They also place general duties on employers such as instituting safe systems of working and providing suitable and safe equipment that must be properly maintained. Machine operators must be given proper information and training for the safe use of the machine.

New machinery (and second hand machinery from outside the EC or EFTA) provided after January 1st, 1993 should satisfy any relevant product directives, e.g., The Machinery Directive (subject to transitional arrangements). Second hand equipment from within the EC or EFTA provided for the first time in the workplace must immediately satisfy regulations 11 to 24.

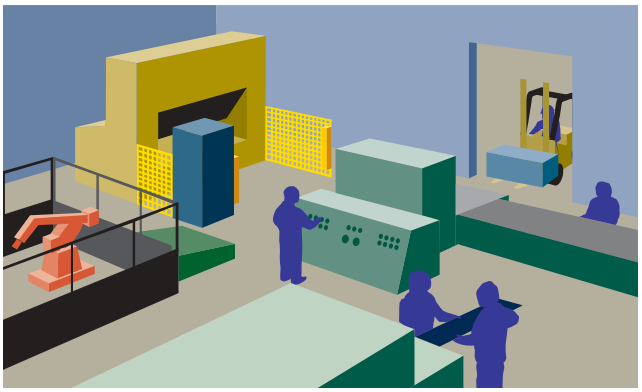

Figure 10

Note: NOTE: Existing or second hand machinery which is significantly overhauled or modified will be classified as new equipment so the work carried out on it must ensure compliance with the Machinery Directive (even if it is for a company's own use).

Regulation 5 "Suitability of work equipment" lies at the heart of the directive and it highlights the employers responsibility (under the Management of Health and Safety at Work Regulations 1992) to carry out a proper process of risk assessment.

Regulation 6 "Maintenance" requires machinery to be properly maintained. This will normally mean that there must be a routine and planned preventive maintenance schedule. It is recommended that a log is compiled and kept up to date. This is especially important in cases where the maintenance and inspection of equipment contributes to the continuing safety integrity of a protective device or system.

Regulations 11 to 24

These regulations cover specific hazards and protective arrangements on machines.

They were not fully implemented until January 1st, 1997 for existing unmodified machines in use before January 1st, 1993. They applied immediately to other equipment. However, if the equipment conforms with relevant product directives, e.g., The Machinery Directive, they will automatically comply with the corresponding requirements of regulations 11 to 24 as they are similar in nature to the EHSRs of that Directive.

Of particular interest is Regulation 11, which gives a hierarchy of protection measures. These are:

A. Fixed enclosing guards.

B. Other guards or protection devices.

C. Protection appliances (jigs, holders, push sticks, etc.).

D. The provision of information, instruction, supervision and training.

These measures should be applied from the top (a) as far as practical and usually a combination of two or more will be required *(see Figure 11).*

EU Harmonized European Standards

These standards are common to all EC and EFTA countries and are produced by the European Standardization bodies CEN and CENELEC. Their use is voluntary but designing and manufacturing equipment to them is the most direct way of demonstrating compliance with the EHSRs.
At the time of publication of this section some of the standards are not yet complete but, as they become available, their titles will be published in the Official Journal of the European Communities. Details will also be given in publications such as BSI News. They will have a common prefix of EN and in the UK they are prefixed BS EN. When they are published, existing national standards which have the same scope will be withdrawn.

They are divided into 3 groups: A, B and C standards.

A. STANDARDS: Cover aspects applicable to all types of machines.

B. STANDARDS: Subdivided into 2 groups.

B1 STANDARDS: Cover particular safety and ergonomic aspects of machinery.

B2 STANDARDS: Cover safety components and devices.

C. STANDARDS: Cover specific types or groups of machines.

It is important to note that complying with a C Standard gives automatic presumption of conformity with the EHSRs. In the absence of a suitable C Standard, A and B Standards can be used as part or full proof of EHSR conformity by pointing to compliance with relevant sections.

The solar system *(see Figure 12)* can be used to model the relationship of the machinery directive to the European standards. The planets represent the standards, which revolve around the sun, which represents the machinery directive. The inner orbits are the "A" and "B" standards. The outer orbits represent the "C" standards.

EU Harmonized European Standards

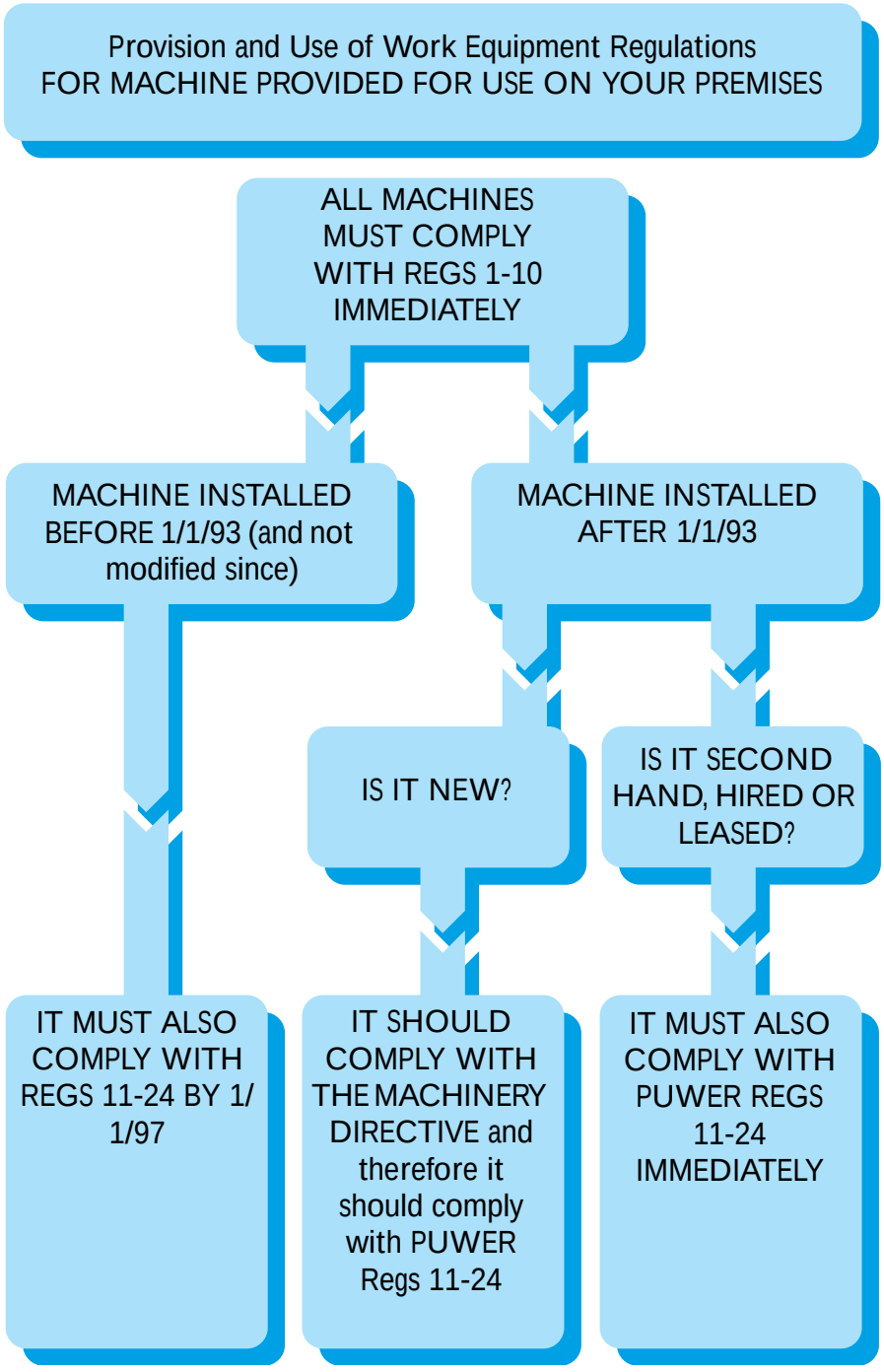

Figure 11: Overview of procedures for the use of Work Equipment Directive as enacted in the UK by Provision A and use of work equipment regulations

Agreements have been reached with other worldwide Standardization Bodies for cooperation between CEN/CENELEC and bodies such as IEC and ISO. This should ultimately result in common worldwide standards.

The following pages list some of the A and B Standards relevant to this section. Where they are prefixed EN they are published standards. Where they are prefixed prEN they have not yet reached the final publication stage at the time of printing of this section.

Machinery Standards

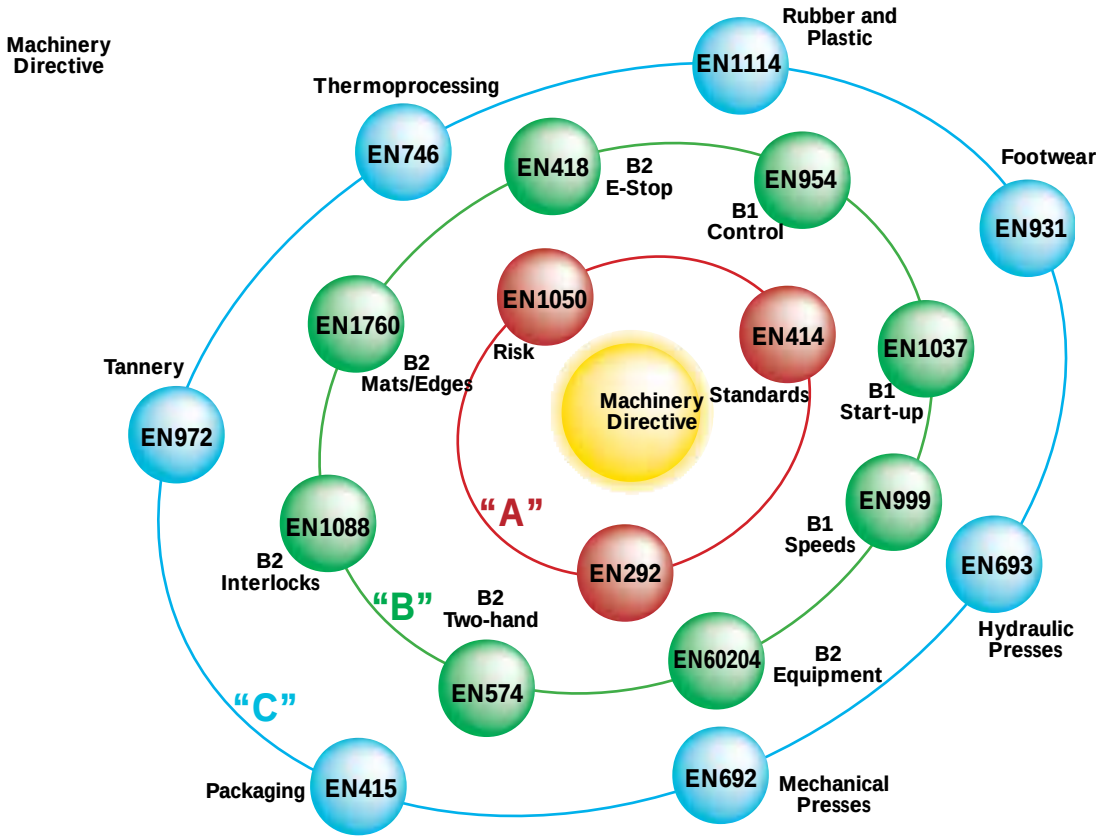

Figure 12

EN 292 (ISO 12100 pts 1&2): Safety of machinery

Basic concepts, general principles for design.

It is an A standard which outlines all the basic principles including risk assessment, guarding, interlocking, emergency stops, trip devices, safety distances, etc. It references other standards and includes the essential safety requirements from the Machinery Directive.

EN 60204-1 (IEC 60204-1): Safety of machinery

Electrical equipment of machines—Pt 1 General requirements.

This is a very important standard that outlines recommendations for safety related aspects of wiring and electrical equipment on machines.

EN 294 (ISO 13852): Safety of machinery

Safety distances to prevent danger zones being reached by the upper limbs.

Provides data for calculation of safe aperture sizes and positioning for guards, etc.

EN 811 (ISO 13853): Safety of machinery

Safety distances to prevent danger zones being reached by the lower limbs.

Provides data for calculation of safe aperture sizes and positioning for guards, etc.

EN 349 (ISO 13854): Safety of machinery

Minimum distances to avoid crushing parts of the human body.

Provides data for calculation of safe gaps between moving parts, etc.

EU Harmonized European Standards

EN 1088 (ISO 14119): Safety of machinery

Interlocking devices associated with guards—Principles for design and selection.

Provides principles for the design and selection of interlocking devices associated with guards.
In order to verify mechanical switches it refers to **IEC 60947-5-1—Low voltage switch gear—Pt 5: Control circuit devices and switching elements—Section 1: Electromechanical control circuit devices.**

In order to verify non-mechanical switches it refers to **IEC 60947-5-3—Particular requirements for proximity devices with fault prevention measures or defined behaviour under fault conditions**. (Provisional number and title only).

EN 954-1 (ISO 13849-1): Safety of machinery

Safety related parts of control systems—Pt 1: General principles for design.

This standard outlines requirements for safety critical parts of machine control systems and describes 5 categories of performance "B, 1, 2, 3 and 4." It is not certain which number it will eventually carry. In whichever form it is published, however, it is important to gather a working knowledge of this document as its categories are becoming accepted as the common "language" for describing the performance of safety related control systems.

EN 1050 (ISO 14121): Safety of machinery

Principles for risk assessment.

Outlines the fundamentals of assessing the risks during the life of the machinery. It summarizes methods for hazard analysis and risk estimation.

EN 999 (ISO 13855): Safety of machinery

The positioning of protective equipment in respect to approach speeds of parts of the human body.

Provides methods for designers to calculate the minimum safety distances from a hazard for specific safety devices, in particular for electrosensitive devices (e.g., light curtains), pressure sensitive mats/floors and two-hand controls. It contains a principle for the positioning of safety devices based on approach speed and machine stopping time that can reasonably be extrapolated to cover interlocked guard doors without guard locking.

EN 574—Safety of machinery

Two-hand control devices—Functional aspects—Principles for design.

Provides requirements and guidance on the design and selection of two-hand control devices, including the prevention of defeat and the avoidance of faults.

EN 418 (ISO 13850): Safety of machinery

Emergency Stop devices, functional aspects—Principles for design.

Provides design principles and requirements.

ISO 11161 (currently under revision for ISO and EN: Industrial Automation Systems

Safety of Integrated Manufacturing Systems—Basic Requirements.

This standard specifies safety requirements where two or more machines are interconnected and operated by a controller capable of being reprogrammed for the manufacture of discrete parts or assemblies.

IEC/EN 61496-1: Safety of machinery

Electro-sensitive protective equipment Pt 1: General requirements and tests. (EN version not published.)

IEC 61496-2: General requirements and tests.

Pt 2: Particular requirements for equipment using active opto-electronic protective devices.

Part 1 gives requirements and test procedures for the control and monitoring aspects for electrosensitive protective equipment. Subsequent parts deal with aspects particular to the sensing side of the system. Part 2 gives particular requirements for safety light curtains.

EN 1760-1: Safety of machinery

Pressure Sensitive Safety Devices—Pt 1: Mats & Floors.

Provides requirements and test procedures.

EN 1760-2: Safety of machinery

Pressure Sensitive Safety Devices—Pt 2: Edges & Bars.

Provides requirements and test procedures.

EN 1037 (ISO 14118): Safety of machinery

General Requirements for the Design and Construction of Guards.

Provides definitions, descriptions and design requirements for fixed and movable guards.

IEC 1038—Safety of machinery

Isolation and energy dissipation—Prevention of unexpected start-up.

Defines measures aimed at isolating machines from power supplies and dissipating stored energy to prevent unexpected machine start-up and allow safe intervention in danger zones.