INTER PLANT STANDARD - STEEL INDUSTRY		
IPSS	**CODE OF PRACTICE FOR SAFE USE OF ARC WELDING EQUIPMENT** *(FIRST REVISION)*	**IPSS:1-07-049-98** Formerly: IPSS:1-07-049-88
	Corresponding IS does not exist	

AUTHENTICATED COPY
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0. FOREWORD

0.1 This Inter Plant Standard prepared by the Standards Committee on Paints and Portable Maintenance Equipment, IPSS 1:7 with the active participation of the representatives of all the steel plants and was adopted in October 1998.

0.2 This Standard was first published in the year 1988. The Standards Committee IPSS 1:7 felt that all the safety precautions given in clause 4.12 were not possible to be displayed in the manner it was given and desired that the display matter should be separately prepared in a short form and included so that important safety precautions could be displayed in the shops. Accordingly, clause 4.12 has been modified in addition to other minor changes.

0.3 List of Indian & IPSS standards referred, is given at Appendix - A (Ref page-7)

1. SCOPE

1.1 This Standard lays down the code of practice for safe use of arc welding equipment.

2. GENERAL INSTRUCTIONS

2.1 The supply cable shall, in all cases, be run as a single length from the main switch to the welding set and shall not exceed 3 m.

2.2 The connection to the welding set shall be through a switch-fuse mounted on the set, if it is transformer type and through a starter, if it is of motor generator set type.

2.3 The supply cable shall be a multicore cable suitable for the voltage and current of the machine and shall incorporate the earthing conductor. Details are given in 3.1.

2.4 The welding set shall be earthed conforming to 15.2 of IS 3043:1987 'Code of Practice for Earthing'.

2.5 **Return Path for Welding Current**

2.5.1 Railway tacks, pipes carrying gases, flammable liquids or electrical conductors, storage tanks, structures primarily carrying such pipelines and machine structures shall positively not be used for the purpose of providing the return path.

2.5.2 Welding of the loads hanging from the crane shall be avoided. In case it becomes absolutely necessary, the complete crane shall be isolated from the power supply and job shall be grounded separately and directly to avoid ropes and crane structures from being used as a return current path.

2.5.3 In case of a machine part or a job mounted on the machine is to be welded, a separate and direct return path shall be provided.

2.5.4 In case welding object is at a distance, steel structures and pipelines may also be used as a return path.

2.5.5 In case pipes or steel structures are used as return path, it shall be made sure that there is no heating or sparking along with complete path, which may create a fire hazard.

2.6 Beyond operating the switch/starter, the welder is not authorized to interfere with the primary supply upto the machine. In case of trouble, he shall call authorized electrician.

2.7 Welding cable shall be run in a single length as far as possible. Wherever joints are necessary, they shall be done through well insulated connectors described in 3.3, failing which cable sockets may alone be used and properly insulated. Jointing by twisting shall in no case be done.

2.8 Welding cable shall be connected to the welding set with cable terminal end.

3. TECHNICAL SPECIFICATIONS FOR THE MATERIALS

3.1 Supply Cable

It shall be capable of withstanding the voltage and current of the machine. The minimum sizes of aluminium cables to be used for the different types of machines are listed below:

Maximum Continuous Hand Welding Current of the Set at 60% Duty Cycle, A	*Nominal Area of Cross Section of the Cable in mm^2*
350	10
600	10
900	25
1200	50
1500	195

3.2 Welding Cable

70 (Seventy) square millimeters round single core flexible welding cable conforming to IS 9857:1990 `Specification for welding cables (*first revision*)' with annealed high conductivity untinned copper conductor and with general heat resistant, oil resistant and flame retardent compound (HDFR) complying with the conductor temperature not exceeding 85^{o}C.

NOMINAL WELDING CURRENT	Conductor			Insulation			
	Nominal area	No. & dia of the wires	Maximum resistance per km at 20^{o}C	Insulation thickness	Heating thickness	Total thickness	Mininimum Insulation resistance
A	mm^2	mm	ohm	mm	mm	mm	megohm
600	70	2,228/0.20	0.2689	0.50	1.50	2.00	35

3.3 **Connectors**

3.3.1 The connectors shall be of insulated type and shall be capable of maintaining electrical and mechanical contact which cannot be disturbed in normal service.

3.3.2 The connector shall be capable of carrying 600 A continuous current without heating.

3.3.3 The connector shall be spring loaded bayonet type, with silver tipped butt type contact of a very low contact resistance.

3.3.4 Male and female ports of the connector shall be protected with neoprene sleeves.

3.3.5 The design of the connector at the point of cable entry shall be such as to minimize the risk of damage due to flexing.

3.4 **Return Current or Earthing Clamp**

It shall conform to 6 of IS 2641:1989 'Specification for electric welding accessories' (*first revision*).

3.5 **Electrode Holder**

It shall be rated for 600 A and shall conform to IPSS:1-07-052-95 'Electrode holders (*first revision*)'.

3.6 **Equipment for Eye and Face Protection**

It shall conform to IPSS:1-05-016-84 'Goggles - spectacle type for electric arc welders, helpers and supervisors'

4. SAFETY PRECAUTIONS

4.1 The welder shall have a thorough knowledge of requirements with regard to safety and shall have been judged competent by their employers before taking charge.

4.2 The welding cable shall be connected firmly to the terminal marked 'work' on the machine.

4.3 When welding is done at a distance from the welding set and welding cable is taken over head, it shall be properly supported. If the cables are laid on the floor or ground, they shall be protected against damage due to heat or by mechanical means and shall not interfere with the safe movement of persons or objects.

4.4 If parts of installation subjected to great stresses, such as steam boilers and other pressure vessels, are to be repaired by welding, then such repairs shall be carried out by welders authorized for such work by a competent authority, and only such methods, equipment and filler metal, as have been declared permissible for such purposes by the competent authority shall be used.

4.5 If an inert gas is used for purging, after the vessel has been filled, the gas shall be allowed to flow slowly into it throughout the welding or cutting operation.

4.6 Whenever welding is to be carried out at heights, all safety precautions for working at heights, shall be followed. In this connection, the following IPSS standards shall also be referred:

i) IPSS:1-11-005-98 'Procedure for working at height by contractor's workers'

ii) IPSS:1-11-008-98 'Procedure for working at height by regular employees of plant/mines'

4.7 Protection against Glare and Flash

4.7.1 Wherever the work permits, the welder shall be enclosed in an individual booth painted with a non reflecting paint, such as zinc oxide or lamp black. Alternatively, an enclosure of non-combustible screens similarly painted may be provided about 60 cm above floor level.

4.7.2 Booths/Screens shall permit circulation of air at floor level and shall be adequately ventilated to prevent accumulation of toxic gases or possible oxygen deficiency.

4.7.3 Workers or other persons adjacent to welding areas shall be shielded from welding glare and flash by non-combustible flame proof screens or shields, failing which they shall be required to wear appropriate goggles.

Where a welder has to enter a confined space through a manhole or other small opening, means shall be provided for quickly removing him in case of emergency. When safety belt are used for this purpose, they shall be so attached to the welder's body that he is not jammed in a small exit opening.

Where arc welding is to be suspended for any substantial period of time, such as during lunch hours or overnight, all electrodes shall be removed from the holders and holders carefully located so that there is no possibility of accidental contact. The machine shall also be switched off from the power source and tested to ensure that power is off.

Where diesel welding sets are used in confined areas, the exhaust shall be led to the outside atmosphere.

The helper who helps the welder in his job, should be thoroughly conversant with the machine and put off the supply switch in case an emergency arises.

The following shall be prominently **DISPLAYED** in shops in ENGLISH, HINDI and Regional Languages:

- OBTAIN WELDING CLEARANCE FOR WORKING IN ENCLOSED/FLAMMABLE AREA
- AVOID CONTACT OF WELDING CABLES FROM GREASE/OIL
- VENT ALL HOLLOW SPACES, CAVITIES OR CONTAINERS BEFORE PREHEATING/ CUTTING/WELDING OPERATIONS
- NEVER WEAR SYNTHETIC CLOTHES WHILE WELDING
- NEVER USE WET CLOTHES WHILE WELDING

- **ENSURE PROPER EARTHING OF WELDING MACHINE BEFORE USE**
- **WELDING MACHINE SHOULD BE KEPT IN DRY PLACE**
- **AVOID USE OF EMPTY GREASE/OIL DRUMS WHILE WELDING**
- **NEVER DIP HOT ELECTRODES IN THE WATER**

Besides this, all other precautions given below shall invariably be followed:

1) **Ensure that the instructions given in this standard are read and understood.**

2) Check up with the area supervisor for safety precautions before starting the job in a particular area.

3) Obtain a written clearance from the area supervisor for working in an enclosed space and flammable areas.

4) Check all the connections of the welding machine and make sure that they are properly made, before starting the job.

5) Keep the welding cable dry and free from grease and oil to prevent premature breakdown of the insulation.

6) Shift the welding object to a safer place near the welding machine, if practicable.

7) Remove all the movable fire hazards from the vicinity if the welding object cannot be shifted.

8) Guard to confine the heat, sparks and slags, if all the fire hazards cannot be removed.

9) Ensure that there is no highly combustible material on the floor, below the floor opening or crack, holes in the wall, open door ways and broken windows, in case it is not possible to close them.

10) Vent all hollow spaces, cavities or containers to permit escape of air or gases, before preheating, cutting or welding. Purge with inert gas if possible.

11) Provide practicable safe means of access to every place at which any person at any time is required to work.

12) Paint the walls of the building bay with a non-reflecting colour to prevent flickering reflections, where the welding is regularly carried on.

13) Use leather or asbestos gloves while welding or gas cutting.

14) Use overalls and in addition, flame proof aprons, made of asbestos, leather or other suitable materials, for protection against radiated heat and sparks where necessary.

15) Keep your sleeves and collars buttoned before starting the job.

16) **Use leather leggings over the safety boots for hot and heavy work.**

17) Keep the gas cylinders and welding machines outside, if the welding or gas cutting is performed in a confined pace.

18) Mark the job 'HOT' or provide some other means of warning that it is hot, after welding operations are completed.

19) Use air supplied respirator or hose masks for welding at a place where clean and respirable air is not adequate.

20) Get the defective cables replaced immediately.

21) Remove the partially used electrodes from the holder and keep the holder in a properly insulated place while not in use.

22) Keep suitable fire extinguishing equipment such as pails of water, buckets of sand, hose lines or portable extinguishers in readiness for instantaneous use.

IMPORTANT: Keep the fire extinguishing equipment in good working conditions all the time.

23) Do not disregard any of the safety provisions covered in this standard, they are meant for your personal protection as well as other in the area.

24) Never dip the hot electrode holder in water whether connected or not, otherwise you will get electric shock due to retained moisture.

25) Do not allow the welding cable to be in proximity to power supply cables or other high tension wires.

26) Do not do any welding or cutting job, if precautions given in No.3, 6, 7 and 8 are not followed.

27) Do not turn up the trousers and overalls on the outside.

28) Do not weld jacketed vessels, tanks, containers or other hollow parts unless every possible precaution has been taken to vent the confined space adequately and an opening has been drilled, otherwise it may explode.

29) Do not keep the job to be welded or allow the molten metal to fall on concrete floor, as a portion of concrete may spall with possible injury to the welder.

30) Do not stand in water while welding without wearing properly insulated foot wears.

31) Do not transport the arc welding cables coiled around the shoulders when the conductor is live.

32) Do not allow the end stubs of the electrodes to scatter as there is a chance of men slipping over them. Collect them in a container.

33) Do not use gunny bags for insulating the cable or cable joints. Insulate them with an adhesive insulated tape.

4.13 The welders shall be trained according to IS 817:1966 'Code of practice for training and testing of metal arc welders (revised)'. There shall be a re-orientation course ONCE in three-four years.

5. ACCESSORIES

5.1 The commonly used accessories are listed below:

Sl.No.	Item
i)	Arc welder's goggles (see IPSS:1-05-016-84)
ii)	Asbestos aprons
iii)	Leather legging
iv)	Safety belt (see IPSS:1-05-028-86)
v)	Face shield for welders
vi)	Dust respirators
vii)	Overall: a) Coat overall blue small b) Coat overall blue medium, and c) Coat overall blue big
viii)	Leather gloves, and
ix)	Electrode holders (see IPSS:1-07-052-95)

APPENDIX - A (REFERENCES USED) {Ref Cl 0.3}

IS 817:1966	Code of practice for training and testing of metal arc welders
IS 1179:1967	Specification for equipment for eye and face protection during welding (*first revision*) (*amendment 1*)
IS 2641:1989	Specification for electric welding accessories (*first revision*)
IS 3043:1987	Code of practice for earthing
IS 9857:1990	Welding cable (*first revision*)
IPSS:1-05-016-84	Goggles - spectacle type for electric arc welders, helpers and supervisors
IPSS:1-05-028-86	Safety belt, harness type, Nylon make
IPSS:1-07-052-95	Electrode holder (*first revision*)
IPSS:1-11-005-98	Procedure for working at height by contractor's workers
IPSS:1-11-008-98	Procedure for working at height by regular employees of plant/mines