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Introduction

1 This guidance note gives advice on the installation, use and maintenance of steam/water pressure cleaners. Use of this equipment kills people every year. The electrical risks that can arise when using this equipment are identified, and advice is given on safety precautions which will minimise these risks.

2 The guidance is aimed at those who select or buy steam/water pressure cleaners, those who manage or supervise work where this type of equipment is used, and those who use it. An HSE leaflet is also available INDG68(rev) *Do you use a steam/water pressure cleaner? You could be in for a shock!*¹

3 A description is given of the equipment and the accidents which it can cause, and information is given on selection, as well as installation and use. This guidance does not cover the design of the equipment.

Equipment description

4 Steam/water pressure cleaners are used in many industries for a variety of different purposes. A typical machine consists of a trolley mounted oil-fired boiler, a water tank with ball valve, a detergent tank, a pump driven by an electric motor, and a length of reinforced hose with a hand lance at the end (see Figure 1). There is usually a hose supplying water to the machine, and on movable machines, a flexible cable for the electricity supply. Some machines omit the detergent tank and clean by a high pressure water jet, sometimes with an added abrasive. Higher pressures are used for paint and corrosion removal, which means that these machines need more powerful pumps and motors. Most machines spray water based solutions, but some spray solvents.

Accident history

5 The use of these machines will create a wet environment where the operator's clothing, skin and footwear are likely to get wet. If an electrical fault occurs, and the operator receives an electric shock, the severity of the shock will be greater than in dry conditions, and will be more likely to result in death or serious injury.

6 An analysis of investigated accidents over the last five years shows that in 50% of incidents there was a fault in the supply cable, or an extension cable where one was used. Typically, the earth wire broke where it flexed most often. Where this was not detected, then a second wiring or insulation failure allowed exposed parts of the equipment to become live at mains voltage.

7 In general, this type of equipment is designed to be used with all exposed metalwork earthed. This is because a fault such as a live conductor touching exposed metalwork will then cause the fuse to blow. In 25% of incidents investigated the earth had become disconnected from the exposed metalwork. This fault will not be immediately obvious to the user of the equipment but can be detected by routine maintenance, for example inspection and testing.

8 In 20% of incidents investigated the waterproofing of the equipment was inadequate, either because of poor design, or lack of maintenance. The electric current may then pass through the water and the operator to earth.

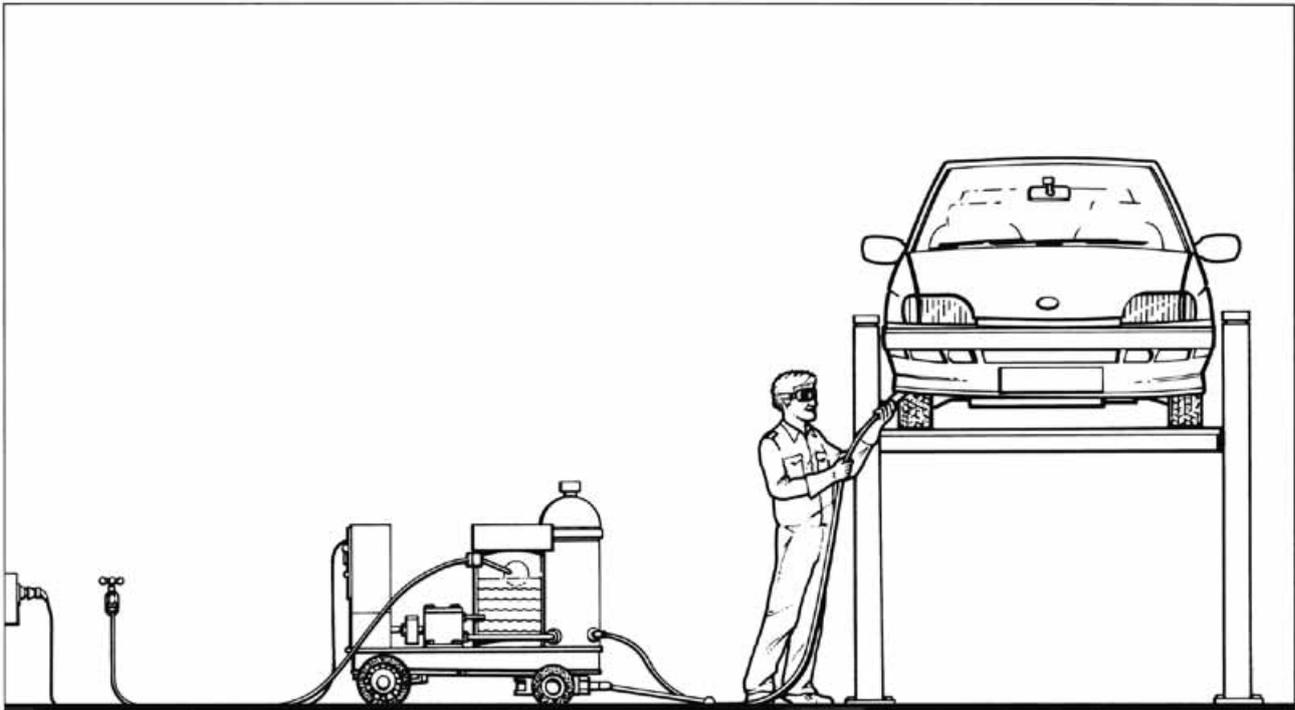


Figure 1 Steam/water pressure cleaner - typical application

Selection of equipment

General

9 It is important that equipment is selected that is suitable for the job. It should be sufficiently well designed and constructed that it is safe when first put into use, and remains safe during the foreseeable conditions of its use. When considering whether an item of equipment will be suitable, you should also consider where it will be used, and what it will be used for.

10 At installations where the electrical equipment may be used outdoors, and is likely to be used close to the worksite, choose equipment, wiring and connectors which can keep water out. For example equipment designed to be drip-proof may be marked IP42; splashproof may be marked IP43; and hoseproof equipment may be marked IP56 or IP57 (in accordance with BS EN 60529,² the standard covering water protection). In good designs, the cable entries will be sealed, and cables will preferably enter from below or be provided with rubber shrouds or effective gland seals. This can be specified when equipment is being selected and installed.

11 The risk of damage to cables and equipment will be reduced by using a fixed installation which has been designed for the purpose. This will also eliminate the need for plugs, sockets and other cable connections which may give rise to faults resulting in danger. Where a fixed installation is not practicable, the alternative is trolley or sledge mounted equipment.

12 A secure earth connection, with the bonding of all locally exposed metalwork to the same earthing point, is a simple way of removing the most common cause of incidents involving these machines. Where a metal reinforced hose is fitted between the lance and the cleaner, the metal reinforcement and the lance should be bonded to the equipment chassis and any other exposed metalwork.

13 The operator is more vulnerable to severe electric shock or electrocution in

wet than in dry conditions. The shock hazard is greatly reduced if Reduced Low Voltage (RLV) systems are used, but these systems will only power the smaller designs of pressure cleaner. On construction sites, 110 volt Centre Tapped to Earth (CTE) supply is the most common used system, and its use is spreading to other industries. The fact that a RLC system is used does not mean that the standards of wiring and installation can be relaxed.

Fixed installations

14 Larger pressurised water installations can be designed so that the pump feeds a pressurised main into which the flexible hoses for the lances can be plugged. This allows the electrical apparatus to be separated from the wet area.

15 Supply cables to fixed installations may use solid core conductors, and it is recommended that these are run in permanently fixed conduit tough enough to protect the cable from damage, installed where they are least likely to be damaged.

Movable equipment

Cables

16 Solid core cables should not be used to supply movable equipment and should only be used for fixed installations. (Ordinary PVC insulated flexible cables are not generally suitable for use with this type of equipment. The equipment rating will define the minimum cable size, but for durability it is recommended that cables have a minimum cross section of 0.75 square mm (rating of 6 Amps), and tough rubber sheathed (TRS) outer insulation).

17 Where movable pressure cleaners may be used in a number of locations, flexible supply cables should not be left trailing on the floor, but should if possible be suspended by hooks or other means, and placed where they are least likely to be damaged. Stress on the cable terminations at the plug and at the machine can be reduced by providing additional cable clamps, or by tethering the machine to a fixed point using a substantial chain.

18 In areas where cables are more likely to be damaged, for example in areas where vehicles are moving, extra precautions will be necessary. Cables may be suspended on a cable bridge, or run through substantial metal pipes secured against being moved by vehicles. Alternatively, armoured cables containing a braided metal sheath may be used to protect against mechanical damage. Note, however, that some types of plug cannot be fitted to an armoured cable.

19 Armouring will also help to anchor the cable. If it is correctly fitted at both ends, and if it is earthed, most forms of cable damage will result in the fuse blowing or other protective device cutting off the power. Cable armouring which is coated in plastic will be protected against abrasion and corrosion. A copper/nylon braided armouring, eg as described in Appendix 2 of BS 6708³ has been shown to give the longest life under flexing.

20 When not in use, it is recommended that the cables are stored on purpose-made cable carriers, preferably fitted to the machine. Remember, long cables on tightly wound drums are susceptible to overheating, so it is essential that such cables are properly selected and used in accordance with the manufacturer's instructions.

Plugs and sockets

21 Square pin or round pin domestic type plugs as shown in Figure 2(a), eg BS 1363⁴ or BS 456⁵ are not recommended for the industrial environment. In dry, indoor areas, good quality plugs and sockets (eg BS 196⁶) should be used, as

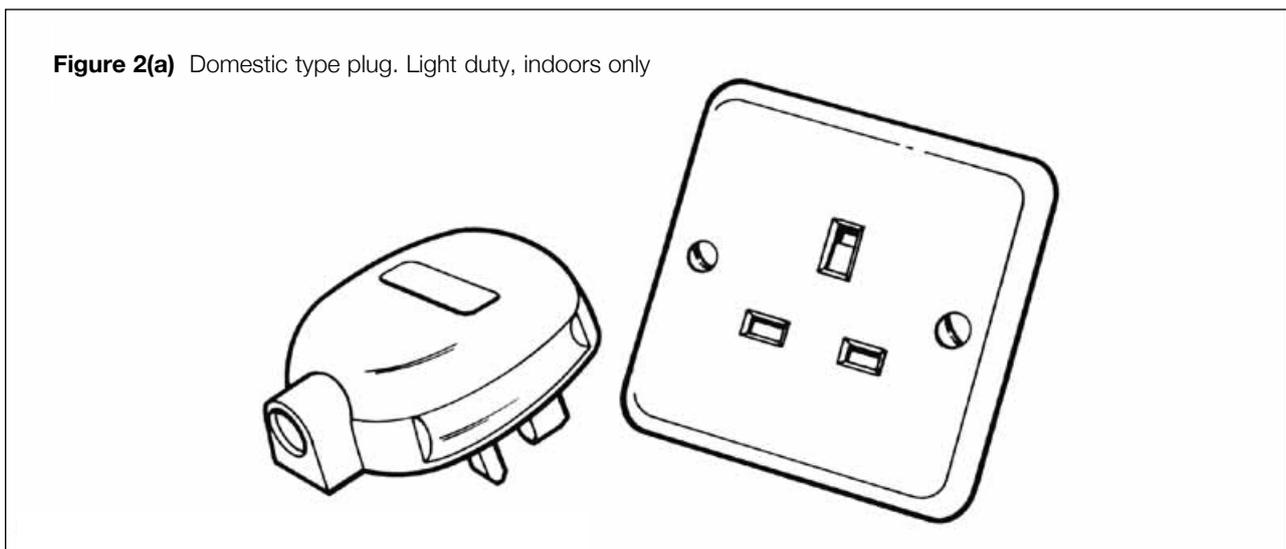
shown in Figure 2(b). Plugs should have a cord grip capable of maintaining a firm hold on the cable sheath, and when wiring the plug, it is recommended that the earth wire is made longer than the other two wires so that it is not the first wire to be pulled out if the cord grip fails. In situations where the cable is subject to considerable flexing where it enters the plug, the cable can be protected at this point with a plastic sheath designed for the purpose.

22 In wet areas or outdoors, plugs and sockets should be designed to provide adequate protection against water, eg BS EN 60309⁷ connectors marked IP44, as shown in Figure 2(c) for general outdoor use, or IP57 with the additional outer sealing ring, as shown in Figure 2(d), for use where they could be sprayed.

Protection by residual current devices

23 Movable equipment should be protected by a Residual Current Device (RCD), preferably provided as part of the fixed wiring installation. An RCD works by detecting earth leakage currents and switching off the supply if the leakage rises above the rated tripping current. Suitably fast-operating and sensitive devices are normally referred to as 30 mA/30 mS RCDs, and may be connected to protect a number of circuits, or restricted to one socket outlet.

Figure 2 Plugs and sockets



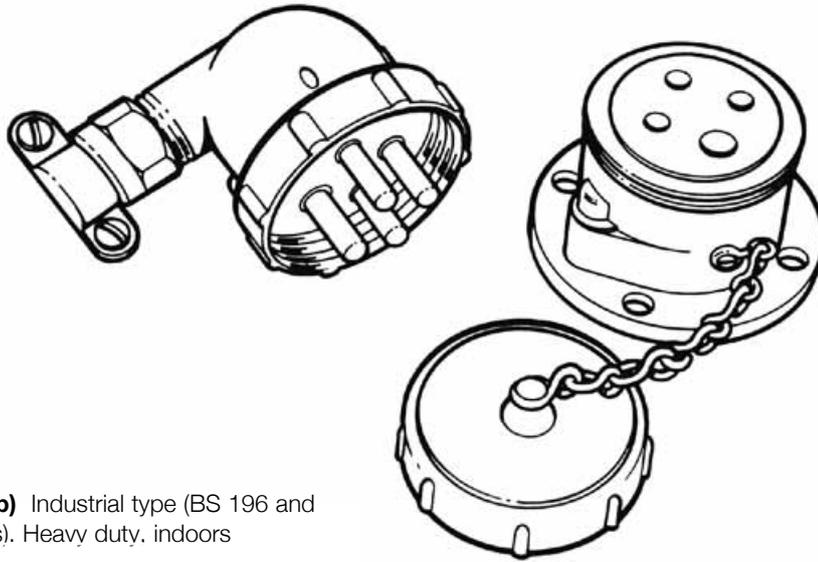


Figure 2(b) Industrial type (BS 196 and derivatives). Heavy duty, indoors

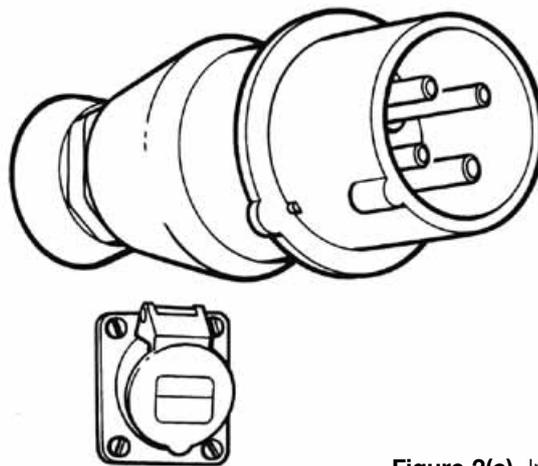


Figure 2(c) Industrial type (BS EN 60309)
Heavy duty, indoors

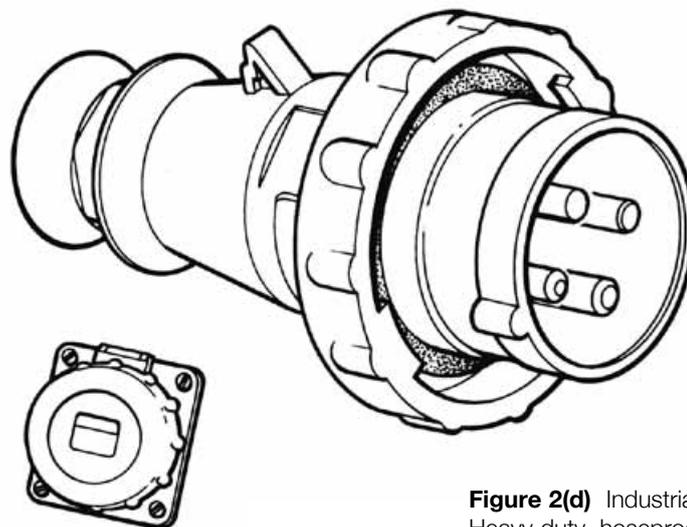


Figure 2(d) Industrial type (BS EN 60309)
Heavy duty, hoseproof

24 In circumstances where the RCD is not provided as part of the fixed installation, the RCD should accompany the machine and should be installed so that it protects both the machine and the supply cable. The use of adapter type or plug top type RCDs is not recommended because these are often left out of use, may not be suitable for wet environments, or may be incorrectly installed.

25 RCDs are sensitive devices and are fitted with a test button which will need to be operated regularly to ensure that the device stays in working order. RCDs are not a substitute for good installation practice.

Circulating current earth monitoring

26 As an alternative to RCD protection, the system may be protected by circulating current earth protection. This system works by continuously proving the integrity of the earth conductor by circulating a small current through it. A break in this circuit operates the trip mechanism and disconnects the supply. This type of protection is particularly recommended where movable equipment is regularly used at a limited number of fixed locations, for example in a motor vehicle cleaning area.

Use and maintenance

27 Carefully thought out working practices can greatly improve safety. The operator should be given training in the safe use of the equipment, and should be made aware of the potential dangers arising from its misuse. It is recommended that machines are used on level ground, in a well drained area. In addition to the electrical hazards, operators will need to be aware of the dangers from spray drifting into adjacent work areas or onto members of the public. High pressure jets can inject liquids into the body and this can be extremely dangerous. Responsible supervision will be necessary to make sure that the safe working procedures are followed.

28 Before using the pressure cleaner to clean equipment which has an electrical supply connected to it, make sure that the electricity supply to the system has been isolated, and electrical enclosures have been sealed to prevent water getting in. Before reconnecting the supply, the equipment may need to be inspected and tested by a competent person to ensure that no damage has been done during the cleaning process.

29 Operators may need special clothing to protect them from the liquid used in the cleaner, and the materials on which it is being used. It is strongly recommended that goggles are worn when the equipment is in use, to protect the eyes from misdirected sprays, or sudden leaks.

30 Operators should check the equipment visually before each use or at the beginning of each shift if the machines are in constant use. They should be trained to identify damage to the equipment, plugs, sockets and cable. Defects should be reported to a responsible person, and operators must never use a machine which appears to be defective. RCDs should also be checked by operating the test button.

31 In addition to user checks a competent person should carry out formal visual inspection of the equipment and installation on a regular basis, for example once per week if it is in daily use.

32 Since correct earthing is crucial to the safe operation of the equipment, it is strongly recommended that earth continuity and insulation tests are carried out on the machine and the fixed installation when the equipment is first installed and at frequent intervals thereafter.

33 It is recommended that the earth continuity and insulation resistance of the equipment is tested every three months. However, if the equipment is used on a construction site, or a similar workplace, tests every month are recommended.

34 Tests of earth bonding of structural and other metalwork in the vicinity, and earth loop impedance at the supply sockets are recommended to be carried out at first installation and at six months to check for deterioration. A comparison of the six month readings with those taken at twelve months will show whether the installation is deteriorating fast enough to require six month tests. If the change in the readings is low, the installation may be tested at twelve month intervals.

35 Records of examinations, tests and repairs are not required by law, but they will provide useful information on the general condition of the machine and its relevant safety fittings. Further guidance on maintenance is given in the HSE guidance booklet HSG107 *Maintaining portable and transportable electrical equipment*.⁸

Summary of legal requirements

36 The following summary outlines the main legal requirements which apply to the use of steam/water cleaners. The list is not complete and does not give a definitive interpretation of the law – it summarises the main issues to be borne in mind when using this equipment. Full details of the legislation can be found in the documents referred to at the end of this guidance note.

37 The Health and Safety at Work etc Act 1974⁹ places duties on employers, employees and the self-employed to ensure, so far as is reasonably practicable, the safety of people involved in work activities, and those who may be affected by work activities.

38 The Management of Health and Safety at Work Regulations 1999¹⁰ require employers and the self-employed to assess the risks arising from work activities, and to control these risks so that they are reduced to an acceptable level.

39 The Electricity at Work Regulations 1989¹¹ require people in control of part or all of an electrical system to ensure that it is safe to use, and that it is maintained in a safe condition.

40 Section 6 of the Health and Safety at Work etc Act 1974 and the Supply of Machinery (Safety) Regulations 1992¹² place duties on manufacturers and suppliers of machinery and equipment for use at work, and require that machinery and equipment is supplied in a safe condition.

41 The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended)¹³ and the Personal Protective Equipment at Work Regulations 1992¹⁴ may apply where the liquid used in the cleaner, or the materials on which it is being used could cause a hazard to health.

References

1 *Do you use a steam/water pressure cleaner? You could be in for a shock!* Leaflet INDG68(rev) HSE Books 1997 (single copy free) Web version: www.hse.gov.uk/pubns/indg68.pdf

- 2 BS EN 60529: 1992 *Specification for degrees of protection provided by enclosures* British Standards Institution
- 3 BS 6708: 1998 *Flexible cables for use at mines and quarries* British Standards Institution
- 4 BS 1363 *13A plugs, socket-outlets and adaptors* British Standards Institution
Part 1: 1995 *Specification for rewirable and non-rewirable 13A fused plugs*
Part 2: 1995 *Specification for 13A switched and unswitched socket outlets*
- 5 BS 546: 1950 *Specification for two pole and earthing pin plugs, socket outlets and socket outlet adapters* British Standards Institution
- 6 BS 196: 1961 *Specification for protected type non-reversible plugs, socket outlets, cable couplers and appliance couplers, with earthing contacts for single phase AC circuits up to 250 volts* British Standards Institution
- 7 BS EN 60309 *Plugs, socket-outlets and couplers for industrial purposes* British Standards Institution
Part 1: 1999 *General requirements*
Part 2: 1999 *Dimensional interchangeability requirements for pin and contact-tube accessories*
- 8 *Maintaining portable and transportable electrical equipment* (Second edition) HSG107 HSE Books ISBN 0 7176 2805 1
- 9 *Health and Safety at Work etc Act 1974 (c.37)* The Stationery Office ISBN 0 10 543774 3
- 10 *Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance L21* (Second edition) HSE Books 2000 ISBN 0 7176 2488 9
- 11 *Electricity at Work Regulations 1989* SI 1989/635 The Stationery Office 1989 ISBN 0 11 096635 X. Also available, *Memorandum of guidance on the Electricity at Work Regulations 1989. Guidance on Regulations* HSR25 HSE Books 1989 ISBN 0 7176 1602 9
- 12 *Supply of Machinery (Safety) Regulations 1992* SI 1992/3073 The Stationery Office 1992 ISBN 0 11 025719 7
- 13 *Control of substances hazardous to health (Fifth edition). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Codes of Practice and guidance L5* (Fifth edition) HSE Books 2005 ISBN 0 7176 2981 3
- 14 *Personal protective equipment at work (Second edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations L25* (Second edition) HSE Books 2005 ISBN 0 7176 6139 3

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Further information

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