Arc welding of steel is at the centre of the industrialised and industrialising world. For some decades studies of men classified as “welders” have been observed to have had a 30-40 % excess risk of developing lung cancer compared to the general population [1-6]. In this case excess risk can be defined as the difference between the proportion of welders with lung cancer and the proportion of the general population with the same disease. As an example: if the risk of lung cancer in the general population was 100 cases per 100 000 population per year, then one could expect there to be 130 to 140 per year in 100 000 welders (after controlling for age and sex with respect to the general population).

In the most recent meta-analysis published by a team of investigators in 2006, the excess risk was calculated at 22-32 % with no difference observed between the types of steel being welded – on the occasions when these were reported by researchers in their original scientific papers [7]. This evaluation is in full agreement with a former meta-analysis from 1997 [8]. A similarly elevated risk found in Denmark was reported in 2007 after a long follow-up study of a large cohort [9]. While an exposure-response relationship indicated carcinogenic effects related to stainless steel welding, it was uncertain whether the mild steel process carried such a correlation.

Even after allowing for the difficulties in making accurate estimates of the risk of cancer from epidemiological and other studies conducted in different countries and where estimates of exposure are usually somewhat crude [10], this apparently increased risk should not be ignored. Welding is a common task in many occupations – with only a relatively small proportion of those using the processes calling themselves welders [11]. With several million workers around the world using arc welding to some extent or other, and many more exposed at work to fumes arising from the processes as a principal part of their daily tasks, the observed slight excess risk of this usually fatal disease would amount to a significant number of deaths globally.

Commission VIII (Health, Safety and Environment) of the International Institute of Welding has sought to recommend actions which will be most effective in eliminating this apparent occupational risk. Given the number of studies that have been completed, it would be reasonable to expect there to be well-evidenced, consistent descriptions of the presence and level of risk and the factors to
which this had been attributed, so that the Commission’s advice could be focused on the particular hazard or hazards responsible. Regrettably, this is not the case as there have been wide variations in the information gathered and the conclusions that have been drawn, and so identification of the hazardous agents has yet to be achieved with absolute certainty.

In 1992 the Commission agreed that there was information about possible causes for much to be done on a general or empirical basis and published a Consensus Statement on the hazards they thought to be related to this excess risk and precautionary actions that could be taken. This statement has been published in Welding in the World [12] and was critically reviewed in 2003 [13] (see Box 1) and the summary conclusions of the review were published in Welding in the World in 2005 [14]. A detailed analysis of the evidence was made available on a website at www.icdachromium.com [15].

2 Review of the 2003 Statement

To provide a framework for the review, Commission VIII identified six prime suspects for possible causes of lung cancer in the work and social environment of welders. These were

1. “welding fume”,
2. asbestos dust,
3. tobacco smoke,
4. ionising radiation (widely used in non-destructive testing of welded fabrications),
5. a social class-linked health package and,
6. for completeness, “something quite different”, i.e. a previously unidentified carcinogenic agent.

Information used to draft the 2003 Statement and that garnered from the relatively few additions to the scientific literature since that time is now presented under these headings to allow conclusions to be drawn and summarized in a new Statement.

2.1 Welding fume

“Welding fume” is a generic term which encompasses the dynamic and often biologically active mixture of particulate matter emitted from a welding process used to join metal components. Fume is considered to be an aerosol, most of which is in the respirable range and can therefore reach the deepest parts of the lung.

The International Agency for Research on Cancer (IARC) conducted and published a review in which it made many broad generalizations about the link between cancer and occupational exposure to welding fume [16]. Much of the material it studied had been obtained during the European Cohort Study [6]. IARC classified welding fume in Group 2B “Possibly carcinogenic to humans” having concluded that there was inadequate evidence of welding fume carcinogenicity in animals and only limited evidence of carcinogenicity in humans. The latter conclusion reflected findings of excess mortality from lung cancer in shipyard, mild steel and stainless steel welders but the absence of an apparent linkage to duration of employment or cumulative exposure to total fumes, total chromium, hexavalent chromium or nickel compounds. This IARC classification suggested that the arc welding of many structural materials, including that of mild steel, was at the same level of concern as welding stainless steel [16, 17, 18].

In vitro and in vivo studies may indicate possible causal exposure-response relationships in humans. A soluble welding fume produced by SMAW/MMA of stainless steel has been shown to generate reactive oxygen species. Consequent DNA and cellular damage responses have been shown to be involved in various toxicological

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| “Arc welders as a broad occupational group are at higher risk of developing lung cancer than people in the general population. This excess risk of lung cancer is present in arc welders both of mild and stainless steel.

After much study and debate over recent years, Commission VIII (Health and Safety) of the International Institute of Welding (IIW), an amalgam of medical, scientific and welding engineering experts from many countries, has agreed to reconfirm its earlier statements that the cause of the excess risk might be found in the welding fume and environment, asbestos exposure and/or tobacco smoking. Additionally, it now considers that the balance of published scientific evidence supports the conclusion that, unless welding fumes contain an as-yet-unappreciated carcinogen, this risk is due, in the main, to occupational exposure to asbestos. Tobacco smoking also makes a significant contribution to the overall incidence of the disease.

To eliminate this excess risk of lung cancer, welders and their managers must ensure that:
- there is no further exposure of welders to asbestos,
- exposure to welding fumes is minimised, at least to national guidelines, and
- welders are encouraged and assisted not to smoke tobacco.

To improve the quality of research and hasten complete understanding of this excess risk, research should be coordinated globally. The world-wide welding community should cooperate in this research and contribute to funding it.” |

Box 1 – Lung cancer statement of Commission VIII in 2003 [12]