Space requirements for plant access, operation and maintenance
Space requirements for plant access, operation and maintenance
Foreword

This document provides guidance on the provision to be made for access to plant and the space requirements for the effective and safe maintenance and operation of mechanical/electrical engineering services in buildings and facilities.

The document highlights the relevant statutory obligations which must be considered in planning the provision of access and space allowance for services. It sets out the normal principles which are used by Project Managers and Designers to address their duty of care under these statutory obligations.

The Guide should be considered as a design aid. Due to the diverse nature of services installations and manufacturer’s requirements, it must not be taken as giving definitive guidance on spatial requirements. This Guide does not relieve Project Managers or Designers from their duties of care to embody statutory obligations and good engineering practice. Project Managers have a duty to ensure that building facilities are fit for purpose, including maintainability.

Whilst this Guide was commissioned by DEO(W) for the MOD Estate, it is acknowledged that it could be usefully applied outside the Estate.

The Guide has been reviewed and endorsed by the Chartered Institution of Building Services Engineers.

Acknowledgement

This guide has been produced for the Industrial Group, DEO(W), by consultant authors Ove Arup & Partners. Comments and contributions by others in DEO(W) and in the building services industry are gratefully acknowledged.

This guide has been sponsored by the Chief Safety Officer, MOD and the lead TLBHs for works.

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<td>Approved Code of Practice</td>
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<tr>
<td>AHU</td>
<td>Air Handling Unit</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<td>ASHRAE</td>
<td>American Society of Heating, Refrigerating and Air Conditioning Engineers</td>
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<tr>
<td>BRECSU</td>
<td>Building Research Energy Conservation Unit</td>
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<td>BS</td>
<td>British Standard</td>
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<td>British Standards Institution</td>
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<td>BSRIA</td>
<td>Building Services Research Information Association</td>
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<td>CIBSE</td>
<td>Chartered Institution of Building Services Engineers</td>
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<tr>
<td>CHP</td>
<td>Combined Heat and Power</td>
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<tr>
<td>COSHH</td>
<td>Control of Substances Hazardous to Health</td>
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<td>CV</td>
<td>Constant Volume</td>
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<td>DEO(W)</td>
<td>Defence Estate Organisation (Works)</td>
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<td>DWS</td>
<td>Defence Works Services</td>
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<td>FD</td>
<td>Fire damper</td>
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<td>FCU</td>
<td>Fan Coil Unit</td>
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<td>HSE</td>
<td>Health and Safety Executive</td>
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<td>HVAC</td>
<td>Heating, Ventilation and Air Conditioning</td>
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<tr>
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<td>IEE</td>
<td>Institution of Electrical Engineers</td>
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<td>Motor Control Centre</td>
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<td>M&amp;E</td>
<td>Mechanical and Electrical</td>
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<td>NALM</td>
<td>National Association of Lift Manufacturers</td>
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<td>National Health Service</td>
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<td>O&amp;M</td>
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<td>VAV</td>
<td>Variable Air Volume</td>
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<td>Volume Control damper</td>
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1 Introduction

Space, and the cost of providing space, for plant and building services distribution is often at a premium. Pressure to reduce the spatial requirements for building services installations is therefore an understandable element of the overall design process.

However, considerable care is required if building services are to be designed and installed to provide adequate space for the safe and efficient maintenance of the installations.

Difficulties can arise with meeting statutory levels of access to safely maintain the installation if space is inadequate. In extreme cases a significant amount of additional work may have to be undertaken after completion of the building to ensure compliance with statutory requirements.

Even when safe access is provided, access to component parts can be so restricted that the cost of maintaining these parts imposes a significant additional operating cost on the maintenance of the building, e.g. if part of the system or plantroom enclosure has to be dismantled.

Where a component needs regular replacement during the life of the building, consideration must be given to how this is to be achieved without incurring excessive cost in the dismantling of large sections of the installation or building fabric to facilitate removal.

Given the above considerations, the purpose of this Guide is to provide a checklist for designers and installers in order that these problems can be addressed and mitigated against at the design/construction stage.

To provide a systematic method of assessing the provision of space and access in an installation, Design Certificates are proposed in this Guide which offer a framework to check the adequacy of space allowances. These Design Certificates are, in essence, a formal way of checking and recording space and access provision at key stages of the design development through to handover.

The Guide is primarily concerned with provision of space and access which will affect the health and safety of staff operating, maintaining, repairing and replacing elements of building services. However, it does not address all design issues or all health and safety considerations relating to those services. (For example, the Guide does not address the requirements to supervise persons working alone in plant rooms, nor does it address the need to provide a route to plant rooms sheltered from weather extremes.)
1.1 SCOPE OF THE DOCUMENT

The aim of this Guide is to provide:
- guidance and a checklist at the outline design stage;
- a checklist at detail design stage;
- a final checklist at snagging/completion stage to minimise the risk of acceptance of building services that cannot be efficiently and safely maintained or replaced.

Due to the diversity in type, configuration and possible location of plant, it is not possible for this document to give definitive guidance for all installations and therefore the designer/installer in complying with this Guide is not relieved from complying with all relevant statutory requirements, British Standards and the specific recommendations of manufacturers.

It should however allow comparison between the proposed plant space and what may be considered the normal allowance for a similar installation. Where these differ, the design should be scrutinised to ensure that sufficient space has been allowed to adequately maintain the installations. This should be completed by reference to the checklists contained in this document.

This Guide also specifies what is considered to be sufficient access by defining levels of access and frequency of access required to commonly found items of plant and equipment, e.g. clear and immediate access for plant which is maintained frequently.

At the completion of the design stage and again at practical completion stage those responsible for the design/construction of the installation should confirm by completion of the forms included in Annex A of this document that the installation has been designed and installed to meet the requirements of the Guide. The project sponsor would be responsible for distribution of the Design Certificates.

In general the Guide is intended to be applied to modern buildings. In the case of new design work for historic buildings the recommendations in this Guide must not be applied unthinkingly in the context of building conservation. For example:

- False ceilings and raised floors are very often inappropriate in historic settings, or if used should be of an appropriate quality.
- Service ducts should not damage historic fabric.
- Siting of external services features such as fuel storage tanks should respect the setting of historic buildings.

For specialised applications such as hardened facilities, explosives storage, etc, space provision is required which is beyond the scope of this document. The Designer should seek advice from the relevant Works Technical Authority at DEO(W).
1.2 USE OF THE GUIDE

1.2.1 Structure of the Guide

The Guide is divided into five main sections; these are:

SECTION 2
Legislation and Good Practice Guidance
Defines the statutory requirements embodied in various health and safety regulations and the implications on the provision of space and access for installation, maintenance repair and replacement. The guides to good practice which provide quantitative recommendations of space provision are also summarised.

SECTION 3
Philosophy of Plantroom Design
Defines the main hazards that a designer should consider in a risk assessment exercise when considering the provision of space and access in a plantroom. The principles of plantroom layout, location and connection to primary distribution routes are discussed. This section pulls together the considerations detailed in Section 5 (Component Requirements) to illustrate the practical issues of combining main plant items with ancillary equipment, e.g. shared space for maintenance activities on different plant items. The variation in the requirement for access due to frequency of maintenance tasks and their duration is also defined.

SECTION 4
System Requirements
Defines the access and space requirements of distribution systems; pipework, ductwork, cabling, etc, in vertical and horizontal distribution arrangements. The requirements of co-ordinated services in false ceiling voids and raised floors are defined. To assist the designer or those involved with checking of existing installations, common problems with access to pipework and ductwork are discussed.

SECTION 5
Component Requirements
Each element of central plant for mechanical and electrical services is considered individually and the access and space requirements to safely install and maintain the installation are defined. Typical ranges of space requirements are quoted and the disposition of that space indicated diagrammatically in the plant data sheets. The risk assessment issues which affect space provision are defined. Cross-reference is made to Health and Safety Regulations, Codes of Practice, British Standards and guides to good practice for each plant item.

SECTION 6
Design Certificates
The Design Certificate is to be used to confirm that the design conforms with the recommendations in this Guide. The certificates will be based upon a series of checklists for various stages of the procurement procedure: outline design, detail design and handover. The level of detail of the checklists will increase as the project proceeds through that sequence.
1.2.2 Data Sheets

The bulk of the information on access and space requirements for distribution systems and central plant items has been presented on data sheets. These data sheets present information in a consistent and concise fashion. The commentary which accompanies the data sheet has been streamlined to impart only the basic information on access and space requirement, for installation and maintenance and associated risk assessment.

If further details of the rationale behind a particular recommendation is required these can be found by cross-referencing to Regulations, Codes of Practice, British Standards, and guides to good practice given in Section 2.

It is not expected that the plant data sheets will be read by the user in sequence; the Guide is more likely to be used as a reference document selecting data sheets to obtain the relevant piece of information on a particular plant item. They have therefore been made as self contained as possible with some duplication of information; e.g. reference in each sub-section to pertinent health and safety legislation.

1.3 DEFINITIONS

**Designer**
The organisation responsible to, and who has a direct or indirect contract with the project manager for the design of the building services installations.

**Installer**
The organisation responsible to, and who has a direct contract with the project manager for the installation of building services plant and equipment.

**Project Manager (PM)**
An official of the MOD or commercial representative responsible for the purpose of management and administration of works covered within this Guide. For work within the remit of the WSM, the term PM should be read as WSM.

**Outline Design**
The stage when the disposition and approximate size of the plantroom and distribution space allowances are being determined.

**Detail Design**
The point in time when the design drawings are complete, but prior to the commencement of installation/fabrication drawings.

**Completion**
When practical completion certificate is being sought.

1.4 KEY

The following symbols are used throughout the guide

- Shaded areas around plant plans and elevations to show space allowance for maintenance and access.

- 1100 All dimensions are in mm.

All clearance dimensions should be considered as minima and should be checked against manufacturer’s/installation requirements.
2 Legislation and Good Practice Guidance

2.1 HEALTH AND SAFETY

There is a significant amount of legislation which affects the provision of access and space for mechanical and electrical services. This is largely embodied in Regulations flowing from the enabling Health and Safety at Work Act 1974.

The principal Regulations are as follows:

- Management of Health and Safety Regulations 1992
- Workplace (Health, Safety and Welfare) Regulations 1992
- Provision and Use of Work Equipment Regulations 1992
- Construction (Design and Management) Regulations 1994
- Electricity at Work Regulations 1989
- Pressure Systems and Transportable Gas Containers Regulations 1989

Whilst the provision of access and space for safe maintenance and operation is referred to in these regulations there is a dearth of detailed guidance on the allowances which should be made. The general requirement of "adequate" or "sufficient" space is often quoted but is rarely quantified.

There are some useful guidance documents and standards which provide some quantitative guidance, e.g. BSRIA Technical Notes, BS 8313, NHS Publications etc. but these tend to be the exceptions.

A summary of the scope of the relevant Health and Safety Regulations is given in sub-section 2.2. Designers are not to ignore the actual Regulations, Codes of Practice and guidance notes, etc. The commentary in the schedule provides only an outline; it is essential that the relevant Regulations, Codes of Practice and guidance notes are referred to before applying this information.
2.2 STATUTORY INSTRUMENTS

A summary of legislation and regulations which affect the provision of access and space is shown in Tables 2.1-2.8. In addition to describing the statutory instrument, the associated codes of practice, guidance notes and approved documents are also noted.

To make cross-referencing easier a coding system is used to reference each document:

R*  - Regulations/ * sequence number
R*/ACOP  - Approved Code of Practice
R*/GN  - Guidance Note/ * sequence number
R*/AD  - Approved Document
Table 2.1  Management of Health and Safety at Work Regulations 1992

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<td>Ref: SI 1992 No.2051</td>
<td>These Regulations impose a duty on employers to develop a systematic approach to risk management to ensure the workplace is safe and healthy for their employees and others who may be affected by their activity. It provides a framework to carry out a risk assessment and organise measures to prevent or minimise those risks, and set up systems for on-going surveillance.</td>
</tr>
<tr>
<td>Date: 1 January 1993</td>
<td>As part of their duties under these Regulations, the employer must carry out risk assessment of the various activities carried out at the workplace, including maintenance and repair of mechanical and electrical systems serving the workplace. Specific requirements are amplified in other regulations such as R2, R3, R5, R6.</td>
</tr>
<tr>
<td>R1/ACOP</td>
<td>Approved Code of Practice.</td>
</tr>
<tr>
<td>Ref: HSC - L21</td>
<td>Provides clarification of the Regulations and guidance on how they should be implemented. This document sets out the general principles of risk assessment, health and safety arrangements, health surveillance, etc.</td>
</tr>
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<td>Date: 1992</td>
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These Regulations require:

- risk assessment of the workplace for the employees and others affected by their activities;
- preventative/protective measures to be put in place arising from the risk assessment;
- health surveillance appropriate to the risks;
- appointment of persons responsible for preventative/protective measures;
- emergency procedures;
- provision of information for those involved in risk assessment, preventative/protective strategies, emergency procedures;
- co-operation between employers who share a premises;
- training and instructions for use of machinery, dangerous substances, etc;
- provisions for temporary works.
Space Requirements

Section 2 Legislation and Good Practice Guidance

Table 2.2 Workplace (Health, Safety & Welfare) Regulations 1992

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<tbody>
<tr>
<td>R2</td>
<td>Workplace (Health, Safety and Welfare) Regulations 1992</td>
</tr>
</tbody>
</table>

These Regulations replace a considerable amount of existing legislation contained in the Factories Act 1961, Offices, Shops and Railway Premises Act 1963 and others. They are applicable to all workplaces except means of transport, construction sites, sites where mineral resources are extracted and fishing boats. They set out the general requirements for the working environment, safety facilities and housekeeping.

These focus on the specific issues which affect the quality of the working environment such as temperature, ventilation, lighting, cleanliness, etc. The Regulations impose duties on the employer and persons having control of the workplace to ensure that the workplace is fit for purpose, with a healthy and clean environment and the equipment and systems are properly maintained.

These Regulations require the workplace, equipment and devices to be maintained to function efficiently (from the viewpoint of health and safety). In this process, provisions should be made to permit maintenance to be carried out properly and at suitable intervals. Reference is made to BS 8210 (Guide to building maintenance management) and also to other Health and Safety Regulations.

The Regulations require traffic routes to be suitable in terms of strength and stability for the loads which will be imposed. Hence there is a requirement to assess the suitability of egress/ingress routes for replacement of major plant components.

The Regulations require that measures are taken to prevent falls from heights, in particular work platforms and ladders above 2m in height.

These Regulations require health and safety issues to be addressed for:

- maintenance of the workplace and of equipment, devices and systems;
- the internal environment, ventilation, temperature, humidity, lighting;
- workplaces and seating;
- sanitary and washing facilities;
- drinking water;
- minimum space for occupied rooms;
- provision of safe and suitable traffic routes (includes the movement of plant and equipment);
- protection from falling from heights.

R2/ACOP

Ref: HSC L24
Date: 1992

Approved Code of Practice.

Provides clarification of the Regulations and guidance for their implementation. The duty of ensuring the workplace, equipment, devices and systems are properly maintained is explained.
Table 2.3  Provision and Use of Work Equipment Regulations

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STATUTORY INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>R3</td>
<td><strong>Provision and Use of Work Equipment Regulations 1992</strong></td>
</tr>
<tr>
<td>Ref: SI 1992 No.2932</td>
<td>These Regulations combine all the existing statutory requirements relating to equipment used at work. The Regulations place a duty on the employer to ensure that work equipment is safe in use and defines minimum requirements. The definition of work equipment is wide; from fork lift trucks to portable drills. The definition of 'use' covers the starting, stopping, transporting, repairing, modifying, maintaining, servicing and cleaning of equipment.</td>
</tr>
<tr>
<td>Dates: 1 January 1993</td>
<td>Employers' general duties include:</td>
</tr>
<tr>
<td>General requirements apply to existing equipment, specific requirements only apply to new equipment.</td>
<td>• equipment which is selected is safe and suitable for the task and the working conditions;</td>
</tr>
<tr>
<td>1 January 1997 Specific requirements apply to all work equipment.</td>
<td>• ensuring that equipment is properly maintained;</td>
</tr>
<tr>
<td></td>
<td>• providing training and information on the equipment.</td>
</tr>
<tr>
<td></td>
<td>Employers' specific duties include:</td>
</tr>
<tr>
<td></td>
<td>• maintenance of equipment;</td>
</tr>
<tr>
<td></td>
<td>• protection from dangerous parts of the equipment and from specific hazards;</td>
</tr>
<tr>
<td></td>
<td>• isolation of equipment from power sources;</td>
</tr>
<tr>
<td></td>
<td>Equipment covered by these Regulations include:</td>
</tr>
<tr>
<td></td>
<td>• equipment which operates at high or low temperatures,</td>
</tr>
<tr>
<td></td>
<td>• controls and control systems;</td>
</tr>
<tr>
<td></td>
<td>• stability of equipment.</td>
</tr>
</tbody>
</table>

| R3/GN1 | **Work Equipment.** |
| Ref: HSE L22 | Provides guidance on the Regulations; guidance on general issues such as suitability of work equipment, maintenance, information and instructions, to specific requirements for lighting, emergency stop controls, isolation from power sources, etc. |
| Date: 1992 | |
The CDM Regulations impose mandatory duties on clients, designers and contractors to minimise risks to construction workers and to those who will eventually maintain and repair the building, with consideration also of the demolition process. Therefore the designer must avoid causing any foreseeable health and safety risks to those persons constructing, maintaining, cleaning or demolishing the building.

Hence in the planning of plant rooms and the distribution of mechanical and electrical services around the building the designer has duties to ensure there is sufficient access and space provision.

The designer must undertake a risk assessment to identify hazards in construction and maintenance activities. In terms of access and space requirements the designer must consider for example:

- space needed for removal and handling of plant components. Sufficient space must be provided for safe manual handling or to facilitate the use of mechanical lifting devices; see also R6.
- provision of safe access to plant components at high level to prevent falling from height.

The guidance notes which accompany the Regulations (see R4/GN1 & R4/GN2) define the duties of the designer, contractor and client and provide more detailed guidance for the risk assessment exercise. However, none of the accompanying guidance to these Regulations provide explicit information on space allowances.

The aim of these Regulations is to improve the health and safety of construction workers by placing new duties on clients, their agents, designers and contractors. These duties extend from the initial concept design through to the execution of works on site and subsequent maintenance and repair. A new role is defined, that of Planning Supervisor (PS), to identify the main hazards and risk and co-ordinate the designers in the process of risk management. Two documents are required in this process:

- The Health and Safety Plan;
  This document contains the Health and Safety information related to the design prepared by the design team and the PS. This will alert Tenderers to hazards and risks associated with the construction works.
- The Health and Safety File;
  This may consist of as-built specifications and drawings and can be considered as an enlarged operation and maintenance manual for the building. The file will contain information on operation and maintenance of plant and equipment, procedures for cleaning and repairing the fabric, and design loadings for structural elements.

The Regulations require a more formal approach to risk management in the construction process from all those involved in the procurement procedure.
Table 2.4  Construction (Design and Management) Regulations 1994 (continued)

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STATUTORY INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>R4/ACOP</td>
<td>Approved Code of Practice.</td>
</tr>
<tr>
<td>Ref: HSC L54</td>
<td>Provides guidance on the application of the Regulations, defines duties of client, designers, principal contractor and planning supervisor. Provides methods for satisfying the requirements of the Regulations albeit in general terms.</td>
</tr>
<tr>
<td>Date: 1995</td>
<td></td>
</tr>
<tr>
<td>R4/GN1</td>
<td>Managing Health and Safety in Construction.</td>
</tr>
<tr>
<td>Ref: HSE C100</td>
<td>Provides guidance on how to comply with the CDM Regulations for all those with responsibilities under the Regulations. It defines when the Regulations are applicable. The design process is tracked from concept through to handover identifying the duties of each of the main members in the design and procurement teams. Examples are given as to how the Regulations will be interpreted in practice.</td>
</tr>
<tr>
<td>Date: 1995</td>
<td></td>
</tr>
<tr>
<td>R4/GN2</td>
<td>Designing for Health and Safety in Construction.</td>
</tr>
<tr>
<td>Ref: HSE</td>
<td>Provides guidance to the CDM Regulations for designers and outlines the principles of designing for health and safety in construction work. Guidance is given on the types of hazards and risks which can occur in construction, maintenance and repair of a building in order to assist the designer in risk assessment.</td>
</tr>
<tr>
<td>Date: 1995</td>
<td></td>
</tr>
</tbody>
</table>
These Regulations impose duties on employers and employees to minimise risk associated with the use of electrical equipment; fixed, portable and self powered. The Regulations require adequate space and means of access to be provided where work is carried out on electrical equipment.

These Regulations supersede the Electricity (Factories Act) Special Regulations 1908 & 1944. They are applicable to all places where work is carried out using electricity and cover all electrical equipment, including fixed, portable and self-powered. There is no distinction between High Voltage and Low Voltage installations. The Regulations place a duty on employers and employees and detail the principles of electrical safety rather than try to cover specific cases. The Regulations fall into two distinct categories with some imposing an absolute duty and others allowing a 'so far as is reasonably practical' interpretation.

These regulations require:

- systems to be constructed and maintained to prevent danger to persons;
- equipment to be suitable for use in its location and environmental conditions;
- all conductors to be suitably insulated, protected or located so as to prevent danger;
- systems and equipment to be correctly earthed;
- systems to have suitable protection against overcurrent and a means of isolation;
- precautions to be taken whilst working on dead equipment to prevent it becoming live;
- no person shall be engaged in any work activity on or so near a live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise.
  (Note: subject to a number of exceptions defined in the Regulations);
- adequate working space, lighting and means of access to be provided where work is carried out on electrical equipment;
- persons to be competent to carry out the work involved or be under suitable supervision.

Memorandum of guidance on the Electricity at Work Regulations.

Provides guidance on the Electricity at Work Regulations 1989, excluding the Regulations applicable to mines and quarries. Provides background information explaining the reasoning behind the regulations with methods for satisfying the requirements of the Regulations in general terms.
Table 2.6  The Manual Handling Operations Regulations 1992

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STATUTORY INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>R6</td>
<td>Manual Handling Operations Regulations 1992</td>
</tr>
<tr>
<td>Ref: SI 1992 No.2793</td>
<td>These Regulations impose a duty on employers to assess the manual handling procedures carried out by their employees in the course of their workplace activities. This will extend to the installation and maintenance of M&amp;E services and overlap with other Health and Safety Regulations.</td>
</tr>
<tr>
<td>Date: 1 January 1993</td>
<td>Adequate space must be provided for correct manual handling of plant components up to defined limits. Thereafter the use of mechanical lifting and handling devices must be considered, which will have a significant influence on space provision around the plant item and along the route of egress from the building.</td>
</tr>
<tr>
<td>R6/GN1</td>
<td>Manual Handling Guidance on Regulations</td>
</tr>
<tr>
<td>Ref: HSE L23</td>
<td>Provides guidance to satisfy the Regulations in terms of manual handling techniques and limits on safe manageable loads for different reach heights and postures. The threshold where mechanical lifting devices are used is addressed and the types of devices which can be used are discussed.</td>
</tr>
<tr>
<td>Date: 1992</td>
<td></td>
</tr>
</tbody>
</table>

The Guidance Note L23 clearly defines the limits on manual handling for particular lifting heights and maximum loads - see Section 3.1 which discusses the issues in more detail.

Duties are placed on employers to assess risks and put in place measures to minimise those risks. Employees have a duty to make use of those measures put in place for their protection.

These Regulations should be read in conjunction with the Management of Health and Safety at Work Regulations (R1) which impose a general duty on employers to carry out a risk assessment of their employees in the workplace. Where the possibility of risks to employees from manual handling is identified from the risk assessment exercise, these Regulations should then be observed.

These Regulations set a hierarchy of measures:

- avoid hazardous manual handling as far as reasonably practicable;
- assess any hazardous manual handling operations that cannot be avoided;
- reduce risk of injury as far as practicable;
Table 2.7 The Pressure Systems and Transportable Gas Containers Regulations 1989

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STATUTORY INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>R7</td>
<td>Pressure Systems and Transportable Gas Containers Regulations 1989</td>
</tr>
<tr>
<td>Ref: SI 1989 No.2169</td>
<td>These Regulations replace parts of the Factories Act 1961 which relate to the safety of pressure systems and their mechanical integrity. They apply to compressed air plant, steam and pressurised hot water plant and various pressurised gas systems.</td>
</tr>
<tr>
<td>Date: 1 July 1990</td>
<td>The Regulations call for a regime of systematic examination and testing of pressure plant. A written scheme of examination is required for all protective devices, pressure vessels and relevant pipework. Thus access and space must be provided to permit the regular inspection of these system elements.</td>
</tr>
<tr>
<td></td>
<td>Furthermore, for the installation, operation and maintenance of these systems there is a duty to provide safe access to the plant.</td>
</tr>
<tr>
<td>R7/ACOP</td>
<td>Safety of Pressure Systems - Approved Code of Practice</td>
</tr>
<tr>
<td>Ref: HSC</td>
<td>Provides guidance on the application of the Regulations. This Code gives a broad outline of the principles which apply to pressure systems. There are, however a number of other ACOPs and guidance notes not cited here which offer guidance to the duties under the Regulations; these are listed in this ACOP.</td>
</tr>
<tr>
<td>Date: 1990</td>
<td></td>
</tr>
<tr>
<td>REFERENCE</td>
<td>STATUTORY INSTRUMENT</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Ref: SI 1991 No.2768</td>
<td>These Regulations make provisions for public health and safety in new building works and apply to new build, refurbishment and extensions. Section B1 requires that the building be designed and constructed so that there are means of escape in the case of fire.</td>
</tr>
<tr>
<td>Date: amended 1992</td>
<td></td>
</tr>
<tr>
<td>R8/AD</td>
<td><strong>Approved Document B</strong></td>
</tr>
<tr>
<td>Ref: DOE</td>
<td>The approved document provides an interpretation of the general requirements cited in the Regulations. It gives guidance on the maximum travel distances and number of escape routes for a variety of building types and plantroom spaces.</td>
</tr>
<tr>
<td>Date: 1992</td>
<td></td>
</tr>
</tbody>
</table>
2.3 GUIDES TO GOOD PRACTICE

There are many guides to activities involved in maintaining mechanical and electrical services and the co-ordination and management of maintenance strategies. However, the references cited below have been limited to those which provide useful quantitative guidance. This sub-section provides a summary of those references which provide a quantitative guide to the provision of space for services and access.

In addition, information should be sought from manufacturers as, for certain plant items, their recommendations will be governing factors affecting space provision, e.g. separation of air cooled chillers from each other and from enclosures.


Space requirements are given for various mechanical and electrical services plantrooms. General plant arrangements are given for boiler rooms, chiller rooms, air handling plant and electrical switchgear. Space and weight provisions are summarised for a range of plant capacities. The document is intended to be used for space planning at the outline stage of design.


Space requirements are given for the purpose of installation and maintenance of pipework, ductwork, cabling etc. The guide is intended for the detail design stage where space provision is given for various pipework types, techniques for insulating the service etc. The Guide restricts itself to distribution services. It does not cover detail design issues of central plant, terminal units or false ceiling and raised floor co-ordination or access.

G3 BS 8313 - Code of Practice for Accommodation of Building Services in Ducts (Formerly CP413). BSI. 1989.

Provides recommendations on the design, construction and installation of fixed ducts. This includes space provisions for safe access, installation and maintenance of service ducts. The influence of the frequency of maintenance on the provision of access is addressed in the Code of Practice. Anthropometric data is given for the fundamental analysis of space requirements for maintenance or installation activities. The Code of Practice concentrates primarily on space provisions for air ducts, considering methods of jointing, insulation and the relationship of the duct to enclosure walls.
Section 2  Legislation and Good Practice Guidance


Volume 1  Management Policy - provides a strategic guide to space requirements and access for mechanical and electrical services for chief executives/general managers who have responsibility for services installations and maintenance. Reference is made to Health and Safety legislation.

Volume 2  Good Practice Guidance - provides recommendation on space requirements of central plant and distribution systems for mechanical and electrical services.

The main thrust of the document is understandably directed to hospital applications, although some of the guidance is relevant to general applications.


This BS provides guidance on a systematic approach to management of building maintenance. It addresses both fabric and engineering services maintenance requirements. The issue of safe access for inspection and maintenance activities is discussed and how the health and safety requirements (pertaining at that time c1986) influence that work.

The decision to make provision for permanent or temporary access is considered and the standards which need to be adhered to when using ladders, scaffolding, cradles, mobile scaffold towers and powered equipment such as scissor lifts, etc.


This Guide has been produced in conjunction with G1 and G2 and considers at each stage of the design process what allowances should be included for maintenance of the building services. Checklists are given to review the detail design to ensure that provisions are in place to allow the system to be maintained effectively.


Provides explanation of the Regulations and outlines the ways of meeting the requirements. Particular emphasis is placed on the difference between regulations imposing absolute duties and those which must be followed as reasonably practical.


This publication is a reprint of several articles which appeared in the Architects' Journal in 1986. Data is given for space requirements of central plant. The layout of distribution systems around the building is discussed with particular attention to the co-ordination of pipework, ductwork and cabling with structure, for accessible vertical and horizontal distribution systems.
Space Requirements Section 2 Legislation and Good Practice Guidance


This Standard Maintenance Specification was produced by the HVCA in conjunction with CIBSE and BRECSU and provides a contractual standard for maintenance work. The document provides schedules of maintenance tasks required by the elements of the building services systems, the frequency of maintenance and notes on the maintenance procedures.

There are five volumes:

Volume 1 Heating and Pipework Systems
Volume 2 Ventilating and Air Conditioning
Volume 3 Control, Energy and Building Management Systems
Volume 4 Ancillaries, Plumbing and Sewerage.
Volume 5 Electrics in Buildings


This handbook provides a useful commentary on most of the legislation, regulations and available guidance which affects health and safety and welfare at the workplace. This version states the law as at 30 September 1994 and is updated to accommodate changes in statute law and regulations by repeal, revocations and enactment, and in cumulative case law. The guide provides an interpretation of issues related to maintenance, access and risk assessment.

2.4 DEO(W)/DWS TECHNICAL PUBLICATIONS

The DEO(W)/DWS "Technical Publications Index" lists the extant MOD and PSA technical publications which are to be used in management and construction of MOD’s built Estate.

The publication "Defence Works Safety Rules and Procedures for Working at Height" is to be issued shortly and is of particular relevance to the provision of safe access.
3 Philosophy of Plantroom Design

3.1 MAINTENANCE AND OPERATION ISSUES AFFECTING THE SPACE ALLOWED FOR PLANT

3.1.1 Basic Considerations

Risk assessment and the consequent provision of access must be made on the basis of the following aspects of the operating and maintenance (O & M) task and the specified O & M staff which are the major determinants:

- Task; type, difficulty, frequency, duration.
- Hazards, identification and evaluation of risks.
- Staff; type, supervision, size of team.

Task type; the main division of tasks is between operation, monitoring, inspection, servicing and maintenance. The first two of these usually require no more than observation and operation of simply operated controls. The last three involve 'in-situ' work with or without dismantling, and/or demounting/removal for on- or off-site overhaul. Demounting requires more local space and local overhaul requires servicing bays.

Task difficulty; this is a function of the type, the location of the activity and the physical actions required. Cramped positions may often be a cause of accidents. Guidance on the space needed is given in the anthropometric data, see Fig 3.1. Numerical guidance on the manual handling of heavy objects is given in Appendix 1 of the HSE guidance booklet L23 to the Manual Handling Operations Regulations 1992. A figure covering lifting and lowering, is reproduced as Fig 3.2.

Task frequency and duration; easier access for more frequently performed and lengthy tasks is justified on economic as well as safety grounds. Categorisation of frequency is given in Section 3.2.

Hazards; must be identified and an estimate made of the risks involved; e.g. falling from heights, tripping, explosive atmospheres, petroleum vapours, methane, etc. There are various approaches to the evaluation of risk ranging from complex fault tree analysis and reliability studies where a single event could lead to death of many people, to a less complex qualitative approach where the hazards may only lead to minor injury.

Staff type; must allow for 'in-house' staff not familiar with equipment and external specialists not familiar with the plant space.

Staff supervision and team size; access must make allowance for the number of staff needed to undertake a particular task, e.g. a pair both committed to a task element simultaneously.
Fig 3.1 Anthropometric Data (page 1 of 2)

(a) Prone

(b) Kneel

(c) Crawl

(f) Maintenance reach levels

(d) Squat

(g) Passageway

All dimensions are in millimetres.
Ladder width 380 min. 450 optimum  
Distance between side walls 600 min.  
Rung distance c 225 to 250  
Rung diameter d 20 to 40  

(h) Ladder

Width for one man 600 to 750.  
Width for two men 1100 min.  
Riser b 184 optimum  
Tread c 240 optimum  

(i) Steps

Width 530 to 600 with handrails  
600 min. between side walls  
Riser b 250 maximum  
Tread width c 80 to 150  

(j) Inclined ladder

Incline not to exceed 20°  
Width 750 min. to 1100 optimum  

(k) Ramp

All dimensions are in millimetres.
Space Requirements

Section 3  Philosophy of Plantroom Design

Fig 3.2  Lifting and Lowering

Notes

1 Full notes are given in HSE L23 (see table 2.1 - R6/GN1)
2 Figures in the boxed zones are maxima for the centres of the zones
3 Interpolate values for other positions in the zones
4 If the object being lifted passes through more than one zone, use the lowest figure
5 Reduce the guideline values by 10% if the body is turned up to 45°, and 20% up to 90°
6 Figures apply for up to 30 lifts/hr
3.1.2 Basic Hazards

Allowance must be made for at least the following hazards, both in terms of basic access and in the provision of "extra" space where the hazards cannot be treated or avoided.

- Hot or cold surfaces not insulated to BS 5970.
- Sharp edges and ends, usually occurring on equipment or supports.
- Hazardous atmospheres; explosive dusts or vapours, petroleum vapours, methane, etc.
  (Note: Special consideration may be required for these hazards which are beyond the scope of this document; specialist advice should be sought.)
- Projecting parts of equipment, particularly at head and ankle height, allow for the most extreme protrusion of any component of an item.
- Unprotected moving parts - 'no go' area delineation may be required in addition to access space.
- The need to work on live electrical parts in accordance with the Electricity at Work Regulations, 1989.
- Flammable materials - handling space for liquid and gas transfer. Consider plantrooms within plant spaces. See 3.3.
- Toxic materials - as for flammable materials.
- Noise - acoustic treatment to the whole of a plant room occupies significant space. Consider plant rooms within plant spaces, or acoustic hoods. See 3.3.
- Heavy and/or awkwardly shaped objects may require lifting eyes and/or runways, suitable for standard lifting techniques, positioned above equipment. The full height of the plant space below the eye or runway must remain free of other services. See also HSE references in Section 2.
- Falling from heights - walkways, protected ladders etc. (to the relevant BSs) must connect with access routes and must not obstruct any other access.
- Tripping - provision of step overs (with or without safety rails etc to the relevant BS) will affect the layout of services overhead.

The following basic hazards are normally dealt with by warning signs, which must not be obscured by adjacent services.

- Insecure hand and foot holds - provide 'do not walk', 'do not lean on', 'do not use as support' signs. Consider designing all hangers for equipment load plus the weight of two operatives.
- Escape routes - sign all escape routes, including labels on large items which obscure views of exits.
- Chemical storage and handling, eg water treatment.

3.1.3 Facilities for Maintenance.

The following general principles should be noted. Some will tend to minimise the area required for access.

- Routes to plant and equipment should be as direct as possible.
- Standing room should be provided at the end of crawlways and at/or near equipment.
Access ladders and platforms are required for high plant (heights greater than 2m), permanent for frequent access, temporary for infrequent access; frequency is defined in 3.2.

Mobile access gear should be capable of lifting equipment as well as personnel, and may be allowed to temporarily compromise access but not escape routes. As a general rule, escape routes should never be compromised and if unavoidable a thorough risk analysis needs to be completed.

Cranage runways should be designed to allow transfer to trucks, trolleys, rollers, skates or airbags close to the point of lift to minimise the space compromised.

Stepovers should be designed to carry the weight of objects likely to be carried over them, plus that of the operatives. Local lifting gear may be required.

3.2 ACCESS, MAINTENANCE FREQUENCY AND DURATION OF TASK.

3.2.1 Access

The statutory duties under the HSWA, Factories Act (requirement until 1 January 1996) and the more specific duties in the Workplace Regulations 1992 require an employer to provide safe access/egress to any place where employees have to work and not merely their normal workplace.

The distinction needs to be made between the access route to a plant item and the space provision around the plant necessary to safely carry out the maintenance task, repair or replacement.

The provision of access must be appropriate to the frequency at which certain tasks will be carried out. Tasks which need to be carried out on a daily basis, e.g. checks on steam boilers, will need open and immediate access. Conversely pipework enclosed in a riser space would not normally require regular inspection.

Fig 3.3 illustrates the relationship between the frequency of maintenance and the level of access required. Definitions of frequency and access are given in Section 3.2.2

The access/egress route must be sufficient in terms of space provision and loading capacity to allow the safe movement of maintenance staff, the handling of major plant items and the use of mechanical lifting devices where necessary.

In the consideration of access to plant above 2m above floor level, falls from height is a major concern. There are two aspects to consider where maintenance tasks are at high level:

- access to the working position (portable ladder, scaffold towers, powered working platform).
- the working space around the plant item

The working platform around the plant item may be permanent for frequent access or temporary for less frequent maintenance. The Workplace Regulations require that it is protected to prevent people falling and objects falling on to people below. This may be with the provision of fencing, guard rails and toe boards see BS 5395.
Fig 3.3 Access for Maintenance

**Maintenance Task**

- **Frequent Maintenance**
  - **Clear & Immediate Access**
    - **Activities**
      - Plant requiring frequent access (up to monthly) for inspection/adjustment/testing/lubrication/cleaning.
      - Eg chillers, boilers, cooling towers
    - **Access**
      - Clear and immediate access to and around plant items.
      - If at high level: Permanent stairs and catwalks suitably guarded with hand rails to BS5395 with sufficient space for the handling or removal of major plant components.
  - **Semi-Clear Access**
    - **Activities**
      - Plant requiring maintenance up to 6 monthly intervals inspection/adjustment/testing/lubrication/cleaning.
      - Eg tank rooms
    - **Access**
      - Access through clearly marked hatches, panels etc, using quick release fasteners.
      - If at high level: Permanent ladders, scaffold towers, hydraulic powered platforms. Clear areas around plant items without the need for dismantling of services or building elements.

- **Occasional Maintenance**
  - **Closed Access**
    - **Activities**
      - Yearly maintenance activities. Repair or replacement of plant components, pipework, ductwork.
    - **Access**
      - Access for preventative maintenance gained through demountable partitions, and semi-permanent panels which can be removed without need for re-decoration. Some dismantling of plant acceptable.
      - Access for replacement of ductwork and pipework in riser voids through panels with minor re-decoration requirements.
      - If at high level: Temporary access equipment, scaffolding, staging, ladders etc.

- **Infrequent Maintenance**
  - **Closed Access**
    - **Activities**
      - Yearly maintenance activities. Repair or replacement of plant components, pipework, ductwork.
    - **Access**
      - Access for preventative maintenance gained through demountable partitions, and semi-permanent panels which can be removed without need for re-decoration. Some dismantling of plant acceptable.
      - Access for replacement of ductwork and pipework in riser voids through panels with minor re-decoration requirements.
      - If at high level: Temporary access equipment, scaffolding, staging, ladders etc.

- **Repair or Replacement**
  - **Closed Access**
    - **Activities**
      - Yearly maintenance activities. Repair or replacement of plant components, pipework, ductwork.
    - **Access**
      - Access for preventative maintenance gained through demountable partitions, and semi-permanent panels which can be removed without need for re-decoration. Some dismantling of plant acceptable.
      - Access for replacement of ductwork and pipework in riser voids through panels with minor re-decoration requirements.
      - If at high level: Temporary access equipment, scaffolding, staging, ladders etc.
3.2.2 Definitions of frequency and level of access.

**Frequency**
As frequency of maintenance will influence the level of access this is clearly defined for each plant item in section 5. For the purposes of this document, frequency is categorised as follows;

- Frequent; less than monthly
- Occasional; between monthly and half yearly
- Infrequent; greater than half yearly

**Access for Frequent Maintenance**
All plant, valves, controls, terminal units, etc which require frequent maintenance and operation should have permanent, clear and immediate access with adequate space provision to carry out the particular task. If enclosed, a hinged door should be provided which opens outward through 180°.

**Access for Maintenance on an Occasional Frequency**
For maintenance tasks which are undertaken on an occasional frequency, access can be readily achieved by removal of clearly marked hatches, floor traps, panels/tiles in false ceilings, walls and partitions. Quick-release fasteners (captive type) are preferred to screwed fixings.

**Access for Infrequent Maintenance**
Infrequent maintenance or emergency repair and replacement of ductwork, pipework and terminal units, should be considered. The removal of demountable partitions, doors, etc, to gain access may be appropriate. The removal of masonry walls is not considered reasonable. The issue of whether permanent clear access is necessary for emergency repair needs to be agreed with the client. Provisions should be allowed for the removal and replacement of pipework lengths in a service duct.

**Duration of task**
Duration cannot be defined so specifically because it is related to operative fatigue. This is dependent not only on the dexterity and physical exertion required but also on the access provided and environmental conditions.

In general, access should be reconsidered for any task, other than observation, which occurs above head level or below hip level and lasts more than 1 minute. Alternative handling procedures should be sought if exertions greater than those of Fig 3.2 are required.

3.3 LOCATION AND LAYOUT OF PLANT ROOMS

The following properties of plant and equipment and characteristics of normal building construction limit the practical locations of plantrooms.

- Plant weight - structural considerations, initial installation and removal for servicing or replacement
- Plant size - removal for servicing or replacement
- Design of floor slabs - floor slabs other than ground floors are not usually designed to support heavy weights particularly items such as lifting gear attached to their underside. If the slab is required to bear fully loaded lifting devices provision should be made in the structural design.
- Ingress and egress - loading facilities for and routes to plant rooms are necessary. Where the size or weight carrying capacity of either are limited, smaller or easily dismantled plant must be used.
• Escape routes - the options for escape routes in basements will be limited.

The following building related factors, when inadequate, affect possible plantroom location by increasing the floor or wall areas required beyond the values that would be expected.

• Relationship to outgoing services - there must be links to dedicated electrical, ductwork and pipework routes of adequate capacity. Also, if these links have significant length, other building spaces may be compromised.

• Heights of plant rooms - inadequate height increases the plant room floor area. The plant room area at the point of exit of services will be congested, which will limit the number of services that can exit to an adjacent riser without compromising access.

• Clear plant space - columns may obstruct withdrawal space or access/escape routes; beams may obstruct cranage or cross-plantroom service routes; imperforable walls will have effects similar to plant rooms of inadequate height.

The following 'rules' apply generally to considerations of access.

• Space requirements for O&M activities may not be adequate for functional requirements (e.g. distance from walls, or other plant, of air cooled chillers may cause recirculation of cooling air).

• Space required for future plant must not be compromised. This includes access routes. The space's eventual purpose should be reserved by floor or wall markings.

• Other items of equipment or the building fabric must not be affected by O&M activities on a particular item of plant. If the equipment is noisy or the maintenance is otherwise dangerous, consider locating duty and standby equipment in separated spaces.

• Equipment should be laid out in a way that creates shared access space between items which are not maintained simultaneously.

• Escape routes must not be blocked by O&M activities. The rule can be relaxed if there is an alternative escape route. However, full risk assessment should be carried out.

• Allow for the effects of hinged components, such as control panel doors, boiler burners, access panels on the underside of plant or ducts, particularly when positioning adjacent services.

• Allow for the furthest projection of any component on an item of equipment.

• Avoid tripping hazards and increase low level access space by running pipe and ductwork at high level in plantrooms with droppers to equipment.

• Motor control panels should be close to the plantroom's normal entry doors.

• Large plant should be close to the main access doors (or specialised removable wall and roof panels).

• Consider what items of plant can be located in the same space and what must be separated, e.g. air compressors and boilers from chillers; larger or emergency electrical generators (and their associated equipment) from all other plant. Separate equipment which is noisy, and/or contains toxic or flammable materials, from other plant. This limits areas affected, eases control and eases rescue operations.
Space Requirements

Section 3  Philosophy of Plantroom Design

- Allow adequate space for items such as breathing apparatus and other cumbersome personal protective equipment, eye washers and dousing showers close to the point of hazard.
- Allow space for emergency lock-off controls close to the normal access doors.

3.4 DEVELOPMENT OF PLANT SPACES

3.4.1 Practical space requirements

The space requirements of individual items of plant, pipes, ducts, cables and wiring developed from the principles described above, are shown in Sections 4 & 5. The clearances shown are those that are required if the item is surrounded by walls or equivalent fixed barriers. For several plant items in a common space there are therefore two corollaries;

- If adjacent items are not maintained simultaneously, a single clearance can be shared.
- The shared clearance must be equal to the larger(est) of those required.

Similarly only equipment which must be lifted from soffit mounted eyes or runways requires the clearances shown in plan for the full plant room height. The consequence is that the sums of volumes and plan areas actually required by plant and access space is usually less than the sum of all of the individual items' requirements.

Some of this space saving is offset by the space requirements for routing pipes and ducts and cableways. Further the shape of the plant space is unlikely to be ideal for the plant it eventually is to contain, bearing in mind standard building design sequences and tendering procedures, which creates less than ideal solutions.

The optimum use of any space is determined by certain of the factors listed in the previous sub-section, such as the relationship of the plant space to the outgoing service routes, external walls and access routes. It must also be accepted that laying out plant spaces is to an extent an amalgam of experience, skill and three dimensional visualisation.

The net consequence of these conflicting sets of factors is that the overall area/volume of a plant space, including wastage, is unlikely to be less than the sum of the requirements of the individual components, neglecting overlaps. The exceptions are most likely to be plant spaces designed after equipment has been selected and containing either a single type of equipment or a wide variety of smaller items.

There are two types of plant room for which these effects are most significant:

- small to medium sized boiler rooms, which conventionally contain HWS calorifiers, all related pumps and water treatment equipment in addition to the boilers.
- small to medium sized water-chiller rooms, which conventionally contain the related pumps.

Demonstration of the use of overlapping access spaces and statistical data for areas of these types of plant space are given in Figs 3.4 - 6.
Space Requirements  Section 3 Philosophy of Plantroom Design

Fig 3.4 Boiler Room Space Planning

![Diagram of Boiler Room Space Planning]

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Fig 3.5  Boiler Room Space Requirements

Note  Space requirements include for ancillary equipment; see fig 3.4
Fig 3.6 Chiller Room Space Planning

Key

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Fig 3.7 Chiller Room Space Requirements

Note: Space requirements include for ancillary equipment, see fig 3.6
4 System Requirements

4.1 MECHANICAL SERVICES DISTRIBUTION SYSTEMS

4.1.1 Plantrooms and Distribution Routes

The designer should ensure that ductwork and pipework are co-ordinated in their distribution throughout the building, and that the central plant room connects logically with the vertical distribution routes. The designer should:

- Position a plant room to be as near as possible to the centre of the zone which it will serve.
- Consider the branches from vertical risers to serve horizontal distribution routes with care as this is likely to be the most congested area of the service core.
- Co-ordinate the mechanical services with other services in the building such as electrical, electronic and communications distribution systems; e.g. cable trays and conduits, see section 4.2.

Sufficient space must be provided for installation and maintenance of the systems which distribute heating, cooling, ventilation, electricity, etc, around the building. Very often the horizontal and vertical distribution of services can be more problematic than the accommodation of central plant which serves those systems.

In false ceiling voids or riser spaces there are several distribution systems vying for restricted space which will need to be carefully co-ordinated with each other and with the structure to ensure ease of installation and access for maintenance, repair and removal of system components.

Positioning of the plant as close as possible to the centre of the zone it serves will reduce the amount of horizontal distribution needed. This is of major importance when considering large ventilation ductwork which needs to be accommodated in a false ceiling or within a raised floor.

The connection of horizontal ductwork or pipework with vertical risers should also be carefully considered. If the service core is enclosed on three sides by lift shaft and external walls, horizontal distribution from the service core will be extremely difficult and will provide little space for installation access and maintenance.

Similarly, the structural stability (and fire integrity) of the core is compromised if too much of its perimeter area (above the false ceiling or on a single level) is removed for service exits.
The area served by a single riser will dictate the size of the horizontal branch duct or pipework. In particular, the depth selected for a branch air duct will have a great influence on the false ceiling or raised floor depth, will affect the overall floor to floor heights and hence have significant influence on building costs.

The depth of the horizontal element is a function of the number of vertical risers, generally:

\[
\text{maximum vertical risers} = \text{minimum horizontal element depth} \\
\text{minimum vertical risers} = \text{maximum horizontal element depth}
\]

### 4.1.2 Access

The level of access required will depend upon the frequency at which that task needs to be carried out. The levels of access required for frequent, occasional, or infrequent maintenance are defined in Section 3.2. Sections 4 and 5 refer to the following maintenance intervals:

- frequent maintenance - clear and immediate access.
- occasional maintenance - access through removal of clearly marked hatches, panels or tiles with quick release fasteners (captive type).
- infrequent maintenance or emergency repair - access obtained with the dismantling of part of the installation, demountable partitions, etc.

### 4.1.3 Mechanical Services Distribution - Data Sheets

The following data-sheets summarise the access and space allowances for pipework, ductwork and terminal units. Space requirements are given for vertical and horizontal distribution and the co-ordination in false ceiling voids and raised floors. The co-ordination of services in these spaces is discussed, considering the accommodation of mechanical distribution, electrical, electronic and communication systems.

Common problems experienced in distribution system access are also noted.
Access to ducts large enough to be entered by maintenance staff should have the minimum dimensions shown above. Access should be increased if breathing apparatus is to be worn.

All access doors should be capable of being opened from within the duct with double sided handles (cold room type). In vertical ducts the hazard from vertical drops should be fully assessed and measures such as guard rails, fixed ladders, etc should be used to minimise risk, see Workplace Regulations R2.

**Commentary**

- Space allowances for building services distribution systems - Detail design stage. BSRIA. 1992.

**Good Practice References**

**British Standards**
Space Requirements

Section 4 System Requirements

D2 Ductwork

**INSULATED DUCTS** Plan: Vertical Riser

If \( W \leq 1000 \text{mm} \);
\[
X = 200 \text{mm} \quad S = 400 \text{mm}
\]

If \( W > 1000 \text{mm} \);
\[
X = 400 \text{mm} \quad S = 600 \text{mm}
\]

**UNINSULATED DUCTS** Plan: Vertical Riser

If \( W \leq 1000 \text{mm} \);
\[
X = 100 \text{mm} \quad S = 300 \text{mm}
\]

If \( W > 1000 \text{mm} \);
\[
X = 300 \text{mm} \quad S = 400 \text{mm}
\]

All dimensions in mm

**Commentary**

Access to ducts is governed by space required to install and insulate the ductwork; this is dependent on the clearance from firm objects, the type of jointing method and whether the ducts are to be insulated after installation, see BS 8313 for detail.

Duct clearances can be reduced with care, providing correct jointing, insulation and maintenance of vapour barrier is achieved. Consideration should also be given as to how the ductwork will be tested or eventually replaced.

**Good Practice References**

- Space allowances for building services distribution systems - Detail design stage. BSRIA. 1992.

**British Standards**

Access to pipework is governed by the space required to install and insulate the pipework. Although infrequent, the removal of a pipework length from the riser, service duct or false ceiling void should be considered and the appropriate space allowed.

Consider the falls of pipework for venting and draining; especially steam or compressed air with trap sets. Vertical space needs to be allowed for air bottles, automatic air vents and drain points.

**Commentary**

**Good Practice**

- Space allowances for building services distribution systems - Detail design stage. BSRIA. 1992.

**British Standards**

- BS 8313. Code of Practice for the accommodation of building services in ducts.
**Simple Pipework Riser**

One row of pipes to allow the installation or removal from the front of riser space without the need to remove other pipework except cross-overs. Avoid double banking of pipes where the top row will obstruct access to the bottom row. Stems and wheels of valves require clearance for operation, consider especially larger valves which may use rising stems.

Clear access is required in front of the riser, hinged door for frequent access, demountable covers for occasional access.

**3 Sided Riser**

See above notes

**Walk-in Riser Cupboard (side entry)**

Headroom clearance minimum 2100mm

**Walk-in Riser Cupboard (front entry)**

All dimensions in mm

---

**Good Practice References**

- Space allowances for building services distribution systems - Detail design stage. BSRIA. 1992.
- BS 8313. Code of Practice for the accommodation of building services in ducts.
D5  Horizontal Services Ducts

Service Trenches
Access from above through continuous covers or covers at junctions and changes of direction. Provision should be made for drainage of the duct in the event of leakage; eg grading of the floors of the duct or service trench.

Crawlway
Access from ends or through removable covers. Dimensions shown are for clear access space clear of valve projections, pipe supports, etc.

Walkway
Access from ends of walkway or through removable covers. Walkways to be adequately ventilated. Dimensions shown are for clear access space.

X  Dependent on pipework size and type - see data sheet D3

All dimensions in mm
Space Requirements Section 4 System Requirements

D5 Horizontal Services Ducts (continued)

Main services corridors require access to the services within and allow clear passage for maintenance staff and any mechanical lifting/handling equipment they might use in the course of their work.

If the service corridor is the egress route for the removal of major plant, the clear space should be large for the plant component and its mechanical handling device. If relevant the turning radii of the handling device should also be considered.

Commentary

Good Practice References

British Standards

- Space allowances for building services distribution systems - Detail design stage. BSRIA. 1992.
- BS 8313. Code of Practice for the accommodation of building services in ducts.
Space Requirements

Section 4 System Requirements

D6 Pipework Access - Common Problems

**Motorised Valves/ Sensors/ Instrumentation**

Removal of actuator, sensor, etc, must not be obstructed by soffit, wall, ductwork or other pipework.

Ensure sufficient clearance to allow actuator/sensor to be withdrawn without the disturbance or removal of other services.

**Strainers**

The removal of the strainer basket must not be impaired by fixed obstructions or other services - see above notes.
Fire Dampers
Access to fire damper must not be obstructed by other services.
Ensure all fire dampers have clear access for inspection and testing
see also data sheet D8.

Ceiling Mounted Terminal Units
The ceiling grid immediately beneath the terminal unit should be demountable to facilitate access for removal and replacement of filters, fans, motors or the complete unit. Access should be provided which is at least the full plan dimensions of the unit (including control and commissioning valves) plus 100mm minimum on all sides.
Overall Distribution

VAV Terminal Unit or FCU  Main duct run-outs

Access  Sprinkler  Access

Floor box  Cable tray

Access  Access  Access

Supply duct for floor supply system or terminal

Horizontal Distribution

Commentary

Points to watch:

1. Ensure clear access to all fire dampers for inspection and testing.
2. Clearance of 1.5 times the luminaire depth to facilitate removal of the fitting.
3. Demountable ceiling grid to permit access to the ceiling mounted terminal unit and removal.
4. Clear access to the terminal unit for removal of the recirculation air filter (FCUs), cleaning of coil and condensate tray.
5. Additional vertical space to be allowed for condensate drains and their fall (FCUs).
6. Access to raised floor shown for the situation where all floor tiles may not be removable.
7. Provision should be made for permanent access to all commissioning and control valves.

Good Practice References

Space Requirements

Section 4  System Requirements

D9  Cross-overs

**False Ceiling Cross-over Zones**

For more complex servicing arrangements provision should be made for cross-overs of ductwork and pipework in the false ceiling. Dimension Z will be governed normally by the depth of the branch ducts.

**Pipework**

Branch pipework must be planned to provide sufficient clearance from other pipes in the main run to permit access to flanged joints, etc and space to insulate.

**Commentary**

Riser space is normally at a premium and absolute clearance dimensions will depend on the actual equipment installed. The drawings indicate critical areas where sufficient space must be allowed.

**Good Practice References**

- BSRIA. Space and weight allowances for building services plant - inception stage design. 1994.
4.2 ELECTRICAL SERVICES DISTRIBUTION SYSTEMS

4.2.1 Substations, Main Switchrooms and Distribution Routes

The designer should ensure that HV, LV (power) and data/communications cable routes are co-ordinated in their distribution throughout the building, and that all rooms with distribution equipment connect logically with the vertical distribution routes. The designer should:

- Position main switchrooms and riser cupboards to be as near as possible to the electrical load centre of the zone which they serve.
- Consider the branches from vertical risers to serve horizontal distribution routes. Care must be taken where risers are located near lift shafts or fire stairs as these may impede horizontal routes.
- Consider the number of risers needed, data/communications cables should be in separate risers from power cables or busbars if possible. If not, risers must be large enough to permit adequate separation.
- Consideration should be given to safety/electric shock notices addressing location, vision line and ease of reading.
- Co-ordinate with the mechanical distribution systems.

4.2.2 Access

Access to electrical services for maintenance are governed by the same fundamental requirements as those for mechanical services; access is largely influenced by frequency of the maintenance task. The level of access and maintenance frequency is detailed in Section 3.2; to summarise:

Access for Frequent Maintenance -
All plant, switchboards, control panels and other units which require frequent maintenance and operation should have permanent clear and immediate access with adequate space provision to carry out the particular task. Where boards are enclosed, locked hinged doors are preferred to covers fixed with screws, as these often do not get replaced after maintenance work.

Access for Maintenance on an Occasional Frequency
For maintenance tasks which are undertaken on an occasional frequency, access can be achieved by removal of clearly marked hatches or panels/tiles in false ceilings. Quick-release fasteners (captive type) are preferred to screwed fixings.

Access for Emergency Repair and Replacement
Replacement of major plant items like transformers, generators or main switchboards units, although generally infrequent, should be considered. The removal of demountable partitions, doors, ductwork, etc to gain access may be appropriate. The removal of masonry walls is not considered reasonable. The issue of whether permanent clear access is necessary for emergency repair needs to be agreed with the client. If a particular item of plant is essential to the operation of the facility sufficient standby capability should be included in the basic design.
4.2.3 Access for Replacement or Installation of Cables

Although main power cables are generally replaced only during major building refurbishment or modification, data and communications cable networks are frequently changed to suit the latest developments in Information Technology (IT). It is essential that provision is made at the design stage to allow new data and communication cables to be installed easily. For example, cable trays on gallows brackets or tree hangers allow new cables to be laid on more easily than trays on trapeze hangers where the cable needs to be threaded in.

4.2.4 Electrical Services Distribution - Data Sheets

The following data-sheets summarise the access and space allowances for cabling, control panels and distribution boards. Space requirements are given for vertical and horizontal distribution and the co-ordination in false ceiling voids and raised floors. The co-ordination of services in these spaces is discussed considering the accommodation of mechanical distribution, electrical, electronic and communications systems.

Common problems experienced in distribution system access are also noted.
D10  Control Panels and Distribution Boards

Commentary
Front panel controls and indicating instruments should be easy to read and operate from a normal standing position. Infrequently used controls such as main isolators may be located outside this range but should be readily accessible. Internal electrical terminations or pneumatic connections may extend outside this range but should not be below 300 mm or above 2000 mm.

Sufficient space must be allowed for cable bending radius above and below panels. Cables must be straight where they enter glands. The published minimum bending radius for a cable is the theoretical minimum to prevent cable damage. In practice it is not practical to install large cables to such a tight bend. A straight length of around half the bending radius is recommended for installation of cable clamps.

Good Practice References
- BSRIA. Space and weight allowances for building services plant - inception stage design. 1994.
Riser space is normally at a premium and absolute clearance dimensions will depend on the actual equipment installed. The drawings indicate critical areas where sufficient space must be allowed. See also clearances given for mechanical risers in D4.

**Good Practice References**

- BSRIA. Space and weight allowances for building services plant - inception stage design. 1994.
Access and space requirements for central plant are considered in each sub-section for individual plant types and the spatial layout information is given in the accompanying data sheets.

Each sub-section deals exclusively with a single type of plant or item of equipment and plant room space requirements will be an aggregation of individual spatial needs. It does not contain any allowances for ancillary equipment (pumps, water treatment plant, etc, are dealt with individually elsewhere in Section 5.1).

Each sub-section highlights the main factors which affect access and space requirements. The influence that the Health and Safety Regulations have in the provision of space to minimise risk in maintenance and operation is discussed.

A range of space requirements against capacity is given for major plant items. This is supplemented with diagrams showing the disposition of that space.
5.1 CENTRAL STATION PLANT - MECHANICAL

5.1.1 LTHW Boilers

The types of gas and oil fired LTHW boiler plant considered are:

- Modular boilers  Floor standing and vertically stacked low water content modular boilers.
- Cast-iron sectional
- Steel boilers  Reverse flame type.
- Fuel oil storage

All boilers require access space in front and at the sides of the plant to facilitate maintenance.

Modular boilers can provide a compact installation with minimum space requirements consistent with the accommodation of flue, shunt pumps, flow and return headers, and valves. Space allowance must permit the safe withdrawal of burner bars or combustion compartment. However, in the planning of plantroom space it is prudent to consider the possible subsequent replacement with sectional boilers which may require a greater space provision.

Cast iron sectional boilers require space in front of the boiler for flue-way cleaning, access to burner and fuel feeds plus clear access for boiler doors to open with burner attached. Space is required at the rear of the boiler for flue inspection, cleaning, combustion testing and leak checks.

Steel boilers have similar requirements to cast iron sectional boilers but the ingress/egress routes through the building must be considered carefully to accommodate the full size and weight of the boiler.

The total plant areas shown in data sheets Ml.1 and Ml.2 show typical ranges required by boiler plant (excluding ancillary plant). This data should be used as a preliminary check to determine if sufficient space has been allowed. Even if there is compliance with the requirements indicated, this should be followed up to ensure that the space is proportioned correctly to allow key tasks to be carried out; e.g. space for cleaning of flueways.

Oil storage tanks:

- Distillate fuel oils -
  Access is required all around the tank for cleaning, painting and inspection. Space needs to be provided at front for draw-off/piping, filter and valves. Tank supports to be high enough for sample draw-off and draining.
  Walls and floor to be treated with oil resistant material to a sufficient height to contain tank contents plus 10%, in the event of tank failure.
- Residual fuel oils -
  Access is required all around the tank as for distillate oil tanks, including sampling and draining facility.
  Space for the withdrawal of the out-flow heater must be provided. Isolating valves must be located clear of the flow heater to allow its removal without obstruction.
  Walls and floors of any bunds or tank rooms to be tanked as for distillate oil tanks to retain contents plus 10%, in the event of tank failure.
Risk assessment - main hazards which influence space provision:

- **Manual handling**
  
  Sufficient space must be provided to allow the removal and handling of major plant components such as burners and boiler sections. On larger boilers this will require the use of mechanical lifting and handling equipment.

- **Falling from height**
  
  On large boilers with valves, controls and instrumentation located at levels above 2m which require frequent inspection or adjustment, permanent safe access should be provided protected by guard rails. Safe access is also applicable to oil storage tanks, e.g. access to man-way on storage tanks. Bund sumps should be protected with open plate covers.

- **Hot surfaces**
  
  Sufficient access space should be provided between boilers, other plant and fixed obstructions to avoid contact with high temperature surfaces. Otherwise insulate and finish to BS 5970.

**Good Practice References**

- CIBSE. Commissioning code series: B. Boiler Plant.

**Legislation and Regulations**

- Health and Safety Regulations: References - R1, R2, R3, R4, R6, R8, see Section 2.2.
- HSE. Guidance Note PM/5. Automatically controlled steam and hot water boilers.
- Gas Safety Regulations (Installation and Use) 1984.

**British Standards**

- BS 799. Oil burning equipment Part 5: Specification for oil storage tanks.
- BS 2594. Specification for carbon steel welded horizontal cylindrical storage tanks.
- BS 5410. Code of practice for oil firing: Part 2 Installations of 44kW and above for space heating, hot water and steam supply purposes.
- BS 5970. Code of practice for thermal insulation (in the temperature range -100°C to 870°C).
- BS 6644. Specification for the installation of gas fired hot water boilers of rated inputs between 60kW and 2MW.
- BS6880. Code of practice for low temperature hot water heating systems of output greater than 45kW.
- BS 8313. Code of practice for the accommodation of building services in ducts.
The summary above indicates typical space requirements for LTHW modular boilers and does not allow for ancillary equipment (dealt with separately in this document). The load expressed in the graphs is the total installed heating capacity of the installation.

The space requirements shown in this graph are based upon the allowances detailed in data sheet M1.3.
M1.2 Cast Iron Sectional and Steel Boilers - Summary of space requirements for LTHW boilers

Commentary

The summary above indicates typical space requirements correlated against the total heat output of the boiler plant for LTHW cast iron and steel boilers and does not allow for ancillary equipment (dealt with separately in this document). The load expressed in the graphs is the total installed heating capacity of the installation.

The space requirements shown in this graph are based upon the allowances detailed in data sheet M1.4.
Space Requirements

Section 5 Component Requirements

M1.3 Modular Boilers - Space Details

Access Requirement Frequent

Floor mounted modular boilers

Vertically stacked modular boilers

Dimensions

W Width of module
L Length of a single module
(All dimensions in mm)

Commentary

Access space is required for routine inspection, cleaning and adjustment of the boilers. Space is required at the front of the boiler for the removal of combustion compartment or burner bars.

Access is required at the rear of the set for access to flue, shunt pumps, flow and return headers, valves, etc.
Component Requirements

M1.4 Cast Iron Sectional and Steel Boilers - Space Details

**Access Requirement**

Frequent

---

**Dimensions**

- **W** Width of boiler
- **L** Length of boiler
- **S** Space required for clearance between adjacent boilers = 1.5 x (burner length + door thickness) = min1100

(All dimensions in mm)

---

**Commentary**

Access is required to inspect and overhaul the burner assembly, check boiler casing for damage or leaks. Clearance must be allowed for the boiler door to be opened by 90° without the removal of the burner. Burner sizes can vary and specific data should be sought from the burner manufacturer.

All flueways require cleaning space which is needed forward of the boiler face for boiler brush clearance. Generally brushes are single piece and run the full length of the flue-ways, this dimension may be significant. This space will also allow for the withdrawal of a tube on a steel boiler.

Space is required for access to the flues for cleaning, inspection, and combustion tests at the rear of the boiler.
Commentary

The summary above indicates typical space requirements for oil storage and preheating equipment and does not allow for other ancillary equipment (dealt with separately in this document). The volume expressed in the graphs is the total storage capacity of the installation.
M1.6 Fuel Oil Storage Tanks - Space Details

Access Requirement
Frequent

**Cylindrical oil storage tanks**

- Access ladder
- Sump
- Section A-A

**Rectangular oil storage tanks**

- Access ladder
- Sump
- Section X-X

**Dimensions**
- \( W \): Width of rectangular tank
- \( L \): Length of tank
- \( D \): Diameter of cylindrical tank
- \( L_h \): Length of outflow heater

(All dimensions in mm)

Access is required all around the tanks for inspection, painting, insulation and repairs. Space is required also for draining water from the tanks and removal of the outflow heaters.

The space requirements of the re-filling tanker should also be considered; access to the point of filling, turning circle of the vehicle, etc.
5.1.2 Liquid Chillers

This section gives the space requirements for both vapour compression and absorption machines. The provision of clearances and access is similar for each type.

Two common groups of vapour compression machines are considered:

- **Packaged air cooled type** -
  The single package contains refrigeration machine and heat rejection fans. Normally located outside the building to facilitate heat rejection through its air cooled condenser. They are generally available up to a capacity of approximately 500kW of cooling.
  
  Space requirements are influenced significantly by the need to allow free movement of air through the machine without 'short-circuiting' or interacting with other machines. However, the separation dimension can vary considerably between manufacturers and lead to a similar variation in space requirements.

- **Water cooled type** -
  These machines use a condenser water circuit as a means of heat rejection, which permits greater flexibility in its location. As a consequence, a heat rejection device is needed to dissipate heat from the condenser circuit; e.g. cooling tower or air blast cooler. Typically, they are used for larger cooling duties from 50kW to in excess of 1MW of cooling.
  
  The space for water cooled machines is more compact. However, an additional allowance must be made for the heat rejection device associated with this type of machine, see Section 5.1.9.

Space and entry shall be provided for the replacement of a compressor, motor, evaporator or condenser tube without disruption to other services, structure or fabric. These tasks will have a significant influence on space provision. General space requirements for chillers are based on the need for frequent inspection, cleaning and adjustment and annual overhaul.

Space for packaged air cooled chillers is governed by the same requirements as cited above, but in addition, sufficient space must be allowed between individual units in a multiple machine installation to prevent the interaction of air flows. The required separation between machines, or from the enclosure, should be sought from the manufacturer's installation data.

The plant areas shown in data sheet M2.1 show a typical range needed by chiller plant (excluding ancillary plant). This data should be used as a preliminary check to determine if sufficient space has been allowed. Even if there is compliance with the requirements indicated, this should be followed up to ensure that the space is proportioned correctly to allow key tasks to be carried out; e.g. space for removal of tubes.

Risk assessment - main hazards which influence space provision:

- **Manual handling**
  The removal of a compressor or motor on the majority of chillers will require the use of a mechanical lifting device. For larger screw and centrifugal chillers, which may have life expectancies in excess of 80,000 hours run, permanent provision for the removal of heavy plant components will be necessary, e.g. lifting beam.
Sufficient space must be provided not only in the plant room to lift and manoeuvre compressors, motors, etc, but also on the entire egress route from the building which must be capable of safely bearing the weight of that component and its lifting mechanism.

- **Hazardous substances**
  Some of the refrigerants used in vapour compression machines have the potential to cause suffocation by exclusion of air, are toxic and/or flammable, the extent varying with the refrigerant type. Replacements for CFCs and HCFCs are no exceptions; e.g. R134a has low flammability and toxicity rating, conversely ammonia is more hazardous in both respects. Exposure to both is controlled under the COSHH Regulations. The size of the plant room and the ventilation strategy should be considered in order that safe exposure levels are not exceeded in the event of a sudden loss of refrigerant from the machine.

Toxicity, asphyxiation hazards and flammability are safety issues which should be dealt with in the design of the system in their own right. The influence on space requirements affects the selection of volume of the chiller space (and its ventilation strategy). If the refrigerant charge is catastrophically lost into the plant room space the health and well-being of someone in that space should not be at risk; see BS 4434 and COSHH Regulations for specific guidance on exposure limits to refrigerants. Measures to minimise this risk may involve the provision of protective equipment and/or a leak detection system.

- **Tripping**
  For example, low level pipework connections to evaporators and condensers, see Section 3.1.2 on basic hazards.

- **Hot/Cold surfaces**
  For example, hot discharge gas pipework, see Section 3.1.2 on basic hazards.

### Good Practice References
- CIBSE. Commissioning code series: R. Refrigerating systems.

### Legislation and Regulations
- Health and Safety Regulations:
  References - R1, R2, R3, R4, R6, R7, R8, see Section 2.2.

### British Standards
- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 4434. Specification for safety aspects in the design, construction and installation of refrigerating appliances and systems.
- BS 5970. Code of Practice for the thermal insulation of pipework and equipment (in the temperature range -100°C to +870°C).
M2.1 Liquid Chillers - Summary of space requirements for air cooled and water cooled chillers

Commentary

The summary above indicates typical space requirements for chiller plant and does not allow for ancillary equipment (dealt with separately in this document). The load expressed in the graphs is the total installed cooling capacity of the installation. Space requirements for air cooled chillers are dependent on manufacturer's recommendations where there are considerable differences in the clearances required for air intakes on the sides of the machines.
**Space Requirements**  
Section 5  Component Requirements

M2.2 Packaged Air Cooled Liquid Chillers - Space Details

**Access Requirement**

Frequent

**Dimensions**

- **S**: Separation between adjacent machines (see manufacturer's recommendation). Space required for removal of evaporator tubes incorporated in clearance to avoid airflow interference between adjacent machines, when S is greater than W.
- **T**: Separation between machine and enclosure (see manufacturer's recommendation).
- **W**: Width of chiller
- **L**: Length of the machine

(All dimensions in mm)

**Commentary**

Access space is required for routine inspection, cleaning and adjustment of the plant; leak detection on refrigerant pipework, access to control panels, pressure and temperature gauges, safety and control valves, sight glasses, etc. This will be on a frequent basis and thus require permanent clear access.

Replacement of major plant components such as compressors or motors will require the use of mechanical lifting equipment, thus space should be allowed to accommodate the handling of the plant item and the lifting device; e.g. electric hoist on mobile gantry. Lifting eyes should be specified for individual plant components to facilitate mechanical handling.

Space will be required for replacement of evaporator tubes. Sufficient space must be allowed for the withdrawal of the tube, equivalent to the full length of the heat exchanger plus clearance.

Separation between individual units is needed to avoid interaction and 'short-circuiting' of air flow. The air cooled chillers shown are assumed to be 'draw-through' discharging through the top of the unit.
Space Requirements

Section 5 Component Requirements

M2.3 Water Cooled Liquid Chillers - Space Details

Access Requirement
Frequent

Dimensions

W  Width of chiller
L  Space required for removal of condenser or evaporator tubes.

Control panel

(All dimensions in mm)

Commentary
See notes on data sheet M2.3.

Space will be required for replacement of evaporator and condenser tubes. Sufficient space must be allowed for the withdrawal of the tube equivalent to the full length of the heat exchanger plus clearance.

For large screw and centrifugal machines (in excess of 1MW cooling capacity) a permanent lifting beam may be necessary; this will require a floor to beam clearance of the order of 4.0m.
Space requirements for hermetic absorption chillers are similar to those for vapour compression machines. Sufficient clearance must be provided on all sides of the machine for access for maintenance. Particular attention should be paid to the control panel door clearance and space for the removal and replacement of heat exchanger tubes. Space requirements shown in the graph are for the chillers only. Ancillary equipment such as steam or hot water boilers servicing the machines' generator, or heat rejection devices are not shown or allowed for in the space provision.
5.1.3 Pumps

Three categories are considered:

- **Circulating Pumps** -
  Serving 'closed-circuit' pipework systems; e.g. heating, chilled water, condenser water (although in some cases may be open circuit). Pumps with small/medium duties (less than 4kW motor size) can be fitted in-line (pipeline mounted) to reduce space requirements. Larger pumps (flow rates in excess of 15 l/s) are generally floor mounted. Space provision may be influenced by other factors other than access for maintenance, e.g. connection to header pipework.

  Space requirements of pumps are dictated by the need for frequent maintenance of bearings and their seals, checking and cleaning of strainers, adjustment of belt drives, etc.

  Motors can be fitted to pump volutes in horizontal or vertical planes. Motors which are horizontally mounted usually require more floor space but allow ready access to seals and bearings.

- **Booster sets: Fire Protection** -
  Serving sprinkler, hose reel and wet riser systems. Two common types of fire service booster set:
  
i) Duplicate electric pumps: Contains two electric-driven pumps + possible jockey pump and control panel.
  
ii) Diesel back up set: Contains one electric driven pump and jockey with diesel driven support pump and control panel.

  General space requirements are based on the need for frequent inspections with test runs and the possibility of occasional replacement of motors.

- **Booster sets: Drinking and Domestic Hot Water** -
  Serving cold potable water systems and other domestic uses within a building. Two common types of package booster set are:
  
i) Single duty duplicate pump set comprising two electric pumps with pressure vessel and control panel.
  
ii) Multiple variable duty set with several pumps, pressure vessel and control panel.

  General space requirements are based on the need for frequent inspections and the possibility of occasional replacement of pump motors.

Risk assessment - main hazards which influence the provision of space:

- **Manual handling**
  Sufficient space must be provided to lift and handle the removal of motors and pump bodies. Space must not only be provided in the vicinity of the pump but also on the entire egress route from the building which must be capable of safely bearing the weight of that component and its lifting mechanism.

  The removal of a pump motor on the majority of sprinkler and wet riser sets will require the use of a mechanical lifting device. Also, the removal of the diesel engine where appropriate, will require a mobile engine hoist.
• **Tripping**
  Pipework discharge connections are generally taken to high level. However in the case of booster sets a small amount of low level pipework may be connected to an adjacent suction tank. See Section 3.1.2 on basic hazards.

• **Hot/Cold surfaces**
  See Section 3.1 on basic hazards.

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**Good Practice References**


  Vol II - Ventilating and air conditioning systems. 1991.

**Legislation and Regulations**

• Health and Safety Regulations:
  References - R1, R2, R3, R4, R6, see Section 2.2.

**British Standards**

• BS 8313. Code of practice for the accommodation of building services in ducts.

• BS 6880. Low temperature hot water heating systems of output greater than 45kW.
Access Requirement
Frequent

In-line pumps mounted in vertical pipework

Access space is required for frequent inspection, cleaning and adjustment of the pump and motor.

In-line pumps mounted in vertical pipework should not be fitted higher than 1200mm from the finished floor level to permit safe handling. At this height a maintenance engineer should not manually lift and lower loads greater than 20kg; if a twisting action is involved in this process the maximum load will be lower, see Manual Handling Operations Regulations. Loads greater than this should be handled with mobile mechanical lifting devices or with ceiling mounted lifting eyes or lifting beams.

If in-line pumps are located above preferred mounting height, space must be provided for the erection and safe use of staging for maintenance purposes.

Where pump component loads require mechanical handing, sufficient space must be allowed for the lifting device to allow it to be brought adjacent to the pump to permit safe handling of the load and then manoeuvred to the location where the repair/overhaul will be carried out.

Commentary

Access space is required for frequent inspection, cleaning and adjustment of the pump and motor.

In-line pumps mounted in vertical pipework should not be fitted higher than 1200mm from the finished floor level to permit safe handling. At this height a maintenance engineer should not manually lift and lower loads greater than 20kg; if a twisting action is involved in this process the maximum load will be lower, see Manual Handling Operations Regulations. Loads greater than this should be handled with mobile mechanical lifting devices or with ceiling mounted lifting eyes or lifting beams.

If in-line pumps are located above preferred mounting height, space must be provided for the erection and safe use of staging for maintenance purposes.

Where pump component loads require mechanical handing, sufficient space must be allowed for the lifting device to allow it to be brought adjacent to the pump to permit safe handling of the load and then manoeuvred to the location where the repair/overhaul will be carried out.
M3.2 Booster Sets: Fire Protection, Drinking and Domestic Water - Space Details

Access Requirement
Frequent

Booster set: Fire Protection

Booster set: Drinking Water and Domestic Water

Dimensions
L Length of package unit
W Width of package unit

(All dimensions in mm)

X Typically these units will be placed against a plant room wall. Refer to manf. recommendations

Commentary
See notes on data sheet M3.1.

Space requirements for diesel engine standby pumps will be considerably greater.
5.1.4 Pressurisation Units

Membrane pressure vessels require access to the vessel to adjust the pressure as necessary, internal access to the tank and space to service the level controller.

Precharged vessels with spill tanks require access to the pressure vessel for topping-up, to the pumps for inspection/lubrication, internal access to the spill tank and space to service the level controller.

Both systems require all-round access for general attendance and removal of equipment items.

Risk assessment - main hazards which influence the provision of space:

- Manual handling
  Space provision must be sufficient for the installation and possible replacement of the entire package. On larger units allowance should be made for the mechanical lifting and handling of major components such as pressure vessels and pumps.

- Tripping
  There will be low level pipework associated with the pressurisation unit that may constitute a tripping hazard. Low level pipework should not intrude into access space - see Section 3.2.

- Pressurised Gas
  Sufficient clear space should be provided for the safe handling and storage of pressurised gas bottles.

Good Practice References


Legislation and Regulations

- Health and Safety Regulations: References - R1, R2, R3, R4, R6 & R7, see Section 2.2.

British Standards

- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 6880. Low temperature hot water heating systems of output greater than 45kW.
Commentary

The summary above indicates the typical space requirements for membrane pressure vessels and precharged vessels with spill tank. Space requirements are expressed in relation to the water content of the system and temperature change which occurs under normal operational conditions.
Space Requirements

Section 5  Component Requirements

M4.2  Pressurisation Units - Space Details

Access Requirement
Frequent

Commentary
Access and space requirements are governed by the installation and possible subsequent replacement of the entire package. On large units consideration should however be given to access to and handling of major components such as pumps, vessels and bottled nitrogen gas. The vessels on large pressurisation units would require mechanical lifting devices for safe handling which necessitates appropriate space provision and clear headroom.
5.1.5 Water Treatment and Water Softening

Equipment will consist of:

- Water softening plant.
- Chemical container and dosing pump.
- Softened water storage.
- Salt storage.

The systems considered are:

- Base exchange water softening sets.
- Chemical treatment from a container and dosing pump into piping systems via an injection fitting.

Both of these systems require space for front and side access to equipment items and for handling salt containers (currently plastic sacks) to replenish the brine tank of the softener. Space to remove, manoeuvre and replace the chemical drums for the water treatment systems is also required.

Both systems require front and side access for general attendance and removal of equipment items. A major space requirement related to water treatment is the storage of salt/chemicals. The traffic route between store and plant needs consideration also.

Dosing pots are used for the manual input of water treatment chemicals to low temperature, low pressure closed systems. Although it is a simple device it will require direct and clear access for valve operation and dispensing chemicals into the container.

The water treatment plant discussed above represents common but basic systems. More sophisticated forms of water treatment, e.g. reverse osmosis, will have greater access requirements; reference should be made to manufacturers recommendations.

Risk assessment - main hazards which influence the provision of space:

- Manual handling
  The provision of space will be governed by the handling of vessels which may necessitate the use of mechanical lifting and handling devices on larger plant. Also consideration should be given to facilitating the lifting, carrying and decanting of salt and chemical containers.
- Spillage of chemicals
  Space needs to be sufficient for the safe handling of salts and chemical drums to minimise the risk of spillage. Provisions need to be in place in the event of spillage of water treatment chemicals; e.g. eye wash, hand washing, etc.

Good Practice References

Legislation and Regulations
- Health and Safety Regulations:
  References - R1, R2, R3, R4, R6, see Section 2.2.
- Control of Substances Hazardous to Health Regulations. 1988.

British Standards
- BS 8313. Code of practice for the accommodation of building services in ducts.
Access Requirement
Frequent

Commentary

The summary above indicates the typical space requirements for water treatment.

All-round clearance will be required to equipment and tanks for general attendance and removal of components when necessary, and for replenishment of brine regenerator.

Softened water storage tank will require internal access, space to service water level controller, and a water-proofed "safe" in case of tank failure where tanks are installed above accommodation areas.

Drain-out provisions will also be necessary.

Space should be allocated for the storage of salt - 3 months supply for a hard water supply for a system with a high throughput may require of the order of 10m2 of storage area.
5.1.6 Water Storage

This section considers the storage of hot and cold water for a variety of applications e.g. domestic cold water supply, sprinklers, domestic hot water supply etc.

Cold water storage -

Storage cisterns covered by this section are assumed to be sectional GRP or galvanised mild steel. General space requirements are based on the need for regular inspections and occasional maintenance of valves. On less frequent occasions internal cleaning of the tank may be required.

The type of sectional tank will affect the space required for erection. Internally flanged as opposed to externally flanged sections will allow the side of the tank to be placed against a wall. With this arrangement space must still be allowed for pipework and valves at either end of the tank. This seems a more efficient use of space but the opportunity of inspection and cleaning of the tank face against the wall is lost.

HWS calorifiers (with storage) -

General space requirements are based on the need for regular inspection and periodic internal cleaning of the calorifiers.

Risk Assessment - main hazards:

- Manual handling
  In normal use there should be no major handling problems with sectional cold water tanks. In the rare event of a tank panel failure the panels can be manhandled by 2 people.
  Most removable components on calorifiers are unlikely to be too heavy for handling by 2 people. Removal of the heat exchangers in large calorifiers may require lifting equipment.
  Replacement of large calorifiers will require heavy lifting equipment such as a beam and pulley block.

- Tripping
  Tank connections at low level will inevitably be on access routes and step over ramps should be provided. Overflow and float valve connections at medium or high level should be routed down the side of the tank to avoid crossing access routes.
  Connections will be made to calorifiers at various levels normally from high level pipework. Careful planning should avoid connections crossing access routes with vertical pipework from connections kept as close as possible to the calorifier.

- Tank access
  Fixed external and corrosion-resistant internal ladders should be provided to maintain the float valve and gain access to the inside of the tank.

- Hazardous substances
  To reduce the risk of legionellosis, stagnation of stored water should be prevented by avoiding oversizing and with good water distribution in the vessel; input one end output the other. In general, the cold water storage tank should be sized for no more than the daily water use.
Good Practice References

- HSE. Health and Safety booklet HS(G)70. the control of legionellosis (including legionnaires disease). 1992.

Legislation and Regulations

- Health and Safety Regulations: References - R1, R2, R3, R4, R6, see Section 2.2.

British Standards

- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 6700. Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.
**M6.1 Water Storage** - Summary of space requirements for cold water storage tanks and HWS storage calorifiers

**Commentary**

The summary above indicates the typical space requirements for sectional cold water storage tanks and hot water calorifiers and does not include any ancillary equipment. A freeboard of 500mm has been assumed for each tank.

For HWS Storage calorifiers the lower boundary limit represents space for vertical vessels, the upper boundary limit for horizontal vessels.
Space Requirements | Section 5 Component Requirements

**M6.2 Cold Water Storage - Space Details**

**Access Requirement**

**Occasional**

---

**Dimensions**

- L Length of tank
- W Width of tank
- H Height of tank
- S Space to Accommodate inflow/outflow pipework typically 1500mm

(All dimensions in mm)

**Commentary**

Space requirements have been based upon the use of a sectional GRP tank or galvanized mild steel. A freeboard of 500mm has been assumed for each tank. An addition of 500mm should be made to clearance heights where external base flanges are used.
Space Requirements

Section 5  Component Requirements

M6.3  Hot Water Storage - Space Details

Access Requirement
Occasional

Dimensions

D  Diameter of vertical calorifier
X  Length of tube bundle
H  Dimension to facilitate cleaning of the floor of the vessel of scale and other debris (approx 500)

(All dimensions in mm)

Commentary
Space requirements are governed by the need to remove heater tube bundles and to gain access to the calorifier manhole for internal inspection.
5.1.7 Air Handling Units

Generally air handling units (AHUs) have the largest space requirements of the mechanical services plant items. The space requirements for access are also large. Where space allowances are reduced in order to improve the net to gross floor area ratio, the client should be aware of the implications on maintenance and repair.

Two categories of air handling units are considered:

- Mechanical Ventilation.
- Air Conditioning.

Specialist containment systems such as microbiological safety cabinets, systems handling nuclear or chemical warfare agents and fume cupboards are excluded. Specialist advice should be sought on these systems.

The space requirements indicated allow for construction and assembly as well as access for maintenance e.g. the removal of coils, filters and fans.

The use of demountable partitions may be specified; if a coil needs replacement the partition will be removed to facilitate coil withdrawal. The removal of a masonry wall is deemed unacceptable as a means of providing access to plant.

Demountable partitions will be accepted if they can be removed in 3 hours and re-erected in 4 hours, but work shall not interrupt the normal operation of the establishment. This approach will increase the repair time but will save on space.

The graphs which summarise air handling space requirements (M7.1) have been separated into space for mechanical ventilation and space for air conditioning plant. Mechanical ventilation plant will typically have fewer components than air conditioning plant and therefore require less space.

Both graphs give a general range defined by an upper and lower boundary. The upper boundary will be typically for single decked plant and the lower boundary for double decked plant. Although double decked plant will require less plant room area, the floor to ceiling height will naturally need to be greater.

Floor-by-floor air handling plant is individually compact in terms of space requirements, however the collective space requirement will normally be in excess of that provided from a single central plant.

Risk assessment - main hazards which influence the provision of space:

- Manual handling
  Plant space must be sufficient for the removal of large bulky items such as heating/cooling coils. The coil length will dictate the withdrawal space allocated. Coils with large cross-sections may be split into modules to facilitate easy removal and handling.
  Where heavy plant items are involved e.g. large fans, a mechanical hoist will be required, or provision of a permanent lifting beam. Sufficient space must be provided not only in the vicinity of the item of plant for the component and its lifting and carrying equipment, but also along the entire egress route.
• Falls from height
Some larger air handling plant may be 'double decked' which may require maintenance access above 2m height. In this case, frequent maintenance checks and adjustments on the AHU must be facilitated by permanent catwalks protected with guard-rails.
For the removal of coils or fans, which may be expected to be infrequent, temporary high level access may be provided with appropriate scaffolding. Space is still required for the erection of the maintenance platform and safe working and handling of equipment at high level.

• Tripping
For example low level pipework serving coils, condensate drains, etc; see Section 3.1.2 on basic hazards.

Good Practice References


Legislation and Regulations

• Health and Safety Regulations:
References - R1, R2, R3, R4, R5, R8, see Section 2.2.

• Building Regulations: Approved Document K - Stairways, ramps and guards.

British Standards

• BS 8313. Code of practice for the accommodation of building services in ducts.

• BS 6180. Code of Practice for protective barriers in and about buildings.

• BS 5395: Part 3. Stairs, ladders and walkways. Code of Practice for the design of industrial type stairs, permanent ladders and walkways.
Component Requirements

M7.1 Air Handling Units - Summary of Space Requirements

Commentary
The summary above indicates typical space requirements for air handling units for mechanical ventilation and air conditioning AHUs. It represents the space for the supply and extract AHU and does not allow for ancillary equipment (dealt with separately in this document).
Space requirement for air handling plant is governed by the removal of major plant components such as coils, fans and filter pods.

Isolating valves must be located clear of the coil withdrawal space to prevent obstruction. Large coils can be sectioned to reduce the space needed for coil withdrawal. Access to the both sides of the coil section will be necessary to facilitate removal and handling of the coil.

Units which operate under high humidity must have sufficient space for regular and adequate cleaning and disinfection of coils and drip trays, etc. Also corrosion can be a significant problem on structure and as a consequence there is a need to gain access to all sides of the unit, i.e. not located hard against the wall.
Space Requirements  
Section 5 Component Requirements

M7.3 Air Handling Units - Space Details

**Access Requirement**

**Frequent**

**Withdrawal space**

- for filter pods
- for coil

**Withdrawal space**

- This can be reduced if provision is made to avoid dirt and debris building up behind the AHU.

**Elevation**

**KEY**

- see data sheet M7.3

**Dimensions**

<table>
<thead>
<tr>
<th><strong>W</strong></th>
<th>Width of AHU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L</strong></td>
<td>Length of AHU (This will be significantly longer for air conditioning systems which normally have a greater number of components than mechanical ventilation AHUs)</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>Attenuator length for cooling coils</td>
</tr>
<tr>
<td><strong>h</strong></td>
<td>Height allowance above finished floor level to accommodate condensate trap. Trap must be deep enough to resist suction pressure of fan and provide sufficient fall to discharge to adjacent drain.</td>
</tr>
</tbody>
</table>

(All dimensions in mm)

**Commentary**

Access is required to inspect the condition of filters, dampers, fans, their drives and guards on a frequent basis; these tasks require permanent safe access.

The changing of filters will normally be at a moderate frequency. If the AHU is double decked this may require maintenance platforms protected by a safety rail.

Cleaning of coils, fan motor checks and adjustments will take place on an occasional basis, access provision for a double decked system may be temporary. If staging is used it should be designed for the safe handling of plant in terms of space and be capable of safely bearing the loads of plant components.
Floor-by-floor Air Handling Units - Space Details

Access Requirement
Frequent

Dimensions
W1 Width of supply section of AHU
W2 Width of exhaust section
L Length of AHU
(All dimensions in mm)

Commentary
See notes on M7.3 and M7.4 regarding maintenance tasks on coils, filters, fans, etc.

Floor by floor air handling plants will give greater flexibility for multi-tenanted buildings but will generally require more space for plant (in total) than a conventional central station arrangement. In smaller buildings low profile air handling plant (up to 1 mVs) can be located in the false ceiling void much the same as fan coils; the provision for maintenance will be similar, see section 4.0.
5.1.8 Fans

Two fan types are considered:

- Centrifugal fans (Single inlet/single width and double inlet/double width)
- Axial fans

Fans discussed here are individual plant items which are used in ventilation systems which may be simple supply or extract arrangements as distinct from the packaged air handling plant discussed in 5.1.7.

Space should be provided for the frequent checks on drives, cleaning and lubrication of bearings, etc. Space is also required for the possible removal of major plant components such as motors, or the fan impeller and casing.

Axial fans may be mounted in-line at high level as a means of reducing space requirements in the plant room. In-line mounting may be in the horizontal or vertical plane. High level axial flow fans which have support frames with anti-vibration mounts fitted below the fans can intrude into bend space below by more than expected. Larger axial fans will tend to be floor mounted.

The space requirements indicated in the data sheets summarise the space required for individual centrifugal and axial flow fans. The upper boundary is typically for double inlet, double width centrifugal fans and a lower boundary is defined for single inlet, single width centrifugal fans. Axial fans tend to be more compact which is indicated by the lowest boundary line. If high level in-line axial fans are used the space requirement will be reduced still further, but space provision for the erection of temporary access for maintenance purposes must be considered.

Risk assessment - main hazards which influence the provision of space:

- Manual handling
  Plant space must be sufficient for the removal of large bulky items such as motors or fans.
  Where the fans are large, a mechanical hoist will be required, or provision of a permanent lifting beam. Sufficient space must be provided for the component being removed and the lifting/carrying device not only in the plant room but on the entire egress route.

- Falls from height
  Some axial fans are mounted in-line at high level which will require maintenance access above 2m height. On small fans this may be temporary safe access for inspection, adjustment and lubrication. On larger fans located at high level frequent maintenance tasks must be facilitated by permanent platforms protected with guard-rails.
  For the removal of axial fans at high level, temporary high level access may be provided with appropriate scaffolding. Space is required for erection of the maintenance platform with sufficient space provided on the platform for safe working, handling, and lowering of equipment from high level.

- Rotating machinery
  Fixed guards are required to enclose dangerous parts of rotating machinery, pulley wheels, fan belts, etc, with finger proof meshes.
Space Requirements

Section 5 Component Requirements

Good Practice References

Legislation and Regulations
- Health and Safety Regulations: References - R1, R2, R3, R4, R6, see Section 2.2.

British Standards
- BS 8313. Code of practice for the accommodation of building services in ducts.
M8.1 Fans - Summary of Space Requirements

Commentary

The summary above indicates typical space requirements for centrifugal and axial flow fans. It represents the space for the fan, motor and, where indicated, attenuators and does not allow for ancillary equipment (dealt with separately in this document).
Access Requirement
Occasional

Commentary
Access is required to inspect the condition of drives and adjust, lubricate bearings, on an occasional basis. For small axial fans mounted in-line at high level with sealed-for-life bearings, temporary access may be sufficient.

Space must be provided also for the removal of major plant components such as motors or fan casings together with the mechanical lifting device which may be used to handle and manoeuvre larger plant items.
5.1.9 Heat Rejection

This section considers the following heat rejection devices:

- Cooling Towers -
  open and closed-circuit towers, using induced or forced draught.
- Air cooled condensers

Space requirements for cooling towers must be sufficient to allow for the effective cleaning of the tower, its packing (open tower) or tube bundle (closed-circuit tower) and pond. Space must be sufficient for regular stripping down of the unit and provision must be made for handling large bulky components such as the packing section. During this process consideration should be given as to where the large plant components will be stored.

The maintenance of cooling towers is governed by the need to minimise the risk of legionnaires disease; detailed guidance is given in HSE and CIBSE documents, see data sheet M9.1. The need to ensure the cleanliness of the tower, its packing (open tower) or tube bundle (closed tower) and ponds is essential.

Cleaning will be carried out at least twice a year - in polluted environments it may be more frequent. It will necessitate the stripping down of the tower to clean individual components such as packing, louvres, eliminators and the pond.

Generally located outside on the roof-top or ground level pen, space should be allowed for the use of a crane for installation or removal of major components. If located internally with ducted air supply, sufficient headroom should be provided for the dismantling of the tower and removal of large bulky components and the associated lifting equipment.

For forced draught cooling towers using centrifugal fans, space must be provided for the removal of the fan shaft which may run the entire length of the unit, driving a number of impellers. The use of axial flow fans will reduce the space requirement.

Air cooled condensers require a greater area than cooling towers for the same heat rejection load.

Both cooling towers and air cooled condensers need free access for the entering air. Buildings, enclosures and other heat rejecting devices can disrupt that airflow or cause 'short-circuiting' which will affect the equipment performance. It is essential that units are separated in accordance with manufacturer's recommendations to minimise the interaction.

Risk assessment - main hazards which influence space provision:

- Manual handling
  The packing or tube bundle section of a cooling tower, axial fans located at high level on induced draught towers and air cooled condensers will require mechanical lifting equipment for removal. Sufficient space must be allowed for the removal of these components in the vicinity of the plant and along the entire egress route from the building which must also be capable of safely bearing the weight of that component and its lifting mechanism.
Space Requirements

Section 5 Component Requirements

- Hazardous substances
  The control of legionellosis depends upon cleanliness of the tower and condenser water. Space and access around the tower will be governed by the need to carry out regular inspection and cleaning, see below for CIBSE and HSE guidance.

- Tripping
  For example, low level pipework connections to cooling tower ponds and air cooled condensers, see Section 3.1.2 on basic hazards.

- Falling from height
  Frequent inspection and cleaning will be necessary for components located at high level, such as eliminators and induced draught fans. For large cooling towers and air cooled condensers the working height will almost certainly be above 2m, and permanent safe access may be necessary in the form of a maintenance platform protected with guard rails.

Good Practice

References
- HSE. Health and Safety booklet HS(G)70. The control of legionellosis (including legionnaires disease). 1992.

Legislation and Regulations
- Health and Safety Regulations: References - R1, R2, R3, R4, R6, see Section 2.2.
- Building Regulations: Approved Document K - Stairways, ramps and guards.

British Standards
- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 6180. Code of Practice for protective barriers in and about buildings.
The summary above indicates typical space requirements for cooling towers (forced draught and induced draught) and air cooled condensers. It represents the space for two units of equal rating; the total heat rejection of the set is expressed in the graphs. The space provisions do not allow for associated equipment (dealt with separately in this document).

For cooling towers the upper limit is typified by forced draught towers, the lower by induced draught types. The space requirement for air cooled condensers (ACCs) is significantly greater than for cooling towers; the upper limit typified by low profile ACCs, the lower limit by machines with vertical coils.
Space Requirements

Section 5 Component Requirements

M9.2 Cooling Towers - Space Details

Access Requirement
Frequent

Forced Draught with Centrifugal Fans

Induced Draught with Axial Fans

Dimensions
- L Length of machines
- S Separation between adjacent machines (see manufacturer's recommendations)
- T Separation from enclosure (see manufacturer's recommendations)
- W Width of machine

Commentary

Space is required for the permanent safe access provisions for the frequent inspection and cleaning of all the towers' wetted surfaces. The tower needs to be stripped down to gain access to the packing (open towers), tube bundle (closed-circuit towers) and the ponds for effective cleaning and water level control adjustment. Space should be provided to facilitate the dismantling procedure and accommodate the mechanical lifting equipment generally needed.

The spacing of cooling towers on installations, where several are used, should be such to avoid interaction of the air flow with the enclosure and from other machines to prevent 'short-circuiting'. On larger towers consideration needs to be made for working at height; this will require the provision of maintenance platforms protected by guard rails to allow frequent inspection and cleaning of components such as induced draught fans and eliminators.

On forced draught cooling towers using centrifugal fans, sufficient clearance needs to be provided for the removal of the fan shaft.
Access Requirement

Frequent

Space Requirements for Air Cooled Condensers

Dimensions

L Length of machine
S Separation between adjacent machines (see manufacturers recommendations)
T Separation from enclosure (see manufacturers recommendations)
W Width of machine

Commentary

Space is required for the frequent inspection and cleaning of the condenser coils, fans etc. which requires permanent safe access.

Space should be provided to facilitate the removal of principal elements such as axial flow fans which are generally located at high level and accommodate the mechanical lifting equipment needed.

The separation of air cooled condensers (ACCs) from the enclosure and from other heat rejection equipment is critical to avoid interaction of the air flow and 'short-circuiting'.
5.1.10 Lifts

There are two common groups of lift drive systems.

- Electric Traction Lifts
- Hydraulic Lifts

General space requirements for lifts are based upon inspection, cleaning and adjustment at frequent intervals. Space should also be provided, however, against the requirement to replace a drive unit, traction sheave, motor, hoisting ropes or controller.

Provisions for safe working in machine/pulley rooms -

It is essential that a safe means of access be provided and that permanent safety signs are displayed on the outside of the machine and pulley room doors.

Electric lighting should be provided on the basis of at least 200 lux at floor level and at the equipment. In addition, an adequate emergency lighting source should be available for use in the event of failure of the normal lighting supply.

All dangerous parts are required to be effectively guarded, unless they are so placed or constructed as to be as safe as if they were so guarded. The following items, for example, are considered as dangerous parts:

- gear and pulley drives
- protruding shaft ends
- overspeed governors

Where practicable, consideration should be given to the provision of certificated lifting facilities for the handling of heavy equipment.

Electric shock treatment notices should be prominently displayed in the machine room.

To protect against electric shock, a rubber mat complying with BS 921 and of suitable dimensions should be placed on the floor in front of each controller, and also, where necessary, at the rear.

The floor should be of non-slip materials without tripping hazards. When the floor comprises a number of levels, differing by more than 0.5m, stairways or steps and guard rails should be provided.

If access to the mains switch for a lift is difficult, or remote from the lift machine and/or controller, the following precautions should be adopted.

- a suitable stop switch should be fitted on, or adjacent to, the lift machine;
- a means of interrupting the main supply should be provided on, or adjacent to, the controller.

On multiple installations, each machine room or all the machine and pulley room equipment associated with each lift should be clearly identified.
Procedures for safe working in machine/pulley rooms -  
Doors to the rooms should be kept locked to prevent unauthorised access.

Works should not:

- be undertaken on machinery while it is in motion, or which is capable of intermittent motion.
- be carried out on or so near to live electrical equipment that electrical danger foreseeably arises, unless working in this way is unavoidable. In such situations, adequate precautions should be taken to avoid electrical shock or burn injuries, e.g. by making use of insulating mats, temporary shrouding and insulated tools, and the work should only be carried out by a skilled person, under the DEO(W) Safety Rules Procedures - Electricity.

Risk assessment - main hazards which influence the provision of space:

- Manual handling
  The removal of a motor, drive unit, traction sheave, hoisting ropes or controller, will require the use of a mechanical lifting device and the permanent provision for the removal of heavy plant lifting components will be necessary e.g. lifting beam.
  Sufficient space must be provided, not only in the plant room, to lift and handle the removal of drive units, motors, etc, but also on the entire egress route from the building which needs to be capable of safely bearing the weight of that component and its lifting mechanism.
- Working on top of lift cars
  The tops of lift cars are extremely hazardous areas, and only authorised and properly trained personnel should be permitted on the top of the lift car.
- Lift motor rooms
  The lift motor room may contain rotating machinery and electrical control devices. Only authorised and properly trained personnel should be permitted in the lift motor rooms.
- Lift wells
  The lift wells may contain rotating and moving machinery. Only authorised trained personnel should be permitted in the lift wells.

Space requirements for lifts -  
Reference should be made to BS 5655. Part 5: Specification for the dimensions of standard lift arrangements. 1989. This Standard gives a comprehensive guide to the provision of space for traction and hydraulic lifts and motor rooms for a large number of lift arrangements.

Good Practice References

Legislation and Regulations
- Health and Safety Regulations:  
  References - R1, R2, R3, R4, R5, R6, see Section 2.2.

British Standards
5.2 CENTRAL STATION PLANT - ELECTRICAL

5.2.1 HV Equipment

Several common types of High Voltage (HV) equipment are considered:

- HV Switchgear - Indoor
- Cast Resin and Dry Type Transformers
- Indoor Substations with Cast Resin and Dry Type Transformers
- Oil Filled Transformers and Transformer Compounds
- Substations with Oil Filled Transformers
- Ring Main Units
- Packaged Substations

Where a substation or switchgear includes the regional electricity company's (REC's) metering the REC may insist on permanent access. This can often serve an additional function as an emergency escape route from the HV room.

Most indoor switchgear includes a truck for withdrawal of the circuit breaker or switch; sufficient space must be allowed for this. Transformers and some packaged substations are provided with wheels or rollers and switchgear cubicles require suitable trolleys or jacks. It is not common practice to install lifting beams in switchrooms.

Plant removal from external installations can be carried out using a street crane providing there are no overhead obstructions. Particular care must be taken if there are overhead lines.

With indoor switchrooms, plant installation and removal may require use of fork lift trucks or manual trolleys. Access doors with demountable lintels and removable panels over the doors may be necessary.

Where cables are installed in trenches suitable trench covers must be provided. These must be smooth enough to allow the switchgear truck to be wheeled across if necessary, and be strong enough to cater for any plant removal operations.

Allow a minimum of 800mm access space for fitting cable glands or greater if required by the manufacturer.

Any space for expansion must be designed in from the start and must include for all upstream and downstream equipment, for example an additional transformer would require provision for an HV switchgear cubicle, an LV switchboard and routes for the LV distribution cables or busbars.

Additional space must be allowed for auxiliary items such as tripping batteries and storage of tools or switchgear removal trucks. These must not reduce the clear gangway areas. Separate storage space for transformer or switchgear oil must be provided; it is not recommended to keep these in the switchroom.

Indoor transformers and large switchgear installations will require permanent ventilation. The heat output should be checked with the manufacturer. Sufficient space must be allowed for ductwork and fans. Ducts may need to be constructed from fire rated materials or fitted with fire dampers. Some locations may require a fixed fire fighting system. (For example where outdoor switchgear is installed in an occupied building.)
Indoor substations constructed using external switchgear (ring main units) may require to be converted to internal cubicle type switchgear at a later date. It is essential that sufficient space for this is designed in at the start.

**Legislation and Regulations**
- Electricity at Work Regulations: R1,R2,R3,R4,R5,R6, see Section 2.2.

**British Standards**
- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 6626 Code of practice for maintenance of electrical switchgear and control gear for voltages above 1 kV and up to and including 36 kV.
Space Requirements  Section 5  Component Requirements

E1.1  HV Switchgear - Indoor - Space Details and Summary of Space Requirements

Headroom  Allow 3500 headroom. Some voltage transformers require to be removed vertically from the top of the cubicle.

Clearance  Dimensions A, B and W must be obtained from manufacturer's data. Dimension A must include any allowance for cable termination boxes. Allow 1000 additional space for working on withdrawn breakers.

(All dimensions in mm)

Commentary  Space requirements are typical of modern 11 kV oil, gas or vacuum breakers, switches or contactors. Some older or air-insulated switchgear may be considerably larger.
Space Requirements

Section 5 Component Requirements

Access Requirement

Occasional

Commentary

In multiple transformer installations the space between adjacent units should be at least 1000 more than the transformer width to permit access for pulling gear and rotating the rollers through 90°. See dimension X.

The doors should be wide enough to permit transformer removal. Installations of more than two transformers in line will require doors for each draw out space.

(Continued)
Commentary

The rating in the graphs is the rating of each individual transformer.
E1.3 Indoor Substations with Cast Resin or Dry Type Transformers - Space Details (Transformers in enclosures)

Access Requirement
Occasional

Headroom
Allow at least 1000 clearance above the tallest enclosure. This will require approx. 3000 headroom for transformers up to 1000kVA and 3500 for larger sizes. These dimensions may need to be increased if top entry connections are used.

Clearances
Dimensions A and B should be 900 minimum but B must allow for any Ring Main Unit operating handles. Dimensions C and D will vary if rear access is required.
(All dimensions in mm)

* Space requirements for HV Switchgear should be determined from Data sheet E1.1

Commentary
Where the HV and LV switchgear and transformer are installed in separate rooms the space requirements should be determined from the data for the individual equipment items.

In multiple transformer installations the space between adjacent units should be at least 1000 more than the transformer width to permit access for pulling gear and rotating the rollers through 90°. See dimension X. The doors should be wide enough to permit transformer removal.

(Continued)
Space Requirements for Substations
Cast resin or dry type transformers

Commentary
The rating in the graphs is the rating of each individual transformer.
E1.4 Oil Filled Transformers and Transformer Compounds - Space Details

Access Requirement
Occasional

Headroom

Allow 3000 headroom for transformers up to 1000kVA and 3500 for larger sizes
Allow extra height for oil conservators if fitted.
(All dimensions in mm)

Commentary

The dimensions L and W include the requirements for an oil catchpit of typical depth. In some installations it may be possible to have a deeper catchpit located directly below the transformer.

The clearance around the transformer should take this into account. For indoor installations the doors should be wide enough to permit transformer removal. In outdoor installations transformers will normally be lifted by crane.

(Continued)
Space Requirements for Transformer Installation -
Oil filled Transformer & Transformer Compounds

Commentary
The rating in the graphs is the rating of each individual transformer.
Access Requirement

Frequent

Headroom
Allow 3000 headroom for transformers up to 1000kVA and 3500 for larger sizes.

Clearances
Dimensions A and B should be 900 minimum but B must allow for any Ring Main Unit operating handles.
Dimensions C and D will vary if rear access is required.
(All dimensions in mm)

* Space requirements for HV Switchgear should be determined from Data sheet E1.1

Commentary

The dimensions L and W include the requirements for an oil catchpit of typical depth. In some installations it may be possible to have a deeper catchpit located directly below the transformer.

The clearance around the transformer should take this into account. For indoor installations the doors should be wide enough to permit transformer or switchgear removal. In outdoor installations equipment will normally be lifted by crane.

(Continued)
Space Requirements for Substations with Oil Filled Transformers

Commentary
The rating in the graphs is the rating of each individual transformer.
Access Requirement
Occasional

Typically 6-10 m². Rating does not affect size

Headroom
Allow 3000 headroom for indoor installations.

Dimensions
A - Ring main unit width
B - Ring main unit length
(All dimensions in mm)

Allow additional space for future conversion to indoor type switchgear for indoor installations

Commentary
The operating area must allow for any removable handles or doors on outdoor units. For indoor installations the doors should be wide enough to permit equipment removal. In outdoor installations equipment will normally be lifted by crane.
Space Requirements

Section 5 Component Requirements

E1.7 Packaged Substations - Space Details - With dry type transformers in basic sheet steel enclosures

Access Requirement

Frequent

Space available for ancillaries or building structure

Headroom

Allow at least 1000 clearance above the enclosure. This will require approx. 3000 headroom for transformers up to 1000kVA and 3500 for larger sizes. These dimensions may need to be increased if top entry connections are used.

(All dimensions in mm)

Commentary

The overall space requirements do not vary significantly with the different transformer orientations. The doors should be wide enough to permit transformer removal.

(Continued)
Commentary

The summary above indicates typical space requirements for substations with a typical mix of outgoing LV circuits.
### 5.2.2 LV Switchgear and Components

Three common groups of Low Voltage (LV) equipment are considered:

- Main LV Switchboards - both front and rear access
- LV switchboards and Motor Control Centres (MCCs) in Plantrooms
- Control/Alarm/Supervisory Systems

Sufficient space must be allowed for MCCs and any control, alarm or supervisory system panels installed in plantrooms. Auto transformers and large contactors may require space for lifting gear for removal.

#### Legislation and Regulations

- Electricity at Work Regulations: reference - R1, R2, R3, R4, R5 & R6, see section 2.2.
- Electricity at Work: safe working practices. HS(G)85. HSE. 1992.

#### British Standards

- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 6423. Code of practice for maintenance of electrical switchgear and controlgear for voltages up to and including 1 kV.
E2.1 Main LV Switchboards (Front Access) - Space Details

Access Requirement
Frequent

Headroom For typical switchgear height of 2250 allow 3000 headroom for bottom entry units and 3500 for top entry.
(All dimensions in mm)

Commentary
An emergency escape exit should be provided but is not a legal requirement.
(Continued)
For single units the space requirements for front and rear access boards are similar. The saving in depth with a front access board is negated by the extra length of the cabling compartments.

The load expressed in the graphs is the total installed capacity.
E2.2 Main LV Switchboards (Rear Access) - Space Details

Access Requirement
Frequent

For typical switchgear height of 2250 allow 3000 headroom for bottom entry units and 3500 for top entry.
(All dimensions in mm)

Commentary
An emergency escape exit should be provided but is not a legal requirement.
For single units the space requirements for front and rear access boards are similar. The saving in depth with a front access board is negated by the extra length of the cabling compartments.
(Continued)
Commentary: The load expressed in the graphs is the total installed capacity.
E2.3 LV Switchboards and Motor Control Centres - Space Details - General requirements for installation in plant rooms or electrical rooms.

Clearances

Dimensions marked A may need to be increased to allow for large door panels or draw-out circuit breakers.

Dimensions marked B may need to be increased if clearance for moving large equipment is required.

(All dimensions in mm)

Commentary

For situations where space cannot be found for a single larger enclosure a number of smaller enclosures may be necessary.
5.2.3 Uninterruptible Power Supplies

Uninterruptible power supplies (UPSs) are considered under two main categories. Battery rooms are similar for both types.

- **Static UPS** -
  Space requirements for the static UPS are similar to MCCs. Units are in floor-standing enclosures, all requiring access from the front with some manufacturer's equipment requiring rear or side access in addition. Larger units are supplied in sections for assembly on site. Small desk-side UPSs for individual computer stations are not covered here.

- **Rotary UPS** -
  Space and access requirements for rotary UPSs vary according to the location of the motor-generator.
  Where the motor-generator is mounted in the base of the control cabinet sufficient space must be available to withdraw it horizontally before it can be lifted.

- **Battery Rooms** -
  Access must be provided for regular inspection of battery electrolyte levels and the layout should enable all cells to be inspected or topped up easily. Individual cells are small enough to be moved through personnel access doors although the weight of large cells or multiple blocks will require a trolley of some type. In this event consideration should be given to the ingress and egress route with respect to the handling of a loaded trolley.

The removal of a transformer or motor-generator will require the use of a mechanical lifting device. On larger rotary UPSs the motor-generator may weigh 4000 to 5000 kg and permanent provision of a lifting beam should be considered.

Control cabinets of large UPSs can normally be split into modules or sections. However, some can still be large enough to cause handling difficulties and determine the size of the access route.

Space must be provided for the safe storage of battery electrolyte and protective clothing. A first-aid cabinet and eye-wash facility are required.

UPS installations require ventilation both for the equipment room and for the battery room. Portable fire extinguishers should be provided.

**Legislation and Regulations**

- Electricity at Work Regulations: reference - R1,R2,R3,R4,R5 &R6, see Section 2.2.

**British Standards**

- BS 8313. Code of practice for the accommodation of building services in ducts.
- BS 6133. Code of practice for safe operation of lead-acid secondary cells and batteries.
Component Requirements

E3.1 Static Uninterruptible Power Supplies - Space Details and Summary of Space Requirements

Access Requirement
Frequent

Headroom
- Most UPSs of less than about 75kVA will be less than 1800 high and will not present a problem. Units over 100kVA may be up to 2200 high and will require 3000 minimum headroom for bottom entry units and 3500 for top entry.

(All dimensions in mm)

Commentary
- If data on the component withdrawal space is not known, a space equal to the depth of the cabinets should be allowed.
- Dimensions marked X depend on the requirement for side or rear access. Where side or rear access is necessary allow 690 minimum.
**Access Requirements**

**Frequent**

---

**Headroom**

Most UPSs of less than about 75kVA will be less than 1800 high and headroom will not present a problem. Units over 100kVA may be up to 2200 high and will require 3000 minimum headroom for bottom entry units and 3500 for top entry.

(All dimensions in mm)

---

**Commentary**

If data on the component withdrawal space is not known a space equal to the depth of the cabinets should be allowed. Some manufacturers provide detachable rails for removal of the internal motor-generator and sufficient space must be allowed for these.

Dimensions marked X depend on the requirement for side or rear access. Where side or rear access is necessary allow 690 minimum.

External motor-generators should be treated as rotating equipment and a minimum space of 900 should be provided on all sides.

Where units have separate motor-generators the cables should be run in floor trenches or ducts. Trench covers should be strong enough to support the weight of any lifting gear or trolleys.

(Continued)
Space Requirements  Component Requirements

E3.2  Rotary Uninterruptible Power Supplies (Continued) - Summary of Space requirements

Commentary  The rating in the graphs is the rating of each individual UPS. Battery rooms are considered separately.
E3.3 Battery Rooms - Space Details

Headroom

Battery racks should be low enough to enable the highest cells to be topped up by a person standing on the floor. The room height should allow sufficient headroom under any ventilation ducts.

(All dimensions in mm)

Commentary

A working area of 900 minimum depth should be allowed in front of battery racks. The clearance between the batteries and the walls, dimension X, should be sufficient to permit viewing of the backs of the cells to check for leakage.

(Continued)
Commentary

The graphs are based on a single level battery room with cells installed in tiered racks.

The kVA ratings are based on a 3-phase 400/230 V UPS with 15 minute autonomy.
5.2.4 Rotating Machinery

Two types of equipment are considered:

- Diesel Generators - water cooled, high speed engines
- Frequency Converters

Space requirements are given for water cooled high speed engines operating at 1500 or 1800 rev min⁻¹. The space requirements for ductwork on air cooled engines vary according to the layout of the engine. Low speed engines used in base load or CHP installations are generally more specialised in nature. In both cases the manufacturer should be consulted.

For generator installations space must be provided for cooling air ductwork and ancillaries such as day tanks or heat exchangers. The room must have sufficient headroom for removing components vertically above the set. Lifting beams should be provided for lifting engine components during major overhauls.

Allowance must be made for cooling air ductwork and fuel and exhaust pipe routes to the generator room. Bulk fuel storage tanks should be outside the building if possible.

Complete removal of the set for rebuilding at the manufacturer's works may involve removal of demountable partitions or ductwork. Demountable partitions are acceptable if they can be removed or re-erected in around three to four hours. The removal of a masonry wall is deemed unacceptable as a means of providing access to plant.

The removal of the motor-generator of a frequency converter will require the use of a mechanical lifting device. On larger units the motor-generator may weigh 4000 to 5000 kg and permanent provision of a lifting beam should be considered. Where the motor-generator is mounted in the base of the control cabinet sufficient space must be available to withdraw it horizontally before it can be lifted.

Legislation and Regulations

- Electricity at Work Regulations: reference - R1,R2,R3,R4,R5 & R6, see Section 2.1.
E4.1 Diesel Generating Sets: Basic Generator Room - Space Details - Water cooled, high speed engines (1500/1800 rev min-1)

Access Requirement
Frequent

Headroom
Allow 3000 headroom for the smallest sets and 3500 above about 150kVA. Requirements vary according to engine configuration and silencer location. Manufacturer’s data should be consulted. Allow space for lifting beam over length of generator set and clear area behind.

(All dimensions in mm)

Commentary
Space requirements for installations using remote radiators without heat exchangers are similar to the basic layout. Heat exchangers require a similar area to the outlet attenuator shown on the room with acoustic louvres.

The double doors for installation/removal of the set may be at either end but should be in line with the set.

(Continued)
The load expressed in the graphs is the capacity of each generating set.
**Space Requirements Section 5 Component Requirements**

**E4.2 Diesel Generating Sets: Generator Room with Acoustic Louvres** - Space Details - Water cooled high speed engines (1500/1800 rev min⁻¹)

**Access Requirements**
**Frequent**

![Diagram of Generator Room with Acoustic Attenuators]

**Commentary**
Space requirements for installations using remote radiators without heat exchangers are similar to the basic layout. Heat exchangers require a similar area to the outlet attenuator.

Either the inlet or outlet louvre must be removable for set installation and removal. Access is required for cleaning debris drawn into the inlet attenuator.

(Continued)
Commentary

The load expressed in the graphs is the capacity of each generating set.
E4.3  
**Diesel Generating Sets - Generator Room with Acoustic Enclosure - Space Details - Water cooled high speed engines (1500/1800 rev min-1)**

**Access Requirement**

**Frequent**

---

**Commentary**

The upper and lower limits represent the space requirements for typical enclosures with 30dB(A) and 15dB(A) reduction respectively.
E4.3 Diesel Generating Sets - Generator Room with Acoustic Enclosure (Continued) - Summary of Space Requirements - Water cooled high speed engines (1500/1800 rev min⁻¹)

Access Requirement
Frequent

**Headroom**
Allow at least 1000 clearance above the acoustic enclosure. This will require approx. 3000 headroom for the smallest sets and 4000 above about 150kVA. Silencers are normally installed above the enclosure. Headroom should allow for any acoustic treatment on the ceiling.
Allow space for a lifting beam over the length of the generator enclosure

(All dimensions in mm)

**Commentary**
Most enclosures have sufficient internal space only for routine maintenance and minor servicing. Space requirements must allow for dismantling the enclosure to perform major work on the set.
E4.4 Rotary Frequency Converters - Space Details and Summary of Space Requirements

Access Requirements
Frequent

<table>
<thead>
<tr>
<th>Headroom</th>
<th>900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units over 100kVA may have control panels up to 2200 high and will require 3000 minimum headroom for bottom entry units and 3500 for top entry.</td>
<td></td>
</tr>
<tr>
<td>(All dimensions in mm)</td>
<td></td>
</tr>
</tbody>
</table>

Commentary
Dimensions marked X depend on the requirement for side or rear access. Where side or rear access is necessary allow 690 minimum.

A minimum space of 900 should be provided on all sides of motor-generators and between the motor generator and the open cabinet doors.

Cables to the motor-generator should be run in floor trenches or ducts. Trench covers should be strong enough to support the weight of any lifting gear or trolleys.
6 Design Certificates

The Design Certificates described in this Section provide a systematic approach to establish compliance of a design or installation with a minimum provision of access and space for services. The Design Certificate is a quality assurance tool which will ensure checks have been carried out on access and space allowances.

Compliance will be established with the completion of the 'checklists' at outline and detail design stages of the project, with a final check at handover.

The checklists and their use are described below.

The Design Certificates should certify that the checklist items are accounted for. Any deviations should be explained and be fully risk assessed.

6.1 CHECKLISTS

These lists are to ensure that the principles embodied in the Functional Guide are fully recognised and taken into account to provide a simple method of recording compliance. Specimen checklists are shown in Annexe A.

6.1.1 Outline Design Stage

At the Outline Design Stage it is intended that consideration is given to overall adequate space for services within the ranges indicated within this document and/or other published documents.

Thus the checklist records that acknowledgement has been made of the space requirements of the particular installation.

It is the responsibility of the Project Manager to complete the Design Certificate with reference to this Guide to verify a minimum standard of access and space has been built into the outline design.

6.1.2 Detail Design Stage

At the Detail Design Stage the particular checklist provides certification that sufficient space has been allocated to enable plant to be placed in position and connected safely; that sufficient space has been designed-in to facilitate safe and progressive testing and commissioning, and that the spaces around all items of equipment forming the installations are safe for access and sufficient for all maintenance activities necessary for the installations.
It is the responsibility of the Project Manager to complete the Design Certificate with reference to this Guide to verify a minimum standard of access and space has been built into the detail design.

### 6.1.3 Handover Stage

The Handover Stage Space Allowance checklist comprises an itemised coverage of required access and maintenance spaces and is to be used to confirm that the provisions made are acceptable in every instance and detail to the person responsible for takeover of the installations on behalf of the client.

This checklist also forms a certificate of conformity with all space allowance requirements and should be counter-signed by the Project Manager.

### 6.1.4 Records

Copies of all checklists should be incorporated into the Health and Safety File (CDM Regulations R4, see Section 2.2) and located as directed by the Project Manager.
Annexe A - Installation Checklists

This Annexe presents specimen checklists referred to in Section 6 of this report.
### OUTLINE DESIGN STAGE SPACE REQUIREMENT CHECKLIST

<table>
<thead>
<tr>
<th>Item</th>
<th>Checked</th>
<th>Comments</th>
</tr>
</thead>
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**Role/Authority**

132 JULY 1996
## DETAIL DESIGN STAGE SPACE REQUIREMENT CHECKLIST

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### Space Requirements

#### Installation Checklist

**HANDOVER STAGE SPACE ALLOWANCE CHECKLIST (continued)**

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<td>operating handles</td>
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<td><strong>UPS - static and rotary / frequency converters</strong></td>
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<td>as LV switchboards plus draw out space for transformers or integral motor generator floor finish suitable for transformer wheels or rollers covers on floor trenches no intrusion by other services (especially wet)</td>
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<td>access allowance egress/escape clearance with circuit breakers withdrawn or panel doors open covers on floor trenches guards in place access to routine maintenance items (filters etc) access to batteries access to inlet air louvres access above set for disassembly or overhaul</td>
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<td><strong>Control panels</strong></td>
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<td>as LV switchboards plus controls and instruments at correct height</td>
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JULY 1996
Annexe B - Change Suggestion Form

If you have any comments on this document please fill in a photocopy of the form opposite and send it to DEO(W). Please do not use the shaded sections of the form.
### Change Suggestion Form

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**Section:**

**Page:**

**Change Detail:**

**Reason:**

Continuation Sheet included? Y/N

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**Action:**

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Action Date:

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