MATERIAL AND EQUIPMENT STANDARD

FOR

PERSONNEL SAFETY

AND

FIRE-FIGHTERS

PROTECTIVE EQUIPMENT

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APPENDICES:

0. INTRODUCTION

The purpose of this Standard is to provide the minimum safety protective clothing requirements for personnel in different jobs and is prepared in two parts.

Part I: Personnel Protective Clothing

In this part different aspect of protective outfits is discussed which shall be used or worn by the employees in order to safeguard them against any mishaps.

The use of safety protective equipment is mandatory and the Company attach great importance to ensure that all employees are aware of it.

Part II: Fire Fighters Protective Clothing

In this part the requirements are given for fire fighters protective clothing in order to protect them against radiant heat and other injuries which may result during fire fighting operation.

Note:

Up to this date no clothing against heat and fire can offer unlimited protection.

The following protective clothing are available:

a) Station work overall

The fabric has limited protection against heat and should not ignite easily. This worn by firemen during fire fighting operations.

b) Entry and exposure suits

Specification is given in IPS-M-SF-455.

c) Uniform

Fire fighters wear uniforms designed as formal clothing for recognition of their occupation. The textile material is fabricated in IRAN and made to measure by local tailors. Therefore the uniform is not covered in this Standard.

1. SCOPE

This Standard specifies the minimum requirements for types, classes, materials, design, physical and performance that afford protection to all body members of the wearer in industrial plants.

This Standard is formed to cover a separate section for each group of protective clothing and is divided in two parts and each part contains the following pattern:

Part I: Personnel Protective Clothing

Section 1 Head Protection
Section 2 Eye Protection
Section 3 Face Protection
Section 4 Hand Protection
Section 5 Ear Protection
Section 6 Foot Protection
Section 7 Body Protection
Section 8 Chemical Protective Clothing

Part II: Fire Fighters Protective Clothing

Section 9:

a) Fire Fighters Protective Clothing;
b) Fire Fighters Helmet;
c) Fire Fighters Footwear
d) Fire Fighter Gloves.

Section 10 Station Work Uniform (Overall)

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor.

Since this Standard is divided in two parts and ten sections therefore the sub-numbers leads to the reference of each section.

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

ANSI # 89.1 (1986) "Protective Headwear for Industrial Workers Requirements"

ANSI # 41.1 (1986) "Personnel Protective Footwear"

BSI (BRITISH STANDARDS INSTITUTION)

BS 5240 (1987) "Industrial Safety Helmets"
Part 1 "Specification for Construction and Performance"

BS 6489 "Headforms for Use in the Testing of Protective Helmets"

BS 679 (1977)	"Specification for Filters for Use During Welding and Similar Industrial Operations"
B S 1542 (1982)	"Equipment for Face and Neck Protection Against Non Ionizing Radiation Arising During Welding and Similar Operations"
BS 2092 (1987)	"Eye Protectors for Industrial and Non Industrial Uses"
BS 2724 (1987)	"Sun Glare Eye Protectors for General Use"
BS 2738 (1989)	"P.2 Spectacle Lenses" "Specification for Tolerances on Optical Properties of Uncut Finished Lenses"
BS 3199 (1972)	"Method for Measurement of Spectacles Including a Glossary of Terms"
BS 903	"Method of Testing Vulcanized Rubber Part A2. Determination of Tensile Stress-Strain Properties. Part A 19 Heat Resistance and Accelerated Air Aging Tests. Part A 38 Determination of Dimensions of Test Pieces and Products for Test Purposes"
BS 1651 (1986)	"For Industrial Gloves"
BS 2471 (1984)	"Methods of Test for Textiles-Woven Fabrics-Determination of Mass"
BS 3144	"Methods of Sampling and Physical Testing of Leather"
BS 5108 (1982) (ISO 4869: 1981)	"Method for Measurement of Sound Attenuation of Hearing Protectors"
BS 6344 (1988) (Parts 1 and 2)	"Industrial Hearing Protectors"
BS 5145 (1989)	"Lined Industrial Vulcanized Rubber Boots"
BS 5451 (1977)	"Electrically Conducting and Antistatic Rubber Footwear"
BS 2576 (1986)	"Method for Determination of Breaking Strength and Elongation (Strip Method) of Woven Fabrics"
BS 3870	"Stitches and Seams"
BS 3870 Part (1) (1991)	"Classification and Terminology of Stitch Types"
BS 3870 Part (2) (1991)	"Classification and Terminology of Seam Types"
BS 6629 (1985)	"Specification for Optical Performance of High Visibility Garments and Accessories for Use on the Highway"
BS 903 (1987)	"Methods of Testing Vulcanized Rubber"
Part A-16	"Determination of the Effects of Liquids"
BS 2576	"Method for Determination of Breaking Strength and Elongation (Strip Method) of Woven Fabrics"
BS 3084 (1981)	"Specification for Solid Fasteners"
BS 3424	"Testing Coated Fabrics"
Part 7, Method 9	"Method for Determination of Coating Adhesion Strength"

BS 3546	"Coated Fabrics for Water Resistant Clothing"
Part 1:	"Specification for Polyurethane and Silicone Elastomer Coated Fabrics"
Part 2:	"Specification for PVC Coated Fabrics"
Part 3:	"Specification for Natural Rubber and Synthetic Rubber Polymer Coated Fabrics"
BS 4724 (1986)	"Resistance of Clothing Materials to Permeation by Liquids"
Part 1 (1986)	"Method for the Assessment of Breakthrough Time"
Part 2 (1988)	"Method for the Determination of Liquid Permeating after Breakthrough"
BS 5438	"Methods of Test for Flammability of Vertically Oriented Textile Fabrics Assemblies Subjected to a Small Igniting Flame"
BS 6249	"Materials and Material Assemblies Used in Clothing for Protection Against Heat and Flame"
Part 1:	"Specification for Flammability Testing and Performance"
BS 2092 (1987)	"Specification for Eye Protectors for Industrial and Non-Industrial Uses"
BS 2723 (1988)	"Specification for Firements Leather Boots"
BS 5145 (1984)	"Specification for Lined Industrial Vulcanized Rubber Boots"

ISIRI (INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN"

ISIRI UDC 614-891 No. 1375	"Specification for Industrial Safety Helmets (Heavy Duty)"
ISIRI 1944 (1992)	"Cotton Fabrics, Specifications of Raw Wool in Packages for Wool Fibre Present"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 4850 (1979)	"Personal Eye-Protectors for Welding and Related Techniques Filter-Utilization and Transmittance Requirement"
ISO 4851 (1979)	"Personal Eye Protectors-Ultra-Violet Filters-Utilization and Transmittance Requirement"
ISO 4852 (1978)	"Personal Eye Protectors-Infra-Red Utilization and Transmittance Requirement"
ISO 4855 (1981)	"Personal Eye Protectors-Non Optical Test Methods"
ISO 2024 (1981)	"Rubber Footwear, Lined Conducting Specification"
ISO 2251 (1975) E	"Lined Antistatic Rubber Footwear"
ISO 6530 (1990)	"Protective Clothing-Protection Against Liquid Chemical-Determination of Resistance of Materials to Penetration by Liquids"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-M-SF-455	"Material and Equipment Standard for Fire Blanket, Fire Fighters Suits, Fire Proof Types, Fire Resisting Curtain and Shields"
IPS-E-SF-900	"Noise and Vibration Control"
IPS-G-SF-110	"Protection Against Radioactive Sealed Sources"
IPS-M-SF-455	"Material and Equipment Standard for Fire Blanket, Fire Fighters Suits, Fire Proof Types, Fire Resisting Curtain and Shields"

JIS (JAPANESE STANDARD INSTITUTE)

JIS T 8103 (1983)	"Anti-Electrostatic Footwears With/Without Safety Toes"

ASTM (AMERICAN STANDARD FOR TEST OF MATERIAL)

ASTM D 2582-67 (1984)	"Standard Test Method for Puncture Propagation Tear Resistance of Plastic Films and Thin Sheeting"
DIN 4843 (1988)	"Safety Footwear, Safety Requirements Testing"

NFC (NATIONAL FIRE CODES) - NFPA

NFC Code No. 1971	"Protective Clothing for Structural Fire Fighters"
NFC Code No. 1972	"Helmets for Structural Fire Fighters"
NFC Code No. 1973	"Gloves for Structural Fire Fighters"
NFC Code No. 1974	"Station/Work Uniform"

3. DEFINITIONS AND TERMINOLOGY

The definitions given below consist of ten parts and each sub-number recall and comprises the definition of that particular section:

3.1 Head Protection

Brim An integral part of the shell extending outward over the entire circumference.

Chin strap An adjustable strap that fits under the chin to secure the helmet to the head.

Crown straps The part of the suspension that passes over the head.

Harness The complete assembly by means of which the helmet is maintained in position on the wearer's head.

Headband The part of the harness that encircles the head.

Helmet A device that is worn to provide protection for the head, or portions thereof, against impact, flying particles, electric shock, or any combination thereof; and that includes a suitable harness.

Nape strap A strap that fits behind the head to secure the helmet to the head; it may be an integral part of the headband.

Peak An integral part of the shell extending forward over the eyes only.

Protective padding A material used to absorb the kinetic energy of impact.

Shell A helmet without its harness, accessories, and fittings.

Suspension The portion of the harness that is designed to act as an energy-absorbing mechanism. It may consist of crown straps, protective padding, or a similar mechanism.

Sweatband The part of the headband, whether integral or replaceable, that comes in contact with at least the wearer's forehead.

Winter liner A sung-fitting cover worn under the helmet to protect the head, ears, and neck from cold.

3.2 Eye Protection

For the purpose of this section of Standard the following definitions apply.

Eye-protector Any form of eye-protective equipment covering at least the region of the eyes.

Ocular The transparent part of the eye-protector that permits vision, for example, lens, visor, screen.

Orbital cavities The apertures in the skull in which the eyes and their appendages sit.

Face screen An eye-protector covering all or a substantial part of the face.

Note:

Also known as 'face shield' or 'visor'.

Spectacles An eye-protector, the oculars of which are mounted in a spectacle-type frame, with or without side shields. Mounted oculars include lenses integral with the frame.

Goggles An eye-protector fitted with a single or two separate oculars enclosing the orbital cavities.

Welding goggles Is a device enclosing 3 space in front of the eyes into which radiation arising from welding can penetrate only through filter(s) and, where provided, filter cover(s).

Note:

Goggles are usually held in position by a headband.

Basic eye-Protector An eye-protector that satisfies the minimum requirements, but does not give the additional protection detailed in the following 5 Clauses:

1) Impact eye-protector

An eye-protector able to withstand the impact test to grade 1 or grade 2 and providing lateral protection to the orbital cavities. Grade 1 impact eye-protectors are able to withstand a velocity of impact of 120 m/s, and grade 2 are able to withstand 45 m/s.

2) Molten metals eye-protector

An eye-protector that provides protection against molten metal splash and hot solids.

3) Gases eye-protector

An eye-protector that provides protection against gases and vapors.

4) Dusts eye-protector

An eye-protector that provides protection against dusts.

5) Liquids eye-protector

An eye-protector that provides protection against splashes or droplets of liquids.

Liquid droplets Very small mass particles or a liquid substance capable of remaining in suspension in gas.

Gradient filter A filter used in sun glare spectacle in which luminous transmittance changes progressively in the vertical meridian, when the filter is mounted, over some or all of the filter.

Photochromic filter A filter used on sun glare spectacle that reversibly alter its luminous transmittance under the influence of sunlight.

Polarizing filter A filter used on sun glare spectacle in which the transmittance is dependent on the amount and orientation of the polarization of the incident radiation.

Backing lens A transparent plate used between the eye and the welding filter.

Note:

The terms' chipping lens' and 'rear cover plate' are also used in practice.

Cover lens A transparent cover used in front of the welding filter as a protection against welding splatter, etc.

Note:

The terms 'filter cover' and 'cover plate' are also used in practice.

Dual shade filter A type of welding filter, part of which is made in a lighter shade and allows the welder to set up the work with a helmet or headshield in position before starting the welding operation; during welding the welder views the process through the darker part of the filter.

Dark shade Shade number corresponding to the minimum value of luminous transmittance τd. (see BS. 679).

Face shield A device worn in front of the face to give protection to the eyes, face and throat. It is either made of the material of the filter itself or is fitted with the filter(s) and, when provided, the filter cover(s).

Filter The part of an eye protector through which a wearer sees and that is designed to reduce the intensity of incident radiation.

Hand shield A device held in the hand to give protection to the eyes, face and throat. It is fitted with filter(s) and, where provided, filter cover(s).

Helmet A device supported on the head to give protection to the face, ears and throat and part of the top of the head. It is fitted with filter(s) and, where provided, filter cover(s).

Housing The part of the equipment that supports the filter(s), filter cover(s) and backing lens.

Light shade Shade number corresponding to the maximum value of luminous transmittance τL. (see BS 679).

Neck shield An article of protective clothing that, when fitted to a helmet, affords protection from reflected radiation to the back and sides of the head and neck.

Note:

The design may include an extension to cover the lower part of the throat.

Variable shade filter A filter in which the transmittance varies in response to the incident light intensity, so enabling the user to set work with the filter in position and with a satisfactory view; on striking the arc the luminous transmittance decreases and the device acts as a conventional welding filter. The process reverses when welding stops.

Note:

The variable transmittance is usually achieved by means of an integral electronic circuit with a built-in power supply.

Variable shade window A device that enables observation of the workpiece before the welding arc is ignited and that automatically changes its shade number from a light shade to a dark shade when the welding arc is ignited.

Note:

A variable shade window is used only in combination with a welding filter which complies with this Standard.

3.3 Face Protection

Definitions given in 3.2 shall apply for face protection.

3.4 Hand Protection

Clute patterns

A four-finger and thumb design, having one-piece palm, including the fronts of all four fingers and a separate cuff [see Fig. 1(a)]. The back comprises three of four separate pieces of material.

Cuff

The extension on a glove or mitt which covers the wrist (examples are shown in Fig. 2).

Flock lined (rubber or PVC) gloves

Gloves which have their inner surface covered in a layer of pure cotton fibers, anchored into the rubber of PVC during manufacture. These absorb perspiration and help to keep the hands cool during use in a warm environment; conversely, they contribute to warmth when used in a cold application.

Gauntlet

A type of glove which, relative to the wrist glove, provides additional protection for the wrist and part of or the whole of the arm.

Gunn pattern

A four-finger and thumb design, having the face of the thumb, the palm, and first (index) and fourth (little) fingers made of one or two pieces of material. The back is of one piece up to the cuff and includes the back of the four fingers at least. The fronts of the second and third fingers may be one piece each, jointed to the palm at the base of the appropriate fingers [see Fig. 1(b)]. The back of the glove may be jointed.

Mitt

A covering for the hand and wrist, having a separate thumb and a common covering for the fingers.

Montpelier pattern

A four-finger and thumb design, having the palm and the fronts of all four fingers in one piece, and the back of the glove and the backs of all four fingers in one piece. This pattern has a fourchette between the fingers (see Fig. 1(c)).

One-Finger mitt

A covering for the hand and wrist, having a separate thumb and forefinger and a common covering for the remaining fingers.

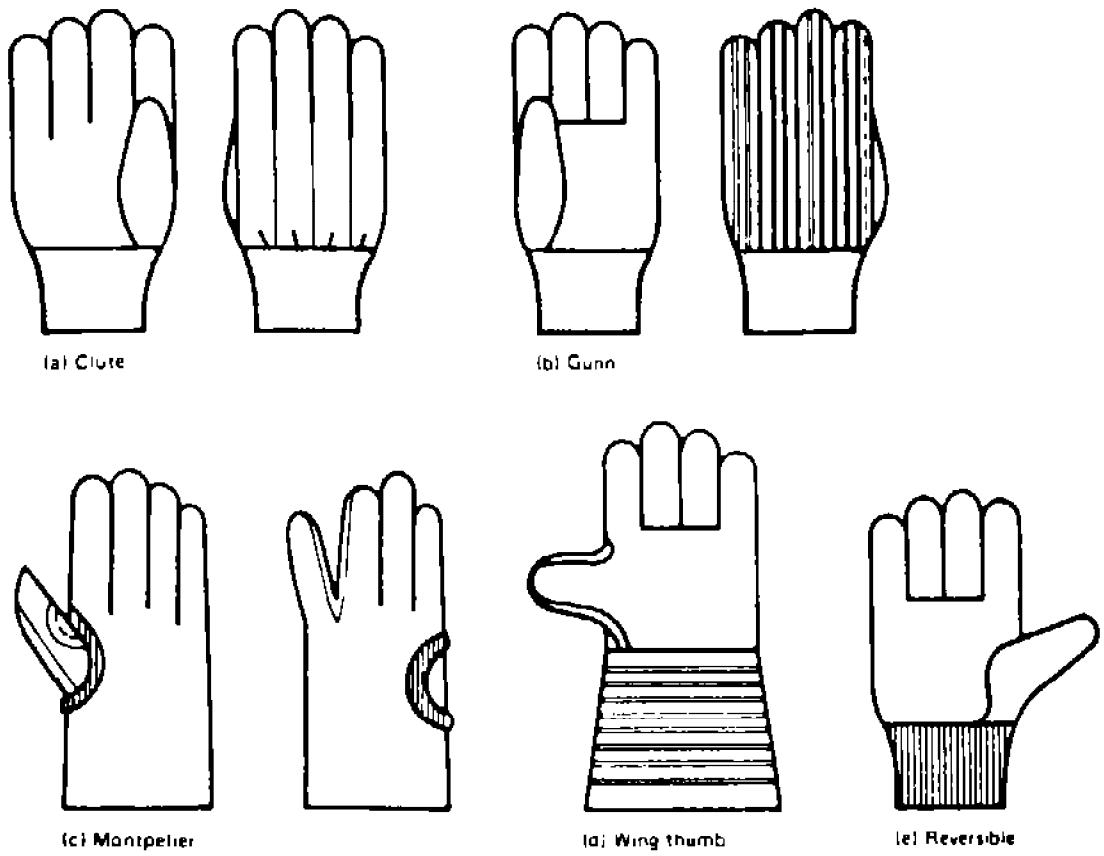
Wrist glove

A wrist length glove providing covering for the hand and wrist, having separate fingers.

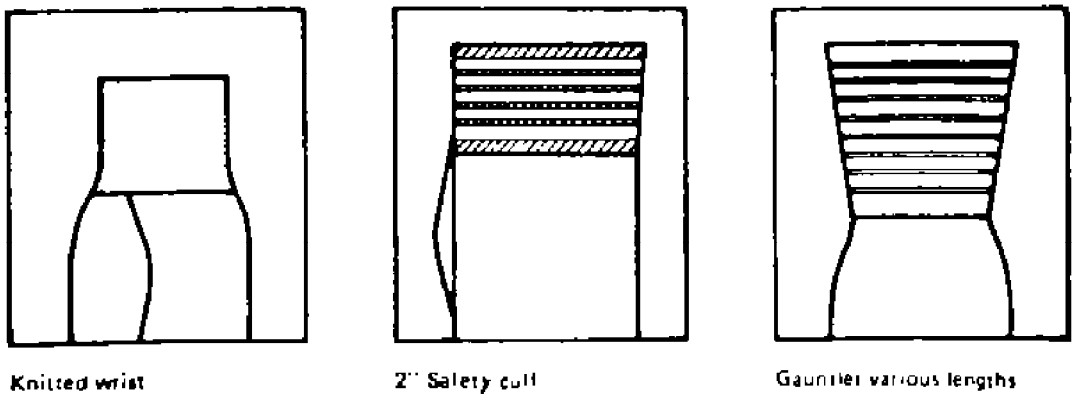
Wristing

Additional fitment attached to the main body of the glove at the open cuff end to present a close fit to the wrist of the wearer.

Basic Patterns



GLOVE PATTERNS
Fig. 1



CUFF PATTERNS
Fig. 2

3.5 Ear Protection

Acoustic Test Fixture (ATF)

A device that approximates certain dimensions of an average adult human head and is used for measuring the insertion loss of ear muffs. For this purpose it includes a microphone arrangement for measuring sound pressure levels.

Attenuation

The algebraic difference in dB between the 1/3 octave band pressure level, as perceived by a real ear at threshold in a specified sound field under specified conditions, with the hearing protector absent and the sound pressure level with the hearing protector being worn, with other conditions identical.

Cup

A hollow, approximately hemispherically shaped component which is mounted on the headband and to which a cushion and a liner are usually fitted.

Note:

In this context, a cup is sometimes referred to as a shell.

Cushion

A deformable cover, usually foam plastics or liquid filled, fitted to the rim of the cup to improve the comfort and fit of the ear muffs on the head.

Note:

In this context, a cushion is sometimes referred to as a seal.

Decibel (dB)

One-tenth of a bel, a scale unit used in comparison of the magnitude of powers. The number of bels, expressing the relative magnitudes of two powers, is the logarithm to the base 10 of the ratio of the powers (see also IPS-E-SF-900 for more detail).

Ear Muffs

A hearing protector, either fitting over and enclosing the pinna and sealing against the side of the head (circumaural) or sealing against the pinna (supraaural). Over-the-head, and ear muffs are designed to be worn with the headband passing over the top of the head and behind the head respectively. A head strap supports behind-the head ear muffs by being in contact with the top of the head. Universal ear muffs can be worn in either mode.

Ear Plugs

A hearing protector inserted and worn in the ear canal or in the ear cavity.

- Disposable

Intended for one fitting only.

- Reusable

Intended for more than one fitting.

- Sonic ear plug

Insert tipe ear protector utilizing a moving diaphragm, that attenuate harmful high level noises without blocking normal background sound.

Head band

A band, usually of metal or plastics, designed to enable the ear muffs to fit securely around the ears by exerting pressure through the cushions.

Head strap

A flexible strap fitted to each cup, or the headband close to the cup. It can be adjusted to support the ear muffs, usually behind-the-head types, by fitting closely to the top of the head.

Helmet

A device covering a substantial part of the head and generally having functions other than, or in addition to, hearing protection.

Head width

Maximum width of head when subject is sitting erect (see Fig. 3).

Head height

Vertical distance between tragus and top of head when subject is sitting erect (see Fig. 3).

Head depth

Horizontal distance between tragus and vertical line through back of head when subject is sitting erect (see Fig. 3).

Insertion loss

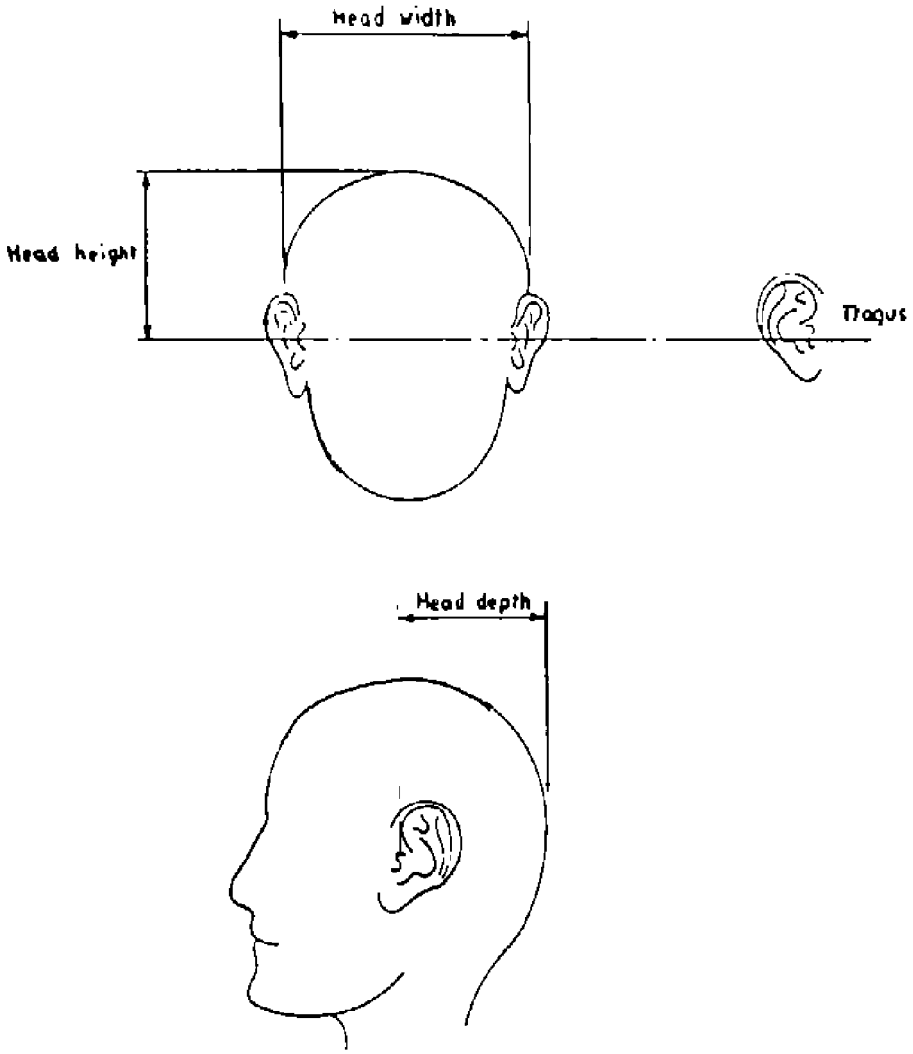
The algebraic difference in dB between the 1/3 octave band pressure level, measured by the microphone of the acoustic test fixture in a specified sound field under specified conditions, with the hearing protector absent and the sound pressure level with the hearing protector on, with other conditions identical.

Liner

Material contained within the cup which can increase the attenuation of the ear muffs at certain frequencies.

Pin noise

Noise whose sound pressure spectral density is inversely proportional to frequency, i.e., equal energy in each 1/3 octave band.



HEAD DIMENSIONS
Fig. 3

3.6 Foot Protection

Insole

The inner part of footwear upon which the foot rests and which conforms to the bottom of the last.

Last

A solid form in the general shape of a foot around which footwear is constructed.

Lining

An all-inclusive term used to describe all of the various lining parts used for the inside of the upper of footwear.

Outsole and heel

The bottom surface of footwear that is exposed to wear.

Protective footwear

As used in this Standard, footwear containing a protective toe box that is specially designed and manufactured to meet the performance requirements of this Standard. However, protective footwear, many include, in addition many other types of protection for the user, such as metatarsal guards, antistatic properties, etc.

Quarter

The complete back part of the footwear upper.

Size

The length and breadth measurement of footwear based on the Iranian System of Grading.

Toe box

A stiffener designed to provide toe protection for the wearer as required by this Standard.

Upper

The upper parts of footwear including the outside and lining.

Vamp

The complete fore part of the footwear upper back to the quarter.

Safety shoes

Such shoes that principally protect the toes of wearer and also provided slip resistance.

Direct vulcanizing process

Such process that the periphery of upper is lasted to the insole, then this assembly and the shoe bottom are set in a vulcanizing press machine, un-vulcanized rubber is introduced into the machine and the shoe bottom is fixed to the upper by vulcanizing the introduced rubber by heating while the said components are pressed.

Note:

The shoe bottom means outsole and heel.

Goodyear welt process

Such process that the periphery of upper is lasted to the rib provided on the insole, stitched to the welt by a welt stitching machine, this assembly is set on the outsole, and then the welt is lock stitched to the periphery of outsole using an outsole stitching machine.

Cement process

Such process that the periphery of upper is lasted to the insole, adhesive is coated on the periphery of upper and periphery of outsole, and then the outsole is bottomed using a sole press machine.

Injection molding process

Such process that the periphery of upper is lasted to the insole, this assembly is set on an injection molding machine, and the shoe bottom is formed by injecting un-vulcanized rubber into the mold.

3.7 Body Protection

Coverall

A one piece type of legged workwear often capable of being fastened at wrist and ankle.

Overall

(Work wear) usually designed to be worn over the everyday clothes to give protection to the body and part of leg.

Jacket

A short coat.

Bar tacking

Reinforcement by means of stitching at point of stress e.g., button holes, pocket corners, seam ends and loops.

Back tacking

Sewing and reverse sewing at the beginning or end of a seam to secure the stitching.

Hem

Producing a folded edge by turning the edge of a material and securing it.

Seaming

Joining together the component part of a garment.

Bound seam

A seam having its material edges bound with a strip of additional material.

Stitch

Generally, the fundamental repeating unit produced by sewing material with one more sewing threads.

Chain stitch

A stitch formed with one or more needle threads and characterized by intralooping.

Lock stitch

The "plain stitch" in which two separate threads are used in formation, one thread is passed through the material, forming a loop, while the second is passed through the loop on the underside of the material.

Safety stitch

A stitch formed by an overedge stitch reinforced by a chain stitch (or sometimes lock stitch) further in form the material edge.

Ligne

A units 0.635 mm (1/40 inch) for measuring the diameter of buttons.

Yoke

The upper section of a garment covering the front and/or back from the shoulder seams usually the chest level.

3.8 Chemical Protective Clothing

For the purpose of this Standard the following definitions shall apply:

Protective clothing

The combined assembly of those garments, the wearing of which affords protection to the skin.

Note:

The primary function of individual garments may be to offer forms of protection other than protection of the skin as such.

Garment

An individual item of protective equipment, the wearing of which affords protection to the skin.

Hood combined with a cape

A garment that completely covers the head, neck and portions of the shoulders or upper part of the body.

Air-Supplied clothing

Clothing that is fitted with facilities for the entry of air which may provide for respiration and/or for thermal conditioning of the wearer. Air supplied clothing may provide complete cover either to the whole or to part of the body according to the circumstances of use.

Gas-Tight suit

A one-piece garment with hood, gloves and boots which, when worn with self-contained or compressed air-line breathing apparatus, affords the wearer a high degree of protection against harmful liquids, dusts and gaseous or vapor contaminants.

Two-Piece suit

A suit which consists of a coat, jacket or other top garment and separate trousers and which covers at least the trunk, arms and legs but not the face, hands nor feet.

Air-Impermeable materials

Materials through which permanent gases cannot pass except by undergoing a process of solution.

Penetration

The passage of chemicals, in any physical form, from the outside of the clothing to the inside via essential openings, fastenings, seams, overlaps between items, pores and any imperfections in the materials of construction.

Permeation

A combined process of molecular diffusion of a chemical through a solid material forming the whole or part of clothing and its desorption into a specified medium.

Chemical hazard

The potential of a chemical, derived from the intrinsic properties of the chemical, to cause harm to the human body by contact with the skin.

Risk

The probability of a specific undesired event occurring so that a chemical hazard will be realized (so as to cause harm to the unprotected wearer's body) during a stated period of time or in specified circumstances.

Danger

The conceptual combination of the chemical hazard with its associated risk, taking into account the quantity of the chemical that may be released during an undesired event.

3.9 Fire Fighters Clothing

The definitions given in (3.1), (3.4), (3.6) and (3.7) shall apply for fire fighter clothing plus the following:

Moisture barrier

The component layer designed to prevent the transfer of liquid, water form the environment to the thermal Barrier.

Trim

Retroreflective and fluorescent material permanently attached to the outer shell for visibility enhancement.

Flame resistance

The property of a material whereby flaming combustion is prevented, terminated, or inhibited following application of a flaming or non-flaming sources of ignition, with or without subsequent removal of the ignition sources. Flame resistance can be an inherent property of the textile material, or it may be imparted by specific treatment.

3.10 Station Work Uniform

The definitions given in 3.9 shall apply for station fire fighting uniform.

4. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

PART I
PERSONNEL PROTECTIVE CLOTHING

SECTION 1
HEAD PROTECTION

5. TYPES AND CLASSES

Protective helmets shall be of the types and classes listed in 5.1 and 5.2.

5.1 Helmet Types

5.1.1 Type 1

Type 1 helmets shall have a full brim.

5.1.2 Type 2

Type 2 helmets have no brim but may include a peak.

5.2 Helmet Classes

5.2.1 Class A

Class A helmets are intended to reduce the force of impact of falling objects and to reduce the danger of contact with exposed low-voltage conductors. Representative sample shells are proof-tested at 2200 volts (phase to ground).

Note:

This voltage is not intended to be an indication of the voltage at which the headgear protects the wearer.

5.2.2 Class B

Class B helmets are intended to reduce the force of impact of falling objects and to reduce the danger of contact with exposed high-voltage conductors. Representative sample shells are proof-tested at 20000 volts (phase to ground).

Note:

This voltage is not intended to be an indication of the voltage at which the headgear protects the wearer.

5.2.3 Class C

Class C helmets are intended to reduce the force of impact of falling objects. This class offers no electrical protection.

5.3 Materials

All materials used shall conform to the requirements of this Standard. All materials that come in contact with the wearer's head shall be those generally known to be non-irritation to normal skin.

5.4 Construction

The construction of the helmet shall be in the form of a hard shell having a smooth outer surface and fitted with a harness.

The outer surface shall be smoothly finished. All edges shall be smooth and rounded. The shell may be shaped to form a brim and/or peak.

If the shell is pierced with holes for any purpose other than for the attachment of the means of energy absorption, no internal chord of any such hole shall exceed 4 mm, and the total area of such holes on either side of the helmet shall not exceed 160 mm², making a total on both sides not exceeding 320 mm².

5.5 Physical Requirements

5.5.1 Each helmet shall consist of a shell and a means of absorbing energy within the shell. The harness shall be securely attached to the shell. Provision shall be made for ventilation between the headband and the shell.

5.5.2 The shell shall be generally dome shaped. There shall be no holes in the shells of Classes A and B helmets that would cause the helmet to fail the electrical insulation test (see 5.7). Identification markers used on shells for Class B helmets shall be affixed without making holes through the shell and without the use of any metal parts or metallic labels. The area under the peak or the front of the brim may be covered with a non-conducting antiglare material.

5.5.3 Headband, sweatband, crown straps, protective padding

The headband, sweatband, crown straps, and protective padding shall be made of any suitable materials that are comfortable.

TABLE 1 - HAT, CAP AND HELMET SIZE GUIDE

HEADBAND SIZE (in.)	CIRCUFERENTIAL MEASUREMENT (CENTIMETERS)
6-1/2"	52.07
6-5/8"	53.02
6-3/4"	53.98
6-7/8"	54.93
7"	55.88
7-1/8"	56.83
7-1/4"	57.79
7-3/8"	58.74
7-1/2"	59.69
7-5/8"	60.64
7-3/4"	61.59
7-7/8"	62.55
8"	63.50

Note:

Nothing in this Standard shall be construed as prohibiting larger or smaller headband sizes than specified. This table is a size guide for round bands, not applicable to integral nape straps because of the contour involved.

5.5.3.1 Headbands shall be adjustable in at least 1/8 hat size increments. The approximate size range that can be accommodated shall be marked on the helmet in a permanently legible manner (see Table 1). When the headband is adjusted to the maximum designated size, there shall be sufficient clearance between the shell and the headband to provide ventilation. Headbands shall be removable and replaceable.

5.5.3.2 Sweatbands may be of the removable-replaceable type or may be integral with the headband. The sweatband shall cover at least the fore-head potion of the headband.

5.5.3.3 Crown straps, when assembled, shall form a cradle for supporting the helmet on the wear's head so that the distance between the top of the head and the underside of the shell cannot be adjusted to less than the manufacturer's requirements for that particular helmet.

5.5.3.4 Protective padding may be used in conjunction with or in place of crown straps.

5.5.4 Mass

The mass of each helmet, complete with harness but exclusive of accessories, should not exceed 0.44 kg for Classes A, B, and C helmets.

5.5.5 Accessories

5.5.5.1 Chin strap and nape strap

The chin strap and nape strap shall be made of suitable material not less than 12.7 mm in width.

5.5.5.2 Winter liners

Winter liner shall be made of suitable materials. Colored materials shall be colorfast. The outer surface may be water resistant. There shall be no metal parts in winter liners intended for use with Class B helmets.

5.5.5.3 Lamp brackets

Headwear equipped with a lamp bracket shall have a low-crown clearance for work in low-ceiling areas and shall be made of lightweight, tough polycarbonate plastic material. see Appendix A.4.

5.5.6 Instructions

Each helmet shall be accompanied by instructions explaining the proper method of adjusting the harness.

5.5.7 Marking

Each helmet conforming to the requirements of this Standard shall bear identification on the inside of the shell stating the name of the manufacturer, the Standard designation, the class of the helmet.

5.6 Labeling

A label shall be attached to each helmet bearing the following information:

a) The following words "for adequate protection this helmet must fit or be adjusted to the size of the user's head".

This helmet is made to absorb the energy of a blow by partial destruction or damage to the shell and the harness or protective padding, and even though such damage may not be readily apparent, any helmet subjected to severe impact should be replaced.

The attention of users is also drawn to the danger of modifying or removing any of the original component parts of the helmet other than those recommended by the helmet manufacturer, and helmets should not be adapted for the purpose of fitting attachments in any way not recommended by the helmet manufacture.

b) Do not apply paint or solvents or adhesives, or self-adhesive labels except in accordance with instructions from the helmet manufacturer.

5.7 Performance

Helmets shall be certified by the manufacturer for the following tests in accordance with BS 5240 or ANSI Z89-1 and ISIRI (Institute of Standards and Industrial Research of IRAN Standard No. UDC 614-891 No. 1375). No helmet that has been subjected to the testing shall be offered for sale:

a) Shock absorption
b) Resistance to penetration
c) Electrical insulation
d) Resistance to flame
e) Water absorption

5.8 Recommendations for the Material and Construction of Helmets

See Appendix A.1.

5.9 Method for Measuring, Wearing, Height Vertical Distance, Horizontal Clearance and Precautions Concerning Helmet Use, Maintenance and Testing

See Appendix A.2.

5.10 Impact System Calibration Procedures

See Appendix A.3.

5.11 Application of Safety Hats and Caps

See Appendix A.4.

SECTION 2
EYE PROTECTION

6. EYE PROTECTION

6.1 General

Eye protective devices must be considered as optical instrument and they shall be comfortable and carefully selected, fitted and used. To give the widest possible field of vision, goggles should be fitted as close to the eyes as possible, without bringing the eye lashes in contact with the lenses.

This section specifies material, design and performance requirements of personal eye protection for industrial use and covers the following:

1) Eye protections for impact, dust, gas, liquid splashes and combination of these which cover:

a) Spectacles type with and without side shield of plastic or tempered glass lenses.
b) Goggle type.

2) Prescription lense (spectacle).

3) Sun glare eye protection.

4) Eye protection and backing lenses for welding and similar operations are included in Section 4 (face protection) of this Standard.

6.2 Materials

6.2.1 Corrosion resistance

Samples of all metal parts used in the eye-protector shall show no sign of corrosion when viewed by the unaided eye of a trained observer and shall be in a serviceable condition.

6.2.2 Ignitability

When tested, no part of the eye-protector apart from headbands and textile edging shall ignite or continue to burn after removal of the rod.

6.2.3 Cleaning

When cleaned by the method recommended by the manufacturer, the eye-protector shall show no visible deterioration.

6.2.4 Skin irritation

All materials that come into contact with the wearer shall be of a kind that is not known to cause skin irritation.

6.2.5 Plastic material

Plastic material shall have strength and elasticity suitable for the use and shall not be flammable such as cellulose.

6.3 Design and Manufacture

6.3.1 Eye-protectors shall be free from patent defects.

6.3.2 Eye-protectors shall have no sharp edges and shall be free from projections, or other features likely to cause discomfort in wear.

6.3.3 Headbands or harnesses, where provided, shall have a width of not less than 9.5 mm.

6.3.4 Adjustable parts or components incorporated in eye-protectors shall be easily adjustable and replaceable.

6.3.5 Where provided, ventilation features shall be designed to prevent the direct access of any particle to the eye from any angle forward from the frontal plane of the eye-protector.

6.3.6 Where eye-protectors have rims secured by a screw or screws, these shall be penned, coated with adhesive or otherwise treated or designed to ensure that they shall not become loosened in use.

6.4 Lenses

6.4.1 Appearance

The lense appearance shall have smooth surfaces and have no visible flaws, striae, bubbles, waves and other foreign objects in or on to it.

6.4.2 Principle

Lenses both serve to afford the vision required for work and to protect the eyes during the performance of specific activities. There are limits to which both sets of requirements can be met at one and the same time. Since the use of eye protectors always involves a certain degree of inconvenience of restriction in movement, in order to guarantee reliable protection, it is imperative that the properties of a lens undergo no substantial alteration during use.

6.4.3 Lenses shall be made of plastic materials, of toughened glass or laminated glass, or any combination of these materials, or untreated glass backed with one of the foregoing materials.

6.4.4 Optical properties

6.4.4.1 Conditioning

The lenses shall be conditioned in accordance with BS 2092.

6.4.4.2 Light transmittance

Lenses shall transmit not less than 80% of the light energy within the visible spectrum unless they are in the impact-resisting group and are double-layered, in which case the transmission shall not be less than 70%. These limits shall not apply to lenses claimed to be tinted.

Note:

Tinted lenses include those with metal coatings applied.

6.4.4.3 Quality

Lenses shall be free to within 3 mm of their edges from inherent faults that can be observed by the wearer when the eye-protector is worn. The inspection for faults shall be made by the wearer with his eyes focused at a variety of focal distances likely to be encountered at work, i.e. the wearer shall not attempt to focus on the lens itself.

Where mould or crease lines are a design feature of the lens they shall not occur within the minimum dimensions given in (6.5.4).

6.5 Construction and Dimensions

6.5.1 The eye protection shall conform to the following general requirements:

- **a)** Eye protector shall not give an excessive uncomfortableness to the wearer.
- **b)** Lenses of eye protector shall not easily come off from the frame nor reform their curve.
- **c)** Each part of the eye protector shall be easily replaced.

6.5.2 Eye protector similar to usual spectacles

Eye protector of this type shall consist of two lenses, frame and two bows.

6.5.3 Eye protector with side-shield

Eye protector of this type shall be the one similar to the usual spectacles with side-shield so attached as not to excessively obstruct the weares view.

6.5.4 Dimension of lens

The minimum dimensions of lenses shall be as follows:

a) For circular lenses

48 mm diameter with a minimum aperture size of 40 mm diameter;

b) For shaped lenses

42 mm horizontal datum length × 35 mm mid. datum vertical depth, using the system of measurement described in BS 3199;

c) For one piece rectangular lenses

105 mm × 50 mm;

d) For one piece shaped lenses

such that two circles 48 mm in diameter can be spaced symmetrically about the vertical center line of the eye-protector with the centers being 66 mm apart measured in the horizontal front plane of the eye-protector as worn.

6.5.5 Refractive, astigmatic and prismatic power for a focal lenses, when measured by telescope in accordance with BS 2092 Appendix D. Eye protectors shall comply with the tolerances given in Table 2.

TABLE 2 - TOLERANCES FOR EYE-PROTECTORS

TYPE OF PROTECTOR	SPHERICAL EFFECT	ASTIGMATISM	PRISMATIC EFFECT
	D	D	Δ
Impact	±0.12	±0.12	0.25
All other eye-protectors	±0.06	±0.06	0.15

Note:

The unit of power is the dioptre (symbol D). The unit of prism power is the prism dioptre (symbol Δ). (see BS 3521: Parts 1 and 2).

The spherical and astigmatic powers shall be within the specified limits at all points on the lens lying within 25 mm of the test point. Individual lenses for spectacles or goggles having separate eyepieces, shall comply with Table 2.

For impact resistant eye-protectors the combined prismatic imbalance in the vertical direction shall not exceed 0.30Δ

6.5.6 Refractive, astigmatic and prismatic powers for prescription lenses. Prescription lenses shall comply with Clause 6.10.

6.6 Performance

6.6.1 Eye protectors shall be subjected to tests listed in Clause 6.8 in the order given. Replacement lenses shall be subject of the relevant tests when mounted in an appropriate housing.

6.6.2 Conditioning

Prior to testing eye-protectors shall be conditioned as described in Appendix F of BS 2092.

6.6.3 Robustness of construction

When tested as described in Appendix G (BS 2092), eye protectors shall not shown any of the following defects:

a) Lens fracture,
b) Lens deformation,
c) Lens housing and/or frame failure,
d) Lateral protection failure.

6.6.4 Protection against impact

6.6.4.1 Type of eye-protector

Grade 1 impact eye-protectors shall be goggles or face shields only.

Note:

Spectacles are specifically excluded from grade 1.

6.6.4.2 Impact eye-protectors

When tested as described in BS 2092 Appendix G using a velocity of impact of 45 m/s for grade 2 and a velocity of impact of 120 m/s for grade 1, impact eye-protectors shall not shown any of the following:

a) Lens fracture,
b) Lens deformation,
c) Lens housing and/or frame failure.

6.6.4.3 Lateral protection of impact eye-protectors

The lateral protection of impact eye-protectors shall comply with the requirements for either grade 1 or 2 as in 6.6.4.2 or for robustness of construction as in 6.6.3. If the lateral protection of any eye-protector has a lesser impact resistance than that of its lenses, the eye-protector shall be marked accordingly.

When the lateral protection is tested in accordance with BS 2092 Appendix G it shall be considered to have failed to meet the particular impact grade or general robustness claimed in respect of the associated lens if it shown any of the defects listed in 6.6.3.(d).

6.6.5 Protection against molten metals and hot solids

6.6.5.1 Type of eye-protector

Molten metals eye-protectors shall be non-metallic or shall be treated to prevent molten metals adhering to the lenses or other parts of the eye-protector when tested as described in BS 2092 Appendix H. They shall include goggles and face screens.

6.6.5.2 Ocular area (face screens)

Face screens shall cover the ocular area defined in BS 2092 Appendix J. When assessed by the method described in 6.6.4.1 shall apply only to that part of the face screen which provides protection to this ocular area.

6.6.5.3 Hot solids penetration

Complete penetration of the lenses and housings of goggles or brow guards and helmet mountings of face-screens shall not occur within 7s when tested as described in BS 2092 Appendix K.

Complete penetration of face-screens shall not occur within 5s.

6.6.6 Protection against liquids

6.6.6.1 Liquid droplets

When tested as described in BS 2092 Appendix L eye-protectors for protection against liquid droplets shall be deemed to comply with this Standard if there is no coloration of the paper representing the ocular areas.

6.6.6.2 Liquid splashes

When tested as described in BS 2092 Appendix J eye-protectors for protection against liquid splashes shall be deemed to comply with this Standard if they cover the ocular area as described.

6.6.7 Protection against dusts

When tested as described in BS 2092 Appendix M eye-protectors for protection against dusts shall be deemed to comply with this Standard if the reflectance of the white test paper is not less than 80% of that before the test.

6.6.8 Protection against gases

When tested as described in BS 2092 Appendix N eye-protectors for protection against gases shall be deemed to comply with this Standard if no staining appears on the area enclosed by the eye-protector beyond the permitted limits.

Note:

Eye-protectors for protection against liquid droplets, dusts and gases are tested for resistance to ingress. Face screens for molten metal and liquid splashes are assessed for coverage on a head-form that does not attempt to cover all head sizes. The greatest care should be taken to ensure a proper fit or adequate coverage on the individual user.

6.7 Quality Assurance

For quality assurance reference shall be made to Appendices A, B, G, H, J, K, L, M, N of BS 2092 or ISO 4855.

6.8 Marking

Eye-protectors complying with this Standard shall be clearly and permanently marked. Marking shall not be placed in such position that it might be confused with other information of eye-protector. Adhesive labels, if used, shall not be easily removed. The manufacturer's name or its abbreviation shall be marked on the lens surface in a way everlasting and not affecting the wearers view and the following shall be marked on the package:

a) Manufacturer's name
b) Date and the standard used

6.9 Sun Glare Eye Protection

6.9.1 General

The main purpose of sun glare filters is to protect the personnel eye against excessive solar radiation so as to reduce eye strain and increase visual perception in order to ensure fatigue-free vision, specially for prolonged usage. The choice of filter depends on the ambient light level and the individual's sensitivity to glare.

6.9.2 Classification and uses of sunglasses

CLASSIFICATION	USE
Cosmetic spectacles	Lightly tinted spectacles not intended to give significant protection against sun glare and worn largely for their fashion properties.
General purpose	Sunglasses intended to reduce sun glare in bright circumstances including the driving of motor vehicles in daylight.
Special purpose	Sunglasses intended to reduce sun glare in abnormal environmental conditions, e.g. near large expanses of water or in snow and mountain altitudes, or for persons who may be abnormally sensitive to glare as a result of medical treatment or otherwise. Non-photochromic filters having a shade number of 4.1 are not considered suitable for use by persons when driving motor vehicles.
Refraction Class 1	Equivalent to prescription lens quality and recommended for continuous daytime wearing.
Refraction Class 2	Suitable for intermittent wearing.
Break resistant sunglasses	Suitable for conditions where mechanical abuse is possible but will not be severe, e.g. driving, cycling, walking, camping or boating.

6.9.3 Transmittance

6.9.3.1 General requirements

a) Shade numbers and transmittance values

Shade numbers and transmittance values of filters shall be as given in BS 2724. Transmittance values shall be determined in accordance with BS 2724 Appendix B.

b) Spectral transmittance

The mean spectral transmittance for the wavelength range 380 nm to 500 nm shall not exceed 1.2 τv when determined in accordance with BS 2724 Appendix B.

Note:

Filters should have a mean spectral transmittance over this spectral range less than τv.

The spectral transmittance for the wavelength range 450 nm to 650 nm shall be less than 0.2 τv when determined in accordance with BS 2724 Appendix B.

c) Uniformity of luminous transmittance

Apart from a marginal zone 5 mm wide, the difference in luminous transmittance when determined in accordance with BS 2724 Appendix B between any two points on the filter shall not be greater than 10% of the higher value.

Note:

For gradient filters this requirement applies in a section perpendicular to the gradient.

For mounted filters the difference between the luminous transmittance of the filters at the visual center for the right and left eye shall not exceed 20% of the higher value.

d) Recognition of signal lights and colors

Each tinted filter shall have a relative visual attenuation coefficient not less than 0.8 for each of the four signal colors specified when determined in accordance with BS 2724 Appendix B.

6.9.3.2 Additional requirements for special filters

a) Photochromic filters

When tested in accordance with BS 2724 Appendix B photochromic filters shall be classified according to their luminous transmittance in the clear state, τ_0, and in the darkened state, τ_1, and their spectral transmittance values shall be as given in 6.9.2 and τ_1 enable the filters to comply with c and d in clear and dark states. The ratio of luminous transmittances τ_0/τ_1 shall be greater than 1.25.

When a representative sample of photochromic filter is tested in accordance with BS 2724, Appendix B the relative change in luminous transmittance τ_1/τ_2 shall not exceed 5% for the determined value for the clear state and 20% for the determined value for the darkened state.

b) Polarizing filters

When tested in accordance with BS 2724 Appendix B sunglasses fitted with polarizing filters shall not show a deviation from the vertical of greater than ±5° for the plane of polarization of the filters in the frame. The mis-alignment between the plane of polarization of the left and right filters shall not be greater than 6°.

The ratio of values of luminous transmittance determined with light polarized parallel and perpendicular to the plane or polarization of the filter shall be greater than 20:1.

c) Gradient filters

Shade numbers for gradient filters shall be determined by the highest and lowest values of transmittance within a distance 15 mm above and below the center of the filter for non-mounted filters or the visual point for mounted filters.

d) Infra-Red filters

If a filter is claimed to attenuate infra-red radiation associated with daylight, the mean infra-red transmittance shall not exceed τv when determined in accordance with BS 2724 Appendix B.

6.9.4 Refraction properties

6.9.4.1 Unmounted filters

When tested in accordance with BS 2724 Appendix B, the values for refractive, astigmatic and prismatic powers for unmounted filters shall be as given in BS 2724 Table 2.

When examined in accordance with BS 2724 Appendix D, Class 1 unmounted filters shall show no local distortion effect to within 2 mm of the edge of the filter.

6.9.4.2 Mounted filters

When tested in accordance with BS 2724 Appendix C, values for mounted filters shall be as given in BS 2724 Tables 2 and 3 for differences between prismatic power of each pair of mounted filters.

When examined in accordance with BS 2724, Class 1 mounted filters shall show no local distortion effect within the full clear aperture of the filters.

6.9.5 Quality of filter material and surface

6.9.5.1 Freedom from visible defects

When filters are examined in accordance with BS 2724 Appendix D, they shall be free, within an area 15 mm in radius about the visual point, from defects that affects their suitability for use, e.g., bubbles, striae, inclusions, scratches, digs, mould marks and distortion due to surface irregularity.

6.9.5.2 Light diffusion

When tested in accordance with BS 2724 Appendix D, the reduced luminance coefficient of unused filters shall not exceed 0.5 cd/m^2lx.

6.9.6 Stability

6.9.6.1 Thermal stability

After treatment in accordance with BS 2724 Appendix E, filters shall not experience any change in their properties leading to them. The relative change in luminous transmittance shall be less than 5% for shade numbers 1.1. to 3.1 and less than 10% for shade Number 4.1.

6.9.6.2 Radiation stability

After exposure to radiation in accordance with BS 2724 Appendix E, the filter shall comply with Clauses 6.9.3 and 6.9.4. The relative change in luminous transmittance shall be less than 5% for shade numbers 1.1 to 3.1 and less than 10% for shade Number 4.1.

6.9.6.3 Flammability

When tested in accordance with BS 2724 Appendix E, plastics filters shall neither ignite nor continue to glow when removed from the oven.

6.9.7 Frames

6.9.7.1 Design and manufacture

Frames shall be free from obvious defects and shall be smoothly finished with no sharp edges or projections likely to cause discomfort or injury to the wearer.

6.9.7.2 Materials

All materials that come into contact with the wearer shall not be known to cause skin discoloration or irritation.

6.9.7.3 Flammability

When tested in accordance with BS 2724 Appendix E, frames shall neither ignite nor continue to glow when removed from the oven.

6.9.7.4 Security of filters

Filters shall be firmly and securely fitted to the frame. If the frame is fitted around the filters there shall be no gaps greater than 0.1 mm between the filter edge and the frame, unless they are a design feature.

6.9.8 Mechanical strength of break resistant, robust and impact resistant sunglasses

6.9.8.1 Break resistant sunglasses

When tested in accordance with either BS 2724 Appendix E (unmounted filters) or (mounted filters), a filter shall not break through its thickness into two or more pieces and more than 30 mg of filter material shall not become detached from the side remote from that receiving the load or from the concave side, as appropriate.

6.9.8.2 Robust sunglasses

When tested in accordance with BS 2724 Appendix E, sunglasses shall not suffer filter displacement, the filter shall not break through its thickness into two or more pieces and more than 30 mg of filter material shall not become detached from the side remote from that struck by the ball.

6.9.8.3 Impact resistant sunglasses

When tested in accordance with BS 2724 Appendix E sunglasses shall not suffer filter displacement, the filter shall not break through its thickness into two or more pieces and more than 30 mg of filter material shall not become detached from the side remote from that struck by the ball. The side pieces of the sunglasses shall not permit penetration of the ball through the material of the side piece and they shall not fracture through their thickness or produce jagged projections of side piece material that could reasonably be expected to damage the eye.

6.9.8.4 Frames

When tested in accordance with BS 2724 Appendix B, the frame and bridge of break resistant, robust and impact resistance sunglasses shall not show any breaks, tears, hairline cracks, sharp edges or points.

Note:

Filters displaced from the frame do not imply non compliance with this subclause.

6.9.9 Information and labeling

6.9.9.1 Information

The manufacturer or supplier of sunglasses shall provide the following information to be used on the packaging, as leaflets, by means of labeling or on a display card so that the information is available.

a) Manufacturer's or supplier's identification mark;
b) classification for recommended use and shade number(s) or nominal luminous transmittance(s);

Notes:

1) Additional information on transmittance values is desirable but not compulsory.
2) For gradient or photochromic filters, classification for recommended use should be determined by the lesser value of luminous transmittance.

c) classification of refractive quality;
d) classification of mechanical strength;
e) a warning that sunglasses are not intended to be used to view the sun directly;
f) where appropriate, warnings related to use, for example if the lenses are too dark for driving or if the sunglasses are unsuitable for use in solaria.

6.9.9.2 Labeling

Sunglasses shall be marked or labeled to show the following:

a) The number and year of Official Standard;
b) the name,trade mark or other identification of the manufacturer or supplier;
c) classification for recommended use;
d) classification of refractive quality;
e) classification of mechanical strength.

6.9.10 Performance and quality assurance

Manufacturers of sun glare eye protectors shall certify in writing that sun glare eye protectors are tested in accordance with relevant official of this Standard or BS 2724 for the following:

a) Test for determination of transmittance for all sun glare filters, the axis of polarization of polarized filters and fatigue of photochromic filters standard; BS 2724 Appendix B.

b) test of refractive, astigmatic and prismatic power; BS 2724 Appendix C.

c) test for quality of material and surface; BS 2724 Appendix D.

d) test for filter material stability and mechanical strength; BS 2724 Appendix E.

6.10 Prescription Safety Lens Spectacle

6.10.1 General

Employees using corrective lenses of prismatic, astigmatic and refracture prescription lenses working in an area and performing any types of work which require eye protections such as chemical handling, chipping, welding, grinding, laboratory, machining, spot welding, furnace operation and in a risk of harmful effect of ultraviolet, infrared and laser beams shall be protected by either safety prescription goggles or safety swing up type lenses or cover goggles to be worn over ordinary prescription lens spectacles.

6.10.2 Optical tests

Employees who shall wear corrective lens spectacle shall be tested and prescribed by ophthalmologist. Spectacles should be fitted with prescribed lenses in accordance with specifications covered in ISO 4855. The supplier shall certify in writing that the safety spectacles are tested as prescribed and meets all requirements for impact protection.

6.10.3 Classification

Prescription lens spectacle shall be classified into two types according to the shape of frame mounting:

1) Conventional spectacle type;
2) spectacle type with side shields.

6.10.4 Material

Material, exclusive of tempered glass lenses shall meet the following requirements:

a) They shall have suitable strength and elasticity for intended use;
b) material of parts to contact the skin shall be non-irritating and capable of being disinfected;
c) metal parts shall be made of corrosion resistance or treated as corrosion resistant;
d) plastic material shall not be of fast burning.

6.10.5 Construction

6.10.5.1 The general construction of the spectacle shall satisfy each of the following requirements:

a) It shall be simple of handling and not to break easily.
b) It shall not give remarkable discomfort to the user.
c) It shall be free from sharp edges or projections likely to cause cuts or scratches to the user.
d) Every part of spectacle shall be easily removed and replaced.

6.10.5.2 Conventional spectacle type shall be composed of two lenses a frame and temples.

6.10.5.3 Spectacles with side shields shall be of conventional spectacles type fixed firmly with side shields which shall obstruct visual field as little as possible.

6.10.6 Quality

6.10.6.1 Impact resistance

The spectacle in case of being subjected to the test shall have neither the lens edge chipped nor the lens displaced from frame by an impact.

6.10.7 Lens

6.10.7.1 Lens shall be free from any visible flaws, striae, bubbles, waves and foreign bodies, and both surfaces of it shall be well polished.

6.10.7.2 The lense shall be checked by ophthalmologist to make sure that they are made as prescribed before issuing to the employees.

6.10.7.3 Lens in case of subjected to the tests specified in accordance with BS 2738 shall not be fractured.

6.10.7.4 If lens supplied as pair, the two lenses should be reasonably matched in shape, size and form.

6.10.8 Cover lens

Ordinary prescription lens spectacle can be fixed with swing type cover safety lenses or employees using prescription lens spectacles can be protected by all plastic soft sided cover goggle with shielded vents or appropriate face shields.

SECTION 3
FACE PROTECTION

7. REQUIREMENTS FOR EYE, FACE AND NECK SHIELD PROTECTION

7.1 General

This section of Standard specifies requirements for equipment to protect an operator above the shoulders against harmful splashes, flying particles and radiations when engaged in welding, cutting and similar operations. The equipment are designed to use protective filters with or without filter covers.

Eyes and face can be protected from injuries caused by the above named factors if any appropriate equipment is made available and worn by the employees.

Face and neck protections against harmful liquid splashes and other hazards such as sand blasting will be covered in body protection in Section 7.

7.2 Classification of Protection Requirements

For the purposes of this Standard, operations in welding shall be grouped into the following classes in ascending order of protection requirements:

a) Class 1

Covering work, other than actual welding, in the vicinity of welding operations, where some protection from harmful radiation is required, but where good general vision is also necessary, for example work of supervisory staff and erectors.

For Class 1 operations, protection is provided by spectacles, goggles, face shields, hand shields, helmets or fixed shields.

b) Class 2

Covering gas welding and cutting, which involve direct exposure to radiation of heat and light, sparks and particles of metal and where moderate reduction of transmitted, ultraviolet and visible radiation is necessary. For Class 2 operations, protection is provided by goggles, face shields, hand shields, helmets or fixed shields.

c) Class 3

Covering electric-arc welding, cutting and similar processes involving direct exposure to high-intensity radiation, sparks and particles of metal, together with the risk of electric arcing from tools. In this work a large reduction in the ultraviolet infra-red and visible radiation is necessary.

For Class 3 operations, protection is provided by face shields, hand shields, helmets or fixed shields. Neck shields may also be necessary.

d) Class 4

Covering gas-shielded arc welding and cutting involving exposure to large amounts of ultraviolet infra-red and visible radiation both from direct radiation and by reflection together with particles of metal ejected from the arc region.

For Class 4 operations, protection is provided by helmets as for Class 3 but with provision for an auxiliary heat absorbing filter.

Neck shields are also sometimes necessary.

7.3 Optical Quality

Filters, cover lenses and backing lenses shall be free to within 5 mm of their edges from inherent faults that can be observed by the wearer when the equipment is worn. The inspection for faults shall be made by the wearer with his eyes focused at a variety of focal distances likely to be encountered at work. There shall be not attempt to focus on the filter cover lens or backing lens itself.

7.4 Protection Against Radiation

7.4.1 Filters and backing lenses

Each filter and backing lenses incorporated or intended for use with the equipment shall comply with BS 679.

7.4.2 Lateral protection, housings and frames

Lateral protection, housings and frames shall comply with Clause 7.5.7.

7.4.3 Replacement

Except for one-piece goggles, filters and filter covers shall be capable of replacement without the use of special tools.

7.5 Design and Manufacture

7.5.1 Field of view

The field of view shall not be obstructed except by the boundaries of the filter holders, if any.

7.5.2 Finish

All parts of the equipment shall be free from sharp edges or projections that could cause harm or discomfort to the user.

7.5.3 Filter housings

Where equipment is designed for replaceable filters, the housing provided shall take filters of one of the sizes specified in Clause 7.7. Filter housings and, in the case of spectacles, frames and lateral protection shall be provided at least the same protection against radiation as that given by the filters.

Note:

A consequence of this requirement is that users should exercise care when replacing filters with those of a darker shade than those originally fitted or supplied.

7.5.4 Additional filters

In the case of equipment for Class 4 duties, provision shall be made for accommodating a filter cover and two filters, the latter separated by a 1 mm thick spacer.

7.5.5 Construction

The design of the equipment shall not allow the direct entry of any particle or stray radiation to the inside from any angle forward of the plane of the rear edge of the equipment.

7.5.6 Heat insulation

All metal fittings that are likely to be exposed to radiation during use and that come into contact with the operator shall be insulated to reduce thermal conductivity.

7.5.7 Robustness

7.5.7.1 General

All equipment shall be designed and constructed to withstand a test for general strength of construction consisting of the impact of a 6.35 mm steel ball traveling at a velocity of 12.2 m/s.

The test shall be applied to the equipment fitted with filter(s) and backing lens(es) as normally offered for sale.

When so tested, the equipment shall not show any failure or deformation as specified in 7.5.7.2 to 7.5.7.5.

7.5.7.2 Filter/Backing lens failure

A filter or backing lens shall be deemed not to comply with this Standard if the ocular nearest to the eye of the test headform cracks through its entire thickness into two or more separate pieces or if more than 30 mg of material becomes detached from the surface of the filter or backing lens nearest to the eye of the test headform.

7.5.7.3 Filter/Backing lens deformation

A filter or backing lens shall be considered to have deformed when a mark appears on the white paper appropriate to the striking face of the ball.

7.5.7.4 Filter housing or frame failure

A filter housing or frame shall be deemed not to comply with this Standard if it is fractured, if its parts separate or if it allows the filter or backing lens nearest to the eye of the test headform to be knocked from it housing or frame.

7.5.7.5 Spectacle frame failure

A frame shall be deemed not to comply with this Standard if it fractures or its parts separate when the steel ball is projected three times on the hinge pin of the earbows and three times on the junctions of the bridge and lens holders.

7.6 Faceshields and Helmets

7.6.1 Design

7.6.1.1 Failure

Where movable filters are employed, for example filters hinged at the top, the design shall be such that on failure of the device, the wearer shall be protected against radiation, i.e. it shall be 'fail safe'.

7.6.2 Variable shade observation lens

7.6.2.1 Where a variable shade observation lens is employed in addition to the welding filter, it shall comply with 7.6.2.2 to 7.6.2.5.

Note:

Variable shade observation lenses enable the welder to commence the welding operation with the helmet or hand shield in position but with a clearer view than would be obtained through a high shade filter but should not be used to view welding operations.

7.6.2.2 The shade number of the observation lens in its darkened state shall be stated on the equipment, together with a warning to the effect that welding filters of a higher shade number than this shall not be used in the equipment.

7.6.2.3 The variable shade observation lens shall revert to its darkened state in the event of failure, i.e. the device shall be 'fail safe' in the event of loss of power or obstruction of the sensing device.

7.6.2.4 The response or activation time, i.e. the time between that taken to reach the 50% level of the maximum arc intensity and the time at which the variable shade observation lens attains a density within a visual density of 0.5 of that in the dark state, from light to darkened state of the variable shade observation lens shall not exceed the values given in Table 3.

TABLE 3 - SHADE NUMBERS AND PERMITTED RESPONSE TIMES

SHADE No. IN "DARK" STATE	MAXIMUM RESPONSE TIME ms
3 to 10	100
11 to 12	10
13 to 14	1
15 to 16	0.1

7.6.2.5 The transmission properties of the variable shade observation lens shall be as follows:

a) The non-visual densities in light or darkened state shall be greater than or equal to the minimum values specified in Clause 13 of BS 679: 1977 for the darkened state shade of the device.

b) The visual density in the darkened state shall be greater than or equal to the minimum values given in Table 4 for that shade number.

c) The visual density in the light state shall not be less than that of a shade number 3 filter.

7.7 Size of Filter Holder and Filters

7.7.1 Size of filter holders

A filter holder shall hold securely filters and filter covers of the appropriate size.

7.7.2 Size of filters

7.7.2.1 Filters shall have minimum dimensions of 105 mm × 50 mm, nominal.

Note:

The preferred sizes of filters are as follows:

a) 108 mm × 51 mm, nominal.
b) 108 mm × 82 mm, nominal.

The actual cutting size shall not differ from the nominal size by more than 1 mm.

Note:

Care should be taken to minimize confusion between sizes.

7.7.3 Hand grips for hand shields

Hand shields shall be provided with a hand grip that shall either be fixed inside the shield or be provided with other means of protection for the hand.

7.7.4 Electrical insulation

The value of electrical insulation between any metal part of the exterior and any part of the interior surface shall not be less than 500 000 Ω when tested as described in 7.12.(3) using a testing voltage of 500 V d.c. With the exception of the harness attachment to the shield, metal components used in the construction of the head harness shall be exempt from this requirement.

7.8 Neck Shields

Neck shields shall comply with 7.7.4 when tested as described in Appendices A to E of BS 679.

7.9 Fixed Shields

Fixed shields are for special needs and shall be exempt from the requirements of 7.4.3 and disinfection.

TABLE 4 - VISUAL DENSITY

SHADE No.	VISUAL DENSITY	
	min.	max.
1.2A	0.00	0.13
1.2	0.00	0.13
1.4	0.13	0.24
1.7	0.24	0.36
2.0	0.36	0.54
2.5	0.54	0.75
3	0.75	1.07
4	1.07	1.49
5	1.49	1.92
6	1.92	2.36
7	2.36	2.80
8	2.80	3.21
9	3.21	3.64
10	3.64	4.07
11	4.07	4.49
12	4.49	4.92
13	4.92	5.36
14	5.36	5.80
15	5.80	6.21
16	6.21	6.64

Note:

Filters, cover lenses and backing lenses for use during welding and similar operation shall comply with BS 679-1989 or ISO 4850, 4851 and 4852.

7.10 Marking

All equipment shall be clearly and permanently marked with the following:

a) The manufacturers name, trade mark or other identification mark.
b) The highest class number for which the article is suitable (see Clause 7.2).
c) The number of Standard.

Filters shall be permanently marked with the following:

a) The manufacturers name and trade mark;

b) the figure denoting shade number or if variable shade filter, the shade number in the light and dark states. If dual shade filter the shade number of each zone. If variable shade, the following warning:

(Do not use variable shade observation lens for viewing welding operation).

7.11 Disinfection

Each piece of equipment shall be disinfected by the user by immersion in a 1% (v/v) solution of dodicyl (deaminoethyl) glycine hydrochlorident or similar in tap water for 10 minutes.

7.12 Tests

The manufacturer shall certify in writing that the following tests have been carried out:

1) Resistance to corrosion test for metal parts Appendix B (BS 1542).
2) Ignitability (heated rod) test Appendix C (BS 1542).
3) Electrical insulation test for helmet and hand shield Appendix E (BS 1542).
4) Filter test Appendices A to E (BS 679) or equivalent Appendix E (BS 1542).

SECTION 4
HAND PROTECTION

8. HAND PROTECTION

8.1 General

This Section of Standard specifies the minimum requirements for material manufacturing details and performance requirements for gloves that afford protection to the hands and as appropriate to the wrists of the wearer when carrying manual operations that are common in IOGP (Iranian Oil, Gas and Petrochemical) work places.

For the purposes of this Standard, industrial gloves are divided into the types given in Tables 5 and 6.

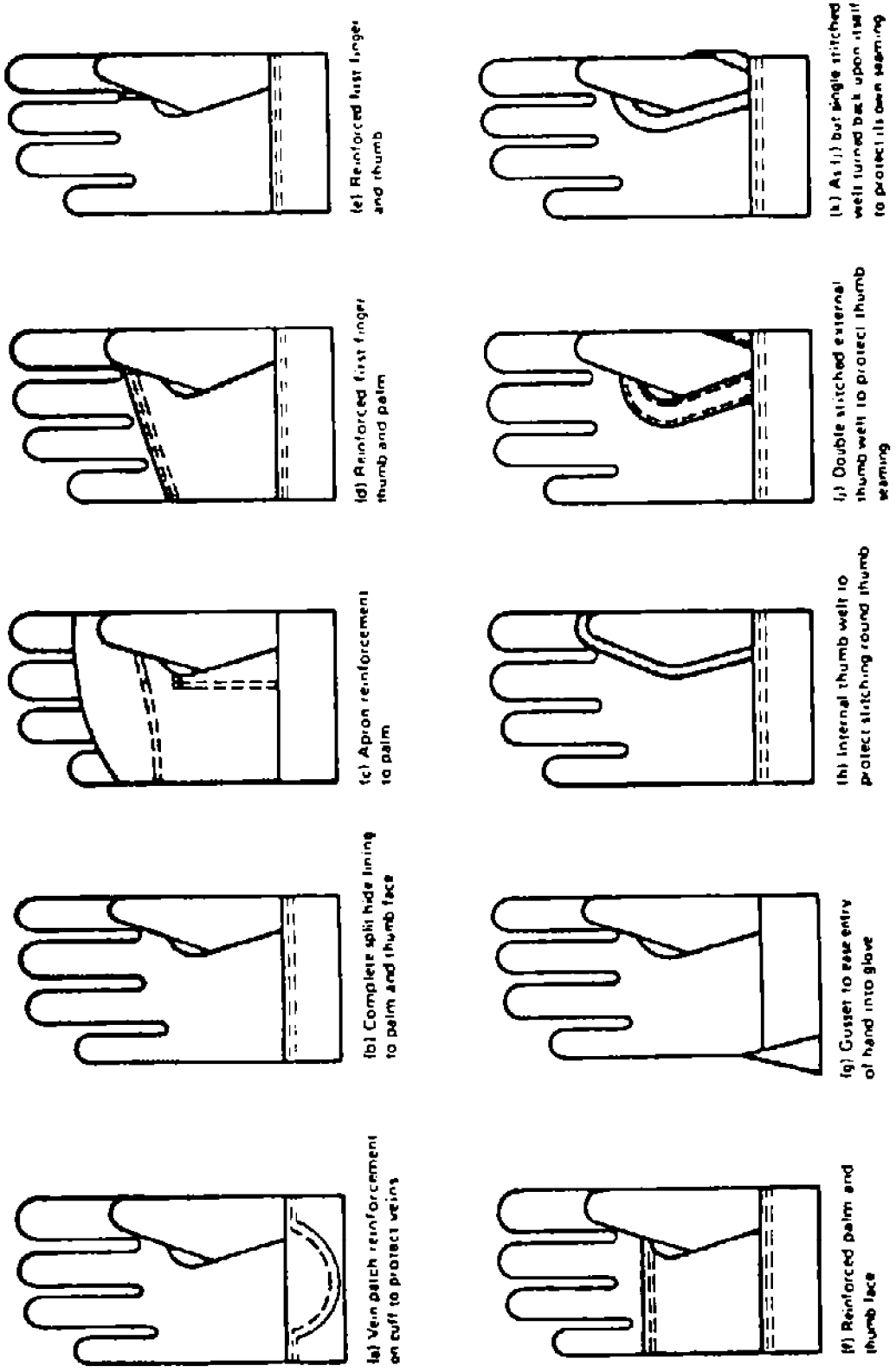
This Standard does not cover requirements for the following:

a) Gloves that are used for special purposes to afford protection against flame and high temperature such as fire entry gloves Ref. IPS-M-SF-455.

b) Gloves that are limited to special hazards such as sterilized surgical gloves.

TABLE 5 - GLOVE TYPES

TYPE NUMBER	DESCRIPTION
1	Flesh split leather inseam gloves, gauntlets, mitts and one finger mitts
2	Grain leather inseam gloves, gauntlets, mitts and one finger mitts
3	Fabric gloves with leather palms
4	Inseam gloves and gauntlets made wholly from fabric
5	Leather outseam armoured gloves and gauntlets
6	Lightweight PVC supported gloves with a rough finish
7	Lightweight PVC supported gloves with a smooth finish
8	Standard weight PVC supported gloves with a smooth finish
9	PVC gloves with a granular finish
10	Flock lined unsupported PVC gauntlets
11	Unflocked, matt finish, unsupported PVC gauntlets
12	Unlined rubber gloves or gauntlets
13	Flock lined rubber gloves or gauntlets
14	Fabric lined rubber gloves or gauntlets
15	Rubber gloves or gauntlets, fabric or flock lined or unlined with additional rubber reinforcement over the whole or part of the hand



ADDITIONAL DESIGN FEATURES FOR LEATHER AND FABRIC GLOVES
Fig. 4

TABLE 6 - CLASSIFICATION OF HAZARDS

HAZARD	TYPICAL OPERATIONS	SUITABLE GLOVES	GLOVE TYPE No.
Heat, but no serious abrasion	Furance work, drop stamping, casting, forging, handling hot objects	Heat resistant leather wrist gloves Heat resistant leather inseam mitts Heat resistant leather gauntlets Heat resistant leather gauntlets with canvas cuffs Felt mitts, palms faced with canvas or heat resistant leather Loop-pile gloves or gauntlets	1,2 1,2 1,2 1,2 3,4 4
Heat and abrasion	riveting, hot chipping	Heat and abrasion resistant leather gauntlets and mitts Fabric mitts with palms faced with canvas or heat and abrasion resistant leather	1,2 3,4
Heat when a fair degree of sensitivity is required and splashes or splatter of molten metal may occur	Welding, casting, galvanizing	Heat resistant leather inseam mitts Heat resistant leather gauntlets Heat resistant leather inseam gauntlets with leather cuffs	1,2 1,2 1,2
Sharp edged materials and objects	Swarf, guillotining metal, blanking, handling metal sheets, handling undressed castings	Leather inseam mitts and gauntlets Fabric gloves with palms faced with canvas or leather Supported PVC gloves with granular finish Reinforced rubber gloves heavy-weight	1,2 3,4 9 15
Sharp materials or objects in an alkaline degreasing bath		Supported PVC gloves with granular finish Reinforced rubber gloves heavy-weight	9 15
Glass or timber with splintered edges	Glass handling, timber handling, building demolition	Leather gloves and mitts Loop pile gloves Supported pvc gloves with granular finish Reinforced rubber gloves heavy-weight	1,2,3 4 9 15
Very heavy abrasion	Shot blasting	Reinforced natural rubber heavy-weight	15
Heavy abrasion	Handling dressed castings or forgings, bricks, concrete cement, steel stock, heavy duty packaging	Abrasion resistant leather inseam mitts Abrasion resistant grain hide palm split leather back inseam gloves Supported loop pile gloves Abrasion resistant leather stapled double palm gloves PVC gloves, granular surface heavy-weight Reinforced natural rubber gloves	1,2 2 4 5 9 15

(to be continued)

TABLE 6 - (continued)

HAZARD	TYPICAL OPERATIONS	SUITABLE GLOVES	GLOVE TYPE No.
Light abrasion	Handling of packaged goods, general laboring	Leather wrist gloves and mitts Fabric gloves Fabric gloves with leather palms Loop pile gloves PVC gloves Rubber gloves	1 4 3 4 6,7,8,9,10,11 12,13,14,15
Solvents*	Degreasing, printing, chemical manufacturing, paint spraying	Supported pvc gloves rough, smooth, lightweight (excluding open back and knitted wrist styles) PVC lined gloves smooth and granular finish (excluding open back and knitted wrist styles) Natural and synthetic rubber gloves and gauntlets	6,7 7,8,9,10 12,13,14
Chemicals*	Acids, alkalis, dyes and general chemical hazards not involving contact with solvents or oils	Standard weight PVC gloves PVC gloves with a granular finish (excluding open back and knitted wrists styles) rubber gloves	8 9 12,13,14,15
Fats, oils*	Chemical hazards involving contact with oils	Standard weight supported pvc gloves and gauntlets Granular finish PVC gloves and gauntlets (excluding open back and knitted wrist styles) Natural and synthetic rubber gloves and gauntlets	8 9 12,13,14

Note:

*** It is important that the Purchaser or user should seek advice from manufacturer before making a final selection of the type of glove to meet his particular needs. Attention is drawn to the method of tests and the type of glove under consideration.**

8.2 Materials

Note:

Materials that are known to be likely to cause skin irritation or any adverse effect on health of the user shall not be considered as materials of construction.

8.2.1 Leather

8.2.1.1 The leather shall not contain cuts, holes or grain damage.

8.2.1.2 Grain leather shall not crack when subjected to a double fold grain-side outward. The second fold shall be at right-angles to the first.

8.2.1.3 The leather shall be full chrome tanned, semichrome tanned or combination tanned.

8.2.1.4 The tear strength of the leather shall not be less than 108 N (11.0 kgf) when tested.

8.2.1.5 The grease content of the leather when a sample is dried; shall not be less than 5% and not greater than 25%.

8.2.1.6 The chromic oxide, zirconium oxide and aluminum oxide content of the leather, calculated on a fat-free bases, shall be in accordance with the following when a sample of the leather is dried and subsequently tested:

Full chrome leathers shall contain not less than 3.5% chromic oxide (Cr_2O_3) and semi-chrome leathers not less than 2% chromic oxide.

Combination tanned leathers not containing an organic tanning agent shall contain not less than 3.5% of metal oxides-derived from mineral tanning agents, i.e. chromic oxide, zirconium oxide and aluminum oxide. Where mineral tanning agents are used in conjunction with an organic tanning agent the leather shall contain not less than 2% metal oxide in total.

8.2.1.7 The pH value of an aqueous extract of the ground leather, shall not be lower than 3.2.

8.2.1.8 When two specimens of the leather are tested at temperature of 90°C and a test time of 1 min., neither specimen shall shrink by more than 10% of its original area.

8.2.19 No chromate shall be detected when a sample of the aqueous extract of the leather is tested.

8.2.2 Woven fabrics

The breaking strength of the woven fabric shall be in accordance with Table 7.

TABLE 7 - BREAKING STRENGTH OF WOVEN FABRICS

DIRECTION	BREAKING STRENGTH	
	UNRAISED	RAISED
	N	N
Warp	1100	980
Weft	580	350

8.2.3 Loop pile fabric (terry fabric)

When tested the cloth shall have a minimum mass per unit area of 670 g/m² for medium weight reversible loop pile fabric gloves and mitts and 930 g/m² for heavy weight reversible loop pile fabric gloves and mitts, using the largest sample possible and adapting the procedure and the calculation of results accordingly. (As described in methods of BS 2471.)

The fabric shall be constructed with 5.5 to 7 courses per centimeter and 3 to 4 wales per centimeter. The abrasion resistance of the fabric shall be such that the loss in mass is not greater than 0.18 g.

8.2.4 Sewing threads

The sewing thread for leather and fabric gloves (Types 1 to 5) shall be a polyester and cotton core spun thread or shall be a cotton or linen thread of equivalent tensile strength.

8.2.5 Stitches

All stitching shall be lock stitch or double thread chain stitch, and there shall be 27 to 35 stitches per 10 cm for fabric gloves and 23 to 31 stitches per 10 cm for all-leather gloves.

8.3 Construction and Design

8.3.1 Type 1

Flesh split leather inseam gloves and gauntlets, mitts and one-finger mitts.

8.3.1.1 Style

Type 1 gloves and gauntlets shall be of the Clute or Gunn pattern and be inseam apart from the back, which may be either inseam or outseam.

8.3.1.2 Materials

The leather shall be flesh splits complying with 8.2.1. The thickness for gloves shall not be less than 1.2 mm and not more than 1.6 mm. For one-finger mitts and mitts, the thickness shall not be less than 1.4 mm. The leather of gloves, gauntlets and mitts marked 'heat resistant' shall comply with Clause 6-2 BS 1651. The sewing thread shall comply with 8.2.4.

8.3.1.3 Design

For clute pattern gloves and one-finger mitts the palm and the leather covering the back of the first finger and the front of all fingers shall be cut from one piece of leather. The cuff shall be cut from not more than two pieces of leather and shall be joined to the glove by a double row of stitching.

Notes:

1) Provision for a wider opening to the gloves, if required, may, for example, be by a triangular leather gusset fitted at the side seam.

In the case of Gunn pattern gloves and inseam mitts, the palm, fronts of the first and fourth fingers and thumb shall be cut from one piece of leather. The fronts of the second and third fingers shall be cut from one or two pieces of leather. The back shall be cut from one piece of leather.

2) Where a wing thumb (see Fig. 8) is used, a seam wholly or partly along the join between the first finger and palm is permissible.

8.3.2 Type 2 grain leather inseam gloves, gauntlets, mitts and one-finger mitts

8.3.2.1 Style

Type 2 gloves and gauntlets, inseam mitts and one-finger mitts, shall be of the Clute or Gunn pattern, and inseam apart from the back, which may be either inseam or outseam.

8.3.2.2 Materials

The leather shall comply with 8.2.1. In the Clute pattern the palm, the fronts of the fingers and the whole of the thumb shall be of grain leather not less than 1.2 mm and not more than 1.7 mm thick. The backs of the fingers shall be either of grain leather or of flesh split leather.

In the Gunn pattern the palm and the fronts of the fingers shall be of grain leather not less than 1.2 mm and not more than 1.7 mm thick. The back shall be of the flesh split leather, cut from one piece and shall cover at least three fingers of the backs up to the cuff. The sewing thread shall comply with 8.2.4

8.3.2.3 Design

The cuff shall be made from no more than two pieces and shall be joined to glove by a double row of stitching. Where a vein patch, comprising a semi-circular piece as shown in Fig. 9 of grain leather, is fitted it shall be sewn midway in the palm of the glove at the cuff seam and sewn on to the cuff. The patch shall not be less than 75 mm in diameter.

Note:

Provision for a wider opening to the gloves, if required, may, for example, be by a triangular leather gusset fitted at the side seam.

8.3.3 Type 3 fabric gloves with leather palms

8.3.3.1 Style

Type 3 gloves shall be of the Gunn or Clute pattern with a fabric back and cuff and be inseam sewn.

8.3.3.2 Materials

The leather shall be flesh splits not less than 1.0 mm thick or grain leather not less than 1.2 mm thick and shall comply with 8.2.1. Woven fabric shall comply with 8.2.2. Loop pile fabric, except for knitted wristing fabric, shall comply with 8.2.3. The sewing thread shall comply with 8.2.4.

8.3.3.3 Design

Clute pattern gloves shall be one of the following three designs:

a) Leather palm and thumb with all four finger backs in a textile fabric.

b) Leather palm, thumb and part wrap around first finger. The second, third and fourth fingers to be from a textile fabric and the leather from the palm shall cover the thumb side of the first finger without seam with the remainder of the first finger to be made from fabric.

c) Leather palm, thumb and first finger with no seam between the first finger and palm. The second, third and fourth fingers shall be made from a textile fabric. If a woven cuff is used the length after sewing shall be not less than 50 mm. The edges shall be hemmed or over-locked.

In the Gunn pattern, the back shall be of textile fabric in one piece and shall cover at least three fingers of the backs up to the cuff.

8.3.4 Type 4 fabric gloves

8.3.4.1 Style

Type 4 gloves shall be inseam gloves and gauntlets made wholly from fabric.

8.3.4.2 Materials

Type 4 gloves shall be made from woven or loop pile fabric complying with 8.2.2 or 8.2.3 respectively. The sewing thread shall comply with 8.2.4.

8.3.4.3 Design

The glove shall be closed inseam and the cuff edge if of woven fabric shall be hemmed or over-locked. The cuff shall be fabricated by one of the following methods:

a) In the same material as the glove;
b) in a canvas material of mass per unit area not less than 320 g/m²; or
c) by use of a fabric to produce a double rib cuff of minimum length 50 mm.

The wristing shall be of mass per unit area not less than 230 g/m² .

8.3.5 Type 5 leather outseam-armoured gloves and gauntlets

8.3.5.1 Style

Type 5 gloves or gauntlets shall be of the Clute or Montpelier pattern. The seams of the fingers and thumb shall be wire-stitched. In the Clute pattern the seams on the back of the glove shall be sewn with thread.

Notes:

1) The fingers and thumb may additionally be sewn with thread.
2) The seams may additionally be wire stitched.

8.3.5.2 Materials

The leather shall be flesh splits complying with 8.2.1. The thickness for the palm/finger shall not be less than 1.4 mm and not more than 2.0 mm. The sewing thread shall comply with 8.2.4.

8.3.5.3 Design

The glove palm, fingers and working surface of thumb shall be reinforced by galvanized steel staples. The closed staples shall not be less than 2.5 mm wide, not less than 0.5 mm thick and not less than 8 mm long.

The stapling shall be applied diagonally or horizontally to the palm, finger and the front face of the thumb, and shall consist of rows of staples running from the tips of the fingers to the seam joining the cuff. there shall be 130 ±15 staples on each glove arranged so as to give maximum protection to the wearer. All staples shall be firmly closed. The palm shall be lined to ensure that the staples do not come into contact with the hand.

Note:

For this purpose the lining should be of leather or heavy-weight fabric of appropriate thickness.

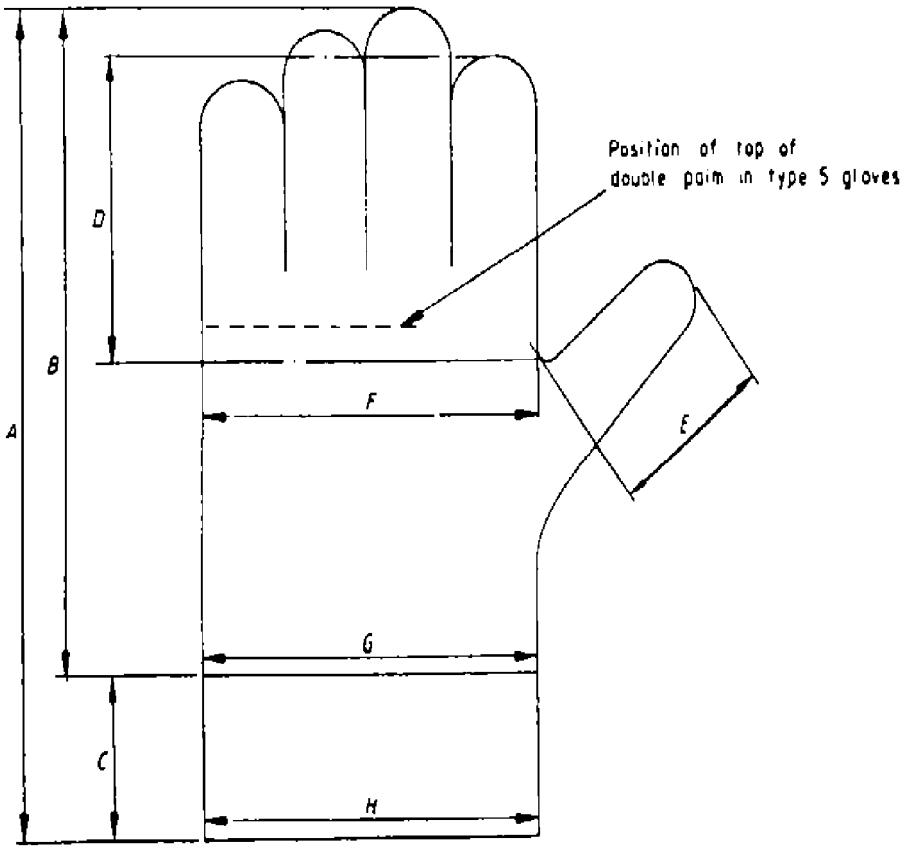
8.3.6 Sizing and dimensions

8.3.6.1 Sizing

Leather and fabric-fingered gloves shall fit on a glove iron the minimum palm circumference of which is 254 mm for men's gloves.

8.3.6.2 Dimensions

The minimum outside dimensions of leather and fabric gloves shall be as given in Tables 8, 9 and 10 and as shown in Fig. 5. Gauntlet cuffs shall not be less than 100 mm nor greater than 250 mm in length.



DIMENSIONS OF LEATHER AND FABRIC GLOVES
Fig. 5

Note:

Dimension C, together, if appropriate, with dimensions G and H, apply to the cuff, particularly when the latter is a discrete extension to the glove or mitt.

TABLE 8 - MINIMUM OUTSIDE DIMENSIONS OF GLOVE TYPES 1, 2, 3 AND 4

POSITION WHERE MEASURED	FIG. 10 REFERENCE	MEN'S SIZE mm
From tip of second finger position to top of cuff	A	225
From tip of second finger position to bottom of cuff	B	205
Cuff length	C*	50
From tip of forefinger position to crotch of thumb	D	125
From tip of thumb to crotch of thumb	E	75
Across palm at crotch of thumb	F	125
Across bottom of cuff	G	125
Across cuff opening	H*♣	125

*** Applicable only to wrist gloves.**

♣Not applicable to knitted wrist cuffs.

TABLE 9 - MINIMUM OUTSIDE DIMENSIONS OF TYPE 5 GLOVES, CLUTE PATTERN

POSITION WHERE MEASURED	FIG. 10 REFERENCE	MEN'S SIZE mm
From tip of second finger to top of glove	A	225
From tip of forefinger to crotch of thumb	D	135
From tip of thumb to crotch of thumb	E	75
Across palm at crotch of thumb	F	135
Across cuff opening	H*	135

*** Applicable only to wrist gloves.**

TABLE 10 - MINIMUM OUTSIDE DIMENSIONS OF TYPE 5 GLOVES, MONTPELIER PATTERN

POSITION WHERE MEASURED	FIG. 10 REFERENCE	MEN'S SIZE mm
From tip of second finger to top of glove	A	225
From tip of forefinger to crotch of thumb	D	125
From tip of thumb to crotch of thumb	E	75
Across palm at crotch of thumb	F	135
Across opening at top of glove	H*	135

*** Applicable only to wrist glove.**

8.4 PVC Gloves (Types 6 to 11 of Table 5)

8.4.1 General

The gloves shall be manufactured by a dipping process from a PVC plastisol or organosol complying with Clause 8.4.2. Where the coating is supported by a fabric, the gloves shall comply with the general requirements of 8.4.3.1 and with the specific requirements of 8.4.3.2. Unsupported PVC gloves shall comply with the general requirements of 8.4.3.1 and with the specific requirements of 8.4.3.3.

8.4.2 Materials

The PVC coating shall be virgin homogeneous PVC plasticized compound.

Note:

Substances that are known to the likely to cause skin irritation or any adverse effect on the health of the user should not be incorporated within the materials from which the gloves are made.

8.4.3 Construction and design

8.4.3.1 Appearance

Gloves for protection against liquids shall be free from patched areas, embedded foreign matter, perforations, porosity, blisters and exposed fiber on the external surface of the glove.

8.4.3.2 Fingers

The fingers shall be entirely separate and shall not be interconnected in any way by PVC.

8.4.4 Supported PVC gloves

8.4.4.1 Classification

Supported PVC gloves shall be classified in accordance with Table 11.

8.4.4.2 Design

Shall be as follows:

a) Size

The sizes of supported PVC gloves, the minimum length of the gloves and, where appropriate, the maximum width and length of wristing shall be as given in Table 12.

b) Gauntlet gloves

All sizes of gauntlet gloves shall have a minimum length of 260 mm.

c) Liner

There shall be no seams on the effective wording surface of the liner.

d) Thumb

There shall be no seam triple union in the crotch area of the thumb.

e) Seams

All seams shall be covered by the PVC coating except the back wrist/hand and part of the side seam opposite the thumb of a palm coated open back glove.

f) Coating

The coating shall show no signs of penetration of PVC into the interior of the glove resulting in nodules which could give rise to abrasion of the skin of the user.

g) Average palm thickness

The average palm thickness of the glove when measured shall be in accordance with Table 11.

8.4.5 Unsupported PVC gloves

8.4.5.1 Classification

Unsupported PVC gloves shall be classified in accordance with Table 13.

8.4.5.2 Sizes

The minimum length of all sizes of unsupported PVC gloves shall be 230 mm.

8.4.5.3 Average palm thickness

The average palm thickness of the glove, when measured shall be in accordance with Table 13.

TABLE 11 - CLASSIFICATION OF SUPPORTED PVC GLOVES

TYPE	WEIGHT/ DESCRIPTION	STYLE PATTERNS	AVERAGE PALM THICKNESS* mm
6	Light weight rough finish.	Knitted wrist, gauntlet, or palm coated open back.	Not less than 0.75, not greater than 1.2.
7	Light weight smooth finish.	Knitted wrist, gauntlet, or palm coated open back.	Not less than 0.75, Not greater than 1.2.
8	Standard weight smooth finish.	Knitted wrist, gauntlet, or fully coated.	Not less than 1.2, Not greater than 1.7.
9	Granular finish.	Knitted wrist, gauntlet, or palm coated open back.	Not less than 1.1.

***Average palm thickness measured by the method described in Appendix H of BS 1651.**

TABLE 12 - SIZE DESIGNATION OF SUPPORTED PVC GLOVES

SIZES	MINIMUM LENGTH mm	MAXIMUM WIDTH OF WRISTING* IF USED mm	MINIMUM LENGTH OF WRISTING IF USED mm
6, 6½ and 7	215	85	50
7½, 8, 8½ and 9	240	90	55
9½, 10 and 10½	255	95	55

*** Measured at base of wristing.**

TABLE 13 - CLASSIFICATION OF UNSUPPORTED PVC GLOVES

TYPE	DESCRIPTION	STYLE PATTERN	AVERAGE PALM THICKNESS* mm
10	Flock lined	Gauntlet	Not less than 0.70
11	Unflocked matt finish	Gauntlet	Not less than 0.076

*** Measured by the method described in Appendix H of BS 1651.**

8.5 Rubber Gloves (Types 12 to 15 of Tables 5 and 17)

8.5.1 Material

8.5.1.1 The glove shall be made from natural or synthetic vulcanized elastomers of natural rubber (NR), chloroprene (CR) or butadiene/acrylonitrile (NBR) or mixtures of these materials.

Note:

Substances that are known to be likely to cause skin irritation or any adverse effect on the health of the user should not be incorporated within the materials from which the gloves are made.

8.5.1.2 When the glove is produced from a mixture of polymers the requirements of BS 1651 Clause 13 shall be applied for the principal polymer used.

8.5.1.3 Sewing threads for liners shall be of cotton 50/2 cord or threads of equivalent strength.

8.5.2 Construction and design

8.5.2.1 Appearance

Gloves for protection against liquids shall be free from patched areas, embedded foreign matter, perforations, porosity, blisters and exposed fiber on the external surface of the glove.

8.5.2.2 Classification

Gloves shall be classified for type and thickness in accordance with Tables 14 and 15. The minimum length and the wall thickness of each type shall be as given in those tables. Thickness shall be measured as described in method A1 of BS 903: Part A38 using a gage with a circular foot of 5 ±0.1 mm diameter.

8.5.2.3 Design

The sizes of rubber gloves and the palm circumference of the glove which shall be measured around the inside of the glove starting and finishing at the thumb crotch, shall be as given in Table 15.

TABLE 14 - THICKNESS CLASSIFICATION OF RUBBER GLOVES

TYPE	WEIGHT	SYMBOL	SINGLE WALL THICKNESS* mm
12 and 13	Ultra-lightweight	U	Not greater than 0.5
12 and 13	Lightweight	L	Greater than 0.5, Not greater than 0.9
12 and 13	Medium-weight	M	Greater than 0.9, Not greater than 1.3
12 and 13	Heavy-weight	H	Greater than 1.3
14	Lightweight	L	Greater than 0.5, Not greater than 1.0
14	Medium-weight	M	Greater than 1.0, Not greater than 1.5
14	Heavy-weight	H	Greater than 1.5

*** For type 14 gloves the specified thickness is that of the elastomer and fabric combined.**

TABLE 15 - SIZE DESIGNATION OF RUBBER GLOVES

SIZE NOMENCLATURE		NUMERICAL SIZE DESIGNATION * in.	INTERNAL PALM CIRCUMFERENCE (TOLERANCE EMBED $^{+10}_{-6}$ mm)
Small	(S)	6 ½	165
Medium	(M)	7 ½	191
Large	(L)	8 ½	216
Extra-large	(XL)	9 ½	241
Extra-extra-large	(XXL)	10 ½	267

*** The figures given in this column are the same as the numerical values of internal palm circumference expressed in inches.**

8.6 Performance Requirement

Gloves should be tested in accordance with Appendices A to K of BS 1651 covering the following:

a) Method for detection of soluble chromate.
b) Method of test for abrasion resistance of loop pile and PVC gloves.
c) Additional design feature of leather and fabric gloves.
d) Method of test for abrasion resistance of leather gloves.
e) Calculation of percentage area loss after testing in accordance with Clause 16 of BS 3144.
f) Preparation of test specimens and condition.
g) Thermal contact test.
h) Method of test for the determination of thickness of PVC gloves
i) Method of test for degree of gelatin of PVC gloves
j) Method of test for flex cracking of PVC gloves
k) Method of test for air permeability of PVC and rubber gloves

TABLE 16 - TYPE DESIGNATION OF RUBBER GLOVES

TYPE	DESCRIPTION	STYLE	MINIMUM LENGTH mm
12	Unlined	Wrist	265
		Gauntlet	305
13	Flock lined	Wrist	265
		Gauntlet	305
14	Fabric lined	Wrist	265
		Gauntlet	305
15	Unlined, flock Lined or fabric Lined with additional Rubber Reinforcement over The whole or part of the hand	Wrist Gauntlet	265 305

8.7 Marking

Gloves or their immediate packaging shall be clearly marked with the following:

a) Gloves type number as given in Table 5.

b) If appropriate, the code letters defining the type of elastomer used or its full name.

c) If appropriate, for rubber gloves, the words "ultra-lightweight", "lightweight", "medium-weight" or "heavy-weight" or the symbol letters given in Table 14.

d) If appropriate, for leather and fabric gloves, the words "heat resistant".

e) If appropriate, for leather and fabric gloves, the words "abrasion resistant".

f) If appropriate, for PVC and rubber gloves, the words "pressure tested".

8.8 Rubber Gloves for Electrical Purposes

8.8.1 Rated potential

The rated potential (a-c(r-m-s) or d.c.) between any conductors and earth in a system does not exceed the following:

a) 650 V
b) 1000 V
c) 3300 V
d) 4000 V

8.8.2 Composition

Gloves shall be made from good quality raw natural rubber or raw synthetic rubber or from a mixture of these, in conjunction with suitable compounding ingredients.

8.8.3 Construction

Gloves shall be made by a one-piece process or shall be built-up from sheet. Gloves shall be free from patched areas, embedded foreign matter, blisters (other than shallow broken blisters) and other physical defects that may arise from any lack of physical homogeneity or continuity in the glove material, when inspected in a well-lit area by the naked eye (aided by spectacles if necessary to ensure normal vision) of a designated person.

Note:

Minor surface irregularities that can cause no hazard nor significant degradation in quality or life may be disregarded.

8.8.4 Length

The minimum internal length from the tip of the second finger to the edge of the cuff, denoted as dimension in Fig. 6, shall be 265 mm for the wrist type and 355 mm for the gauntlet type.

8.8.5 Typical dimensions

Two types of former may be used in the manufacture of rubber gloves, namely, a flat type and a shaped type. Gloves made on the shaped type of former are generally more comfortable.

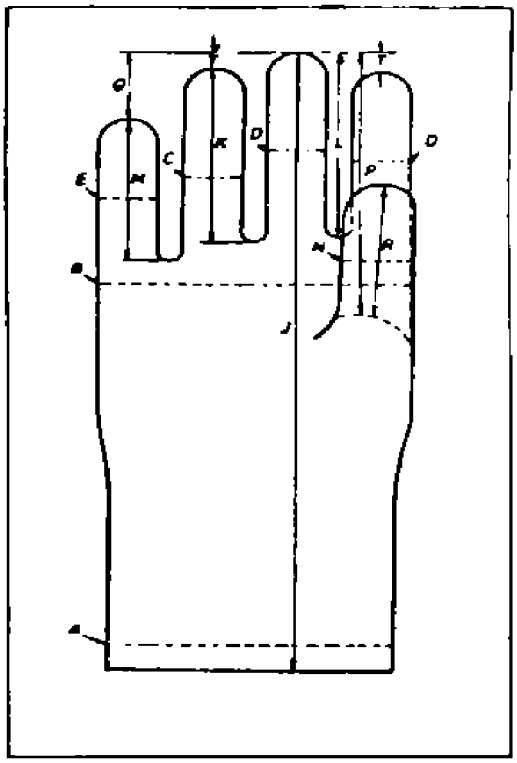
Table 17 gives typical values of the principal internal dimensions of well proportioned gloves. The external dimensions will depend on the thickness of the rubber used.

TABLE 17 - TYPICAL INTERNAL DIMENSIONS

DETAIL (SEE FIG. 6)	SIZE			
	8 mm	9 mm	10 mm	11 mm
Circumferences				
A	218	236	254	271
B	218	236	254	271
C*	58	62	67	72
D*	60	65	70	75
E*	57	60	65	69
N*	72	78	84	90
Lengths				
J (Minimum) ♣ Wrist	265	265	265	265
Gauntlet	355	355	355	355
K	67	70	74	78
L	75	80	84	88
M	57	60	63	67
P	110	116	122	128
Q	28	31	31	33
R	57	59	62	65
T	8.5	9	9.5	10

*** Circumference is measured half-way between crotch and tip.**

♣The values for dimension J are the minimum requirements.



OUTLINE OF TYPICAL STANDARD GLOVE (INTERNAL DIMENSIONS)
Fig. 6

Note:

If required, a reinforced extension for suspension purposes may be incorporated on the back of the wrist of wrist-type rubber gloves but an extension should be the subject of agreement between the Purchaser and the manufacturer.

8.8.6 Color codes

If gloves are color coded to indicate the rated potential, the colors used shall be in accordance with Table 18.

TABLE 18 - COLOR CODES

RATED POTENTIAL	COLOR
V (r.m.s.)	
650	White
1000	Red
3300	Green
4000	Blue

8.8.7 Performance

Rubber gloves for electrical purposes shall be tested by manufacturer and subsequently by user in accordance with BS 697 for the following tests:

a) measurement of thickness;
b) electrical resistance

8.8.8 Instructions

Instructions shall accompany each pair of gloves and shall include the following information:

a) recommendations for storage and cleaning (including maximum washing and drying temperatures);
b) appropriate details of inspection and re-testing procedures.

8.8.9 Marking

Each glove shall be marked with the following:

a) The number and date of relevant standard;
b) the name, trade mark or other means of identification of the manufacturer;
c) the month and year of manufacture;
d) the rated potential followed by the word 'working' in brackets;
e) the size.

The marking shall be durable and shall not impair the properties and characteristics of the glove.

8.8.10 Guidance concerning the maintenance, storage, inspection, re-testing and use of rubber gloves after purchase

8.8.10.1 Storage

Gloves should be stored unfolded in a container in a dry, dark place where the temperature is between 10°C and 21°C. Gloves that have been issued for service but which are not in use should be kept in containers used solely for that purpose or in a place where they will not be subject to mechanical or chemical damage.

8.8.10.2 Issue

Gloves intended for linesmen and other outdoor workers should be issued in a protective container free from grease and oil, and suitable for the class of work for which they will be used. Canvas or leather bags that can be attached to the linesmen's belts are suitable for overhead line work. Fiber boxes are appropriate when gloves need to be kept in tool boxes. Gloves issued for emergency use only should be kept in waterproof containers.

8.8.10.3 Examination before use

Each glove shall be examined inside and outside before each occasion of use. If either of a pair of gloves is thought to be unsafe, the pair should be re-tested.

8.8.10.4 Precautions in use

Care shall be taken to avoid mechanical damage caused by abrasion or sharp edges. Gloves shall not be exposed unnecessarily to heat or light or allowed to come into contact with solvents, oils or other chemical agents.

If other protective gloves are used at the same time as rubber gloves for electrical purposes, they should be worn over the rubber gloves. If the outer protective gloves become damp, oily or greasy, they should be removed. They should also be removed from the rubber gloves when the latter are not in use.

When rubber gloves become soiled they should be cleaned by washing with soap and water at a temperature not exceeding that recommended by the glove manufacturer, thoroughly dried and dusted with talc. If insulating compounds such as tar and paint continue to stick to the glove, the affected parts should be wiped immediately with a suitable solvent, avoiding excessive use, and then immediately cleaned as described in the preceding sentence. In case of difficulty, advice should be sought from the manufacturer.

Gloves which become wet in use or by washing should be dried thoroughly, but not in a manner that will cause the temperature of the gloves to exceed 65°C.

8.8.10.5 Inspection and re-testing of gloves

Gloves that are used frequently should be re-tested at intervals of not more than 6 months. Gloves that are used only occasionally should be re-tested after use and, in any event, at intervals of not more than 12 months. Gloves held in store should be re-tested at intervals not exceeding 12 months.

Surface defects may develop with use, resulting from the breaking of blisters in the rubber or from foreign matter breaking through the surface. Gloves showing any such defects on return to store should be destroyed or rendered unusable. Each finger of each glove should be stretched by hand to ascertain that its mechanical strength is adequate. Those which appear to be in good condition should be re-tested by being given a single electrical test in accordance with the appropriate test potential specified in this Standard (i.e.,according to the rated potential), and in the manner described in Appendix B of BS 697. In the re-test, no glove should break down or show a leakage in excess of the specified maximum value shown in Table 1 or 3, BS 697, as appropriate. Only those gloves that pass the re-test should be accepted as satisfactory. Other gloves should be rejected and destroyed or rendered unusable for electrical purposes.

8.8.10.6 Salvage

When only one glove of a pair is rejected, the other, where possible, may be mated with a similar glove of same size and make; the resulting pair, after re-testing, may be placed in serviceable stock. No glove should be turned inside out for mating.

8.9 Protective Leather Gloves for Welders

8.9.1 Types

The types of gloves shall be as shown in Table 19, according to the materials, shapes and purposes.

TABLE 19

TYPE		MATERIAL		SHAPE	PURPOSE
Class 1	No. 1	Palm and back	Cow-leather	2- Finger	For chiefly arc welding
	No. 2	Cuff	Back split	3- Finger	
	No. 3		Cow leather	5- Finger	
Class 2	No. 1	Palm and back	Back split	2- Finger	For chiefly gas welding, fusion cutting
	No. 2		Cow leather	3- Finger	
	No. 3		Back leather	5- Finger	
		Cuff	Cow leather		

8.9.2 Construction, dimensions and thickness of leather

8.9.2.1 Construction of gloves

The construction of gloves shall be in 2-finger, 3-finger and 5-finger types, for both Classes 1 and 2, the seam between the palm and back being stitched together with a welt leather inserted in. For the welt, chrome tanned cow leather or back split of cow leather shall be used. For inset and reinforcing leather, the same leather as for the palm and back shall be used, and the width of reinforcing leather shall not be less than 15 mm. The parts of glove where such additional pieces are to be used shall conform to Table 20.

TABLE 20

TYPE		APPLICABLE PART		
		Welt leather	Reinforcing leather	Inset leather
Class 1 and Class 2	No. 1	Seam of palm and back	Boundary of crotch of thumb	—
	No. 2	Seam of palm and back	Boundary of crotch of thumb	Sides between Forefinger and middle finger
	No. 3	Seams at crotches of middle and ring finger and thumb	—	—

Note:

The inset leather may be omitted according to the construction for manufacturing convenience.

8.9.2.2 Dimensions

The minimum standard dimensions of the gloves shall conform to Table 21. In the Table, A is the outside length from the tip of middle finger to the bottom of cuff, B is the outside length from the tip of middle finger to the top of cuff, C is the length of cuff and D is the width across palm at the crotches of forefinger and little finger (see Figs. 7, 8 and 9).

TABLE 21

UNIT: mm

TYPE		LENGTH			WIDTH
		A	B	C	D
Class 1	No. 1	350	200	150	130
and	No. 2	350	200	150	130
Class 2	No. 3	350	200	150	130

8.9.2.3 Thickness

The thickness of leather shall conform to Table 22.

TABLE 22

UNIT: mm

APPLICABLE PART	KIND OF LEATHER	THICKNESS
Palm and back	Cow leather	1.5 min.
	Back split cow leather	1.5 min.
Cuff	Back split cow leather	1.0 min.

Remark:

The thickness for palm and back of No. 3 shall not be less than 1.0 mm.

8.9.2.4 Material

a) Leather

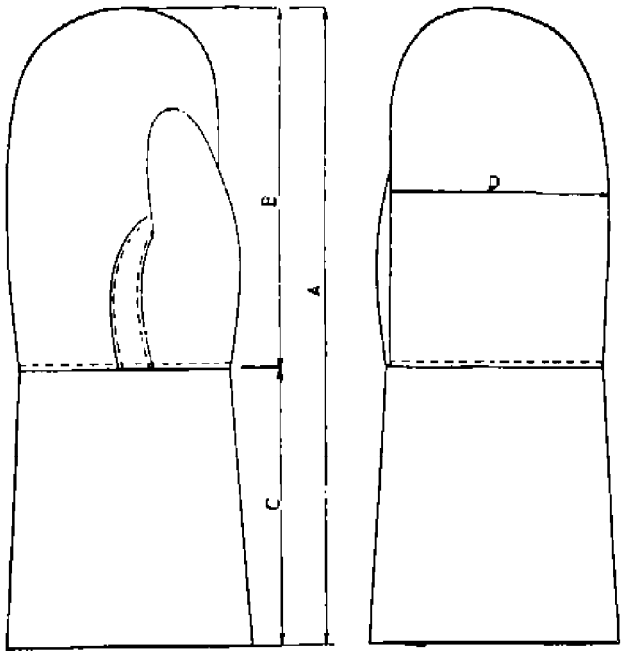
The main materials of the gloves shall be chrome tanned cow leather and back split thereof, which shall satisfy the values in Table 23. For the palm and back of the gloves, in particular, leather of nearly uniform thickness, being free from uneven splitting, and being flexible and strong shall be used, and the leather for the cuff shall be of moderate elasticity.

TABLE 23

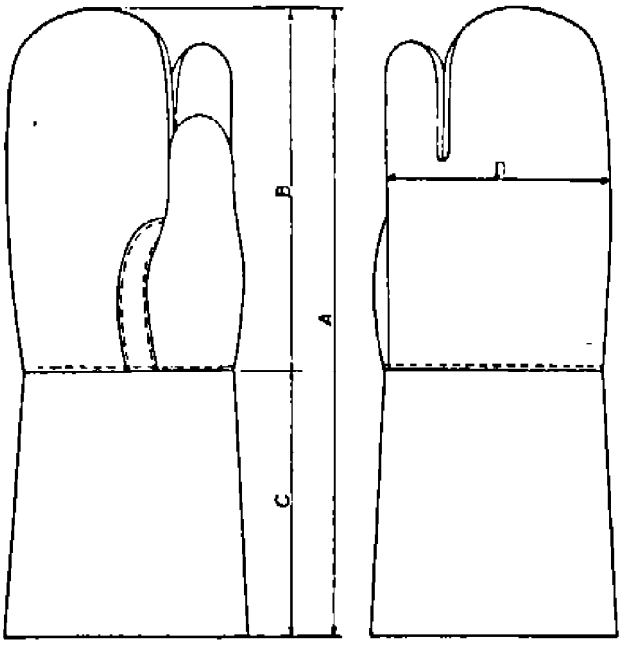
ITEM		COW LEATHER (CHROME TANNED)	BACK SPLIT COW LEATHER (CHROME TANNED)
Tensile strength	(kgf/mm²) {MPa}	2.0 {19.16} min.	1.0 {9.81} min.
Elongation	(%)	40 min.	30 min.
Tear strength (	kgf/mm) {N/mm}	5.0 {49.03} min.	3.0 {29.42} min.
Grease content	(%)	6.0 min.	2.0 min.
Chrome content	(as Cr_2O_3) (%)	2.5 min.	2.5 min.

b) Sewing thread

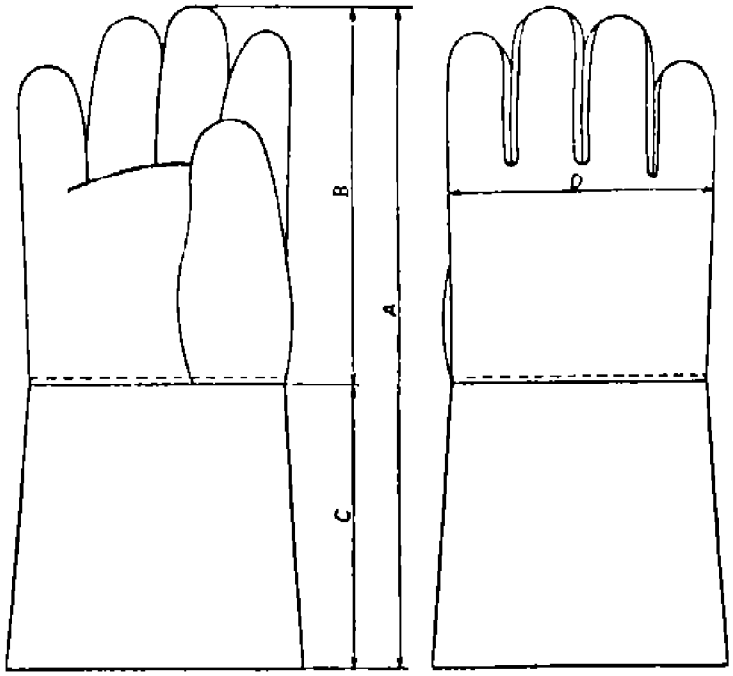
The sewing thread used for sewing the gloves shall be the spinned thread of synthetic fibre such as nylon, polyester, vinylon, etc., of 20-count or the equivalent, being free from irregularity in twist, flaw, etc., and its tensile strength shall be not less than 22.56 N (2.3 kgf).



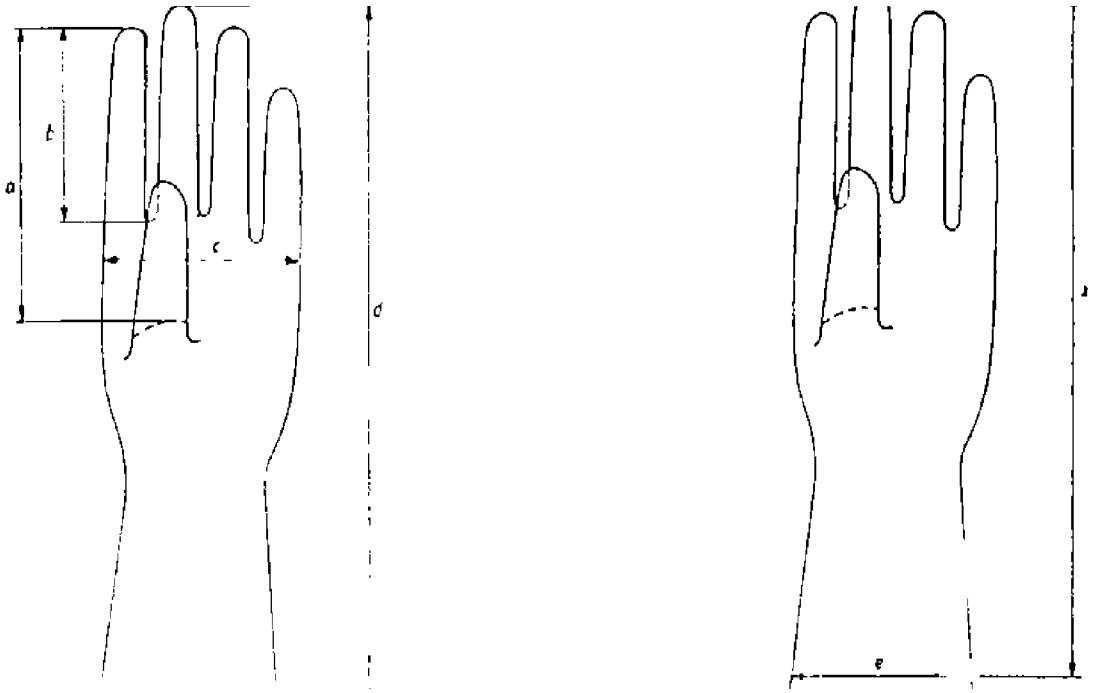
CLASS 1, No. 1 AND CLASS 2, No. 1 (2-FINGER TYPE)
Fig. 7



CLASS 1, No. 2 AND CLASS 2, No. 2 (3-FINGER TYPE)
Fig. 8



CLASS 1, No. 3 AND CLASS 2, No. 3 (5-FINGER TYPE)
Fig. 9



a) Glove dimensions **b) Measurement of dimension e**

DIMENSIONS OF LEATHER AND FABRIC GLOVES
Fig. 10

SECTION 5
EAR PROTECTION

9. EAR PROTECTION

9.1 General

This section of Standard specifies ear protectors which are used to protect employees from the harmful effects of noise in working environment with high noise level. This Standard is divided in three sub-sections as follows:

1) Industrial hearing protection: Ear Muffs.
2) Industrial hearing protection: Ear Plugs.
3) Sonic Ear Valve.

9.2 Construction and Design (Ear Muffs see also Appendix D)

9.2.1 Materials

9.2.1.1 Ear muff materials that can only be cleaned with substances that are known to be harmful to health shall not be used.

9.2.1.2 Materials of the cushions that may come into contact with the skin shall be non-staining, soft, pliable and not known to be likely to cause skin irritation or any adverse effect on health.

9.2.1.3 All materials shall be visibly unimpaired after cleaning by the method specified by the manufacturer.

9.2.1.4 The ear muffs shall have an ignitability (heated rod) index of P when tested in accordance with Appendix B, BS 6344. The metal part shall be processed with a suitable rust prevention and shall be capable of being disinfected.

9.2.2 Construction

9.2.2.1 All parts shall be designed and manufactured such that they are not liable to cause physical damage to the wearer when used as intended.

9.2.2.2 All edges that are in contact with plastics cushions shall be radiused, finished smooth and be free from sharp edges which could cause damage to the cushions.

9.2.2.3 Where the cushions are not intended to last the lifetime of the muff, the cushions shall be replaceable without the use of a special tool(s).

9.2.2.4 In the case of ear muffs they should be suitable for wearing other than over the head, a head strap shall be provided.

9.2.3 Fit and size

9.2.3.1 Adjustability and size

Note:

The requirements of this clause give rise to and accord with the classification of ear muffs given in Table 26.

9.2.3.2 General

Unless wearer information is provided, the adjustability of the ear muffs shall comply with 7.2.3 (3) 7.2.3 (4) as appropriate.

9.2.3.3 Over-the-head ear muffs

For each of the combinations of head dimensions for over-the-head ear muffs shown in Table 24, the range of adjustment of the head band and of the width between the cushions shall enable the ear muffs to be fitted to the apparatus (see Appendix L.2, BS 6344).

TABLE 24 - HEAD DIMENSIONS (OVER-THE-HEAD EAR MUFFS)

HEAD HEIGHT	HEAD WIDTH		
	mm 130	mm 150	mm 160
mm 115	×	t	×
130	t	t	t
140	×	t	×

t **Indicates ear muffs to fit this size.**
× **Indicates no requirement for this size to be fitted.**

9.2.3.4 Behind-the-head ear muffs

For each of the combinations of head dimensions for behind-the-head ear muffs shown in Table 25, the range of adjustment of the headband and of the width between the cushions shall enable the ear muffs to be fitted to the apparatus (see Appendix L, BS 6344).

TABLE 25 - HEAD DIMENSIONS (BEHIND-THE-HEAD EAR MUFFS)

HEAD HEIGHT	HEAD WIDTH		
	mm 130	mm 150	mm 160
mm 90	×	t	×
105	t	t	t
115	×	t	×

t **Indicates ear muffs to fit this size.**
× **Indicates no requirement for this size to be fitted.**

Note:

The dimensions quoted in Tables 24 and 25 have been chosen to cover the appropriate combinations of the head width with the head height or with the head depth of the 5th, 50th, and 95th percentiles of the industrial population.

9.2.3.5 Universal ear muffs

The range of adjustment of the headband and of the width between the cushions shall enable the ear muffs to be fitted to the apparatus (see Appendix L, BS 6344).

9.2.3.6 Head straps

Head straps, where provided, shall be continuously adjustable, shall accommodate the range of head sizes in Tables 24 and 25 and shall not disengage under normal head movements.

9.2.3.7 Cup rotation

Each cup shall be capable of movement through ±10° about two orthogonal axes (one of which is horizontal) set in the plane defined against which a cup rests with the headband set (9.2.4.4) appropriate to the width and height or depth specified in Table 26. The contact between the cushions and test mounting plates shall be continuous throughout this range.

9.2.3.8 Size of openings in cups

The maximum length (measured in the plane of, or in a plane parallel to the face of the cup) of the opening in the cups of the ear muffs, with the cushions fitted, shall be not less than 50 mm and the maximum width of the opening, measured along an axis that is in the plane of, or in a plane parallel to, the face of the cup and orthogonal to the line defining the length, shall not be less than 35 mm.

9.2.4 Comfort

9.2.4.1 Ear muffs with a total mass greater than 400 g shall be marked with their total mass.

9.2.4.2 The headband force shall not be greater than 16 N when measured with the headband set in accordance with 9.2.4.4 if appropriate to the width and height or depth as specified in Table 26.

9.2.4.3 The cushion pressure shall not be greater than 4000 Pa when measured with the headband set.

9.2.4.4 In the case of ear muffs claimed to be universal the tests shall be undertaken according to the requirements for both over-the-head and behind-the-head ear muffs.

TABLE 26 - EAR MUFF SETTINGS FOR THE MEASUREMENT OF CUP ROTATION, HEADBAND FORCE AND CUSHION PRESSURE

<table>
<tr><th rowspan="2">CLASSIFICATION</th><th rowspan="2">TYPE</th><th colspan="2">CORRESPONDING SETTING OF APPARATUS AND EAR MUFFS (SEE FIG. 2 OF BS 6344: PART 1)</th></tr>
<tr><th>HEAD WIDTH</th><th>HEAD HEIGHT OR HEAD DEPTH</th></tr>
<tr><td rowspan="3">Ear muffs which do fit the head dimensions that cover those given in Tables 24 and 25 when tested in accordance with Appendix L, BS 6344</td><td rowspan="2">Over-the-head ear muffs</td><td>mm</td><td>mm</td></tr>
<tr><td>150</td><td>130</td></tr>
<tr><td>Behind-the-head ear muffs</td><td>150</td><td>Mid-point of range of cup adjustment</td></tr>
<tr><td rowspan="2">Ear muffs which do not fit the head dimensions that cover those given in tables 24 and 25 when tested in accordance with Appendix L-BS 6344</td><td>Over-the-head ear muffs</td><td colspan="2" rowspan="2">Mid-point of range of head dimensions stated by the manufacturer in accordance with 9.5.1(f)</td></tr>
<tr><td>Behind-the-head ear muffs</td></tr>
</table>

9.3 Performance Tests

Manufacturer shall certify in writing that the following tests have been carried out as specified in BS 6344: Part 1:

1) Sampling, conditioning and order of testing	Appendix A
2) Ignitability (heated rod) test	Appendix B
3) Method of measurement of rotation of cups	Appendix C
4) Method of test for head band test	Appendix D
5) Cushion pressure test (see Note 1)	Appendix E
6) Drop test.(see Note 2)	Appendix F
7) Vibration test	Appendix G
8) Headband durability test	Appendix H
9) Objective method for measurement of insertion.	Appendix I
10) Loss of ear muffs	Appendix J
11) Cushion leakage test	Appendix K
12) Test for adjustability	Appendix L

Notes:

1) Any cushion deformation which is present on first unpacking the ear muffs shall disappear within 30 minutes of ear muffs being used.

2) Attenuation. Values of the attenuation of the ear muffs as measured and presented by the procedures described in BS 5108 shall be provided for the type of ear muffs being assessed against this Standard. In the case of universal ear muffs, attenuation values shall be provided for both modes of use.

9.4 Test Result

9.4.1 For the following tests:

a) Resistance to damage when dropped;
b) resistance to damage when vibrated;
c) headband durability.

The ear muffs shall not crack, rupture, or otherwise suffer damage likely to affect performance.

9.4.2 Headband force

The headband force shall not change by more than ±25% from that measured after the performance of the ear muffs has been assessed.

9.4.3 Change in insertion loss

The change in insertion loss measured after carrying out the performance tests on each cup of the designated sample shall not be greater than 4 dB at more than one test frequency.

9.4.4 Resistance to leakage

In the case of liquid or gas-filled cushions, the cushions fitted to ear muffs shall not leak when tested.

9.5 Information

9.5.1 Wearer information

The following information for the wearer shall be supplied with the ear muffs by manufacturer:

a) Method of fitting/adjustment.

b) Method of cleaning which shall not require the use of cleaning agents that are known to be harmful to the health of the wearer.

c) Method of maintenance.

d) The address from which further background information can be obtained.

e) The statement "Hearing protector cushions may deteriorate with use and will then need replacement.

f) The head dimensions which the ear muffs are designed to fit if the dimensional range does not cover those given in Tables 24 and 25, when tested.

g) If the requirement given in 9.2.4.1 applies, mass of ear muffs.

h) If the requirement given in 9.2.2.3 applies, method of cushion replacement.

i) Tabulated mean attenuation at each frequency and tabulated standard deviation of attenuation at each frequency both measured by the procedures given in BS 5108.

9.6 Marking

Each pair of ear muffs shall be durably marked with the following information:

a) The name of manufacturer's or trade mark.
b) The referenced standard followed for manufacturing.
c) Year and month of manufacture or their abbreviation.
d) Sound insulation performance.
e) The requirement given in 9.2.4.1 for mass of ear muffs.
f) If particular orientation of the ear cup is intended by the manufacturer, the ear muff (cups) shall be labeled by Top and/or Front.

9.7 Ear Plugs (see Appendix D.1)

9.7.1 Materials of construction

Materials used in parts of ear plugs coming into contact with the wearer's skin shall comply with the following requirements.

a) The materials shall be non-staining.

b) The materials shall not be known to be likely to cause skin irritation, skin disorders nor any other adverse effects to health within the lifetime of the use of the ear plugs.

c) When subjected to contact with sweat, ear wax or with other materials likely to be found in the ear canal, the materials shall not be known to undergo changes within the lifetime of the use of the ear plugs that would result in:

1) Significant alteration to those properties of the ear plugs that are required to be assessed when the ear plugs are examined for compliance with Clauses in 9.7.2.

2) Such changes as would be expected to cause significant alteration to the attenuation characteristics.

9.7.2 Design

9.7.2.1 All parts of ear plugs shall be designed and manufactured such that they are not liable to cause physical damage to the wearer when fitted and used according to the manufacturer's instructions.

9.7.2.2 Any part of the ear plug that is likely to protrude outside the ear canal when fitted in accordance with the manufacturer's instructions shall be of such a construction that mechanical contact with the ear plug is unlikely to cause any injury to the ear.

9.7.2.3 When inserted in accordance with the manufacturer's instructions, ear plugs shall be capable of being readily and completely removed from the ear canal by the user without the use of special instruments. It shall be well intimate with ear and not easily slip off.

9.7.2.4 The dimensions of the ear plug shall be such as to enable the ear plug to be assigned at least one of the nominal size designations given in Table 27 and shall be free from remarkable discomfort feeling in use.

9.7.2.5 The total length including nipple, tongue, etc., (except for the connecting element between two plugs) of ear plugs to be worn in the ear canal shall not exceed 35 mm.

TABLE 27- NOMINAL SIZE DESIGNATIONS OF EAR PLUGS

NOMINAL SIZE DESIGNATIONS	5	6	7	8	9	10	11	12	13	14
Diameter of circular holes in gage (in mm)	5 ±0.1	6 ±0.1	7 ±0.1	8 ±0.1	9 ±0.1	10 ±0.1	11 ±0.1	12 ±0.1	13 ±0.1	14 ±0.1

9.7.3 Storage

Where ear plugs are marked "re-usable", they shall be supplied in suitable packaging to ensure hygienic storage between use.

9.7.4 Cleaning

If ear plugs are marked "re-usable", there shall not be:

a) Any significant alteration to those initial properties of the ear plugs that are required.
b) Any changes that would be expected to cause any significant alteration to the attenuation characteristics when the ear plugs are cleaned.

9.7.5 Ignitability

The ear plugs shall have an ignitability (heated rod) index of "P" when tested as described in Appendices A and B, of BS 6344: P.2.

9.7.6 Assumed protection

The algebraic mean value of assumed protection of the ear plugs at the test frequencies of 500 Hz, 1 kHz and 2 kHz shall be greater than or equal to 12 dB.

9.7.7 Information

9.7.7.1 Wearer information

The following information for the wearer shall be supplied with the ear plugs:

a) Tabulated mean attenuation at each frequency and tabulated standard deviation of attenuation at each frequency;

b) guidance on ensuring correct fit of the ear plugs;

c) if the ear plugs are marked "re-usable", the method of cleaning which shall not require the use of cleaning agents that are known to be harmful to the health of the wearer;

d) if the ear plugs are marked "re-usable", the number of times the ear plug may be cleaned.

9.8 Sonic Ear Valve

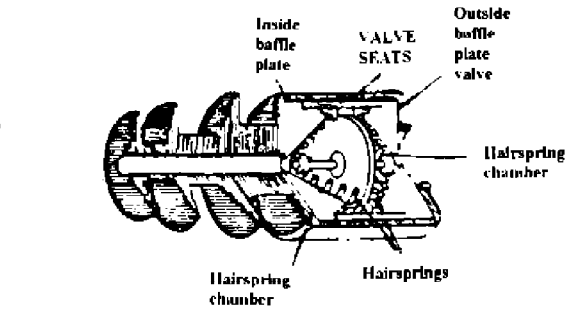
9.8.1 General

Sonic ear valves are insert type ear protector that attenuate high level noises while allowing low level environmental sound and air to pass through. They are specially effective against impulsive or repitative-impulsive noises like those generate by drop forces, jackhammer, punch press, piston engines, riveting stamping and chipping operating (see Fig. 11).

9.8.2 Design and construction

a) The material shall be of non toxic and non allergic.
b) The sizes to be of small-medium-large and marked with letter S-M-L respectively.
c) The sonic ear valve shall provide at least as much protection as commonly used by ear muffs.
d) The air shall easily pass through sonic ear valve for normal circulation.
e) Sonic ear valve shall cause diffraction and attenuation of continuous high frequency noises to impede the passage of the hazardous components of sound energy, so that the wearer can communicate with others while wearing.

Precision metal mechanism inside silicone rubber unit permits normal conversation while providing protection against the loud harmful noises of guns, factories, airplanes, tractors, construction equipment, rock music, traffic, automobiles and motorcycles plus other high-frequency, impulse-impact type noises.



Filters Noise Instead of Plugging

Sonic Ear Valves leave ear canals open to healthful, comfortable air circulation and pressure equilization. Unlike conventional ear plugs the Sonic ear Valve does not cause that "plugged-up" sensation.

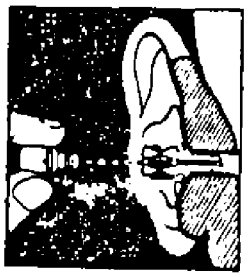


Fig. 11

9.9 Marking

9.9.1 Ear plug

The ear plugs or immediate packaging or dispensers shall carry the following information:

a) The name, trade mark or other identifying mark of the manufacturer;
b) the number of standard marked by manufacturer;
c) the model designation;
d) whether the ear plugs are disposable or re-usable;
e) instructions for fitting and use, which shall indicate the need for proper fitting;
f) the nominal size designations of the ear plugs;
g) attenuation chart.

9.9.2 Sonic ear valves

The ear valve shall be supplied in package of 12 and each pair with hand carrying case and chain. The carrying case shall carry the following information:

a) The name, trades mark or other identifying mark of the manufacturer.
b) The number of standard followed.
c) Instruction for fitting and use.
d) The size.
e) Attenuation chart.

SECTION 6
FOOT PROTECTION

10. FOOT PROTECTION

10.1 General

This section of Standard specifies the minimum requirements for protection of occupational footwear designed primarily to protect the wearer's foot against injuries. Protective footwear introduced in this Standard are:

a) Safety footwear (General requirement).
b) Conductive safety footwear.
c) Electrical hazard footwear.
d) Rubber safety footwear.
e) Puncture resistance.

10.2 General Requirements

10.2.1 Description

Protective footwear is intended to provide protection for the toes against external forces by the use of a protective toe box incorporated in the footwear that is capable of complying with the requirements of this Standard (Fig. 12).

10.2.2 The footwear shall be felt comfortable and suitable for work by the wearer.

10.2.3 The footwear shall be firmly made of the materials to have well balanced shape, and the upper leather, outsole, etc., shall be carefully finished.

10.2.4 Inner side of toe cap shall be lined with cloth, leather, rubber, plastic, etc., and inner side of the rear end portion shall be reinforced.

The tongue should be a sheath tongue, as possible. The toe box shall be incorporated into the footwear during construction and shall be an integral part of the footwear.

10.2.5 Material and workmanship

10.2.5.1 Footwear material

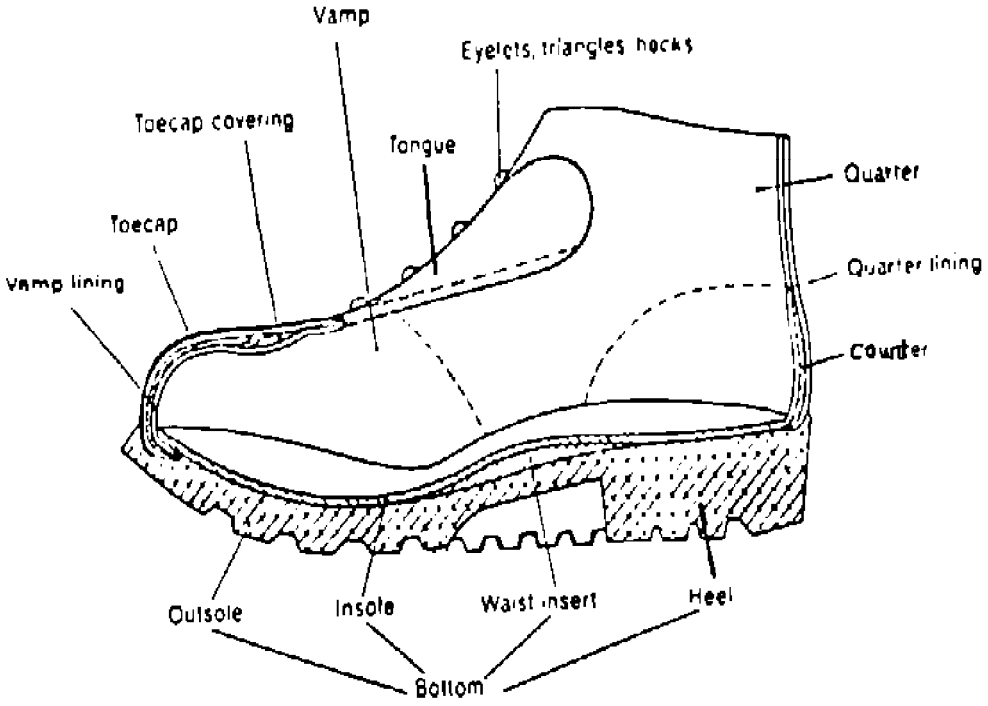
Protective footwear shall be constructed of materials suitable for the exposure it is intended to receive and shall provide protection, comfort, and wearability.

10.2.6 Construction of each part and dimensions

10.2.6.1 Upper leather

The upper leather shall be uniform in thickness and free from such defects as flaws, and the thickness shall be 1.5 mm or more.

COMPONENTS-SAFETY BOOTS



SAFETY FOOTWEAR COMPONENTS
Fig. 12

10.2.6.2 Toe cap

All the surfaces of toe cap shall be finished smooth, the edges and corners shall be rounded, and all the surfaces of steel toe cap shall be treated deterrent to rusting.

10.2.6.3 Dimensions of toe cap

The dimensions of toe cap shall be as follows (refer to Fig. 12):

a) The horizontal distance between the upper center of arch and the tip of toe "*a*" shall be 40 to 60 mm.

b) The height at the highest point of toe cap "*b*" shall be at least 33 mm.

c) The flanged bottom edge shall be bent almost horizontal and the width of such horizontal bottom edge "*c*" shall be at least 3 mm.

d) Such part as sole, heel, leg, and upper which are sticked or stiched together shall be complete so that such defects as water leakage, rubber separation, cloth separation and rubber float-on do not occur.

e) Such defects as scar, crack, froth, air form, mixing of foreign particle, which are detrimental to service shall not be found.

10.2.6.4 Thickness of outsole, leg, and upper

The thickness of the outsole, leg, and upper shall be measured by the measuring method and the result shall comply with Table 28:

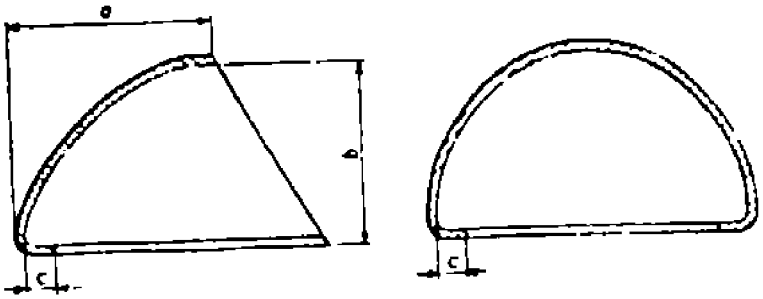
TABLE 28

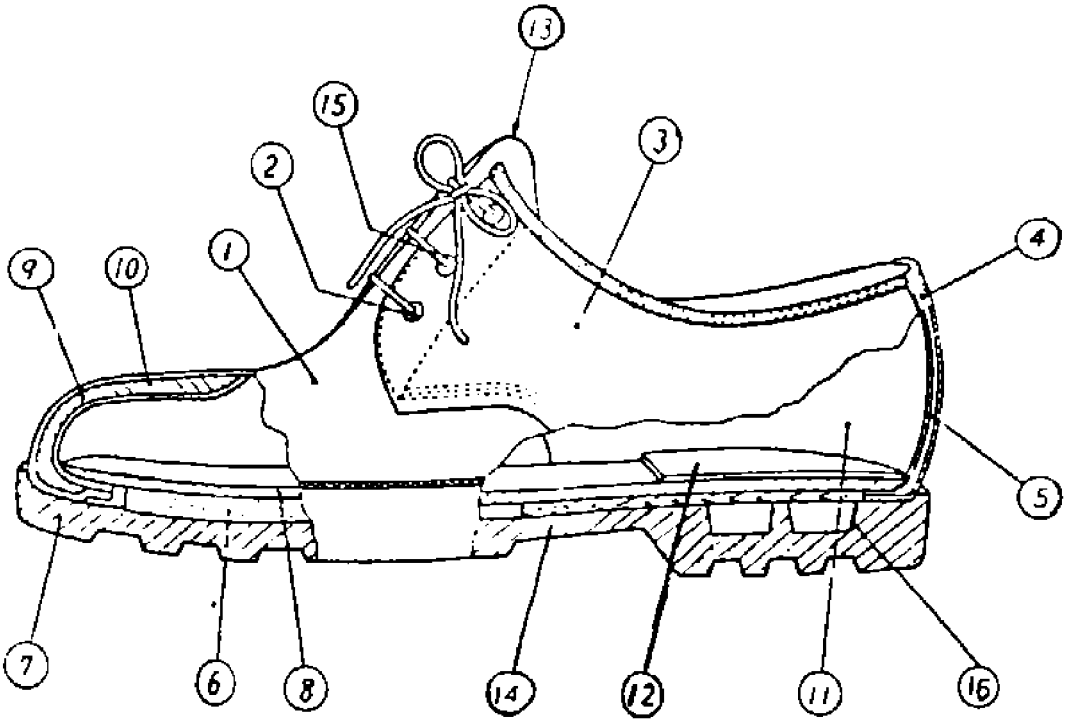
Unit: mm

PART	OUTSOLE		Leg	Upper
Classification	Non thread part	Main part of thread (including projection)		
Boots	2.8 min.	8.0 min.	1.2 min.	—
Shoes	2.5 min.	7.0 min.	—	1.2 min.

10.2.6.5 The outsole (including heel) shall have a pattern effective to prevent slip, and the thickness, when the thinnest part is tested shall be at least 3.5 mm. The outsole (including heel) shall be of homogeneous synthetic rubber appropriate for the purpose of use.

(The shape shows one example)
"TOE CAP"



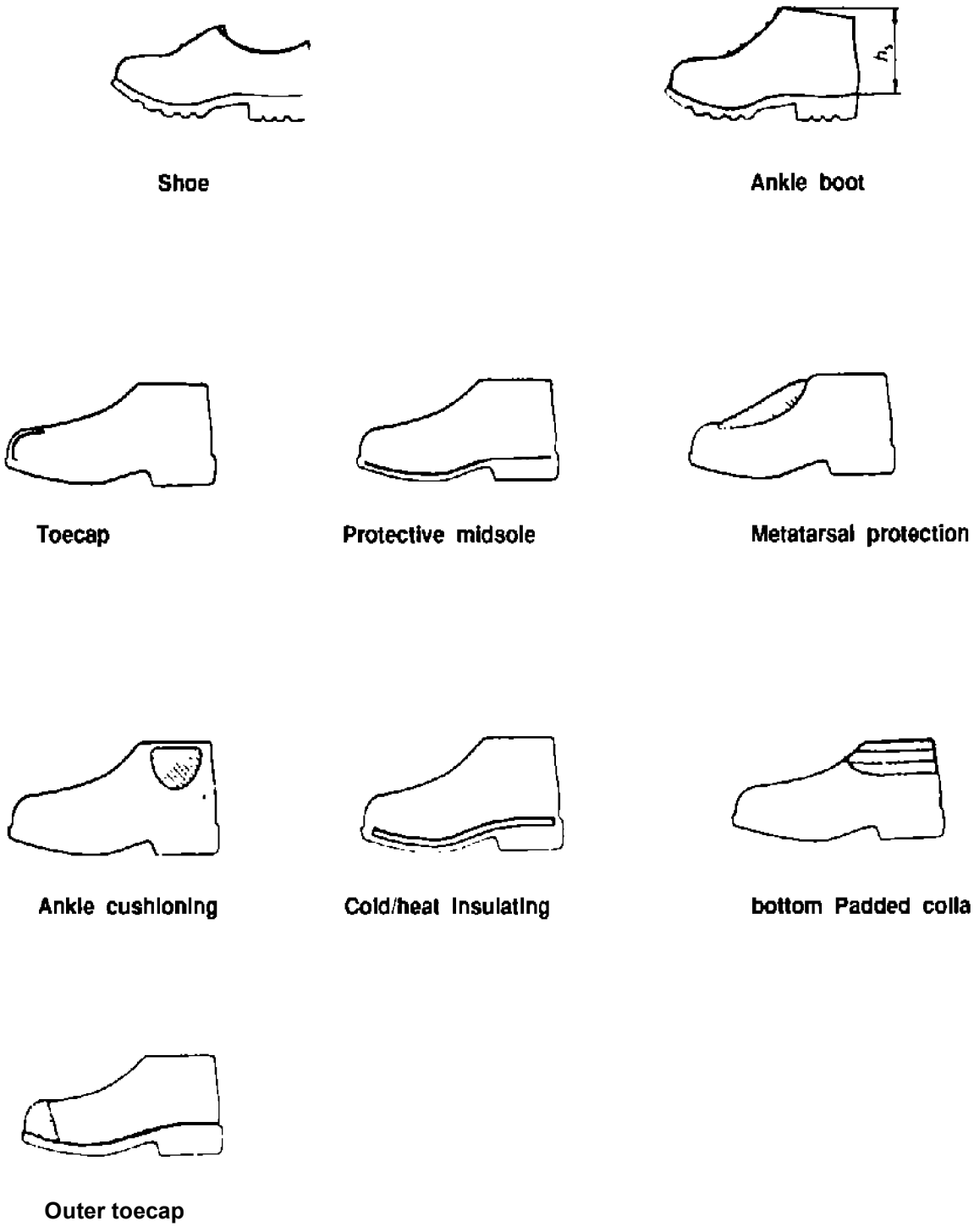


No.	ITEM	No.	ITEM
1	Upper leather (VAMP)	9	Steel toe cap
2	Eyelet	10	Vamp lining
3	Quarter	11	Quarter lining
4	Back stay	12	Sock
5	Counter	13	Tongue
6	Bottom filling	14	Shank lining
7	Rubber outsole (Including heel)	15	Lace
8	Insole	16	Heel core

TOE CAP AND SAFETY SHOES COMPONENTS
Fig. 13

10.2.7 Types

Different types of safety footwear are shown in Fig. 14.



PROTECTIVE FEATURES
Fig. 14

10.2.8 Sizes of safety boots

Metric sizes of safety footwear shall be from 36 to 45 and the minimum toe cap sizes shall be as follows:

SIZE	TOE CAP SIZE
Up to 38	6
39 - 40	7
41 - 42	8
43 - 44	9
Over 44	10

For further information of sizes reference should be made to JIS S 5037.

10.3 Conductive Safety Footwear

Conductive footwear intended to provide protection to wearer from static electricity accumulated on the body of the wearer. Such shoes are designed primarily to dissipate the static charged.

10.3.1 General requirement

10.3.1.1 Hazard

Accumulation of static electricity in the body cause spark when the body comes in contact with materials.

10.3.2 Classification

Conductive protective-toe footwear shall be of two types, designated Types 1 and 2.

10.3.2.1 The requirements for Type 1 footwear are applicable to conductive shoes intended to protect the wearer and the environment where the accumulation of static electricity on the body is a hazard. Type 1 shoes are designed to dissipate static electricity to the ground and prevent the ignition of sensitive explosive mixtures. These shoes should not be used by personnel working near open electrical circuits.

10.3.2.2 The requirements for Type 2 footwear are applicable to conductive shoes intended for use by linemen or personnel operating on high-voltage lines where the potential of the person and the energized parts must be equalized. Type 2 conductive shoes are designed to protect personnel working on Faraday-type shielded aerial lift equipment, or similar types of equipment on high-voltage lines, or where induced voltage is a problem.

10.3.3 General requirements

10.3.3.1 Conductive protective-toe footwear, Types 1 and 2, shall meet the requirements given in (ANSI Z 41 Clause 1.4).

10.3.3.2 Types 1 and 2 footwear shall be of any construction that facilitates a stable conductive path. All exposed external metal parts shall be nonferrous.

10.3.4 Material and workmanship

10.3.4.1 Toe box

The toe box shall be incorporated into the footwear during construction and shall be an integral part of the footwear. The toe box shall comply with the Clause 1.4 of ANSI Z 41.

10.3.4.2 Uppers, linings, and outsoles

The uppers, linings, and outsoles shall be of materials that facilitate the performance requirements stated in this Section.

10.3.4.3 Heels

The heels shall be nonmetallic half heels or full heels composed of conductive rubber or any combination of materials and construction that facilitate conductance and transfer of electricity to ground. The tread surface shall be smooth. Washer-type heels shall not be used. The area of the conductive surface in contact with the ground shall be 256 mm² or greater.

The heel shall be attached to assure permanent conductivity. The nail heads shall be below the tread surface, they shall be covered by the rubber (blind nailing), and they shall not be visible.

10.3.4.4 Strap connector

When required, Type 2 footwear shall contain a conductive strap connector that fits around the calf of the wearer. The strap connector shall be electrically connected to the back part of the shoe and shall facilitate a path for electricity through the heel and sole.

10.3.5 Conductance (electrical resistance inverse)

10.3.5.1 Type 1: Footwear

The electrical resistance of a new or unworn type-1 shoes shall range between 0 and 500,000 ohms when measured. Reference shall be made to BS 5145 Clause 5.

10.3.5.2 Type 2: Footwear

The electrical resistance of Type 2 shoes for each conductive component and sock lining shall not exceed 10000 ohms when measured.

10.3.5.3 Method of test for electrical resistance of shoes

Test Specimens

For test specimens and it's procedures reference shall be made to Clause 3.5 of ANSI Z 41.

10.3.6 Performance

10.3.6.1 Conductive safety footwear shall be tested in accordance with JIS-T 8103, Clause 6 or ANSI Z 41, Clause 3.5 or BS 5451, Clause 8 and Appendices A, B, C or ISO 2024-2251.

10.3.6.2 For antistatic purposes (Low Voltage) the discharge path through a product should normally have an electrical resistance of less than $10^8\Omega$ at anytime throughout its useful life. A value of $5 \times 10^4\Omega$ is specified as the lowest limit of resistance of a product when new. During service the electrical resistance of footwear (boots, shoes and overshoes) made from conductive or antistatic materials may change significantly due to flexing and contamination and it is therefore necessary to ensure that the product is capable of fulfilling its designed function of dissipating electrostatic charges and also of giving any protection during the whole of its life. The user is required to carry out the test for electrical resistance at regular and frequent intervals.

10.4 Electrical Hazard Footwear

10.4.1 General

10.4.1.1 The electrical hazard footwear described in this Section shall also comply with the requirements given in ANSI Z 41, Clause 1.4.

10.4.1.2 The construction shall provide an assembly that assures prolonged insulation against electricity when tested as specified in 10.3.5. No metal parts shall be present in the sole or heel of the footwear.

10.4.1.3 A protective-toe box shall be incorporated into the shoe during construction and shall be an integral part of the shoe or boot.

10.4.2 Material and workmanship

10.4.2.1 Uppers and insole

The uppers and insoles shall be of any suitable material.

10.4.2.2 Outsole and heel

The outsole and heel shall be of a suitable material that shall meet the requirements of 10.2.6.5

10.4.3 Electrical properties

Each shoe shall be capable of withstanding the application of 14000 Volts (root mean square [r.m.s.] value) at 50 Hz for 1 minute showing no leakage current in excess of 5.0 milliamperes when tested.

10.4.3.1 Voltage withstand and current leakage test

The following test is to be conducted in accordance with ANSI Z 41, Clause 4.

10.4.4 Apparatus

A 0.5 KVA (500-VA) transformer or larger shall be used and the impedance value of the measuring system shall not exceed 280000 ohms, see 10.4.3 for electrical properties.

10.4.5 Procedures

10.4.5.1 Blotting paper as specified in Blotting Paper (Laboratory), shall be cut to cover 65 percent or more of the insole, but not touch the upper when the paper is inserted in the footwear. Immerse the cut paper in a 1 percent solution of sodium chloride for 15 to 30 seconds or until completely saturated. Insert the wet paper on the insole avoiding the upper and lining of the upper and test for current leakage after five minutes.

10.4.5.2 The shoe shall be mounted on a metal base (larger in width and length than the test shoe outsole) electrode, and a 2.265 kg metal foil electrode shall be placed inside the shoe so that it is in contact with at least 65 percent of the surface of the insole including the wet blotting paper. Voltage is applied in accordance with 10.4.3.

10.4.6 Test results

All shoes shall meet the minimum test requirements given in 10.4.3.

10.5 Rubber Safety Boots

Rubber boots are of three types as illustrated in Fig. 15:

Ankle - Knee and thigh types.

10.5.1 Main material and parts

10.5.1.1 Rubber

The rubber shall be manufactured into uniform composition so that it fits for the purpose of use.

10.5.1.2 Cloth

The cloth such as knit and flannel used as the insole cloth padding and lining cloth of lining product shall have uniform density suitable composition for the purpose of use and tearing strength of 0.39 MPa (3.9 Bars) or more when it is tested.

10.5.1.3 Toe cap

The toe cap shall be of material having suitable strength for the purpose of use.

10.5.2 Construction

The rubber safety boots shall be designed in such a manner as to protect wearer's toe from compression and impact by fitting of toe caps on the toe box in the production process and shall comply with the following:

a) It shall be comfortable and be easy to work for wearer.

b) It shall be made of material specified in 10.5.1.3, and into robust structure and well balanced shape.

c) Such parts as sole, heel, leg and upper which are sticked, vulcanized or stitched together shall be complete so that such defect as water leakage, rubber separation, cloth separation, and rubber float-on do not occur.

d) The inside of toe cap shall be lined with cloth, rubber or plastic and specially the inside of rear shall be reinforced.

e) Such defects as scar, cracks, froth, air form, mixing of foreign particles, which are detrimental to service shall not be found.

f) The outsole shall be shaped in such a manner as to present a wearer from slipping.

g) The rubber boot used in oil production facilities shall be made of oil resistance materials.

10.5.3 Puncture resistance footwear

10.5.3.1 The purpose of this requirement is to reduce the hazard of puncture wounds caused by sharp objects which could penetrate the sole of footwear. Puncture resistance footwear (protective midsole) shall not be removed from the bottom without the bottom being destroyed and shall comply with Clause 5 of ANSI Z 41.

10.5.4 Protective device requirements

10.5.4.1 The protective device shall cover the maximum of the insole allowed by the construction of the footwear and shall at least extend from the toe to overlaps the breast of the heel.

10.5.4.2 The footwear shall withstand an average of force on each device of not less than 150 kg to penetration when tested.

10.6 Performance Requirements

Manufacturer shall certify in writing that the type of foot protection supplied have been tested in accordance with this Standard.

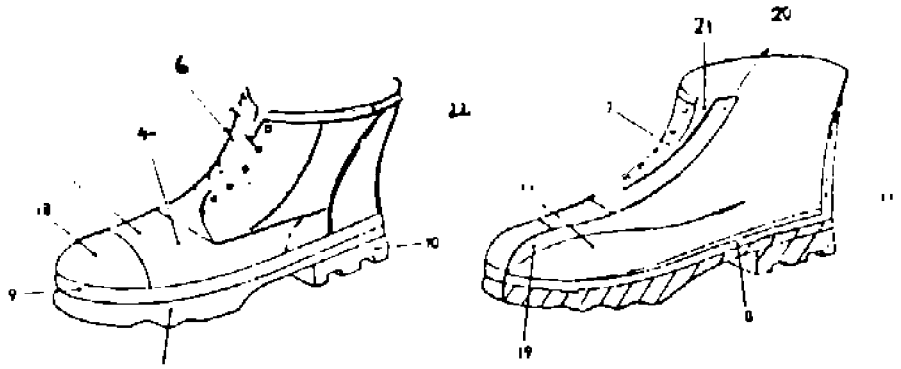
10.7 Marking

Footwear shall be indelibly and legibly marked with the following particulars:

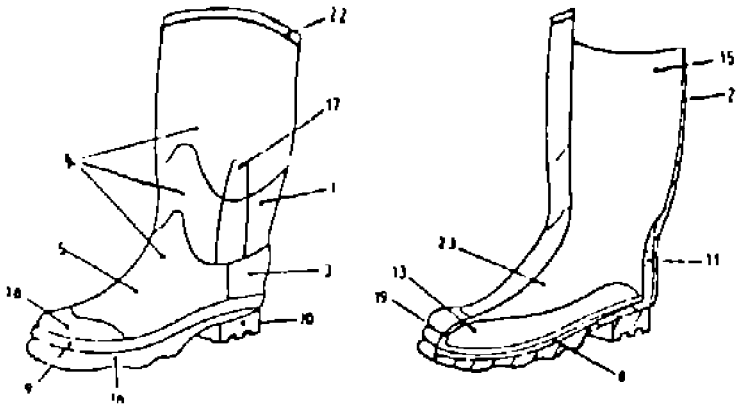
a) size;
b) manufacturer identification;
c) the number of standard;
d) type of protective footwear (conductive-electrical hazard puncture resistance).

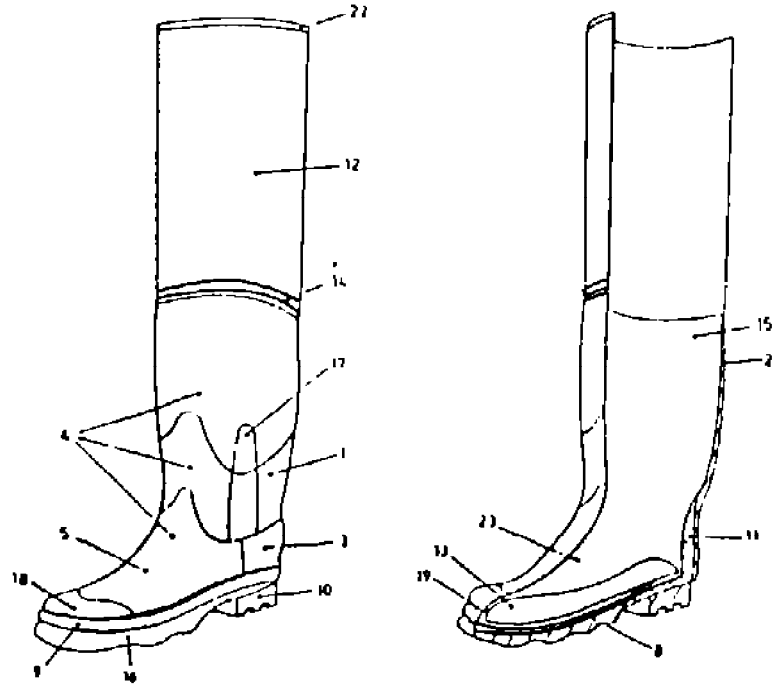
For electrically conducting footwear, each article shall have a red label bearing the words (ELECTRICALLY CONDUCTING), bonded or otherwise securely fixed, in a suitable position to the outside of the footwear "TEST REGULARLY" shall appear on each article on or near the label.

a) Ankle boot



b) Knee boot





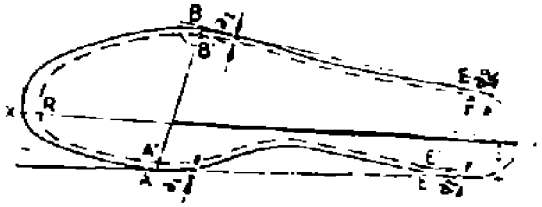
Key:

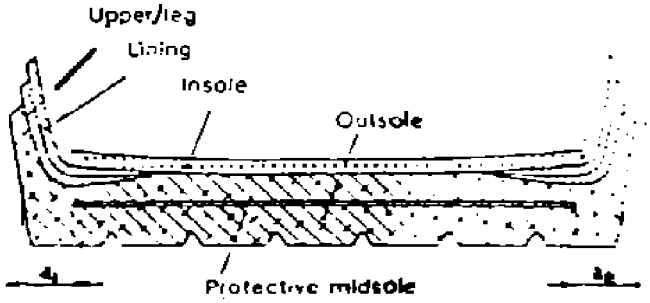
1) Anklet
2) Backstrip
3) Boot counter
4) Boot upper
5) Boot vamp
6) Eyelet
7) Eyelet stay
8) Filler
9) Foxing strip
10) Heel
11) Heel piece
12) Hip top
13) Insole
14) Joint strip
15) Leg lining
16) Outsole
17) Side stay
18) Toe cap
19) Toe piece
20) Tongue
21) Tongue gusset (bellows
22) Top binding

c) Thigh boot

TYPICAL INDUSTRIAL VULCANIZED RUBBER BOOTS: ANKLE, KNEE AND THIGH TYPES
Fig. 15

SIZE	A 'B'	E 'F'
37, 38	83	54
39, 40	86	56
41, 42	89	58
43, 44	92	60
45, 46	95	62
47, 48	98	64





POSITION OF PROTECTIVE MIDSOLE
Fig. 16

For antistatic footwear each article shall have a lemon yellow back strip together with lemon yellow label bearing the word "ANTISTATIC" bonded or otherwise securely fixed in a suitable position to the outside of the footwear. The words "Test Regularly" shall appear on each article on or near the label.

10.8 Labeling

With each pair of conductive or electrical hazard protective footwear an information label shall be supplied. This label shall state:

"Flexing, contamination, damage and wear can cause changes in electrical resistance (TEST REGULARLY)"

SECTION 7
BODY PROTECTION

11. BODY PROTECTION

11.1 General

In this Section personnel body protection covering the following titles is discussed:

11.2 Specifications for general industrial workwear.

11.3 Protective apron for wetwork.

11.4 High visibility garments and accessories.

Notes:

Body protections for the following sections have been given in:

1) IPS-M-SF-455	**"Fire Entry and Fire Proximity"**
IPS-G-SF-110	**"Radio Active Protection Against Sealed Sources"**
2) Sections 2 & 3 of this Standard specifies	**"Welders Protective Clothing".**
Section 8 of this Standard specifies	**"Chemical Protective Clothing"**

11.2 Specification for General Industrial Workwear

11.2.1 Special requirements

This sub-section specifics materials, standards of manufacture, sizing and marking requirements for workwear used by general industrial sectors and also gives requirements for a lightweight two piece working rig.

11.2.2 Materials

11.2.2.1 Unless otherwise specified, fabrics complying with institute of standard and industrial research of Iran (ISIRI 1944 shall be used).

11.2.3 Manufacture

11.2.3.1 Seams

11.2.3.1.1 All visible seams (i.e., those that are visible on the surface or inside the garment) shall be one of the following:

a) Seam type overedged, sewn in one or more operation (see BS 3870 Part 2).
b) a bound seam for example seam types (see BS 3870 Part 2).
c) a lapped seam with two or more rows of sewing for example seam type (see BS 3870 Part 2).

There shall be no raw edges, but a single row of stitching where the edges are selvedged.

11.2.3.1.2 Hidden seams (e.g., inside collar) seam type shown in (BS 3870 Part 2) shall be used.

11.2.3.1.3 The minimum seam allowance shall be 8 mm for all fabrics.

11.2.3.2 Stitching

11.2.3.2.1 For garments with the exception of the lightweight two-piece working rig, the stitching shall be one of the following:

a) Multi thread chain stitch (see BS 3870 Part 1);
b) Lock stitch (see BS 3870 Part 1).

There shall be no less than 3.2 and not more than 4 stitches per centimeter.

11.2.3.2.2 For the lightweight two piece working rig, for side sleeve head, sleeve, shoulder, yoke, inside leg and seat seams, side pockets and pocket bags stitching shall be one of the following:

a) Multi thread chain stitch (see BS 3870 Part 1);
b) combination stitch (see BS 3870 Part 1);
c) six thread safety stitch.

11.2.3.3 Sewing threads

Sewing threads shall be spun polyester fiber or polyester cellulosic core spun or 100% polyester core spun.

11.2.3.4 Facing

Where facing of coats and jackets are stitched on, the inner edges shall be stitched to the foreparts using seam type 5.31. 01 as described in BS 3870 Part 2. The stitching shall be no more than 0.5 cm from the edge.

11.2.3.5 Fronts

Where studs and buttons are used, the fronts of jackets and coats shall be finished with the button stand of not less than 20 mm.

11.2.3.6 Closures and fasteners

Closures and fasteners shall be suitable for the care, maintenance process to which the garment is to be subjected and shall be in correct register. Buttons, buttonholes and studs shall be affixed through a minimum of two thickness of fabric or through one thickness and a fused patch. Buttonholes shall not be less than 2 mm and not greater than 4 mm longer than the diameter of the button used. The slide fastener if used shall be centrally located and open ended. It shall have a locking slider and shall be made from polyamide.

11.2.3.7 Pockets

All pockets shall be fastened by bar tacking, back tacking, triangular tacking, or riveting..

11.2.3.8 Hanger

All garments shall be provided with hanger. The hanger strength shall not be less than 30% of the breaking strength, in the warpwise direction of the fabric used for the manufacture of the garment.

11.2.3.9 Garment presentation

Garments shall be clean and free from loose threads and ends of thread.

11.2.3.10 Seam strength

Seams shall have the minimum strength of 185 N for load bearing seams and 135 N for all other seams when measured using the method described in Appendix E.

11.2.3.11 Sizing

11.2.3.11.1 Dimension of finished garments shall be as given in; Appendix F, Figs. 41(a-8).

11.2.3.11.2 Skirt hemigirth

For a coat of 100 cm length, the hemigirth shall be equal to the wearer's chest measurement plus 37 cm. This allowance shall be increased or decreased by 3 cm for each 8 cm change in length.

For a jacket of 74 cm length the hemigirth shall be equal to the wearer's chest measurement plus 20 cm. All measurement of garments shall be carried out in accordance with method given in Appendix G.

11.2.3.12 Marking

Labels shall be attached to each garment, sewn-on the inside 2 cm below the collar, the label shall be durable to the appropriate cleaning process. The label shall give the following informations:

a) The name, trademark or other means of identification of supplier.

b) An indication of body measurement of the person. The garment is intended to fit-by giving the size designation as shown in Appendices E and F. An indication shall be given of the height of person the garment is intended to fit. Garment designed specially for short, regular, tall or very tall persons shall be provided with indication to that effect by means of suffixes S, R, T or XT respectively.

c) Instructions for care and cleaning.

11.2.4 Particular requirements for lightweight two piece working rig

11.2.4.1 General

11.2.4.1.1 The lightweight two piece working rig (Fig. 17) consists of a jacket and trousers. The jacket being fastened at the front by a centrally located slide fastener.

11.2.4.1.2 The lightweight working rig shall comply with the requirement of this section in addition to the requirements of Section 11.2.

11.2.4.2 Jacket

11.2.4.2.1 Fabric

Unless otherwise specified standard given for fabrics in ISIRI 1944 shall be used.

11.2.4.2.2 Design requirements

Jacket shall be single breasted and hip length with front yoke, center slide fastener, two slanted pockets and breast patch pocket.

11.2.4.2.3 Yoke

The yoke shall be 22 cm deep measured from the neck point.

11.2.4.2.4 Front

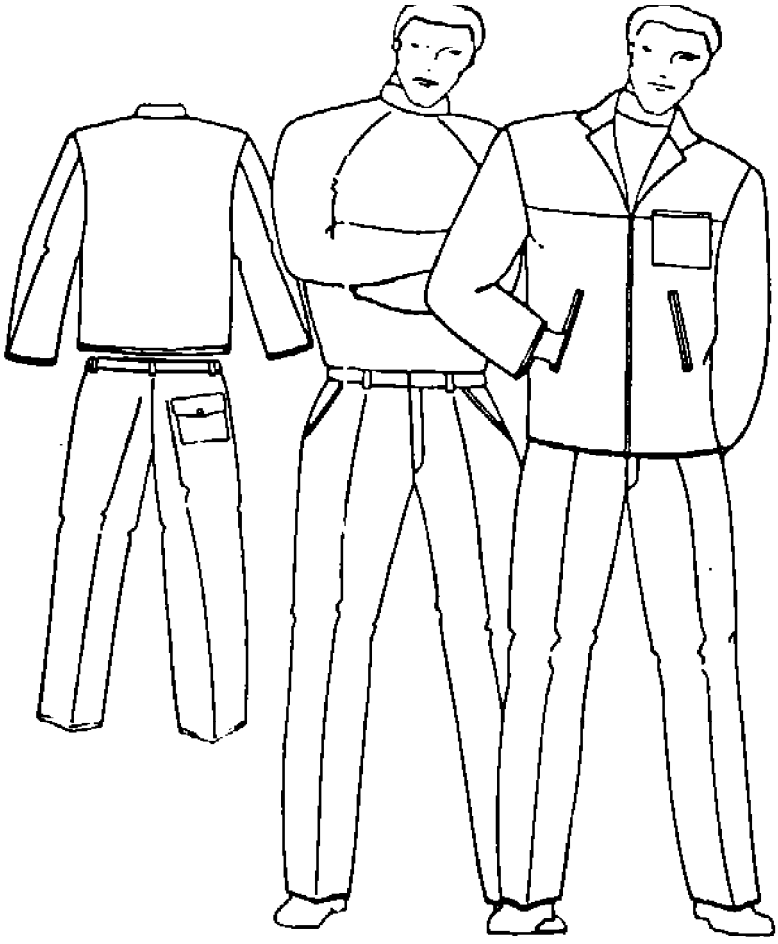
The front shall have two slanted pockets, with the overall size of the pocket opening 18 cm. The bottom of the pocket opening shall be 13 cm from the hem. The top of the pocket opening shall be 30 cm from the hem. The pocket bag shall be fully overlocked.

11.2.4.2.5 Slide fastener

The slide fastener shall be centrally located and open ended. It shall have a locking slider and shall be made of poly-amide.

11.2.4.2.6 Breast patch pocket(s)

A breast patch pocket (or pockets) with a square closing flap shall be positioned on the jacket with the top of the pocket against the yoke. The pocket shall be 14 cm deep and 13 cm wide overall. The pocket shall be top stitched in matching color polyester thread and stress points shall be bar tacked. Hems shall be neatened. The top of the forepart above the slide fastener shall be pressed back (lapel style).



LIGHTWEIGHT TWO-PIECE WORKING RIG: EXAMPLE OF SEAM AND POCKET DETAILS
Fig. 17

11.2.4.2.7 Collar

The collar shall be one piece, with pointed ends bagged to the gorge (with no leaf-edge seam but bagged at the collar end). It shall be pressed into a 3 cm stand with a 4 cm fall and shall be 7 cm wide at the collar end. The inside of the top collar shall be turned in and neatened. The top of the forepart above the slide fastener shall be pressed back (lapel style).

11.2.4.2.8 Edges

Edges on forepart, collar, patch pocket and hems shall be top-stitched in self-color polyester thread. The upturn at the bottom and sleeves shall be neatened to 2 cm and machined through.

11.2.4.2.9 Hanger

The hanger shall be sewn-in, with the stitching at the bottom of the collar, inside the center-back neck position.

11.2.4.3 Trousers

11.2.4.3.1 Fabric

The same fabric as used for the coat shall be used (see 11.2.4.2.1).

11.2.4.3.2 Design requirements

a) General

Trousers shall be made with 2 side pockets and 1 hip patch pocket with a button-down flap.

b) Waistband

A one-piece outer waistband shall be 4 cm wide. The inner waistband shall be in a white polyamide with shirt gripper and shall be 5 cm wide. The waistband closure shall be a 30 ligne (19 mm), 4 hole button matching the color of the main fabric. The buttonhole shall be machined through the outer waistband, and bar tacked.

c) Belt loops

Six belt loops, each 1 cm wide, shall be attached to each waistband.

d) Adjusting tabs

Adjusting tabs, of finished dimensions 9 cm long and 2 cm wide shall be laid-on, 3 cm in advance of the side seams, turned back and sewn through the waistband, 15 mm away from the fold. Each tab shall be fitted with nickel-plated-steel waist adjustment buckles.

e) Pockets

The top and bottom of the side pocket mouths and each top corner of the hip pocket shall be bar tacked. The hip pocket shall be 14 cm deep and 13 cm wide, positioned on the right hip, 9 cm from the top of the waistband. If required, a flap shall be positioned 7 cm from the top of the waistband and shall be 7 cm deep. The flap shall be fastened by means of a 30 ligne (19 mm) matching-color button on a patch with a buttonhole in the flap.

f) Fly

All garments shall be fitted with a fly slide fastener in polyamide, with locking slider. The finished width of the top fly shall be 5 cm and the under fly 4 cm. A slide fastener tape shall be inserted between the center front seam under the fly, top sewn and overedged. The edge of the slide fastener tape at the top fly shall be attached 3 cm from the fly edge by two rows of stitching, 5 cm to 6 cm apart. The under fly shall be single thickness and arm locked on edge.

g) Inlays

The upturn of the bottom of the leg shall be neatened to 4 cm and machined through.

11.2.4.4 Marking

11.2.4.4.1 The lightweight two-piece working rig shall comply with 11.2.4.4.2 in addition to the requirements of Clause 11.2.3.12.

11.2.4.4.2 Labels shall be cellulosic and shall be sewn inside, the jacket label being sewn inside the back neck.

11.3 Protective Apron for Wetwork

11.3.1 Materials

11.3.1.1 Apron shall be made from coated fabric, material composed of two or more layers at least one of which is a textile material (woven knitted, or non woven) and at least one of which is a substantially continuous polymeric film, bonded closely together by means of an added adhesive or by the adhesive properties of one or more of the component layers. The material may be specified either single face coated or double face coated fabrics with the following exceptions:

a) PVC coated fabric shall have a total mass per unit area not less than 140 g/m².
b) Silicon coated fabrics shall not be used.

11.3.1.2 Eyelets and press stud fasteners shall be of non ferrous metal, nickel plated or PVC.

11.3.2 Dimensions

11.3.2.1 Aprons shall not be less than 900 mm long and not less than 750 mm wide across the skirt.

11.3.2.2 The bib top shall not be less than 250 mm wide extending to the full width of the apron over a depth of not less than 200 mm and not more than 300 mm.

Note:

The minimum dimensions of aprons and style details are given in Fig. 18.

11.3.2.3 Where straps are supplied with the apron they shall have the following minimum length measured from the edge of the apron:

Waist straps	500 mm
Shoulder	750 mm
Neck loop (strap)	500 mm

11.3.3 Making-Up

11.3.3.1 There shall be no seams or joints in the main body of the apron.

11.3.3.2 For the purpose of attaching straps or eyelets the corner of bib and waist shall be reinforced with triangular pieces of self material stitched or welded except where wieldable eyelets are used or where the fabric mass per unit area is greater than 270 g/m².

11.3.3.3 Sewing shall not be less than four and not more than 5 stitches per 10 mm. The sewing threads shall be appropriate for the fabric used.

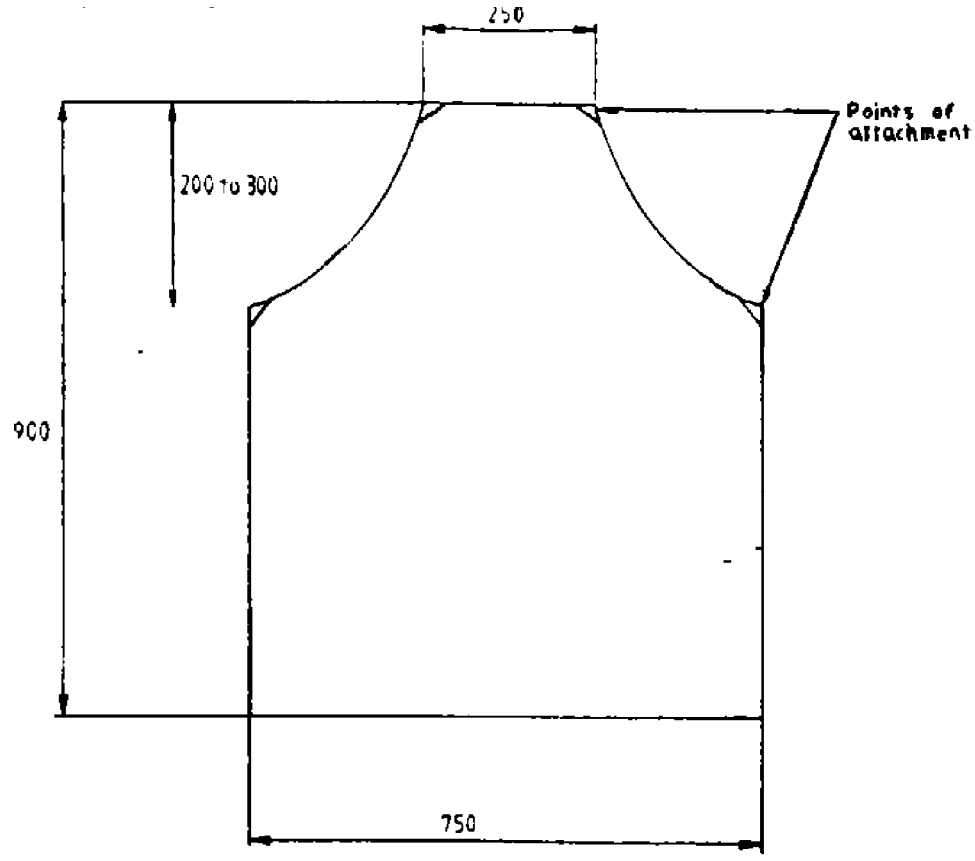
11.3.3.4 If provided, eyelets for tying-tapes shall be set in at the upper corners of the bib and skirt and shall be positioned clear of any stitching.

11.3.3.5 If fitted, straps (either permanently fixed or with a quick release fastening) shall be at least 10 mm in finished width and finished to prevent fraying.

11.3.4 Labeling

Aprons complying with this Standard shall be labeled with the following information:

a) The name, trade mark or other means of identification of the manufacturer;
b) the standard reference for the fabric used;
c) the length and the width of the apron.
d) cleaning and washing instructions.



All dimensions are in millimeters.

MINIMUM DIMENSIONS AND STYLE
Fig. 18

11.4 High Visibility Garments and Accessories

11.4.1 General

This part of body protection requires the retroreflective garments and accessories intended primarily to provide conspicuity of the wearer working on the roadway or other industrial premises.

11.4.2 Classification (see Appendix H)

Garment and accessories are categorized in three classes:

- **Class A:** High visibility aid providing the highest level of conspicuity.
- **Class B:** High visibility aid, providing the intermediate level of conspicuity.
- **Class C:** High visibility aid providing the lowest level of conspicuity.

11.4.3 Performance of materials

Garments and accessories may be constructed from separate performance materials or from combined performance materials. Performance of materials shall comply with BS 6629 (1985): Clause 4.

11.4.4 Construction of garments and accessories

11.4.4.1 For construction of garments and accessories reference shall be made to Clause 5 of BS 6629.

11.4.5 Labeling

Garments and accessories shall be durably and legibly labeled with the following:

a) The name or identification of the manufacturer;
b) cleaning instructions;
c) the class and level of conspicuity using one of the three following forms of words as appropriate:

Class A: **High Visibility Aid**

This garment provides the highest level of conspicuity.

Class B: **High Visibility Aid**

This garment provides the intermediate level of conspicuity.

Class C: **High Visibility Aid**

This accessory provides the lowest level of conspicuity.

11.4.6 Testing

Manufacturer shall certify in writing that materials used have been tested in accordance with Appendices B, C, D, E and F of BS 6629 (1985).

SECTION 8
CHEMICAL PROTECTIVE CLOTHING

12. CHEMICAL PROTECTIVE CLOTHING

12.1 General

Where chemical hazard exist in a work area, it is important to assess whether the risk of exposure to chemicals can be minimized or avoided. Relevant approaches are:

a) The use of alternative equipment or chemical that would be involved in the event of an incident.
b) The introduction of appropriate working practices and system of work to give early warning of possible exposure.

After all reasonable efforts have been made to eliminate or minimize the hazard then consideration should be given to personal protective equipment (if required) for selection and use in work area.

Care in selection of protective clothing will ensure proper use and correct protection. Suppliers or manufacturers should be consulted before placing an order for chemical protective clothing.

12.2 Materials

12.2.1 General

The garments shall be made from one or more of the coated fabrics specified in BS 3546: Parts 1, 2 and 3. The primary function of protective clothing is to prevent, or reduce to an acceptable level, the exposure of the skin to a chemical hazard.

The use of protective clothing offering a higher degree of protection that is necessary under routine conditions maybe advisable temporarily when the nature of a hazard is unclear, or when steps to reduce it cannot be taken immediately (see Appendix I).

Clothing materials are classed broadly as air-permeable or air-impermeable. The two types of material have different applications and are considered separately in 12.2.2 and 12.2.7. Although general rules can be drawn up showing fabrics and materials which are likely to give suitable protection against different classes of chemicals, the adequacy of a material against a specific chemical can only be established by practical tests, as are referred to in 12.2.2. and 12.2.3.

12.2.2 Air-Impermeable materials

Materials of a solid nature offering resistance to permeation by chemicals would, in general, be selected for the construction of protective gloves, boots and over garments that are likely to be exposed to organic solvents, liquid formulations of hazardous agents, toxic dusts, undiluted acids and other corrosive or aggressive agents and formulated products.

12.2.3 Types of material of construction

12.2.3.1 Coated textiles

Flexible non-absorbent sheet materials with no pores to prevent penetration by liquids or gases. Relevant materials are made from a light, tightly woven textile base (commonly polyamide) with a suitable polymeric coating. The textile gives stability, strength and durability to the composite is acceptable. If both faces of the textile are coated, the barrier is

the more effective. The coating should be free from pinholes and there should be no exposed textile on the surface that could provide a path for liquid penetration by wicking.

12.2.3.2 Polymer sheet

Unsupported plastics film (e.g., polyethylene) or rubber sheet can be used to construct aprons or similar garments, especially clothing designated as "disposable". The possibility of accidentally puncturing or tearing such films is greater than for a textile based material and are less suitable for high risk applications where significant mechanical stress on the garment can occur.

12.2.4 Permeation by liquid

12.2.4.1 Even without any surface flaws or holes, coatings can absorb certain liquid chemicals, which are able to diffuse by permeation through the material. This process proceeds broadly in three stages:

a) Initial absorption of the chemical by the polymer film or coating;
b) solution of the chemical in the polymer film or coating;
c) desorption from the opposite surface of the material into the internal environment of the garment.

12.2.5 Classification of air-impermeable materials according to resistance to permeation

12.2.5.1 The rate of permeation of chemicals through air-impermeable materials is governed not only by the natures of the chemicals and polymers but also by the thickness of the protective coating or film and by the temperature. The measurements of breakthrough times and permeation rates under relatively artificial conditions in a laboratory should not be used as precise indicators of risk nor of the "safe" period of wear of a contaminated item nor of the effective life of a manufactured item in service. The principal application of such measurements lies with the process of selection of the most effective material from a group available for test. In a specific work situation, an acceptable time of wear can only be defined after appropriate consideration has been given to influencing factors within the workplace itself that affect the potential exposure to a chemical.

Subject to this consideration the risk of chemicals coming into contact with the skin is when air-impermeable forms of protective clothing are worn. This can be minimized by following the actions indicated in Table 29.

TABLE 29 - CLASSIFICATION OF BREAKTHROUGH TIME IN RELATION TO TYPE OF APPLICATION

BREAKTHROUGH TIME	ACTION IF CONTAMINATED	APPLICATION
up to 12 min.	Removes as soon as possible	Emergency use/disposable garments only
12 min. to 2h	Wash off/clean immediately	Short term protection
2h to 6h	Wash off/clean at end of work period	Routine tasks
Over 6h	Wash off/clean at end of work period	Long term continuous exposure

12.2.6 Durability

Coatings and polymer films may be susceptible to attack by particular chemicals over a period (or repeated periods) of exposure, leading to degradation and eventual failure of the protective layer by brittle cracking. Resistance to permeation may be reduced by damage in use. Guidance from manufactures of garments and from chemical suppliers should be sought and, if necessary, tests should be performed after representative cleaning treatments and other processing to simulate the effects of continued use. It is essential to confirm that the barrier material will remain effective during its intended lifetime (see BS 903: Part A16). In relation to various aspects of durability (reference should be made to BS 3424, BS 3546 and ASTM D2582-67).

12.2.7 Air-Permeable materials

12.2.7.1 General

Materials of a porous or semi-permeable nature (e.g., woven and spun-bonded fabrics, laminates incorporating a micro-porous film or coating) would normally be selected for the construction of overgarments for wear in circumstances where a compromise between protective efficiency and comfort is acceptable. This clothing would not be suitable for protection against hazardous undiluted liquid chemicals and formulations except perhaps in well-defined circumstances where contamination is limited to an occasional droplet or small drip. Their principal application would lie with the construction of overgarments for an acceptable but limited degree of protection against sprays, dusts, small drips or splashes of diluted chemicals, generally rated in a low to moderate category of chemical hazard.

12.2.7.2 Textile fabrics

Air-Permeable materials used in protective clothing act either by shedding liquids with minimum absorption and penetration, by delaying penetration sufficiently for the wearer to retreat to a safe place and remove the clothing, or, in the case of dustproof fabrics, by preventing penetration by solid particles.

Fabrics are tightly woven or spun-bonded which allow air and moisture vapor to pass through them and promote wearer comfort. They give only limited protection against liquids and dusts, and cannot provide a satisfactory barrier to gases (some special absorbent materials containing activated charcoal are effective against many gases and vapor while the absorbent layer remains unsaturated).

12.2.7.3 Semi-Permeable materials

Semi-permeable or microporous materials, such as specially treated polytetrafluoroethylene films or polyurethane coated fabrics, allow air and water vapor to diffuse through them while presenting a barrier to the passage of liquids. They are penetrable by liquids of low surface tension and molecular size. Tests generally applicable to air-impermeable materials (see Clause 12.2.2) may apply also to semi-permeable materials.

12.3 Types and Construction

12.3.1 Garments for localized protection

Where there is a specific danger to part of the body only, local protection of that part may be adequate, such as:

a) Face protection, the face, eyes and respiratory tract may need protection as appropriate.

b) Hand protection, to protect the hands, suitable gloves are required and the material and seams shall be proof against the chemicals involved.

c) Footwear, similar considerations shall be given for the footwear.

d) Aprons and bibs are appropriate wear if there is a clear danger of chemical attack to the front of the body only.

e) Sleeves (see Appendix J) shall be tubular in construction and shall be designed to cover the forearm and/or upper arm so as to fit over other work wear (such as that part of a glove as may extend over the wrist). If the entries at each end of the sleeve are elasticated, the elasticated section shall be covered by a wrap-over extension of the sleeve complete with adjustable grip. The upper closure shall be sufficiently tight when closed so as to grip the underlying garment.

Notes:

1) The required elasticity may be obtained either by the use of a fabric that is inherently elastic or by the separate use of elastic materials, attached or inserted within the material of construction of the sleeve.

2) An example of a suitable design for a sleeve is given in Fig. 19.

12.3.2 Jackets and coats

12.3.2.1 Special requirements

Jackets and coats shall be capable of being closed to the neck.

Notes:

1) Jackets and coats may have an integral hood should be designed to overlap the trousers by at least 20 cm.

2) If appropriate, a double cuff should be provided with the cuff being of sufficient length to allow the fitting of gauntlet type gloves. Both inner and outer cuffs should be elasticated or provided with other means of ensuring a close fit.

3) A double thickness panel to act as reinforcement may be provided to the outside back of the suit to cover the area from shoulder to waist, so as to protect the suit against damage when breathing apparatus is worn.

4) Suits may be fitted with reinforced elbows and knees.

12.3.2.2 Collar

A collar, if provided, shall be of self material and of minimum depth of 7 cm if a turnover collar and 4 cm if stand up collar.

12.3.2.3 Pockets

Pockets weaken the resistance of the base fabric at the seams, present the risks of snagging, and may collect split or splashed chemicals. There shall be no external pockets.

12.3.2.4 Hanger

A self hanger shall be provided. When the garment is suspended from its hanger, no permanent distortion nor damage to the garment shall ensue.

12.3.2.5 Hood

A hood shall be provided with the means of enabling it to be adjusted to the user's outline and to protect the throat. The distance from neck seam at one shoulder to neck seam at the other shoulder of the hood shall not be less than 70 cm when measured over the crown of the head. The distance from edge to edge of the hood measured around the back of the head at eye level shall not be less than 48 cm.

Notes:

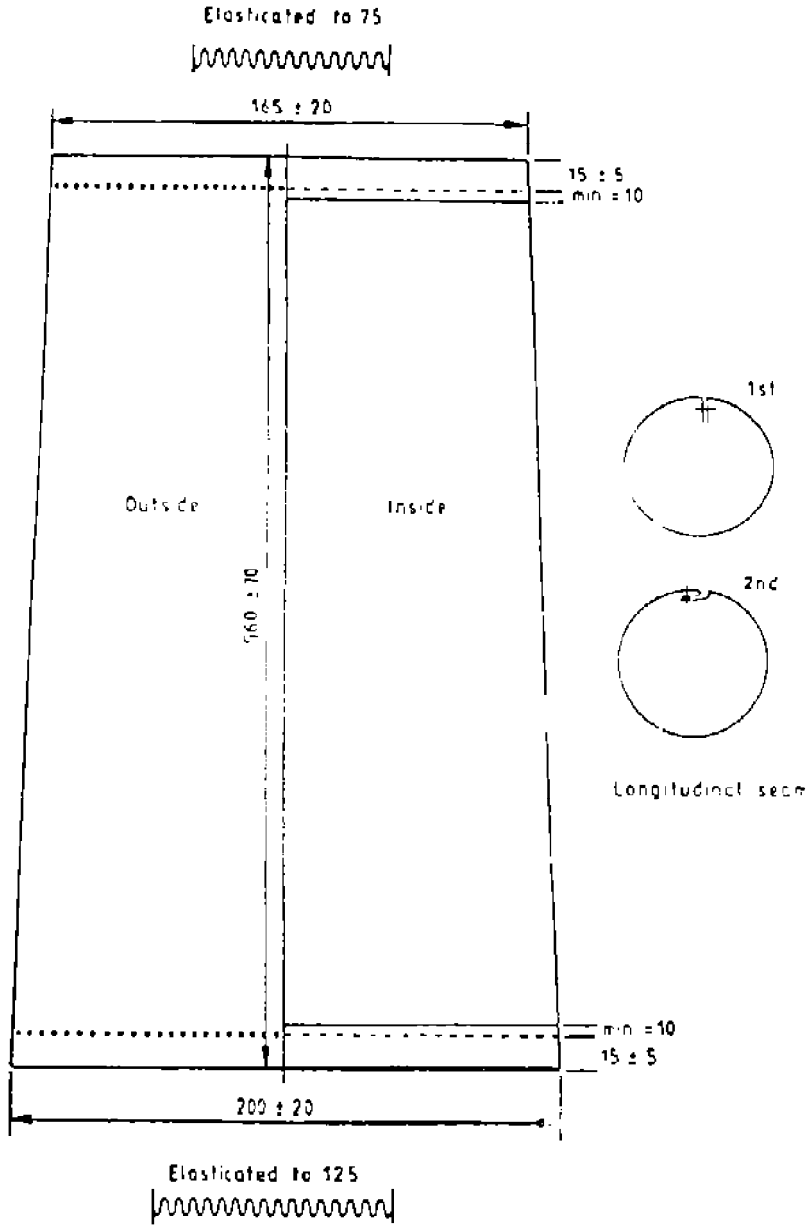
1) A hood is intended to offer protection against chemicals to the head and neck.

2) For adjustment to the user's outline, a draw string or an elasticated closure may be incorporated into the garment.

3) In cases where elastic properties may be adversely affected by exposure to chemicals elasticated sections should be protected by a suitable covering.

4) Where garments fitted with hoods are designed to be worn with industrial safety helmets, there is a need to increase these dimensions to values above the minimal in order to allow the weight of the garment to be carried on the shoulders rather than the head.

5) The hood should also be designed to accommodate the wearing of eye, ear and respiratory protective equipment.



DESIGN OF A SLEEVE
Fig. 19

12.3.3 Trousers

Trousers shall be supported, self-supported or be of the bib and brace type. The trouser legs shall be designed to permit a seal or overlap to be made with protective footwear so as to prevent the ingress of liquid.

Note:

In a suitable design a double leg/ankle is provided with the leg being of sufficient length to allow the fitting of suitable footwear. Both inner and outer legs may be elasticated.

12.3.4 Two-Piece suits

The overlap of the top garment over the trousers shall be sufficient to ensure that protection of the body is maintained during the foreseeable range of articulation and movement of the wearer.

12.3.5 Complete cover garments

Complete cover garments (see Fig. 20) can be worn with some form of visor and respirator or breathing apparatus to protect the eyes and face and to guard against inhaling chemicals. Where the danger to the skin is small, air-permeable garments together with specifically approved respiratory protection may be acceptable when dealing with chemicals in powder form.

Otherwise an air-impermeable assembly should be adopted comprising one or two-piece plastics or elastomer coated coverall, gloves, boots and complete head protection. Hoods should be sufficiently large to accommodate goggles, etc., comfortably, and (if attached to a coat-like garment) to allow the weight of the garment to be taken by the wearer's shoulders, rather than by the head.

For protection where particularly hazardous chemicals are not involved, and respiratory protection is not indicated, air-impermeable coveralls worn with gloves, goggles and boots are often adequate.

12.3.6 Air-Supplied clothing

An enveloping garments (see Fig. 20) inflated by an independent air supply, presents a double barrier to the entry of chemicals. At any small holes or pores which may exist in the fabric, the excess pressure will tend to drive contaminants outward. However, the pumping action caused by the wearer's movements can still suck gases or particles into the suit through openings at neck, wrists and ankles, or through pinholes. The protection afforded by air-fed suits is therefore increased by minimizing the apertures in them. Since the system does not eliminate the possibility of solvents and gases passing through the fabric by permeation, it still remains necessary to assess the resistance of the suit material to chemical permeation.

The air flow (which may be at a controlled temperature) will provide breathing air, and also maintains a tolerable temperature and humidity around the wearer.

Any chemicals entering the suit, either by permeation or through holes, are likely to be inhaled. If the suit is to be worn for periods exceeding the known breakthrough time for permeation, the rate at which chemicals pass into the suit should be low enough, and the air flow high enough, to reduce the concentration of chemicals to well below the occupational exposure limit. Appropriate account should be taken of the noise levels within air-supplied clothing .

12.3.7 Gas-Tight suits (see Appendix K)

To isolate a wearer completely from his environment (e.g., from a toxic gas) an all-enveloping garment should have no pinholes and be proof against passage of the gas by dissolution in the membrane (see Fig. 20).

If the breathing apparatus is isolated from the interior of the suit, the latter is effectively a sealed container. Any chemicals entering by permeation cannot be swept away and a greater concentration of contaminant will build up than in the case of the air-fed suit. Breathing apparatus (which may be either inside or outside the suit) is obviously necessary. Reinforcement of the part of the suit in contact with the apparatus may be desirable to give added support and to reduce the risk of abrasion to the suit. A gas-tight, air-supplied suit, in which the interior of the suit is purged and conditioned by an external air supply while breathing air is fed from a separate air line or self-contained breathing apparatus, provides maximum protection for both skin and lungs.

Note:

A reinforcement shall be provided to protect against damage caused by the breathing apparatus when this is worn externally.

12.3.8 Combinations of equipment

When protective clothing is worn together with other forms of personal protective equipment, such as respiratory protective equipment, eye protection, protective helmets and/or hearing protection devices, whose primary function is other than protection of the skin as such, the following consideration apply:

a) Care should be taken that no new or additional hazard is introduced.

b) Whatever the primary function of each individual garment or item of personal protective equipment, the personal protective equipment as a whole should afford due protection to the skin.

c) As far as practicable, the personal protective equipment as a whole should fit the wearer and be comfortable in use.

12.3.9 Seams

12.3.9.1 Seams shall be so constructed and sealed (by using a double overlap type of seam or other appropriate design) to prevent penetration of liquid through stitch holes or, by penetration or permeation, through other components of a seam. The performance of the seam in these respects shall not be inferior to that of the material from which it is made.

12.3.9.2 Seams shall have a strength of not less than 150 N when tested as described in BS 2576.

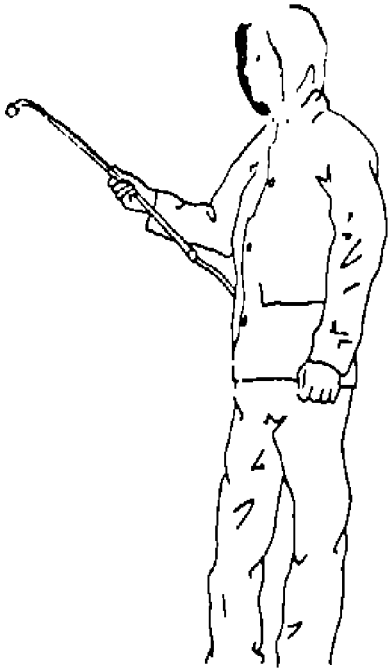
12.3.9.3 Where taped seams are used, the peel attachment strength of the tape when tested as described in method 9B of BS 3424: Part 7: 1982 shall not be less than 5 N/cm of tape width.

12.3.10 Closures

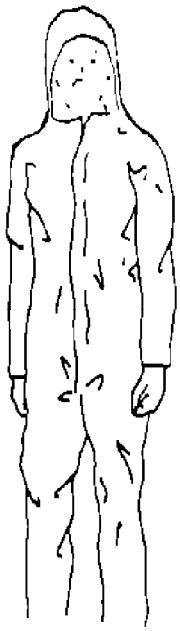
12.3.10.1 Buttonholes and eyelet holes shall be adequate for the size of button to be used and shall be through a minimum of two thicknesses of fabric. No buttonhole edge shall be less than 1.5 cm from the edge of a facing.

Note:

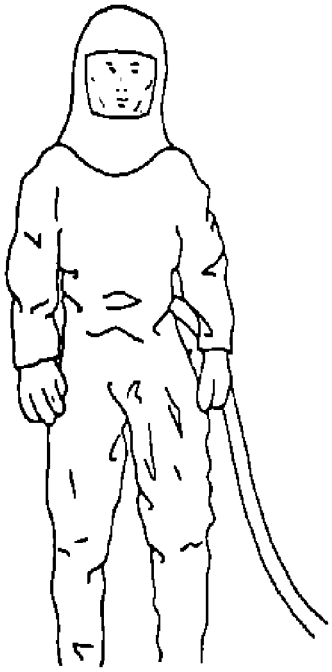
Particular attention should be paid to the bight of buttonholes. The bight of overlock and safety stitching should be adequate for its purpose.



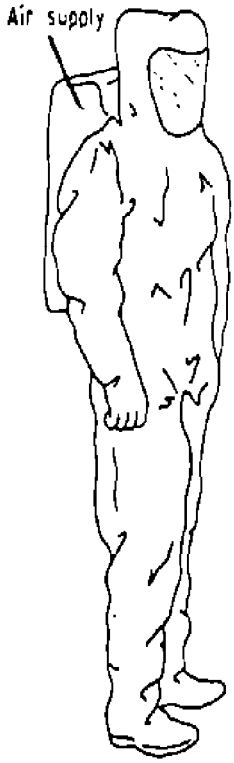
a) Two Piece spray suit



b) One piece coverall with hood



c) Air-Supplied clothing

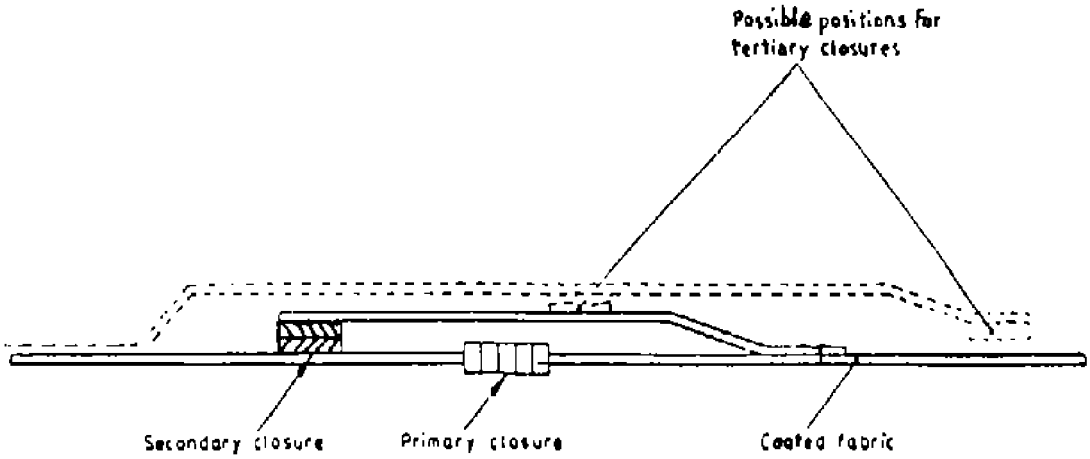


d) Gas-Tight coverall with self-contained breathing apparatus

SOME EXAMPLES OF GARMENTS
Fig. 20

12.3.10.2 The design and construction of the closure assembly shall be such that there is no route for liquid to penetrate into the interior of the garment through the closure (see Fig. 21). Any seams that form part of the closure shall comply with 12.3.9.

12.3.10.3 Since fastenings (zip fasteners etc.) are weak points, care is needed, particularly in high performance garments, in the design (placement of fastenings, covering flaps, overlaps) to ensure adequate sealing. Attention is drawn to BS 3084: 1981 (Table 3, Codes C, D, E). All fasteners should be able to withstand the cleaning operations used on the garment.



CROSS SECTION OF COMPONENTS IN A POSSIBLE CLOSURE ASSEMBLY
Fig. 21

Note:

The provision of secondary or tertiary closures may sometimes be required. Fig. 21 shows a possible arrangement of components in a closure assembly.

12.3.11 Openings

As far as possible, garment openings should be so placed as to allow easy putting on and removal, without undue strain on the material and without transfer of contamination to the wearer. In this respect, particular care should be taken in the removal of garments, such as blouses and ponchos, that are taken off over the top of the body because chemicals may thereby be readily transferred to the face and head. The primary garment closure may be supplemented by secondary or further closures to prevent the entry of liquids (see Fig. 21).

12.3.12 Apertures

Where separate garments combine to cover the body, good design is needed to avoid direct routes of entry for chemicals, particularly liquid jets, at the junctures, e.g., joins between respiratory protective mask and hood (or coverall); gloves and sleeves; jacket and trousers; trouser legs and boots. The direction from which the hazard is expected will dictate which of the components should be the outer (e.g., jacket outside trousers to guard against falling liquids). Elasticated cuffs and elasticated trouser bottoms are valuable in preventing liquids from running up sleeves and trouser legs but may allow liquids to come in contact with the skin. Further protection is given by interleaved double overlap junctures, especially if the two components can be held together or against the body by draw strings, etc.

12.3.13 Protection against additional hazards

12.3.13.1 Protection against hazards other than exposure to or contact with chemicals

Notes:

1) The recommendations given in Clause 7 of Section 3 when garments that are primarily designed to protect the skin against contact with chemicals are required to afford a degree of protection against other hazards.

2) It should be borne in mind that some hazardous chemicals if spilled onto certain types of material might not be detected immediately and a hazard could be realized at some subsequent time.

12.3.13.2 Explosion

Mixture of flammable gas or dust and air can be ignited by sparks. In such circumstances the build-up and effective ignition discharge of static electricity should be avoided by selecting non-spark clothing and footwear.

12.3.13.3 Heat stress

The human body produces about 100 W of heat energy at rest, increasing to perhaps 700 W with vigorous exercise. This heat has to be dissipated to the surroundings by convection or other means.

While sweating is the body's response to high temperatures, giving efficient evaporative cooling to regulate the body temperature, all enveloping clothing restricts heat dissipation by both convection and evaporation, and allows the heat stored in the body to increase. Heat stress results in discomfort (damp underclothing), lethargy, fatigue, loss of concentration, and eventual unconsciousness. It is possible for employees to be unaware of the danger until they are on the point of collapse. Although the hazard is worst for clothing such as gas tight suits and other incompletely enveloping garments, where body moisture can not escape. Thus a PVC coverall worn on a warm day can cause distress to the wearer even when he is not working hard physically.

For such clothing, particularly at high levels of physical exertion, work periods should be limited to a defined maximum time and should include enforced rests. If this is not possible suits with an outside supply of air for ventilation should be used.

To overcome potential problems of heat stress, there may be advantages in designing garment interfaces which permit good air flow whilst still protecting against liquid drenching, e.g., trousers suspended by braces and overlapping jacket.

12.4 Use and Maintenance

12.4.1 Limitations

Employees at all levels shall be made familiar with the function and limitations of protective clothing, and they shall be encouraged of wearing them.

12.4.2 Storage

Adequate space should be provided in a dry, well ventilated room maintained at a moderate temperature for storage of garment.

Protective clothing should be stored separately from personal clothing and chemicals and away from bright sunlight and from any equipment liable to produce ultraviolet radiation or ozone which might degrade it. Garments should be stored neatly, as far as possible free from creases or other types of distortion that could cause cracking.

Garments of different types and constructions should be kept apart from each other to avoid confusion. New garments should be kept separate from used ones. If possible, each employee should have his own clothing to make control easier, for hygiene, and to encourage personal responsibility. Wherever practical, a set practice should be laid down for the issue and storage of new and old garments, and records kept of the receipt, inspection and use of each one.

12.4.3 Inspection

Garments shall be inspected on receipt, before and after use, and after repair. The garment shall have no signs of damage or contamination (e.g., pinholes, abrasion, cuts, cracking discoloration and lifting of seams or welds).

12.4.4 Use of protective clothing

a) Wearers shall inspect the clothing for possible damage or soiling before putting it on.
b) Correct closure of all seals and fastenings shall be checked.
c) Garments shall be taken off in a set order that minimizes the chance of contaminating the wearer, with the help of an assistant if necessary.

Note:

Since contamination on hands or clothing can be transferred to food, drink, tobacco or cosmetics, and then ingested, contaminated clothing should not be worn in places where food and drink is consumed or where cosmetic application or smoking is permitted.

After using protective clothing wearers should practice exact personal hygiene and should not smoke, eat, drink nor use cosmetics nor use a toilet until they have washed at least face and hands and have moved to an area free of chemicals.

12.4.5 Cleaning

12.4.5.1 General

It shall be considered preferable to dispose of contaminated garments rather than cleaning them. Information for safe handling of contaminated items of protective clothing shall be provided whether disposal or cleaning is carried out at the work location or off the site.

12.4.5.2 Cleaning facilities

Depending on the nature of the work and the chemicals involved, consideration should be given to the following recommendations:

a) The cleaning station shall be spacious, well ventilated and provided with running water and approved drainage.

b) It shall have a well defined work flow system to prevent cross-contamination.

c) Consideration shall be given to the provision of separate "clean" an "dirty" rooms, with intermediate areas where wearers can put on or remove their clothing , and pass through a shower on leaving the contaminated room.

d) The cleaning station shall be located as close as practicable to the working area:

1) To minimize the time between contamination and cleaning;
2) to minimize risk of contaminant being transferred on clothing to a nominally clean area where unprotected persons are working.

12.4.5.3 Cleaning operation

Garments shall be cleaned according to the manufacturer's instructions. Any contaminated waste shall be safely disposed of. Some possible sequences of cleaning operations are shown in the flow chart (Fig. 22).

Note:

Static soaking merely serves to redistribute the contaminant, and is to be avoided. Solvents that may cause the garment material to swell or crack, or that may leach out certain components (such as plasticizers), should not be used for cleaning.

The staff responsible for cleaning shall be well trained and familiar with the properties of the chemicals and clothing in use. Where cleaning is performed by a separate organization, the cleaner shall be informed of the recommended procedures and of any chemical hazard associated with the clothing, and shall be required to certify that cleaning has been carried out according to the recommendations.

12.4.5.4 Repair

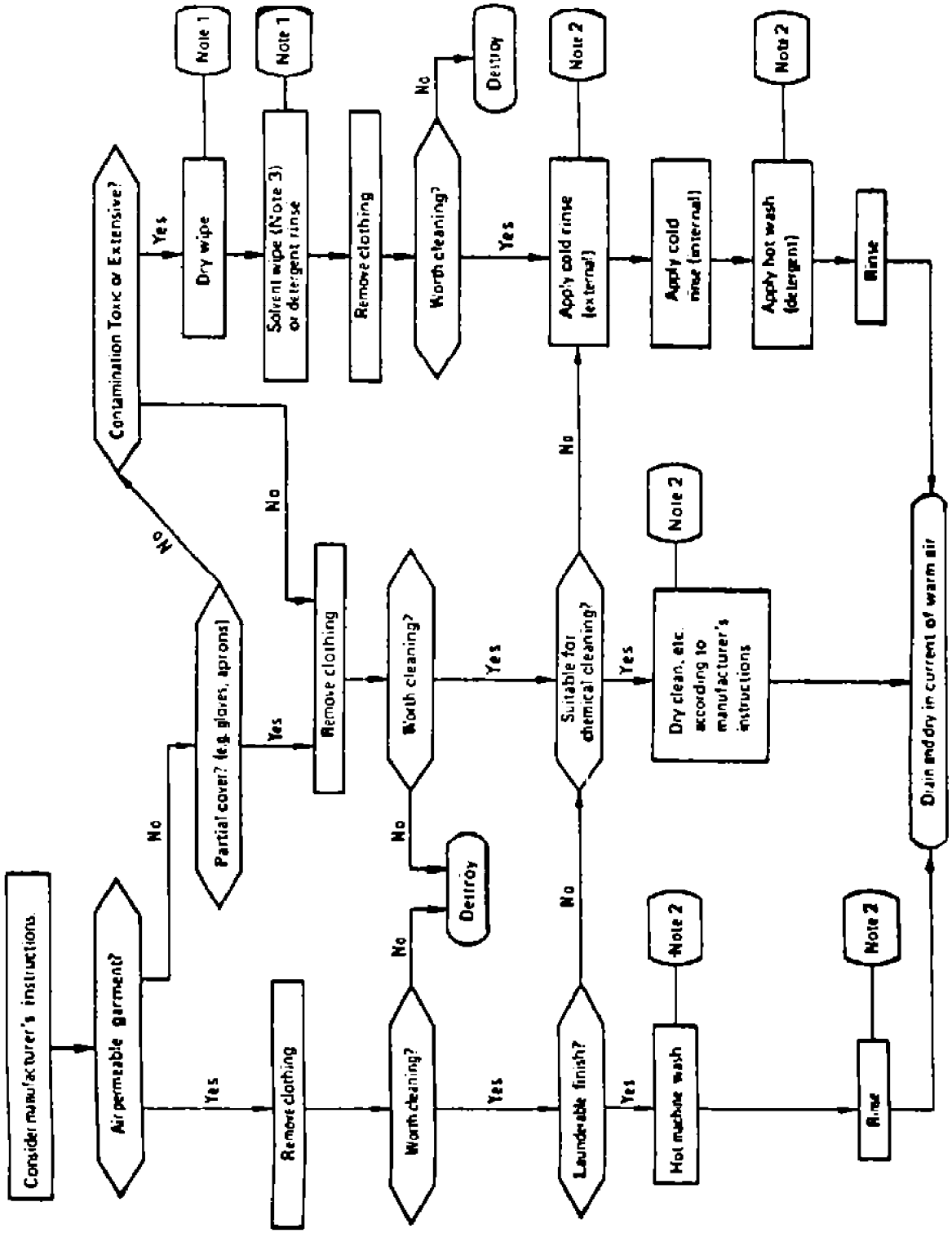
The repair of damaged garments is not recommended, but if the damage is minor the repair shall be followed in accordance with manufacturer's instructions. Repaired clothing shall be inspected and tested before every use.

Reference shall be made to ISO 6530 for penetration test and BS 4724 Parts 1 and 2 for breakthrough time test.

12.4.5.5 Disposal

Where a garment has been damaged so badly or highly contaminated it shall be considered unserviceable and destroyed at once.

Garments deteriorate slowly by wear, contamination, and cleaning, therefore an estimation of garments lifetime shall be made in consultation with the manufacturer, and the garments shall be destroyed well before the point of possible breakdown.



Notes:

1) Contaminated rags/cloths should be disposed off in a safe manner.

2) Care is needed with disposal of contaminated effluent and decontamination or disposal of cleaning equipment.

3) Use solvent that does not affect the garment material.

POSSIBLE SEQUENCE OF CLEANING PROCEDURES
Fig. 22

12.4.6 Records of use

Where appropriate, according to the type of hazard under consideration, records should be kept of the use of protective clothing under the following headings:

a) Garment type and specification;

b) dates of purchase and issue;

c) inspection;

d) names of previous wearers;

e) previous use (with appropriate details of chemical exposure, particularly when the garment has been used to protect against chemicals presenting a high degree of hazard);

f) cleaning;

g) final disposal.

These records should be in a form that is easy to up-date.

12.5 Sizing of Jackets, Coats, Overtrousers and One-Piece Suits

12.5.1 General

The finished garment measurements for jackets, coats, over trousers and one-piece suits, shall be not less than those given in Tables 30, 31 and 32.

12.5.2 Jackets and coats

Jackets and coats shall have a minimum length of 86 cm.

12.5.3 Overtrousers

All sizes of overtrousers shall have a circumference at the bottom of the trousers of at least 53 cm.

TABLE 30 - SIZING DETAILS FOR JACKETS AND COATS

WEARER'S CHEST GIRTH	SIZE NOMENCLATURE		CHEST MEASUREMENT OF FASTENED GARMENT	GARMENT SLEEVE * LENGTH	CUFF CIRCUMFERENCE
cm			cm	cm	cm
92	Small	S	115	77	33
100	Medium	M	123	81	33
108	Large	L	131	85	33
116	Extra Large	XL	139	89	33
124	Extra Extra Large	XXL	147	93	33

*** Sleeve lengths shall be measured from center back to cuff.**

TABLE 31 - SIZING DETAILS FOR OVERTROUSERS INCLUDING "BIB AND BRACE"

WEARER'S WAIST GIRTH	SIZE NOMENCLATURE		(GARMENT WAIST MEASUREMENT WITH FULLY EXTENDED WAIST	GARMENT INSIDE LEG	CUFF OUTSIDE LEG
cm			cm	cm	cm
80	Small	S	106	70	104
92	Medium	M	118	74	109
104	Large	L	130	77	113
116	Extra Long	XL	142	78	115
128	Extra Extra Long	XXL	154	79	117

TABLE 32 - SIZING DETAILS FOR ONE-PIECE SUITS

SIZING DETAILS FOR ONE-PIECE SUITS								
WEARER'S CHEST GIRTH	SIZE NOMENCLATURE		GARMENT MEASUREMENT BACK NECK TO CROTCH	CHEST MEASURE-MENT OF FASTENED GARMENT	GARMENT SLEEVE LENGTH*	GARMENT INSIDE LEG	CUFF CIRCUM-FERENCE	ANKLE CUFF CIRCUM-FERENCE
cm			cm	cm	cm	cm	cm	cm
92	Small	S	91	115	77	67	33	53
100	Medium	M	95	123	81	71	33	53
108	Large	L	99	131	85	75	33	53
116	Extra Large	XL	103	139	89	79	33	53
124	Extra Extra Large	XXL	107	147	93	83	33	53

*** Sleeve lengths shall be measured from center back to cuff.**

12.6 Instructions and Marking

12.6.1 Instructions

Instructions shall accompany each garment or shall be provided by the manufacturer in separate literature and shall include the following information:

a) The identity of the materials of construction;
b) if the clothing is marked to indicate the extent that the clothing offers protection against specific chemicals, either:

1) If such chemicals are liquid, the results of tests (on the materials of construction) carried out as described in BS 4724: Part 1 or 2; or

2) if such chemicals are not liquid, details of relevant characteristics of the clothing when exposed to such chemicals.

TABLE 33 - EXAMPLES OF PROTECTIVE CLOTHING RELATED TO THE ACTIVITY OF THE WEARER

Activity	Estimate of danger 1 = Low 10 = High	Protection*
Hazard: Concentrated hydrochloric acid or concentrated sulphuric acid		
Laboratory user		
(a) Collecting Winchester from stores and carrying in properly designed basket	1	None (ordinary clothes)
(b) Depositing Winchester in laboratory in special storage tray	2	Safety spectacles to basic standard (always required in laboratory – increase in estimate of danger from 1 to 2 is due to change of environment)
(c) Pouring out 200 ml from Winchester into beaker	4	Chemical eye protection (goggles or face screen), laboratory coat, chemical resistant gloves
(d) Carrying out chemical reaction with acid in flask or dropping funnel	The form of protection to be considered (column 3) is related to the danger as estimated by the chemist	Form (1) Basic safety spectacles and laboratory coat Form (2) Fully screened-off apparatus Form (3) Apparatus completely isolated from worker (e.g. in a fume cupboard)
Industrial user (intermittent)		
(e) Walking around plant area outside bunded stock tanks and pumps	3	Carrying goggles, standard coverall and safety helmet
(f) Inspection in bunded areas walking past pumps	4	As above: goggles worn
(g) Maintenance near pumps or pipes carrying acid	4	Move out of the area for the short time pumps are running so that the danger is reduced allowing the estimate of risk and consequent protection to be the same as for (f)
(h) Maintenance on pipeline used for acid transfer, rest of area not carrying/using corrosive chemicals	6	Goggles, PVC coverall, safety helmet, chemical resistant gauntlets, rubber boots, breathing apparatus
(i) Coupling and uncoupling of road tankers and discharging a load to storage tanks	8	Goggles (full face screen preferable), PVC coverall, safety helmet, chemical resistant gauntlets, rubber boots and standby breathing apparatus
Manufacture of acid		
(j) Attending to plant under atmospheric pressure where leaks are not expected	5	Goggles, standard or acid resistant coveralls, safety helmet, chemical resistant gloves and rubber boots
(k) As above but where leaks (drips) may be possible	6	Goggles, heavy duty coveralls or PVC suit, safety helmet, chemical resistant gloves and rubber boots
(l) Breaking into pipelines after washing out (whilst other lines in the area contain acid)	7	Goggles (full face screen prefereable), PVC coverall, chemical resistant gauntlets with elasticated cuff to grip coverall and rubber boots
(m) As above if acid gas is present (not just fumes from liquid splashes)	9	As above with an air-fed hood or with separate breathing apparatus
(n) Maintenance/operation where severe splashing may occur, e.g. closing valve on corroded line (for expected working time of 10 min or less)	10	Gas-tight suit with breathing apparatus inside the suit
(o) As above, (for work of long duration)	10	Air-fed gas-tight suit – air for breathing and cooling

*** Note:**

Terms for eye protection are taken from BS 2092.

c) if appropriate, i.e., if the specific chemicals stated in accordance with Clause 12.6.2 are liquids, the classification of the garment in terms of the breakthrough time of the material of construction in accordance with the following categories:

1) less than 2 minutes;
2) more than 12 minutes and less than 2 hrs;
3) more than 2 hrs and less than 6 hrs;
4) more than 6 hrs.

Note:

The breakthrough time is measured in accordance with BS 4724: Part 1 or 2.

12.6.2 Marking

Clothing shall be labeled with the following information:

a) The name, trademark or other means of identification of the manufacturer.

b) The number and date of standard followed.

c) The month and year of manufacture.

d) The manufacturer's type number, identification number or model number.

e) As appropriate, the waist, chest or head girth measurement of the wearer the garment is intended to fit as specified in Clause 12.5 and the size nomenclature, e.g., size medium to fit up to chest 100 cm.

f) If appropriate an indication that boots of gas-tight suits are provided with protective mid-soles.

g) If appropriate, a statement to indicate the extent that the clothing offers protection against specific chemicals and to explain which of the following sources of information should be referred to for details of relevant characteristics of the clothing when exposed to such chemicals:

1) The manufacturer;
2) the manufacturer's instructions;
3) appropriate test certificates.

Notes:

Consideration should be given to suitable additional marking:

1) Where the garment is designed to offer protection against gases or solids.

2) Where the garment is constructed from materials having special characteristics.

Attention is drawn to BS 3424, BS 5438 and BS 6249: Part 1.

3) In cold locations periodic test inspections as stated above shall be made at least every month.

12.7 Examples

For examples of protection against a single hazard under differing degrees of danger see Appendix L and examples of protective clothing related to the activity of the wearer are given in Table 32.

PART II
"FIRE-FIGHTERS PROTECTIVE CLOTHING"

SECTION 9
(HELMET, CLOTHING, FOOTWEAR AND GLOVES)

13. FIRE-FIGHTERS PROTECTIVE CLOTHING (HELMET, FOOTWEAR AND GLOVES)

13.1 General

13.1.1 The hazards to be expected in condition of heat particularly in fire fighting are:

- **a)** The effect of heat on the body, face and hands;
- **b)** the danger of clothing catching fire;
- **c)** the effect on the lungs due to combustion products and vapor used for fire extinction;
- **d)** reduced visibility owing to smoke and lighting failure;
- **e)** electric shock;
- **f)** falling objects;
- **g)** the effect of high rates of heating by conduction caused in contact with hot surface;
- **h)** falling and slipping.

Because of the diverse nature of these hazards, the protective clothing specified in this Standard should be worn by fire fighters and being aware of the limitations of the clothing.

13.1.2 Manufacturers of protective clothing data requirement

The requirements of this Standard shall provide a written statement that the protective clothing produced by manufactures meets or exceed the requirement of this Standard. The manufacturer shall furnish upon request the laboratory data showing individual values upon which the statement is based.

13.1.3 The manufacturer shall provide on request, guidelines for maintenance, inspection and retirement.

13.2 Garment Requirement

13.2.1 The garment shall consist of a composite of an outer shell, moisture barrier, and thermal barrier.

13.2.2 Protective garments shall have a means of securing moisture barrier, thermal barrier to the outer shell.

13.2.3 The garment including the front closure, shall be constructed in a manner that provides secure and complete moisture and thermal protection. If non-positive fasteners such as snaps or hook and pile tape are used in garment closures, a positive locking fastener such as hooks and dees (D'S) or zippers shall also be utilized.

13.2.4 Cargo pockets where provided shall have a means of drainage of water and shall have flaps with a means of fastening them in closed position.

13.2.5 Trim to be utilized to meet visibility, requirement and shall not be less than 50 mm wide and shall have retroreflective and fluorescent surface.

13.3 Labeling Requirements

13.3.1 Protective garment applicable to this Standard shall be labeled, with the following:

a) The outer shell of each protective garment shall have a label permanently and conspicuously attached to the inside upon which at least the following informations are printed.

Outer shell, moisture barrier, and thermal barrier must be utilized and all garment closures must be fastened when in use. Do not keep this garment in direct contact with flame or molten metal. Do not use for proximity or fire entry application or protection from chemical, radiological or biological agents. Use extreme care for all emergency operations.

b) Manufacturers name and address.

c) Country of manufacture.

d) Manufacturers garment identification number.

e) Date of manufacture.

f) Size.

g) Cleaning and drying instructions.

13.4 Additional Requirements for Protective Coats

13.4.1 Protective coats shall provide protection as specified to the upper torso, neck, arms and wrists including hands and head.

13.4.2 Protective coat hardware shall not penetrate through the outer shell moisture barrier, and thermal barrier to contact the wearer's body when the coat is worn covered by external closure flaps.

13.4.3 Each protective coat sleeve shall have a resilient wristlet.

13.4.4 Protective coats shall have a composite collar not less than 100 mm. in height at any point with a closure system. Collar and closure system shall consist of an outer shell, moisture barrier, and thermal barrier that meet all performance requirements as specified in performance requirement of this Standard.

13.4.5 Protective coat trim configuration shall include a circumferential band around the coat and each wrist.

13.4.6 Protective coat trim shall have not less than 2000 sq cm of fluorescent area.

13.4.7 Protective coat trim shall include not less than 800 sq cm of fluorescent area visible from the front and 800 sq cm of fluorescent area visible from the rear when the garment is properly closed and is laid on a flat inspection surface.

13.5 Additional Requirements for Protective Trousers

13.5.1 Protective trousers shall provide protection as specified to the lower torso and legs, excluding the ankles and feet.

13.5.2 The thermal barrier of the protective trousers may be configured as a protective uniform pant. When configured in this manner, the protective uniform pant component shall meet all requirements for thermal barriers and the entire protective trousers with outer shell, moisture barrier, and protective uniform pant as the thermal barrier assembled shall meet the requirements specified in this Standard.

13.5.3 Protective trousers hardware shall not penetrate through the outer shell, moisture barrier, and thermal barrier to contact the wearer's body when trousers is worn with closures fastened, unless the hardware is located on the waistband or hardware is completely covered by external closure flaps.

13.5.4 Protective trouser trim shall include a circumferential band around each leg between the hem and knee.

13.5.5 Protective trouser trim shall have not less than 500 sq cm of fluorescent area.

13.5.6 Protective trouser trim shall include not less than 260 sq cm of fluorescent area visible from the front and 260 sq cm of fluorescent area visible from the rear when the garment is properly close and is laid on a flat inspection surface.

13.6 Additional Requirements for Protective Coverall

13.6.1 That portion of the protective coverall that corresponds to the protective coat shall meet all requirements of Clause 13.4.

13.6.2 That portion of the protective coverall that corresponds to the protective trouser shall meet all requirements of Clause 13.5 of this Section.

13.7 Performance and Tests Requirement

Fire fighters protective clothing shall meet the requirements of Chapter 3 of NFPA Code No. 1971 for:

a) garment requirement;
b) textile;
c) outer shell requirement;
d) moisture barrier requirement;
e) thermal barrier requirement;
f) winter liner requirement;
g) thread requirement;
h) visibility requirement;
i) hardware requirement;
j) snap requirement;
k) fastener tape requirement;
l) zipper;
m) hooks and dees;
n) label requirement;
o) collar lining requirement.

13.8 Testing and Inspection

Protective clothing for fire fighters shall be tested in accordance with Chapter 4 testing and inspection and Chapter 5 tests methods of NFPA Standard 1971 for the following tests:

a) Thermal protective performance test;
b) head, char, and ignition resistance test;
c) tear resistance test;
d) retroreflectivity test.

13.9 Helmet for Fire-Fighters

13.9.1 General

13.9.1.1 Fire fighters helmet shall essentially consist of a shell, an energy absorbing system, a retention system, face-shield, ear cover and retroreflective marking.

13.9.1.2 Manufacturers shall employ adequate quality assurance measures to guarantee that the helmets manufactured to this Standard meet the requirements of performance requirement of Chapter 3 of NFPA 1972.

13.9.1.3 Helmets shall be listed to all performance criteria as specified on Section 4.4 "verification testing of NFPA No. 1972". Verification testing shall be performed by an independent authorized testing laboratory.

13.9.1.4 Labeling affixed to helmets shall only be made on helmets that satisfy all the requirement specified in Clause 13.9.1.3.

13.9.2 Marking and instructions

13.9.2.1 Each helmet shall be durably and legibly marked in a manner such that the marking can be easily read. Each marking shall include the following informations:

- **a)** Name or designation of manufacturer;
- **b)** model number or design;
- **c)** month and year of manufacture;
- **d)** lot number;
- **e)** nominal weight of helmet;
- **f)** recommended cleaning procedure;
- **g)** helmet size or size range.

13.9.2.2 The manufacturer shall provide information advisory material with each helmet, including instructions for cleaning painting, marking, storage and frequency detail of inspections.

13.9.2.3 Each helmet shall be durably and legibly marked with the following warning at least 1.5 mm high letter:

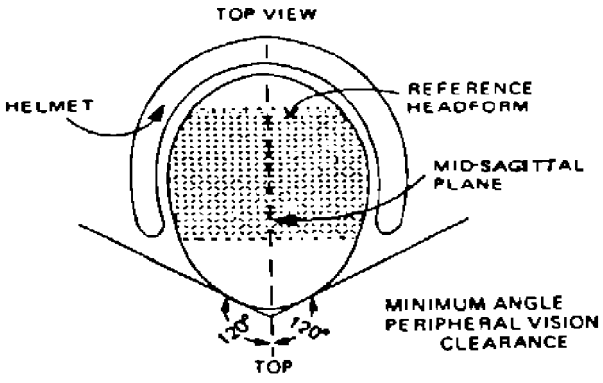
This helmet must be properly adjusted and secured to the head, with all components in place, in order to provide designed protection.

Do not modify or replace any component of this helmet, including shell, energy absorbing system, retention system. Fluorescent retroreflective marking, ear covers or face shield with component or accessories other than those approved by the manufacturer.

13.9.2.4 A warning label with letters at least 1.5 mm high shall be attached to the faceshield that warns the user that the faceshield may not provide sufficient eye protection and additional eye protection may be required.

13.9.3 Configuration

13.9.3.1 The helmet shall provide peripheral vision clearance of at least 120 degrees to each side of the midsagittal plane as shown in Fig. 23.



PERIPHERAL VISION
Fig. 23

13.9.3.2 There shall be no openings penetrating the shell except those provided by the manufacturer for mounting energy absorbing system, retention system and accessories.

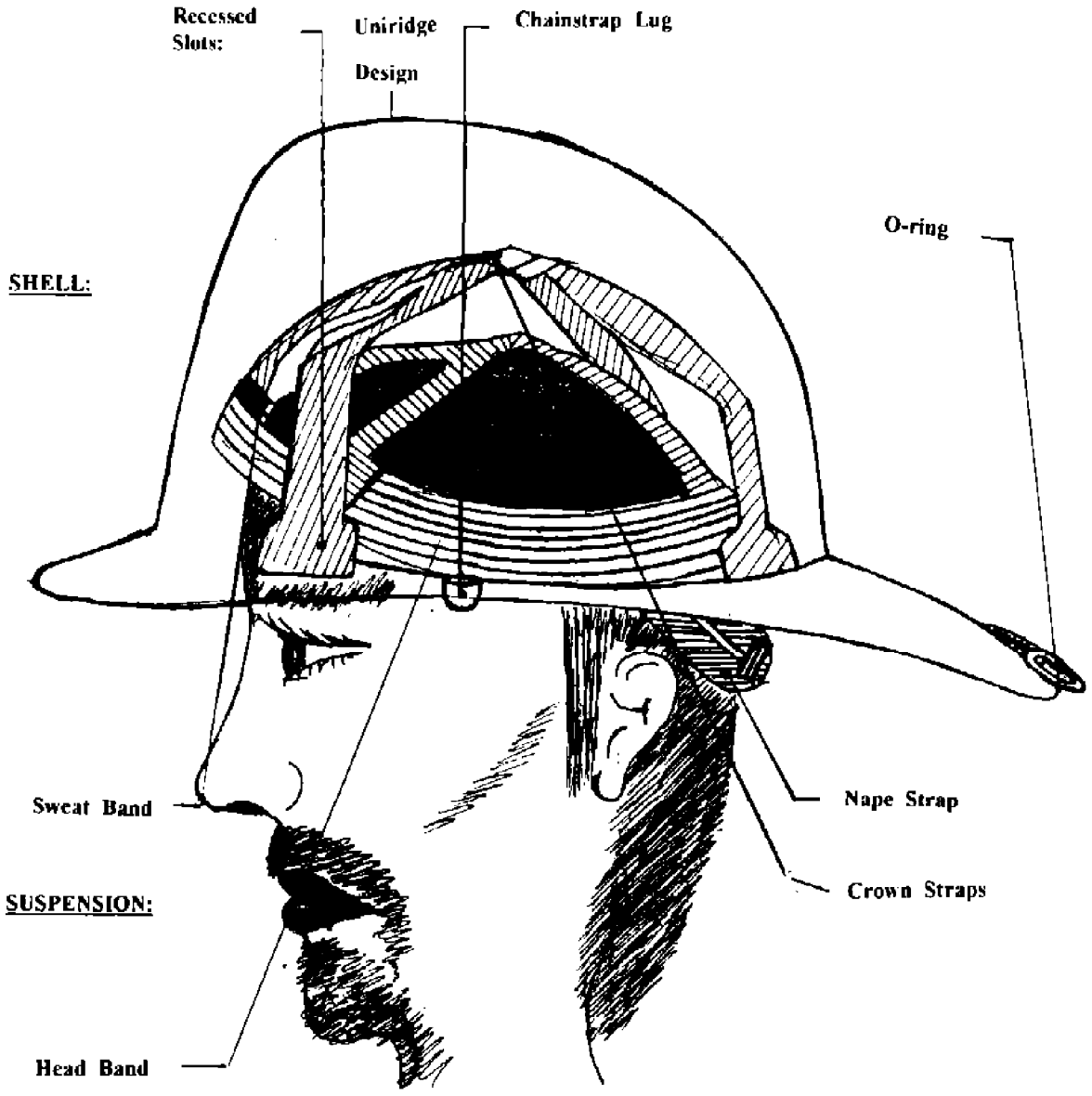
13.9.4 Accessories

13.9.4.1 The addition of helmet accessories shall not interfere with the function of the helmet or its component parts and shall not degrade the helmet performance below the requirement of this Standard.

13.9.4.2 Helmet manufacturers shall certify that helmet accessories provided by the manufacturer meet the requirements specified in 13.9.4.1.

13.9.5 Performance requirement

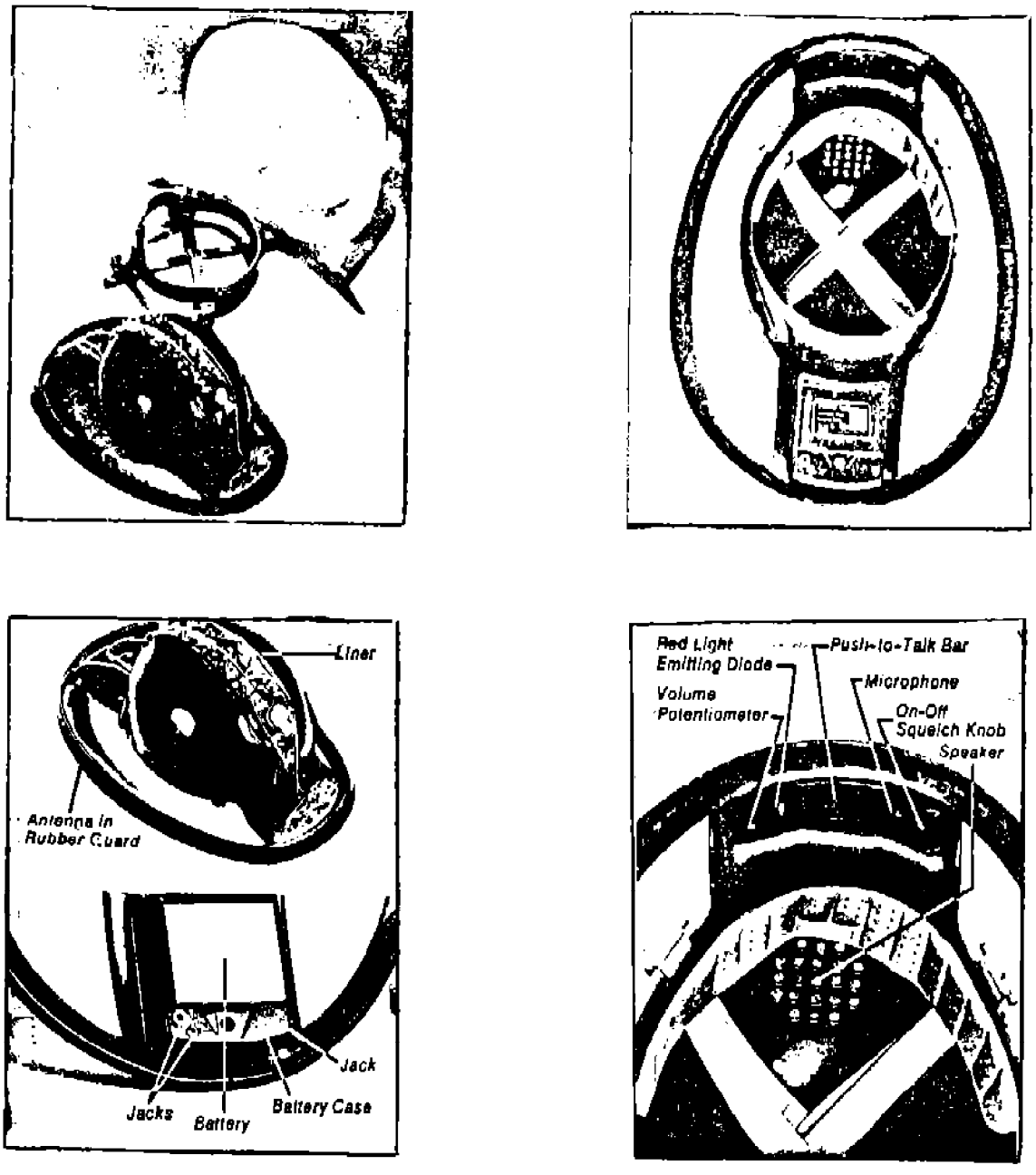
Fire fighters helmets shall meet the performance requirements of Chapters 3 and 4 and also Appendix A of NFPA 1972.



HELMET WITH ABSORBING SYSTEMS
Fig. 24

13.9.6 Transceiver helmet

Transceiver is a two-way communications system designed to be used into fireman's helmet. The system permits the firefighter to transmit and receive voice communication over ¾ of a kilometer line of sight range. It eliminates the need for carrying conventional walkie-talkies, leaving both hands free for fire fighting see Fig. 25 for general aspect of transceiver helmet.



TRANSCEIVER WITH MINIATURE SOLID STATE ELECTRONIC COMPONENTS ATTACHED TO A CONTOURED CIRCUIT BOARD. CONTROLS, MICROPHONE AND BATTERY ARE FITTED TO THE LINER.
Fig. 25

13.10 Protective Footwear for Fire-Fighters

13.10.1 General

Fire fighter protective footwear manufactured in accordance with this Standard is designed to mitigate adverse environmental effects to the fire fighter's foot and ankle.

13.10.2 Design requirements

13.10.2.1 Fire fighters footwear shall consist of a sole with heel upper with lining, and insole with a puncture resistant device, an impact and compression resistant toecap permanently attached.

13.10.2.2 Fire fighters footwear shall not be less than 200 mm in height when measured from the plane of the wear surface at the heel to the top of the boot.

13.10.2.3 Heel breast shall not be less than 12.5 mm nor more than 25 mm. Heel breasting angle shall not be less than 90° nor more than 135°. Sides and rear of heel shall not be flared or tapered and edges shall not be less than, or extend more than 15 mm laterally from the upper at any point.

13.10.3 Sizing

13.10.3.1 Sizing shall be in conformity with the standards of DIN 4843 or BS 2723 Clause 4.

13.10.4 Construction

Metal parts shall not penetrate from the outside into the lining or insole at any point.

No metal parts including but not limited to nails or screws, shall be present or utilized in the construction or attachment of the sole (with heel) to the puncture resistant device insole at any point.

13.10.5 Safety requirement

Safety boots for fire fighters shall be in accordance with application symbol for footwear types SHR or SH DIN 4843 or requirement of BS 2723 1988.

13.10.6 Marking

Boots shall comply with this Standard and marked with the following particulars:

a) Size and fitting

These shall be indelibly stamped with 20 mm metal stamps on the waist of the outsole and top of the leg.

b) Manufacturer's name and year of manufacture

These shall be stamped at the top of the leg.

c) The number of standard used

13.10.7 Testing

Testing shall be in accordance with DIN 4843 for footwear type SH or SHH Clause 6 for the following tests or in accordance with N.F.P.A Standard 1974 Chapter 3.

1) Cut growth resistance outsole;
2) abrasion resistance outsole;
3) effect of fuel outsole;
4) effect of water vapor outsole;
5) thickness of insole, upper/leg material, lining and tongue;
6) abrasion resistance of insole;
7) effect of water on insole;
8) Ph value for insole, upper leg material, lining and tongue;
9) cut growth resistance of upper/leg material lining and tongue;
10) tensile strength and elongation at tear of upper leg material;
11) resistance of upper/leg material to water penetration;
12) water proofness of footwear;
13) moisture flow coefficient of upper/leg material and lining;
14) abrasion resistance of shoe lace;
15) volume resistibility of bottom;
16) energy absorption of bottom in the seat region;
17) resistance to repeated flexing of bottom;
18) nail penetration resistant bottom;
19) heat insulating bottoms;
20) cold insulating bottoms;
21) resistance of footwear forepart to deformation;
22) sole bond peeling strength;
23) effect of calcium chloride on footwear;
24) tensile strength of counter.

13.11 Fire Fighters Rubber Boots

Rubber boots for fire fighters shall be of the size 330 to 450 mm in height and shall meet the requirement of specification for lined industrial vulcanized rubber boots Section 6, Clause 10.5 and also BS 5145.

13.12 Gloves

13.12.1 Design

13.12.1.1 Gloves for fire fighters shall be designed to mitigate adverse environmental effects to the fire fighters hands and wrists. Gloves are designed and made of two, three or four fingers to provide limited protection.

13.12.1.2 Gloves for fire fighters shall be designed to minimize the effect of flame, heat, sharp objects and other hazards that are encountered during fire fighting. Gloves shall be designed and constructed in a manner that provides secure and complete thermal and moisture protection.

13.12.1.3 Gloves shall be designed to minimally interfere with physical movement, the use of fire fighting tools and self contained breathing apparatus.

13.12.1.4 Gloves shall reduce the incidents of burn or injury by providing complete coverage of the wrist area.

13.12.1.5 Gloves shall extend not less than 25 mm above the wrist crease and shall be close fitting at the opening to restrict the embers and other foreign particles.

13.12.1.6 The glove material that comes in contact with the skin shall be non-irritating.

13.12.2 Sizing

13.12.2.1 Gloves shall be available in not less than 5 separate and distinct sizes. The manufacturer shall provide hand dimension ranges for each size provided.

13.12.2.2 Gloves size indicated on the label shall be determined by the following:

Size	to fit	Hand Circumference
XS	to fit	175 to 200 mm
S	to fit	200 to 225 mm
M	to fit	225 to 250 mm
L	to fit	250 to 275 mm
XL	to fit	275 to 300 mm

13.12.3 Compliance and labeling

13.12.3.1 Manufacturers of protective gloves for fire fighters shall provide a written statement that the protective gloves meet or exceed the requirements of this Standard.

13.12.3.2 The gloves manufacturer shall provide with each pair of gloves inspection, maintenance, criteria for removal from service and any other information with regard to gloves serviceability.

13.12.3.3 The label shall include the following information:

a) Gloves for fire fighters;
b) name and designation of manufacturer;
c) model, name, number or design;
d) lot serial number;
e) date of certification test;
f) size;
g) country of manufacture.

13.12.4 Performance requirements and testing

13.12.4.1 Gloves shall be tested for the following performance requirements:

a) Heat resistance;
b) flame resistance;
c) conductive heat resistance;
d) thermal protective performance;
e) water penetration;
f) cut resistance;
g) dexterity test;
h) grip test.

13.12.4.2 Testing shall conform to NFPA Standard 1973 Chapter 3.

SECTION 10
STATION WORK UNIFORM (OVERALL)

14. STATION WORK UNIFORM (OVERALL)

14.1 Requirements

14.1.1 Station work uniform should not ignite easily, but if ignited it should cease to burn on removal from igniting sources of flame.

14.1.2 Manufacturers of fireman station work uniform using textile materials meeting the requirements of this Standard, shall provide upon request a certification statement that the uniform was constructed with textile materials and components which meet the requirements of this Standard and data substantiating the conformance.

14.1.3 All component of garments shall not burn or melt when placed in a 250°C(+10-0°C) forced air oven for 5 minutes.

14.1.4 The manufacturer shall provide care and cleaning instructions with each overall.

14.1.5 All joining of clothing shall have sufficient overlap to prevent ingress of heat and sparks e.g. in the design of two piece garments care should be taken that no separation of any two parts is caused by movements of the wearer. Similar attention shall be paid to joining between body garments and accouterments.

14.1.6 Fasteners shall be secure in use yet shall permit rapid removal of the clothing in an emergency.

14.1.7 All metal components shall be smoothly finished and adequately protected against corrosion.

14.2 Labeling

14.2.1 Label shall be permanently attached to each station/work uniform (overall) that meets the requirements of this Standard indicating the textile material(s) used in construction of that uniform garment, and give details of specific care instructions.

14.2.2 The label shall include the following information:

a) Name and designation of manufacturer;
b) style, name, number, or design;
c) textile material number;
d) statement: "this garment meets all requirements of fire fighters station/work uniform".

14.3 Performance Requirement

Textile used for fire fighters station/work uniform shall meet performance requirements of NFPA Standard 1975 Chapter 3.

APPENDICES

APPENDIX A
HEAD PROTECTION

A.1 Recommendations for the Material and Construction of Helmets

The materials used in the manufacture of helmets should be of durable quality, i.e. their characteristics should not undergo significant alteration under the influence of aging or of the circumstances of use to which the helmet is normally subjected, e.g. exposure to sun, rain, cold, dust, vibrations, contact with the skin, effects of sweat or of products applied to the skin or hair. For those parts of the harness coming into contact with the skin, materials which are known to cause irritation should not be used.

For a material not in general use, advice as to its suitability should be sought before use. Any devices fitted to the helmet should be so designed that they are unlikely to cause any injury to the wearer in the event of an accident. In particular there should be no metallic or other rigid projections on the inside of the helmet.

No part of the helmet should have sharp protruding edges. Where stitching is used to secure the harness to the shell, it should be protected against abrasion.

No part of the shock absorbing device should be capable of being easily modified by the user.

A chin strap should have sufficient strength to maintain the helmet on the wear's head in circumstance where helmet retention would otherwise be unreliable.

If other protective equipment is designed to be used with a particular industrial helmet, that helmet should still comply with this Standard when worn in conjunction with the designed equipment.

A.2 Method for Measuring Wearing Height, Vertical Distance, Horizontal Clearance and Precautions Concerning Helmet Use, Maintenance and Testing

A.2.1 Headforms

Headforms for these measurements are in accordance with BS 6489 above the reference plane and are of sizes B, D, F, J, L and N.

A.2.2 Procedure

Mount the helmet on a headform of appropriate size, leveled and in the normal wearing position. If the size of the harness is adjustable to such an extent that the helmet can fit more than one of the sizes of headform, carry out these measurements twice, once at each extreme of the range of appropriate sizes of headform. Measure the wearing height, the vertical distance and the horizontal clearance.

A.2.3 Painting

Caution should be exercised if shells are to be painted, since some paints and thinners may attack and damage the shell and reduce protection. The manufacturer should be consulted with regard to paints or cleaning materials.

(to be continued)

APPENDIX A (continued)

A.2.4 Periodic inspection

All components, shells, suspensions, headbands, sweatbands, and accessories, if any, should be visually inspected daily for signs of dents, cracks, penetration, and any damage due to impact, rough treatment, or wear that might reduce the degree of safety originally provided. Any industrial helmet that requires replacement or the replacement of any worn, damaged, or defective part should be removed from service until the condition of wear or damage has been corrected.

Note:

All items constructed of polymeric materials are susceptible to damage from ultraviolet light and chemical degradation, and safety helmets are no exception. Periodic examinations should be made of all safety helmets and in particular those worn or stored in areas exposed to sunlight for long periods. Ultraviolet degradation will first manifest itself in a loss of surface gloss, called chalking. Upon further degradation the surface will craze or flake away, or both. At the first appearance of either or both of the latter two phenomena the shell should be replaced immediately for maximum safety.

A.2.5 Cleaning

Shells should be scrubbed with a mild detergent and rinsed in clear water approximately 60°C. After rinsing, the shell should be carefully inspected for any signs of damage.

Removal of tars, paints, oils, and other materials may require the use of a solvent. Since many solvents may attack and damage the shell, the manufacturer should be consulted with regard to an acceptable solvent.

A.2.6 Precautions

Because helmets can be damaged, they should not be abused. They should be kept free from abrasions, scrapes, and nicks and should not be dropped, thrown, or used as supports. This applies especially to helmets that are intended to afford protection against electrical hazards.

Industrial protective helmets should not be stored or carried on the rear-window shelf of an automobile, since sunlight and extreme heat may cause degradation that will adversely affect the degree of protection they provide. Also, in the case of an emergency stop or accident, the helmet might become a hazardous missile.

The addition of accessories to the helmet may adversely affect the original degree of protection, then precautions or limitations are indicated by the manufacturer, they should be transmitted to the wearer and care taken to see that such precautions and limitations are strictly observed.

A.3 Impact System Calibration Procedures

A.3.1 Medium calibration

This calibration step should be carried out with a guided-fall system and an accelerometer mounted on the 3.64-kg falling mass. The accelerometer should have the following characteristics:

Minimum Range	0-125	g's
Maximum Resolution	1	g
Minimum Frequency Response (±0.5 dB)	0.1-2000	Hz
Minimum Resonant Frequency	20	kHz
Linearity	1%	full scale
Repeatability and Stability	0.5%	full scale

(to be continued)

APPENDIX A (continued)

The accelerometer should be mounted, according to the manufacturer's instructions, on the falling mass within 5° of true vertical. A suitable amplifier and peak meter (or equivalent devices) are required; a storage oscilloscope is recommended but not required.

Mount a calibrating medium over the load cell. Drop the mass from at least 915 mm to strike the medium. The centers of the load cell, medium, mass, and accelerometer must be co-linear. A means to verify the velocity at impact should be used.

The values shown on two peak meters should read such that the acceleration value a, in g's, times the weight of the falling mass m equals the force value F within 2.5% (F = ma). This accuracy must be repeatable through at least five impacts.

A.3.2 System calibration only

A calibrating medium that has been tested in accordance with A.3.1 may be used without the accelerometer or guided mass. The force value obtained when the medium was tested according to A.3.1 should be recorded and this information provided with the calibrating medium. The calibrating medium is mounted over the load cell with the centers of both aligned. The mass is then dropped directly on the center of the medium. The force value obtained should be within 2.5% of that achieved during testing according to A.3.1. The calibrating medium should be retested according to A.3.1 at least three times a year and more often if a significant change in force becomes apparent.

A.3.3 Electronic calibration

Electronic calibration of the normally used amplifier and peak meter scales should be performed at least weekly. This can be accomplished with a precision voltage source coupled to the input circuit via a precision capacitor, with a precision voltmeter attached to the output circuit. A compact unit, such as a hand calibrator that meets the following requirements, may be used instead:

Resolution	0.02%	full scale min
Linearity	±0.25%	full scale
Output Voltage	Typically	0-10 V
(Suitable for Amplifier)	100 ±10	Hz
External Load	100	kΩ min
	0.1	μF max

A.3.4 Static Calibration

A rough determination of the calibration of the system may be obtained as follows:

1) Apply a known weight of at least 45 kg to it,
2) Zero the peak meter and amplifier,
3) If the amplifier has an adjustable time constant, move it to the longest setting available,
4) Slowly add the weight, being careful not to impart acceleration to it.

The peak meter should indicate the weight. This method should be used before each series of tests. An error in weight can indicate the need for a more sophisticated calibration check.

(to be continued)

APPENDIX A (continued)

A.3.5 A Proven system

The following electronic components have been shown to be effective in determining peak load on a guided-fall impact-attenuation test system:

1) Load cell

Diameter	75	mm
Range, full-scale compression	400500	N
Sensitivity	10	pC/lb
Resolution	0.445	N
Rigidity	8.76×10^{-7}	N/M
Minimum resonant frequency	50	kHz
Linearity	1	%

2) Amplifier and peak meter

R		
Range (at least one)	(0-4450)	N
Transducer sensitivity		compatible with load cell
Permissible system error, including linearity	±2.5%	full scale max
Rise Time of circuit	<10	μ sec
Frequency response	0.016-100	kHz
Minimum storage time constant of display	>10	
Maximum zero drift	1.0%	full scale

3) Filter

Frequency Cutoff 3 dB Down	5 ±10%	kHz
Minimum Rolloff	12	dB/octave

A.4 Application of Safety Hats & Caps

Hats have a full brim and are designed primarily for use in industrial situations requiring additional protection around the back and sides (1) from falling objects and (2) from the weather (rain) (see Fig. 26). Caps have a peak without a full brim and are designed primarily for use in tight or confined areas. Cap configuration minimizes the possibility of accidentally dislodging the cap from the head.

(to be continued)

APPENDIX A (continued)

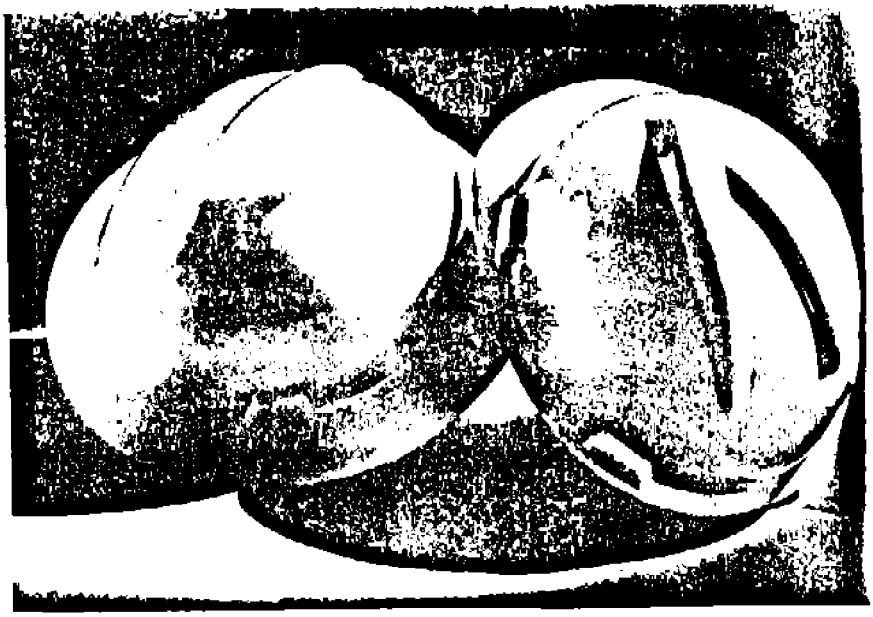


Fig. 26

The Cap provides head protection from impact hazards in industrial plants and, at the same time, provides capability for wearing hearing protection devices, and faceshields or welding helmets. Widely used in construction industry, government, utilities, manufacturing plants (see Fig. 27).

Fig. 27

(to be continued)

APPENDIX A (continued)

Hats and Caps provide head protection for personnel likely to encounter electrical contact as well as impact hazards, such as linemen, electric utility, maintenance crews, and electricians. The hat model is especially suitable for linemen and utility crews because of the more complete protection afforded the neck and back (see Fig. 28).

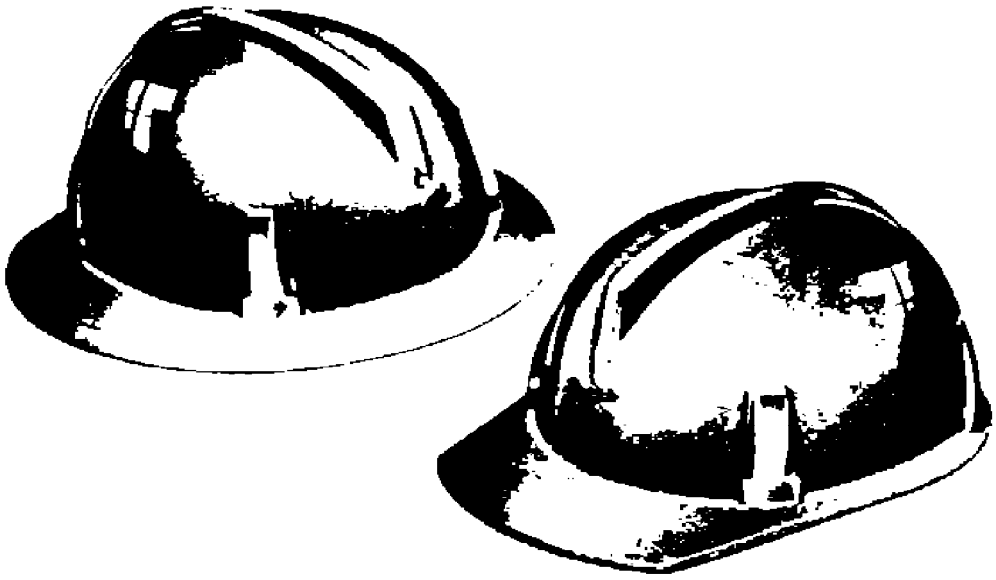


Fig. 28

An Aluminum Hats and Caps are used for head protection in various industries, especially for workers exposed to hot-weather conditions, such as those in the petroleum, forestry, and construction industries (see Fig. 29).

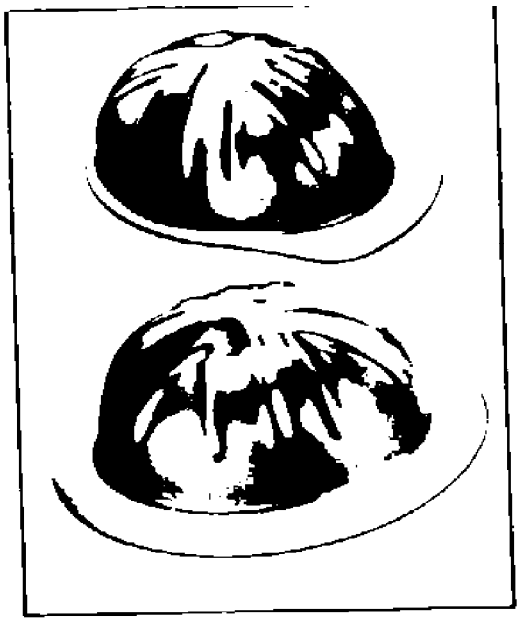


Fig. 29

(to be continued)

APPENDIX A (continued)

Winter Liners can be worn alone or under protective hats and caps to provide warmth in cold weather (see Fig. 30).

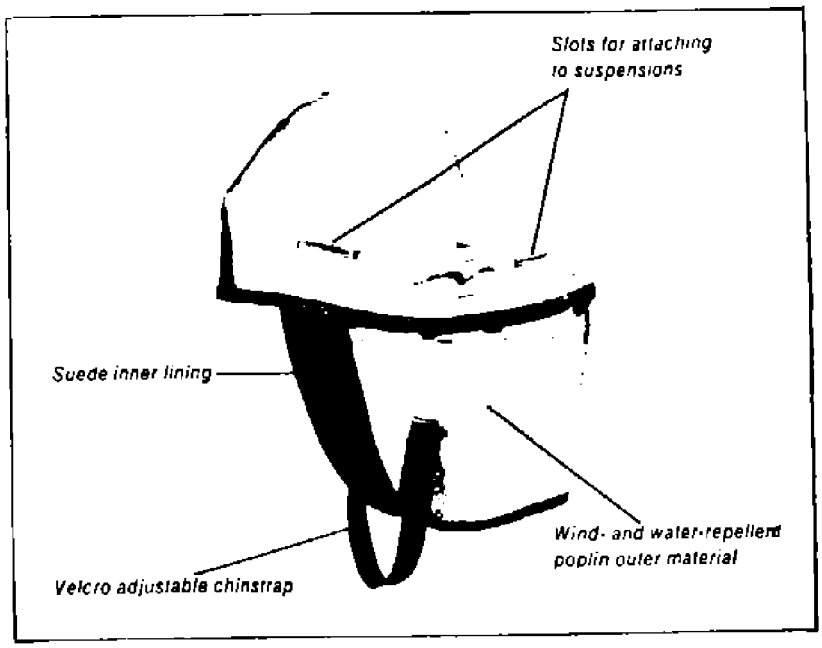


Fig. 30

The instant Release Attachment can be used wherever faceshields, visors, and welding shields must be worn with protective caps (see Fig. 31).

Fig. 31

(to be continued)

APPENDIX A (continued)

Headwear with a lamp bracket for work in low ceiling areas (see Fig. 32).

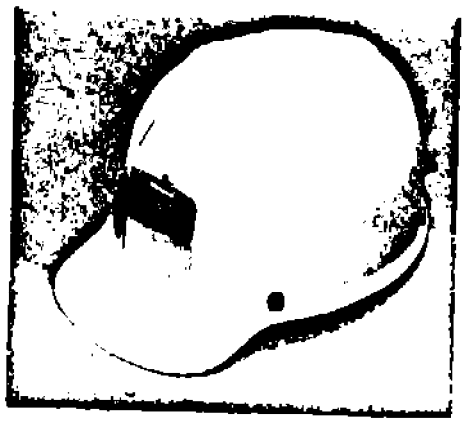


Fig. 32

APPENDIX B
EYE PROTECTION

B.1 Description of Faults Sometimes Found in Glass and Plastics Used for Eye-Protectors

B.1.1 Thermoplastics

The following faults may be found in transparent thermoplastics.

a) Bubble

This can be totally within the sheet material or complete and on the surface. If broken and on the surface the bubble appears pit-like.

b) Dust

Fine inclusions in the surface coating are sometimes referred to as haze.

c) Gel

Non-homogeneous areas in the sheet, normally undissolved polymer.

In surface coating, usually undissolved lacquer, etc.

d) Inclusion

This is a foreign particle usually in the sheet; commonly 'black species' are small particles of degraded polymer.

e) Line

A mark usually in the direction of extrusion with the surface unbroken. Also known as extrusion lines or hair lines.

f) Organ peel

The surface has an appearance as indicated by the description; a term associated with the poor surface finish of a moulding tool.

g) Ridge

This is an undulation normally at right angles to the direction of the sheet. It can be associated with local thickness variations.

h) Run

This is a coating run on a coated sheet.

i) Scratch

This is a surface mark of an open nature from mechanical damage if at the sheet production stage, normally running in the direction of extrusion.

(to be continued)

APPENDIX B (continued)

j) Surface gel

There is no common description. This is a small area of molten polymer on the surface of sheet.

k) Watermark

This is a less common fault with extruded sheet. Normally it is a repeated pattern at right angles to the direction of extrusion, invariably in edge areas of original extrusion widths.

B.1.2 Glass

The following faults may be found in glass:

a) Bubble

This is a large gaseous inclusion generally over 0.25 mm in size.

b) Check

This is a small fracture penetrating below the surface generally less than 1 mm in length.

c) Chip

This is evidence of small fragments broken from a surface.

d) Draw line

Straight lines that occur in drawn sheet glass.

e) Fled

This is a fracture like a check but penetrating generally more than 1 mm.

f) Inclusion

This is a non-glassy particle within glass. This may be further identified using the terms: bubble, seed or stone.

g) Organ peel

A term associated with imperfectly polished glass giving the surface an appearance as indicated by the description.

h) Seed

A small gaseous inclusion generally less than 0.25 mm in size.

i) Stone

An opaque solid inclusion.

(to be continued)

APPENDIX B (continued)

Note:

Stones result from unmelted glass raw material or fragments of refractory material used in the construction' of the melting tank. These gradually dissolve into the glassy mix, and on occasion they may be completely dissolved but leave a transparent sac within the glassy mix. Such an inclusion is known as a knot.

j) Vein

Veins are glass inhomogeneities within glass, usually having directional characteristics associated with the method of forming a particular glass product.

B.1.3 General terms used for faults in optical materials

The following general terms are used for faults in optical materials:

a) Dig

This is a small defect in the polished surface due either to an inclusion breaking surface or to some abusive damage.

b) Scratch

This is the rupture of the polished surface through abrasion by one or more hard particles.

c) Wave

This is the local geometrical distortion of the lens surface deviating rays of transmitted light.

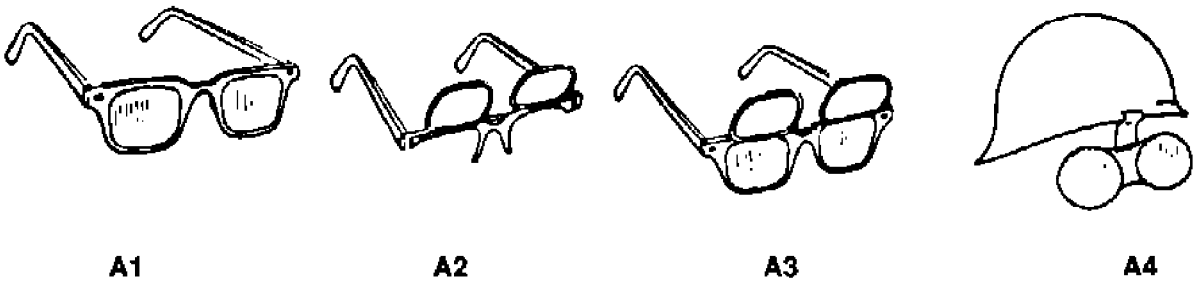
TABLE 1 - KIND AND TYPES OF EYE-PROTECTORS

KIND	TYPE			SYMBOL
Shield Eyeglasses	Spectacles Type	Without side shield	Common eyeglasses type	A-1
			Single swing up type	A-2
			Double swing up type	A-3
			Safety helmet mount type	A-4
		With side shield	Common eyeglasses type	B-1
			Single swing up type	B-2
			Double swing up type	B-3
			Safety helmet mount type	B-4
	Front type		Fixed type	C-1
			Swing up type	C-2
	Goggle type		Box type	D-1
			Cup type	D-2

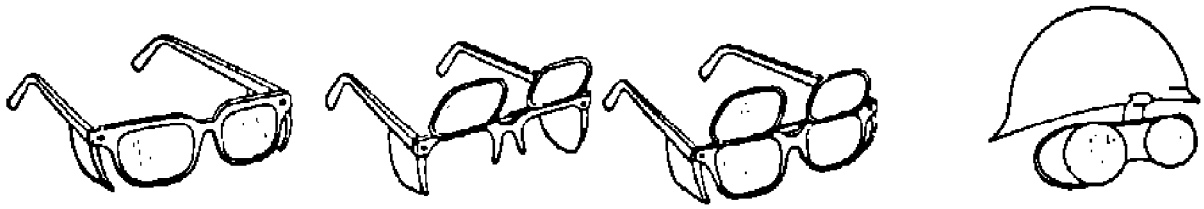
(to be continued)

APPENDIX B (continued)

KIND AND TYPES OF EYE-PROTECTORS



A1 A2 A3 A4



B1 B2 B3 B4

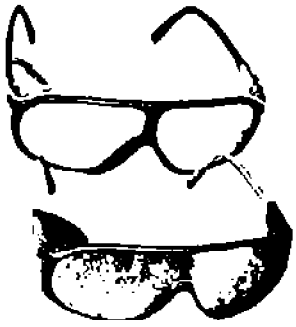
C1 C2 C3 C4

Fig. 33

(to be continued)

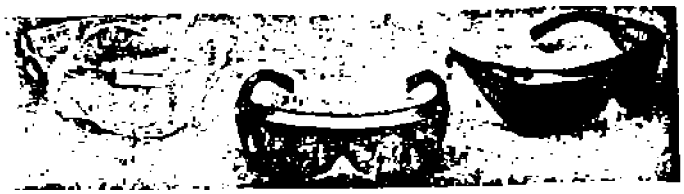
APPENDIX B (continued)

SPECTACLES TYPE



E) LIGHT WEIGHT PLASTIC FRAME WITH HOLDED SIDE SHIELD, LENS, CLEAR, GRAY MIRRORED

F) SCRATCH RESISTANCE LENSES, PLASTIC SIDE SHIELD LENS CLEAR. TINTED OR MIRROR SMOKE

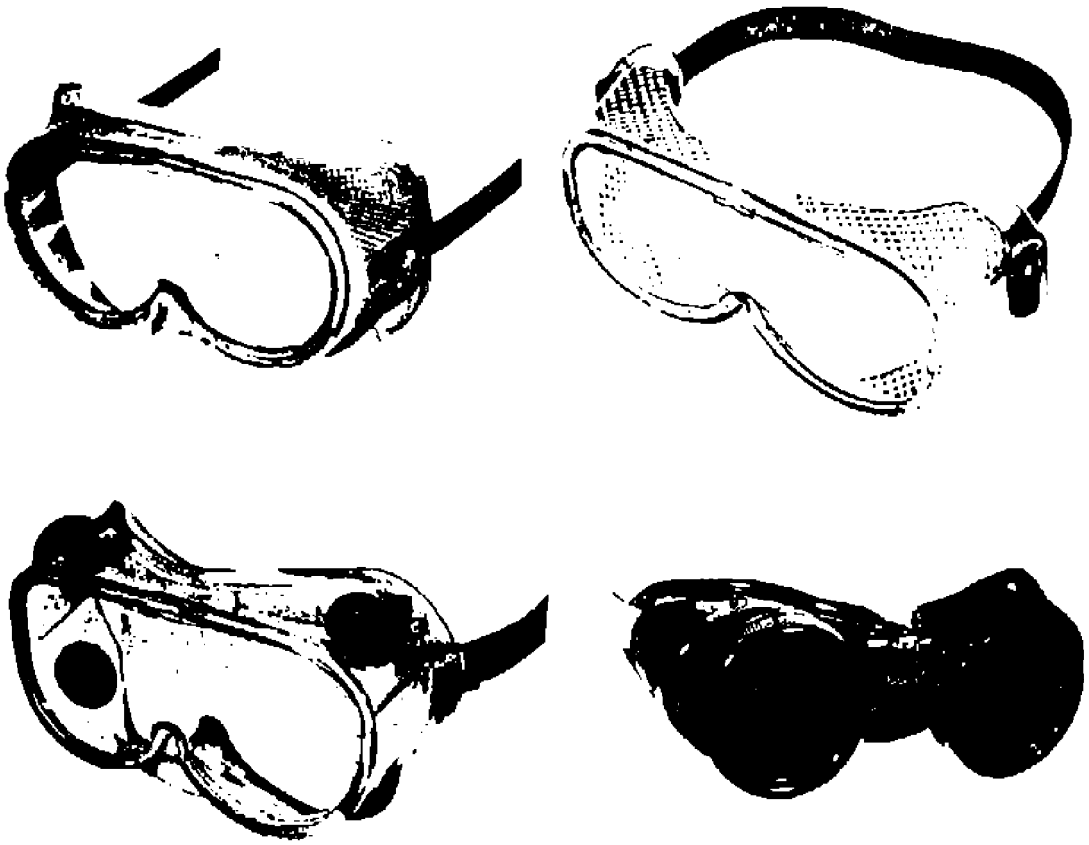


G) LARGE PROTECTIVE AREA. EXTENDED FIELD OF VISION IMPACT RESISTANCE, BROWN GUARD VENTED SIDE SHIELD CLEAR-AMBER-GREEN-GRAY

(to be continued)

APPENDIX B (continued)

H) GOGGLES WITH SWING TYPE SHADE

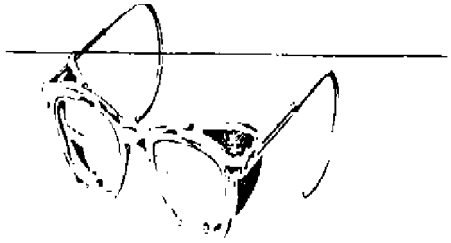


I) GOGGLE TYPE

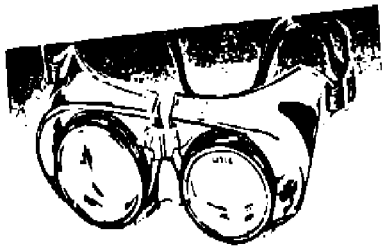
(to be continued)

APPENDIX B (continued)

J) PLASTIC AND METAL FRAME SAFETY SPECTACLES, DESIGNED AFTER REGULAR STREETWEAR GLASSES



K) PLASTIC-FRAME SAFETY SPECTACLES WITH SCREENED SIDE SHIELDS



L) RIGID PLASTIC CHIPPER'S GOGGLES WITH STANDARD ROUND LENSES DESIGNED TO FIT OVER REGULAR GLASSES

M) LIGHT-WEIGHT, ALL-PLASTIC VISITOR'S SPECTACLE

(to be continued)

APPENDIX B (continued)

N) ALL-PLASTIC, SOFT-SIDED COVER GOGGLE WITH SHIELDED VENTS

O) ALL-PLASTIC, SOFT-SIDED CHEMICAL SPLASH GOGGLE WITH INDIRECT AND FILTERED VENTILATION FOR PROTECTION AGAINST HEAVY SPLASH AND DRIVEN MIST

(to be continued)

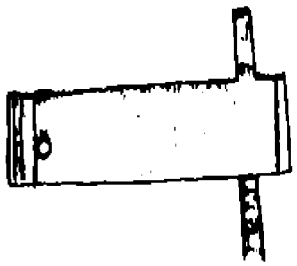
APPENDIX B (continued)

COOLBAND

Cellulose sponge perspiration absorber with an elastic rubberband, shall be worn across the forehead to prevent sweat-filled eyes, streaked glasses and goggles (see Fig. 34(a).

a)

Material is identical with coolband, attachments are made of plastic for snapping into place on the headband of a protective hat, welding helmet, or faceshield. No metal parts are included. (see Fig. 34(b).



(b)

UNDER HAT COOLBAND
Fig. 34

APPENDIX C
FACE PROTECTION

TABLE 1 - TRANSMITTANCES AND TOLERANCES IN TRANSMITTANCE OF VARIOUS SHADES OF FILTER LENSES

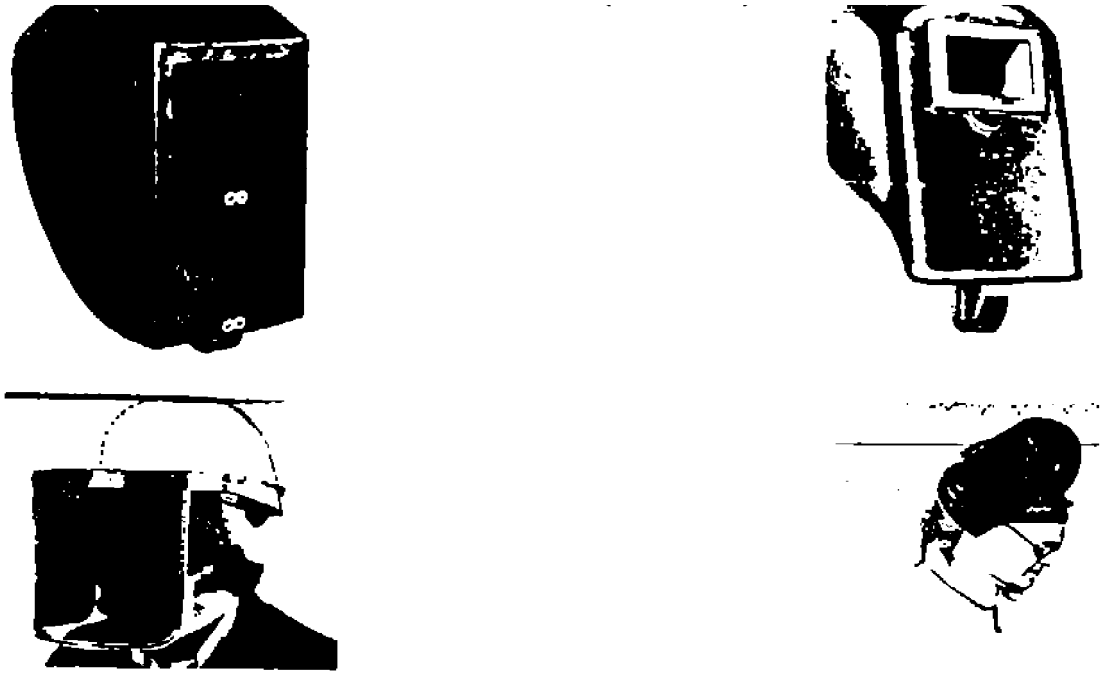
SHADE No.	OPTICAL DENSITY			LUMINOUS TRANSMITTANCE			MAXIMUM INFRARED TRANSMITTANCE	MAXIMUM SPECTRAL TRANSMITTANCE IN THE ULTRAVIOLET AND VIOLET FOR FOUR WAVE LENGTHS(MILLIMICRONS)			
	Min.	Std.	Max.	Min.	Std.	Max.		313 405	334	365	
				PERCENT			PERCENT	PERCENT			
1.5	0.17	0.214	026	67	61 1	55	25	0.2	0.8	25	65
1.7	0.26	0.318	0.36	55	50.1	43	20	0.2	0.7	20	50
2.0	0.36	0.429	0.54	43	37.3	29	15	0.2	0.5	14	35
2.5	0.54	0.643	0.75	29	22.8	18.0	12	0.2	0.3	5	15
3.0	0.75	0.857	1.07	18.0	13.9	8.50	9.0	0.2	0.2	0.5	6
4.0	1.07	1.286	1.50	8.50	5.18	3.16	5.0	0.2	0.2	0.5	1 0
5.0	1.50	1.714	1.93	3.16	1.93	1.18	2.5	0.2	0.2	0.2	0.5
6.0	1.93	2.143	2.36	1.18	0.72	0.44	1.5	0.1	0.1	0.1	0.5
7.0	2.36	2.571	2.79	0.44	0.27	0.164	1.3	0.1	0.1	0.1	0.5
8.0	2.79	3.000	3.21	0.164	0.100	0.061	1.0	0.1	0.1	0.1	0.5
9.0	3.21	3.429	3.64	0.061	0.037	0.023	0.8	0.1	0.1	0.1	0.5
10.0	3.64	3.857	4.07	0.023	0.0139	0.0085	0.6	0.1	0.1	0.1	0.5
11.0	4.07	4.286	4.50	0.0085	0.0052	0.0032	0.5	0.05	0.05	0.05	0.1
12.0	4.50	4.714	4.93	0.0032	0.0019	0.0012	0.5	0.05	0.05	0.05	0.1
13.0	4.93	5.143	5.36	0.0012	0.00072	0.00044	0.4	0.05	0.05	0.05	0.1
14.0	5.36	5.571	5.79	0.0004	0.00027	0.00016	0.3	0.05	0.05	0.05	0.1

Note:

The values given apply to Class I filter glass. For Class II filter lenses, the transmittances and tolerances are the same, with the additional requirement that the transmittance of 589.3 millimicrons shall not exceed 15 percent of the luminous transmittance.

(to be continued)

APPENDIX C (continued)



FILTER LENS SHADE NUMBERS FOR VARIOUS WELDING AND CUTTING OPERATIONS (WELDER AND HELPERS)
Fig. 35

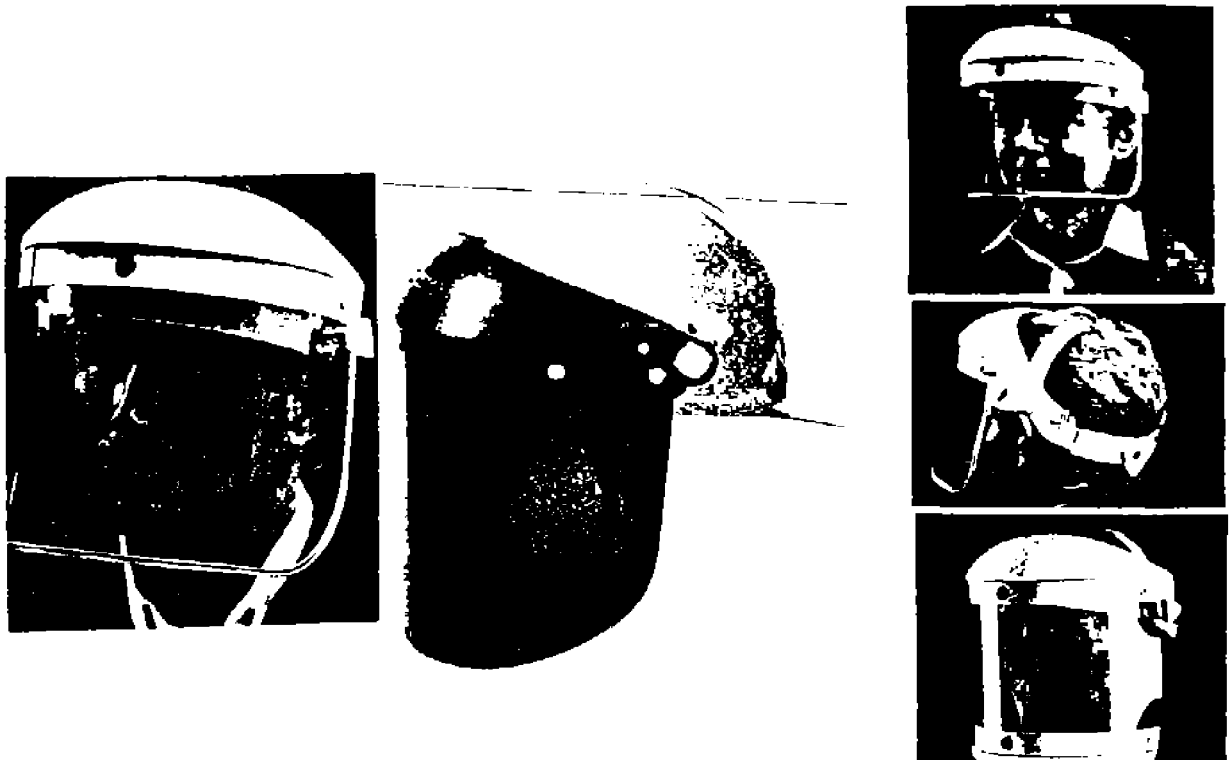
TYPE OF OPERATION	RECOMMENDED SHADE NUMBER
Resistance welding, and for protection against stray light from nearby welding and cutting (if persons are out of the danger zone)	Clear or filters up to No. 2
Torch brazing or soldering	
Light oxygen cutting and gas welding (to 3.175 mm (1/8 in.)	3 to 4
Oxygen cutting, medium gas welding 3.175 to 12.7 mm	4 or 5
(1/8 to 1/2 in.) and arc welding up to 30 amps	5 or 6
Heavy gas welding over 12.7 mm (1/2 in.) and arc welding and cutting from 30 to 75 amps	6 or 8
Arc welding and cutting from 75 to 200 amps	10
Arc welding and cutting from 200 to 400 amps	12
Arc welding and cutting exceeding 400 amps	14

Note:

Flash goggles should be worn under all arc-welding helmets, particularly for gas-shielded metal arc welding.

(to be continued)

APPENDIX C (continued)



a) b)

PROTECTIVE CAP WITH ATTACHMENT FOR EASY INSTALLATION AND REMOVAL OF FACESHIELDS, WELDING HELMETS, ETC.

c)

PROTECTIVE HEADGEAR WITH REMOVABLE-TYPE ATTACHMENT FOR FACESHIELDS FACESHIELDS (see Fig. 36 a-c)

Fig. 36

APPENDIX D
EAR PROTECTION

EAR MUFFS

Ear Muffs are designed to reduce the effects of excessive noise found typically in plants, factories, airports, and areas where air compressors, jackhammers, and turbines are used (see Fig. 37).

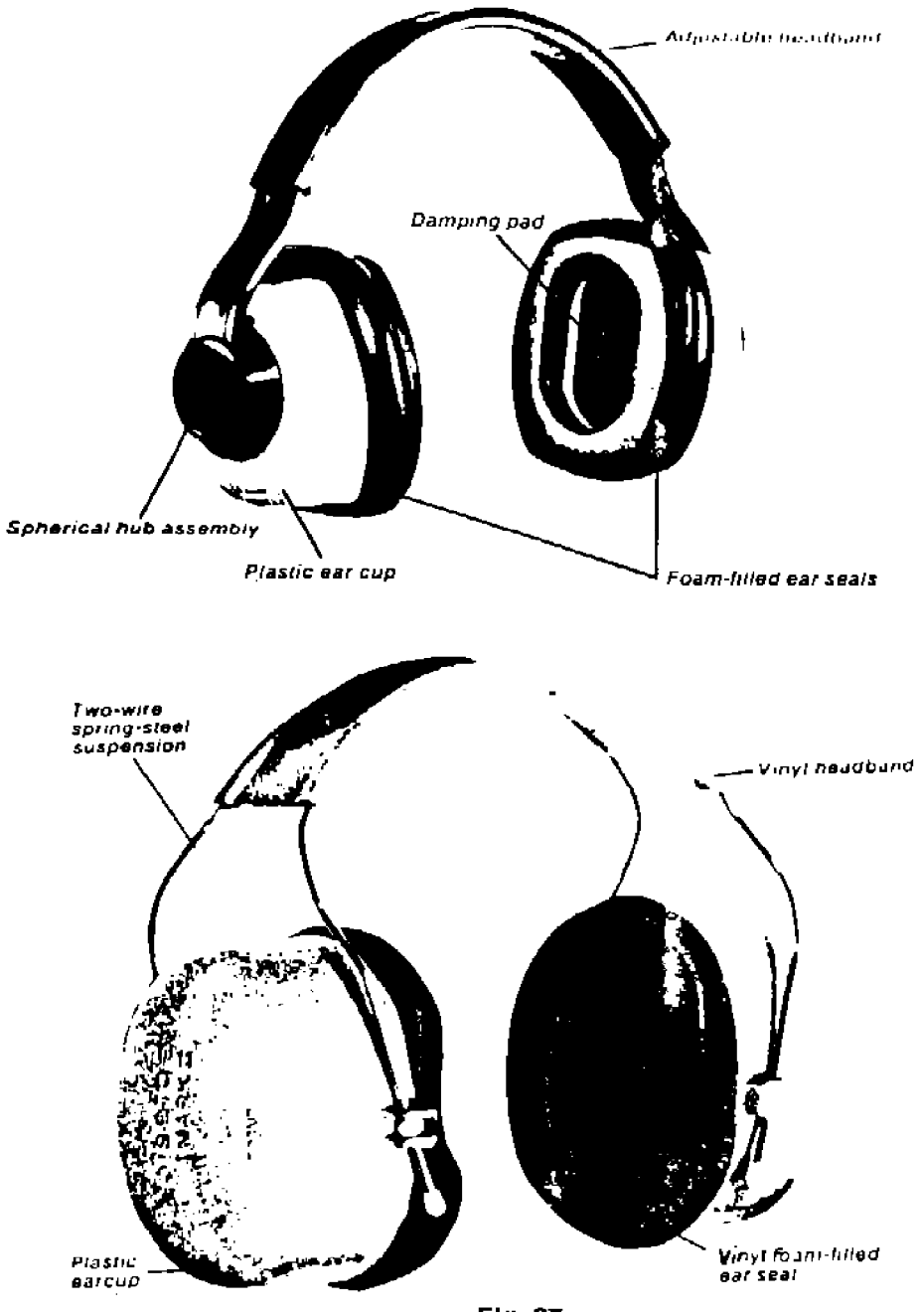
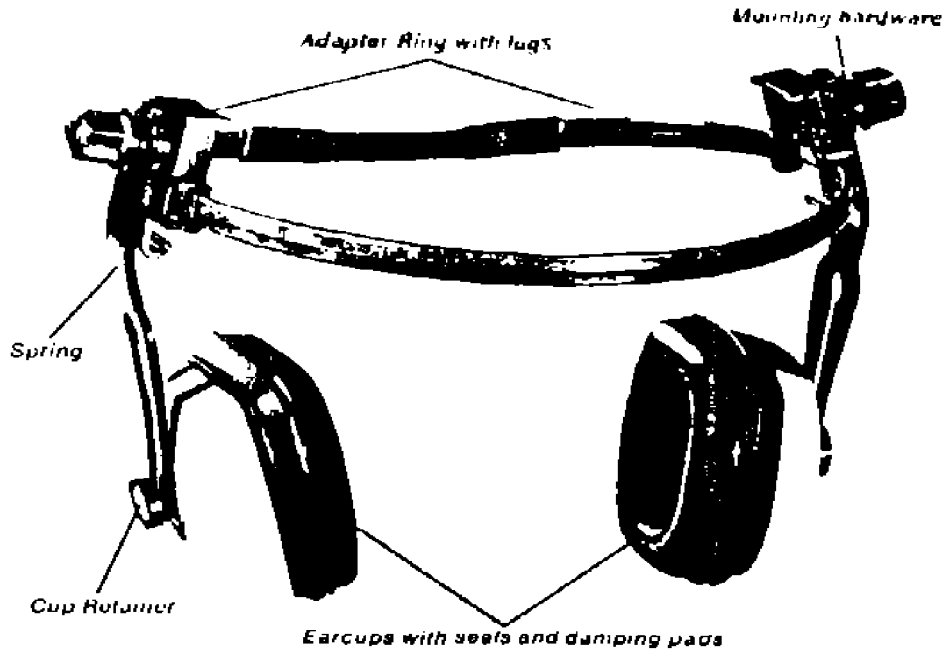


Fig. 37

(to be continued)

APPENDIX D (continued)



a)

Assemblies can be worn with welding shields, faceshields, and other face protection devices:

b) Muffs stow on cap when not in use

c) Can be worn with faceshield

d) Can be worn with welding shield

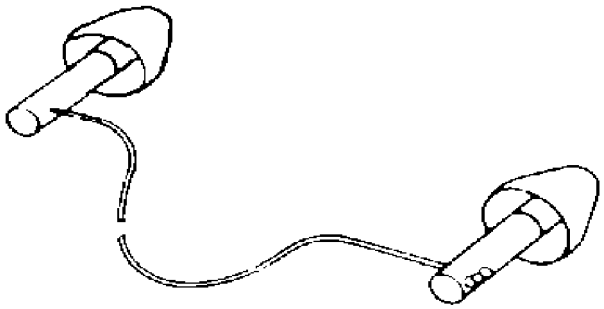
CAP-MOUNTED HEARING PROTECTION
Fig. 38

(to be continued)

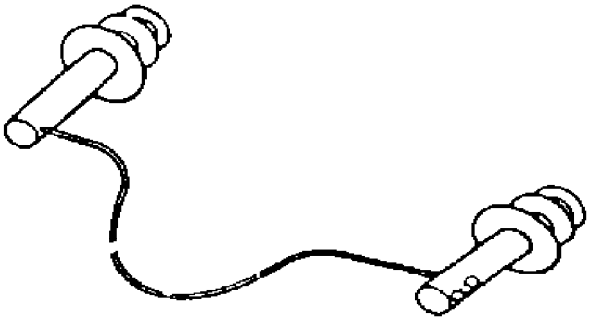
APPENDIX D (continued)

Ear plugs, made of a soft elastomeric material, are manufactured in five sizes; size is marked on each plug. These small, featherweight plugs effectively seal the outer quarter of the ear canal. A molded tab permits easy insertion and removal. Plugs clean easily with mild soap and warm water. (see Fig. 39 a-d)

a)



b)



c)

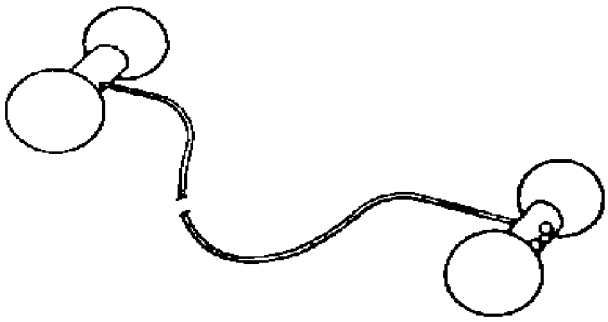
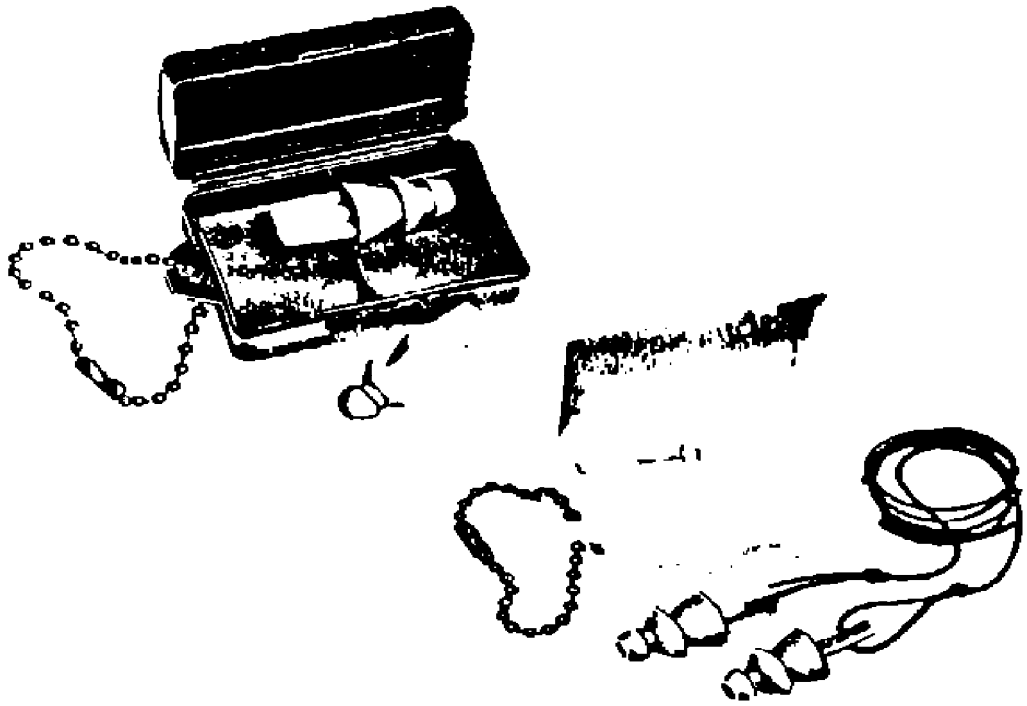


Fig. 39

(to be continued)

APPENDIX D (continued)



(d)

APPENDIX E
BODY PROTECTION METHOD FOR THE DETERMINATION OF SEAM STRENGTH

E.1 Apparatus

E.1.1 A constant rate of extension tensile testing machine as described in BS 2576, except that the machine does not require means for indicating (or recording) extension.

E.2 Preparation of Test Specimens

Cut specimens from the garment from a double thickness of fabric that includes a seam, such that the seam lies midway between the ends and perpendicular to the major axis of the specimen when prepared and opened out as shown in Fig. 40a.

Cut the specimen 5 cm wide and of length/such as to provide a nominal gage length of 100 mm. Cut one specimen from each main load bearing seam (up to a maximum of five) of the garment ensuring that the following seams are included:

a) For garments with sleeves, an armhole seam;
b) for garments with trousers, the seat seam;
c) for garments with two piece back, the back seam;
d) for bib and brace overalls, the waist seam.

Cut one specimen from each non-load bearing seam (up to a maximum of five) of the garment.

E.3 Procedure

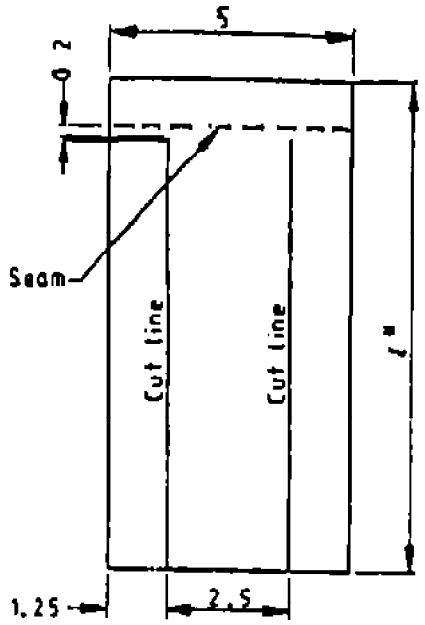
Carry out the test in accordance with 7.1 of BS 2576, additionally ensuring that the seam lies midway between the jaws and perpendicular to the direction of pull as shown in Fig. 40b.

E.4 Calculation and Expression of Results

Record the seam strength, in newtons, of each of the load bearing seams and calculate the mean value. Express the average strength of the load bearing seams to 0.1 N or to 1% of the sea strength, whichever be the greater, in newtons.

(to be continued)

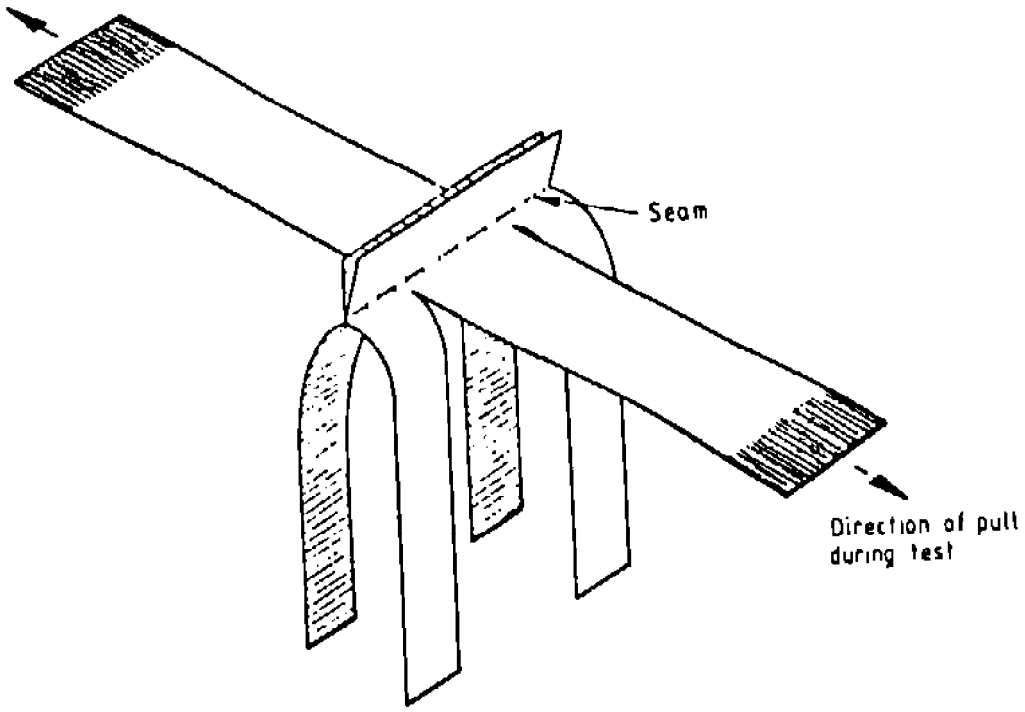
APPENDIX E (continued)



Note:

All dimensions are in centimeters.

a) Double thickness specimen as cut from garment



b) Opened out specimen

SEAM STRENGTH TEST SPECIMEN
Fig. 40

APPENDIX F
BODY PROTECTION MEASUREMENT AND SIZES

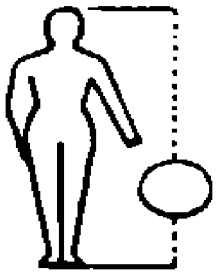
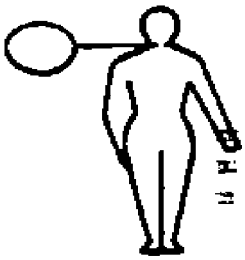
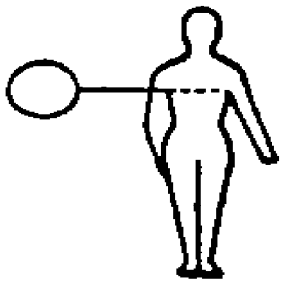
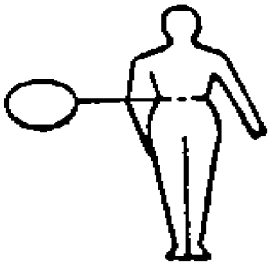
DEFINITION	PICTOGRAM
Height: The length of the body measured in a straight line from the crown of the head to the soles of the feet. See Fig. 41(a).	 a)
Neck girth: The girth of the neck measured with the tape-measured passed 2 cm below the Adam's apple and at the level of the 7th cervical vertebra. See Fig. 41(b).	 b)
Chest girth: The maximum horizontal girth measured during normal breathing with the subject standing erect and the tape-measure passed over the shoulder blades (scapular), under the armpits (axillae), and across the chest. See Fig. 41(c).	 c)
Waist girth: The girth of the natural waist-line between the top of the hip bones (iliac crests) and the lower ribs, measured with the subject breathing normally and standing erect with the abdomen relaxed. See Fig. 41(d).	 d)

Fig. 41

(to be continued)

APPENDIX F (continued)

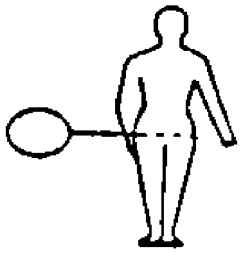
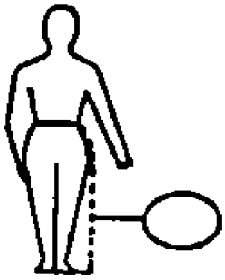
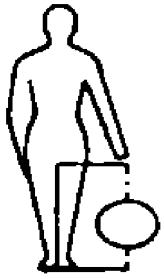
DEFINITION	PICTOGRAM
Hip girth: The horizontal girth measured round the buttocks at the level of maximum circumference. See Fig. 41(e).	e) 
Outside leg length: The distance from the waist to the ground, measured with the tape-measure following the contour of the hip. See Fig. 41(f).	f) 
Inside leg length: The distance between the crotch and the soles of the feet, measured in a straight line with the subject erect, feet slightly apart, and the weight of the body equally distributed on both legs. See Fig. 41(g).	g) 

Fig. 41

(to be continued)

APPENDIX F (continued)

TABLE 1 - COVERALLS FOR MEN AND YOUTHS

SIZE *	MEASUREMENTS OF WEARER		MEASUREMENTS OF GARMENT WHEN FASTENED						
	Height	Chest Girth (Over Shirt)	Chest	Seat	Back Neck to Crotch	Across Back	Sleeve Length	Inside Leg	Bottom of Leg
	cm	cm	cm	cm	cm	cm	cm	cm	cm
92S	156	92	106	106	88	42	76	70	49
100S	TO	100	114	114	90	44	77	70	49
108S	166	108	122	122	92	46	78	70	49
92R		92	106	106	92	42	80	74	49
100R	166	100	114	114	94	44	81	74	49
108R	TO	108	122	122	96	46	82	74	49
116R	176	116	130	130	98	48	83	74	49
124R		124	138	138	100	50	84	74	49
92T		92	106	106	96	42	84	78	49
100T	176	100	114	114	98	44	85	78	49
108T	TO	108	122	122	100	46	86	78	49
116T	186	116	130	130	102	48	87	78	49
124T		124	138	138	104	50	88	78	49
92XT		92	106	106	100	42	88	82	49
100XT	186	100	114	114	102	44	89	82	49
108XT	TO	108	122	122	104	46	90	82	49
116XT	196	116	130	130	106	48	91	82	49
124XT		124	138	138	108	50	92	82	49

*** See Clause 11.2.3.12(b).**

TABLE 2 - COATS AND JACKETS FOR MEN AND YOUTHS

SIZE *	MEASUREMENTS OF WEARER		MEASUREMENTS OF GARMENT WHEN FASTENED		
	Height	Chest Girth (Over Shirt)	Chest	Sleeve Length	Across Back
	cm	cm	cm	cm	cm
92S		92	104	76	42
100S	156	100	112	77	44
108S	TO	108	120	78	46
116S	170	116	128	79	48
92R		92	104	82	42
100R	170	100	112	83	44
108R	TO	108	120	84	46
116R	182	116	128	85	48
124R		124	136	86	50
92T		92	104	88	42
100T	182	100	112	89	44
108T	TO	108	120	90	46
116T	196	116	128	91	48
124T		124	136	92	50

*** See Clause 11.2.3.12(b).**

(to be continued)

APPENDIX F (continued)

TABLE 3 - BIB AND BRACE OVERALLS FOR MEN AND YOUTHS

SIZE *	MEASUREMENTS OF WEARER		MEASUREMENTS OF GARMENT WHEN FASTENED								
	Inside Leg max.	Waist Girth (Over Shirt) max.	Waist	Seat	Inside Leg	Side Seam	Upper Leg	Knee	Bottom of Leg	Crotch to Top of BIB	Width of Bib
	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
76S	82	76	78	98	70	98	64	50	49	54	24
84S	82	84	86	106	70	99	68	52	49	57	25
92S	82	92	94	114	70	100	72	54	49	60	26
100S	82	100	102	122	70	101	76	56	49	63	27
108S	82	108	110	126	70	102	80	58	49	66	28
76R	90	76	78	98	76	105	64	50	49	57	24
84R	90	84	86	106	76	106	68	52	49	60	25
92R	90	92	94	114	76	107	72	54	49	63	26
100R	90	100	102	122	76	108	76	56	49	66	27
108R	90	108	110	126	76	109	80	58	49	69	28
116R	90	116	118	134	76	110	84	60	49	72	29
124R	90	124	126	142	76	111	88	62	49	75	30
76T	98	76	78	98	82	112	64	50	49	60	24
84T	98	84	86	106	82	113	68	52	49	63	25
92T	98	92	94	114	82	114	72	54	49	66	26
100T	98	100	102	122	82	115	76	56	49	69	27
108T	98	108	110	126	82	116	80	58	49	72	28

*** See Clause 11.2.3.12(b).**

(to be continued)

APPENDIX F (continued)

TABLE 4 - OVERALLS TROUSERS FOR MEN AND YOUTHS

SIZE *	MEASUREMENTS OF WEARER		MEASUREMENTS OF GARMENT WHEN FASTENED						
	Inside Leg max.	Chest Girth (Over Shirt)	Waist	Seat	Inside Leg	Side Seam	Upper Leg	Knee	Bottom of Leg
	cm	cm	cm	cm	cm	cm	cm	cm	cm
72S	82	72	72	92	72	98	60	49	49
76S	82	76	76	96	72	98	62	49	49
80S	82	80	80	100	72	99	64	50	49
84S	82	84	84	104	72	99	66	51	49
88S	82	88	88	108	72	100	68	52	49
92S	82	92	92	112	72	100	70	53	49
96S	82	96	96	116	72	101	72	54	49
100S	82	100	100	120	72	101	74	55	49
104S	82	104	104	120	72	102	76	56	49
72R	90	72	72	92	78	105	60	49	49
76R	90	76	76	96	78	105	62	49	49
80R	90	80	80	100	78	106	64	50	49
84R	90	84	84	104	78	106	66	51	49
88R	90	88	88	108	78	107	68	52	49
92R	90	92	92	112	78	107	70	53	49
96R	90	96	96	116	78	108	72	54	49
100R	90	100	100	120	78	108	74	55	49
104R	90	104	104	120	78	109	76	56	49
108R	90	108	108	124	78	109	78	57	49
112R	90	112	112	128	78	110	80	58	49
116R	90	116	116	132	78	110	82	59	49
76T	98	76	76	96	84	112	62	49	49
80T	98	80	80	100	84	113	64	50	49
84T	98	84	84	104	84	113	66	51	49
88T	98	88	88	108	84	114	68	52	49
92T	98	92	92	112	84	114	70	53	49
96T	98	96	96	116	84	115	72	54	49
100T	98	100	100	120	84	115	74	55	49
104T	98	104	104	120	84	116	76	56	49

See Clause 11.2.3.12(b).

(to be continued)

APPENDIX F (continued)

TABLE 5 - LIGHTWEIGHT, TWO-PIECE WORKING RIG, JACKET

Size	Measurements of wearer	Measurements of garment when fastened						
	Chest	Waist	length of jacket	Sleeve length	Cuff	Chest*	Waist*	Back♣
small	cm 90 to 96	cm 80 to 84	cm 69	cm 78	cm 28	cm	cm	cm 44
Medium	100 to 104	90 to 94	69	79	28	Chest measurement of wearer plug 17	Waist measurement of wearer plug 17	45
Large	110 to 114	100 to 104	69	81	30			46
Extra large	120 to 124	110 to 114	71	83	32			47

*** From edge to edge.**

♣Full width.

TABLE 6 - LIGHTWEIGHT, TWO-PIECE WORKING RIG, TROUSERS

SIZE *	MEASUREMENTS OF WEARER		MEASUREMENTS OF GARMENT WHEN FASTENED						
	Inside Leg	Chest Girth (Over Shirt)	Seat	Waist	Inside Leg	Side Seam	Upper Leg	Knee	Bottom of Leg
	cm	cm	cm	cm	cm	cm	cm	cm	cm
76R	90	76	93	76	76	102	62	54	50
80R	90	80	97	80	76	102	64	54	50
84R	90	84	101	84	76	102	68	54	50
88R	90	88	105	88	76	102	70	54	50
92R	90	92	107	92	76	104	72	58	54
96R	90	96	109	96	76	104	74	58	54
100R	90	100	113	100	76	104	74	58	54
108R	90	108	121	108	76	106	74	58	54
116R	90	116	127	116	76	108	78	62	56
124R	90	124	134	124	76	110	78	62	56
80T	cm	80	97	80	82	108	64	54	50
84T	98	84	101	84	82	108	68	54	50
88T	98	88	105	88	82	108	70	54	50
92T	98	92	107	92	82	110	70	54	54
96T	98	96	109	96	82	110	74	58	54
100T	98	100	113	100	82	110	74	58	54
108T	98	108	121	106	82	112	74	58	54
116T	98	116	127	116	82	114	78	62	56
124T	98	124	134	124	82	116	78	62	56

TABLE 7 - GENERAL PURPOSE GOWNS (GARMENTS MADE FROM POLYESTER/CELLULOSIC FABRICS; NOT FOR USE IN ANESTHETIZING AREAS)

SIZE	MEASUREMENTS OF GARMENT WHEN FASTENED					
	Chest	Neck	Sleeve Length*	Cuff	Length	Skirt Hem Girth
	cm	cm	cm	cm	cm	cm
S	112	46	46	38	117	162
M	122	51	47	41	117	172
L	132	56	48	43	117	182

*** The sleeve length given is measured from the neck point to the sleeve edge along the shoulder line.**

Note: Tolerances are $^{+5}_{-0}$ cm for total length and $^{+3}_{-0}$ cm for all girth measurements.

APPENDIX G

BODY PROTECTION

METHOD OF MEASURING GARMENTS

G.1 General

When taking measurements, place the garment flat on a smooth, flat surface of adequate size for measuring. Unless otherwise stated, garments shall be measured when fastened. Figs. 42 and 43 are provided to illustrate the locations at which measurements shall be taken; they do not purport to indicate style.

G.2 Neck (Appendix F, Table 7)

Measure the binding.

G.3 Chest or Bust (Appendix F, Tables 1, 2 and 5)

Measure 2.5 cm below the underarm seam (location A, Figs. 42 and 43a), side seam to side seam, 30 cm down from the shoulder line. Multiply the value by two. Measure wrap-over overalls opened out flat.

G.4 Across Back (Appendix F, Tables 1, 2)

Measure at a point 12 cm below the center back neck, straight across, between the armholes (location B, Figs. 42b and 43b).

G.5 Waist (Appendix F, Tables 3, 4, 5 and 6)

Measure the fastened waistband (location D, Fig. 42b). If no waistband is present, measure the distance at the narrowest point between bust and hip locations. Multiply the value by two.

G.6 Seat (Appendix F , Tables 1, 3 and 4)

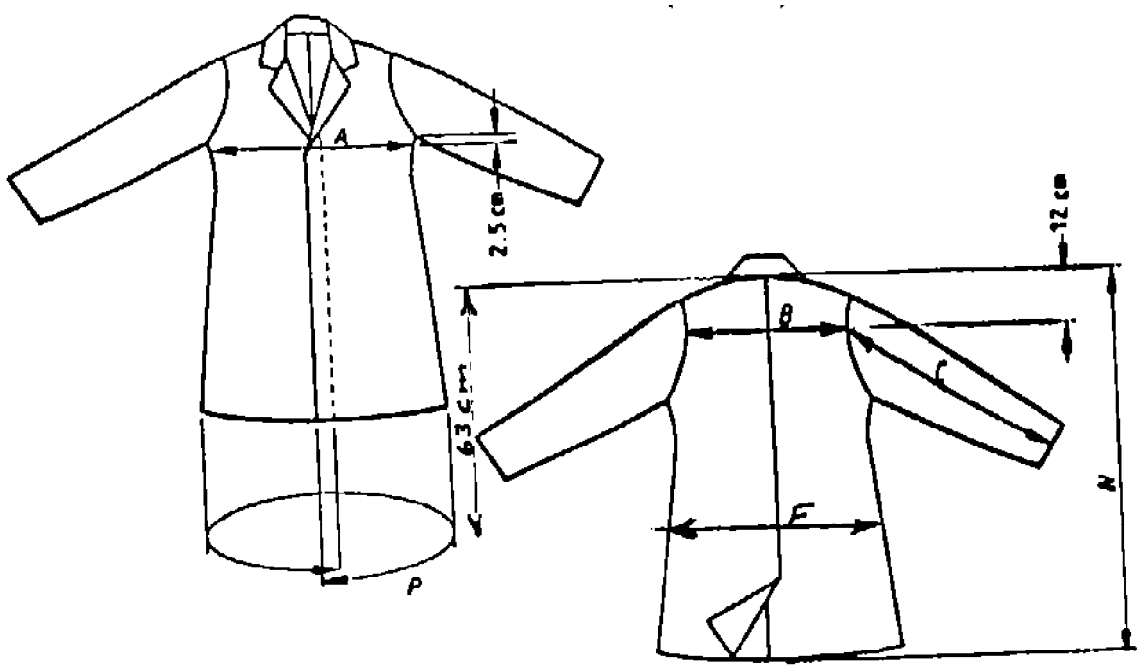
Measure 20 cm below the waist line (location E, Fig. 43b). Multiply the value by two.

G.7 Hips

Measure at a point 63 cm below center back neck (location F, Fig. 42b). Multiply the value by two. Measure wrap-over overalls opened out flat.

(to be continued)

APPENDIX G (continue)



a) Front view b) Back view

MAN'S COAT (SEE APPENDIX C)
Fig. 42

G.8 Back Neck to Crotch (Appendix F, Table 1)

Measure from center back neck collar seam to crotch (location G, Fig. 43b).

G.9 Crotch to Top of Bib (Appendix F, Table 3)

Measure from top of bib at center to crotch Fig. 43b.

G.10 Inside Leg (Appendix F, Tables 1, 3, 4 and 6)

Measure from the crotch seam to the bottom of the leg hem.

G.11 Upper Leg (Appendix F, Tables 3, 4 and 6)

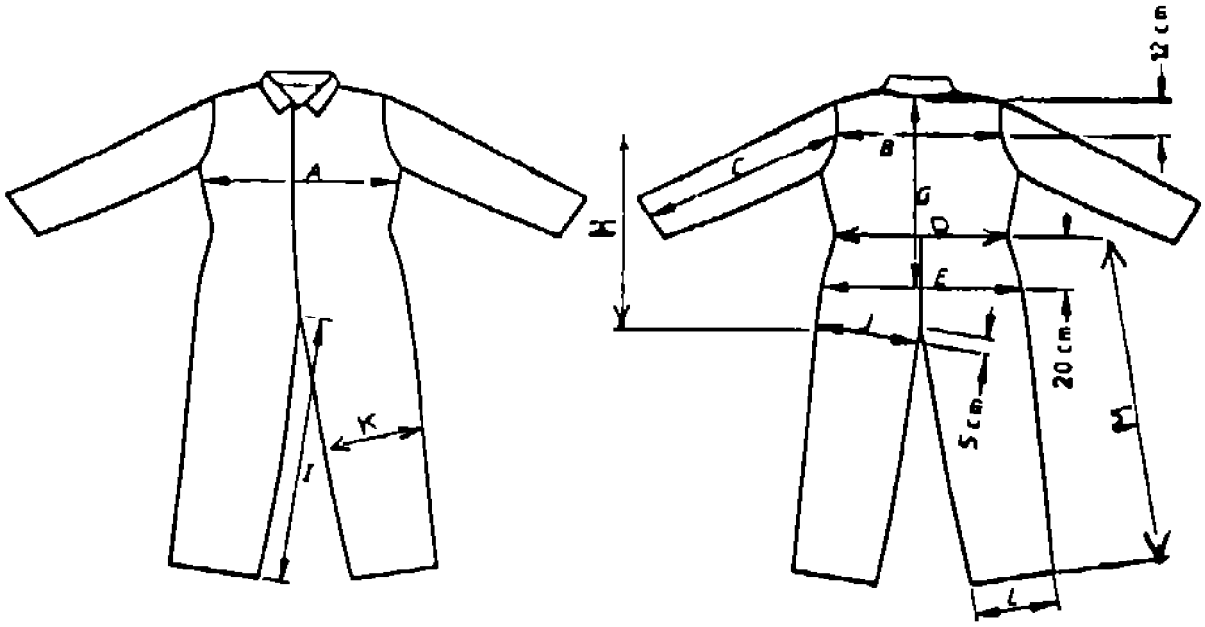
Measure across the leg 5 cm below the crotch line. Multiply the value by two.

G.12 Knee (Appendix F, Tables 3, 4 and 6)

Measure across the leg at the knee. Multiply the value by two (location K, Fig. 43a). The position of the knee is taken as the distance up, from the bottom of the leg, of half the inside leg measurement plus 5 cm.

(to be continued)

APPENDIX G (continued)



a) Front view

b) Back view

COVERALL
Fig. 43

G.13 Bottom of Leg (Appendix F, Tables 1, 3, 4 and 6)

Measure across the leg along the edge of the hem (location L, Fig. 43b). Multiply the valve by two.

G.14 Side Seam (Appendix F, Tables 3, 4 and 6)

Measure from the top of the waistband to the bottom of the leg hem (location M, Fig. 43b).

G.15 Sleeve Length

Long sleeves (Appendix F, Tables 1, 2 and 5). Measure from the center back to the full length of the sleeve (location C +0.5 B, Figs. 42b and 43b).

G.16 Cuff (Appendix F, Tables 5)

Measure across the sleeve along the edge of the hem. Multiply the value by two.

APPENDIX H

BODY PROTECTION

GUIDANCE FOR THE USE OF GARMENTS AND ACCESSORIES

Class A garments provide the wearer with a significantly higher level of conspicuity than Class B garments and these in turn provide considerably higher conspicuity than Class C accessories. For this reason Class A garments should be selected wherever conditions allow their use. In particular, those wearer likely to be exposed to relatively high risk (for example pedal cyclists or motor cyclists) should wear Class A garments, and those exposed to particularly sever risk (for example traffic police officers or road workers) should consider wearing garments the performance of which is significantly better than the minimum specified for Class A.

The requirements for retroreflective performance in this Standard are based upon typical positions for head lamps and drivers of vehicles, and upon typical positions for pedestrian and cyclist wearers, on public roads, railways and factory roadways. Articles complying with this Standard are not necessarily suitable if the situation of lamps or observer or target differs significantly from these. Examples might be marine situations, or airfields, where specialist advice should be sought.

Use of garments or accessories complying with this Standard does not free the wearer from the normal duty to take all reasonable care.

APPENDIX I
CHEMICAL PROTECTION

GUIDE LINES ON SELECTION AND USE OF CHEMICAL PROTECTIVE CLOTHING

I.1 Assessment of Chemical Hazard

I.1.1 Sources of data

Any chemical should be regarded as a potential health hazard to an extent dependent upon the circumstances of use. For information on the chemical hazards presented by a specific chemical or formulation, the supplier should be consulted, in this respect.

Note:

Suppliers have a legal duty to label the containers of dangerous substances with standard warning phrases appropriate to the hazard presented by the contents. Suppliers of dangerous substances also have a duty to ensure that their products are safe so far as is reasonably practicable and without risks to health when properly used, to advise users of their products of any hazards involved and (were appropriate) to indicate suitable protective clothing.

I.1.2 Assessment of nature of chemical hazard

Exposure of the skin to chemicals may cause harm both to the skin and to the body as a whole. The following considerations should be taken into account in appreciating the nature of the chemical hazard in the light of the information obtained from the sources given in I.1.1:

a) Corrosive chemicals may destroy the skin and flesh by direct attack. Other chemicals such as petrol, paint solvents and cleaning fluids can dissolve the skin's natural oils so leaving the skin dry and liable to from painful cracks. Such damage to the skin together with any existent cuts and grazes provide entry points for foreign substances and thus increase the risk of harm to the body.

b) Chemicals may pass through the skin and be carried by the bloodstream so as to cause injury to other parts of the body that may be remote from the initial point of contact.

c) Chemicals may gain access to the body via, for example, the eyes, respiratory or digestive tract.

d) The body's tolerance and rate of elimination of a foreign substance varies from person to person.

e) The harmful effects depend broadly on the amount of substance contacted or absorbed and hence are related to the concentration of the substance to which the body has been exposed or to the concentration in the environment, and to the duration of exposure.

f) The rate at which a chemical is taken up by the body may depend on whether it is swallowed, inhaled or absorbed through the skin.

g) Adverse effects on health may arise from a single exposure or repeated exposure to small amounts of a chemical and may be immediate, delayed or long term.

h) A mixture of chemicals may create a greater hazard than would the same chemicals separately.

(to be continued)

APPENDIX I (continued)

I.2 Assessment of risk and danger

I.2.1 General

After steps have been taken to contain, minimize or eliminate the chemical hazard and to reduce the risk, an assessment should be undertaken of how the chemical might inadvertently be released from within the plant or system in which it is contained and what the consequences of such release might be.

I.2.2 Risk in relation to the physical form of chemicals

The type of risk associated with chemicals var with their physical forms, as indicated as follow:

a) Provided that they are free from volatile products or fumes or dust, solid materials in bulk may usually be contained without undue risk.

b) Liquids and free-running powders are mobile and can give intimate contact with the skin. Exposure may range from accidental splashes of laboratory reagents to deluge conditions.

c) Although gases and vapors present relatively small amounts of matter in contact with the skin, they require more efficient barriers to exclude them. The danger associated with gases and vapors is high, especially if they are not detectable by the human senses.

d) The risk of release of airborne particles (fine dusts and liquid mists) and the consequent danger may be very high because particles in such physical forms are both pervasive and dense.

I.2.3 Risk and danger in relation to storage and distribution

The danger associated with the inadvertent discharge of a chemical depends (for example) on the quantity, mode of transport and the manner of distribution of material present, the method of containment (flow pipes, glass bottles, etc.), the pressure and temperature at which it is held, and its proximity to working areas. The exposure to be considered may range from foreseeable incidents with moderate or high probability of occurrence (spillage whilst handling; contamination by sprays) to infrequent, but more serious, possibilities (for example, the fracture of a pipe in a chemical plant).

I.2.4 Risk in relation to duration of exposure

The duration of exposure may increase when:

a) Contamination of the body is not apparent as soon as it occurs:

b) An employee has to set emergency procedures in operation (e.g., switching off machinery) before leaving the hazard area.

c) An employee is some distance from a place where the contaminant can be washed off.

Note:

The protection provided to employees and to rescue personnel should take into account the time needed to carry out necessary emergency actions.

(to be continued)

APPENDIX I (continued)

I.3 Assessment of the Need for Protection

For this assessment of protection the following questions should be answered:

a) What is the chemical hazard, physical state, quantity, and mode of use of the chemical substance(s) involved?
b) Do these constitute a potential danger?
c) If so, can the hazard be removed, or the danger minimized by means other than the use of protective clothing.
d) How serious is the potential hazard?

If the answers to questions (a) to (d) indicate that, in addition to other precautions, the need for protective clothing should be considered, the following questions apply.

e) What form and extent of exposure is envisaged (e.g.,spillage, liquid jets)?
f) What is the probability of exposure?
g) Will workers be immediately aware of exposure if it occurs?
h) What is the likely duration of exposure?
i) Is exposure likely to be restricted to specific parts of the body (i.e., eyes, ears, lungs, head, hands and feet) or to specific areas of the skin?

I.4 Selection of Protective Clothing

I.4.1 Introduction

It should be recognized that protective clothing is generally inherently prone to permeation and hence the form of protection provided should not be regarded as a complete barrier (to chemicals) under all circumstances.

Subsequent sections consider in detail the various factors which can influence the final selection and the test methods that are available to assess the relevant characteristics of protective clothing material. However, there are many factors involved in the selection and use of protective clothing which cannot be easily quantified, the relative importance of which may seem different to different people. Hence the view of all interested parties should be considered to achieve the best balance. This should enable the features that determine the ability of the clothing to protect the wearer to be clearly defined and corresponding physical and chemical characteristics to be adequately checked using appropriate test procedures.

I.4.2 Compatibility

Individual items of protective clothing should not be considered in isolation as they may have to be worn with other protective devices (respiratory protective equipment, goggles, etc.), special tools, or communications equipment. The wearer should not be isolated from other workers and should be able to acknowledge and respond to emergency procedures while wearing the clothing.

(to be continued)

APPENDIX I (continued)

I.4.3 Selection of material of construction

Suppliers of protective clothing should be able to advise on the general suitability and limitations of their garments, and on their practical value for protection against particular chemicals under defined conditions. In the selection of construction the following questions arise:

a) What chemical resistance is required of the garment material, and for how long?
b) What other requirements are there for the garment material (e.g.,durability)?
c) Is an air-permeable garment material acceptable?
d) If there is a risk of significant chemical permeation through the garment material, will the concentration to which the skin is exposed be acceptably low throughout the period of work?

Discussion with chemical suppliers, safety experts, occupational hygienists and garment suppliers will frequently be necessary to answer these questions and to make an initial choice of protective garments. Further consultations will normally be needed to ensure that the final choice meets the need to provide adequate protection under the circumstances that apply. The decisions to be taken during the selection of the material of construction are shown in Section 8 Fig. 21, Clause 12.3.10.2.

I.4.4 Selection of design

Having made an initial choice of garments, the following questions then arise:

a) Does the clothing give adequate protection against any other hazards (e.g., fire) which may be anticipated?
b) Will the clothing chosen interfere unduly with the wearer's activity or subject him to stress and discomfort?
c) Is the clothing compatible with the task in hand and with the use of any equipment or tools that are needed?
d) Are workers sufficiently trained in the use of the clothing and any relevant safety procedures?
e) Is there a risk of contamination being transferred to the wearer when putting on or removing the clothing?
f) Are adequate cleaning procedures available?
g) Is there a suitable system of maintenance?
h) Is there an adequate management and supervision system?

I.4.5 Additional considerations

I.4.5.1 Restrictive limitations

Where clothing that is clearly adequate for the danger cannot be obtained, it is not unusual for work to be permitted for restricted periods in the best available clothing. Such decisions require careful consideration of the relevant risks by responsible persons. Special safeguards, such as setting up showers adjacent to the workplace, may be needed.

I.4.5.2 Possible disadvantages

It is possible for protective clothing to create a hazard, for instance, by limiting the wearer's movements or vision, or by preventing him from sensing spilt chemicals.

All protective clothing causes some stress in the wearer, whether by discomfort, built-up of heat, or restriction of movement, and this should be borne in mind in the selection procedure.

The presence of hazards other than chemical action on the body (e.g., high temperatures) may restrict the choice of clothing further.

APPENDIX J

CHEMICAL PROTECTION
EXAMPLE OF A SUITABLE DESIGN FOR A SLEEVE

J.1 Fabric

The fabric should comply with appropriate requirements of Section 8, Clause 12.2.

J.2 Design

The tubular sleeve should be to the dimensions given in Section 8, Fig. 19. At each end the tube should be elasticated by single elastic set in a tunnel to reduce the opening to approximately the width shown.

J.3 Seams

The seams may be stitched or high frequency welded. If stitched, the longitudinal seam should be doubled as shown in Fig. 19.

APPENDIX K

CHEMICAL PROTECTION
LEAK TEST FOR GAS-TIGHT SUITS

K.1 Principle

The suit is inflated and the loss of pressure over a defined period is noted.

K.2 Procedure

K.2.1 Lay out the suit, including gloves and boots, and face mask if appropriate, on a suitable flat and clean surface away from any sources of heat and/or drought.

K.2.2 Remove any creases or folds in the suit as far as practicable. Make an inflation connection and carefully blank off the valves etc., with appropriate components as recommended for test purposes by the manufacturer.

K.2.3 Inflate the suit carefully to a maximum pressure of 180 mm H_2O, and then allow it to settle for a period of at least 10 min to allow any creased areas to unfold, the suit to stretch, the temperature to stabilize and the pressure throughout the suit to reach equilibrium.

K.2.4 Adjust the pressure in the suit to 170 mm H_2O.

K.2.5 Allow a further period of 6 min to elapse and note any loss of pressure.

Note:

Pay careful attention to the cleanliness and the refitting of valves which have been obstructed or removed in order to carry out the test, to ensure that they function satisfactorily after the test.

APPENDIX L

CHEMICAL PROTECTION
EXAMPLES OF PROTECTION AGAINST
A SINGLE HAZARD UNDER DIFFERING DEGREES OF DANGER

The selection of protection shown in Section 8, Table 33 has been chosen to apply to either concentrated hydrochloric acid or concentrated sulphuric acid. In either case the liquid poses a hazard to the exposed skin and eyes and the vapor mainly to the lungs and eyes. Dilute acid would not pose such a serious hazard to the lungs, unless present as a mist, but could still present a serious corrosion hazard to the skin and eyes. Thus respiratory protection is specified where the risk of vapor inhalation is high.

The protection quoted in Section 8, Table 33 illustrates a possible approach to the problem of providing adequate protection for varying degrees of danger. More protection than suggested could be provided particularly where the activity has been over-simplified. Thus examples(n) and (o) assume a risk of serious all-over splashing and consequent inhalation of fumes. This implies large storage tanks and wide bore pipes. The level of protection would be likely to be considered excessive if, for example, the storage tank held one liter and the pipes were only 3 mm bore.

Sulphuric acid is more damaging to the exposed skin than hydrochloric acid, whereas the latter poses more of a fume problem. Thus in each example, particularly from (e) onwards, it would be a matter of informed judgment whether there is justification for increasing skin protection for the one and lung protection for the other using the suggestions made in the table as a starting point.

Danger has been graded on an arbitrary scale from 1 to 10. The higher the number, the greater the chance of injury if no precautions are taken.

Notes:

1) In example (d), of Section 8, Table 33 the logic of increasing protection according to the danger is combined with an informed assessment based on the following questions:

a) What is the risk?

b) What protection is suitable?

c) Would increased protection hamper the worker and make the operation less safe?

Question (c) needs careful consideration and, in critical applications, might warrant carrying out a rehearsal to check that the protection does not introduce extra factors not readily foreseen.

2) Example (g) of Section 8, Table 33, illustrates a situation where it has been decided that (because of the short time involved) it is better to avoid the hazard rather than to increase protection.