ADVISORY COMMITTEE FOR ROOFSAFETY

Materials Standard

ACR [M] 002:2015 Rev2

TESTING OF ROOF ANCHORS ON ROOF SYSTEMS

(*being Part 2 of the Magenta Book*)

FOREWORD

One of the main causes of deaths and injuries at work each year is falling from height, particularly through or from roofs. To ensure safety during roof work requires the commitment of all those involved in the procurement process.

This document was initially introduced to fulfil the concerns of industry in relation to directly fixing to the roof sheeting and not covered in BS EN 795 1996.

Product Standards BS EN795: 2012 (single user anchors) and PD CEN/TS 16415 :2013 have recently been revised and now include an updated version of the information that was original included in this document.

The Magenta Book ACR [CP]007 has now been revised accordingly and the content of this document needs to be considered by the manufacturers of horizontal rigid, flexible lines, and single point roof anchors to ensure their application provides a safe system of work.

Where collective protection is not possible personal protection equipment must be used. Many of these rely on horizontal rigid, flexible anchor lines and single point anchors fixed, using 'top fix' anchors, to the roof sheeting rather than through the roof to the supporting structure.

This material standard addresses this issue and gives practical advice on what the ACR considers is 'current good practice' for the testing of Roof Anchors on Roof Systems. It concentrates on profiled roofs. This publication should be read in conjunction with ACR Magenta Book Current Version - 'Recommended good practice for use of horizontal safety lines in roofwork'.

Those engaged in designing & installing safety systems on other roof deck types (E.g. concrete, timber or metal) would benefit from the advice given as many of the principles do apply and offer good practice.

The delivery of improvements in the prevention of falls from height will only be achieved with the full involvement of all those with a role to play, i.e. clients, employers, self-employed, workers, trade unions, trade associations, manufacturers, training providers and others.

I thank those involved for their valued input and the often lively and wide-ranging debate, in producing this guide .

Graham Willmott Chairman of the ACR.

CONTENTS

Note: Any reference to an ACR publications in the following text should be taken to mean the latest version of that document

INTRODUCTION

The Advisory Committee for Roof Safety (ACR) was set up in 1998, at the instigation of the Health and Safety Executive (HSE), to consider the safety implications of fragile roof assemblies. It is made up of nominees from trade associations and organizations involved in roofwork that, together with HM Specialist Inspectors, produce documents that provide advice based on sound technical knowledge and many years' collective experience of roof work.
Concerns have been expressed to the ACR about the reliability, adequacy of testing and overall performance of horizontal flexible anchor lines rigid rails and single point anchors (particularly those using 'top fix' anchors) being installed on different roof types.

This is an advisory book recommending suitable tests to be conducted replicating the application of a product as installed on roof structures. In response, the ACR convened a Working Group which included representatives of:

- the ACR (including the HSE);
- safety equipment manufacturers;
- safety equipment installers; and
- UK representatives on British and European standards committees dealing with relevant product standards and codes of practice

To produce a test specification for "top fix" style roof anchors and fall protection systems that could be used by manufacturers and contractors to verify that products sold in the market met required performance standards.

0. DEFINITIONS

For the purposes of this document the following definitions apply:

0.1 Competent person or persons

Person [or persons] who can demonstrate that they have sufficient professional or technical training, knowledge, actual experience and authority to enable them to:

a) Carry out their assigned duties at the level of responsibility allocated to them;
b) Understand any potential hazards related to the work (or equipment) under consideration;
c) Detect any technical defects or omissions in that work (or equipment), recognise any implications for health and safety caused by those defects or omissions; and
d) Be able to specify a remedial action to mitigate those implications.

In this context, for assessing suitability of roof anchors on a roof system, a competent person is one who can demonstrate that he/they has/have:

a) Thorough knowledge of roofing and of the mechanical and physical properties and behaviour of the particular product and assembly when subjected to this test; and
b) Extensive knowledge and experience of installation of the product, its usage limitations, behaviour and mode of failure in service.

Note: The competent person's responsibilities include ensuring that the worst-case scenario has been covered when:

a) Defining roof assembly to be tested (4.5 & 4.6)
b) Defining test position(s) (4.4.7 & 5.0)
c) Determining the samples to be tested (4.7 & 4.4.7)
d) Deciding the number of tests necessary to ensure results are statistically significant (5)
e) Determining the number of profiles/anchors to be tested (4.7, 4.8, 5.1.1 & 5.1.2)
f) Evaluating the damage to the assembly (6.1 & 6.2)
g) Together with signing of the test report (7.1 (b))

0.2 Inspection

0.2.1 Visual exercise, which is not carried out at close-quarters.

0.3 Examination

0.3.1 Thorough inspection carried out at close-quarters, which may, at the discretion of a competent person, be more than just visual.

0.4 Other definitions

0.4.1 Other definitions are as described in the Terminology paragraph of ACR[CP]007 "Recommended practice for use of horizontal safety lines in roofwork" which should be read in conjunction with this document

1. SCOPE

1.1 This ACR book prescribes a method for testing fall protection anchor devices used to support horizontal flexible anchor lines, rigid rails and single point anchors that are connected only to the top sheet or underlying structure E.g. metal deck, hollow concrete, wooden deck of the roof assembly. Hereafter referred to as "Top Fix Anchors".

2. RESPONSIBILITIES

2.1 The responsibilities of the key parties are as follows:

NOTE: *Where a party fulfils more than one role they assume the responsibility for each.*

2.2 Roofing manufacturer

2.2.1 Responsible for providing:

- the components of a roofing assembly and supporting information and
- technical assistance to help in the construction of that roof assembly in order to support the fall protection system manufacturer in their testing programme.
- authoritative information and advice to architects and designers on the suitability and reliability of 'top fix' fall protection systems when used on their product(s).

NOTE: ***Roof anchor testing is undertaken at the risk of the safety system manufacturer and does not guarantee approval by a roofing manufacturer. Roof manufacturer approvals are given at the manufacturers discretion and may be influenced by other elements including, but not limited to product quality, product appearance, weatherproofing, compatibility of materials, CE Approval, where applicable, Manufacturers***

quality system, installation training programmes, technical competence, method of predicting system loading, instructions for use and guarantees.

2.3 Designers & Roofing contractors

2.3.1 Responsible for:

· selecting a properly designed and tested fall protection system to meet clients needs in accordance with the roof manufacturer's instructions and guidance, supported by evidence of testing

2.4 Anchor device manufacturer/supplier

2.4.1 Responsible for:

· designing and manufacturing fall protection system(s) and for the preparation and issue of all necessary installation and user instructions;

· ensuring that product(s) meet relevant standards and 'industry good practice' and its recommended products, where possible, are independently type-tested against the requirements of relevant standards by a Notified Body; .)

· Where applicable product(s) should be CE-marked;

· that the anchor device (e.g. horizontal line, rigid rail or single point anchor) has proved satisfactory when tested in accordance with this book (and upon each roofing type to which it is intended it will be installed).

3. NORMATIVE REFERENCES

BS EN795: 2012– Protection against falls from height. Anchor devices.

PD CEN/TS 16415: 2013 – Personal fall protection equipment – Anchor devices – Recommendations for anchor devices for use by more than one person simultaneously.

BS EN364: 1993 – Personal Protective Equipment against falls from height. Test Methods

4. TESTING REQUIREMENTS

4.1 Principles of the Test

4.1.1 An impact load, which is intended to simulate a person or more than one person attached to a lifeline or single anchor point falling, is applied to the anchor device. The test investigates the ability of the anchor device and roof system to which it is attached to resist these impact loads and arrest the fall of the person(s) falling from the edge of the roof or through a fragile element of the roof. e.g. rooflight.

4.2 General

4.2.1 In order to facilitate the satisfactory design, construction and testing of a top fix single point anchor, or a horizontal anchor line supported by top fix brackets, that is to be installed on top of a roof, the roofing manufacturer should provide the manufacturer of the safety system with full details of the technical specification for the roof system concerned, and should provide a roof sample (or samples) as may be required for test purposes.

4.2.2 All necessary installation or adaptation of the roof sample during the course of setting up, or conducting tests should be undertaken by individuals that are acknowledged by the roof manufacturer to be competent for the task(s) concerned.

4.2.3 Testing by the safety system manufacturer may be undertaken by the safety system manufacturer 'in-house' or 'externally' and should be either witnessed by a representative of the roofing manufacturer or as a minimum requirement be recorded on video.

4.2.4 The results of all testing should be documented and submitted to the roofing manufacturer for their consideration in a format which is readily understood and that imparts all of the information required in accordance with the test protocol.

4.3 Test Apparatus

4.3.1 The force measuring apparatus for the dynamic and static testing recommended in this document should conform to the requirements of BS EN 364 clause 4.6

4.3.2 Force measuring equipment should be calibrated at least once every twelve months.

4.3.3 The test mass to be used in the testing recommended in this guideline should constitute a mass of 100kg x n, where 'n' is the number of users.

4.4 Test rig

4.4.1 The test rig should be capable of accommodating a properly made up roof panel of a minimum size '6-metres x 6-metres'.

4.4.2 The rig should comprise 2 steel universal beams (i.e. I-beams: typically 305 x 165 x 40 section), each 6-metres long and mounted horizontally on a rigid base.

4.4.3 The beams should be parallel to each other with 6-metres between centres.

4.4.4 The rig should have the facility to apply horizontal forces parallel to the rigid base, both along and across the orientation of the beams.

4.4.5 The test rig should be fixed down such that the application of the dynamic force and static force referred to in this document should not cause any permanent plastic deformation.

4.4.6 Test rig details are shown in Figure 1.

4.4.7 Where the safety system manufacturer permits the use of the anchor device on a smaller area of roof then additional testing should be carried out. In this case the roof construction and test rig should reflect the smallest permissible area of roof.

4.5 The Test Roof

4.5.1 The test roof should be as recommended or advised by the manufacturer of the roof system or where project specific testing is required, as advised by a structural or other such suitably qualified engineer.

4.5.2 Where purlins are required, unless otherwise advised by the roof manufacture, they should be cold rolled, of a depth of 140mm and of a maximum thickness of 1.5mm.

4.5.3 The purlin spacing will be determined by the roof manufacturer and should be installed to the largest permissible span between purlins for the specific roof system. Typically this span may be 1.8m.

4.6 Roof sample

4.6.1 The roof system used as a test sample should meet the roof manufacturers minimum specification and be a properly made up roof panel/section 6-metres x 6-metres. The test sample should meet the minimum requirements for material construction of the particular roof type as specified by the roof manufacturer with purlins of the type specified above.

4.7 Anchor device samples

4.7.1 The test method requires a minimum of three top fix anchor devices of each type permitted in the system to be tested for each roof profile on which they are to be used.

4.7.2 Anchors should be taken from a production batch.

4.8 Intermediate Anchors

4.8.1 Intermediate supports should be tested in accordance with BS EN 795 Type A of BS EN 795 : 2012) Anchor Devices

4.8.2 PD CEN/TS 16415 : 2013 for multi –users requires 12kN + 1kN for each additional user

Note: *These anchors do not require to be tested to the Magenta Book standard*

4.8.3 Where the anchor is an intermediate anchor the static strength test shall be to a minimum of 12kN or where any load bearing component is made from non-metallic material(s), and where evidence of durability is not provided by the manufacturer 18 kN (BS EN 795 : 2013)

4.8.4 PD CEN/TS 16415: 2013 for multi –users requires 12kN + 1kN for each additional user.

4.8.5 Roof system test samples should be constructed in accordance with the rules laid out in this document.

5. TEST METHOD

5.1.1 For single point, end and corner anchors, incorporating integral energy absorbing elements and end anchors incorporating inline energy absorbing elements test in accordance with part 2 of the Magenta Book (refer to Figure 5). Where energy absorbing elements are not incorporated or required test to Part 2 Magenta Book (refer to Figure 5) and also test in accordance with**:-**

· Type A of BS EN 795: 2012)

· PD CEN/TS 16415 : 2013 for multi –users requires 12kN + 1kN for each additional user.

5.1.2 In addition to the above Product Standard testing is recommended to prove the installation of these products on different roof structures provides a safe system. By following the recommendations within this document Manufacturers will establish their products performance when installed.

5.2 Dynamic test parallel to the seam for single point, end and corner anchors of the roof (refer to Figure 2 & 4)

5.2.1 Install the roof sample onto the test rig in accordance with the roof manufacturer's installation instructions.

5.2.2 Install an anchor device including any separate energy absorbing components that is a component of the horizontal lifeline system. The anchor device should be as close to the front edge of the sample roof system as may be permitted in the system design by the safety system manufacturer. Ensure that the test force to be applied to the anchor device will be parallel to the seam of the roof sample.

5.2.3 Attach a force-measuring device (load cell) to the connection point of the anchor device or energy-absorbing component as appropriate.

5.2.4 Connect a length of 8mm diameter steel wire rope to the force-measuring device. Where necessary to provide adjustment a chain may be used between the force measuring device and the wire rope.

5.2.5 Connect the opposite end of the wire rope to a rigid test mass representing the maximum number of users recommended by the manufacturer of the anchor device (e.g. 2 users = 200 kg; 3 users = 300 kg, etc). Anchors that support horizontal lifeline systems should be tested for a minimum of 2 users.

5.2.6 Use a system of pulleys to guide the wire rope and raise the test mass so that it can fall freely through 1.5 m and suspend it by means of a quick release device.

5.2.7 Release the test mass by means of the quick release device.

5.2.8 Check that the test mass does not strike the ground or test apparatus and record the peak force measured at the anchor device.

5.2.9 Retain dynamic load tested anchor as fixed and tested on sample roof system for Static Load test

5.2.10 Static test parallel to the seam of the roof (refer to Figure 3)

5.2.11 The anchor device or energy absorbing component should remain attached to the sample roof system used in the dynamic test by the fixings used in the dynamic test. The assembly of energy absorbing, anchoring components and sample roof system should not be adjusted or altered between the dynamic and static test.

5.2.12 Attach a load cell and winch to the anchor device or energy absorbing component previously used in the dynamic test. Ensure that the test force to be applied to the anchor device will be parallel to the seam of the roof.

5.2.13 Apply a static force to the anchor device equal to twice the peak force recorded in the dynamic test or twice the maximum permitted arrest load in the system proven and controlled by verifiable calculation. Hold the load for 3 minutes. The anchor and its fixings shall not yield.

5.2.14 Record the static test force.

5.2.15 Examine the roof structure and note any damage.

5.3 Dynamic test perpendicular to the seam of the roof (refer to Figure 2)

5.3.1 Install a new anchor device, including any separate energy absorbing components. The anchor device should be as close to the front edge of the roof as may be permitted by the manufacturer. Ensure that the test force to be applied to the anchor device will be perpendicular to the seam of the roof sample.

5.3.2 Repeat actions 5.1.3 to 5.1.9 inclusive.

5.4 Static test perpendicular to the seam of the roof (refer to Figure 3)

5.4.1 The anchor device or energy absorbing component should remain attached to the sample roof system used in the dynamic test by the fixings used in the dynamic test. The assembly of energy absorbing, anchoring components and sample roof system should not be adjusted or altered between the dynamic and static test.

5.4.2 Attach a load cell and winch to the anchor device or energy absorbing component previously used in the dynamic test. Ensure that the test force to be applied to the anchor device will be perpendicular to the seam of the roof.

5.4.3 Repeat actions 5.2.3 to 5.2.5 inclusive.

5.5 Dynamic Test at 45 degrees to the seam of the roof (refer to Figure 2)

5.5.1 Install a new anchor device, including any separate energy absorbing components. The anchor device should be as close to the front edge of the roof as may be permitted by the manufacturer. Ensure that the test force to be applied to the anchor device will be at 45 degrees to the seam of the roof sample.

5.5.2 Repeat actions 5.1.3 to 5.1.9 inclusive.

5.6 Static Test (refer to Figure 3)

5.6.1 The anchor device or energy-absorbing component should remain attached to the sample roof system used in the dynamic test by the fixings used in the dynamic test. The assembly of energy absorbing, anchoring components and sample roof system should not be adjusted or altered between the dynamic and static test

5.6.2 Attach a load cell and winch to the anchor device or energy-absorbing component previously used in the dynamic test.

5.6.3 Ensure that the test force to be applied to the anchor device will be at 45 degrees to the seam of the roof sample.

5.6.4 Repeat actions 5.2.3 to 5.2.5 inclusive

5.6.5 Refer to EN 795 2012 and CEN/TS 16415: 2013 for multi user test criteria

6. TESTING – PASS CRITERIA

6.1 Dynamic Test

6.1.1 The roof anchor and roof system retain the fallen suspended mass.

6.2 Static Test

6.2.1 The anchor and roof system shall hold the applied load for a period of 3-minutes.

7. TEST REPORT

7.1.1 The paper/electronic report for this test should contain at least the following information.

a) Name and address of test house or place that test took place

b) The name, address and dated signature of the competent person(s), including a statement confirming evidence of compliance with the requirements of 0.1.

c) Type and name of roof assembly under test

d) List tests carried out

e) A statement that the test was carried out in accordance with this document

f) The mass allowed to free fall

g) The direction of application of the load

h) A statement that the device satisfies the pass/fail criteria including details of the dynamic and static loads

i) A statement as to what damage the roof sustained

j) Photographs/videos of the test set up and results

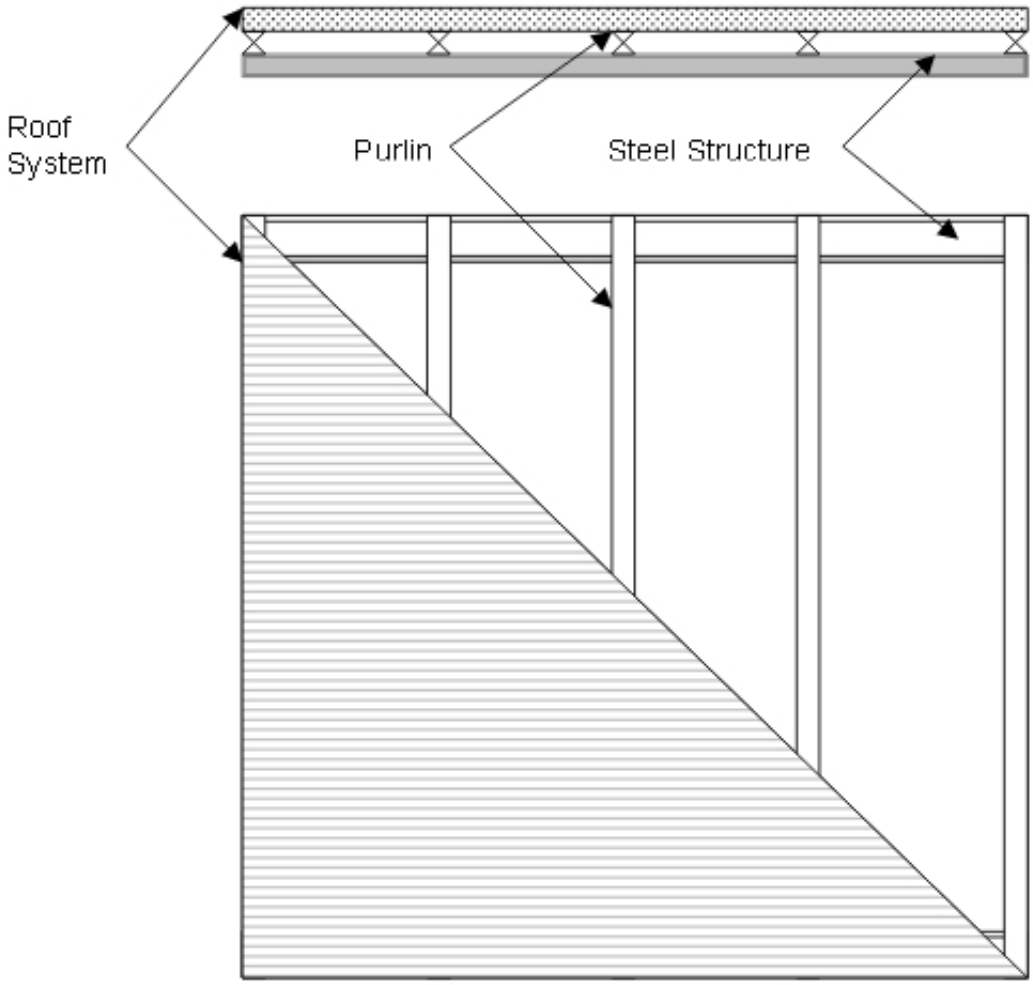


FIG 1 – TEST RIG SET UP

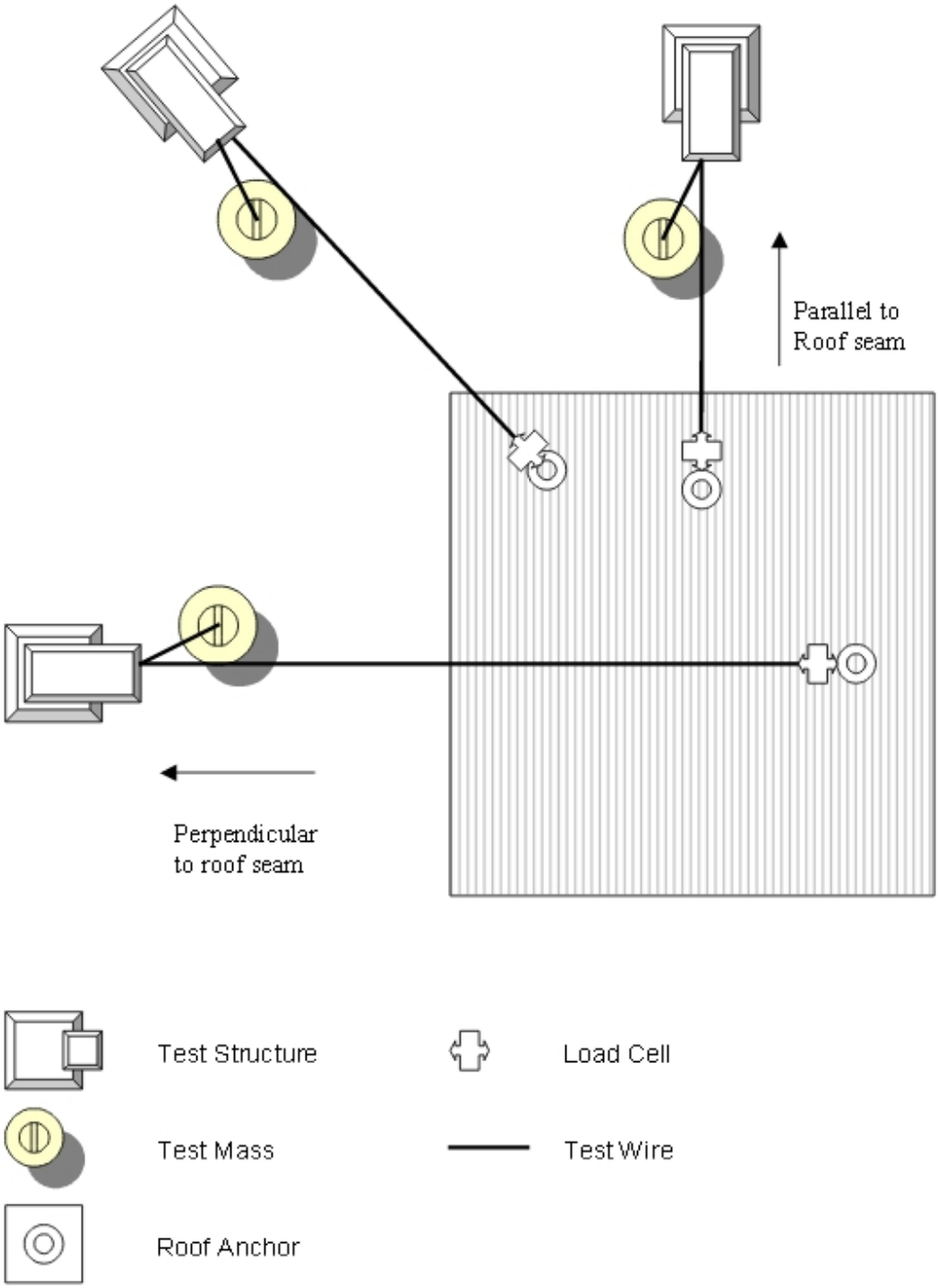


FIG 2 -TYPICAL DYNAMIC TEST SET UP - PLAN VIEW
showing all possible test orientations

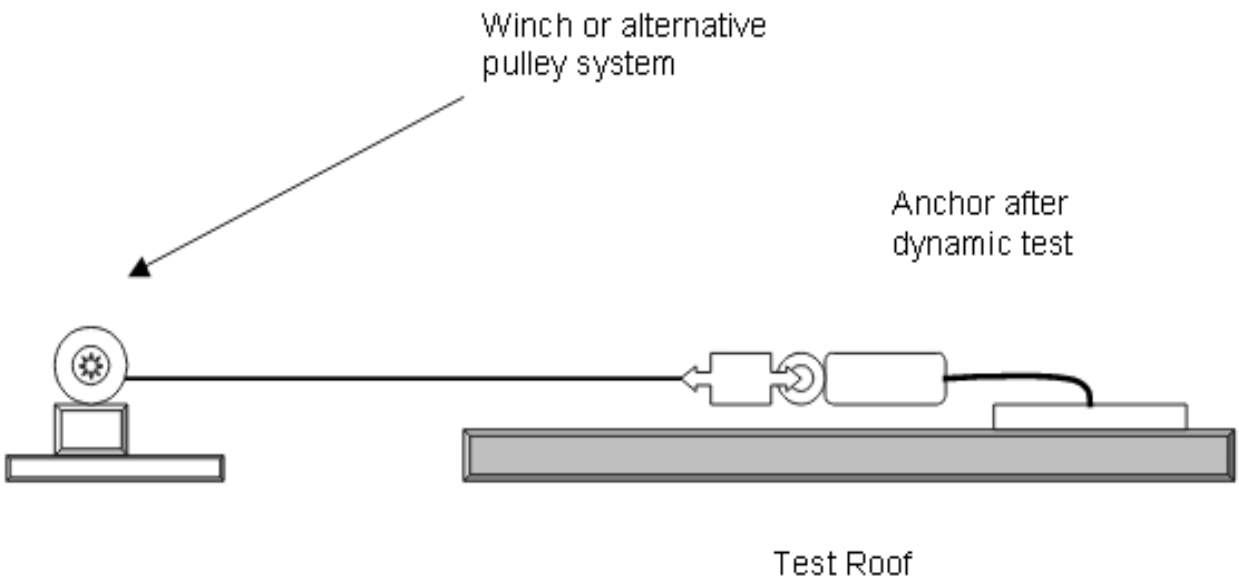


FIG 3 – STATIC TEST ARRANGEMENT - TYPICAL

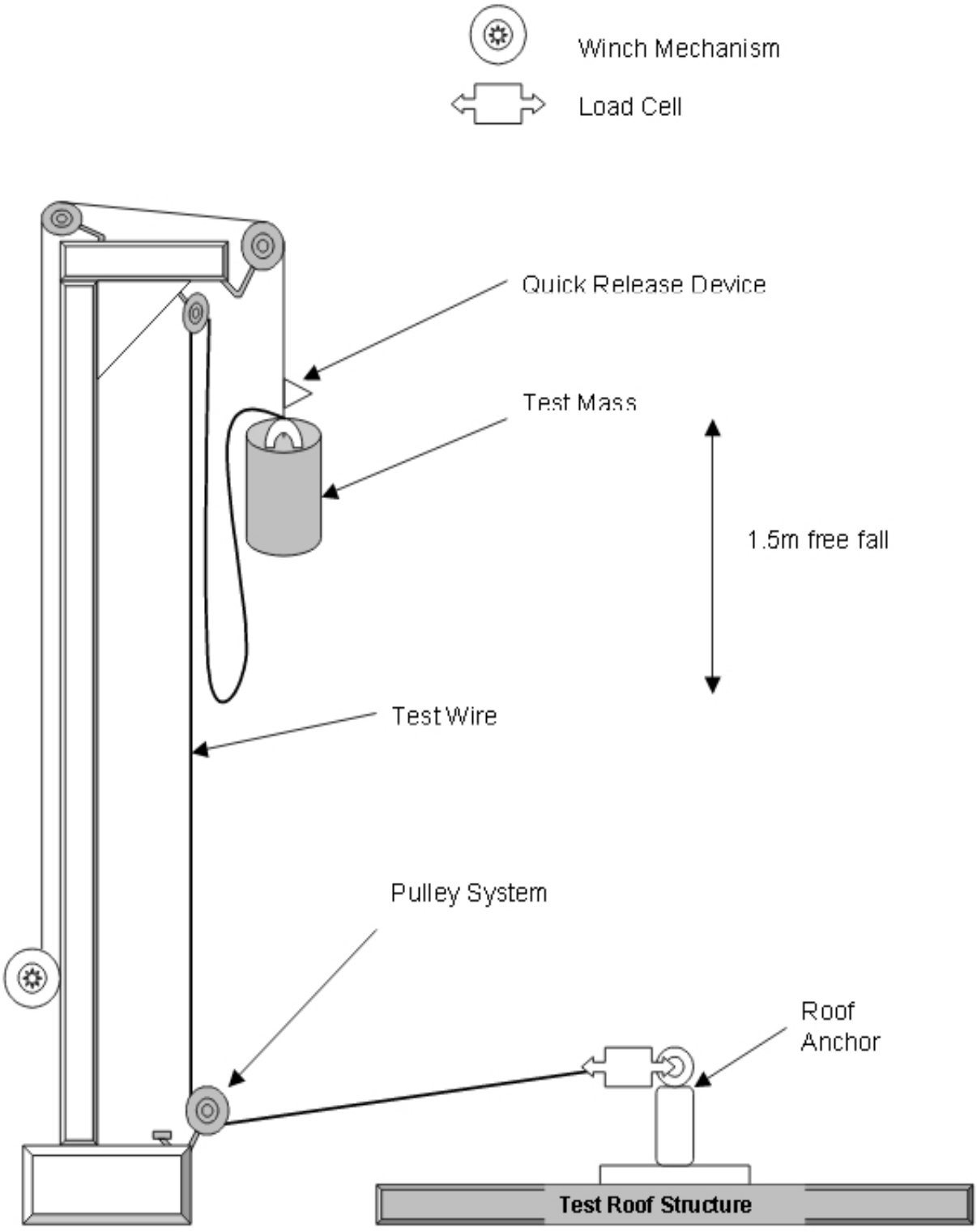
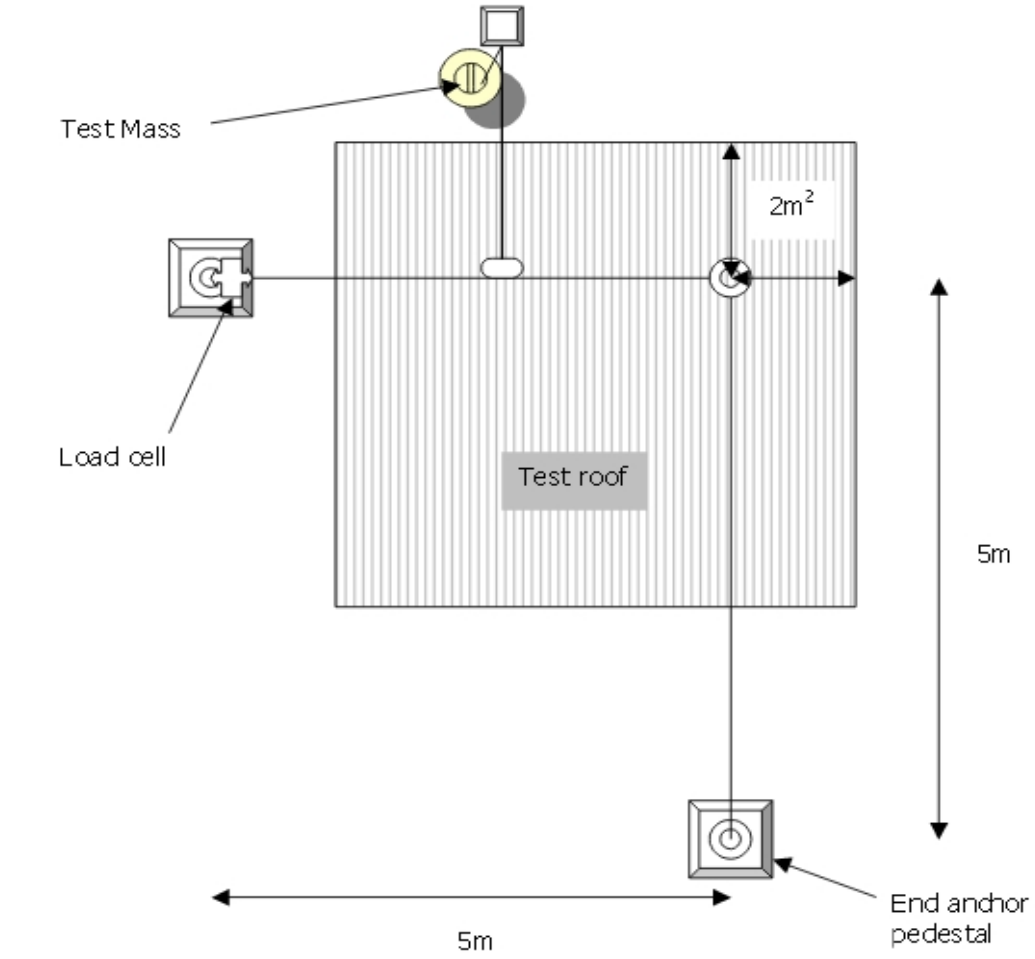


FIG4 – TYPICAL DYNAMIC TEST SET UP



Key

Cable horizontal lifeline

Roof Anchor

Mobile Attachment Device

FIG 5 Corner Test Method

APPENDIX 1 WORKING GROUP AND REVISIONS

9. CONSTITUTION OF THE ORIGINAL TASK GROUP

The following people represented the Associations and Manufacturers during the drafting of the original version of this document:

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The following people represented the Associations and Manufacturers invited to the task group to revise this document:

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Tim Bissett	Latchways (CEN/TC160)
Graham Willmott	Kee Safety (BSIF) (HSG)

10. REVISION INFORMATION

This version contains the following revisons

Foreword	Revised to include reference to BS EN 795 : 2012 and PD CEN/TS 16415 : 2013
Working group	Moved to Appendix 1
Competent Person (01)	Updated ref numbers
Normative References (3.0)	Updated to include reference to BS EN 795 : 2012 and PD CEN/TS 16415 : 2013
Intermediate Anchors (4.8)	Updated to include reference to BS EN 795 : 2012 and PD CEN/TS 16415 : 2013
Test Method (5.0)	Updated to include reference to BS EN 795 : 2012 and PD CEN/TS 16415 : 2013
Clause (5.1.1)	Additional clarification for testing single, end & corner anchors with energy and non-energy absorbing elements. This replaces Section 6 in original document
Clause 5.1.2	Additional clarification for testing on different roof structures
Section 6	Deleted

This document can be downloaded free of charge from the ACR website at http://www.roofworkadvice.info

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DISCLAIMER

The Advisory Committee for Roofsafety (ACR) is a body dedicated to making working on roofs safer. Its membership is made up of nominees from the major roof working Federations and Associations and the Health and Safety Executive, who provide the experience of many years of involvement in working on roofs in the advice given in their documents