



GENERAL WORKPLACE SAFETY

PTS 60.2115

Rev 1

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PREFACE

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The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

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AMENDMENT RECORD SHEET

Chap No.	Section No.	Description	Issue No.	Date	Rev., No.	Date	App by: (initial)
All	All	Remumbering from PTS 60.0302 to PTS 60.2115	1	June 06	1	June 06	IGA

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1 INTRODUCTION

1.1 BACKGROUND

The practices described in this document are common to many activities, for example in construction and maintenance. Many of them are routine and involve hazards and effects that can be overlooked or underestimated. In industry in general, hazards and effects in these practices have contributed to a high proportion of incidents, ranging from minor to severe injuries and in some cases to fatalities.

With early identification and appreciation of the hazards involved, approaches can be devised to avoid the release of the hazards or at least minimise the exposure to them. This can be achieved by changes in design, work sequence, material selection, work methods, equipment choice, for example. In all cases competency of the workforce (including training where necessary) is a prime requisite.

Local regulations will very often exist for elements of general workplace practices (for example the need to inspect hoists at prescribed intervals or inspection of Pressure Vessel under Factory Machinery Act, 1967) and these should be treated as minimum requirements. Practices should be specified with local regulations in mind but should in general conform with the requirements of this document or comparable HSE alternatives.

PETRONAS, in conjunction with other companies and standards organisations, is participating in the international effort to develop ISO standards that can be recognised and used worldwide, with regional and national adaptation as necessary. PETRONAS Group documents such as Petronas Technical Standards, etc are based where possible on these ISO standards with adaptation as necessary. PETRONAS Group documents are in turn adopted by OPU/JV where possible and adapted for local circumstances, if necessary. However, international standards, , etc are not available for many of the practices covered in this document.

1.2 OBJECTIVES OF THIS DOCUMENT

The four main objectives are to provide:

- a summary of HSE subjects, hazards and effects in workplace practices
- guidance to those responsible for planning and supervising activities which involve the practices described
- more detailed references (including the PTS) to these practices and in particular, the different stages involved in the planning, specifying, executing and checking
- activity outline sheets for activities commonly encountered in the workplace together with associated outline hazard sheets.

1.3 SCOPE

This document covers guidelines for the provision of safe working conditions for general workplace practices, with due regard for health and the environment. Major activities and tasks involving construction, maintenance, transport and materials handling are covered elsewhere in the HSE Manual as follows:

- PTS 60.0108 Construction and Commissioning
- PTS 60.0109 Production and Maintenance
- PTS 60.0110 Logistics
- PTS 60.1502 Chemical Management Program

Those practices which are common to a number of business areas or do not fit easily within the other sections of the manual have been included in this document. Guidance has been prepared in general terms and is applicable to aspects of all construction projects, maintenance activities and in other places of work (e.g. in offices).

The practices described in this document are not unique . There are many excellent guides available by industry and government agencies. These guides are targeted at different levels and range from inexpensive pamphlets produced for distribution to workers, to comprehensive and costly updateable manuals prepared by specialist companies for HSE advisers.

The scope of this document addresses the following points:

- easy-to-use summary coverage format

This document presents the information in summary form, highlighting the key activities/sequence in each practice, the potential hazards and effects and the controls needed to manage them

- avoidance of duplication with other industry guidelines

This document does not reproduce advice readily available elsewhere. All personnel planning, supervising or carrying out general workplace practices must have access to the necessary information and guidance. This document seeks to present the key points in a form that is easy to assimilate and aligns with the Group HSE management system, in particular the Hazards and Effects Management Process (HEMP).

- sources of reference for further details

The document also provides enough information for the reader to determine whether further details should be sought from the references given and the sources of that information.

The document therefore makes reference to a number of UK publications including:

- UK Health and Safety Executive guidance (also on CD-ROM from Silver Platter Information Ltd, 10 Barley Mow Passage, Chiswick, London W4 4PH)
- Construction Safety (published by the Building Advisory Service (BAS)).
- Construction Site Safety Course (Safety Notes) published by Construction Industry Training Board (CITB).

2 **OVERVIEW**

2.1 **ELEMENTS OF GENERAL WORKPLACE PRACTICES AND JOB HAZARD ANALYSIS**

When analysing and planning jobs, a comprehensive assessment of the work involved is needed in order to be confident that all the hazards and effects inherent in the job have been identified and assessed and controls are in place to manage those hazards and effects. In this document, it is suggested that such an assessment is broken down into the six elements illustrated in Figure 2.1.

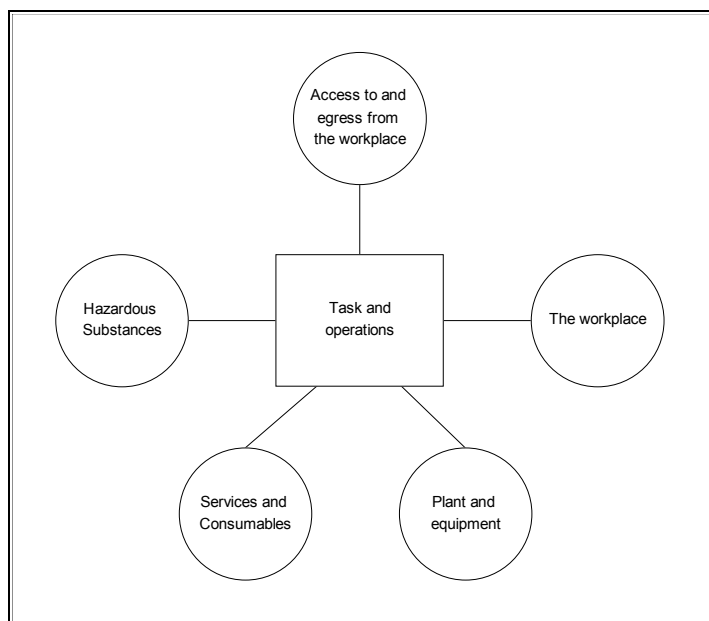


Figure 2.1 A framework for job hazard analysis

OPU / JV utilise techniques such as work or job hazard analysis, PTS 60.2005, to promote a structured review of the tasks. The results of this analysis (particularly the hazards and effects management controls) can then be linked to the conditions of the permit to work (PTW) system, PTS 60.2001. This document addresses common general practices; it is not be considered as a substitute for the analysis process but as an aid.

2.2 STRUCTURE OF THE GUIDELINES

The most important steps in job HSE analysis are those of the Hazards and Effects Management Process (HEMP), i.e. the identification and assessment of the hazards and effects and the means established to control and eventually recover from situations where the hazards may be released. During such analysis, the common general workplace practices, described in this document, may be encountered. In the past job hazard analysis has tended to emphasise the identification, assessment and control aspects of HEMP but neglect the recovery element.

The overall structure and main elements of the document are described below in Table 2.1.

Table 2.1 Outline structure of the document

Element	Description
Contents	Page numbers for: • main subjects • outline activity sheets index • outline hazard sheets index • references
Chapter 2	Overview of the document
Chapters 3-8	Summary of main HSE aspects of each subject with reference to: • outline activity sheet • outline hazard sheet • primary reference titles • secondary reference titles
Appendix I	Outline activity sheets containing: • activity description • hazard management objectives • hazard management controls • HSE principles in planning, scheduling and executing the activity
Appendix II	Outline hazard sheets containing: • hazard description • threats • controls • recovery measures

Appendix III	Index to references of: • Building Advisory Service Construction Safety Manual • Construction Industries Training Board Safety Notes
References	Detailed listing of all references

Both outline activity and hazard sheets follow a typical structure for use in an HSE Case compilation. In general only those elements described in Table 2.1 have been completed. The reader is encouraged to develop these and the remaining elements to suit the local circumstances of the job, the context in which HSE documentation is required and the specific approach used by the OPU/JV.

Chapters 3 through 8 are structured according to the basic framework described in Figure 2.1. The task or operation (presented in chapter 3) is the central part of the job but is affected by the extent to which each of the other elements occurs. In conducting a job hazard analysis, the following aspects need to be considered (the chapter number where the subject is covered is given in parentheses):

- workplace (chapter 4)

Where is the task to be carried out, what general problems are there (e.g. space, lighting, restrictions, concurrent operations, etc) and are there special workplace problems (i.e. is it in a confined space, at height, over water, etc)?

- access (chapter 5)

How will safe access to the workplace (and egress from it) be gained for personnel, equipment and materials?

- plant and equipment (chapter 6)

What are the correct tools, plant and equipment needed to carry out the work safely and the correct methods of use?

- services/consumables (chapter 7)

What services/consumables are needed (e.g. electricity, compressed air, fuel, etc)?

- hazardous substances (chapter 8)

Are hazardous substances likely to be encountered during the task (e.g. H₂S, asbestos, etc)?

The extent and circumstances of each of these elements in turn determines the extent of the potential hazards and effects in carrying out the task or operation.

Primary references (indicating the main recommended sources of information) and secondary references are given in tables in the chapters under each heading.

In addition the document has made extensive reference to:

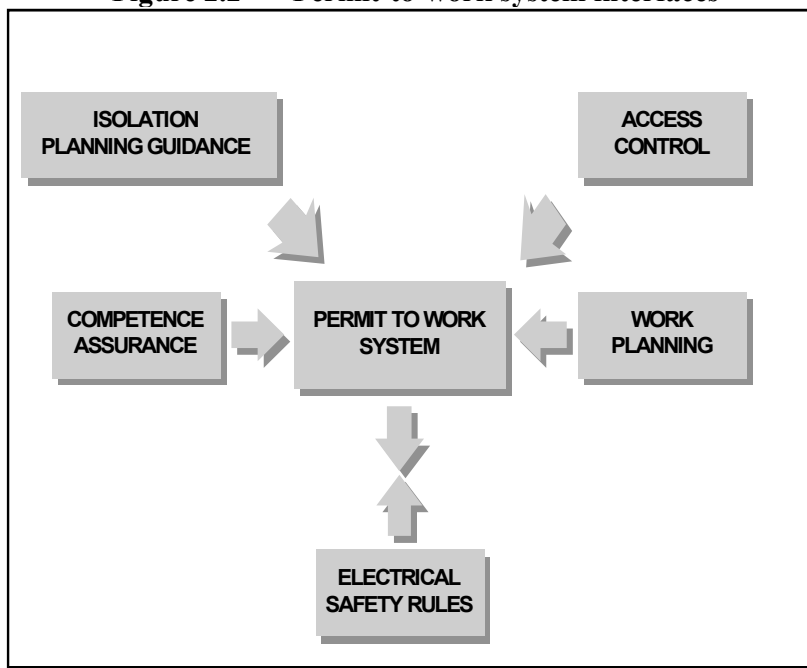
- Construction Safety published by the Building Advisory Service (BAS)
- Construction Site Safety Course (Safety Notes) published by the Construction Industry Training Board (CITB).

Both these references offer guidance on the majority of subjects covered in this document and are a useful practical guide in addition to the primary and secondary references given. The contents summary of both of these references is given in Appendix III. A full list of references used in this document is also given.

2.3 THE ROLE OF PERMIT-TO-WORK (PTW) SYSTEM

General workplace practices may frequently be used as part of an activity that is not routine e.g. a small construction project involving additional piping and making tie-ins to an existing live facility, maintenance repair work inside a storage tank, etc. Under such circumstances, the work must be carried out under the OPU/JV's PTW system. Figure 2.2 shows the interfaces in a PTW system.

Figure 2.2 Permit-to-work system interfaces

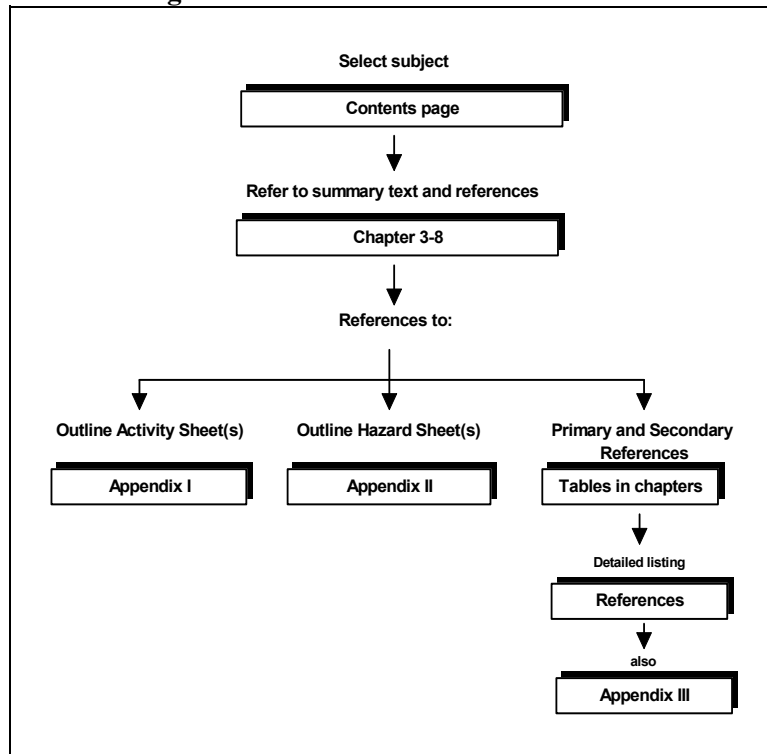


The guidance given in this document can be used as part of the planning process for undertaking general workplace practices under PTW.

2.4 HOW TO USE THESE GUIDELINES

Figure 2.3 provides a route map to how the information in this document can be used.

Figure 2.3 How to use this document



3. TASKS AND OPERATIONS

The two most commonly used welding processes are:

- electric arc
- gas

The principal consequences resulting from the hazards in welding and cutting are:

- fires and explosions (from hazards of naked flame/arc/hot surfaces, fuel/oxygen leakage, flammable materials)
- burns (from hazards of hot metal, weld spatter, thermal radiation)
- eye injuries (from hazards of glare, UV radiation)
- respiratory disease (from hazards of fumes and toxic gases, such as carbon monoxide/nitrogen dioxide/ozone)
- poisoning (from hazards of fumes from, e.g. galvanised metals, lead-coated or other toxic coatings, etc)

- electric shock (from hazard of electricity from electric arc generators).

For hazards from cutting operations, refer to information on gas welding.

3.1 WELDING AND CUTTING

3.1.1 Welding on equipment/piping containing fluids

General

- work is subject to a minimum wall thickness of the vessel/piping containing the fluids
- work is subject to a minimum temperature of the contained process fluids
- surfaces should be free of residual materials (potential impact on weld integrity and risk of generating flammable mixtures due to the heat from the welding process).

Liquids

Welding on liquid-filled vessels, tanks, etc should be subject to rigorous controls:

- not permitted within a minimum distance below liquid level
- carefully check prior to start of work for trapped liquids inside vessel, etc (in structural members, behind wear plates, linings, baffles, division walls, etc).

Welding is subject to a minimum flow through line or provision for expansion (not using pressure-relieving devices).

Gases

Working on vessels containing gases carries an enhanced level of risk of welding penetration due to the much reduced cooling effect of gas compared to liquid. It should not be approved without rigorous evaluation of safety beforehand.

Prohibited activities

Welding activities that are prohibited should be detailed. Examples of such activities are on equipment containing materials that decompose explosively at elevated temperatures, are within their flammable range or which may become flammable as a result of the welding operation

Firefighters

The use of a trained fire-fighter with appropriate fire extinguishing provisions should always be considered to support welding operations

3.1.2 Location of work and welding/cutting equipment

Exclusion of flammable materials	Exclusion zones of the potential occurrence of flammable or combustible materials (based on three-dimensional considerations) should form part of preparations. Careful attention should be paid to the isolation of flammable process fluids including, where necessary the provision of temporary isolations
Exclusion of ignition source	Since welding generator sets are a potential source of ignition, their siting must also be considered as part of preparations.
Welding cables and connectors	The return current cable connecting clamp for electric welding should at all times be connected to the workpiece at a point as close as possible to the actual weld. Return paths via pipe hangers, steelwork or structures should not to be permitted. Welding cables should pass only through areas that are free from flammable liquids or gases. The insulation of welding cables and connectors should be in sound condition.
Safe access	Access to and from the worksite for work personnel and emergency services should form part of preparations. Contingency plans should include evacuation from the work area
Confined spaces	Work HSE, involving welding and cutting operations, in a confined area requires a strict system of precautions.
Lighting	Work HSE at the job face should ensure proper levels of lighting including, where needed, artificial lighting.
First aid	First aid facilities, including breathing and resuscitation equipment, should be readily available.

3.1.3 Welding equipment

Gas welding

The following aspects should be addressed:

- storage of cylinders (storage areas, housekeeping, protection from weather).
- handling of and use of cylinders.
- care of cylinder attachments (connections, regulators, blow pipes and torches).

Table 3.1 Welding and cutting: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.1
References	BS 1542 Equipment for eye, face and neck protection during welding BS 2653 Welders protective clothing BS 6158 Safety devices for fuel gases and oxygen or compressed air for welding HS(G) 118 Electrical safety and arc welding EH 54 Assessment of exposure to fumes from welding and allied processes EH 55 Control of exposure from weld fumes from welding, brazing and similar processes HS(G)5 Hot work : welding and cutting on plant containing flammable materials HS(G)53 RPE - a practical guide for users

3.2 CLEANING AND COATINGS REMOVAL

The main processes used in the cleaning or coatings removal from plant, buildings, etc are:

- grit blasting

This process may be carried out wet or dry although, because of the dust hazard, the former is preferable

- high-pressure water jetting
- chemical cleaning agents (e.g. degreasing solvents, acids/alkalis for masonry cleaning, etc)

The principal consequences resulting from the hazards in cleaning and coatings removal are:

- respiratory diseases (from hazardous substances such as dusts, e.g. silica)
- toxic poisoning (from hazardous substances such as solvents, cleaning agents, etc)
- explosion (from hazard of static electricity discharge and flammable atmosphere)
- environmental (from hazard of disposal of waste material, e.g. abrasives)
- hearing damage (from hazard of high noise levels).

Table 3.2 Cleaning and coatings removal: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.2
References	BRE Digest 280 - cleaning external surfaces of buildings BS 6270 Parts 1-3 Code of practice for cleaning and surface repair of buildings PM 29 (Rev) Electrical hazards from steam/water pressure cleaners, etc Code of practice for the use of high-pressure water jetting equipment (Association of HPWJ Contractors)

3.3 PAINTING AND COATING

The main methods of application used in painting and coating are:

- brush
- roller
- spraying.

The principal consequences resulting from the hazards in painting and coating are:

- ingestion, inhalation and skin contact (from contact with hazardous substances such as paints, solvents, cleaning agents)
- fire and explosion (from hazards of flammable materials [oxygen and source of ignition])
- environmental (from hazard of disposal of waste materials).

Table 3.3 Painting and coating: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.3
References	HS(G) 4 Highly flammable liquids in the paint industry EH 9 Spraying of highly flammable liquids

3.4 FORMWORK, REINFORCING STEEL-FIXING AND CONCRETING

The casting of concrete in the form of slabs, columns, walls, etc usually involves the erection of formwork, reinforcing steel-fixing and pouring of the concrete itself.

The principal consequences resulting from the hazards in formwork, reinforced steel fixing and concreting are:

- falling objects (from hazard of collapse due to inadequate formwork design)
- skin burns (from hazardous substances, e.g. fresh concrete)
- falls from height (due to inadequate platforms or edge protection)
- slips, trips or falls at same level (from obstacles and tripping hazards)
- cuts and abrasions (from hazards of sharp objects such as protruding reinforcing bar, nails on dismantled timbers, etc).

Table 3.4 Formwork, reinforcing steel-fixing and concreting: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.4
References	HS(G)46 A guide for small contractors. Site safety and concrete construction. Formwork: A guide to good practice (Concrete Society)

3.5 EXCAVATING

Almost all construction work involves some form of excavation, e.g. for the installation of foundations, drains, underground pipework, etc. The extent of the excavation can vary from deep trenches (requiring substantial side support) to shallow excavations that can be battered to a safe slope.

The principal consequences resulting from the hazards in excavating are:

- explosion and fire (from hazards of flammable materials released due to mechanical impact and subsequent pipe rupture)
- electrocution (from hazards of contact with live electrical cables)
- impact on plant operation (from top event of damage to electrical or instrument control cables)
- collapsed structures/buildings (due to hazard of falling material resulting from top event of undermining foundations)
- falls into excavations (due to inadequate edge protection for personnel)

- release of hazardous materials causing contamination of soil and groundwater (from pipe rupture).

Table 3.5 Excavating: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.5
References	HS(G) 47 Avoiding danger from underground services

3.6 MANUAL HANDLING

The vast majority of injuries attributable to manual handling result in sprains and strains arising from incorrect application of body forces, poor posture and/or excessive repetition. Many injuries are cumulative rather than attributable to a single incident. However complete recovery from such injuries does not always occur and the result can be physical impairment or permanent disability. Current knowledge stresses the importance of an ergonomic approach to removing or reducing the risk of manual handling injuries by examining the nature of the task, the load, the working environment and the individual capacity.

Table 3.6 Manual handling: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.6
References	L23 Manual handling - Guidance on regulations Manual handling and lifting : an information and literature review with special reference to the back

4 ACCESS TO THE WORKPLACE

This chapter addresses the general methods under which access to the workplace is obtained for personnel, equipment and materials.

4.1 ACCESS METHOD SELECTION

The key parameters to be considered in determining the most appropriate access method are:

- height of working platform from ground
- horizontal and vertical range to be covered
- number of working levels
- extent of working area to be accessible from platform

- ground conditions supporting access platform
- duration of activities from access platform
- type of activities from access platform, numbers of personnel, equipment, etc
- load on platform (personnel, equipment, materials, wind).

The main access methods available are:

- scaffolds
- suspended access
- mobile platforms
- ladders and lightweight staging (trestles).

A summary description of each is given below.

4.2 SCAFFOLDS

The types of scaffolding available in common construction and maintenance practice are:

- independently tied

For work where the scaffold structure itself has to carry its own weight and the loads of personnel, materials and wind. It still is not totally independent in that it relies for stability on being tied to the associated structure or building. The duty, and hence the distributed load, dictates the design of the scaffold. There are variations of tied scaffolds such as truss and cantilever.

- putlog or bricklayer's

Putlog scaffolding is mostly used where brick structures are being built. It is often called a bricklayer's scaffold or a single scaffold. It depends for its support on the wall of the adjacent building on the inner side and a row of standards on the outer side.

- tower (known as mobile towers when mounted on wheels)

For lightweight work requiring movement from place to place with access required at the same height; towers can be made from normal tube and fittings but are frequently constructed from proprietary components.

- birdcage

For interior work needing access to ceilings, walls or soffits for light work such as painting, plastering or decorating; they provide a single working platform

- slung scaffold

A slung scaffold is suspended at a fixed height below load-bearing members, using tubular members or by lifting gear with wire ropes (but not provided with the means of raising or lowering when in use). They are used for any type work where it is impractical to build up from the ground (e.g. offshore).

Table 4.1 Scaffolds: Outline Activity Sheet, primary and secondary references

Outline Sheet	Activity	Sheet Number AS I.7
References		BS 5973 Code of Practice for access and working scaffolds and special scaffold structures in steel GN:GS 42 Tower scaffolds (1987)

4.3 SUSPENDED ACCESS

Suspended access provides a platform that may be raised and lowered from the roof of a building or structure. They are divided into two classes:

- those relying on counterweight for stability
- those which are structurally attached to the roof or top part of building or structure.

The platforms may be raised or lowered by roof-mounted winches or by winches/climbing devices, platform-mounted. There are four main types:

- hinged continuous platform (wire rope suspension)
- individual platforms (wire rope suspension)
- painter's cradle (wire or fibre rope suspension)
- suspended safety chairs (bosuns' chairs) (wire or fibre rope suspension).

Table 4.2 Suspended access: Outline Activity Sheet, primary and secondary references

Outline Sheet	Activity	Sheet Number AS I.8
Primary Reference		No primary references
Secondary References		GN:PM30 Suspended access equipment, (1983)

4.4 MOBILE PLATFORMS

Mobile platforms are designed to provide a temporary working platform that can be easily moved from one location to another, where the erection of a scaffolding platform would be time-consuming or impractical in relation to the work. The basic types are:

- scissors lift
- telescopic boom or jib
- articulating and telescopic boom

All of these may be available as:

- towable units
- vehicle mounted
- self-propelled
- pedestrian-controlled.

Table 4.3 Mobile platforms: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.9
References	GN:PM 28 Working platforms on fork lift trucks (1981) HS(G) 19 Safety in working with power operated mobile work platforms (1982) HS(G) 23 Safety at power-operated mast work platforms (1985)

4.5 LADDERS AND LIGHTWEIGHT STAGING (TRESTLES)

The use of ladders as a working place is limited to light work of short duration, since:

- only one person should be permitted on a ladder at any one time
- loads should not be carried at the same time as climbing
- overreaching and overbalancing should be avoided
- ladders should be secured, preferably at the top and bottom.

Lightweight staging should similarly only be used for light work of short duration.

The use of aluminium ladders or their components in hazardous areas should be subject to the cautions as for temporary use of aluminium in such areas. Their use should be regarded as potentially spark producing. In any areas where flammable atmosphere could be present, the use of such equipment should be controlled by a PTW system and precautions specified so that a safe atmosphere is provided. Where this is impractical alternative materials should be used. Measures to prevent sparks are difficult to apply to large equipment like ladders e.g. covering with rubber or plastic and even more difficult to maintain. These items should therefore only be used under gas-free conditions and work stopped immediately the atmosphere ceases to be gas-free.

Table 4.4 Ladders and lightweight staging: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.10
References	GN:GS31 Safe use of ladders, step ladders and trestles (1984) BS 1129 Specification for portable timber ladders, steps, trestles and lightweight stagings BS 2037 Part 4 Specification for portable aluminium ladders, steps, trestles and lightweight stagings

4.6 ROPE ACCESS

This method of providing access to a worksite is a relatively new and developing technique.

It relates to gaining access to buildings, other structures (on or offshore) or geological features (such as cliff faces) by means of ropes suspended from the structure or the features concerned. It applies to all cases where ropes are used as:

- the primary means of support
- the means of primary protection or positioning
- where people descend or ascend on a rope or traverse along horizontal rope.

This technique can be particularly effective for inspection or light work activities on high structures or under offshore platform decks, for example.

The effectiveness of industrial rope access applications very much depends upon the capabilities of the personnel who are responsible for and perform rope access as well as the equipment used.

Competence gained in rope techniques in sport does not necessarily provide the required skills. Using such techniques for work positioning purposes requires a different attitude on the part of the workers. A sporting activity requires the participants to use their skills, paying close attention to the method of descent as a

main part of the activity. At work, however, the employee will be more concerned with the purpose of gaining access. This means that a different degree of attention will usually be given to the means of access. Consequently the safeguards that might be adequate for sporting activities are unlikely to be sufficient for work applications.

Opcos considering using rope access techniques should only do so if the personnel work to within documented procedures and have demonstrated their competence to do so under a formal assessment scheme. Where guidelines or assessment schemes are not available nationally they should meet or exceed those requirements described in two guidelines prepared by the Industrial Rope Access Trade Association (Table 4.5).

Table 4.5 Rope access: Primary and secondary references

References	Guidelines on the use of Rope Access Methods for Industrial Purposes, Edition Revision 2 July 1994 General Requirements for Certification of Personnel Engaged in Industrial Rope Access Methods, Edition 4 August 1995
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Secondary references published by The Industrial Rope Access Trade Association, Association House, 235 Ash Road, Aldershot, Hampshire, GU12 4DD.

5 **THE WORKPLACE**

This chapter addresses the conditions of the place where tasks and operations are carried out, under two headings:

- general conditions

General conditions that must be taken into account to ensure a safe workplace or to meet occupational health requirements include space, illumination requirements, conditions giving rise to thermal stress, locations exposed to noise or vibration, interface with concurrent operations, etc.

- special workplace conditions

Special conditions are defined here as those that demand additional attention because they involve specific types of locations, i.e. working in confined spaces, at height, over water or in excavations.

5.1 **GENERAL WORKPLACE CONDITIONS**

The guidance under this heading refers to general workplace conditions (both indoors and outdoors) that are encountered when carrying out general workplace practices.

5.1.1 Work space

The spatial limitations imposed by the worksite must be assessed as part of the development of a safe system of work, including the criteria of:

- congestion/restriction

Even if the workplace is not defined as 'confined', it may still exhibit characteristics that present hazards due to proximity, e.g. lifting operations occurring in close proximity to personnel engaged in other tasks, work adjacent to operating facilities, one task being carried out close to another and which impinges on the other, etc.

- interference

If the space is normally used for other purposes, it may be necessary to take special precautions whilst the tasks are in progress, to provide additional risk reduction. For example, if a plant escape route is temporarily blocked to carry out a heavy lift, then operations personnel must be advised and additional signposting provided, temporary routes prepared, etc.

- cross contamination

If the space is close enough to an adjacent work area such that the consequences of a hazard impinge on it then this must be included in any hazard assessment.

5.1.2 Lighting

For the purposes of this document, the guidance provided below applies to:

- indoors

Offices, workshops, warehouses, general indoor access ways.

- outdoors

General plant areas, inside process vessels, tanks, equipment enclosures, etc in connection with general workplace practices.

Good lighting is an essential element of providing workplace conditions that promote incident-free working. Besides being important in the context of carrying out the tasks themselves, it is equally vital to avoid injuries associated with slips, trips and falls, due to hidden obstacles, openings, etc.

The principal controls involved in providing the correct lighting conditions are:

- select light intensity according to the tasks being carried out in the area
- assess the requirements for localised task as well as general lighting

- avoid excessive brightness differences in the visual field
- limit brightness differences between the task area itself, the close surroundings and the wider surroundings
- where the visibility of information is a key requirement but is insufficient, improve the legibility rather than increase the light intensity
- select a combination of ambient and localised lighting (except for orientation tasks)
- make use of daylight as ambient lighting but avoid excessive brightness differences in the visual field (applies to indoors only).

Additional aspects associated with the use of lighting for construction, maintenance tasks, etc include:

- mount general lighting as high as possible above the general work area
- position so as to prevent glare, dazzle or reflection
- make adaptable for changes in position as work proceeds (e.g. portability)
- make adaptable to the age of the workforce (personnel over 40 generally require more light)
- make adaptable for the task (e.g. more light required for work where goggles are worn, greater precision required)
- make adequate in areas with potential obstacles, tripping or falling hazards
- treat as a source of heat and a potential fire hazard
- select in accordance with the local environment (e.g. low voltage).

5.1.3 **Heat stress**

The conditions under which general workplace practices are carried out may give rise to heat stress (due to temperature and humidity), e.g. by virtue of the local climatic conditions and/or the proximity to plant or workplace equipment that are sources of conductive, convective or radiant heat. It can be exacerbated by the need to wear PPE and to work in confined spaces where heat dissipation is reduced. Heat is a physical stress on the body and presents a serious potential health hazard. It can cause fatalities.

Details of essential factors to take account of when tasks and operations are carried out under such conditions are given in the Outline Hazard Sheet No. HS II.1 on this subject in Appendix II.

5.1.4 Cold stress

General workplace practices carried out under a cold work environment may give rise to cold stress. These are due almost exclusively to local climatic conditions, i.e. low temperatures, wind-chill effects, damp and cold conditions or immersion (partial or total) in cold water. In a number of workplaces contact with metal below freezing temperatures can also present a hazard. Cold is a physical stress on the body and can cause fatalities, e.g. through hypothermia. Even in less severe forms, it presents a threat to health, e.g. through frostbite, chilblains, etc.

Details of essential factors to be considered when tasks and operations are carried out under such conditions are given in the Outline Hazard Sheet No. HS II.2 on this subject in Appendix II.

5.1.5 Noise and vibration

Noise and vibration hazards need to be considered in assessing a safe working environment for general workplace practices in two areas:

- proximity to operating production plant

i.e. due to the tasks or operations being carried out in close proximity to operating plant and equipment, e.g. inside compressor houses, close to flares, adjacent to pipework/valves containing high velocity fluids, etc.

proximity to the plant and equipment used in the tasks and operations themselves e.g. welding generator sets, high-speed power tools, compressed air generators, pneumatic hammers and drills, etc.

Details of essential factors to take account of when tasks and operations are carried out under such conditions are given in the Outline Hazard Sheets Nos HS II.3 and 4 on noise and vibration in Appendix II.

5.1.6 Adverse weather conditions

For general workplace practices carried out outdoors, the impact of adverse weather on the ability to provide a safe work should be considered (e.g. heavy rain, electric storm, high winds, sandstorm, etc).

Measures should include:

- protection against weather (where practicable), e.g. to provide dry working conditions

- adherence to procedures (e.g. restricted access to masts, storage tanks, etc in event of thunderstorms)
- rescheduling/suspension of work in severe conditions.

Table 5.1 Workspace (General conditions): Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.11
References	L24 Workplace (Health, Safety and Welfare) Regs 1992 ACOP HS(G) 38 Lighting at work HS(G) 88 Hand-arm vibration

5.2 SPECIAL WORKPLACE CONDITIONS

5.2.1 Working in confined spaces

General workplace practices carried out in confined spaces present additional potential consequences such as:

- asphyxiation (from hazard of oxygen deficiency, either present already or as a result of the carrying out the practices)
- poisoning or respiratory diseases (from presence of toxic substances)
- exposure to radioactive sources
- noise and vibration (magnified by the confinement)
- explosion and fire (from presence or development of a flammable atmosphere [with an ignition source])
- falls (from hazards of unseen obstacles, unrestricted drops to lower levels, slippery conditions)
- physical entrapment (because of narrow gaps, entanglement of clothing and PPE, etc).

Examples of confined spaces include inside tanks, vessels, bund areas, ducts, shafts, manhole chambers, excavations, etc. Entry and work in confined spaces shall only be carried out under the OPU / JV PTW system.

Partially enclosed spaces shall be treated equally with those that are totally enclosed and operations that involve only partial entry into the confined space shall be subject to the same stringent appraisal and PTW controls (there are examples from industry

of personnel being overcome by fumes from only partial upper body entry through equipment manholes).

The main considerations to be assessed for working in confined spaces are:

- is entry essential or can the tasks and operations be carried out remotely via a safer alternative method
- is the entry point into the confined space restrictive
- are the conditions in the confined space known precisely or do they have to be determined by inspection
- does the confined space trap hazardous concentrations of toxic or flammable gases or vapours
- are the tasks or operations to be carried out likely to result in a hazardous atmosphere (e.g. toxic, flammable, suffocating, etc)
- is the confined space restrictive for personnel moving about and carrying out tasks and operations
- does the confined space exhibit geometric characteristics or a physical state that exposes personnel to further hazards

For example in gaining access to the worksite, are platforms needed, will slippery conditions be encountered, etc.

Testing and monitoring of the atmosphere is a key requirement of any PTW system for entry and work in a confined space. It should comply with the principles of being:

- completed initially prior to entry
- repeated at intervals during the work for confirmation
- representative of the whole work area under test
- carried out only by authorised and trained personnel
- carried out using suitable and adequately maintained equipment
- recorded in writing.

5.2.2 Working at heights

General workplace practices carried out at heights present potential consequences such as:

- falls by personnel from working platforms
- dropped objects from working platforms
- structural collapse of working platforms.

The main considerations to be assessed are:

- selection of the most appropriate type of working platform
- platforms designed and constructed for the working loads involved (including climatic conditions such as wind loadings, where necessary)
- protection for personnel gaining access to platforms at height
- protection for personnel in the course of carrying out tasks and operations at height
- protection against accidental dislodgement of tools, materials and equipment from working platforms
- correct use of stabilising mechanisms for attachments to permanent structures
- protection of personnel, equipment from dropped objects from working platforms
- platforms built and dismantled in the sequence determined by the design
- platforms loaded within the design limitations
- platforms protected against physical impact by vehicles, construction plant or equipment (by barriers or operational exclusion envelopes).

Details of essential factors to take account of when providing access at heights to carry out tasks and operations are given in Chapter 4 and the relevant Outline Activity Sheets.

Details on falls, structural failures/collapses and falling objects are given in Outline Hazard Sheets Nos. II.5 and 6 in Appendix II.

5.2.3 **Working over water**

General workplace practices carried out over water present the additional potential consequence of falls into the water.

Where work over water is necessary it should consider the use of:

- controls to prevent personnel falling into the water
- controls to keep personnel afloat if they should fall into the water
- controls to effect rescue quickly (e.g. supervisory support, rescue boats, etc)
- swimming competency levels for all personnel working over water
- suspension of exposed over-water work when weather conditions would delay or prevent rescue.

5.2.4 **Working in excavations**

General Workplace Practices carried out in excavations present additional potential consequences such as:

- suffocation or physical injury (due to hazard of collapsing trench walls)
- falling materials, etc (due to inadequate barriers for materials, vehicles, etc)
- falls into excavations
- non life-supporting atmosphere (from hazard of accumulation of gases, vapours, etc)
- contact with live underground services (e.g. electrical cables).

Controls for these hazards are described in Chapter 3, under the Outline Activity Sheet for excavating.

5.2.5 **Working on or near live plant**

Working near overhead conductors

The following principles should be observed:

- regard all power lines as live, unless and until proven to be dead
- place adequate and suitable barriers and warnings (e.g. goal posts, hazard bunting, etc)

- prohibit storing of materials in the area between barriers and overhead lines, even if work is of short duration
- modify equipment and plant, if possible, with suitable physical restraints to limit operations to within a safe envelope or fit proximity warning devices
- where work takes place beneath overhead lines, prevent (wherever possible) and warn against upward movement of ladders, scaffold poles, crane jibs, etc
- post restricted access warning notices.

Lifting operations near live equipment and piping

The general principles of lifting loads are covered in PTS 60.0110 Logistics. The consequences of the load swinging or dropping and hitting live plant should be considered and appropriate additional controls selected, where necessary. In order of preference these are:

- shut down and depressure the plant before the lifting operation
- reduce operating pressure temporarily during the lift
- protect the plant with beams, posts, reinforced covers or similar
- double-sling the load.

Table 5.2 Workspace (Special conditions): Outline Activity Sheets, primary and secondary references

Outline Activity Sheets	Sheet Number AS I.12 (Confined spaces) Sheet Number AS I.13 (At heights) Sheet Number AS I.14 (Over water)
References	PTS 60. 2109 Storage Tank Cleaning PTS 60.2105 Entry Into Confined Space PTS 60.2101 Electrical Safety
References	HS(G) 47 Avoiding danger from underground services GN:GS 6 Avoidance of danger from overhead electricity lines

5.3 OFFICE HSE

Hazards to office staff generally present a lower level of risk than to production and maintenance personnel but controls should be provided in the following areas:

- office equipment and housekeeping
- office machinery (knowledge of hazards, use by trained personnel, guards in place/maintained, machine controls)

- signs and barriers
- safe use of electricity and electrical apparatus
- fire precautions

Firefighting equipment and fire alarms (working order, testing periods, exercising of emergency evacuation, posted visible fire alarm procedures)

- first-aid equipment (in working order, with nominated, available and trained first-aiders).

Table 5.3 Office HSE: Primary and secondary references

References	PTS 60.2119 Office Safety PTS 60.1503.01 Working with Visual Display Units
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5.4 LABORATORY HSE

The provision of HSE in laboratories should address issues of:

- basic precautions
- laboratory equipment and fittings
- PPE
- handling of toxic and hazardous substances
- handling of compressed gases
- waste disposal
- evacuation and escape.

Table 5.4 Laboratory HSE: Primary and secondary references

Primary Reference	PTS 60.2112 Guidelines for Laboratory Safety
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5.5 WORKSHOP HSE

5.5.1 Workshop location

There are a number of HSE and logistics considerations in the siting of a workshop, including:

- safe distance from operating plant
- close proximity to material stores
- close to inspection and advisory departments
- accessible to documentation; drawings, spare part information, historical data, etc
- nearby to offices to facilitate close supervision.

5.5.2 Layout and traffic routes

The principles for layout and traffic routing of workshops are:

- segregation

People/vehicles, hazardous and non-hazardous materials, incompatible materials and operations (e.g. sparking machinery and flammable materials), noisy or 'dirty' activities from others, should be segregated from each other.

- marking

All storage areas, roadways, gangways and barriers should be clearly marked.

- normal routing

Routing should facilitate ease of transportation of people, equipment and materials, define in/out doors, one way systems, avoid (wherever possible) uneven surfaces, changes in gradient, tight corners, etc.

- escape routes

These should be clearly marked, easily operated, unobstructed and readily accessible.

Typical layouts are given in the PTS references in Table 5.5.

5.5.3 **Permanent fixtures, hardware and safety devices**

Facilities, machinery storage facilities and materials should be specified to reflect the size and nature of operations. Highly specialised operational equipment may require dedicated maintenance tools and replacement components. Schedules of workshop machines are given in PTS references in Table 5.5.

All machines should be fitted with safety devices including:

- machine guards
- power take-off and trip switches
- clamps
- appropriate ventilation measures, where relevant, including local exhaust extraction
- firefighting equipment.

5.5.4 **Procedural controls**

Operations procedures should be written to suit each type of workshop and equipment, including:

- housekeeping; cleaning, swarf and waste removal
- tool changing
- clothing and PPE.

Guidance on detailed workshop design and planning is provided in the DEPs for equipment and tools for maintenance and inspection, listed in Table 5.5.

Table 5.5 Workshop HSE: Primary and secondary references

Primary References	PTS 34.17.00.72 Minimum requirements for design and engineering of buildings PTS 70.08.10.11 Mechanical Maintenance Part 2 - Equipment, tools and bolt tensioning PTS 70.08.10.13 Equipment and tools for maintenance and inspection; Part 4 - Electrical workshop - testing equipment and tools PTS 70.08.10.14 Equipment and tools for maintenance and inspection; Part 5 - Instrument technical centre and workshop - equipment and tools
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6 **WORKING WITH PLANT AND EQUIPMENT**

6.1 GENERAL REQUIREMENTS

Routine tasks and operations in construction and maintenance make extensive use of a wide range of plant and equipment. This chapter presents a summary description of the main categories, with references to the outline activity specification sheets. It covers both powered and non-powered tools and the categories of abrasive wheels, cartridge tools and hand tools.

In the case of the tools dependent on a power supply, the reader is also referred to Chapter 7 for hazards associated with electricity and compressed air and the use of fuels in internal combustion engines.

The HSE of any plant and equipment item can be considered under the following three main headings:

Initial integrity and maintenance of the integrity during use

The item must be suitable, by design, construction or adaptation for the work to be undertaken and used in accordance with the manufacturer's specifications and instructions. If it is adapted then such adaptation must still result in the item being suitable for its intended purpose. Some parts of an item may need to be regularly inspected and maintained for the item to be fit for use at all times and to avoid deterioration (e.g. guards, ventilation equipment, dust filters, lubricated bearings, etc). Such checks will vary from simple visual inspections to a formal maintenance programme. Particularly important are checks on faults in HSE-critical components that could remain undetected unless maintenance procedures provide adequate inspection or testing. In some instances, legislation may set minimum requirements.

Selection and use appropriate to the place where it is used

The location in which the item is to be used must be taken into account when assessing the risks that may arise from its use (e.g. is the item to be used in outdoor wet weather conditions, in a confined space or in an area where a flammable atmosphere may exist, in a confined space where noise levels will be exacerbated, etc). Less risk may be involved if the work is carried out in a workshop rather than in-situ.

Selection and use appropriate for the purpose for which it is used

The item should always be suitable for the purpose for which it is used. Incidents often arise because an item is used improperly, for reasons of apparent expediency or availability, only to result in an increased level of risk in accomplishing the task.

Competence of the person using it

The person using the item should be competent to do so (including use, hazard awareness, daily inspection). They should take reasonable care of their own safety

and that of others affected by their actions, have access to adequate information and instructions and have been given the necessary training. In some instances, it may be necessary to restrict use of certain items to authorised personnel only. Such judgements can only be determined as part of a risk assessment.

Table 6.1 Plant and Equipment (General): Primary and secondary references

Reference	L22 Work equipment - Guidance on Regulation

6.2 PORTABLE TOOLS (ELECTRIC-, HYDRAULIC- AND PNEUMATIC-POWERED)

Portable tools, using power supplied electrically, hydraulically or pneumatically (e.g. drills, jack hammers, sanders, etc) present potential consequences under the following headings:

- generation of non-life supporting conditions (from hazardous substances, e.g. dusts)
- electric shock
- cuts, abrasions, gouges, etc (from hazards of contact with moving parts)
- physical injury (from hazard of contact with high-pressure fluids [hydraulic and pneumatic])
- noise
- musculo-skeletal disorders (e.g. vibration white finger [VWF]).

Abrasive wheels and cartridge tools are considered as special types of this category, and are treated separately below.

Table 6.2 Portable tools: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.15
References	L22 Work equipment - Guidance on Regulations HS(G) 54 The maintenance, examination and testing of local exhaust ventilation

6.3 ABRASIVE WHEELS

This category covers all power-driven wheels, cylinders, discs or points having abrasive particles. It may consist entirely of abrasive particles or be a surface covered with abrasive material. They rotate at very high speeds and injuries can be caused by

contact with the wheel, abrasive particles thrown off in the grinding process or wheel disintegration.

Table 6.3 Abrasive wheels: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.16
References	HS(G)17 Safety in the use of abrasive wheels

6.4 CARTRIDGE-OPERATED TOOLS

This category covers tools that use an explosive cartridge to drive a fixing device (e.g. drive nails, eyelet nails, threaded studs, etc) into most forms of concrete, brick and steel. They offer the advantage of portability, unencumbered by cables or hoses and speed of operation. They have the potential to be lethal if used recklessly or incompetently. The two main conditions that need to be controlled are through-penetration and ricochet.

Table 6.4 Cartridge-operated tools: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.17
Reference	PM17 Pneumatic nailing and stapling tools

6.5 HAND TOOLS

This category covers common, non-powered portable tools (e.g. screwdrivers, hammers, chisels, files, spanners and wrenches, pliers, knives, punches, jacks, hacksaws, picks and shovels, etc). Most injuries are repetitive strain injuries (RSI) or result from contact with sharp points or cutting edges and are due to inappropriate selection, hurried or non-ergonomic use, defective tools or tools kept in poor condition.

Table 6.5 Hand tools: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.18
Primary Reference	API 2214
Secondary References	L22 Work equipment - Guidance on Regulations

6.6 POWERED WOOD- AND METAL-WORKING MACHINES

This category includes the principal machines used in wood- and metal-working (e.g. saws, planing machines, lathes, etc). They can be both fixed installation and, in some types, portable. Besides injuries from contact with moving parts, they present potential health hazards due to noise, vibration, dust, sprains/strains through non-

ergonomic use, musculo-skeletal disorders and the associated use of hazardous chemicals.

Table 6.6 Powered wood- and metal-working machines: Outline Activity Sheet, primary and secondary references

Outline Sheet	Activity	Sheet Number AS I.19
Secondary References		BS 5304 Safeguarding of Machinery BS EN 294: 1992 Safety of machinery - safety distances to prevent danger zones being reached by the upper limbs EN 292 parts 1/2 Safety of machinery HS(G) 44 Drilling machines: guarding of spindles and attachments (1988) HS(G) 54 The maintenance, examination and testing of local exhaust ventilation

7 WORKING WITH SERVICES AND CONSUMABLES

7.1 ELECTRICITY

The use of electricity on worksites in connection with general workplace practices should consider the following issues:

7.1.1 Definition of electrical requirements

- determine size, location of loads and variation with time
- identify problem areas (e.g. remote locations, confined spaces, damp areas, etc)
- comply with local regulations.

7.1.2 Electrical supply and distribution

- determine source (i.e. permanent or generated supply)
- categorise users and the associated voltage levels

Use reduced voltage (110V) for portable tools and lighting, consider lower voltages for confined or damp areas

- comply with local regulations
- modify only in accordance with overall plan
- use documentation (design and circuit drawings) where appropriate (e.g. for large/complex installations)

- provide warning signs for all supply, distribution and transformer units.

7.1.3 Supply and distribution components

- use only components that comply with local regulations
- provide monitored earthing for all voltages above 110V
- use plugs and sockets with voltage-specific forcing functions to prevent incorrect use
- use cables with overall protective sheathing suitable for the conditions likely to be encountered
- use cables with continuous armouring, effectively earthed, if carrying >65V with respect to earth.

7.1.4 Use of supply and distribution components

- where cables on the ground are unavoidable, permit for short periods only

Provide with additional protection, fix to floor and mark clearly (to avoid tripping hazard)

- prevent damage to suspended cables

Install at a height above ground to avoid damage (e.g. by traffic), ensure they are adequately supported by proper hooks, conspicuously marked and not subject to tension in the connections

- test installations initially and inspect at intervals in accordance with local regulations, where required
- take care that cables are placed so that damage by the activity is avoided.

7.1.5 First aid and emergency procedures

- provide instructions for immediate action
- provide information for calling emergency services.

Table 7.1 Electricity: Outline Hazard Sheet, primary and secondary references

Outline Hazard Sheet	Sheet Number HS II.7
Primary Reference	PTS 60.2101 Electrical Safety PTS 60.2108 Static Electricity, Technical and Safety Aspects
Secondary References	BS 4343 IEC 309-1, 2, CEE 17 Industrial plugs, socket outlets and couplets for ac and dc supplies BS 7375 Code of practice for distribution of electricity on construction and building sites BS 7430 Code of practice for earthing CP 1013 Earthing CP 1017 Distribution of electricity on construction sites HS(G) 141 Electrical safety on construction sites (1995) GN:GS 27 Protecting against electric shock (1984) GN:GS 37 Flexible leads, plugs, sockets, etc (1985) GN:GS 38 Electrical test equipment for use by electricians (rev 1991) HS(G) 85 Electricity at Work: safe working practices

7.2 COMPRESSED AIR

Compressed air presents a direct potential hazard as a high pressure fluid source that can cause physical injury (particularly to the eye) and an indirect hazard when in contact with dusts or similar particulate material or as a source of noise.

Table 7.2 Compressed air: Outline Activity Sheet, primary and secondary references

Outline Sheet	Activity	Sheet Number AS I.20
Secondary Reference		PM 26 Noise from pneumatic systems HS(G) 39 Compressed air safety

7.3 STEAM

Steam can be used as a cleaning medium, usually in proprietary equipment.

Table 7.3 Steam: Outline Activity Sheet, primary and secondary references

Outline Sheet	Activity	Sheet Number AS I.21
Secondary Reference		GN:PM 29 (Rev) Electrical hazards from steam/water pressure cleaners, etc

7.4 CONSUMABLES

The category includes LPG, petrol/gasoline and diesel.

Controls for the management of hazards and effects can be categorised into:

- storage

Dedicated areas with controlled access and adequate ventilation (where needed) should be provided.

- transportation and handling

Consider both transport to and from site and handling from task to task.

- marking and labelling

Warnings of contents and hazards should be firmly fixed to containers.

7.4.1 LPG

LPG can be stored in one of three ways:

- in fixed storage tanks (on larger sites where bulk storage needed)
- in refillable cylinders (most likely method for construction sites)
- in non-refillable cylinders (for use with small portable equipment items, e.g. blowlamps).

The main principles for safe practice are summarised in the outline activity sheet (not exhaustive).

7.4.2 Automotive fuels (petrol/gasoline, diesel)

Automotive fuels, in addition to their use for vehicles, may also be used to fuel the engines of chain saws, small portable generators, disc cutters, etc.

The main principles for safe practice are summarised in the outline activity sheet (not exhaustive):

Table 7.4 Consumables: Outline Activity Sheet, primary and secondary references

Outline Activity Sheet	Sheet Number AS I.22
Primary References	PTS 30.06.10.10-Gen. Introduction and physical properties and characteristics of LPG PTS 30.06.10.15-Gen. LPG - Part 5 - Cylinders and skid tanks - Consumer equipment and installations
Secondary References	CS 4 Keeping of LPG cylinders and similar containers CS 6 Storage and use of LPG on construction sites CS15 Cleaning and gas-freeing of tanks containing flammable residues HS(G) 34 Storage of LPG at fixed installations HS(G) 51 Storage of flammable liquids in containers

8 WORKING WITH HAZARDOUS SUBSTANCES

8.1 APPROACH TO THE MANAGEMENT OF HAZARDOUS SUBSTANCES

8.1.1 Categories of substances

The hazardous substances covered in this chapter are presented under one of the following three headings:

- process fluids and solids
- dusts, smoke, mists, vapours, fumes, etc resulting from general workplace practices
- construction materials (e.g. cement, paints, adhesives, radioactive sources used in radiography, etc).

The substances covered in this chapter are the most commonly encountered in general workplace practices; it is not an exhaustive list. The reader is also referred to PTS 60.1507 Chemical Management Program.

NB Radioactive scale is covered in PTS 60.0109 Production and Maintenance.

8.1.2 Potential consequences of the hazards

Examples of the principal consequences resulting from contact with hazardous substances are given under the three HSE headings as follows:

Occupational Health

- skin diseases (e.g. dermatitis, skin ulcerations)
- lung diseases (e.g. asbestosis)
- cancer (e.g. mesothelioma)
- poisoning (due to systemic toxicity)
- respiratory complaints (e.g. occupational asthma).

Safety

- burns
- chemical burns
- smoke inhalation
- physical injuries from the effects of explosion.

Environment

- aqueous effluents
- soil pollution
- waste disposal.

8.1.3 Identifying the substances

Identification of hazardous substances should include such questions as:

- which substances are involved?
- in what form does the substance occur?
- how much of the substance is involved?

8.1.4 **Assessing the risks**

The risks of exposure to hazardous substances are determined by considering the following questions:

- how does the substance enter the body (inhalation, ingestion or absorption)?
- what concentration or condition is likely to cause adverse health problems (e.g. long-term maximum exposure level, short term exposure level)?
- what are the first symptoms of over-exposure?
- how is the exposure likely to occur (e.g. to personnel carrying out general workplace practices, other personnel affected by such practices, through accidents, etc)?
- who could be exposed?
- how many personnel could be exposed?
- how often do they work with the substance?
- how much do they work with the substance?

8.1.5 **Determining the controls**

The controls for eliminating or reducing the risks of exposure to hazardous substances should be determined in the following order:

- elimination of use
- substitution by less hazardous substances/use of safer work method
- minimisation of the extent of manual intervention
- isolation or enclosure of the activity involving the substance(s)
- reduction of the number of personnel exposed
- reduction of the period of exposure
- use of local exhaust ventilation
- use of general ventilation
- use of good housekeeping practices
- adherence to high standards of welfare and personal hygiene