

## Health and Safety in Arc Welding (Current Status and Action Plan)

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### 1.0 INTRODUCTION

There is now growing awareness of the need to control pollution and to protect the environment. This holds good equally for welding shops, and adequate safeguards have to be provided to prevent pollution through fume generation. Furthermore, health and safety of personnel need to be taken into account. Electrical hazards, welding fumes, ultraviolet rays and heat are direct outcome of the welding operation. While the overall situation in these two aspects of health and safety in India was far from satisfactory for years together, with more and more welding being employed, a number of Industries are making systematic efforts and providing for the substantial investment required, to tackle these aspects on a long term basis. And yet, these aspects need to be emphasized for the reason that with quality, productivity and cost control receiving due attention, health and safety have to attract the attention they demand. This is now facilitated because all these risks and preventive / corrective measures required, are well-documented in available literature, and have, in fact, been made a part of the Safety and Health training programmes in the training centres of numerous large corporates. What is called for is to update the programme contents by incorporating

information based on the latest findings and improved "personal protection equipment" being made available for the welding industry.

### 2.0 HAZARDS

Electrical hazards are so common and well known. Oxy-fuel welding / cutting gas cylinders and flame, ultraviolet radiation, radiography noise and vibrations, solvents in MPI and anti-spatter products fumes and dust. These are prominent hazards which are now covered with wide ranging literature on risks and preventive / corrective measures. The relevant question one needs to ask oneself, is whether all such literature is made use of and put into practice, as a part of overall safety programme. For this to happen in a planned manner, in the first place, IIW - India has to make the concerned personnel aware of such available literature. For instance, the risk of electrical shocks is known only too well, but it tends to be known only qualitatively and through actual experience. An attempt to quantify the risk will result in better understanding of its seriousness and chances of proving fatal at apparently low amperes. The Accident Prevention Manual of American Safety Council shows in tabular form the risk factor in terms of milliamperes of current. This is reproduced hereunder:

**Effects of Electric Current on Men/Women**

Effect	Current in milli Amp			
	60 Hz		19,000 Hz	
	Men	Women	Men	Women
Slight sensation on hand	0.4	0.3	7	5
Perception threshold	1.1	0.7	12	8
Shock-not painful, muscular control not lost	1.8	1.2	17	11
Shock-painful, let-go threshold	16	10.5	75	50
Shock-Painful and severe muscular contractions, breathing difficult	23	15	94	63
Shock-Possible ventricular fibrillation effects from 3 seconds shock	100	100		

(Source: Accident Prevention Manual, American Safety Council).

### 3.0 WELDING FUMES

This subject is vast and is relevant to the successful working of any industry engaged in welded fabrication. While there has been growing awareness of its importance, it is still not receiving adequate attention, especially in the units of the unorganized sector. The aspect of safety is well covered through numerous documents on safe practices in welding. Moreover, the various issues are discussed in the HRD programmes of corporates as well as workshops conducted by professional bodies. Thus, a great deal of literature is available and the important point is of implementation of various measures in a planned manner. When it comes to the aspect of health of the personnel involved in welding activity the single most important factor is of welding fumes and it is in this area that steps are continuing for :

- a) Accurate and rapid measurement of fumes,
- b) Analysis of particulates of fumes,
- c) Assessment of adverse effects on the human body and systems through extensive medical studies,
- d) Laying down limits for exposure in respect of every constituent of welding fumes,

- e) Preventive or controlling measures to counter the adverse effect, through development of consumables, and suitable equipment for ventilation, dilution, extraction of fumes, combined with respirators.

### 4.0 INDIAN SCENARIO

In India, the "Factories Act, 1948" lays down several provisions to cover safety and health aspects in manufacturing industries - chemical mechanical and electrical. Chapter 4, sub 67 in which Schedule I and II (pages 124, 125) specify use of appropriate eye protection from ultraviolet and infrared radiations emitted by welding. Chapter 3 Section 14 deals with protective measures in areas where hazardous dust/fumes are likely to be generated. THE SECOND SCHEDULE Section 41 F (pages 75-78) lays down permissible levels of numerous chemical substances in work environment.

Permissible Exposure limit for welding fumes is 5 mg /m<sup>3</sup> for Time weighted average of 8 hours of exposure. So, it is in line with the limit prescribed in the USA and UK.

Welding Fumes	Permissible limits of Exposure			
	Time weighted average concentration (TWA) (8 Hours)		Short term exposure limit (STEL) (15 min)	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
	-	5	-	-
Beryllium and Compounds (as Be)	-	0.002	-	-
Cadmium dust and salts (as Cd)	-	0.05	-	-
Calcium Oxide	-	2	-	-
Chromous salts (as Cr)	-	0.5	-	-
Chromic acid and chromates, Water soluble (as Cr)	-	0.05	-	-
Copper fume	-	0.2	-	-
Fluoride (as F)	-	2.5	-	-
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> ) fume (as Fe)	-	5	-	-
Manganese dust and compounds (as Mn)	-	5	-	-
Manganese fume (as Mn)	-	1	-	0.03
Nickel carbonyl (as Ni)	0.05	0.35	-	-
Ozone	0.1	0.2	0.3	0.6
Zinc Oxide fume	-	5.0	-	10

It is noteworthy that the Factories Act, 1948 contains a provision for Safety Committee consisting of equal number of members from management and workers to promote cooperation in maintaining safety and health at work in hazardous processes for which special license is required to set up the manufacturing unit even in respect of its location. While this does not apply to welding industries, the relevant point is ensuring safety and health through cooperative effort and awareness programmes at all levels of workforce.

In "The Third Schedule" (page 80) are listed the Notifiable Diseases which include Manganese poisoning, or its sequelae.

Thus the provisions in Factories Act 1948 do cover the aspect of fumes and limits for hazardous constituents. What is necessary is to update the provision in line with the revised international limits. Process of revision in the Factories Act may be somewhat slow because of the procedures involved. Hence, the need for industry and industrial safety organizations to deal with the issue, based on the latest data available.

**5.0 WHAT MORE NEEDS TO BE DONE IN INDIA**

In tackling the problem of fumes as health hazard one has to keep in mind that the adverse effects on human body and health continue to be the subject of intensive and extensive research, especially in medical. The status for several elements in both qualitative and quantitative terms is not clear even for fixing safe WES (in UK) and OES (in USA). Manganese and nickel, two of the most important elements are in this category. As far as Hexavalent Chromium is concerned, the new stringent standard calls for carefully planned and monitored measures on a regular basis, especially in welding of stainless steels, in respect of quantum of generation and its effective control in the welder breathing zone and shop environment. In the light of such a situation combined with the growing concern

for health and environment, the welding industry has to give due attention to measures for ventilation and extraction. In the long run, investment for good working environment will prove beneficial.

Having given due attention to the numerous sources of health hazards, it is of paramount importance to help welders and operators in particular to overcome the fears about welding fumes. Imparting knowledge of the inevitability of fumes, and simple precautions during welding (e.g. use of head shield for SMAW) will result in a realistic attitude towards fumes, more so when appropriate measures are taken for ventilation and fume extraction. It has to be a combined effort on the part of management and the workforce.

**6.0 CONCLUSION**

Today's need is to ensure the optimum blend of technological advancement with requisite planning and implementation of measures aimed at safety and health of workforce, and overall environment protection. In this planning, every Industrial unit ought to educate the workforce, especially welders and welding operators, to treat the hazards in a realistic manner, without unwarranted fears of risk from fumes in particular, more so because the quality and quantity are subject to wide variations depending on arc welding process and the consumable including shielding gas. In today's situation of demand for higher productivity, role of the welding professional body has to be enlarged to give due guidance to the vast unorganized sector of SMEs who, while making a handsome contribution to industrial output of welded fabrication, lack facilities to educate their workforce in the area of safety and health, and with a large number not having requisite safe practices in place to ensure environment control. Creating awareness at all levels has to be the prime objective of the entire welding fraternity.

