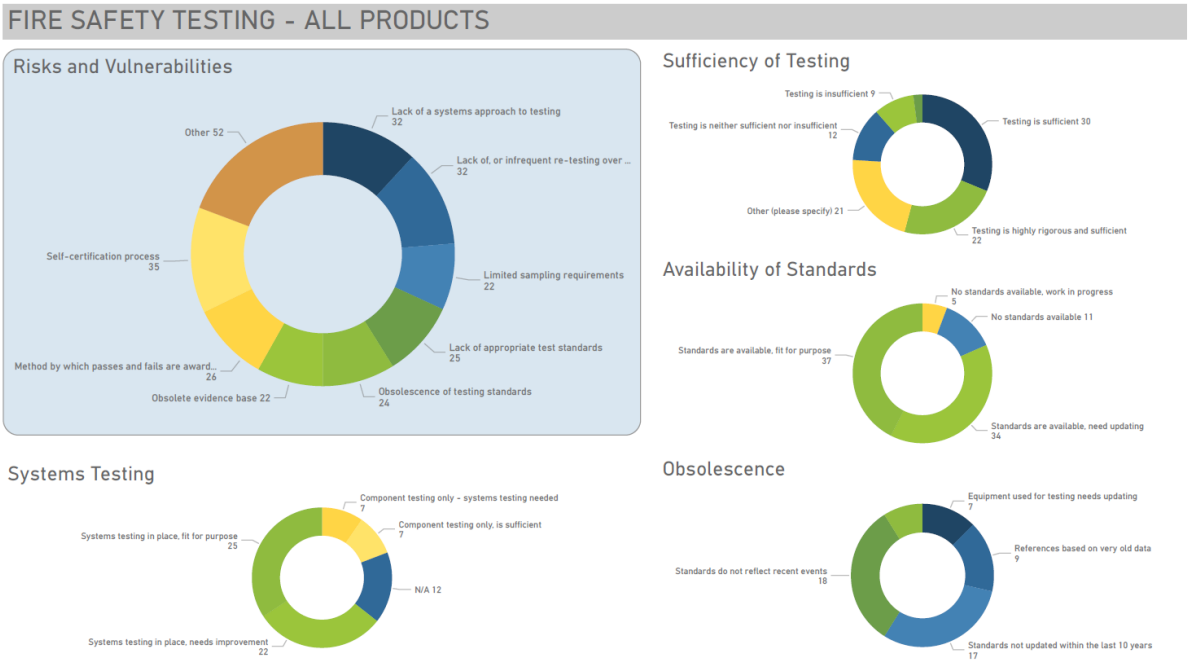

Figure 3 - Risks and Vulnerabilities Dashboard of the Current Fire Safety Standards and Testing Regime (All Products). Numbers represent the number of responses from the Construction Products Testing Survey.

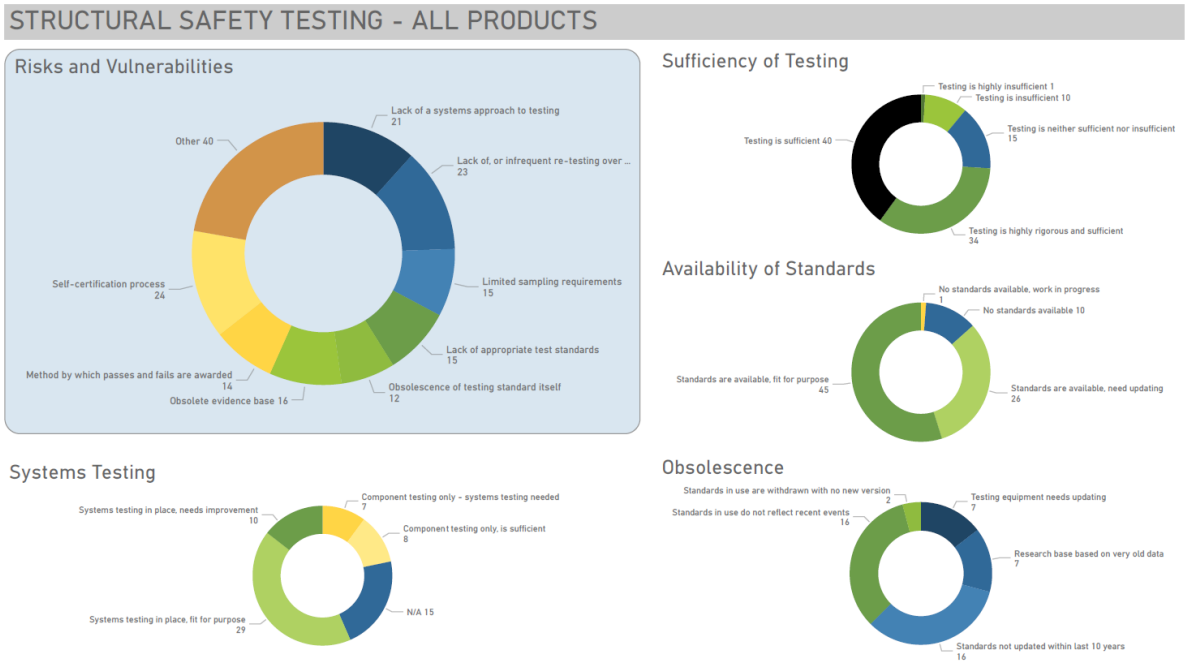

Figure 4 - Risks and Vulnerabilities Dashboard of the Current Structural Safety Standards and Testing Regime (All Products). Numbers represent the number of responses from the Construction Products Testing Survey.

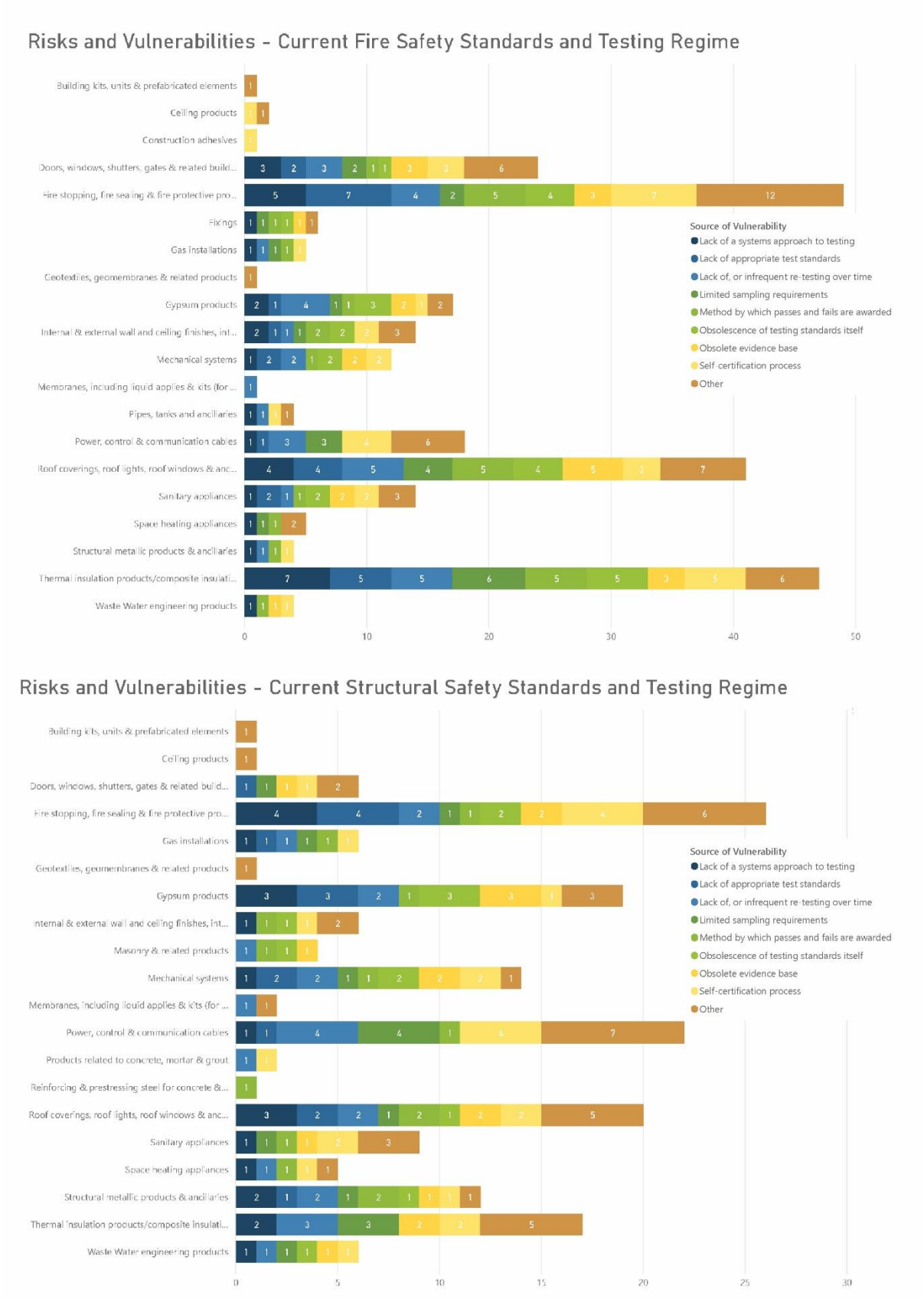

Figure 5. Risks and Vulnerabilities of the Current Fire Safety Standards and Testing Regime (All Products). Numbers represent the number of responses from the Construction Products Testing Survey.

5.3.7. Most of the responses under the 'Other' category related to vulnerability issues are to do with wider issues rather than the standards themselves, including issues around the high cost of testing, voluntary third-party certification, the CE marking process, re-testing, audits, inconsistencies of approach between different notified bodies, enforcement, and market surveillance.

5.3.8. With regards to the standards themselves, some of the respondents pointed out that within each product category, the vulnerabilities may apply to some products within a particular product category but not others (e.g. classification issues regarding laminated glass, or lack of standards for the fire performance of rainscreen systems, or the lack of EXAP standards for composite door sets), and likewise for the same product, the vulnerabilities may arise from the fact that testing for some aspects is robust (e.g. resistance to fire) and not as robust for others (e.g. reaction to fire).

5.3.9. Some comments are related to the limitations of testing in terms of testing more 'realistic' fire scenarios, and the lack of standards around compartmentation, and inherent weaknesses in modern construction methods. The use of 'inadequate' BS fire resistance standards was also cited as a vulnerability, and that these were exploited as a loophole when used alongside newer BS EN standards. The interactions between certain individual components, and between different systems were also cited as an area of vulnerability. Finally, the lack of harmonised standards leading to products not being able to be CE marked, leading to spurious claims for achieving certain standards.

5.3.10. A full summary of the survey results can be found in Appendix D.

5.4. Construction Products Testing Workshop

5.4.1. The online workshops, which were held over four two-hour online sessions in June 2020, were aimed at experts with a keen understanding of construction products, the relevant tests and standards for these products, and their wider implications of these testing regimes on the industry and on the built environment.

5.4.2. Recruitment was undertaken via the CPA for the majority of the construction product manufacturers, with other organisations such as the BSI, academic institutions, notified bodies, research bodies and test

houses being contacted by MHCLG and PRP. It was our hope that through these workshops, we will be able to build a community of experts who can provide insight into the standards that cover a wide range of construction products, particularly with regards to fire and structural safety, not just within the boundaries of the workshop, but as part of on-going discussions, as required. Due to GDPR considerations, we have not included the names of the attendees in this report.

5.4.3. A LinkedIn Group has also been established to provide added support to survey respondents as well as serve as an informal discussion forum pre- and post-workshop.

5.4.4. To differentiate between the different workshops, we divided the product categories into the following groups:

- Internal building components (46 attendees)
- Building kits/assemblies and structural elements (47 attendees)
- External and internal building components (65 attendees)
- External building components (74 attendees)

5.4.5. Each workshop was based on a standard format, with additional discussion points added to accommodate the unique issues for each product group. The discussions were organised into the following themes:

- Risks and consequences – this session was focused on concerns regarding the current standards and testing regime, the risks surrounding the current standards being used for products, the potential consequences of these risks not being addressed, and suggestions for how these risks could be mitigated.
- Gaps and inconsistencies – this session was focused on aspects related to product safety, quality or performance that are not currently adequately covered by existing standards, inconsistencies between standards for the same product, loopholes, and strategies for addressing these gaps and inconsistencies.
- Setting priorities – the key question for this session was "What should the CPSC focus on first?", including any feedback on aspects that need improvement, challenges to the improvement of existing standards and the development of new standards, and how these barriers might be overcome, including suggestions for areas where research may be needed to fill in the gaps.

5.4.6. The workshop was run via Microsoft Teams, with responses and feedback being monitored through both the main discussion channel and chat channel. In addition, an online app called mentimeter was used to facilitate Q&A and gather live responses to questions which would form the basis for the discussions.

5.4.7. A copy of the workshop and mentimeter slides can be found in Appendix E

5.5. Survey and Workshop Findings to date

5.5.1. The survey and workshops proved to be a rich source of data that can be used for the project, covering a number of aspects:

- Identification of the most commonly used standards across the construction products industry;
- Identification of the most problematic standards currently in use, that need updating;
- Verification of the range of reasons for why standards might need to be updated;
- Identification of gaps where standards are required, due to the lack of availability of any standards for certain products, or the lack of availability of standards for a particular issue related to fire or structural safety. Gaps also exist where harmonised standards do not exist, either because they are new or innovative products, or because of the length of the process for getting new standards approved.
- Stakeholder input into the development of weightings for the prioritisation criteria

5.5.2. The findings from the survey and workshop have been analysed as part of our gap analysis and can be found in *Section 7 – Stage 5 – Gap Analysis.* The data has also been used to fill in any gaps in the Standards Database in terms of the inclusion of the most commonly used standards for the industry. This is discussed in more detail in the following section, *Section 6 – Stage 4 – Development of a Prioritisation Framework and Scoring.*

6. Stage 4 - Development of a Prioritisation Framework and Scoring

6.1. Proposed criteria

6.1.1. Based on the research specification for this project, we initially drafted a list of prioritisation criteria as part of our research proposal. The aim of the criteria was to providing a consistent set of indicators that can be used by the CPSC to identify and prioritise construction product testing standards. The criteria were selected based on their potential to evaluate the need for a particular standard to be looked at more closely, and needed to focus on the standards themselves, rather than the wider standards and testing regime, which is not within the scope of this research. The initial criteria included the following aspects, which following the scoring stage, have proven to be unsuitable for the scoring.

- **Evidence base** – we initially looked at the list of references at the end of each standards document and investigated the dates of publication for the evidence, as an indication of whether the fundamental basis for the standard is current. This method worked for some of the older references, but newer references do not tend to have this information, or if they do, the references consist of other standards and sometimes the referencing goes around in a loop where a family of standards just references other standards in that family and there are no references that actually point to independently published academic or industry research. Some standards do not have a bibliography at all. Given this situation, we could not use the currency of the evidence base as a consistent metric across the standards to be evaluated, however this did raise some concern about the research rigour that is involved in the development of each standard. We reached out to BSI and our interviewee assured us that the checks and balances that underpin the development and updating of any standard are based on having a committee of experts, including representatives from academia, from all over Europe (in the case of the EN standards), who are all very knowledgeable in their fields, working on drafting, reviewing and discussing how these standards are to be set out. Information on the scientific basis for each standard can be requested from CEN, but it's a long process (ca. 3 months) and would have to consist of very specific queries that would then be

directed to the expert/s responsible for drafting that component. We did not see this as feasible given the timescales and scope of this work, but this could be something to consider for the future if specific standards need to be looked at in detail.

- **Uncertainty/level of confidence** – our detailed deep-dive into a selection of standards showed that this is expressed in many different ways. Test standards sometimes specify tolerances, most of them are expressed as percentages, but these are not an indication of the robustness of the standard but rather is probably more closely linked to the precision of the equipment used for the testing and the testing methodology. Due to the range of tolerances and the different ways that it is expressed, we do not believe this to be a suitable comparison metric.
- **Limit values and decision criteria** – similar to uncertainty, the decision criteria and limit values are expressed in so many different ways and are usually conditional based on very specific conditions or material behaviour. In themselves they are not an indication of the robustness of the standard – the standards themselves do not elaborate on the basis for these limit values so it is difficult to determine from the standard itself whether these values are backed by a robust evidence base.
- **Maintenance/Obsolescence** – most of the standards in the database are BS, EN or ISO standard, in which case most of them would be reviewed regularly by CEN, ISO or BSI as part of the regular cycle for updating these standards. We have therefore removed this as a criteria as it does not provide any distinguishability between standards.

6.1.2. The following criteria have been used to evaluate the standards:

- **Product Risk Rating** – this checks whether the standard pertains to a high structural risk or a high fire risk product.
- **Age of Standard/Obsolescence** – this checks whether the standard is over 20 years old, and either still designated as "Current" or is currently cited in Building Regulations.
- **Commonly used by industry –** we asked product manufacturers to identify the most commonly used standards for their product

family for the testing, classification and evaluation of structural safety and fire safety.

- **Issues/feedback** – have there been any complaints or concerns regarding this particular test? Have the industry expressed any concerns regarding this particular standard or test? This checked whether members of the industry have raised concerns about any aspect of a particular standard.

6.2. Scoring

6.3. We have assigned a very simple scoring system to the above criteria in order to generate a score – flags for **obsolescence** and standards **commonly used by industry** (which in themselves do not automatically mean that a standard is risky or safety critical) get one point for each flag, while standards that have flags for **product risk** and **issues/feedback** get two points for each flag, for a highest total possible score of 6.

6.4. The following are the highest scoring standards from the database (scores of 5 and 6):

7. Risk Evaluation

ID	Name of Standard	Risk Rating STRUC	Risk Rating FIRE	OBS Score	USE Score	RISK Score	ISSUES Score	SCORE
BS 476-11:1982	Fire tests on building materials and structures. Method for assessing the heat emission from building materials.	0	**H**	1	1	2	2	**6**
BS 476-20:1987	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles).	0	**H**	1	1	2	2	**6**
BS 476-21:1987	Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction.	0	**H**	1	1	2	2	**6**
BS 476-22:1987	Methods for determination of the fire resistance of non-loadbearing elements of construction [1987]	0	**H**	1	1	2	2	**6**
BS 476-23:1987	Fire tests on building materials and structures. Methods for determination of the contribution of components to the fire resistance of a structure	0	**H**	1	1	2	2	**6**
BS 476-24:1987, ISO 6944:1985	Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts	0	**H**	1	1	2	2	**6**
BS 476-31.1:1983	Methods for measuring smoke penetration through doorsets and shutter assemblies. Method of measurement under ambient temperature conditions [1983]	0	**H**	1	1	2	2	**6**
BS 476-4:1970	Fire tests on building materials and structures. Non-combustibility test for materials. AMD 2483 and AMD 4390.	0	**H**	1	1	2	2	**6**
BS 476-6:1989	Method of test for fire propagation for products [1989 + A1 2009]	0	**H**	1	1	2	2	**6**
BS 476-7:1997	Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products	0	**H**	1	1	2	2	**6**

BS 476-8:1972	Test methods and criteria for the fire resistance of elements of building construction [1972]	0	**H**	1	1	2	2	**6**
BS 8414-2:2015+A1:2017	Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame	**H**	**H**	1	1	2	2	**6**
BS EN 1154:1997	Building hardware. Controlled door closing devices. Requirements and test methods	0	**H**	1	1	2	2	**6**
BS EN 1155:1997	Building hardware. Electrically powered hold-open devices for swing doors. Requirements and test methods	0	**H**	1	1	2	2	**6**
BS EN 1363-2:1999	Fire resistance tests. Alternative and Additional Procedures	0	**H**	1	1	2	2	**6**
BS 476-33:1993	Fire tests on building materials and structures. Full-scale room test for surface products	0	**H**	1	1	2	2	**6**
BS 476-32:1989	Fire tests on building materials and structures. Guide to full scale fire tests within buildings	0	**H**	1	1	2	2	**6**
BS 476-13:1987	Fire tests on building materials and structures. Method of measuring the ignitability of products subject to thermal radiance'	0	**H**	1	1	2	2	**6**
BS 476-12:1991	Fire tests on building materials and structures. Method of test for ignitability of products by direct flame impingement	0	**H**	1	1	2	2	**6**
BS 476-10:2009	Fire tests on building materials and structures. Guide to the principles, selection, role and application of fire testing and their outputs	0	**H**	0	1	2	2	**5**
BS 476-3:2004	Fire tests on building materials and structures. Classification and method of test for external fire exposure to roofs	0	**H**	0	1	2	2	**5**
BS 5839-1:2017	Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises	0	**H**	0	1	2	2	**5**
BS 5839-6:2019	Fire detection and fire alarm systems for buildings	0	**H**	0	1	2	2	**5**

BS 5839-8:2013	Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of voice alarm systems	0	**H**	0	1	2	2	**5**
BS 5839-9:2011	Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of emergency voice communication systems	0	**H**	0	1	2	2	**5**
BS 8414-1:2020	Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to, and supported by, a masonry substrate	**H**	**H**	0	1	2	2	**5**
BS EN 13501-1:2018	Fire classification of construction products and building elements. Classification using data from reaction to fire tests	0	**H**	0	1	2	2	**5**
BS EN 13501-2:2016	Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services	0	**H**	0	1	2	2	**5**
BS EN 13501-3	Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers [2005 + A1 2009]	0	**H**	0	1	2	2	**5**
BS EN 13501-4	Classification using data from fire resistance tests on components of smoke control systems [2016]	0	**H**	0	1	2	2	**5**
BS EN 1363-1:2020	Fire resistance tests. General requirements	0	**H**	0	1	2	2	**5**
BS EN 1366-4:2006 + A1:2010	Fire resistance tests for service installations. Linear joint seals	0	**H**	0	1	2	2	**5**
BS EN 1634-1:2014+A1:2018	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows	0	**H**	0	1	2	2	**5**
TGD 019	Fire resistance test for 'open-state' cavity barriers used in the external envelope or fabric of buildings	**H**	**H**	0	1	2	2	**5**
EN 13830:2015 + A1:2020	Curtain walling - product standard	**H**	**H**	0	1	2	2	**5**

BS EN 15882-4:2012	Extended application of results from fire resistance tests for service installations. Linear joint seals	0	**H**	0	1	2	2	**5**
BS EN 15882-3:2009	Extended applications of results from fire resistance tests for service installations. Penetration seals	0	**H**	0	1	2	2	**5**
BS 8414-2:2020	Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to, and supported by, a structural steel frame	**H**	**H**	0	1	2	2	**5**
BS 9414:2019	Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests	**H**	**H**	0	1	2	2	**5**

7.1.1. More detail on the specific issues associated with these standards will be covered in the product-by-product discussion in the gap analysis in *Section 8 – Stage 6 – Gap Analysis*. Each product family had its unique set of issues with a particular standard, but generally there were concerns about the lack of updates, or updates that left industry concerns unaddressed. The approvals process for standards development and the co-existence of similar BS and BS EN standards was also a source of concern for many in both the workshop and the survey.

8. Stage 5 - Gap Analysis

8.1. The construction products market is vast – we were happy to have received good levels of engagement with the industry that has enabled us to gain valuable insight into the weaknesses and vulnerabilities for the testing standards that cover their respective product families.

8.2. This gap analysis has been structured according to findings for each product family. Each product family has a different focus – some are more structural safety critical, some are more fire safety critical. Some industries are heavily regulated, others are not. Some industries are neither fire nor safety critical, but need to adhere to other performance standards and have concerns that would have been lost in discussions focused mostly on structural and fire safety. The following gap analysis presents products with high risk ratings first, followed by medium risk products, and then finally low risk products.

8.3. High risk Products

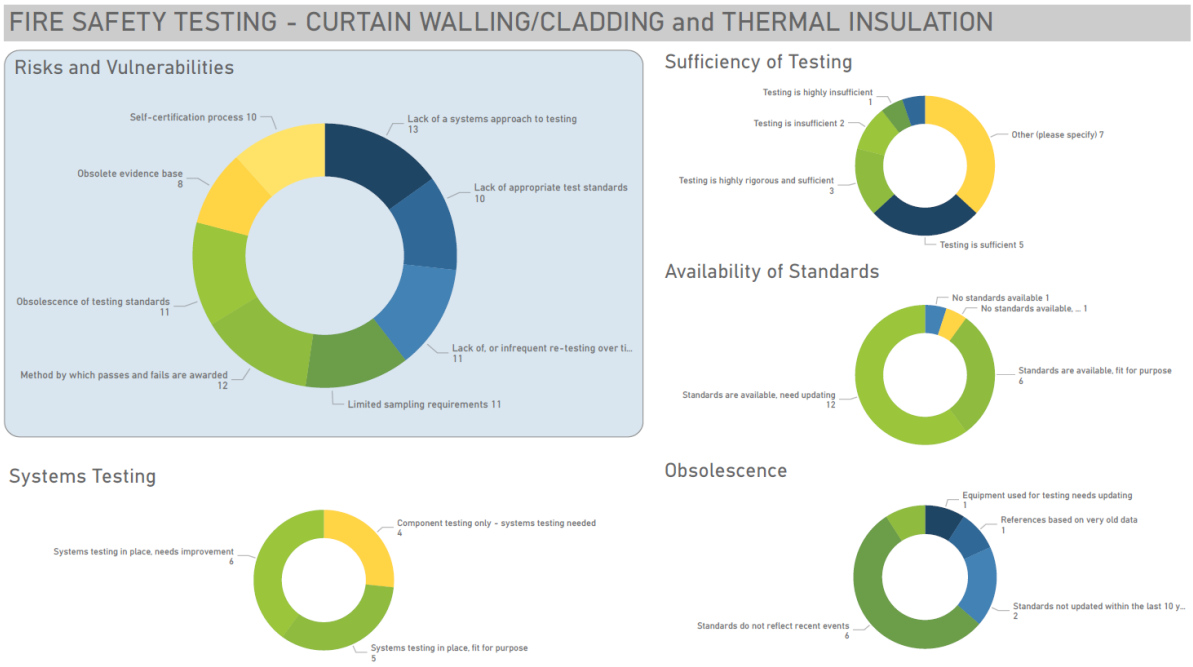

Figure 6 - Risk and Vulnerability Dashboard for fire safety testing of curtain walling/cladding and thermal insulation. Numbers represent the number of responses from the Construction Products Testing Survey

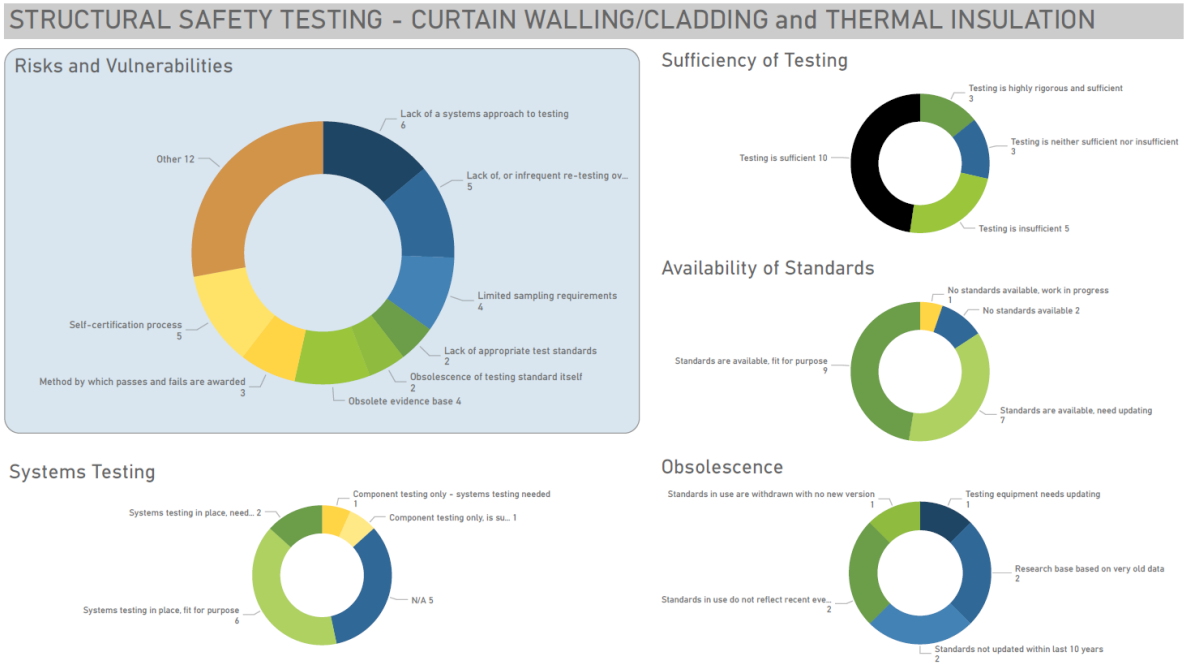

Figure 7- Risk and Vulnerability Dashboard for structural safety testing of curtain walling/cladding and thermal insulation. Numbers represent the number of responses from the Construction Products Testing Survey

8.3.1. **Curtain wallings/Cladding** - products this category currently have a high risk profile due to the incidence of façade fires and the sensitivities arising from these. Given the focus on this area we expect strengthened legislation and remediation activities to reduce this risk

over time, however the following issues remain: questions over the applicability of façade fire testing; reliability of reaction to fire testing, certification and application; evaluation of small components; need for further research on the extent of risk from external wall components; and difficulties surrounding the combustibles ban. The most commonly used standards for this product family include:

- BS 5534 - Slating and tiling for pitched roofs and vertical cladding. Code of practice
- BS EN 490 - Concrete roofing tiles and fittings for roof covering and wall cladding. Product specifications
- BS EN 14782 - Self-supporting metal sheet for roofing, external cladding and internal lining. Product specification and requirements
- LPCB-LPS 1181-1 - Loss Prevention Standard: Requirements and tests for built up cladding and sandwich panel systems for use as the external envelope of buildings
- BS 8414 Parts 1 and 2 - Test method for non-loadbearing external cladding systems applied to the masonry face of a building
- BS 5427 – Code of practice for the use of profiled sheet for roof and wall cladding on buildings
- BS 9414 - Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests

8.3.2. **Thermal insulation products/ composite insulating kits/ systems** - the most commonly used structural safety standards for this product family include the following:

- BS 6229 - Flat roofs with continuously supported flexible waterproof coverings. Code of practice
- BS EN 1995-1 - Eurocode 5: Design of timber structures. General. Common rules and rules for buildings
- ETAG 19 - Pre-fabricated wood-based loadbearing stressed Skin Panels
- EOTA TR002 - Test methods for Light Composite Wood-based Beams and Columns
- EOTA TR019 - Calculation models for prefabricated wood-based Loadbearing stressed skin panels for use in roofs
- BS EN 826 - Thermal insulating products for building applications. Determination of compression behaviour
- ETAG 004 - External Thermal Insulation Composite Systems with Rendering
- EN 1607 - Thermal insulating products for building applications - Determination of tensile strength perpendicular to faces

- BS EN 1365 - Fire resistance tests for loadbearing elements
- EN 1504 - Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity
- CWCT – The thermal assessment of window assemblies, curtain walling and non-traditional building envelopes (Second edition, 2011)

8.3.3. The most commonly used standards for fire safety include the following:

- BR 135 – Fire performance of external thermal insulation for walls of multi-storey buildings
- BS EN 13501-1 - Fire classification of construction products and building elements. Classification using data from reaction to fire tests
- BS EN 13501-2 - Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services
- BS EN 13501-5 - Classification using data from external fire exposure to roof tests
- BS EN 1363-1 - Fire resistance tests. General requirements
- BS EN 1363-2 - Fire resistance tests. Alternative and Additional Procedures
- BS EN 1365-1 - Fire resistance tests for loadbearing elements. Walls
- BS EN 1365-2 - Fire resistance tests for loadbearing elements. Floors and Roofs
- BS EN 1365-3 - Fire resistance tests for loadbearing elements. Beams
- BS EN 1365-4 - Fire resistance tests for loadbearing elements. Columns
- BS EN 1366-1 - Fire resistance tests for service installations. Ventilation ducts
- BS EN 1366-3 - Fire resistance tests for service installations. Penetration seals
- BS EN 1366-4 - Fire resistance tests for service installations. Linear joint seals
- BS EN 1366-8 - Fire resistance tests for service installations. Smoke extraction ducts
- BS 8414-1 - Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to, and supported by, a masonry substrate

- BS 8414-2 - Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame
- CEN/TS 1187 - Test methods for external fire exposure to roofs
- BS 9414 - Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests
- BS 476-20 - Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
- BS 476-21 - Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction
- BS 476-22 - Methods for determination of the fire resistance of non-loadbearing elements of construction
- BS 476-24 - Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts
- ASFP TGD 19 - Fire resistance test for 'open-state' cavity barriers used in the external envelope or fabric of buildings

8.3.4. The European standardisation of thermal insulation products comes under CEN/TC 88 – Thermal insulating materials and products. All products used for insulation in buildings should be included in the scope of CEN/TC 88. There have been a number of concerns raised by manufacturers in this industry regarding the testing regime for their products. These include the following:

- **Fire tests** – there are shortcomings in terms of the adequacy of reporting the test results for the construction and its components. There is a perceived lack of understanding of construction product tolerances in the manufacturing process, and of construction tolerances in the build process when reporting and clarifying fire test results. Material characteristics are not robustly obtained (either through a lab-based assessment or independent documentation), nor are they adequately described in test reports. There is no obligation on test sponsors to disclose information on critical aspects of the system or provide comprehensive design details of the system tested. There is also a lack of transparency on the provision of information from failed tests, the findings from which could potentially compromise a product's performance.

- **Sampling –** the sampling of materials for inclusion in test structures in the lab is perceived as not being sufficiently rigorous. Current fire testing and certification protocols are such that test bodies are not always required to closely scrutinise product samples for reaction to fire properties.
- **Smoke and Toxicity -** similar to the comments made by manufacturers in the fire stopping, fire sealing and fire protective products, fire retardant products sector, smoke and toxicity needs to be better considered for insulation products as well. There is a need for a national standard for testing, classifying and labelling building products for their propensity to produce toxic smoke, as this is a major cause of -fire-related injuries and deaths.
- **Field of Application -** there has been feedback that current classification documents do not provide enough rigorous guidance on extended field of application
- **Market Surveillance -** there is a concern about the absence of mechanisms for verifying that products placed on the market do not have the same properties as those that had been tested, and that the impact of production changes is not currently adequately being considered.
- **Conflicts between Standards –** there is a concern that the BS fire resistance standards (BS 476 Parts 20, 21, 22 and 24) continue to be used alongside BS EN standards. On one hand, some consider the BS fire resistance standards to be deficient, whereas the main criticism of the BS EN standards are their inability to reflect real life hazards. At this point in time, neither appear to be completely fit for purpose, however the possibility of choosing between one or the other leads to weaknesses in the safety assurance process and also market distortion, as some manufacturers can selectively choose which standard to comply with that presents their product in the best light, leading to a situation where two competing products may have been tested differently and yet appear to be similar to the consumer and thus considered to be of comparative value.

8.3.5. The Fire Protection Association (FPA) have previously raised concerns that the BS 8414 large scale fire test does not reflect real world practice. Many in the industry are of the opinion that large scale

testing opportunities are limited and that BS 8414 is not sufficient. In conjunction with the BR 135 test, BS 8414 is perceived to have significant shortcomings (despite having been recently revised) and some believe it is not fit for purpose in terms of determining whether the façade on a real building will perform to an appropriate safety standard in the event of a fire. Specifically the use of a wooden crib as the fire load has been questioned (as this does not reflect the speed and intensity of building fires in modern buildings that often include plastic materials); the actual spacing of cavity barriers on the test rig (which are more closely spaced than on actual buildings, and can be positioned to buffer the thermocouples, making the test easier to pass); and the lack of ventilation openings or windows in the test rig.

8.3.6. Some manufacturers have also pointed out that a review of BR 135 test criteria is required, because the current evaluation period and fail temperature are 'extremely' insufficient. This classification system is used to demonstrate regulatory compliance, however as it is not a British Standard it is not currently subject to the same scrutiny and review process.

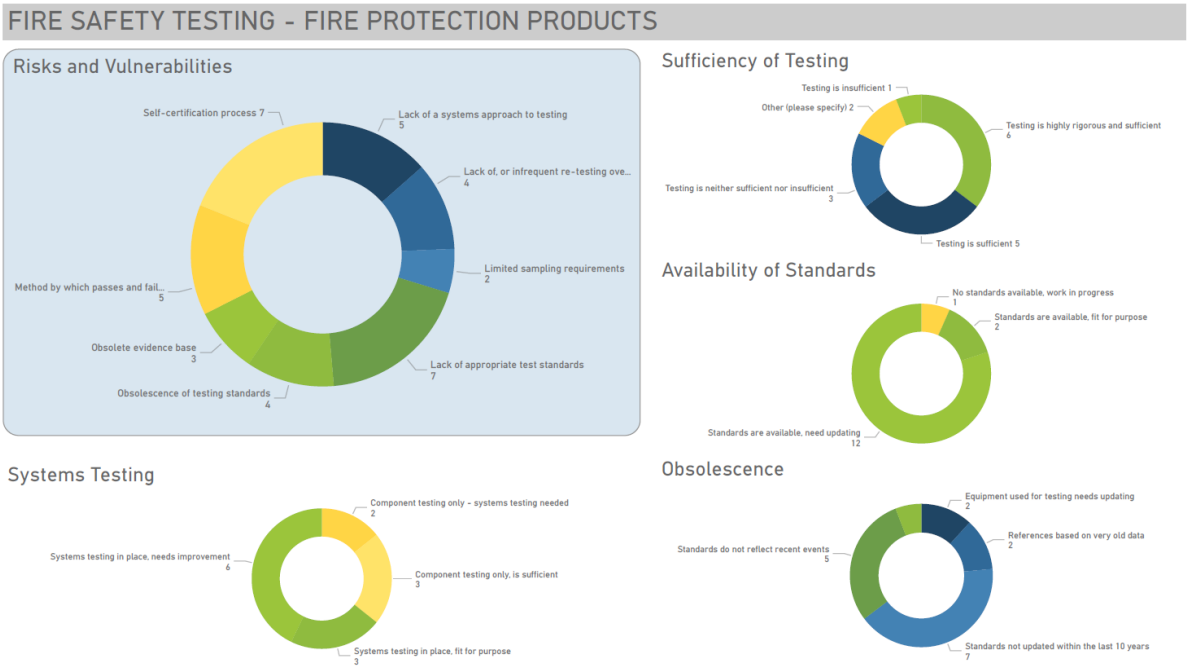

Figure 8 - Risk and Vulnerability Dashboard for the fire safety testing of fire protection products. Numbers represent the number of responses from the Construction Products Testing Survey

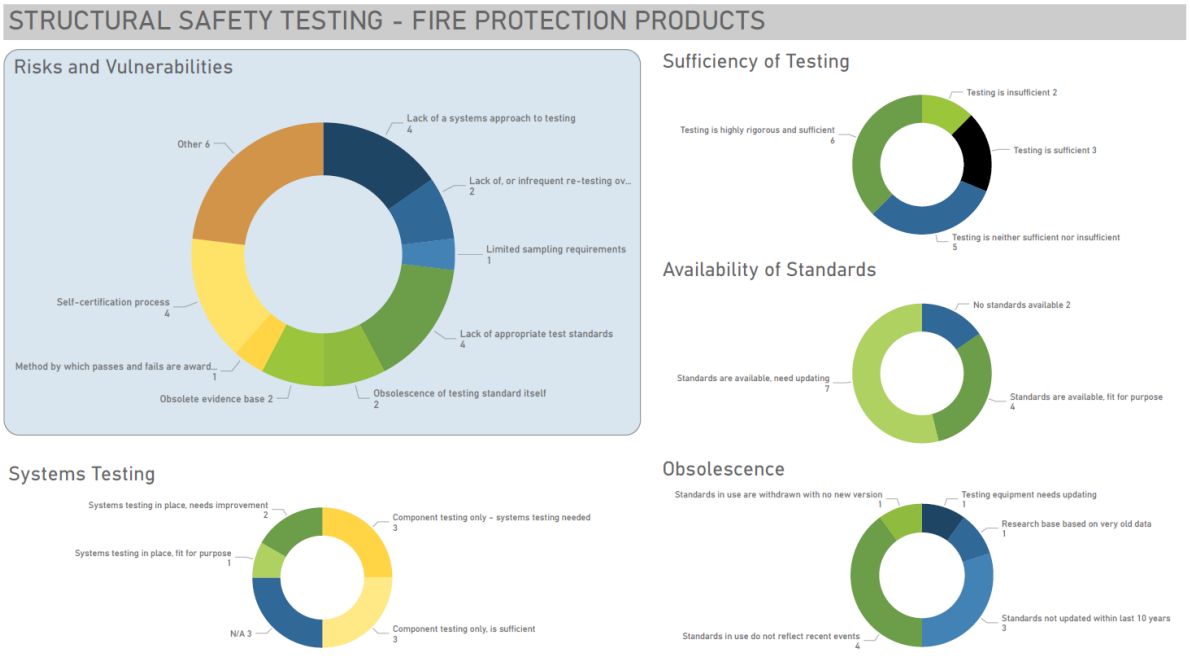

Figure 9 - Risk and Vulnerability Dashboard for the structural safety testing of fire protection products. Numbers represent the number of responses from the Construction Products Testing Survey

8.3.7. **Fire stopping, fire sealing and fire protective products, fire retardant products -** This product family includes intumescent passive fire protection coatings, cavity fire barriers, fire resisting and smoke control ductwork, penetration seals, linear joint seals, firestopping, fire, smoke and acoustic seals, and flame retardant systems.

8.3.8. Compartmentation is a fundamental enabler for 'stay put' strategies. Issues surrounding this include the lack of testing standards for compartmentation; gaps inadvertently left in compartment structure; sealing of penetrations; quality control; gaps over party wall lines in roof voids; post-construction alterations; and fires being able to bypass compartment lines.

8.3.9. Fire stopping and fire sealing is strongly interlinked with the issue of compartmentation and is vital towards ensuring the integrity of compartmentation. In addition, it is a component that has a known poor construction quality issue. Other known issues include the wide range of testing needed; problems with identification of test data; the need for an installation quality assurance system; and that there are numerous untested or bespoke products and methods in use.

8.3.10. The combustibles ban has lessened the reliance on cavity barriers, however, similar to fire stopping, there is also a bad–legacy of inadequate product usage and poor installation associated with cavity barriers. There also seems to be a gap in terms of authoritative testing methods that are applicable to these crucial components. Issues include the lack of a specific product standard or testing regime for cavity barriers; the fact that open state cavity barriers need special consideration; the ambiguity regarding closure around openings; poor construction installation quality; the shorter design life of cavity barriers compared to that of the walls they are situated in; and the difficulty associated with the maintenance of these elements.

8.3.11. The most commonly used standards for testing these products are the following:

- ASFP TGD 19 - Fire resistance test for 'open-state' cavity barriers used in the external envelope or fabric of buildings
- BS 476-20 - Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
- BS 476-21 - Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction
- BS 476-22 - Methods for determination of the fire resistance of non-loadbearing elements of construction
- BS 476-24 - Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts
- BS 476-6 - Method of test for fire propagation for products
- BS 476-7 - Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
- BS 8414 - Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems
- BS EN 1195 - Timber structures. Test methods. Performance of structural floor decking
- BS EN 13381-10 - Test methods for determining the contribution to the fire resistance of structural members. Applied protection to solid steel bars in tension
- BS EN 13381-3 - Test methods for determining the contribution to the fire resistance of structural members. Applied protection to concrete members

- BS EN 13381-8 - Test methods for determining the contribution to the fire resistance of structural members. Applied reactive protection to steel members
- BS EN 13381-9 - Test methods for determining the contribution to the fire resistance of structural members. Applied fire protection systems to steel beams with web openings
- BS EN 1363-1 - Fire resistance tests. General requirements
- BS EN 1363-2 - Fire resistance tests. Alternative and Additional Procedures
- BS EN 1365-2 - Fire resistance tests for loadbearing elements. Floors and Roofs
- BS EN 1365-3 - Fire resistance tests for loadbearing elements. Beams
- BS EN 1365-4 - Fire resistance tests for loadbearing elements. Columns
- BS EN 1366-1 - Fire resistance tests for service installations. Ventilation ducts
- BS EN 1366-3 - Fire resistance tests for service installations. Penetration seals
- BS EN 1366-4 - Fire resistance tests for service installations. Linear joint seals
- BS EN 1366-8 - Fire resistance tests for service installations. Smoke extraction ducts
- BS EN 13823 - Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item
- BS EN 13986 - Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking
- BS EN 1634-1 - Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows
- BS EN 1634-3 - Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Smoke control test for door and shutter assemblies
- BS EN 1634-5 - Fire resistance tests for non-loadbearing elements. Air transfer grilles
- CEN/TS 1187 - Test methods for external fire exposure to roofs
- EAD 35041-00-1106 - Reactive coatings for fire protection of steel elements
- EAD 350454-00-1104 - Fire stopping and fire sealing products: penetration seals

- EN 13381-7 - Test methods for determining the contribution to the fire resistance of structural members. Applied protection to timber members
- EN 13501-1 - Fire classification of construction products and building elements. Classification using data from reaction to fire tests
- EN 13501-2 - Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services
- EN 1363-1 - Fire resistance tests - Part 1: General requirements
- EN 1364-4 – Fire resistance tests for non-loadbearing elements – Part 4: Curtain Walling
- EN 1365-2 – Fire resistance tests for loadbearing elements – Part 2: Floors and Roofs
- EN 1366-3 – Fire resistance tests for service installations – Part 3: Penetration Seals
- EN 1366-4 – Fire resistance tests for service installations – Part 4 – Linear Joint Seals
- EN 15882-3 – Extended applications of results from fire resistance tests for service installations – Part 3 – Penetration Seals
- prEN 15882-5 - Extended application of results from fire resistance tests for service installations - Part 5: Combined penetration seals
- EN 16755 - Durability of reaction to fire performance - Classes of fire-retardant treated wood products in interior and exterior end use applications
- EN ISO 11925-2 - Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test
- EOTA TR 001 - Determination of impact resistance of panels and panel assemblies
- EOTA TR 024 - Technical description and assessment of reactive products effective in case of fire
- UL 263 - Standard for Fire Tests of Building Construction and Materials

8.3.12. Manufacturers in this category have pointed out weaknesses in market surveillance and the prevalence of the use of 'golden samples' to certify products, which may lead to weaknesses in the verification of products actually being placed on the market.

8.3.13. In terms of the fire test and classification standards themselves, the industry is divided on the issue of whether testing should reflect actual buildings and actual fire conditions. In both the surveys and workshops, many were pointing out that the current standards for fire

testing fall unacceptably short of determining whether systems tested will perform adequately in real life (e.g. BS 8414:2020; BS EN 1366-4' BS EN 1363-1 and CEN/TS 1187). This is countered by professionals working in the testing and certification field who say that most test standards are not designed to replicate real-life conditions and that aiming to do so would not be a viable approach. The standards themselves often contain a caveat to say that the tests are not aimed at simulating real life conditions.

8.3.14. Respondents have also pointed out that there are currently no national standards for testing, classifying and labelling building products for their propensity to produce toxic fire effluents, which lead to building users being overcome by smoke or toxic gases – one of the most common cause of fire-related fatalities in building fires in the UK. A gap in the standards regime therefore is the creation of standards that enable the determination of toxic fire effluents from building products. A number of other stakeholders have pointed out that this issue has already been explored in other industries and that the railway infrastructure industry may well provide the groundwork to look into this issue (via BS 9992).

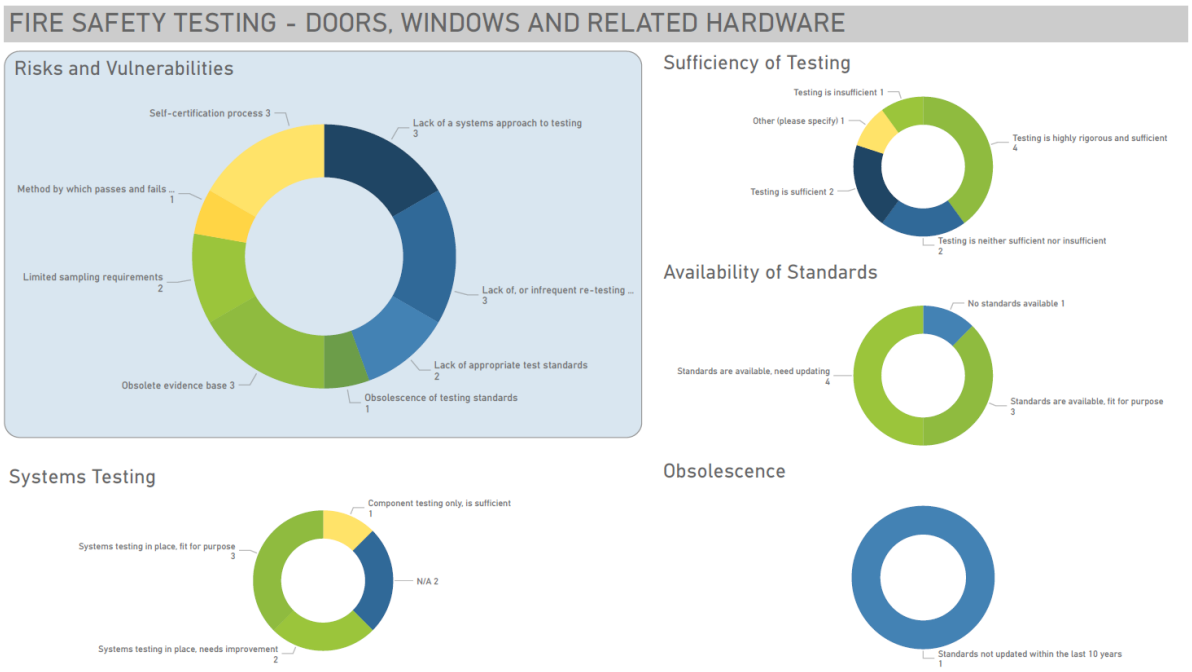

Figure 10 - Risk and Vulnerability Dashboard for fire safety testing of doors, windows and related hardware products. Numbers represent the number of responses from the Construction Products Testing Survey

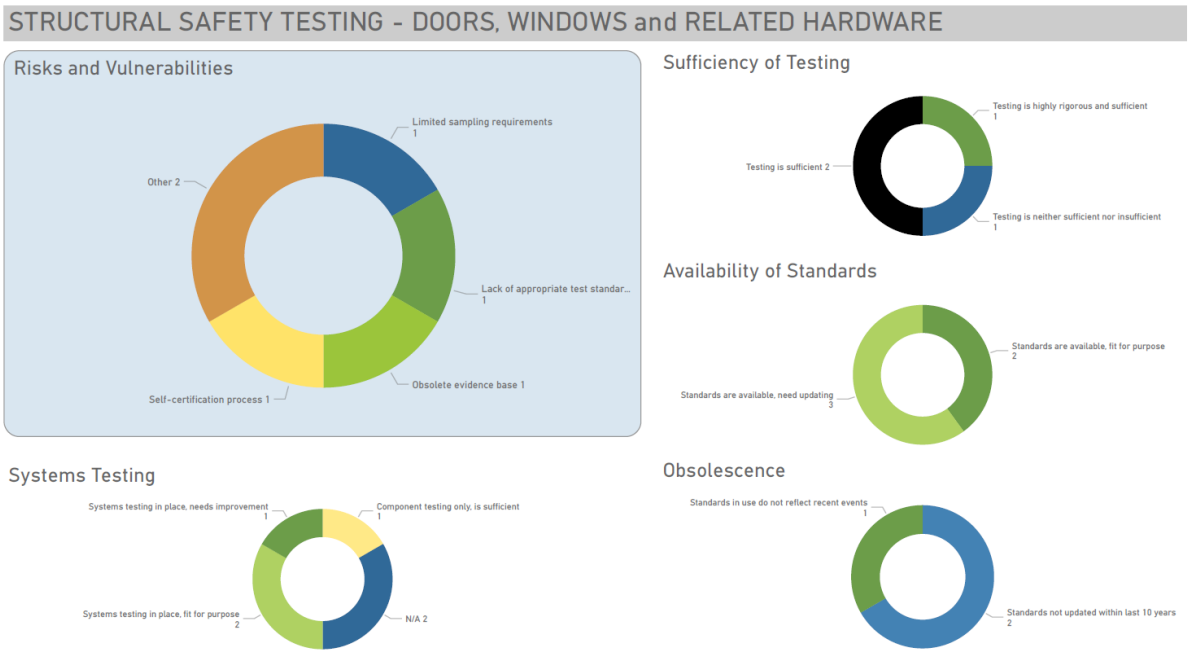

Figure 11 - Risk and Vulnerability Dashboard for structural safety testing of doors, windows and related hardware products. Numbers represent the number of responses from the Construction Products Testing Survey

8.3.15. **Doors, windows, shutters, gates & related building hardware**

8.3.16. This product family covers a range of products, including fenestration products, shading devices, rooflights, roof windows, patent glazing, louvers, architectural metalwork, ventilation devices, doorsets and assemblies, and fire doors.

8.3.17. Fire doors have long been a sensitive topic following a chequered history of testing, accreditation and installation. Progress has been made following Grenfell, but there is still work to be done. Issues around fire doors include evidence of misapplied testing; inconsistent production methods; problems with identification and verification trails; a record of poor installation; and a disconnect between test house installations and actual on-site installations.

8.3.18. The most commonly used standards for structural safety include:

- EN 1154 - Building hardware. Controlled door closing devices. Requirements and test methods
- EN 1155 - Building hardware. Electrically powered hold-open devices for swing doors. Requirements and test methods
- EN 1125 – Building hardware – Panic exit devices operated by a horizontal bar, for use on escape routes – requirements and test methods

- EN 179 – Building hardware – Emergency exit devices operated by a level handle or push pad, for use on escape routes – Requirements and test methods
- EN 12209 – Building hardware – Mechanically operated locks and locking plates – Requirements and test methods
- EN 1158 – Building hardware – Door coordinator devices – Requirements and test methods
- BS 7412 - Specification for windows and doorsets made from unplasticized polyvinyl chloride (PVC-U) extruded hollow profiles
- BS 6375 - Performance of windows and doors. Classification for weathertightness and guidance on selection and specification
- EN 1991-1-4 – Eurocode 1 – Actions on Structures – Part 1-4: General actions – Wind actions
- EN 12179 – Curtain walling – Resistance to wind load – Test method
- EN 12211 – Windows and doors – Resistance to wind load – Test method
- EN 16612 - Glass in building - Determination of the lateral load resistance of glass panes by calculation
- EN 16613 - Glass in building - Laminated glass and laminated safety glass - Determination of interlayer viscoelastic properties
- EN 13830 - Curtain walling. Product standard

8.3.19. In terms of fire safety, the most commonly used standards include:

- EN 1634-1 - Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 1: Fire resistance test for door and shutter assemblies and openable windows
- EN 1634-2 - Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware - Part 2: Fire resistance characterisation test for elements of building hardware
- EN 1634-3 - Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 3: Smoke control test for door and shutter assemblies
- BS 476-10 - Fire tests on building materials and structures. Guide to the principles, selection, role and application of fire testing and their outputs
- BS 476-22 - Fire tests on building materials and structures, Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction

- BS 476-20 - Fire tests on building materials and structures, Part 20: Methods for determination of the fire resistance of elements of construction (general principles)
- BS 476-31 - Methods for measuring smoke penetration through doorsets and shutter assemblies. Method of measurement under ambient temperature conditions
- BS EN 1634-1:2014 - Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 1: Fire resistance test for door and shutter assemblies and openable windows (not current but is a dated normative reference in BS EN 16034)
- EN 1363-1 - Fire resistance tests - Part 1: General Requirements
- EN 1364-1 - Fire resistance tests for non-loadbearing elements. Walls
- EN 1364-2 - Fire resistance tests for non-loadbearing elements. Ceilings
- EN 1364-3 - Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly)
- EN 1364-4 - Fire resistance tests for non-loadbearing elements. Curtain walling. Part configuration
- EN 1365-2 - Fire resistance tests for loadbearing elements. Floors and Roofs
- BS EN 16034 - Pedestrian doorsets, industrial, commercial, garage doors and openable windows. Product standard, performance characteristics. Fire resisting and/or smoke control characteristics
- EN 13501-1 - Fire classification of construction products and building elements. Classification using data from reaction to fire tests
- EN 13501-2 - Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services
- EN ISO 11925-2 - Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test
- EN 13823 - Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item
- EN ISO 1182 - Reaction to fire tests for products. Non-combustibility test
- EN ISO 1716 - Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)

- EN 179 – Building hardware – Emergency exit devices operated by a lever handle or push pad, for use on escape routes – Requirements and test methods
- EN 1125 - Building hardware. Panic exit devices operated by a horizontal bar, for use on escape routes. Requirements and test methods
- EN 1935 – Building hardware – Single axis hinges – Requirements and test methods
- EN 15998 – Glass in building – Safety in case of fire, fire resistance – Glass testing methodology for the purpose of classification
- EN 12101-1 – Smoke and heat control systems – Part 1: Specification for Smoke Barriers

8.3.20. Product manufacturers working in this area consider the testing for fire resistant glazing systems to be highly rigorous and sufficient, however the testing for reaction to fire and spread of flame is currently deemed to be unsuitable. Other vulnerabilities for this product family for structural safety include the self-certification process, limited sampling requirements, and an obsolete evidence base for some of the existing standards. For fire safety, there are more perceived vulnerabilities within the industry, including lack of or infrequent testing over time, the self-certification process, limited sampling requirements, an obsolete evidence base, and the lack of a systems approach to testing.

8.3.21. There is a lack of appropriate test standards and a systems approach to testing for attachments such as balconies and dynamic shading systems. The glass and glazing industry are also looking at improvements in terms of taking a systems approach to testing – resistance to fire is already being tested as a system, but reaction to fire is still largely component based.

8.3.22. Glazing products in general are considered to have a robust regime for testing resistance to fire, although system level testing is not generally applicable for many finished glazing products. Laminated glass, however, remains a problem area, where issues remain around the proper classification of this particular product according to EN 13501-1

8.3.23. The lack of an expanded application standard for composite doorsets causes differences in the manner in which certification bodies develop assessments for composite doorsets. An EXAP for composite doorsets

has been in development through the European system for some years but as the UK is the only major user of composite fire doors, there appears to be little urgency in completing this work. The availability of third party certification schemes for composite fire doorsets is an issue, and where they are available, there is a large variation in the requirements for certification. The development of a certification standard based on a series of core requirements for certification would be beneficial and provide a level playing field for manufacturers and provide assurance in certification schemes for clients when making purchasing decisions.

8.3.24. Certification in the doorset sector is voluntary, and there are no requirements for re-testing the product following the initial testing. Some members of the industry believe that fire test reports should have a limited life (say 3 years) and clients should be advised that they should ensure the test report they are relying on is current and in date.

8.3.25. For fire doors in particular, it was pointed out by one respondent that for products that rely on a particular standard of mechanical performance, the fire performance of a brand new product can be very different to the same product after ten years and that the tests need to backed up with a system for monitoring replacements over the lifetime of the product.

8.3.26. The standard for door closing devices is currently an issue for the industry. The standard specifies a minimum closing force with a relatively low operating efficiency. This results in doors being too hard to open for many users and the door closers subsequently being removed. The reason for this is cited as being the result of the standard being based on production capabilities that were the state of the art some 50 years ago, with members of the industry stressing that the standards are in great need of a review and update in order to enable improvements to the required operating forces and efficiencies.

8.3.27. The testing and assurance regime for specialist timber fire doors is likewise considered to be robust, reliable and consistent. The industry believes that current standards are fit for purpose, that the creation or modification of existing standards would serve only to create disruption, and that any shortcomings should be addressed by

focusing on the robust implementation of third party certification. For more information see Annex A.

8.3.28. Most of the respondents from the wider product family agree that third party certification is the correct route and that self-certification should not be allowed. There were also some criticism of the current sampling regime, and a suggestion that samples should be taken from the market when re-testing instead of being selected by the manufacturer.

8.4. Medium risk Products

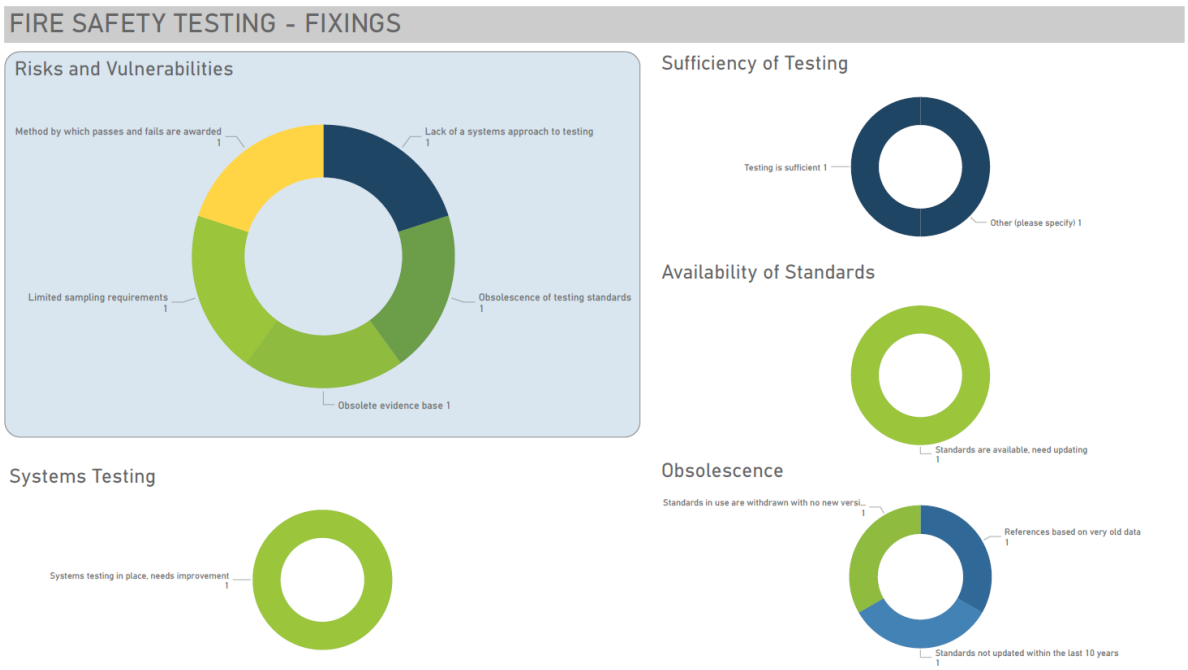

Figure 12 - Risk and Vulnerability Dashboard for fire safety testing of fixings. Numbers represent the number of responses from the Construction Products Testing Survey. Note that we have not included a dashboard for structural safety testing as there were not enough responses for that aspect.

8.4.1. **Fixings -** This product family includes fasteners, hangers, straps, clips, plates, nails, screws and any other components used to mechanically connect building elements together for both structural and non-structural purposes. The most commonly used structural safety standards for this product family include:

- BS 5427 – Code of practice for the use of profiled sheet for roof and wall cladding on buildings
- ETAG 015 - Three Dimensional Nailing Plates
- EN 845 - Specification for ancillary components for masonry
- EN 14545 - Timber structures - Connectors - Requirements

- EN 14592 - Timber structures - Dowel-type fasteners - Requirements
- EN 1995-1-1 - Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings

8.4.2. The most commonly used fire safety standards for fixings include:

- EN 1365-2 - Fire resistance tests for loadbearing elements. Floors and Roofs
- BS 476 - Fire tests on building materials and structures.

8.4.3. In terms of fire safety, members of this industry have pointed out that testing to BS 476 is still acceptable and that this leads to vulnerabilities in the regime. They believe that this practice should no longer be acceptable and that only EN 1365-2 should be used. Some products in this category, such as three dimensional nailing plates (hangers) are only covered by an ETAG and not an EN standard.

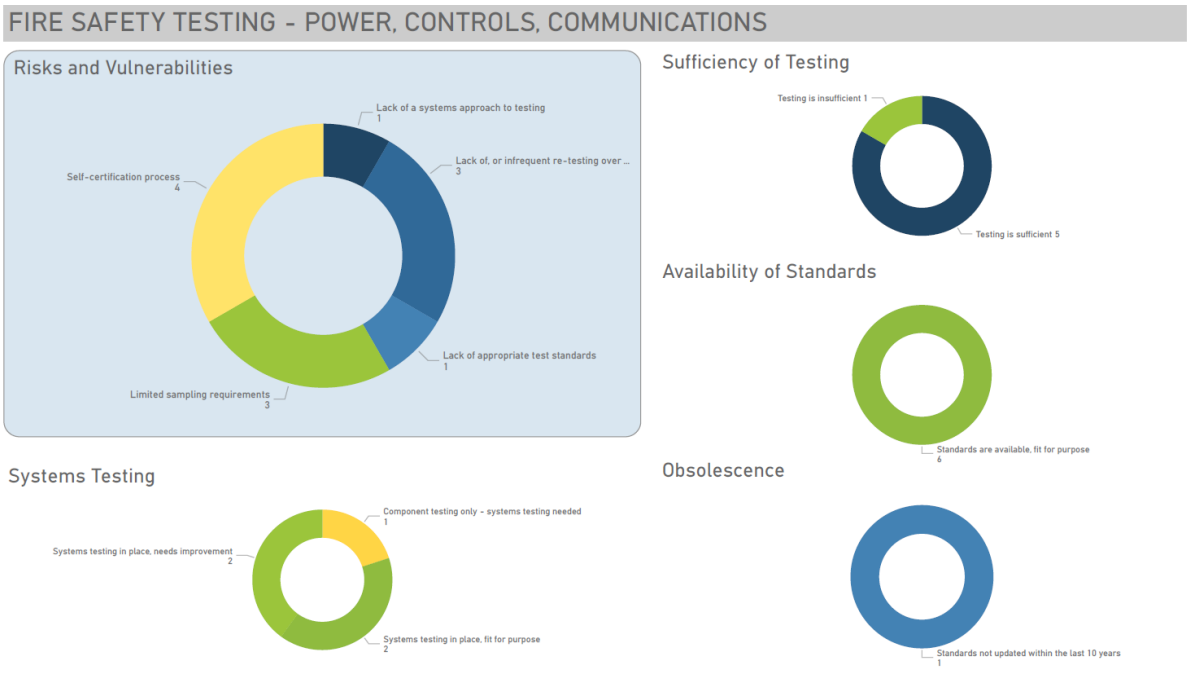

Figure 13 - Risk and Vulnerability Dashboard for fire safety testing of power, controls and communication products. Numbers represent the number of responses from the Construction Products Testing Survey

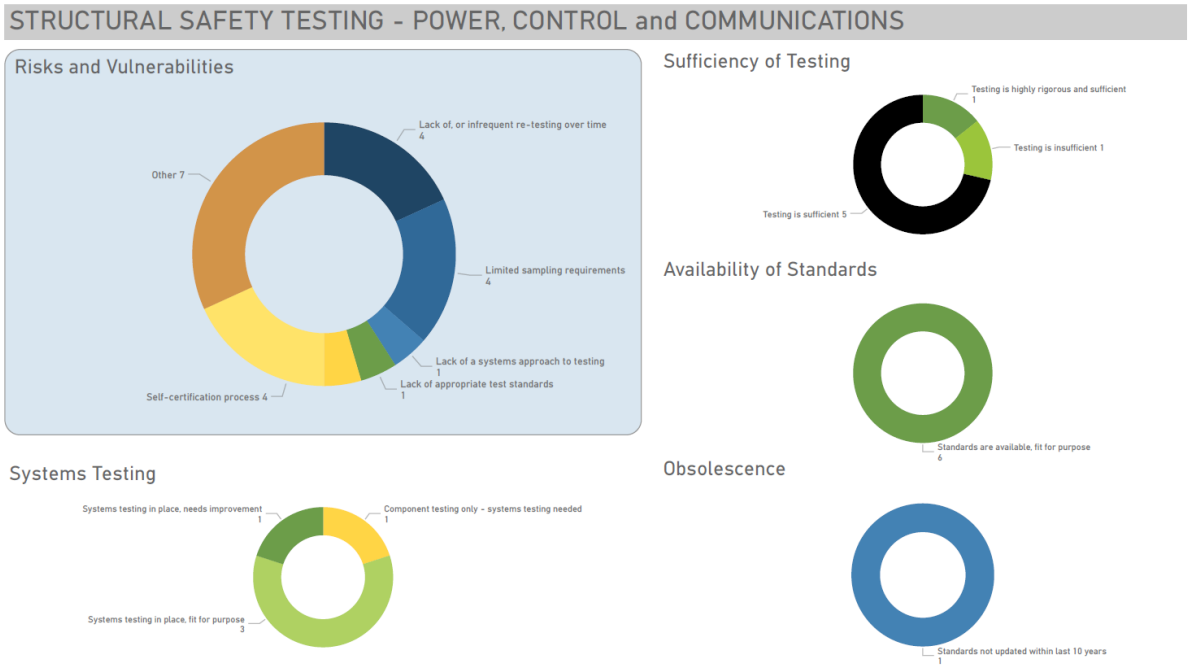

Figure 14 - Risk and Vulnerability Dashboard for fire safety testing of power, controls and communication products. Numbers represent the number of responses from the Construction Products Testing Survey

8.4.4. **Power, control & communication installations -** This product family includes electrical distribution boards, circuit protection equipment, electrical switchgear, switches, sockets, control equipment and communications equipment. It also includes life safety systems. Recommendations exist that require various life safety systems to be able to continue to run during emergency situations. Secondary power sources, protected circuits and fire enclosures all form part of this category. Certain aspects of this can be difficult to specify and are easily overlooked. The main standard for life safety systems is BS 9999.

8.4.5. Another type of electrical installation that sits in this category is wayfinding devices. Emergency lighting and signage does not commonly present many vulnerabilities in terms of fire safety. Issues include the maintenance for emergency lighting systems and the lack of a standard for storey signage. The main standards for wayfinding include BS 5266, BS 3864 and BS 5499.

8.4.6. The most commonly used standards for power, control and communication installations include the following:

- BS 1363 - 13 A plugs, socket-outlets, adaptors and connection units. Specification for rewirable and non-rewirable 13 A fused plugs

- BS 7671 - Requirements for Electrical Installations. IET Wiring Regulations
- BS EN 50085 - Cable trunking systems and cable ducting systems for electrical installations. General requirements
- BS EN 60439 - Low-voltage switchgear and controlgear assemblies. General rules
- BS EN 60626 - Combined flexible materials for electrical insulation. Definitions and general requirements
- BS EN 60669 - Switches for household and similar fixed-electrical installations. General requirements
- BS EN 60695 - Fire hazard testing. Guidance for assessing the fire hazard of electrotechnical products - Preselection testing process. General guidelines
- BS EN 60898 - Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations. Circuit-breakers for a.c. operation
- BS EN 60947 - Low-voltage switchgear and controlgear. General rules
- BS EN 61008 - Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). General rules
- BS EN 61009 - Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs). General rules
- BS EN 61439 - Low-voltage switchgear and controlgear assemblies. General rules
- BS EN 61534 - Powertrack systems. General requirements
- BS EN 61537 - Cable management. Cable tray systems and cable ladder systems
- BS EN 61643-11 - Low-voltage surge protective devices. Surge protective devices connected to low-voltage power systems. Requirements and test methods

8.4.7. **Masonry & related products** - The most commonly used structural safety standards for this product family include:

- EN 771 - Specification for masonry units
- EN 772 - Methods of test for masonry units.
- EN 1745 - Masonry and masonry products - Methods for determining thermal properties
- EN 12602 - Prefabricated reinforced components of autoclaved aerated concrete (for aircrete blocks)
- BS 1217 - Cast stone. Specification
- BS EN 12390-3 - Testing hardened concrete. Compressive strength of test specimens

- BS 1881-208 - Testing concrete. Recommendations for the determination of the initial surface absorption of concrete

8.4.8. The most commonly used fire safety standard for this product family is EN 13501-1. In general, the standards used for this product family are considered to be robust and fit for purpose, and no issues have been reported.

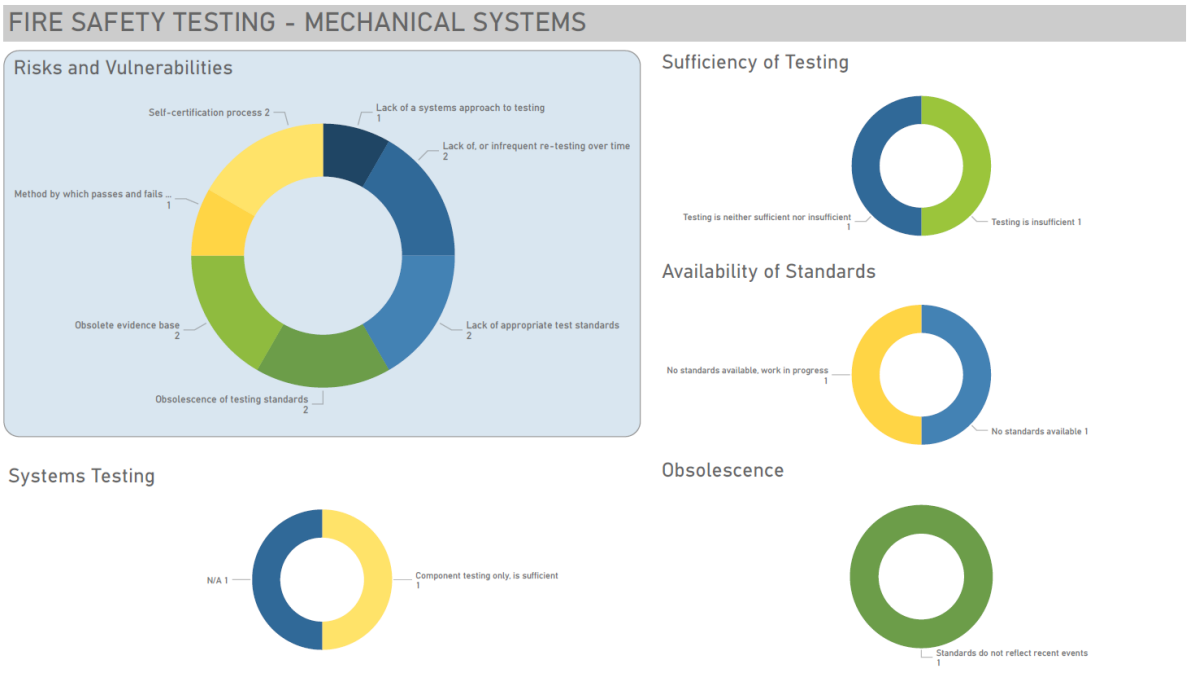

Figure 15 - Risk and Vulnerability Dashboard for fire safety testing of mechanical systems. Numbers represent the number of responses from the Construction Products Testing Survey

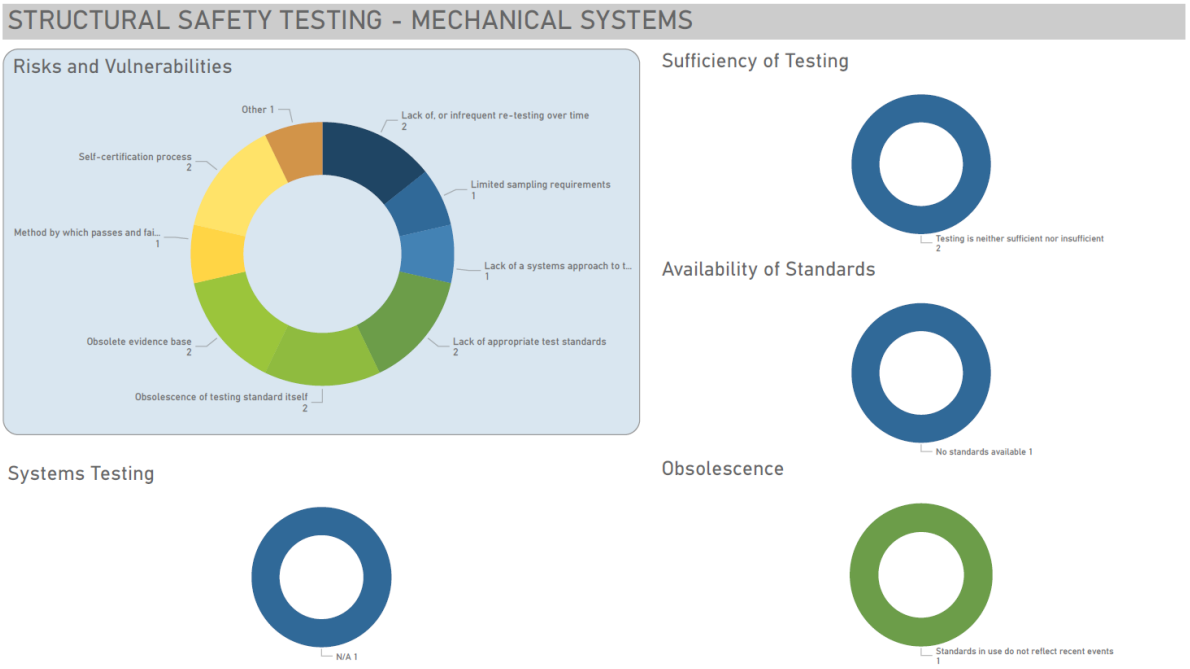

Figure 16 - Risk and Vulnerability Dashboard for structural safety testing of mechanical systems. Numbers represent the number of responses from the Construction Products Testing Survey

8.4.9. **Mechanical systems -** Mechanical systems include extractor fans, MVHR units, roof ventilators, through wall and underfloor ventilation. The most commonly used structural safety standard for this product family is BS 8612 (specifically with regards to roof ventilators and their relationship to dry fixed ridge, hip and verge systems for slating and tiling), and for fire safety the general fire standards contained within BS 476 (Fire tests on building materials and structures) are used.

8.4.10. Ventilation ducts, protected shafts and service risers are all potential conduits for fire spread and have all been historically prone to construction quality faults that erode fire safety. The issues surrounding this product category include: incomplete duct lining out; missing or inadequate fire stopping of penetrations; permissible damper modes of activation; and the lack of centralised or updated guidance. The key standards for this category include:

- BS EN 1366
- BS EN 15650
- BS 8313
- BS EN 13501-3

8.4.11. **Building kits, units and prefabricated units** - Testing for modular building elements is highly rigorous. The following are the most commonly used standards for structural safety testing:

- Eurocode 3 - Design of steel structures. Fatigue
- BS EN 1990:2002+A1:2005 - Eurocode – Basis of structural design; with UK National Annex to BS EN 1990:2002+A1:2005.
- BS EN 1993-1-1:2005 - Eurocode 3: Design of steel structures – Part 1.1: General rules and rules for buildings; with UK National Annex to BS EN 1993-1-1:2005.
- BS EN 1090-2:2018 - Execution of steel structures and aluminium structures. Technical requirements for steel structures

8.4.12. The following are the most commonly used standards for fire safety testing:

- BS EN 13501 Parts 1, 2 and 5 - Fire classification of construction products and building elements. Classification using data from reaction to fire tests
- BS 476 Part 22 - Methods for determination of the fire resistance of non-loadbearing elements of construction
- BS 476 Part 6 - Method of test for fire propagation for products
- BS 476 Part 7 - Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
- LPS 1181 Parts 1 and 2 – Loss Prevention Standard: Requirements and tests for built up cladding and sandwich panel systems
- BS 8414 Parts 1 and 2 - Test method for non-loadbearing external cladding systems applied to the masonry face of a building

8.4.13. The use of BS EN 9001:2008 as a mechanism for establishing the traceability of the supply chain for structural materials and components used in these prefabricated systems was also cited. For this product family, there are standards in place for both individual assemblies as well as entire modular building product platforms.

8.4.14. The range of products in this product family are diverse and varied. Product ranges are typically also subject to third party peer reviewed and manufacturers would have additional certification in place (e.g. BBA certification or European Technical Approvals (ETAs). A key concern for this product family is that the standards available are very much based on traditional construction techniques and do not always align with innovative new construction techniques. Despite this, the industry believes that their testing regime is very good, but that testing capacity is often an issue. Self-certification of these systems is

currently allowed for some of the system components, however the respondents to our survey did agree that a move towards third party approval would be beneficial if the capacity for this approvals process is increased.

8.4.15. Another concern from this industry is that the pace of change of the emerging Fire Safety legislation will require rapid re-education of the sector and that existing training packages are not sufficient. The same can probably be said across the entire construction products industry in the face of the changing Building Safety policy landscape.

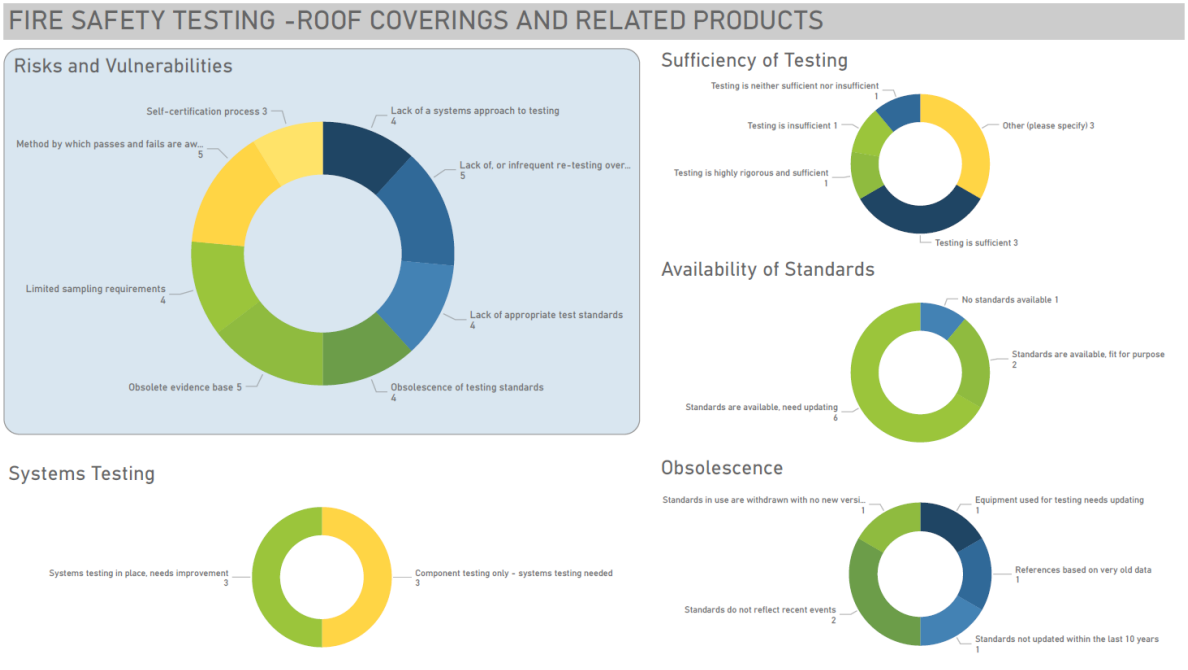

Figure 17 - Risk and Vulnerability Dashboard for fire safety testing of roof coverings and related products. Numbers represent the number of responses from the Construction Products Testing Survey

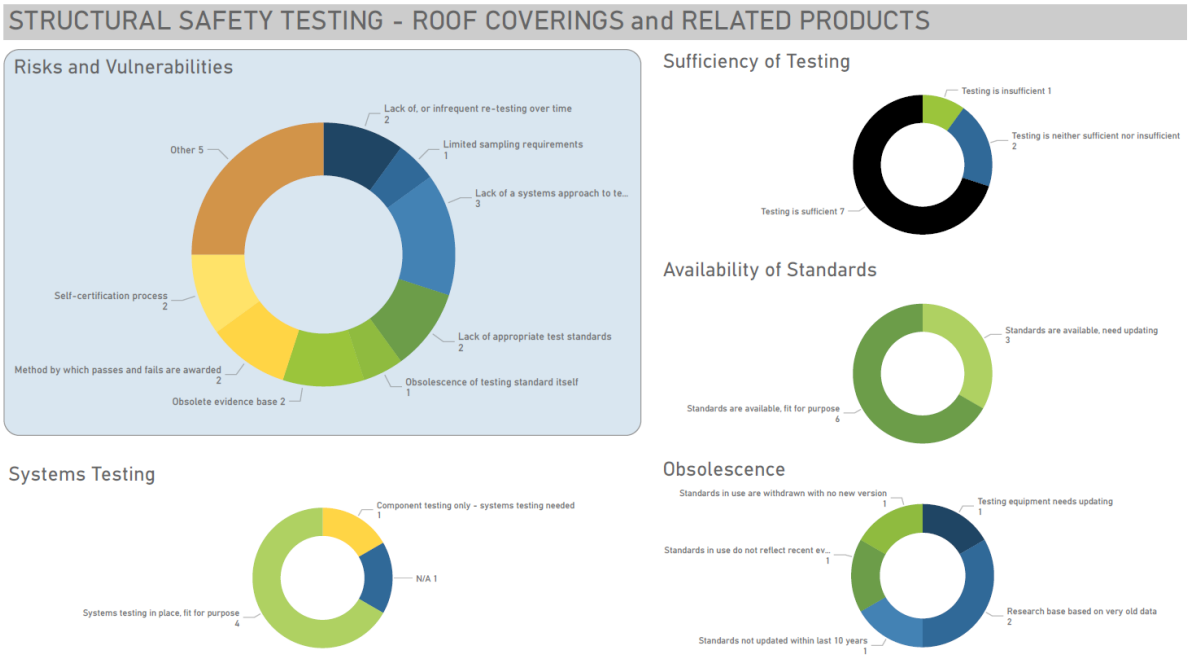

Figure 18 - Risk and Vulnerability Dashboard for structural safety testing of roof coverings and related products. Numbers represent the number of responses from the Construction Products Testing Survey

8.4.16. **Roof coverings, roof lights, roof windows & ancillary products, roof kits -** this product family includes roofing panels, roof tiles/slates, rooflights, roof windows, liquid applied roofing, metal roofing, and associated accessories and components.

8.4.17. There is generally a low rate of incidence of roof fires. Issues for roofs include gaps in pitched roof voids and at eaves; fire stopping at party wall lines; and combustible insulation being located in flat roof, podium and walkway roof build-ups. The last issue is a matter of growing concern and currently lacks guidance.

8.4.18. The most commonly used structural safety standards for this product family include the following:

- CWCT TN67 – Safety and Fragility of Glazed Roofing
- BS 5534 - Slating and tiling for pitched roofs and vertical cladding. Code of practice
- BS EN 14437 - Determination of the uplift resistance of installed clay or concrete tiles for roofing. Roof system test method
- BS EN 490 - Concrete roofing tiles and fittings for roof covering and wall cladding. Product specifications
- BS EN 1304 - Clay roofing tiles and fittings. Product definitions and specifications
- ETAG 005 - Liquid Applied Roof Waterproofing Kits

- BS EN 16002 - Flexible sheets for waterproofing. Determination of the resistance to wind load of mechanically fastened flexible sheets for roof waterproofing
- BS EN 13501-5 - Classification using data from external fire exposure to roof tests
- BS EN 1991 Parts 1 to 4 - Eurocode 1: Actions on structures
- BS EN 1993 - Eurocode 3. Design of steel structures.
- BS EN 1994 - Eurocode 4: Design of composite steel and concrete structures
- BS EN 1090 - Execution of steel structures and aluminium structures
- BS EN 14509 - Self-supporting double skin metal faced insulating panels. Factory made products. Specifications
- BS EN 14782 - Self-supporting metal sheet for roofing, external cladding and internal lining. Product specification and requirements

8.4.19. The most commonly used fire safety standards for this product family include the following:

- BS EN 1365 - Fire resistance tests for loadbearing elements
- EN 13501-2 - Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services
- EN 13501-1 - Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
- EN 13501-5 - Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests
- BS 476-22 - Methods for determination of the fire resistance of non-loadbearing elements of construction
- LPCB-LPS 1181-1 - Loss Prevention Standard: Requirements and tests for built up cladding and sandwich panel systems for use as the external envelope of buildings
- FM 4880 - Evaluating the Fire Performance of Insulated Building Panel Assemblies and Interior Finish Materials
- BS 8414 - Fire performance of external cladding systems
- BS 9414 - Fire performance of external cladding systems. The application of results from BS 8414-1 and BS 8414-2 tests
- TS 1187 - Test methods for external fire exposure to roofs
- TS 16459 - External fire exposure of roofs and roof coverings. Extended application of test results from CEN/TS 1187

- BS 476-3 - Fire tests on building materials and structures. Classification and method of test for external fire exposure to roofs
- BS 5516 - Patent glazing and sloping glazing for buildings
- BS 6229 - Flat roofs with continuously supported flexible waterproof coverings. Code of practice
- BS EN 13707 - Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics

8.4.20. For roofing tiles and slates that require fire testing, such as resin slates, manufacturers have expressed concerns relating to TS 1187 and classifications under BS EN 13501-5. TS 1187 does not adequately cover conditions at joints and the extended application rules for TS 1187 still need to be updated (TS 16459). The roofing tile sector has also raised concerns regarding the lack of references to BS 5534 in Approved Document A of the Building Regulations, which has been cited by the LABC as an impediment to the enforcement of fixing standards, resulting in injuries to persons and also damage to property during high winds. Another vulnerability identified by manufacturers is the current sampling regime, which allows for the possibility of using "golden samples" for demonstrating compliance with structural safety standards. In terms of BS EN 490 and BS EN 1304, the new version of this standard is still not referenced in OJEU so current CE marking is still based on the old version of this standard. BS EN 14437 likewise also requires updating but is currently "stuck" due to the Construction Products Regulation (CPR) processes.

8.4.21. In terms of rooflights and roof windows, the current structural safety regime is only concerned with the fragility of the glass in terms of its resistance to hard and soft body impacts, and that the regime relies heavily on calculations and is unable to take account of build quality and workmanship. Rooflight and roof window manufacturers are of the opinion that available test methods do not seem to be relevant to their particular product type, leaving room for interpretation as to how they should be applied (CWCT TN67). New standards are in progress (prEN 1873-2 and prEN 14963-2), however these are still in very early stages and is anticipated that it will be held up in the standards approval process for some time. This sector has also pointed out that BS 5516 is desperately in need of an update but has expressed

frustration at the lack of response from the BSI committee responsible for this standard.

8.4.22. For flat roofing products, the manufacturers have concerns regarding the quality, accuracy and availability of fire safety testing for their product family. These concerns include the capacity of test labs; the competence of these test labs; the lack of surveillance of these test labs; the lack of consistency between different test labs; the slowness of development of test standards (in particular TS 1187); the maximum dimensions of the constructions that can be tested; and the adequacy of the EXAP rules.

8.4.23. Other issues include the lack of referencing of the relevant standards (ETAG 005 and BS EN 16002) in the Approved Documents, which presents an obstacle to industry acceptance as well as enforcement; the difficulty associated with getting hEN standards amended to reflect changes in practice, within a reasonable timescale; and the cumbersome nature of the CEN cross-country agreement process. The manufacturers from this product family are also of the opinion that BS 476-3 should be removed in favour of a single unified standard. Members of this industry also cited a need to establish a clear set of definitions for worst case scenarios in flat roofs on which fire tests can be based to avoid having to do 100's of fire tests for every single configuration of construction.

8.4.24. **Fixed fire fighting equipment (Fire alarm/detection, fixed firefighting, fire and smoke control)** - fixed fire fighting equipment is a a vital front-line safety feature in blocks of flats. This product family includes fire detection and alarm systems and fire and smoke control systems. As such, it may naturally be seen as being of high priority risk item. However, as it is a complex and specialist area with a high degree of specialist input that maintains a high standard for product, installation and performance, we consider this set of products to be generally reliable, and therefore can be considered to have a medium risk rating. Due to the nature of the products, structural safety is not so much of an issue, and the main standards covering these products are covered by the EN 54 series – Fire detection and fire alarm systems. The testing regime is generally considered to be highly rigorous and sufficient.

8.4.25. Sprinkler protection is a vital fire safety aid, with the amount of take-up expected to increase over time. The industry is developing new techniques and products to meet this demand, and these will need to be reviewed and standardised going forward.

8.4.26. Standards for fixed fire fighting installations are robust. Numerous aspects of fire fighting equipment are outside the scope of the CPR, including water supply systems. Potential issues for this category include: water supply; the conflict of space between escape and firefighting; the abuse and maintenance of fire mains; provision of hydrants; and the lack of a standard covering storey signage.

8.4.27. In terms of smoke control, these components do not exhibit too many problems in practice, but it is crucial to many building designs by way of keeping means of escape and fire fighting arrangements safe and viable. Increasing the density and height of buildings will make these components more vulnerable to failure, and given the interoperability of these systems with vital fire safety aspects, this should be seen as a high priority.

8.4.28. Key issues for fire detection and warning system products include over-complexity, occasional misconfiguration of systems, product failure (rare), over-sensitive or mis designed products leading to false alarm sounding, potential for damage, abuse and lack of understanding of controls and operation, and the need for a reliable and regular maintenance regime. The following standards are key to this product category:

- BS 5839 series
- BS 8629:2019
- BS EN 54 series
- BS 5446 series
- BS EN 14604
- BS 5839 series
- BS 7273
- BS 8591
- BS 9251
- BS 9252
- BS 8458
- BS 12845
- BS EN 12259-1
- BS EN 12101 series

- BS 7346 series
- BS EN 1366 series
- BS 750
- BS 5041
- BS EN 14339
- BS EN 14384
- BS EN 12101 series
- BS EN 81-20, -72
- BS 8629

8.5. Low Risk products

8.5.1. **Aggregates -** testing for structural safety for aggregates is sufficient. As an ingredient for structural elements, testing of aggregates to European and UK standards generally gives sufficient data on the performance of these aggregates to enable designers of these structural elements to design structural components such as concrete or precast concrete, alongside other considerations for structural performance. The following are considered to be the most commonly used standards for aggregates:

- EN 1097 - Tests for mechanical and physical properties of aggregates (Parts 1-11)
- EN 1367 - Test for thermal and weathering properties of aggregates
- EN 932 - Tests for general properties of aggregates
- EN 1744 - Tests for chemical properties of aggregates

8.5.2. In terms of fire safety, aggregates are generally categorised as A1 without testing due to their inherent characteristics. Aggregates themselves are not tested for fire performance, but rather the final products that they are used for.

8.5.3. CEN/TC 154 is the relevant CEN technical body for Aggregates. As of writing, work is currently being undertaken on the revisions for EN 1097, EN 1367 and EN 932. Generally speaking, as a product family, aggregates are considered to be low risk in terms of structural safety and fire safety, although a small number of respondents have noted that the standards are in need of updating.

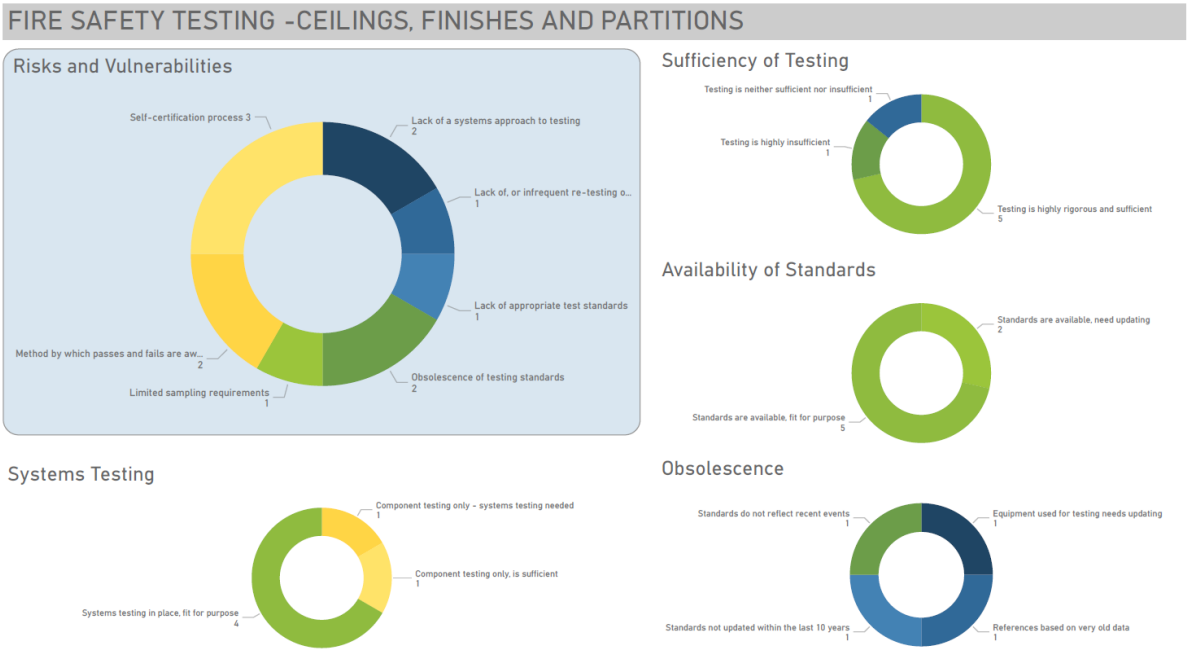

Figure 19 - Risk and Vulnerability Dashboard for fire safety testing of ceilings, finishes and partition products. Numbers represent the number of responses from the Construction Products Testing Survey

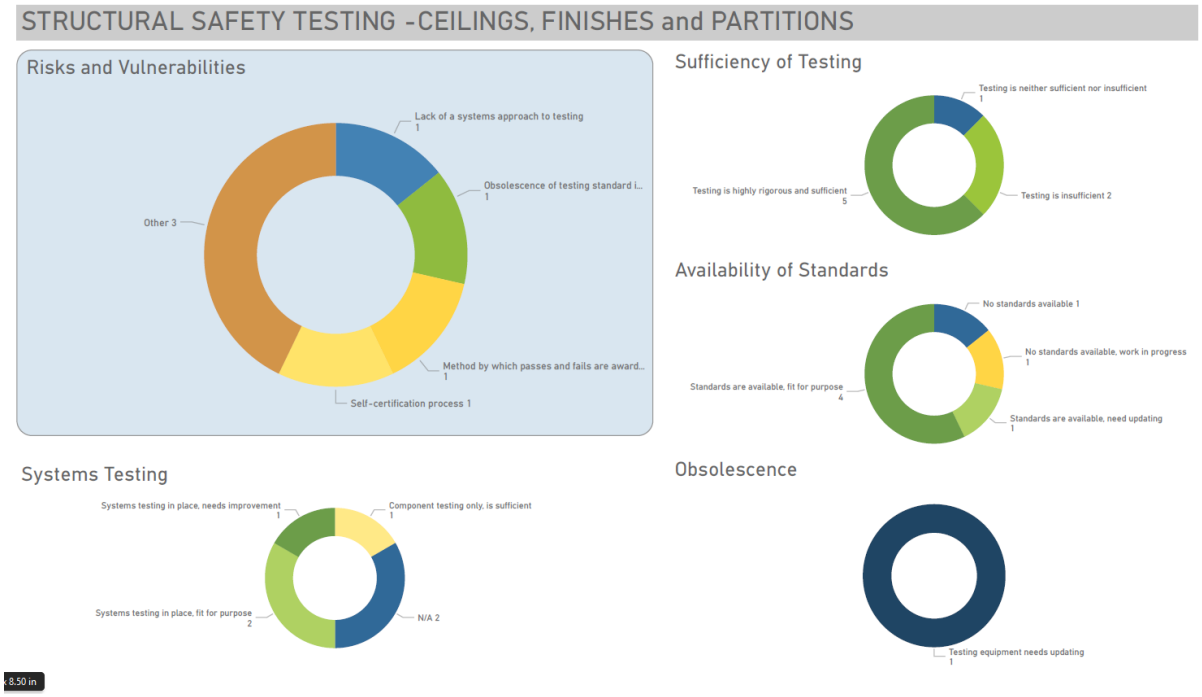

Figure 20 - Risk and Vulnerability Dashboard for structural safety testing of ceilings, finishes and partition products. Numbers represent the number of responses from the Construction Products Testing Survey

8.5.4. **Ceiling Products** - this product family covers ceiling products, including acoustic solutions and sound absorption panels, which are not typically expected to meet standards for structural safety. The

following are the most commonly used fire safety testing standards for this product family:

- BS 476 – Fire tests on building materials and structure
- EN ISO 1182:2010 – Non-combustibility test
- EN ISO 1716:2018 – Determination of the gross heat of combustion (calorific value)
- EN 13823:2010+A1:2014 – Single burning item (SBI) test
- EN ISO 11925-2 – Single-flame source test/ignitability test

8.5.5. BS 476, despite being commonly used, is considered by manufacturers from this sector to be obsolete, and based on a research base consisting of very old data, resulting in a standard that does not reflect the impact of recent events or technological developments. For this particular product family, only individual components are typically tested and not assemblies or systems, but the manufacturers do not believe this to be an issue.

8.5.6. One respondent to the survey cited issues around the high cost of testing being a significantly limiting factor in terms of stifling new product innovation for ceiling products. They agree that re-testing should be carried out, however the cost of testing and re-testing could be considered too prohibitive for the manufacturers to bear.

8.5.7. Further to the issue of re-testing, flammability testing is normally only carried out at product launch but not re-tested unless there are significant changes to the product.

8.5.8. **Internal & external wall and ceiling finishes, internal partition kits** - this product family includes internal partitions, fire resistant and acoustic attenuating partition systems, wall panels, cavity wall assemblies, paints, roll wallcoverings and other finishes. The most commonly used structural safety standards for this product family include:

- BS 5234 - Partitions (including matching linings). Code of practice for design and installation
- BS 6180 - Barriers in and about buildings. Code of practice
- ANSI/FM 4881 – Evaluating Exterior Wall Systems
- FM 4411 - Cavity walls and rainscreens
- BS EN 15102 - Decorative wall coverings. Roll and panel form

8.5.9. The most commonly used fire safety standards for this product family include:

- BS 476 - Fire tests on building materials and structures.

- EN 13501-1 - Fire classification of construction products and building elements. Classification using data from reaction to fire tests
- BS EN 15102 - Decorative wall coverings. Roll and panel form

8.5.10. Gaps for this product family include the lack of specific test standards for frameless glass within BS 5234, and an insufficient testing regime for non-loadbearing partitions – there is a need for a more comprehensive testing regime that covers all variations, but with a simpler methodology. We believe that the F.I.S. are currently looking at this.

8.5.11. For wall assemblies, the use and acceptance of desk-based reviews is a source of vulnerability for both structural and fire safety performance. In addition, a wide variety of standards exists for this product family globally, and these standards vary widely in terms of robustness and sufficiency. The variation in these standards on a country by country basis is difficult to navigate for companies that operate on an international level.

8.5.12. For paints and coatings, the differences in BS vs EN testing causes vulnerabilities in the system, at the very least because of the discrepancy in the number of classes, i.e. the EN classification has more classes compared to the BS. Situations can arise where a particular paint that passes one test can fail the other test, even within the same test lab. There is a lack of standards around sampling and flake analysis and the industry feels that this needs to be put in place.

8.5.13. **Wood based panels & elements** - this product family includes Oriented Strand Board (OSB), particleboard and MDF. The main standard used for testing is EN 13986 (Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking). Testing for this product family is generally considered to be robust and fit for purpose.

8.5.14. **Cement, building limes & other hydraulic binders** - this product family includes cement (Portland cement (CEM I)/composite cements (CEM II)), precast concrete blocks, pavers and slabs, Granulated Ground Blast Furnace Slag (GGBS), fly ash, building limes, and building limestone. The testing regime for this product family is considered to be highly rigorous and sufficient. The most commonly used standards

for testing structural safety are the following. These standards are considered to be fit for purpose.

- BS EN 197 Part 1 and 2 – Cement. Composition, specifications and conformity criteria (Part 1); Conformity evaluation (Part 2)
- BS EN 15167-1 - Ground granulated blast furnace slag for use in concrete, mortar and grout. Definitions, specifications and conformity criteria
- BS EN 196 Parts 1, 2 and 3 – Method of testing cement
- BS EN 450 - Fly ash for concrete. Definition, specifications and conformity criteria
- BS 7979 - Specification for limestone fines for use with Portland cement
- BS 8500 Parts 1 and 2 – Concrete. Method of specifying and guidance for the specifier

8.5.15. Since the products within this product family are not building components in themselves, it is the end product that is tested for fire safety rather than the cement or hydraulic binders and as such there are no standards for testing fire safety for this product family.

8.5.16. **Construction Adhesives -** testing for this product family is rigorous and sufficient. The most commonly used standards for testing structural safety include the following:

- EN 12004 - Adhesives for tiles - Requirements, evaluation of conformity, classification and designation
- EN 13813 – Screed materials and floor screeds – screed material – properties and requirements
- EN 14891 – Liquid applied water impermeable products for use beneath ceramic tiling bonded with adhesives – requirements, test methods, assessment and verification of constancy of performance, classification and marking
- EN 13888 – Grout for tiles – requirements, evaluation of conformity, classification and designation
- EN 1504 - Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity.

8.5.17. The most commonly used standards for testing fire safety for this product family include the following:

- EN 13501 - Fire classification of construction products and building elements
- EN 13823 - SBI, fire technical testing of building products except flooring materials exposed to thermal heat from a gas burner

8.5.18. The feedback from industry on this family of products is that in general, standards are available and are fit for purpose. The only vulnerability identified was that the research base or references for some of the standards are based on very old data.

8.5.19. **Balconies** - the recent spate of balcony fires has highlighted the need for further study and codification for balconies, as this is a growing design trend that has been neglected in terms of standardisation. Issues include: a historic lack of standards and guidance; coverage by the combustibles ban; uncertainty over the degree of risk from small components; and a large variety of design formats and options that may make standardisation challenging. The current standards that cover balconies include the following:

- BS EN 13501-1
- BS EN 1366-5
- BS 8579 (in draft)

8.5.20. **Floorings** - the most commonly used standards for structural safety for this product family include the following:

- BS 8204 - Screeds, bases and in situ floorings. Concrete bases and cementitious levelling screeds to receive floorings. Code of practice
- BS 8203 - Code of practice for installation of resilient floor coverings
- EN 1307 - Textile floor coverings - Classification
- BS EN 14411 - Ceramic tiles. Definition, classification, characteristics, assessment and verification of constancy of performance and marking
- BS 5385 – 3 - Ceramic tiles. Definition, classification, characteristics, assessment and verification of constancy of performance and marking
- BS 8000-11 - Workmanship on building sites. Internal and external wall and floor tiling. Ceramic and agglomerated stone tiles, natural stone and terrazzo tiles and slabs, and mosaics. Code of practice

8.5.21. The most commonly used standards for fire safety for this product family include the following:

- ISO 9239 - Fire Tests for Determination of the Burning Behaviour of Floorings. Part 1: Determination of the Burning Behaviour Using a Radiant Heat Source
- ISO 11925 - Reaction to fire tests - Ignitability of products subjected to direct impingement of flame

8.5.22. With regards to floor tiles, responses from the industry indicate that that standards require regular updates due to changes in production techniques, and that a 5-8 year cycle for amendment is in place. The biggest challenge the industry sees is support from the BSI for undertaking the work – they note that "there is no lack of volunteers" to carry out the updating work for BS 5385-3 and that a general update is needed to reflect changes in market use, production techniques, and to integrate the information from BS 5385-5:2009 so that the standard can be withdrawn. They also note that BS 8000-11 needs to be updated in order to ensure consistency with BS 5385 Parts 1 to 4. Responses from the carpet manufacturer industry indicate that the existing test regime is robust and fit for purpose.

8.5.23. **Gas installations -** this product family includes gas analysis, detection and measurement equipment and systems. The most commonly used standards include:

- Directive 1994/9/EC - ATEX 95/ATEX Equipment Directive on the approximation of the laws of Members States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
- IEC/EN 60079-10-1 - Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres
- IEC/EN 60079-10-2 - Explosive atmospheres - Part 10-2: Classification of areas - Explosive dust atmospheres
- IEC 60079-11 - Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"
- NIST Special Publication 260-126 Rev 2013 – The NIST Traceable Reference Material Program for Gas Standards
- NEMA 250 – Enclosures for Electrical Equipment (drop testing)
- BS EN 1775 - Gas supply. Gas pipework for buildings. Maximum operating pressure less than or equal to 5 bar. Functional recommendations
- BS EN 15266 - Stainless steel pliable corrugated tubing kits in buildings for gas with an operating pressure up to 0,5 bar
- BS 7838 - Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50

8.5.24. The testing regime for this product family is generally considered to be robust and reliable. Products covered by these standards also use ExZone and ExVeritas Certification schemes.

8.5.25. In terms of gas pipework, vulnerabilities were identified in terms of the need to review BS EN 15266 in terms of reaction to fire aspects. BS 7838 was considered robust, but in need of updating, but is currently at a standstill due to the lack of harmonisation for BS EN 15266. BS 7838 has now been withdrawn but EN 15266 has still not been updated.

8.5.26. **Geotextiles, geomembranes and other related products -** in general terms, only a limited number of geosynthetics products are structural safety-critical and where long-term design strength is important. Bearing this in mind, the testing regime is currently sufficient. For the limited number of geosynthetics applications with structural safety implications, the testing required is aimed at providing engineers with values and reduction factors that can be used for structural design as set out in the appropriate codes of practice. The most commonly used standards for this product family in terms of structural safety include the following:

- BS EN ISO 10319
- BS EN ISO 13431
- PD ISO/TR 20432
- BS 8006 – Code of practice for strengthened/reinforced soils

8.5.27. Geosynthetics in use generally involve burial in soil or aggregates, therefore fire safety testing is not relevant to the overriding majority of geosynthetic applications.

8.5.28. The main issue relevant to this product family lies in shortcomings with the ease of understanding and interpretation of the CE mark hEN application standards, e.g. issues associated with making them CPR compliant (the elimination of the old 'Table 1 and issues around properties like creep limited strength not being required for harmonisation). Geosynthetics are currently at a level 2+ attestation system, and the industry believes this to be appropriate.

8.5.29. **Waterproofing membranes -** bituminous waterproofing membranes, single ply waterproofing membranes and liquid applied waterproofing systems are covered by the fire classification as set out in BS EN 13501-5:2016 and need to meet BroofT4 specifications. Testing is generally considered to be sufficient, and the only issues reported are related to inconsistencies in the incorporation and interpretation of build ups and test results by the BBA, in addition to

the high cost of certification and the slowness and rigidity of the certification process.

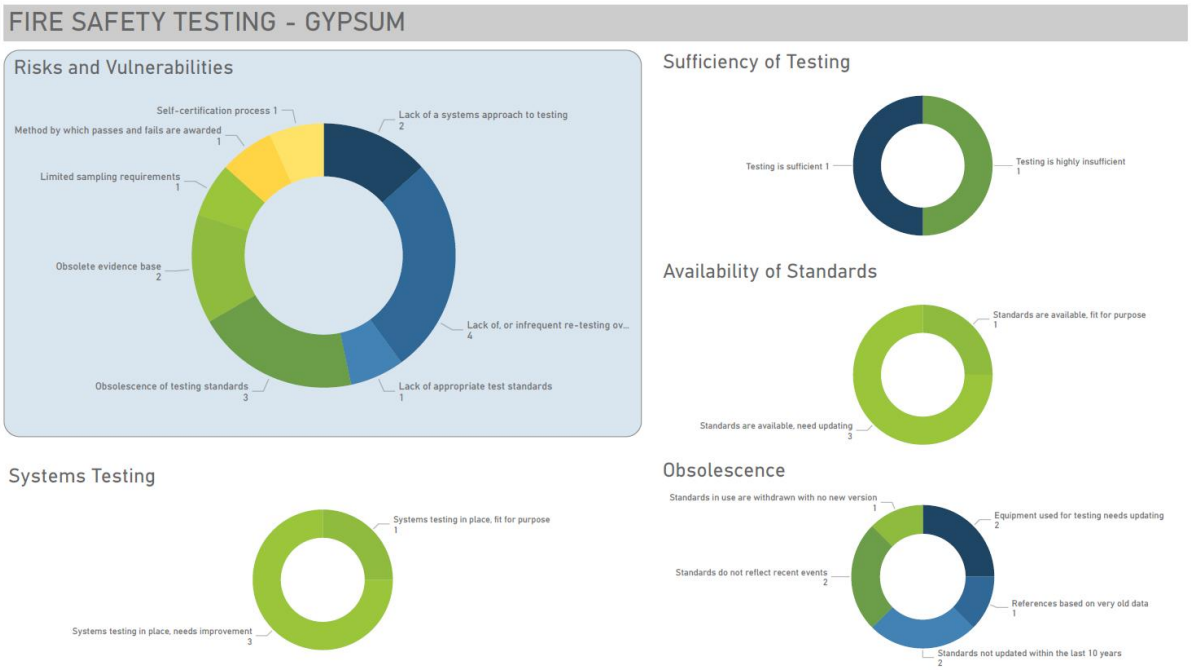

Figure 21 - Risk and Vulnerability Dashboard for fire safety testing of gypsum products. Numbers represent the number of responses from the Construction Products Testing Survey

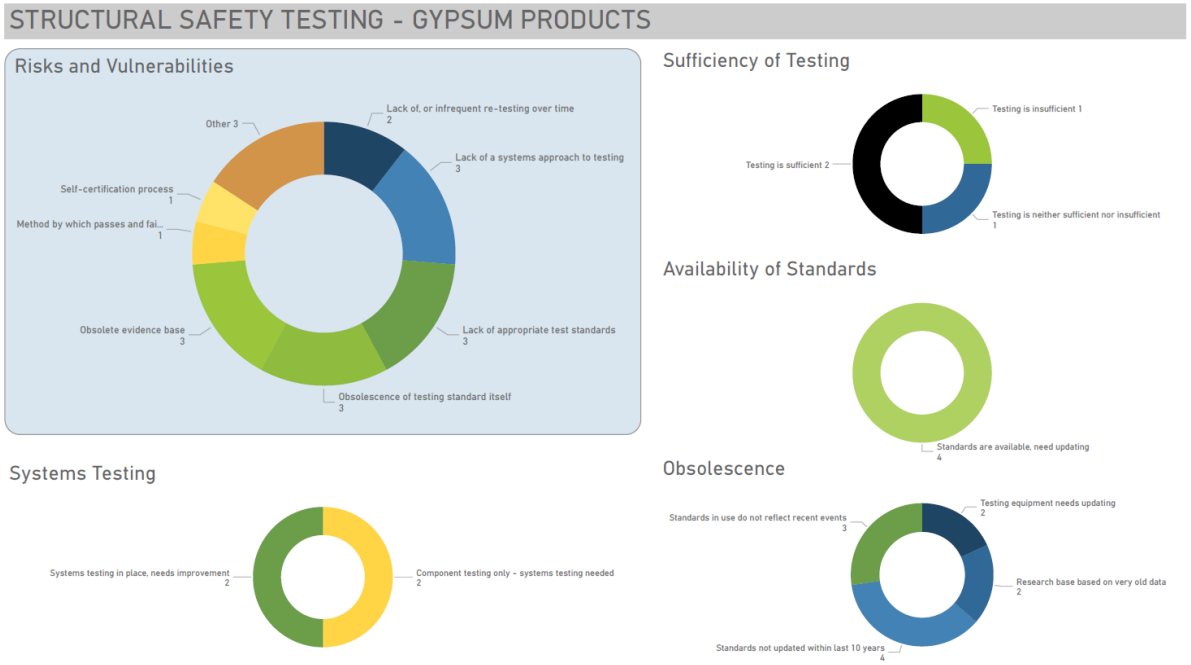

Figure 22 - Risk and Vulnerability Dashboard for structural safety testing of gypsum products. Numbers represent the number of responses from the Construction Products Testing Survey

8.5.30. **Gypsum products -** this product family includes plaster, plasterboard, dry lining systems, plasterboard ceilings, façade boards and

associated metal framing systems. The most commonly used structural safety standards for this product family include:

- BS 5234-2 - Partitions (including matching linings). Specification for performance requirements for strength and robustness including methods of test
- EN 1991 - Eurocode 1: Actions on structures
- EN 1993 - Eurocode 3. Design of steel structures.
- BS EN 520 - Gypsum plasterboards. Definitions, requirements and test methods
- BS EN 13964 - Suspended ceilings - requirements and test methods
- BS EN 14195 - Metal framing components for gypsum board systems

8.5.31. The most commonly used fire safety standards for this product family include:

- BS 476-20 - Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
- BS 476-21 - Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction
- BS 476-22 - Methods for determination of the fire resistance of non-loadbearing elements of construction
- BS 476-23 - Fire tests on building materials and structures. Methods for determination of the contribution of components to the fire resistance of a structure
- EN 1363-1 - Fire resistance tests. General requirements
- BS EN 1364-1 - Fire resistance tests for non-loadbearing elements. Walls
- BS EN 1364-2 - Fire resistance tests for non-loadbearing elements. Ceilings
- BS EN 1365-1 - Fire resistance tests for loadbearing elements. Walls
- BS EN 1365-2 - Fire resistance tests for loadbearing elements. Floors and Roofs
- BS EN 1366 - Fire resistance tests for service installations. Ventilation ducts

8.5.32. Stakeholders from this product family were critical of BS 5234, citing that it is open to interpretation and therefore contains loopholes for manufacturers to exploit. The test methods can be restricted to not cover all scenarios that can happen on construction sites (leading to

the use of "Field of Application") which has led to concerns within the industry.

8.5.33. Calculation methods are widely used to determine structural stability instead of physical testing, which can be limited due to the size of the test rigs (i.e. it is only 3 m in height) and testing apparatus, and there is a perceived need to test against 'real life' as-built conditions (BS EN 1366). The standards for fire safety also do not adequately cover fire testing at the corners of partitions and interfaces with external elements (e.g. steel frames, roofing etc.). We believe that BBA are currently looking at system-level certification going forward.

8.5.34. Echoing criticism from other product families, the gypsum product manufacturers also believe that the BS 476 standards should be withdrawn in favour of the EN 1361-1 standard and that the co-existence of both leads to confusion within the market. It was noted that the BS 476 series does not adequately cover system heights and is obsolete.

8.5.35. They have also pointed out that BS 5234 should be updated as it is obsolete, in order to meet current standard practice, improve flexibility of approach, and to remove confusion around system heights in cold state vs fire state. We believe that BSI already have plans in place to look at this within the next few years.

8.5.36. **Waterproofing membranes -** bituminous waterproofing membranes, single ply waterproofing membranes and liquid applied waterproofing systems are covered by the fire classification as set out in BS EN 13501-5:2016 and need to meet BroofT4 specifications. Testing is generally considered to be sufficient, and the only issues reported are related to inconsistencies in the incorporation and interpretation of build ups and test results by the BBA, in addition to the high cost of certification and the slowness and rigidity of the certification process.

8.5.37. **Concrete Products -** this product family includes precast concrete products, such as concrete block paving, concrete kerbs, concrete drainage products, concrete walling, and concrete blocks as well as ready mixed concrete and mortar products. The most commonly used structural safety standards for this product family include the following:

- BS EN 1338 - Concrete paving blocks. Requirements and test methods
- BS EN 1339 - Concrete paving flags. Requirements and test methods
- BS EN 1340 - Concrete kerb units. Requirements and test methods
- BS EN 1916 - Concrete pipes and fittings, unreinforced, steel fibre and reinforced
- BS EN 1917 - Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced
- BS EN 772-1 - Methods of test for masonry units. Determination of compressive strength
- BS EN 12390-3 - Testing hardened concrete. Compressive strength of test specimens
- BS EN 12390-2 - Testing hardened concrete. Making and curing specimens for strength tests
- BS EN 12390-1 - Testing hardened concrete. Shape, dimensions and other requirements for specimens and moulds
- BS EN 12390-4 - Testing hardened concrete. Compressive strength. Specification for testing machines
- BS EN 12350-1 - Testing fresh concrete. Sampling and common apparatus
- BS EN 1015 - Methods of test for mortar for masonry.
- BS 4551 - Mortar. Methods of test for mortar and screed. Chemical analysis and physical testing
- BS EN 998-2 - Specification for mortar for masonry. Masonry mortar

8.5.38. Generally the perception is that standards for concrete are available and fit for purpose. In terms of fire safety, concrete is considered to be a non-combustible material so no standards exist for concrete elements, however mortar is subject to BS EN 13501-1. One minor comment for mortar is that the equipment used for testing needs updating.

8.5.39. **Reinforcing & prestressing steel for concrete & ancillaries, post-tensioning kits -** this product family includes reinforcement wire, mesh and fabricated steel products and cages. Testing for this product usually involves ISO 15630 Parts 1 and 2 (Steel for the reinforcement and prestressing of concrete - Test methods) and there are currently no fire test requirements for these products. The following standards, which were issued in 2005 following an update

and review process but have not been widely used by the market as previous versions are considered to be more fit for purpose:

- BS 4449 - Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification
- BS 4483 - Steel fabric for the reinforcement of concrete. Specification
- BS 4482 - Steel wire for the reinforcement of concrete products. Specification

8.5.40. Manufacturers from this product family also pointed out a discrepancy between the following standards, wherein the test requirements for the BS standard do not match the BS EN ISO standard, despite them both being current.

- BS 8548 – Guidance for arc welding of reinforcing steel
- BS EN ISO 17660 - Welding. Welding of reinforcing steel. Load-bearing welded joints

8.5.41. According to stakeholders from this product family, there is a perceived disinterest from BSI with regards to working on the improvement of these standards due to a harmonised EN standard being discussed, although progress on this is slow and not yet accepted by most European countries.

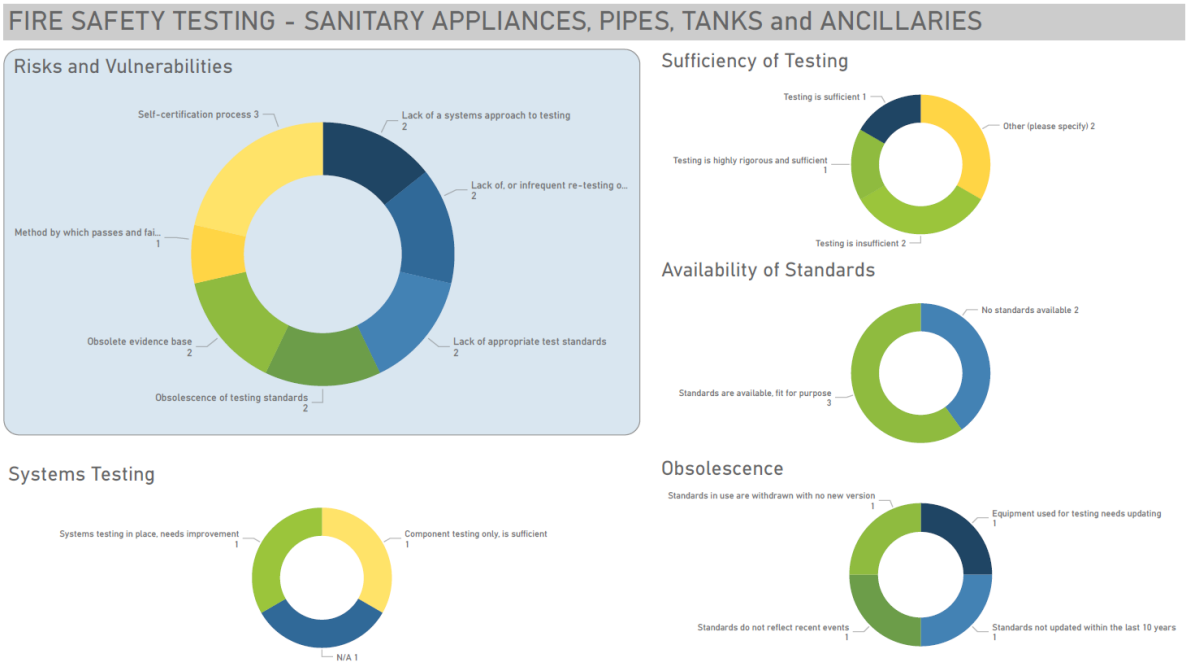

Figure 23 - Risk and Vulnerability Dashboard for fire safety testing of sanitary appliances, pipes and tanks. Numbers represent the number of responses from the Construction Products Testing Survey

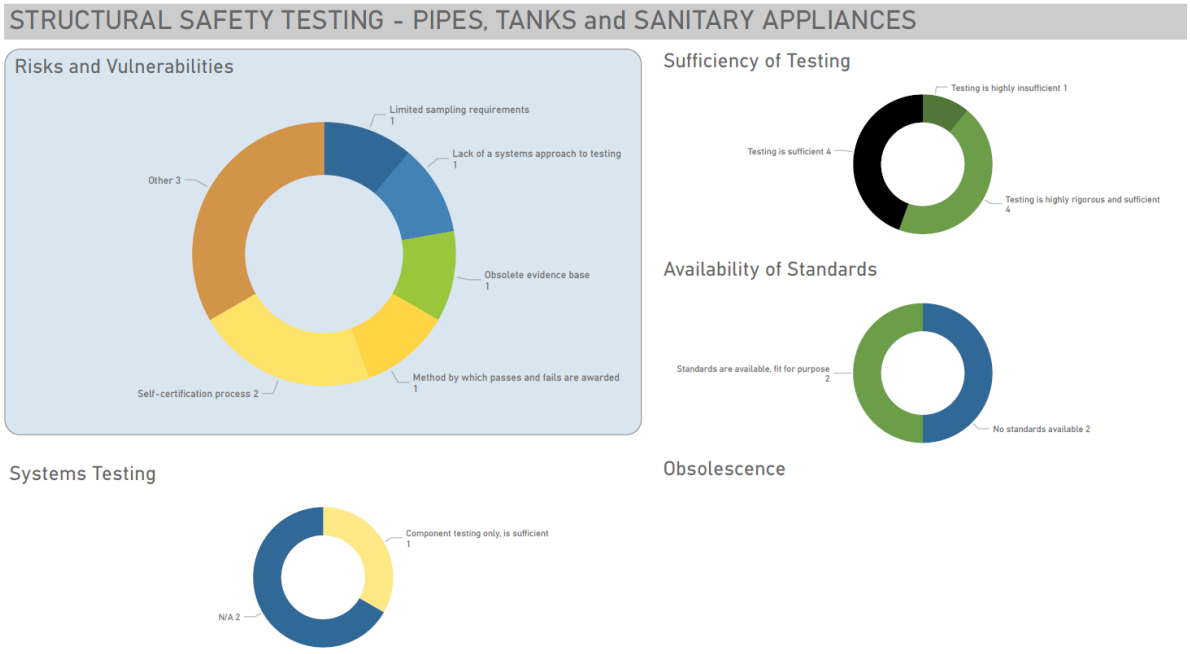

Figure 24 - Risk and Vulnerability Dashboard for structural safety testing of sanitary appliances, pipes and tanks. Numbers represent the number of responses from the Construction Products Testing Survey

8.5.42. **Sanitary appliances -** in terms of standards for sanitary appliances, the products in this category are generally not subject to structural or fire safety standards, but rather general safety standards for various aspects relevant to sanitaryware and sanitary tapware. This include the following standards, and a more extensive list can be found in Annex B.

- The Water Supply (Water Fittings) Regulations 1999
- RoHS Directive 2002/95/EC
- REACH Regulation 1907/2006
- BS EN 60335-1 - Household and similar electrical appliances. Safety. General requirements
- BS EN 60335-2 - Household and similar electrical appliances. Safety. Particular requirements for instantaneous water heaters
- BS EN 60730-1 - Automatic electrical controls. General requirements
- EN 817 - Sanitary tapware - Mechanical mixing valves (PN 10) - General technical specifications
- EN 200 - Sanitary tapware - Single taps and combination taps for water supply systems of type 1 and type 2 - General technical specification
- EN 1111 - Sanitary tapware - Thermostatic mixing valves (PN 10) - General technical specification

- EN 1287 - Sanitary tapware - Low pressure thermostatic mixing valves - General technical specification
- EN 997 - WC pans and WC suites with integral trap
- EN 14055 - WC and urinal flushing cisterns
- EN 14428 - Shower enclosures - Functional requirements and test methods
- EN 14516 - Baths for domestic purposes
- EN 14527 - Shower trays for domestic purposes

8.5.43. For sanitary appliances, fire retardance is mainly covered by standards for the raw materials used in the manufacture of products in this category. Regulations for electrical products in bathrooms are covered by IEC requirements and heavily legislated.

8.5.44. **Pipes, tanks and ancillaries –** there are no specific standards for structural safety as these are not typically structural elements, but in terms of general specifications for pipes, the following are the most commonly used standards:

- BS 8000-15
- ISO 9239 series
- BS 5955
- BS 8558
- BS EN 1775
- BS EN 806
- CIPHE Design Guide for Plumbing Engineering Services
- HTM 04-01

8.5.45. For fire safety, the most common standard in use is EN 13501-1 (Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests). In terms of plastic piping and pumps, testing is generally considered to be rigorous and sufficient.

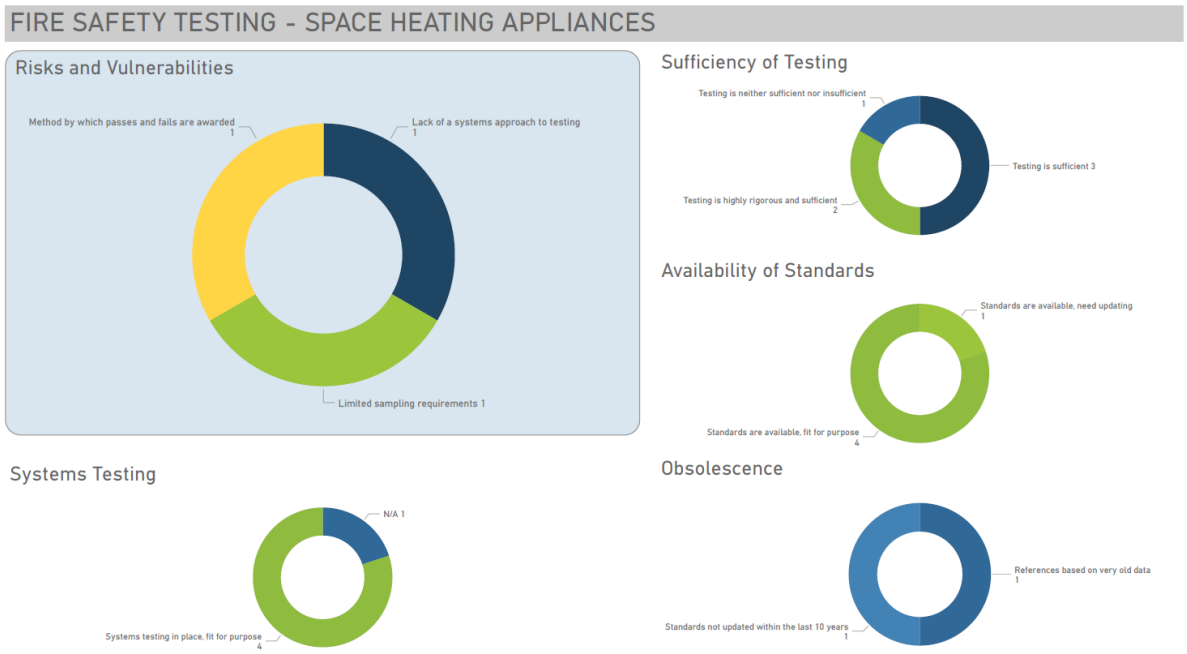

Figure 25 - Risk and Vulnerability Dashboard for fire safety testing of space heating appliances. Numbers represent the number of responses from the Construction Products Testing Survey

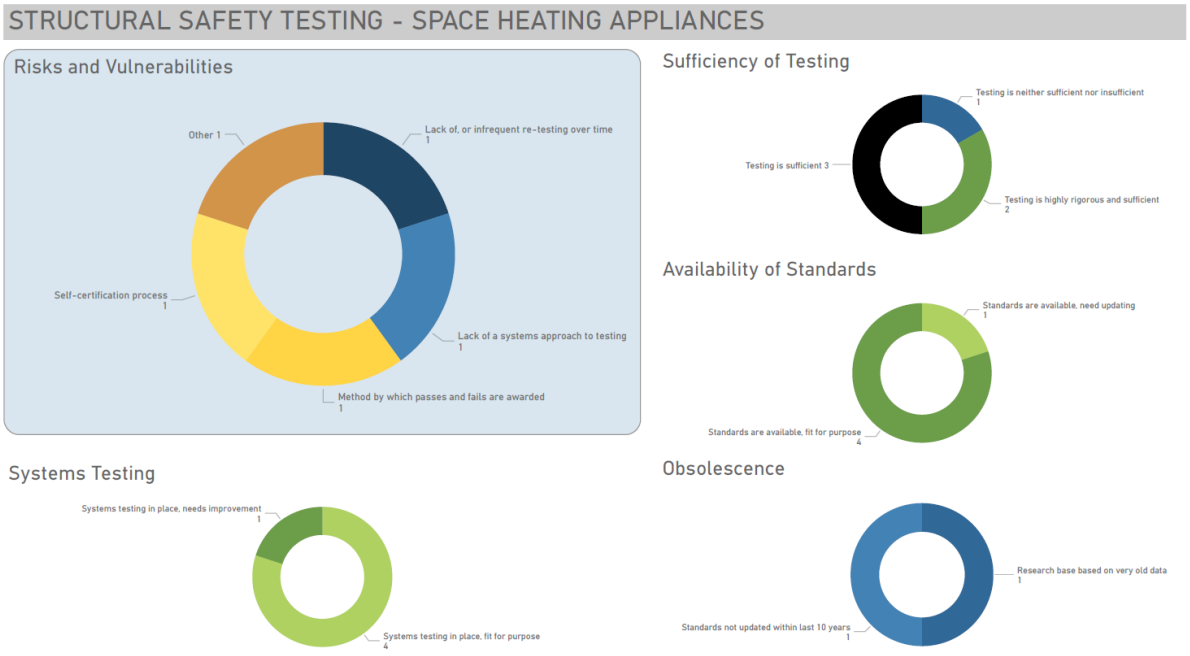

Figure 26 - Risk and Vulnerability Dashboard for structural safety testing of space heating appliances. Numbers represent the number of responses from the Construction Products Testing Survey

8.5.46. **Space heating appliances -** products in this product family include heating, cooling and ventilation products, heat pumps, thermostats, hot water heaters and storage, wood burning stoves, radiators,

underfloor heating systems, and boilers. Structural safety standards relevant to this product family include:

- BS EN 13240 - Roomheaters fired by solid fuel. Requirements and test methods
- BS EN 13229 - Inset appliances including open fires fired by solid fuels. Requirements and test methods
- EN 16510-1 - Residential solid fuel burning appliances - Part 1: General requirements and test methods
- EN 12897 - Water supply. Specification for indirectly heated unvented (closed) storage water heaters
- ERP Regulations
- EN 442-2 - Radiators and convectors - Part 2: Test methods and rating
- EN 15502-1 - Gas-fired heating boilers - Part 1: General requirements and tests
- EN 15502-2-1 - Gas-fired central heating boilers - Part 2-1: Specific standard for type C appliances and type B2, B3 and B5 appliances of a nominal heat input not exceeding 1 000 kW

8.5.47. Fire safety standards relevant to this product family include:

- Regulation 2016/426 – Gas Appliances Regulation
- Regulation 2014/35/EU – Low Voltage Directive
- EMC Directive 2014/30/EU – Electromagnetic Compatibility Directive
- MC Directive 2006/42/EC – Machinery Directive
- BS EN 13240 - Roomheaters fired by solid fuel. Requirements and test methods
- BS EN 13229 - Inset appliances including open fires fired by solid fuels. Requirements and test methods
- EN 16510-1 - Residential solid fuel burning appliances - Part 1: General requirements and test methods

8.5.48. For most of these products, installation procedures are also independently covered by manufacturer installation instructions, who often also provide training and certification to any operatives installing their products.

8.5.49. At present, there has been a new standard written for wood burning and multifuel stoves (EN 16510-1:2018) which is currently non-harmonised as it has not been agreed by all EU member states. Again there is frustration from this industry that this process is taking so long (over 10 years) and that standards often become out of date before it becomes harmonised.

10. Summary and Findings

10.1. We have identified a range of product standards from a wide selection of standards types and product families, including both harmonised and non-harmonised standards, from a variety of sources.

10.2. We have carried out an initial characterisation on over 2,700 standards as part of and developed a spreadsheet tool that will form the basis for decision-making activity associated with the prioritisation of standards that the CPSC need to look at first.

10.3. It is becoming clear that the large body of standards governing the safety of construction products is an extremely complex ecosystem and, that while the identification of these standards has been quite a substantial task in itself, the challenge of ensuring consistency across all of these standards as per the remit of the CPSC is not going to be a trivial task.

10.4. In terms of areas that the CPSC need to focus on first, we have identified a number of key standards that the industry has raised issues with, and that pose a high risk in terms of their fire or structural safety aspects:

- BS 476 series
- BS 8414 series
- BS EN 1154
- BS EN 1155
- BS EN 1363 series
- BS 5839 series
- BS EN 13501 series
- BS EN 1366 series
- BS EN 1364 series
- TGD 019
- EN 13830
- BS EN 15882 series
- BS 9414

10.5. A gap analysis has been carried out combining findings from all of the research activities for the project and we have identified key standards and vulnerabilities for each family of products.

10.6. In terms of gaps in the availability of standards, feedback from the surveys and workshops indicate that the following product families may need standards to be developed:

- For fire safety, there are gaps in the availability of standards for fire stopping, fire sealing and fire protective systems, roof coverings,

building kits, structural timber products, laminated glass, and thermal insulation products.

- Issues around the lack of standards for fully investigating reaction to fire, and smoke toxicity, were also raised at the workshops and in the survey.
- For structural safety, there are gaps in the availability of standards for gypsum products and roof coverings.
- A number of product families have also cited the lack of a systems approach to testing as being an issue that needs to be addressed. In particular, a lack of/issues with standards for compartmentation, fire stopping and fire sealing has been cited.

10.7. We hope that the prioritisation framework and the insights gathered during the course of this project will be useful to the CPSC in terms of clarifying its priorities and building an understanding of the challenges that the construction products industry face in terms of product testing standards.

10.8. We would highly recommend that the prioritisation tool database be maintained for it to retain its usefulness. We have sought to provide as much transparency as possible into how it was developed and structured and hope that after an initial period of discussion that a mechanism can be established for regular updates to be undertaken and for new standards to be regularly added to the database.

10.9. The community of experts we engaged with during the workshops could provide a valuable resource for further discussions on construction product standards specific to certain families of products – we have provided a good overview of the concerns for each product grouping but as we tried to cover as wide a range of products as possible, we believe there to be opportunities for further discussion and engagement with specifically targeted groups of product manufacturers, particularly those manufacturing 'higher risk' products, as well as those who are most in need of updated or improved standards.

10.10. Finally, there remain questions about the evidence base for the standards most commonly in use by the industry. The lack of academically rigorous referencing or references to primary scientific research in most of the standards we looked at is the result of the system under which these standards are written, and is largely based on consensus between a diverse group of experts as opposed to commissioned research for the purpose of standards

development. We would suggest that this needs to be looked at more closely. Is a consensus between experts sufficient to ensure that our current set of standards takes into account the most recent academic and industrial research for the testing covered in the standard? Perhaps it is, but if this is the case, should there be more transparency with regards to the rigour to which the underpinning knowledge and research that is used to make their decisions is referenced in the actual standards. Most official publications have a bibliography or list of references, and it is surprising that published standards are not held to the same level of transparency and scrutiny.

Appendices

Appendix A

Product Categories

1. Beam/block Floor Units and Elements incorporating organic materials
2. Chimneys, flues and specific products
3. Curtain wallings/Cladding
4. Exterior wall cladding kits
5. External thermal insulation composite systems/kits with rendering
6. Fire alarm/detection, fixed fire-fighting, fire and smoke control and explosion suppression products
7. Fire stopping, fire sealing and fire protection products
8. Metal frame building kits
9. Panels, prefabricated wood-based load bearing stressed skin
10. Panels, self-supporting composite lightweight
11. Internal & external wall and ceiling finishes
12. Pipes, tanks and ancillaries
13. Light composite wood-based beams and columns
14. Piping and Storage System kits, Pipes, Tanks, Valves
15. Power, control and communication cables
16. Prefabricated building units
17. Prefabricated stair kits
18. Roof coverings, roof lights, roof windows & ancillary products, roof kits
19. Self-supporting translucent roof kits (except glass)
20. Space heating appliances
21. Structural timber products/elements & ancillaries
22. Thermal insulation products/composite insulating kits/systems
23. Timber frame and log prefabricated building kits
24. Wood-based panels
25. Plastics
26. Lifts and other conveyancing systems
27. Concrete - precast normal/lightweight/autoclaved aerated products
28. Concrete, mortar and grout products
29. Flat glass, profiled glass and glass-block products
30. Geotextiles, geomembranes & related products

31. Gypsum Board Partition Kits
32. Membranes
33. Gypsum Products
34. Permanent shuttering, non-load bearing
35. Masonry and related products
36. Membrane systems (mechanically fastened flexible roof waterproofing)
37. Sealants, structural (glazing kits - curtain walling)
38. Concrete frame building kits
39. Doors, windows, shutters, gates & related building hardware
40. Floorings
41. Internal partition kits
42. Steel, reinforcing and prestressing steel for concrete
43. Structural metallic products & ancillaries
44. Signage, including escape route signage
45. Aggregates for uses with high safety requirements
46. Aggregates for uses without high safety requirements
47. Cements, building limes and other hydraulic binders
48. Circulation fixtures
49. Construction adhesives
50. Dowels for structural joints
51. Fasteners for structural timber products
52. Fixings
53. Mechanical Systems
54. Metal anchors for use in concrete
55. Metal injection anchors for use in masonry
56. Pins for structural joints
57. Liquid applied bridge deck waterproofing kits
58. Liquid applied roof waterproofing kits
59. Plastic anchors for use in concrete and masonry
60. Post-tensioning kits for prestressing of structures
61. Sanitary appliances
62. Sealants, non-structural use
63. Structural bearings
64. Waste water engineering products
65. Earthquake Resistance
66. General, Fire

67. General, Structural
68. General, Other
69. Other
70. Gas, Oil, Petroleum-related

Appendix B

Abbreviations and Prefixes used in this report

BS – British Standard developed by BSI

BS EN – European standard developed by CEN and adopted by BSI

BS EN ISO – International standard developed by ISO and adopted by CEN and BSI

BS ISO – International standard developed by ISO and adopted by BSI

BS PD or BSI PD – Published document developed by BSI

CEN/TS – Technical specification published by CEN

CLC/TS – Technical specification published by CENELEC

CR – Technical report published by CEN

DD – Draft for development released early by standardisation bodies when guidance is urgently needed

DD/CEN/TS – Draft for development of a technical specification published by CEN

DD/ENV – Draft for development of a European pre-standard

EN - European standard developed by CEN

EN ISO – International standard developed by ISO and adopted by CEN

EN ISO/IEC - International standard developed by ISO/IEC and adopted by CEN

ENV – European pre-standard (9)

ETAG – European technical approvals guidelines

EXAP - Extended Field of Application

FEM – Technical guidance developed by the European Material Handling Federation

HD – Harmonised document published by CENELEC

hEN – Harmonised European Standards

HSE – Guidance note issued by the Health and Safety Executive

IEC – International standard developed by IEC

IGEM/UP – Standard developed by the Institution of gas engineers and managers - utilisation series

ISO – International standard developed by ISO

ISO/AWI – Approved new work item under development by ISO

ISO/CD – International harmonised stage code under development by ISO

ISO/DIS – Draft international standard stage under development by ISO

ISO/FDIS – Final draft international standard under development by ISO

ISO/PAS - Publicly available specification developed by ISO

ISO/PRF – Proof of a new international standard under development by ISO

ISO/R – Recommended practice developed by ISO – ISO/R are early version of the standard and usually withdrawn

ISO/TR – Technical report published by ISO

ISO/TS – Technical specification published by ISO

ISO/WD – Working draft under development by ISO

NANDO - New Approach Notified and Designated Organisations

NA to BS EN –National Annex to European standard adopted by BSI

NF EN ISO – French Standard adopted by CEN and ISO (10)

OJEU – Official Journal of the European Union

PAS – Publicly available specification

PD – Published document

prEN – Draft European standard distributed by CEN/CENELEC

prEN ISO – Draft European standard distributed by CEN/CENELEC and adopted by ISO (11)

TR – Technical report

UKLPG – Industry technical standard developed by UKLPG that is a trade association for the natural gas industry

Appendix C

Standards Database v.12 (see attachment)

Appendix D1

Construction Products Testing Survey (see attachment)

Appendix D2

Construction Products Testing Survey – Results (see attachment)

Appendix D3

Construction Products Testing Survey – Raw Data v8 (see attachment)

Appendix E

Workshop Slides and Notes (see attachment)