An Approach to Best Welding Practice : Part – XIII

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"AN APPROACH TO BEST WELDING PRACTICE, Part – XIII" is the Thirteenth Detail Part of **"AN APPROACH TO BEST WELDING PRACTICE"** which was written a s a General and Overall approach to the subject matter.

AN APPROACH TO BEST WELDING PRACTICE, Part – XIII is particularly focused on the Gases and Fumes generated especially for Arc Welding to obtain the best results in shop floor operation.

GASES AND FUMES

The hazards imposed by the Gases and Fumes generated by Welding Processes must be safe guarded for welders to work safely to obtain the best possible Accident Free shop floor operation resulting high productivity.

This is a Working Guideline for Supervisors and Operators working in any Engineering Fabrication Plant using welding as a manufacturing process to initiate awareness for observing Safety Rules and regulations.

In all the Welding operations Gases and Fumes are generated in large volume. Generally it is termed as "Welding Smoke." Welding "smoke" is a mixture of very fine particles (fumes) and gases. The sources of Gas and Smoke generated in Welding are from :

- Base material being welded,
- Filler material that is used,
- Coatings covering the electrode,
- Coatings and paints on the metal being welded,
- Shielding gases supplied from cylinders,
- Chemical reactions which result by the action of ultraviolet light from the arc and heat,
- Process and consumables used,
- Contaminants in the air, for example vapors from cleaners and degreasers.

Hazards from welding gases include:

- asphyxiation (lack of oxygen)
- fire or explosion
- toxicity

The effects of exposures to the Gases and Fumes generated by the welding processes to the welder and the coworkers are multi directional because the fumes may contain so many different substances that are known to be harmful to different parts of the body including the lungs, heart, kidneys and central nervous system.

Welders are at the highest risk for exposure to welding gases and fumes, but anyone who works near a welder can also inhale welding fumes. This is especially true indoors or in confined spaces. In those areas, fumes can't dissipate and hazardous levels can build up. Workers in an enclosure or confined space with a welder should assume that they are at the same level of risk as the welder. Welding fumes are made of many different metallic components. Each fume will be different depending on the material being welded, the electrode, and the type of welding. The airborne gases and fumes produced or present during welding can include:

- Nitrous oxide
- Carbon dioxide
- Carbon monoxide
- Shielding gases like argon or helium
- Ozone
- Metal fumes such as manganese and chromium

Many of the substances in welding smoke, such as chromium, nickel, arsenic, asbestos, manganese, silica, beryllium, cadmium, nitrogen oxides, phosgene, acrolein, fluorine compounds, carbon monoxide, cobalt, copper, lead, ozone, selenium and zinc, can be extremely toxic.

Welders who smoke may be at greater risk of health impairment than welders who do not smoke, although all welders are at risk.

GASES

All welding processes produce GASES. Gases are also formed from the decomposition of the shielding gases and fluxes and from interaction of ultraviolet light or high temperatures with atmospheric gases and the shielding gas. In general ozone, nitrogen oxides and carbon monoxide are the most common gases formed. Phosgene gas produced from chlorinated solvents decomposing in the welding arc can react with moisture in the lungs to form hydrochloric acid which is extremely toxic. To prevent this, use of solvent or storage near welding should be prohibited. At normal concentration in use, these gases are not visible to the eye and, in the case of carbon monoxide, not detectable by smell also. The concentration of gases from welding may potentially reach toxic levels in confined spaces or in areas with little or no ventilation for which care must be taken to ensure dilution with proper ventilation.

A regulation adopted by Oregon Occupational Safety and Health Administration (Oregon OSHA) titled: OAR 437 Division 2 Subdivision Q: Welding, Cutting, and Brazing can be followed on such situations.

FUMES

All welding processes produce fumes. Fumes are very fine solid particles produced by the condensation from the gaseous state. Welding fumes often contain metals, metal oxides and other compounds volatilized from either the base metal, electrode, or flux material. The quantity varies widely depending on the welding process. Welding fume particles are very tiny almost all are less than one micro milimeter in diameter, so that fumes will be present during welding whether a smoke plume is visible or not. Also, due to their small size, fumes are able to penetrate deep into the respiratory system to the alveoli.

In determining the degree of the hazard of fumes, the presence of certain toxic metals in fumes will be the more important factor than the total quantity of fumes. The parent metal to be welded containing manganese, chromium, nickel, cadmium, zinc, and copper may be present as small fractions of the total fume, but may impose as the major hazard of the job. The major sources of the fume come from the electrode metal, flux material and coatings on the base metal. Prolonged and repeated overexposure to these metals may cause respiratory and/or neurological problems. Welding fumes have also been classified as "possibly carcinogenic" by the International Agency for Research on Cancer (IARC Group 2B). Fume generation rates can be altered by voltage, arc length, current, electrode diameter, electrode polarity, shielding gas, base metal, fluxes, fillers, wire feed speed, humidity, and position of the weld. As the voltage, arc length, current, wire feed speed, and humidity increases, more fumes are generated. 30% more fumes are generated by welding DC positive compared to DC negative or AC.

MATERIALS USED IN WELDING PRODUCING GASES AND FUMES

Core and Filler Metals

Core and filler metals are usually made of alloy similar in chemical composition to the materials being welded. The most commonly used material is mild steel. Special steels may contain chromium, nickel, molybdenum, aluminium, cobalt, vanadium or tungsten. Stainless steel electrodes may contain up to 26 per cent chromium and 21 per cent nickel. Manganese as high as 14 per cent may also be present in certain types of steel electrodes, for example, high-manganese hardfacing electrodes. High-chromium hardfacing electrodes may contain up to 30 per cent chromium, present as chromium metal and chromium carbide.

Electrode Coatings (Fluxes)

MMAW electrodes are coated with a complex mixture of materials which, by melting and chemical decomposition, provide the following functions:

- a non-oxidising atmosphere (cellulose, carbonates);
- optimum weld and weld pool metallurgy (various metals or their oxides, calcium fluoride);
- slag formers (clays and oxides of titanium, silicon, manganese and magnesium); and
- additional charge carriers to the plasma (readily ionisable elements such as sodium,
- potassium and calcium from their compounds).

Electrode coatings may also include ferro-manganese, ferro-vanadium and ferro-silicon. In addition, the following agents are used in manufacturing MMAW electrodes:

- Moulding agents, such as aluminium and magnesium silicate;

- Extruding agents, such as starch, glucose and methyl cellulose;
- Binders, such as potassium and sodium silicate; and
- Fibrous materials, such as mica (asbestos is not used now).
- Coatings of low-hydrogen electrodes have a high fluoride content. Electrode coatings in certain instances may have substantial amounts of metallic constituents added which contribute to the weld deposit, for example, iron, manganese, chromium and nickel.

Coatings on materials to be welded

Materials being welded may be:

- metal coated with zinc, lead or tin, which may be achieved by electroplating, hot dipping
- or metal spraying;
- electroplated with cadmium, copper, chromium or nickel;
- primed, painted with coatings containing lead pigments, zinc chromate, zinc dust or
- copper (as in anti- fouling coatings); and
- coated with resins, such as epoxy, phenol formaldehyde, vinyl, polyurethane, bitumen, oil
- modified alkyd and sodium/potassium silicate.

Fume Formation in Welding Processes

Welding fume is an extremely complex by-product of certain kinds of welding processes. In MMAW, fume arises by vaporisation of the core metal and flux components of the electrode. The various constituents of the core metal and flux react at the high temperatures of the welding arc to produce fume particles consisting of a mixture of complex oxides, etc. The extent to which the products of reaction of core and flux components will appear in the welding fume depend on factors such as:

- welding conditions, which influence arc and gas temperatures;
- heats of formation, a thermochemical factor; and
- relative volatilities, that is, vaporisation behaviour, of the metal oxides, etc.
- In certain cases, materials other than the welding consumables may represent a significant source of atmospheric contamination. Some examples are:

- where the workpiece itself contains volatile constituents, such as beryllium in copper;
- where ferrous alloys have a surface coating (see the section on welding processes and
- materials), or
- where non- ferrous metals, such as copper and nickel or their alloys, are cut, heated or welded; and
- where painted metal surfaces are used, metal fumes may result from the paint pigment and organic pollutants from the paint binder.

Fume Production in Different Welding Processes

As a rough guide, it may be noted that among the arc processes, SAW has the lowest fume formation rate. Then, in ascending order, come

GTAW,

GMAW,

MMAW and

FCAW.

NOTE : In GMAW, carbon dioxide-shielding results in much higher fume formation rates than argon or helium gas-shielding. Oxygen or carbon dioxide additions to the inert shield gas stabilise the arc, but usually result in increased fume formation rates. However, small additions of carbon dioxide to argon or helium have been found to result in spray transfer at low arc voltages, accompanied by very low spatter rates and low fume formation rates.

Welding : Fumes

Grinding and abrasive blasting are known to produce large amounts of fume and dust. In SAW there may be a dust problem due to flux handling but, since there is no open arc, fume and gas problems are minimal. The arc-air gouging process represents environmental hazards of both noise and atmospheric contaminants showing not only high total fume levels but also high copper in the fume from the copper coating on the graphite electrode, and significant concentrations of nitrogen oxides, ozone and carbon monoxide.

The amount of fume given off during plasma welding or cutting is, in general, greater than that encountered in GMAW. Microwelding and specialist processes such as friction welding, electron beam, and laser welding generally produce very little fume.

Fume Formation Rates and Fume Composition

Both the fume formation rate and the chemical composition of the fume are affected by the welding parameters and the type of application. Listed below are the most important factors which have been shown to affect the rate of fume formation and the fume composition:

- voltage drop across the welding arc which is related to the arc length being maintained;
- welding mode, that is, AC, DC electrode positive (DCEP) or DC electrode negative (DCEN);
- arc current;
- angle between electrode and workpiece;
- position and type of weld, that is, fillet, bead-on-plate, etc.; and
- heat input, which is related directly to arc power (arc voltage x arc current) and inversely to welding speed.

Fume formation rates may vary critically with arc length, which in turn may be affected by the degree of skill of the welder. In general, fumes increase with increasing current, with increasing voltage and with longer arc lengths.

Fume formation rates may be expressed as:

- g/min;
- g/kg electrode; or
- g/kg weld deposit.

Note: Fume (g/min) = fume (g/kg electrode) x electrode melting rate (kg/hr) 60

Fume Particle Size

Welding fume particles are less than 1 μm, that is, 0.001 mm in diameter, when produced, but they appear to grow in size with time due to agglomeration, that is, particles sticking together. Particles in the size range 1-7 μm thus develop with time. The 1-7 μm diameter particles constitute the greatest health hazard because of their ability to penetrate deep into the lungs and because they are not readily cleared by the cilia lining the respiratory tract. The particles visible in the fume plume are usually the heavier, that is, larger, particles which will rapidly precipitate onto adjacent surfaces as 'dustfall'. Particles in the welder's breathing zone are usually 2 μm or less - these lighter, smaller, particles may remain in the air for some hours if they are not removed by ventilation.

Source and Health Effect of Welding Fumes

Table 1 : Source and Health Effect of Welding Fumes

Fume Type	Source	Health Effect
Aluminum	Aluminum component of some alloys, e.g., Inconels, copper, zinc, steel, magnesium, brass and filler materials.	Respiratory irritant.
Beryllium	Hardening agent found in copper, magnesium, aluminum alloys and electrical contacts.	"Metal Fume Fever." A carcinogen. Other chronic effects include damage to the respiratory tract.
Cadmium Oxides	Stainless steel containing cadmium or plated materials, zinc alloy.	Irritation of respiratory system, sore and dry throat, chest pain and breathing difficulty. Chronic effects include kidney damage and emphysema. Suspected carcinogen.
Chromium	Most stainless-steel and high-alloy materials, welding rods. Also used as plating material.	Increased risk of lung cancer. Some individuals may develop skin irritation. Some forms are carcinogens (hexavalent chromium).
Copper	Alloys such as Monel, brass, bronze. Also some welding rods.	Acute effects include irritation of the eyes, nose and throat, nausea and "Metal Fume Fever."

Fume Type	Source	Health Effect
Fluorides	Common electrode coating and flux material for both low- and high-alloy steels.	Acute effect is irritation of the eyes, nose and throat. Long-term exposures may result in bone and joint problems. Chronic effects also include excess fluid in the lungs.
Iron Oxides	The major contaminant in all iron or steel welding processes.	Siderosis – a benign form of lung disease caused by particles deposited in the lungs. Acute symptoms include irritation of the nose and lungs. Tends to clear up when exposure stops.
Lead	Solder, brass and bronze alloys, primer/coating on steels.	Chronic effects to nervous system, kidneys, digestive system and mental capacity. Can cause lead poisoning.
Manganese	Most welding processes, especially high-tensile steels.	"Metal Fume Fever." Chronic effects may include central nervous system problems.
Molybdenum	Steel alloys, iron, stainless steel, nickel alloys.	Acute effects are eye, nose and throat irritation, and shortness of breath.
Nickel	Stainless steel, Inconel, Monel, Hastelloy and other high-alloy materials, welding rods and plated steel.	Acute effect is irritation of the eyes, nose and throat. Increased cancer risk has been noted in occupations other than welding. Also associated with dermatitis and lung problems.
Vanadium	Some steel alloys, iron, stainless steel, nickel alloys.	Acute effect is irritation of the eyes, skin and respiratory tract. Chronic effects include bronchitis, retinitis, fluid in the lungs and pneumonia.
Zinc	Galvanized and painted metal.	Metal Fume Fever.

Table 2 : Source and Health Effect of Welding Gases

Gas Type	Source	Health Effect
Carbon Monoxide	Formed in the arc.	Absorbed readily into the bloodstream, causing headaches, dizziness or muscular weakness. High concentrations may result in unconsciousness and death.
Hydrogen Fluoride	Decomposition of rod coatings.	Irritating to the eyes and respiratory tract. Over-exposure can cause lung, kidney, bone and liver damage. Chronic exposure can result in chronic irritation of the nose, throat and bronchi.

Gas Type	Source	Health Effect
Nitrogen Oxides	Formed in the arc.	Eye, nose and throat irritation in low concentrations. Abnormal fluid in the lung and other serious effects at higher concentrations. Chronic effects include lung problems such as emphysema.
Oxygen Deficiency	Welding in confined spaces, and air displacement by shielding gas.	Dizziness, mental confusion, asphyxiation and death.
Ozone	Formed in the welding arc, especially during plasma-arc, MIG and TIG processes.	Acute effects include fluid in the lungs and hemorrhaging. Very low concentrations (e.g., one part per million) cause headaches and dryness of the eyes. Chronic effects include significant changes in lung function.

Table 3 : Source and Health Effect of Organic Vapours as a result of Welding

Gas Type	Source	Health Effect
Aldehydes (such as formaldehyde)	Metal coating with binders and pigments. Degreasing solvents	Irritant to eyes and respiratory tract.
Diisocyanates	Metal with polyurethane paint.	Eye, nose and throat irritation. High possibility of sensitization, producing asthmatic or other allergic symptoms, even at very low exposures.
Phosgene	Metal with residual degreasing solvents. (Phosgene is formed by reaction of the solvent and welding radiation.)	Severe irritant to eyes, nose and respiratory system. Symptoms may be delayed.
Phosphine	Metal coated with rust inhibitors. (Phosphine is formed by reaction of the rust inhibitor with welding radiation.)	Irritant to eyes and respiratory system, can damage kidneys and other organs.

There are health effects for both short-term and long-term exposure to these gases and fumes. Some of these are stated below:

Short-term exposure
- Eye, nose, and throat irritation
- Dizziness
- Nausea

Long-term exposure
- Occupational asthma
- Pneumonia
- Metal fume fever
- Reduced lung function
- Stomach ulcers
- Kidney damage
- Nervous system damage
- Prolonged manganese exposure can cause Parkinson's-like symptoms
- Cancer of the lungs, larynx and urinary tract

Short-Term (Acute) Health Effects

Metal Fume Fever

Exposure to metal fumes (such as zinc, magnesium, copper, and copper oxide) can cause metal fume fever. Symptoms of metal fume fever may occur 4 to 12 hours after exposure, and include chills, thirst, fever, muscle ache, chest soreness, coughing, wheezing, fatigue, nausea and a metallic taste in the mouth.

Irritation to Eyes, Nose, Chest, and Respiratory Tract

Welding smoke can also irritate the eyes, nose, chest, and respiratory tract, and cause coughing, wheezing, shortness of breath, bronchitis, pulmonary edema (fluid in the lungs) and pneumonitis (inflammation of the lungs).

Gastrointestinal Effects

Gastrointestinal effects, such as nausea, loss of appetite, vomiting, cramps, and slow digestion, have also been associated with welding.

Cadmium Fumes Effects

Some components of welding fume, for example cadmium, can be fatal in a short time.

Utraviolet Radiation Effect

Gases given off by the welding process can also be extremely dangerous. For example, ultraviolet radiation given off by welding reacts with oxygen and nitrogen in the air to form ozone and nitrogen oxides. These gases are deadly at high doses and can also cause irritation of the nose and throat and serious lung disease.

Ultraviolet rays given off by welding can react with chlorinated hydrocarbon solvents, such as 1, 1, 1-trichloroethane, trichloroethylene, methylene chloride, and perchloroethylene, to form phosgene gas. Even a very small amount of phosgene may be deadly, although early symptoms of exposure -- dizziness, chills, and cough -- usually take 5 or 6 hours to appear. Arc welding should never be performed within 200 feet of degreasing equipment or solvents.

Long-Term (Chronic) Health Effects

- Studies of welders, flame cutters, and burners have shown that welders have an increased risk of lung cancer, and, possibly cancer of the larynx (voice box) and urinary tract.
- These findings are not surprising in view of the large quantity of toxic substances in welding smoke, including cancer-causing agents such as cadmium, nickel, beryllium, chromium, and arsenic.
- Welders may also experience a variety of chronic respiratory (lung) problems, including bronchitis, asthma, pneumonia, emphysema, pneumoconiosis (refers to dust-related diseases), decreased lung capacity, silicosis (caused by silica exposure) and siderosis (a dust-related disease caused by iron oxide dust in the lungs).
- Other health problems that appear to be related to welding include: heart disease, skin diseases, hearing loss and chronic gastritis (inflammation of the stomach), gastroduodenitis (inflammation of the stomach and small intestine) and ulcers of the stomach and small intestine. Welders exposed to heavy metals such as chromium and nickel have also experienced kidney damage.
- Welding also poses reproductive risks to welders. A recent study found that welders, and especially welders who worked with stainless steel, had poorer sperm quality than men in other types of work. Several studies have shown an increase in either miscarriages or delayed conception among welders or their spouses. Possible causes include exposure to: (1) metals, such as aluminum, chromium, nickel, cadmium, iron, manganese, and copper, (2) gases, such as nitrous gases and ozone, (3) heat and (4) ionizing radiation (used to check the welding seams).
- Welders who perform welding or cutting on surfaces covered with asbestos insulation are at risk of asbestosis, lung cancer, mesothelioma and other asbestos-related diseases. Employees should be trained and provided with the proper equipment before welding near materials that contain asbestos.

NEVER weld on or near anything that's been cleaned with a chlorinated hydrocarbon like brake-cleaner. When combined with UV light, chlorinated hydrocarbons can create phosgene gas, which can cause serious injury or death. Ventilation will not prevent poisoning.

HAZARDS AND RISKS

In every work place there will be "hazards". When considering the hazards associated with any workplace, it is essential to understand the relationship between 'hazard', 'exposure' and 'risk'.

- 'Hazard' is the potential for an agent or process to cause injury or harm.
- 'Risk' is the likelihood that an agent will produce injury or disease under specified conditions.

- Health effects can only occur if a worker is actually exposed to the hazard.

The risk of injury or disease usually increases with the duration and frequency of exposure to the agent, and the intensity/ concentration and toxicity of the agent or process.

Toxicity refers to the capacity of an agent to produce disease or injury.

The evaluation of toxicity takes into account the route of exposure and the actual concentration of an agent in the body.

In cases of welders exposed to Gases and Fumes a prior study on Hazards, Exposure and Risks involved will be the determinant of the degree of Preventive measures to be taken especially for Ventilation, use of Respirators and work to "Safe Exposure Time."

Fume Formation Rates and Fume Composition

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Vilation

Ventilation refers to changes of room air as often as necessary to prevent welders and other workers from breathing high levels of airborne contaminants. Ventilation is a means of providing adequate breathing air, and it must be provided for all welding, cutting, brazing and related operations. Adequate ventilation depends on the following factors:

- Volume and configuration of the space where the welding operations occur
- Number and type of operations that are generating contaminants
- Natural air flow rate where operations are taking place
- Location of the welders' and other workers' breathing zones in relation to contaminants or sources.

Two types of ventilation can be used to reduce fume exposures; local exhaust and dilution ventilation. Local exhaust ventilation is the preferred method of ventilation, where the fumes are captured at the source and are removed from the workplace. Dilution ventilation provides large amounts of air into the workplace to dilute the contaminant. Dilution does not remove the contaminant. Fume hoods are not recommended as the fume is generally passed through the workers breathing zone.

Proper ventilation can be obtained either naturally or mechanically. Natural ventilation is considered sufficient for welding and brazing operations if the work area meets these requirements:

- Space of more than 10,000 square feet is provided per welder

- A ceiling height of more than 16 feet
- Welding is not done in a confined space
- Welding space does not contain partitions, balconies or structured barriers that obstruct cross ventilation

If the specific welding operation does not fall within the natural ventilation guidelines, mechanical ventilation will be required. Mechanical ventilation options generally fall into two basic categories.

* The first is a low-vacuum system, which takes large volumes of air at low velocities. This system consists of hoods positioned at a distance from the work area. The hood and housing may have to be repositioned by the worker to get maximum benefit from this means of ventilation. Hoods generally remove the fumes and contaminated air through ducting and exhaust the contaminants to the outdoors. Hoods should be placed as near as practical to the work and should provide effective air flow with a velocity of 100 linear feet (30 meters) per minute at its most remote distance from the point of welding. Processes where low-vacuum systems work best are arc air gouging and arc cutting.
* Another category of mechanical ventilation is a high-vacuum system. This system consists of a close-range extractor aimed at capturing and extracting fumes as near to the work as possible. Fume extractors often have an immediate area of welding. By removing a small volume of air at a high velocity, the potentially hazardous materials are effectively removed before reaching the welder's breathing zone. These systems often are equipped with a fan that pulls the contaminants into a filtration system, with a high-efficiency particulate absolute (HEPA) filter or combination of HEPA filter and prefilter and then recirculates the clean air back into the work area. Advantages of high-vacuum systems are greater flexibility for job adaptation, more efficient means of fume removal and greater visibility to the welder due to reduced clouds of fumes and vapors being created.

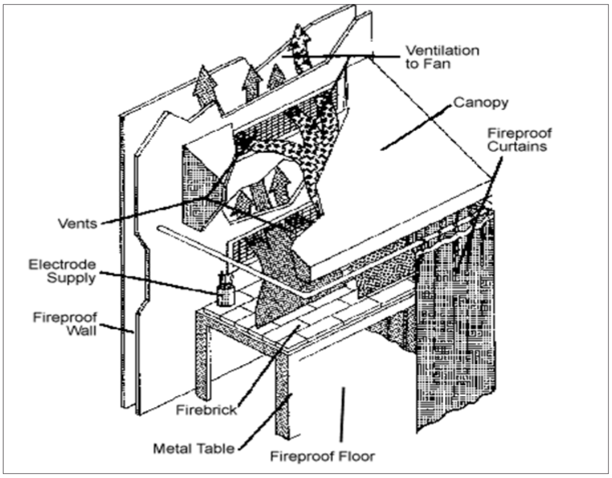
Fumes and gases from welding and cutting cannot be easily classified. The quantity of fumes and gases is relative to the metal being worked and the processes and consumable material being used, such as coatings (like paint, galvanizing and platings), along with contaminants in the atmosphere, such as halogenated hydrocarbon vapors from cleaning and degreasing activities. Air sampling to verify the concentration levels of toxic fumes and gases is necessary. Respiratory protection is required along with mechanical ventilation in the cutting and/or welding of certain metals and compounds.

The welder should be located in an area with adequate ventilation. In general, when welding is being done on metals not considered hazardous, a ventilation system that will move a minimum of 2000 cubic feet per minute (CFM) of air per welder is satisfactory. However, many materials are considered very hazardous and should be welded only in adequately ventilated areas to prevent the accumulation of toxic materials or to eliminate possible oxygen deficiency not only to the operator but to others in the immediate vicinity. Such ventilation should be supplied by an exhaust system located as close to the work as possible. When welding or cutting metals with hazardous coatings such as galvanized metal the operator should use a supplied-air type respirator or a respirator specially designed to filter the specific metal fume. Materials included in the very hazardous category are welding rod fluxes, coverings, or other materials containing fluorine compounds, zinc, lead, beryllium, admium, and mercury. Some cleaning and degreasing compounds as well as the metals they were cleaned with are also hazardous. Always follow the manufacturers precautions before welding or cutting in the presence of these materials.

FUMES and GASES can be hazardous to your health. Keep your head out of the fumes. Do not breathe fumes and gases caused by the arc. Use enough ventilation.

Provide enough ventilation wherever welding and cutting are performed. Proper ventilation will protect the operator from the evolving noxious fumes and gases. The degree and type of ventilation will depend on the specific welding and cutting operation. It varies with the size of work area; on the number of operators; and on the types of materials to be welded or cut. Potentially hazardous materials may exist in certain fluxes, coatings, and filler metals. They can be released into the atmosphere during welding and cutting. In some cases, general natural-draft ventilation may be adequate. Other operations may require forced-draft ventilation, local exhaust hoods or booths, or personal filter respirators or air-supplied masks. Welding inside tanks, boilers, or other confined spaces require special procedures, such as the use of an air supplied hood or hose mask.

TYPICAL METHODS FOR VENTILATION AND RESPIRATORY PROTECTION.



Respiratory Protection

Respiratory protection equipment falls under the BS EN 149:2001 and BS EN 140:1999 classifications. Protective equipment provides basic breathing defence, such as filtering half masks to protect against dust and dangerous particles. Respiratory protection devices are often referred to by their differing levels of protection, for instance: Type 1, 2 or 3 or P1, P2 or P3.

Respiratory protection is needed when ventilation is not sufficient to remove welding fumes or when there is risk of oxygen deficiency. Select and use respirators in compliance with applicable regulations. Seek expert advice, conduct a hazard assessment, and initiate an appropriate respiratory protection program.

The process of selecting appropriate respiratory protection is also outlined in CSA standard Z94.4 and ANSI (American National Standards Institute) standard Z88.2 "Respiratory Protection".

Breathe Freely. Fumes and smoke emitted during welding pose a health hazard. When welding in confined spaces, toxic fumes may accumulate, or shielding gasses may replace breathable air. Use an exhaust hood to remove fumes from the area and ensure enough clean breathing air is available. Some materials specifically require respirators when welding, so consult the manufacturers welding electrode's data sheet, your welding engineer or industrial safety specialist for proper procedures.

Respirator masks filter weld fumes and particles from the air and increase operator comfort and safety. Miller welding respirators are designed to fit under the welding helmet or integrate airflow into the helmet system for maximum comfort and portability. Choose from disposable respirators, half mask respirators or disposable respirators.

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HALF MASK RESPIRATOR

The large valve help to reduce the user's breathing resistance and prevents condensations from the breath from building up inside the mask. This mask is oil proof and protects against particles. There are 4 different positions that the mask can be adjusted to for customizing fit even further.