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## **Safety**

# **Electric Shock Hazard in the Use of Electric Arc Welding Plant**

Notice to Shipowners, Masters, Officers and Seamen

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In recent years the carriage or installation on shipboard of electric arc welding plant intended for use by ship's personnel has become commonplace. Such equipment used in certain special locations can give rise to hazards in its use not normally encountered elsewhere. Three recent fatalities resulting from electric shock while using electric arc welding equipment in hot damp situations indicate that the electric shock hazard is not fully appreciated. In each case the victim was working in a restricted hot damp situation surrounded by earthed metal work which possibly allowed large areas of his body to come into contact with the steelwork of the ship to which the welding set was "earthed". Subsequent investigation in each case showed no faults in the electric welding equipment concerned. The sets were of the commonly used alternating current type where the open circuit (striking) voltage is in the region of 70 to 80 volts. Such voltages can be fatal in circumstances encountered while welding on shipboard, especially when the effective surface body resistance is greatly reduced due to sweating or dampness from salt water. A further reduction of body resistance can result should burning of the skin occur while welding.

That electric arc welding should be undertaken only by persons properly trained in the use of such equipment is self evident if the sets are to be used effectively; it is even more important that the electrical safety precautions should be understood not only by the welder but also by those in attendance upon him. In especially damp and humid conditions the danger of electric shock can be such that consideration must be given to whether or not electric arc welding should in any case be undertaken. Such a decision and the suitability of any person to undertake welding should be taken by the senior officer in charge eg the Chief Engineer Officer.

The following precautions relating to electrical safety are brought to the attention of shipowners, of masters and officers, and to operators:

### **Plant and Equipment**

#### *Welding Sets*

Since the effect of shock from direct current (d.c.) is less (at the operating voltages used) than with alternating current (a.c.) the use of welding sets having a d.c. output, especially those incorporating d.c. generators providing an open circuit (idling) voltage of 70 volts or less, will enhance the safety of operating personnel. Direct current obtained from rectified alternating current may however contain a degree of a.c. ripple which if excessive would greatly reduce the advantage provided by pure direct current, in which case it is recommended that the idling voltage be limited to 42 volts by provision of voltage reduction safety devices.

Voltage reduction safety devices which limit the "idling" voltage to 25 volts or less are also available for use with alternating current electric arc welding plant of the type normally fitted on shipboard, as plug in or installed units.

These safety devices ensure that the idling voltage only is applied until there is contact between the electrode and the "work" when the full open circuit voltage becomes available to strike the arc. Once struck, welding continues in the normal way at the voltage necessary to maintain the arc (normally 25–30 volts) until the arc is broken. There is little noticeable difference in the welding procedure but safety is greatly enhanced and the use of such devices is strongly recommended.

Electrode holders should be of the fully insulated type.

When joints in the cables are necessary the connectors should also be fully insulated and should be designed and used so that, when disconnected the live parts are not exposed. A "go and return" system where two cables are used from the welding set with one cable solidly clamped to the workpiece is recommended in all cases. While not recommended, if a single cable with hull return is used exceptionally, care should be

taken to ensure that both the workpiece and the return terminal on the welding set are making direct contact with the hull using clamps and short lengths of "earthing" cable as necessary.

Means should be available whereby the current can rapidly be cut off from the electrode holder should the operator get into difficulties. This can be achieved in several ways but the essential feature is that the time taken to de-energise the equipment should be as short as possible. Means of disconnection should be available to the welder for use when changing electrodes.

#### *Clothing*

Proper welder's gloves, apron and welding helmet or shield should be available at all times and the use of non-conducting rubber boots is recommended.

#### *Lighting*

Adequate fixed lighting or portable lighting capable of being properly secured whilst welding should also be available. Hand held lighting can be a hazard to the welder and should be avoided.

#### *First Aid*

Wall charts giving Instructions on Artificial Respiration and Treatment for Electric Shock, should be prominently displayed where personnel likely to use the equipment can best be expected to see them. These subjects are dealt with in the Chapter entitled "First Aid" in the Ship Captain's Medical Guide.

### **Operational**

#### *Attendant*

Normally welding should be undertaken only when a knowledgeable attendant is standing by the operator. The attendant should be prepared at all times to cut off the current at once in the event of accidents, and he must appreciate that when the operator experiences an electric shock he may be unable to let go of the live metal due to the effects of the current. The attendant should therefore break the supply to the welder preferably by instantly switching off the current or removing the welder from contact with the live metal, *having regard for his own safety while so doing*, noting that it may be possible to pull the electrode holder away from the victim by using the comparative safety of the

insulated flexible cable. (Recommendations will be found on the instructional wall chart previously mentioned.)

#### *Clothing*

Protective clothing mentioned above should be used on every occasion and particularly when welding in the prone position where large areas of the body might otherwise be in contact with the earthed "work" or ship's structure. The body should be fully clothed and the clothing maintained as dry as possible to provide insulation against the open circuit voltage which even when using the safety devices mentioned above, will momentarily be of the order of the striking voltage. Although not a guarantee and by no means always effective, use of a non-hygroscopic insulating material between the welder and exposed metal parts should be considered. Welding gloves must always be maintained in a dry condition.

#### *Working Conditions*

It should be ensured that the ventilation is adequate, and the work is well lighted and is as accessible as safety requires.

Welding should not be undertaken when standing in, or when any part of the body is resting in water.

#### *Handling Electrodes*

Operators should appreciate that some electrode coatings have extremely low resistance and should therefore be handled (like bare electrodes) with the greatest care especially when being inserted into the electrode holder. Even a flux coating which is normally insulating can become damp from sweating hands and thus potentially dangerous.

It follows therefore that electrodes should never be inserted into a live holder and similar precautions should apply to their removal.

#### *First Aid*

Operators and their assistants should read and digest the Instructions given on the wall charts mentioned above so as to be ready to give effect to them in case of need. Practice in artificial respiration should be undertaken and demonstrations, particularly by those giving instruction to welders, are recommended.

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