PAS 122:2009

Specification for the installation of audiovisual equipment in classrooms and general publicly accessible areas

Becta leading next generation learning

BSi

Publishing and copyright information

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Contents

Foreword

This Publicly Available Specification (PAS) was sponsored by Becta and its development was facilitated by The British Standards Institution (BSI).

Acknowledgment is given to the following organizations that were instrumental in the development of this PAS:

- Becta
- Extron
- HSE (Health and Safety)
- Infocomm
- Intenect Ltd
- Sky
- Unicol

Wider comments from other interested parties were invited by BSI. The expert contributions made by the organizations and individuals consulted in the development of this PAS are gratefully acknowledged.

This PAS will be reviewed at intervals not exceeding two years and any amendments arising from the review will be published in an amended PAS and publicized in *Update Standards*. Feedback on this PAS will be gratefully received.

This document is not to be regarded as a British Standard. It will be withdrawn upon publication of its contents in, or as, a British Standard.

This publication does not purport to include all necessary provisions of a contract. Users are responsible for its correct application.

Compliance with this PAS does not in itself confer immunity from legal obligations.

Introduction

This Publicly Available Specification provides requirements for the installation of Audio Visual equipment in a wide variety of settings. It is intended as a reference point for AV and electrical installers to ensure that the quality and standards of installations are raised to a sustainable level where any customer can be aware that specific criteria are being met.

In particular it has been noted over the past number of years that resellers of Interactive Whiteboards and AV equipment use third party sub-contractors to install their equipment. It has become apparent following completion of a number of audits that there are no strict guidelines relating to how the installations are carried out and that the processes employed by suppliers and subcontract staff differed greatly. This adds to the risk as, in a few isolated cases, installs have been carried out without adhering to the appropriate processes.

As such, the primary aim of this specification is to provide a framework that helps to ensure increased safety and analysis / management of risks, whilst also demonstrating due diligence in these areas.

Ultimately, an objective of this specification is to provide a means of assessment and certification in order to assure the users and wider industry of compliance with best practice. Wherever possible and where appropriate the equipment and installation processes should have measureable performance figures that can be validated by appropriate assessors and auditors.

This PAS is not a training document and therefore a suitably trained and or competent engineer is required to be able to carry out work to these guidelines. Assumptions are made for knowledge and market place understanding to suit the installation that is being undertaken.

Annex **A** provides further information on the technology referred to in this document.

Annex **B** provides guidance on optical radiation safety.

Annex **C** provides a sample site survey document (pre-installation).

Annex **D** provides sample codes of conduct.

Annex **E** provides a sample static load test.

Annex **F** provides general guidance for using whiteboards and projectors.

Annex **G** provides a sample post installation document.

Although most of the above documents are samples for whiteboard and projector implementations this PAS is not restricted to this type of technology. It is intended to cover the many differing existing and emerging technologies used in the audio visual world.

All the information contained in the Annexes is for illustrative purposes only.

1 Scope

This PAS specifies requirements for the correct and safe implementation of Audio Visual installations.

It does not specify requirements for the training of installation engineers.

It is for use by Audio Visual installation companies in the UK who provide installations comprising of a significant AV component such as, but not limited to, computers, projectors, whiteboards, plasma screens, LCD screens, loud speakers (both wall and ceiling mounted) and light arrays to the public and private sectors and their end users.

This PAS has been created to give end users / customers a level of confidence and assurance when purchasing Audio Visual Installation services.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1129, *Specification for portable timber ladders, steps, trestles and lightweight stagings*

BS 2037, *Specification for portable aluminium ladders, steps, trestles and lightweight stagings*

BS 5499-10:2006, *Safety signs, including fire safety signs. Code of practice for the use of safety signs, including fire safety signs*

BS 6399, *Loading for Buildings*

BS 7671, *Requirements for electrical installations. IEE Wiring Regulations*

BS 8437, *Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace*

BS 8454, *Code of practice for the delivery of training and education for work at height and rescue*

BS EN 131-1, *Ladders*

BS EN 795:1997, *Protection against falls from a height. Anchor devices. Requirements and testing*

BS EN ISO 8765: 2001, *Hexagon head bolts with metric fine pitch thread. Product grades A and B*

ISO/IEC 11801:2002, *Information Technology – Generic cabling for customer premises*

IEC 61156-5, *Multicore and symmetrical Multicore and symmetrical pair/quad cables for digital communications – Symmetrical pair/quad cables with transmission characteristics up to 600 MHz – Horizontal floor wiring – Sectional specification*

IEC 61156-6, *Multicore and symmetrical Multicore and symmetrical pair/quad cables for digital communications – Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification*

DIN 962:2001, *Designation system for fasteners*

ANSI/TIA/EIA-568-B, *Commercial Building Telecommunications Cabling Standard*

3 Terms and definitions

For the purposes of this PAS the following terms and definitions apply.

3.1 audio

anything pertaining to equipment or conduction of sound

3.2 ceiling mounted

equipment mounted to the ceiling structure using an adapter bracket, or to beams or other load bearing structures using appropriate bracketry

NOTE *In high ceiling installations a suspension column is normally employed to suspend the equipment at the correct height*

3.3 competent person

person who can demonstrate that they have sufficient professional knowledge 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 to the work (or equipment) under consideration;

c) detect any technical defects or omissions in that work (or equipment), recognize any implications for health and safety, where appropriate, caused by those defects or omissions, and be able to specify a remedial action to mitigate those implications.

3.4 customer/client

corporate body/individual that is responsible for procuring the work

3.5 employer

person, persons or legally defined business entity that either uses, erects or installs audio-visual equipment

3.6 equipment

3.6.1 personal protective equipment

equipment which is intended to be worn or held by a person at work and which protects him/her against one or more risks to his/her health and safety

3.6.2 use of work equipment

any activity involving work equipment, including starting and stopping, erecting, installing, dismantling, programming, setting, using, transporting, repairing, modifying, maintaining, servicing and cleaning

3.7 floor / surface mounted

equipment mounted on a wheeled trolley (cart) or static stand, which may be fixed to the floor structure

NOTE *There are circumstances where floor and ceiling is used in combination i.e. fixed to floor and fixed to ceiling as a continuous mounting assembly. AV equipment can also be mounted on desks or tables.*

3.8 management

body of people who, collectively, manage or direct an organization

3.9 method statement

document prepared by an organization that describes in a logical sequence exactly how a work activity is to be carried out in a manner which is safe and without risks to health

3.10 organization

administrative and functional structure

3.11 risk assessment

process of hazard identification and evaluation that enables appropriate steps to be taken in the control of injury risks to people, damage risks to property and pollution risks to the environment that might otherwise arise from such hazards

3.12 site owner

landlord, organization or persons responsible for the operational management of the building in which the subject premises is located

3.13 visual

any device that either converts light into an electrical signal or an electrical signal into light

3.14 wall mounted

equipment mounted directly to the wall or via an adapter bracket or a bracket designed to stand the equipment off the wall for any specific purpose

4 Abbreviations

4.1 AV
Audio Visual

4.2 BS
British Standard

4.3 HSE
Health and Safety Executive

5 Health and safety

5.1 General

5.1.1 Management shall continue to work in close co-operation with employees, contractors, customers/clients, site owners and visitors to achieve continuous health and safety performance improvements.

NOTE *This should be indicated by the knowledge held by management and employees of the relevant laws and regulations applicable to the areas of work.*

5.1.2 Management shall ensure that employees participate in the development of programmes to improve health and safety and are responsible and accountable for ensuring that they work within current health and safety standards.

5.1.3 Management shall ensure that hazards are eliminated where reasonably practicable and residual risks are controlled to the lowest possible level.

5.1.4 Where it is not reasonably practical to eliminate hazardous situations, safe working practices and procedures (including method statements and permits to work) shall be developed for all remaining potentially hazardous situations and compliance shall be rigorously enforced.

NOTE *Attention is drawn to Regulation 3 of the Management of Health and Safety at Work Regulations 1999 [1].*

5.2 Working at height

5.2.1 When working at height all installation engineers shall operate following the recommendations given in **BS 8437**, *Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace* and **BS 8454**, *Code of practice for the delivery of training and education for work at height and rescue.*

NOTE *Attention is drawn to the Work at Height Regulations 2005 as amended [2].*

5.2.2 Where ladders are being used, the ladders shall comply with:

BS 2037 *Specification for portable aluminium ladders, steps, trestles and lightweight stagings;*

BS 1129, *Specification for portable timber ladders, steps, trestles and lightweight stagings;*

BS EN 131-1 *Ladders.*

5.2.3 Where platforms are being used, the installation engineer shall have completed an accredited working at height safety course.

5.3 Asbestos

The room in which the work is to be a carried out shall have been checked for asbestos prior to any works being carried out.

NOTE *Attention is drawn to the Control of Asbestos at Work Regulations 2006 [3].*

5.4 Electrical Safety

All electrical installations shall comply with **BS 7671**, *Requirements for electrical installations. IEE Wiring Regulations.*

5.5 Hazards

Where a hazardous area has been created during the job being carried out, this area shall be sectioned off and identified with signage following the recommendations in **BS 5499-10**, *Safety signs, including fire safety signs. Code of practice for the use of safety signs, including fire safety signs.*

5.6 Optical Radiation Safety

Guidance on optical radiation safety is given in Annex **B**.

6 Pre install

6.1 Site survey

Pre-installation site surveys shall be carried out by a person or persons who are experienced in the siting and installation of audio visual devices. During the survey, a review of the product selection shall be carried out in relation to the environment where the equipment is to be installed. Detailed measurements, dimensions and angles shall be recorded and any existing electrical cabling (where applicable) shall be noted and any recommendations for alteration to aid the installation of the AV equipment made.

***NOTE** A sample site survey is given in Annex **C**.*

6.2 Risk assessment of works to be carried out

A risk assessment shall be performed prior to any work being carried out. All risk assessments shall be completed in accordance with HSE Risk Assessment guidelines.

***NOTE 1** Reference should be made to the HSE Five Steps to Risk Assessment publication which includes:*

- *Identify the hazards;*
- *Decide who might be harmed and how;*
- *Evaluate the risks and decide on precaution;*
- *Record your findings and implement them;*
- *Review your assessment and update if necessary.*

During the risk assessment, observations shall be made to calculate the PPE that will be required in accordance with Personal Protective Equipment at Work Regulations 1992 (as amended) [4].

***NOTE 2** The risk assessment should enable the installation work to be completed safely by installation personnel and without risk of injury to other persons who may be at the installation premises. It should also enable the customer or end-user to subsequently use the installation safely and without risk to the health of any of the users, staff, students, pupils, members of the public or others as the case may be. This includes the need to pay particular attention towards the risk of staring directly into a projector beam if this is included as part of the installation.*

Audio visual equipment installation shall be safe in any reasonably foreseeable circumstance of use which, for all installations, shall include the possibility of miscreant behaviour by anyone that would result in a pull-out force being generated.

Consideration shall be given to the possibility that someone may attempt to swing from any AV equipment that is accessible. The excess forces applied to any equipment will be substantial. The intended location for the AV equipment shall be checked during the survey for its suitability to deal with any peak loading that could occur. Particular attention shall be paid to the wall brackets and fixings used (see **7.2**).

***NOTE** Attention is drawn to the Health and Safety at Work etc. Act 1974 [5].*

6.3 Customer actions

Customers shall be informed of any actions that need to be carried out by them prior to installation taking place.

6.4 Installer conduct

Installers shall act in a polite and professional manner at all times, and treat all people and property with due respect.

***NOTE** An example code of conduct is given in Annex **D**.*

7 Installation

7.1 Health and safety

The installation company shall have a documented health and safety policy which is the core document from which the implementation of safe systems of work develops.

***NOTE** Attention is drawn to the following regulations and guidance:*

The Management of Health and Safety at Work Regulations 1999 [1].

The Personal Protective Equipment at Work Regulations 1992 [4].

The Provision and Use of Work Equipment Regulations 1998 [6].

HSG65 Successful Health and Safety Management 1997 [7].

All tools and equipment used shall have achieved Portable Appliance Testing (PAT) [8] where required.

7.2 Fixings and brackets

7.2.1 General

All fixings utilized shall have passed a tensile loading test for the product being attached as specified in **BS EN 795:1997**, *Protection against falls from a height. Anchor devices.* Requirements and testing.

Fixings shall meet the requirements in **BS EN ISO 8765:2001**, *Hexagon head bolts with metric fine pitch thread. Product grades A and B.*

7.2.2 Product grades A and B

All mounting systems shall be capable of supporting the combined mass of the complete mounting assembly and all AV equipment attached. Any extraneous loads identified in the risk assessment (peak loads) shall also be taken into consideration.

***NOTE 1** The 5:1 rule should be applied.*

***NOTE 2** To deter the unauthorized removal of AV equipment consideration should be given to the use of Loss Prevention Certification Board (LPCB) approved fixings.*

***NOTE 3** When considering perpendicular loads a safety factor of 5 should be applied (5:1 Rule). 5 multiplied by the combined mass of complete mounting assembly plus AV equipment including any peripherals being supported. Peak loads identified in the risk assessment may be considerably more than the values calculated using the 5:1 rule and should be taken into consideration when choosing the mounting system and fixings.*

***NOTE 4** Correct fixings and mounts should be utilized to carry the weight of a miscreant if they could be reached by one (see **6.2**).*

Whilst it is impossible to ensure compliance with every eventuality, an agreed force loading shall be determined and the installation shall be capable of supporting that loading.

***NOTE 5** The duty to do this rests with the installer ensuring that equipment fixings and mounts will either perform to the required loading, following consultation with the customer about their miscreant behaviour mitigation needs, or to ensure that, in the event of it not being practicable to achieve the required loading performance, the customer is aware of the operational control measures that will be needed in order to avoid any fixings or mount failures.*

7.2.3 Floor mounted

Freestanding trolleys and stands shall have been subject to (and passed) a recognized static load balance test by the manufacturer.

***NOTE 1** An example of a static load balance test can be found in Annex **E** of this document.*

The equipment supplied by the installer shall have been tested by the manufacturer to ensure it is fit for purpose.

Where this information is not available (for example where the customer has provided an existing legacy trolley or stand), the installer shall notify the customer that the installation has not been subject to a static load test. If the installer is of the opinion that the installation may be unsafe, the installation shall not be completed. The installation shall be made safe and the customer notified.

Specified limits stated on equipment (such as size and weight) shall not be exceeded, and only equipment or fixing methods approved by the manufacturer shall be used to secure any part of the equipment being installed.

Where AV equipment is installed on a generic trolley or stand that is not supplied with fixings for that equipment, the equipment shall be secured in

place and would not topple or fall in the event the equipment is moved/knocked or any leads/cables are pulled.

NOTE 2 *This could be accomplished through the use of bespoke mounting brackets, tethers, cable clamps, etc.*

If floor fixed stands are installed in places which are subject to overcrowding the structure and fixings shall be capable of withstanding horizontal crowd loading as specified in **BS 6399**, *Loading for Buildings*.

7.2.4 Wall mounted

The wall structure shall be strong enough to support the load. If the wall structure is deemed incapable of supporting the Safety Factor load imposed upon it consideration shall be given to strengthening and/or stabilizing the wall or adopting an alternative method of mounting, i.e. floor or ceiling suspension.

If the equipment is mounted away from the wall on an arm or extended bracket, the increased forces imposed on the fixings and wall shall be taken into account. Where the length of arm extends beyond this, secondary support or bracing shall be provided.

The installer shall inform the customer in writing of any concerns about the structure that the equipment is to be mounted to.

NOTE *This is advice only and the customer should be encouraged to seek advice from a structural engineer.*

If the installer thinks that the structure will become unsafe they shall not do the work.

7.2.5 Ceiling mounted

Any structure i.e. concrete ceilings, beams, Purlins etc. shall be capable of supporting the Safety Factor load imposed.

Where suspension columns or other means are employed to bring the equipment to the required installation height (generally min 2.1M to the underside of the equipment) there are circumstances, especially with large screens, where airflow or other forces can

impose horizontal loads on suspended equipment to the detriment of the fixings into the ceiling structure. The correct choice of ceiling mount and/or use of secondary bracing shall be implemented.

7.2.6 Local considerations

Fixings and brackets shall be designed to carry the weight of a child if they could be reached by one.

NOTE 1 *The duty to do this rests with the installer, and extends to their ensuring that equipment fixings and brackets will either perform to the required loading, following discussion with the customer about their miscreant behaviour mitigation needs, or to ensuring that, in the event of its not being practicable to achieve the required loading performance, the customer is aware of the operational control measures that will be needed in order to avoid any fixings or bracket failures.*

NOTE 2 *Attention is drawn to the Health and Safety at Work etc. Act 1974 [5], Sections 2,3 and 6 in particular.*

NOTE 3 *Given that there are no specific regulatory requirements in regard to fixings and bracket performance, what's needed here is a sensible approach to, on the one hand, assessment of the likelihood and consequence of miscreant behaviour on their safety performance and, on the other, to taking reasonably practicable steps to reduce the likelihood of such eventualities.*

7.3 Structural considerations

Ceiling and wall fixings manufactured and tested to high specification shall be utilized at all times.

Fixings shall, as a minimum, be able to support the imposed load plus safety factor.

All fixings shall be supplied with a 10 year guarantee.

Any AV component shall be affixed to the fabric of the building and not to any false or suspended ceilings unless the product has been specifically designed for that application or a secondary mechanism has been installed to take the load.

Mounting supports shall be attached to the structure of the building not the ceiling.

The installer shall never drill into structural beams. A specific clamping mount shall be used.

The 5: 1 rule shall be applied to load limits.

All fasteners shall comply with **DIN 962:2001**, *Designation system for fasteners.*

7.4 Electrical considerations

Installers who are specifically used to install a fixed electrical installation terminating in a 13 amp outlet shall be qualified to NICEIC [9]

From this fixed 13 amp outlet any AV equipment connected by means of a power cord shall be considered a portable installation and may be carried out by the AV installer.

Any cable(s) carrying a data signal will be segregated from any power cable(s) unless it can be clearly demonstrated that there is no interference between them.

An isolation switch that can be easily accessed shall be provided to stop the power flow to any device not reachable without the need for steps etc.

All installations shall comply with **BS 7671**, *Requirements for electrical installations. IEE Wiring Regulations*.

7.5 Cabling considerations

Installers who are specifically used to install structured cabling shall be qualified to a minimum of EAL Level 2 NVQ in Installing Structured Cabling Systems.

Any cable installation shall comply with the following cabling standards:

ISO/IEC 11801:2002, *Information Technology – Generic cabling for customer premises*

IEC 61156-5, *Multicore and symmetrical Multicore and symmetrical pair/quad cables for digital communications – Symmetrical pair/quad cables with transmission characteristics up to 600 MHz – Horizontal floor wiring – Sectional specification*

IEC 61156-6, *Multicore and symmetrical Multicore and symmetrical pair/quad cables for digital communications – Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification*

ANSI/TIA/EIA-568-B, *Commercial Building Telecommunications Cabling Standard*

8 Post install

8.1 General

The installer shall carry out a full test and commissioning of the systems installed.

8.2 Commissioning

A full visual inspection of the installation shall be carried out. Attention shall be paid to the positioning of any wiring to ensure that compliance with health and safety has been adhered to.

Any system shall have all inputs and outputs tested to confirm performance and functionality of live mains and data fed into it and the outputs checked for functionality and clarity.

Any projector in use shall be set to the safe and/or lowest lumens setting appropriate to the installation environment as published by the HSE [10].

Where the installation is a projector and whiteboard, an A4 sized document shall be permenantly posted alongside the whiteboard advising guidance on safe use of the equipment (see Annex **F**).

8.3 Sign off

A completion document shall be signed by the customer to ensure full satisfaction or to outline and agree outstanding works to be carried out.

***NOTE** A sample post-installation document is given in Annex **G**.*

8.4 Audit trail

An archive of site works and documentation shall be kept by the installation company detailing the paper trail which provides proof of compliance to this PAS standard. All serial numbers shall be recorded by the installation team and a copy of this made available to the customer on completion of installation.

Annex A (informative)
Technology overview

Audio visual technology may refer to an item that operates with sound and/or a visual component and can be defined as the tools used to convey information input from a variety of sources.

An interactive whiteboard is a large interactive display that connects to a computer and projector. The board is typically mounted to a wall or on a floor stand.

A projector projects the computer's video output onto the board's surface, where users control the computer using a pen, finger or other device.

A screen is used to display images and text delivered to it electronically (LCD/Plasma) or through the transmission of a light source (projection screen).

An LED array is constructed of a plurality of first and second light-emitting rows generating an equable arrangement of coloured light.

Annex B (informative)
Optical radiation safety

B.1 General

Most computer projectors used in shows and presentations and in interactive whiteboards applications, have projection distances that are large enough to allow people to stand in front of them and look at the very intense light that they produce. Anyone who does this, runs the risk of exposing their eyes to light intensities that could exceed one of the exposure limits which the Health and Safety Executive (HSE) uses as a guide for determining compliance with applicable legislation. Therefore, although these exposure limits will not be statutory until April 2010, HSE nonetheless considers the following advice to be good practice in respect of the use of these projectors by employers, particularly those who work in the education sector.

B.2 Safety advice

Employers should establish work procedures for teachers/lecturers and pupils/students and give instruction on their adoption so that:

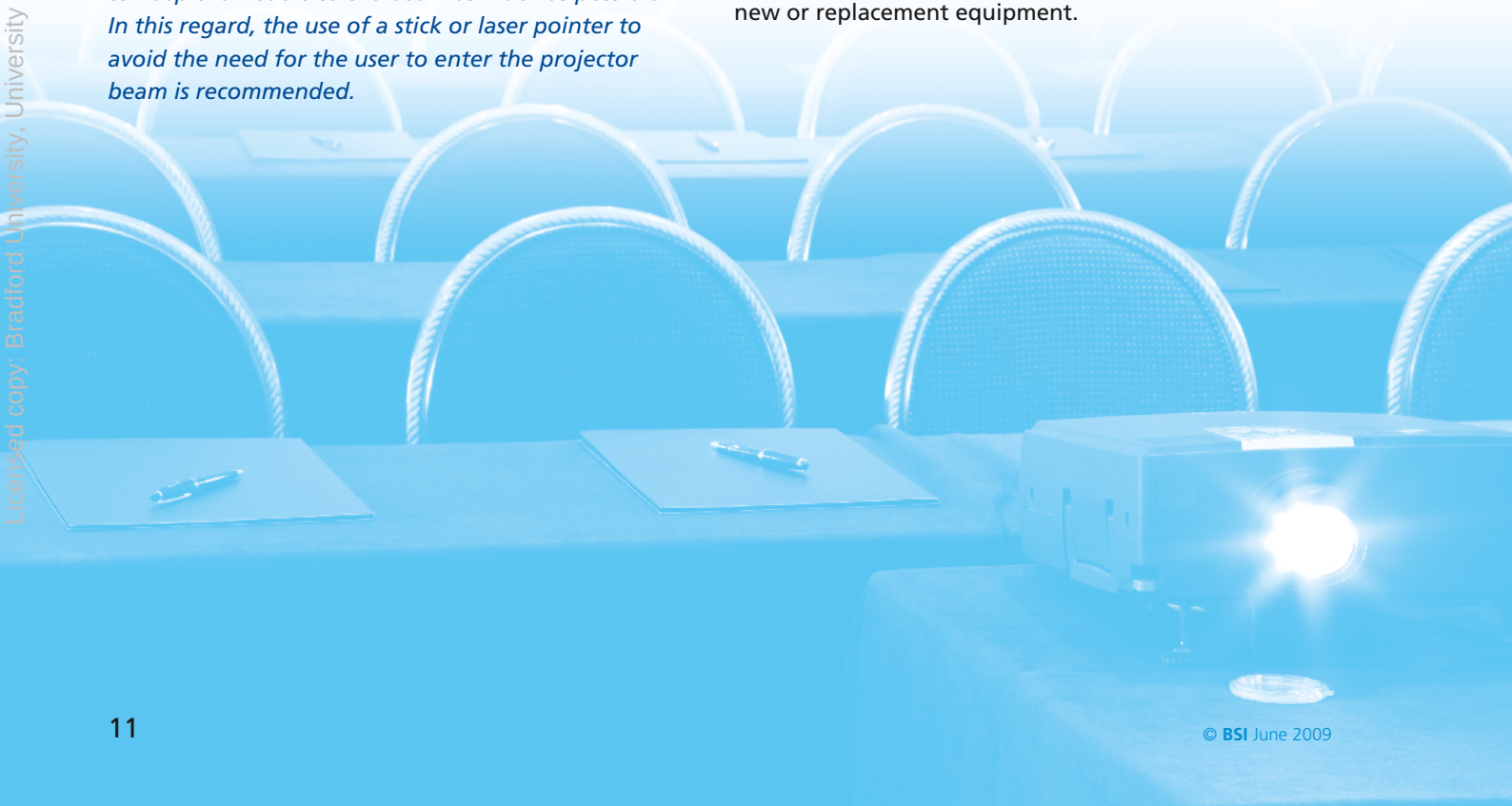
- Staring directly into the projector beam is avoided at all times;
- Standing facing into the beam is minimized;
- Pupils and students are adequately supervised when they are asked to point out something on the screen.

NOTE *Users, especially pupils and students, should try to keep their backs to the beam as much as possible. In this regard, the use of a stick or laser pointer to avoid the need for the user to enter the projector beam is recommended.*

Employers should also try to ensure that projectors are located so that they are not in a presenter's line-of-sight when they stand in front of the screen to address an audience; this ensures that, when presenters look at an audience, they do not also have to stare directly at the projector lamp. In most cases, the best way to achieve this is by ceiling-mounting rather than floor or table-mounting the projector.

In order to minimize the lamp power needed to project a visible presentation, employers should, where practicable, use room blinds to reduce ambient light levels.

Recent technological developments in projector and interactive whiteboard design have allowed inherently safer "ultra-short throw" devices to be brought to market. These employ sophisticated optics to enable the projector to be mounted above the display screen and so close to it that it becomes impossible for a user to directly expose their eyes to the beam. Employers who use these designs therefore do not need to follow the foregoing work procedure guidance because residual eye exposure risks are wholly removed by this type of equipment's design and construction. Given that safe work procedures may sometimes be disregarded by users, HSE considers that the improved inherent safety of "ultra-short throw" devices is sufficient reason for employers and organisations to actively consider them as an option when they purchase new or replacement equipment.



Annex C (informative)
Site survey sample documentation

NOTE The documentation shown in this annex is a sample only and is given for illustrative purposes.

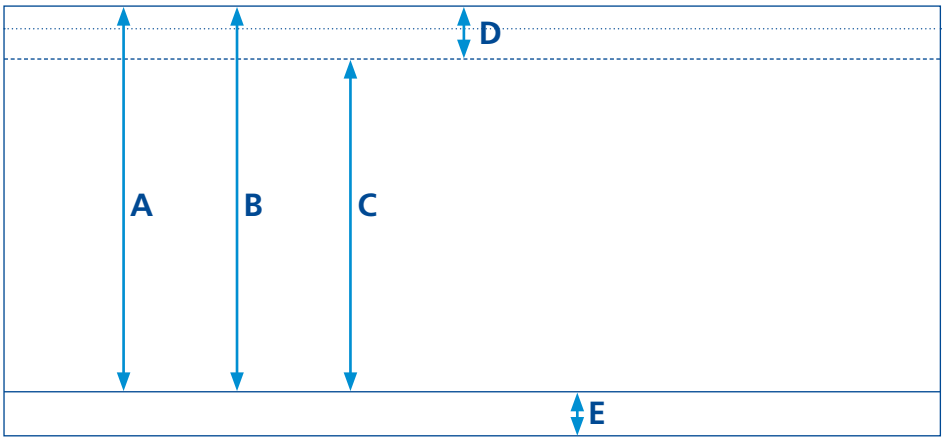
Site details

Customer		**Site**	
Tel			
Fax		**Tel**	
Email		**Fax**	
Contact		**Contact**	
Survey date		**Install date**	

General

Equipment to be installed	
Is asbestos present/register checked?	
Parking available/space allocated?	
Access times, any restrictions *(noise etc.)*	
Agreed height to underside of projector/ LCD screen/plasma screen/LED array etc.	
Agreed height to top of whiteboard/ LCD screen/plasma screen/LED array etc.	

Room ceiling height details



A Finished floor to ceiling	
B Finished floor to girder joist	
C Finished floor to false ceiling	
D False ceiling void	
E Slab to finished floor	

Room/area details

Height	**m**	**Width**	**m**	**Length**	**m**

Type of ceiling *(i.e. concrete slab suspended)*	
Possible obstructions *(i.e. ducts, pipes, cables etc.)*	
Type of floor *(i.e. concrete slab or wood)*	
Possible obstructions *(i.e. ducts, pipes, cables etc.)*	
Type of wall *(i.e. solid brick, plastered, dry lined etc.)*	
Type of bracket required	
Power required and supplied by others?	
Note any jobs required to be carried out by the client prior to installation. *(i.e. moving cupboards etc.)*	

Sketch of floor plan show location of projector, interactive board, face plate, LCD screen, plasma screen, LED array etc and any cabling

Customer acceptance

I, as a representative of the above company/customer accept the proposed positions of the above equipment. I fully understand that if the positions of equipment change which is no fault of the installer, additional charges may be incurred.

Signature		**Print name**	
Position		**Date**	

Annex D (normative)
Sample code of conduct

NOTE The documentation shown in this annex is a sample only and is given for illustrative purposes.

As an Audio Visual Installation engineer, I understand that my personal standards of honour and integrity must, at all times, be above reproach and I must conduct myself in a manner that reflects favourably on my profession. By doing so, I will strive to create an ethical climate within my organization, my industry, and the community of clients which I serve, building honesty and trustworthiness in all of my relationships and ensuring my reliability in performing my assigned responsibilities.

- As an Audio Visual Installation engineer, I pledge to be truthful and accurate in what I say, do, and write. I will exhibit constructiveness and cooperation in all of my working relationships, ensuring adherence to the law at all times. I will efficiently use resources and will not reveal fact, data, or information obtained in connection with services rendered without the prior consent of the client or employer- except as authorized or required by law.
- As an Audio Visual Installation engineer, I will demonstrate a commitment to excellence in all aspects of my profession and will consistently promote and encourage the highest level of ethics within the industry. I will refuse to engage in, or countenance, activities for personal gain at the expense of my company.
- As an Audio Visual Installation engineer, I will undertake only those assignments for which I am competent by way of education, training, and experience. I will not misrepresent or permit misrepresentation of my own or associate's academic or professional qualifications nor exaggerate my degree of responsibility for any work. Furthermore, I will admit and accept my own errors when proven wrong, refraining from distorting or altering the facts in an attempt to justify my decisions.
- As an Audio Visual Installation engineer, I will use every opportunity to improve public understanding of the role of the communications industry. I will also have due regard for the physical environment and for public safety, health, and well-being. If my judgment is overruled under circumstances where the safety, health, property, or welfare of the public may be endangered, I will notify my employer, client, and/or such other authority as may be appropriate.
- As an Audio Visual Installation engineer, I will always strive to maintain proficiency by updating technical knowledge and skills.
- As an Audio Visual Installation engineer, I will avoid compromise of professional judgment by conflicts of interest.
- As an Audio Visual Installation engineer, I will act in a manner free of bias with regard to religion, ethnicity, gender age, national origin or disability.
- As an Audio Visual Installation engineer, I will uphold and follow all policies and procedures required by the Certification Committee to remain in good standing, and abide by the Code of Professional Ethics.

I have read, understand and agree with the Code of Professional Ethics. Therefore, I understand and agree that my failure to abide by the Code of Professional Ethics shall constitute grounds for denial or revocation of my certification.

Signature	
Print name	
Date	

Annex E (informative)
Mechanical stability and static balance test (from BS 7429:1991 [11])

E.1 Practical considerations

E.1.1 The test described is a static test, but the test requirements have been determined from dynamic conditions.

E.1.2 A condition of danger is most likely to be reached when equipment mounted on a mobile stand (trolley) is brought to a halt by some obstruction on the ground (step, raised tile or paving stone, or some other object not likely to be moved out of the way by the leading wheel) while the equipment is being moved from one place to another. While the assembly of equipment and trolley is in motion it has kinetic energy proportional to the speed and its mass. There will also be kinetic energy due to the movement of the mass of the person pushing the assembly. Upon coming to a sudden halt, with the leading wheels jammed, the kinetic energy in the system, assembly and pusher, is dissipated in lifting the assembly such that it tips forward (in the direction of the previous travelling motion) pivoting about the axles of the leading wheels.

If there is sufficient kinetic energy to lift the assembly far enough for the centre of gravity of the complete assembly to pass beyond the vertical line above the pivot point, the assembly will fall to the floor. If the centre of gravity does not reach that line, the assembly will fall back towards its normal vertical position. There may be some mechanical oscillation of the assembly about this normal position before it settles. If the centre of gravity just reaches the vertical line from the pivot point, a condition of unstable equilibrium is reached: the assembly will not balance in this position, but will fall either forwards (towards the ground) or backwards dependent upon any subsequent disturbance. At the condition of unstable equilibrium, the assembly shows a gain in potential energy due to the increased height of the centre of gravity; this gain in potential energy is proportional to the increase in height and the mass of the assembly of equipment and trolley.

E.1.3 If the position of the centre of gravity of the assembly is known, the angle of tilt required to reach the condition of unstable equilibrium may be calculated. This is determined entirely by the height of the centre of gravity above the axles of the leading wheels, and the horizontal distance from the axles of the leading wheels to a vertical line downwards from the centre of gravity. It should be noted that in the case of wheels with castor action, the distance between the axles of the leading wheels and the vertical line from the centre of gravity will be less than the distance between the axles of the same wheels and the vertical line from the centre of gravity if the assembly is travelling in the opposite direction. Also it should be noted that a centre of gravity of an equipment and trolley assembly is not necessarily geometrically central in any dimension.

E.1.4 Relating the kinetic energy in the system to what is and is not safe is complex. It has already been stated that a moving assembly, when stopped by an obstruction to the wheels, dissipates its kinetic energy in lifting the centre of gravity.

If the horizontal distance between the pivot point and the vertical line from the centre of gravity is made larger (by increasing the spread of the trolley), the centre of gravity has to be lifted further in order for the condition of unstable equilibrium to be reached. (It is assumed for the purposes of this argument that an increase in the spread of the trolley involves no increase in the total mass or change in the height of the centre of gravity.) Thus, due to the extra lift required with a wider spread of the trolley, when the kinetic energy is unchanged, the assembly will not tip so far due to kinetic energy as with the trolley having the narrower spread.

E.1.5 Conversely, if the trolley spread is to be reduced, the lift required is less, so the kinetic energy will be able to pivot the assembly through a greater angle. If that greater angle is larger than the angle of unstable equilibrium, the assembly will fall to the ground.

E.2 Theoretical considerations

E.2.1 In order to carry out the test in **E.3**, certain information concerning the equipment and trolley assembly needs determining:

a) the mass in kilograms of the complete assembly, M_1;

b) the height (h) of the centre of gravity of the

assembly above the axles of the leading wheels of the trolley.

E.2.2 The test involves tilting the assembly forward in the normal direction of motion (see 4.2.8 of BS 7429:1991) until the point of unstable equilibrium is reached. The angle of tilt is then measured, θ'.

E.2.3 It is then necessary to calculate the angle, θ, through which the kinetic energy in the system will turn the assembly. In this calculation various constants have to be assumed.

E.2.4 The value of θ which is calculated is the angle at which the kinetic energy of the moving system is fully dissipated having lifted the centre of gravity of the assembly through such a height that the consequent gain in potential energy equals the original kinetic energy.

$$\text{kinetic energy in system} = 0.5\,(M_1 + M_2)\,v^2 \qquad (1)$$

where

M_1 is the mass of the complete assembly of equipment and trolley (in kg);

M_2 is the mass of the person pushing (in kg);

v is the velocity at which the assembly is being pushed (in m/s).

$$\text{At critical condition, potential energy in assembly} = (M_1 \times g_n h) \times (\sec\theta' - 1) \qquad (2)$$

where

θ' is the angle measured according to **E.2.2**;

g_n is acceleration due to gravity (9.8 m/s^2);

h is the height of the centre of gravity above axles of the leading wheels when the assembly is in its normal, upright position (in m).

E.2.5 If the kinetic energy in the system is just sufficient to raise the centre of gravity vertically above the axles of the leading wheels, it follows that the kinetic energy equals the potential energy at the critical condition, i.e.: $0.5\,(M_1 + M_2)v^2 = (M_1 \times g_n h)(\sec\theta - 1)$

Dividing by M_1, and rearranging:

$$\theta = \arccos[(2g_n h \times M_1)/\{v^2\,(M_1 + M_2) + (2g_n h \times M_1)\}$$
$$= \arccos[(2g_n h \times M_1)/\{(2g_n h + v^2)\,M_1 + (v^2 \times M_2)\}]$$

As a general case, the kinetic energy can be either insufficient to tilt the assembly as far as the angle of unstable equilibrium, or sufficient to tilt the assembly further; the subject of the equation therefore becomes the general variable, θ.

For the present purpose, M_2 is assumed to be 75 kg and v is taken as 0.8 m/s. With these values,

$$\theta = \arccos[(19.6h \times M1)/\{(19.6h + 0.64) \times (M1 + 48)\}] \qquad (3)$$

E.2.6 Measuring M_1 by weighing, and h by the method described in **E.2.7**, we may use equation 3 to determine the value of θ. It is necessary that this angle is less than the critical angle θ', measured as described in **E.2.2**.

NOTE *With some designs the method described in* ***E.2.7*** *may be inconvenient, in which case another method, of at least equal accuracy, may be used.*

E.2.7 The height of the centre of gravity above the axles of the leading wheels (h) is determined by balancing the assembly on its most convenient vertical side; this will usually be one of the sides at right angles to the plane of the screen. Using a firm horizontal table-top or bench the assembly is supported on a suitable fulcrum bar. This enables the assembly to be moved back and forth to find the point of balance. The bar should be kept at right angles to the normal vertical axis of the assembly.

At the point of balance, h is the horizontal distance (with the assembly in its balanced position) between the line of contact between the bar and the assembly, and the vertical plane containing the axles of the leading wheels. It will usually be more convenient to measure initially the distance between the line of contact with the bar and some readily identified point such as an edge of the casing of the equipment and to complete the measurement of h after restoring the assembly to its normal upright position.

If the centre of gravity is below the bottom of the casing of the equipment, the assembly will have to be placed on a board to enable it to be balanced on the fulcrum bar. It is important to ensure that, at the point of balance, the board itself is balanced: i.e. the point of balance is half way along the length of the board [see Figure 1 (a)]. Re-positioning of the assembly on the board will be necessary to achieve this. If the design of the trolley causes obstruction to the placing of the board as described, it may be necessary to balance the assembly successively on each side [see Figure 1 (b) and Figure 1 (c)] to locate the position of the centre of gravity).

E.3 Static balance test

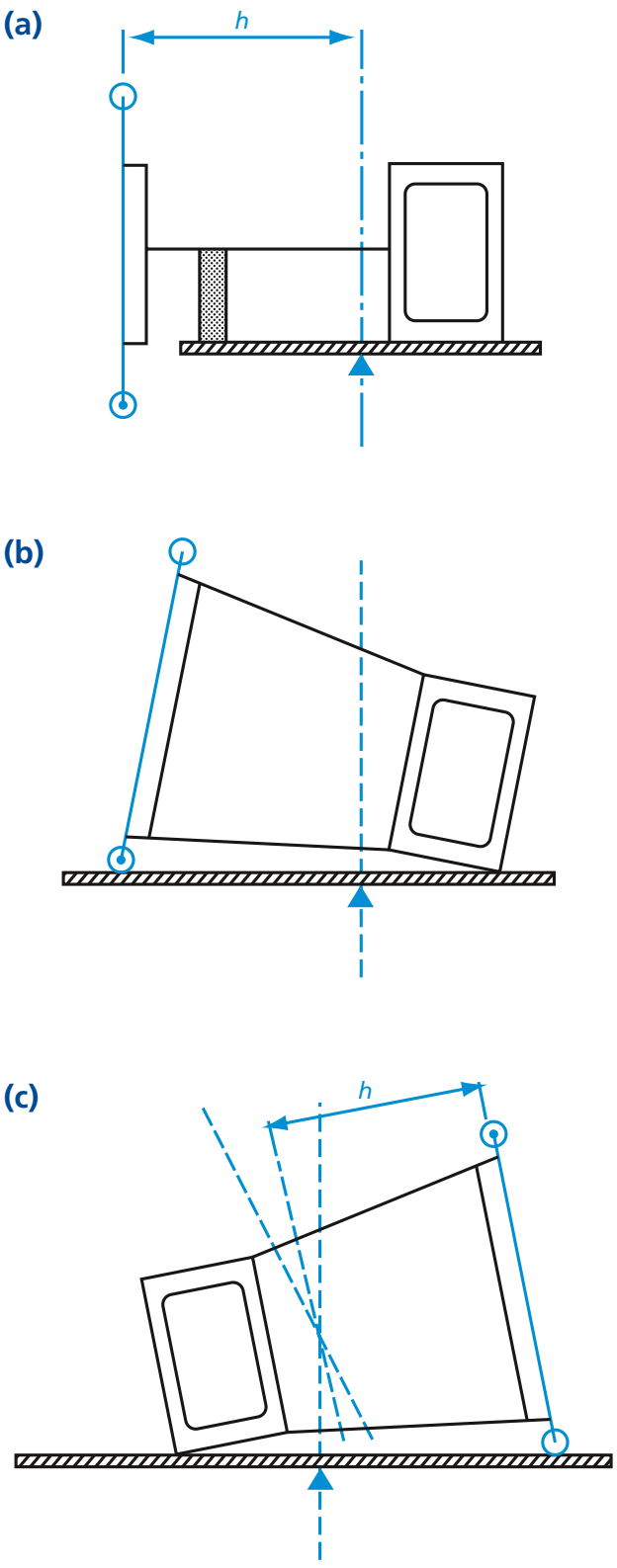
Determine the total mass of the equipment and stand assembly (M_1), in kilograms.

Ensure that the leading wheels of the assembly are restrained from movement. Tip the assembly about the leading axle until it is just balanced over the leading axle. Measure the angle θ' as the angle between the vertical axis of the assembly (when in its normal position) and a plumb line dropped from any point on the assembly when in the balanced position. If the measured angle, θ', is greater than the calculated angle, θ [see equation(3)], the assembly passes the test.

If the assembly fails this test refer to Appendix C of BS 7429: 1991 for information that will assist in achieving a satisfactory solution to the problem.

NOTE *Dotted material is a low mass packing material, e.g. expanded polystyrene.*

Figure 1 – Determination of the height of the centre of gravity of an assembly



Key

h is the height of centre of gravity above wheel axles.

Annex F (informative)
Interactive whiteboard guidance

F.1 Guidelines

The text below is example text that could be used on an A4 sized document posted beside an interactive whiteboard. This text is almost identical to that recommended and approved by the HSE and Becta for use in educational establishments.

Please read and ensure that the guidelines detailed below are observed:

- Staring directly into the projector beam is avoided at all times.
- Standing facing into the beam is minimized. ALL users, especially pupils and students, should try to keep their backs to the beam as much as possible. *In this regard, the use of a stick or laser pointer to avoid the need for the user to enter the beam is recommended.*
- Users, where appropriate, are adequately supervised when they are asked to point out something on the screen.

In order to minimize the lamp power needed to project a visible presentation, please, where possible, use room blinds to reduce ambient light levels.

Annex G (informative)
Post installation sample documentation

Room sign off and completion report

Address	**Room**
	Date

Equipment checklist

	Yes	No
Projector/LCD screen/plasma screen/LED array etc		
Device installed securely and squarely to ceiling/wall using appropriate fixings		
Device security bracket installed		
Device security cage installed		
Device security screws in mount and device		
Device aligned		
Device at correct height from ground *(Record height to underside IF projector = cms)*		
ALL relevant inputs connected *(2 x VGA 1 x S-video 1 x Composite video 2 x loop through audio etc etc)*		
Device power lead connected		
Device security key *(left with customer)*		
Device documentation/remote control/soft case/accessories/cables *(if any)*		
Interactive board *(if applicable)*		
Interactive board installed		
Interactive board installed squarely		
Interactive board installed at correct height *(Record height to top of screen = cms)*		
Interactive board securely fixed to wall		
No indents, tears in board material/surface		
All pens and eraser supplied and left with customer		
Interactive Board documentation and software supplied		

Equipment checklist *(continued)*	Yes	No
Audio installation		
Audio amplifier and speakers supplied		
Mini amplifier/speakers supplied		
Powered speakers supplied		
No external speakers supplied *(IF projector or device cabled for internal audio only)*		
Speakers securely fixed to wall/bracket using appropriate fixings		
Amplifier/speaker documentation supplied		
Faceplate (if applicable)		
Faceplate fitted squarely and securely using appropriate fixings		
Connectivity/functionality explained to customer		
2 x VGA ports, 1 x serial, 1 x USB		
1 x scart – 3 phono cable left plugged into faceplate		
1 x 3.5mm mini jack – 2 x phono cable left plugged into face plate		
Additional equipment / cables		
2 x male – male SVGA cable *(for PCs/ laptop to wallplate)*		
Monitor redrive installed		
Serial to USB Interactive board cable installed from board/faceplate to PC *(if needed)*		
Testing		
Interactive board s/w loaded on to customers PC/Laptop		
PC/Laptop powered up/on		
Device powered up/on using the remote control		
Any image fits screen squarely, zoom & focus working *(if applicable)*		
Image clear and in sync		
Orientate the interactive board *(if applicable)* – give software overview to client *(15mins max)*		
Switch signal inputs		
Connect VCR/DVD and demonstrate image *(if applicable)*		
If Amplifier fitted connect and demonstrate PC audio and video audio functionality		
Else demonstrate device audio, switch between PC and video/DVD *(if applicable)*		
Shut system down and demonstrate cooling down cycle IF projector and its importance		

Room sign off and completion report

	Yes	No
General		
Cables neat and cable tied at projector end		
Ceiling mount kit/wall mount clean and free from finger marks		
Ceiling or ceiling tiles *(where applicable)* free from finger marks and excessive damage		
Trunking from ceiling kit to faceplate secure clean and all lids secured		
Trunking corners installed		
Speaker cables trunked or hidden as appropriate		
Desks cleaned and floor area vacuumed		
Packaging and rubbish removed from site		

Serial numbers of installed equipment

Projector/LED array	
Interactive board/LCD screen/plasma screen	
Amplifier	
Speakers	

Engineers comments

Customers comments

Engineer sign off

I/we confirm that the installation has been completed to a standard fully acceptable by us. We are completely satisfied that all of the above points have been checked and implemented. All equipment is in working order with no defects. All rooms have been left in a clean and workable condition.

Signature	
Print name	
Position	
Date	
Interactive board installer accreditation number	

Customer sign off

I/we confirm that the installation has been completed to a standard fully acceptable by us. We are completely satisfied that all of the above points have been checked and implemented. All equipment is in working order with no defects. All rooms have been left in a clean and workable condition.

Signature	
Print name	
Position	
Date	

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Further information

Infocomm http://www.infocomm.org/cps/rde/xchg/infocomm/hs.xsl/index.htm

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