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Structural Funds 2007-2013

ECOSOLDER

Romania – Republic of Serbia
IPA Cross-border Cooperation Programme

Project: Promoting new ecologic filler alloys for soldering, based on the non-ferrous ore of the Romanian-Serbian cross-border area

Project Reference: MIS ETC Code 1409

CLOSING CONFERENCE 21st of November 2014

"Achievements of the ECOSOLDER Project. Recommended applications for ecological filler alloys"

Horia Florin Dașcău; Victor Verbitchi - NATIONAL RESEARCH AND DEVELOPMENT INSTITUTE FOR WELDING AND MATERIAL TESTING - ISIM TIMIŞOARA, ROMANIA

„Occupational health, work safety and environment protection by soldering and brazing"

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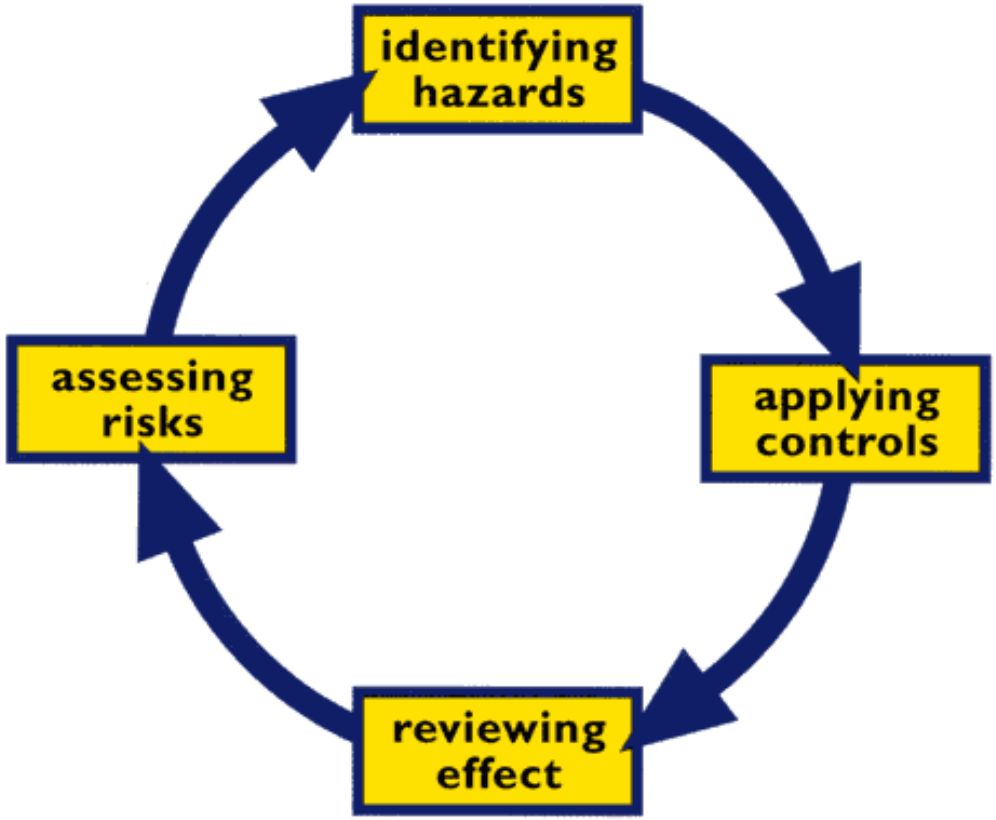
What is a hazard?

- A **hazard** is a situation that poses a level of threat to life, health, property or environment



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Safe Environment

- A safe environment is an environment free of accidents.
  - *Created by managing the risks associated with hazards.*
- Concerns
  - *How do you define acceptable level of risk?*
  - *Is the acceptable level of risk the same?*
  - *Is a persons perception of risk accurate?*

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Acceptable Level of Risk

- How do you determining acceptable level of risk.
  - H&S guidelines
  - State regulations
  - Accepted (common) practices
  - Possible Law suits
  - Company policies
  - Experience.

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Acceptable Level of Risk

- Many factors influence an individuals acceptable level of risk. E.g.:
  - Age
  - Physical ability
  - Education
  - Experience
  - Etc.

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Managing HSE Risk

- How do you manage the risk associated with hazards?
  - + Elimination
  - + Education
  - + Follow existing best management practices
  - + Research and development of new best practices.

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Classification of hazardous substances according to their occurrence and effects

Occurrence				Effects	
Gaseous	Particles		Lung stressing	Toxic	Carcinogenic
	Inhalable	Respirable			
Nitrogen oxides				X	
Ozone				X	
Carbon Monoxide				X	
Phosgene				X	
Hydrogen cyanide				X	
Formaldehyde					X
	Aluminium oxide		X		
	Iron oxide		X		
	Magnesium oxide		X		
	Barium compounds			X	
	Lead oxide			X	
	Fluorides			X	
	Copper oxide			X	
	Manganese oxide			X	
	Molybdenum oxide			X	
	Vanadium pentoxide			X	
	Zinc oxide			X	
	Chromium VI compounds				X
	Nickel oxide				X
	Cobalt oxide				X
	Cadmium oxide				X
	Beryllium oxide				X

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Hazardous substances in soldering and brazing

Solder or brazing alloy		Flux (flux basis	Hazardous substances (list of hazardous substances possibly generated
Field of Application	**Type of solder or brazing alloy**		
Soldering (temp. < 450° C)			
Heavy metals	A) antimony-containing, low-antimony, and antimony-free lead-tin- and tin-lead-soft solders B) Tin-lead soft solders with copper, silver or phosphorus addition C) Special soft solders some with increased contents of cadmium and silver	1) Zinc- and other metal chlorides, and/- or ammonium chloride (in aqueous solution or organic preparation) 2) Organic acids, e. g. citric, oleic, stearic, benzoic, acid 3) Amines, diamines and urea 4) Organic halogen compounds 5) Natural resins (colophony) or modified natural resins with and without addition of organic and/or activators containing halogen	Hydrogen bromide Lead oxide Hydrogen choride Formaldehyde Hydrazine Colophony Inorganic tin compounds Organic tin compounds
Light metals	D) soft solders based on: a. Tin-zinc b. Zinc-Cadmium c. Zinc-aluminium	6) Chlorides and fluorides 7) Zinc- and/or tin chloride 8) Pure organic compounds, e. g. amines 9) Organic halogen compounds	
Brazing (temp. ≥ 450° C)			
Heavy metals	A) copper-base brazing alloys B) Silver-containing brazing alloys with less than 20% Ag C) Silver-containing brazing alloys with at least 20% Ag D) Aluminium-base brazing alloys E) Nickel-base brazing alloys	1) boron compounds with additions of single and complex fluorides, phosphates and silicates 2) fluxes free from boron, mainly of chlorides and fluorides	Boron oxide Boron trifluoride Cadmium oxide Fluorides Copper oxide Pfosphorus pentoxide Silver oxide Zinc oxide
Light metals		3) Hygroscopic chlorides and fluorides and non hygroscopic fluorides	

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Short and long time effects

Two Types of Health Affects:

- Acute: Short-Term effects on body. Symptoms develop immediately or shortly after exposure. Effect is usually of short duration.
- Chronic: Long-Term effects on body resulting from repeated low level exposures with symptoms developing slowly over a period of time.
- Examples: Drunkenness is the acute effect from overindulgence in alcohol. Liver & brain damage are chronic affects.
- Smoking: Acute = Wheezing, Shortness of Breath

  Chronic = Lung Cancer, Emphysema

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Exposure Limits

Developed to protect you from adverse health effects, both acute and chronic. Two main types:

- PEL: Permissible Exposure Limits determined by the National Health Regulation Organization for which the majority of persons can be exposed up to 8 hours a day, 40 hours/week, without experiencing adverse health effects.
- TLV: Threshold Limit Values established by the American Conference of Governmental Industrial Hygienists (ACGIH). Recommended Exposure Limits. PELs take precedent over TLVs.
  - Both types usually expressed as maximum concentration or mass per unit volume (ug/m^3).
  - TLVs and PELs have STELs - 15 minute values (Short Term Exposure Limits)
  - Use other recommendations in absence of PEL/TLV

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Cadmium exposure from joining processses

- Fumes are poisonous and can kill.
- Overexposure may cause death. Some fume and dust from different joining processes may contain cadmium or cadmium oxide compounds. The specific form and concentration of cadmium present in the fume and dust are dependant on the composition of the filler metal, base metals, metal coatings, atmosphere, flux, and the joining process.
- ACUTE (SHORT TERM) EFFECTS OF OVEREXPOSURE TO CADMIUM
- Similar, but much more severe, to the effects produced by fume and dust from other metals.
- Inhalation exposure to high concentrations of fume may cause symptoms such as nausea, headaches, dizziness, nervousness, lung complicatons, and death.
- CHRONIC (LONG TERM) EFFECTS OF OVEREXPOSURE TO CADMIUM
- Long term exposure to cadmium oxide fume and dust has caused severe chronic effects, kidney failure, and may, with longer exposure and/or higher concentrations lead to severe respiratory disease and death.
- Inhalation of cadmium by smokers may accelerate the development of respiratory diseases.
- There is evidence that long term exposure to cadmium may cause lung cancer.

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Possible effects of specific hazardous substances in welding and allied processes

Hazardous substances	Effects
2.1. Lung-stressing	
Aluminium oxide	Dust deposits in the lungs, aluminosis
Iron oxide	Dust deposits in the lungs, siderosis
Potassium oxide	Dust deposits in the lungs
Sodium oxide	
Titanium dioxide	
2.2. Toxic	
Barium compounds, soluble	Toxic * nausea * possible potassium deficiency
Iron oxide	Toxic * nausea * indigestion * nervous and renal lesions
Fluorides	Toxic * irritation of mucous membrane * bone damage
Copper oxide	Toxic * metal fume fever (copper fume fever)
Manganese oxide	Toxic * irritation of mucous membrane * nerve damage
Vanadium pentoxide	Toxic * irritation of eyes and respiratory tract * lung damage
Zinc oxide	Toxic * metal fume fever (zinc fume fever)
2.3. Carcinogenic	
Baryllium oxide	Carcinogenic * metal fume fever * chronic pneumonia
Cadmium oxide	Carcinogenic * irritation of mucous membrane * emphysema
Chromium (VI) compounds	Carcinogenic (respiratory system) * irritation of mucous membrane
Cobalt oxide	Carcinogenic * impairment of respiratory system
Nickel oxides	Carcinogenic (respiratory system)

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Toxic Effects

- **Corrosive**: Liquid or solid that causes visible destruction or irreversible alterations in human tissue. Usually thought of as a Physical Hazard.
- *Examples: Acids, Flux, Caustics, Hydroxides, Ammonia*
- **Irritant**: Inflammatory response of eye, skin or respiratory system
- Al, Ba, Be, Cd, Cr, Cu, Mg, Mn, Ni, Zn compounds O_3, NOx
- **Sensitizer**: Can become sensitized after just one exposure if you are susceptible. Skin sensitization is most common form.
- *Examples: Isocyanates used in Plastics and Resins*
- **Neurotoxin**: Capable of causing neurological damage to the central nervous system, usually only after long-term over exposures.
- *Examples: welding gases*

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Metal Fumes

- Iron
  - Usually the majority of the metal in welding on ferrous alloys
  - Prolonged exposure can cause siderosis
- Copper Fume/Dust
  - Found in non-ferrous alloys such as brass, bronze, Monel
  - May also be present in electrodes in especially arc gouging
- Zinc Oxide
  - Sources
    - Alloys containing zinc
    - Surface coatings such as galvanized or galvaneal which contain zinc
  - Health effects are related to the freshly formed fume so grinding does not create a problem
- Manganese
  - Found in many consumables used for steel welding
  - Focus of a great deal of attention right now
    - Alleged to be associated with a Parkinson's-like disorder
    - Data for this is in welding applications is not very strong
- Metals that are rarely an issue at the current exposure limits
  - Aluminum
  - Molybdenum
  - Nickel
  - Tin
  - Titanium

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Metal Fumes- Lead

- Sources
  - Surface coatings
    - Galvaneal/galvanized metals
    - Paints or other surface coatings
    - Terne plate
  - Alloys
    - Brass/bronze leaded alloys
    - Solders
  - Lead burning for tanks and vessels
- Especially a problem when working with "old stuff"
- Problem in welding, cutting and grinding
- It doesn't take much to cause a problem!
- Health Effects
  - Anemia
  - Gastrointestinal
  - Reproductive
  - Neurological

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FLUXES FOR ARC WELDING AND BRAZING: SAFE HANDLING AND USE

INTRODUCTION

Fluxes are used in various arc welding processes, such as Submerged–Arc Welding (SAW) and Electroslag Welding (ESW). Fluxes are also used in most brazing applications. Fluxes are available in various forms such as granules, powder, paste, or liquid. There are hazards when dealing with fluxes.

HAZARD OVERVIEW

The possible hazards associated with handling and using fluxes include the following:

- Inhaling toxic or corrosive flux dust
- Breathing welding fumes and gases
- Getting flux on the skin and in the eyes
- Swallowing toxic or corrosive flux or dust
- Breathing and swallowing flux particles during recovering and grinding.

The makeup and amount of these hazardous materials varies depending on the flux and the process. Individuals with pre-existing physical conditions, such as allergies or lung diseases, may react to levels below allowable exposure limits and have symptoms that normal, healthy adults do not experience.

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Protection Against Overexposure

OVERALL EVALUATION OF POTENTIAL HAZARDS

Fluxes are safe and useful when handled and used properly and when recommended safety procedures are followed. The major hazards to avoid are overexposure by breathing, swallowing, or inhaling the dust or fumes and gases, especially those containing respirable crystalline silica and fluorides. If the application recovers used flux, as is common in Submerged–Arc Welding (SAW), and then reuses or grinds the flux for reuse, overexposure to dust happens quickly if precautions are not taken. Some submerged arc welding fluxes may contain very small quantities of naturally occurring radioactive material (NORM). Flux materials containing sufficiently low concentrations of NORM are not subject to federal radiation control regulations. These fluxes do not present an environmental or health hazard. Contact the flux manufacturer for further information.

HOW TO PROTECT AGAINST OVEREXPOSURE

- Wear proper hand, face, and body protection when handling or when otherwise exposed to fluxes and their dust, fumes and gases––this means protective (leather, rubber) gloves, goggles, and full clothing with long sleeves and long pants (not shorts).
- Avoid breathing the dust or fumes and gases. Keep your head out of the fumes, dust, and gases. Use enough ventilation, exhaust at the arc, or both, to keep fumes, dust, and gases from your breathing zone and the general area. When necessary, wear an approved mask or respirator.
- Do not consume food or beverages in areas where flux dust or fumes or gases may be generated or may be present.
- During brazing, do not overheat the fluxes. Follow the manufacturer’s recommended procedures. Overheating results in the generation of, and potential exposure to, excessive fumes and gases.

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Nitrogen by soldering

- The development of lead- free soldering has been rapid over the last few years, with improvements in soldering materials, processes, and inspection techniques for the production of printed circuit boards.
- Solder paste reflow profile uses nitrogen reflow atmosphere; air was also applied.
- Fluxless solder perform spread tests on Sn3.5Ag solder with a melting point of 221 ° C, with use of nitrogen atmosphere has results during lead-free soldering.

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Thermal Hazards

1) Air temperature,
2) Air velocity,
3) Moisture contained in the air, and
4) Radiant heat.

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Procedures for electric shock

- Turn off the electric power.

- Use nonconducting material, such as dry wood, to free the victim from contact with live parts or wires.

- If the victim is not breathing, call for emergency services.

- Where an automatic electronic defibrillator (AED) is available, use according to instructions.

- Treat an electrical burn as a thermal burn by applying clean, cold (iced) compresses. Prevent contamination, and cover with a clean, dry dressing.

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Fire and Explosion Prevention

Flying sparks, spatter and molten metal are the main cause of fires and explosions in welding and cutting. They can travel up to

10 meters) from the work area. They can travel greater distances when falling, or with some processes, they can pass through or become lodged in cracks, clothing, pipe holes, and other openings in floors, walls, or partitions. Heat can be transferred through walls and surfaces.

Typical combustible materials inside buildings include: wood, paper, rags, clothing, plastics, chemicals, flammable liquids and gases, dusts, and trash. Parts of buildings such as floors, partitions, and

roofs may also be combustible.

Typical combustible materials outside buildings include dry leaves, grass, brush, and trash.

Welding and cutting can cause explosions in spaces containing flammable gases, vapors, liquids, or dusts.

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Rules to Extinguish the Fires

Fires can be very dangerous and you should always be certain that you will not endanger yourself or others when attempting to put out a fire. For this reason, when a fire is discovered:

- **SOUND THE ALARM. If there is no alarm in the building, warn the other occupants by knocking on doors and shouting as you leave.**
- **LEAVE THE BUILDING. Do not go back into the building until the fire department says it is safe to do so.**
- **CALL THE FIRE DEPARTMENT. Dial 112. Give as much information as possible to the emergency dispatcher.**

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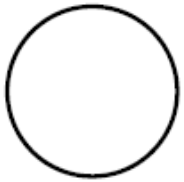
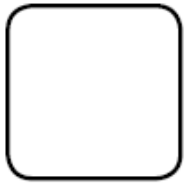
Sign Categories

Category	Sub-category	Colour
 1. Regulatory A circle indicates that an order is in force	**1.1 Prohibition** forbids an action	Red and black on v
	1.2 Mandatory requires an action	White on black
 2. Warning A triangle indicates caution or danger	**2.1 Caution** indicates a potential hazard	Black on yellow
	2.2 Danger indicates a definite hazard	White on red
 3. Information A square indicates information	**3.1 Emergency** indicates first aid, health, fire protection, fire fighting and emergency equipment	White on green
	3.2 General Information indicates permission or public information	White on blue

	Symbol sign		Symbol sign with text Text sign
1. Regulatory 1.1 Prohibition			
1.2 Mandatory			
2. Warning 2.1 Caution			
2.2 Danger			
3. Information 3.1 Emergency			
3.2 General Information			

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Compressed gases – acetylene HANDLING & USE

Cylinders containing flammable gases such as hydrogen or acetylene must not be stored in close proximity to open flames, areas where electrical sparks are generated, or where other sources of ignition may be present.

Cylinders containing acetylene shall never be stored on their side.

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Compressed gases – oxygen HANDLING & USE

- Oxygen cylinders, full or empty, shall not be stored in the same vicinity as flammable gases.
- The proper storage for oxygen cylinders requires that a minimum of 7meters be maintained between flammable gas cylinders and oxygen cylinders or the storage areas be separated, at a minimum, by a fire wall five feet high with a fire rating of 0.5 hours.
- Greasy and oily materials shall never be stored around oxygen; nor should oil or grease be applied to fittings.

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Eye and Face Protection Selection Chart

Source	Assessment of Hazard	Protection
IMPACT - chipping, grinding, machining, drilling, chiseling, riveting, sanding	Flying fragments, objects, large chips, particles, sand, dirt, etc.	**Spectacles** with side protection, goggles, face shields…for severe exposure, use face shields over primary eye protection
HEAT - furnace operations, pouring, casting, hot dipping, and welding	Hot sparks, splash from molten metals, high temperature exposure	**Goggles or safety spectacles** with special-purpose lenses and side shields. Many heat hazard exposures require the use of a face shield *in addition* to safety spectacles or goggles.
CHEMICALS – acid and chemicals handling degreasing, plating, and working with blood.	Splash, irritating mists	**Goggles** - primary protectors intended to shield the eyes against liquid or chemical splash, irritating mists, vapors, and fumes. **Face Shields** - secondary protectors intended to protect the entire face against exposure to chemical hazards.
DUST Woodworking, buffing, and general dusty conditions	Harmful Dust	**Goggles**-primary protectors intended to protect the eyes against a variety of airborne particles and dust
OPTICAL RADIATION welding, torch-cutting, brazing, soldering, and laser work	Radiant energy, glare, and intense light	When selecting filter lenses, begin with a shade too dark to see the welding zone. Then try lighter shades until one allows a sufficient view of the welding zone without going below the minimum protective shade.

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Toxic and Hazardous Atmospheres

Toxic atmosphere may be caused by:

- Product stored in a confined space may cause toxic atmosphere:
  - Gases released when cleaning.
  - Materials absorbed into walls of confined space.
  - Decomposition of materials in the confined space.
- Work performed in a confined space:
  - Welding, cutting, brazing, soldering.
  - Painting, scraping, sanding, degreasing.
  - Sealing, bonding, melting.
- Areas adjacent to a confined space.
- Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL) is hazardous.
- **Airborne combustible dust** at a concentration that meets or exceeds its LFL; NOTE: This concentration may be approximated as a condition in which the dust **obscures vision at a distance of 1.5 m or less.**

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- ”***Confined or enclosed space***" means any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere.

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Typical Confined Spaces

- Boiler, Degreaser, Furnace
- Pipeline, Pit, Pumping Station
- Reaction or Process Vessel, Mills
- Septic Tank, Sewage Digestor
- Silo, Storage Tank, Barges
- Sewer, Utility Vault, Manhole
- Trenches, Shafts, Caissons

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Hot Work Permit

- If an operation is to be performed that is capable of providing a source of ignition (for example, riveting, welding, cutting, burning or heating), a “HOT WORK PERMIT” must be issued.

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Welding, cutting, and heating in confined spaces

- Either general mechanical or local exhaust ventilation meeting the requirements of paragraph (a) of this section shall be provided ***whenever welding, cutting, or heating is performed in a confined space.***

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Confined space testing

- ***FOUR-GAS DETECTOR***
  - Oxygen content
  - Flammability / explosion potential
  - Carbon monoxide
  - Hydrogen sulfide
- ***CRITICAL ISSUES***
  - Training
  - Procedures
  - Calibration

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Ventilation by welding, soldering and brazing

Ventilation is used for three general purposes:

- Remove air contaminants from a worker's breathing zone,
- Prevent the accumulation of flammable or combustible gases or vapours; and,
- Prevent oxygen rich or oxygen deficient atmospheres

For processes such as welding, brazing, soldering, and torch cutting, the primary purpose of ventilation is to remove air contaminants from the worker's breathing zone.

Different ventilation strategies may be needed in each case to remove air contaminants from the welder's breathing zone. General guidelines have been published in ANSI Z49.1 Standard Safety in Welding and Cutting.

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Types of ventilation

Ventilation strategies fall into three general categories:

- Natural Dilution Ventilation
- Mechanical Dilution Ventilation
- Local Exhaust Ventilation
- Respirators
- Ambient Capture Air Cleaning for Welding Safety

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Local Exhaust Ventilation

- Local exhaust ventilation (LEV) is the preferred method of removing welding fumes and gases. It exhausts or removes the toxic gases, fumes, dusts and vapours before they can mix with the room air.
- A specifically designed welding helmet is recommended to reduce a welder's exposure to welding fumes by diverting the fume away from the welder's breathing zone.
- The most important types of local exhaust ventilation are presented next .

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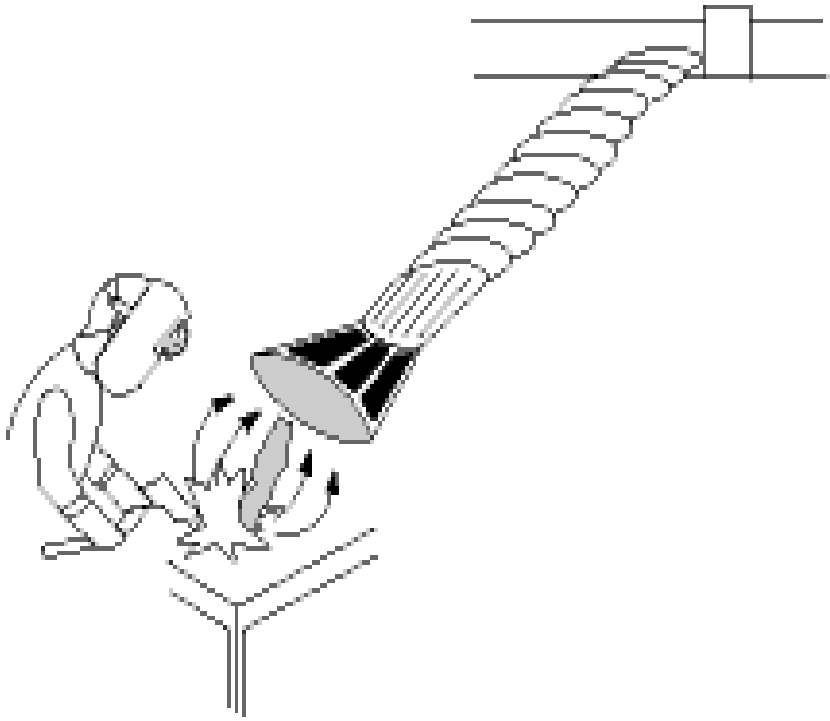
Moveable Hood

- Flexible ducting allows the capture hood to be moved where required. Provide an air velocity of at least (0.5 m/s) across the welding arc. Place the hood as close as practical to the work.
- The optimal location for the hood is about 1 duct diameter from the arc.



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Managing Chemical Hazards

- Store chemicals in original containers.
- Store chemicals in appropriate cabinet.
- Never mix unknown chemicals.
- Eliminate old and/or unused chemicals
- Wear appropriate PPE.

PPE that must be worn at all times?

PPE which may be required, depending on the hazards?

1. Chemical Goggles
2. Safety glasses
3. Face shield
4. Tinted lens
5. Respirator
6. Gloves
7. Leather apparel
8. Steel toed shoes
9. Hard hat
10. SCBA
11. HAZMAT apparel
12. Long sleeves
13. Other

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THE CONCENTRATION LINE
HEALTH SAFETY

0% **AL** **PEL** **IDLH** **LEL** **UEL** 100%

PURE CLEAN FRESH AIR

PURE DIRTY AIR

- **AL** - ACTION LEVEL
- **PEL** - PERMISSIABLE EXPOSURE LIMIT (OSHA)
- **REL** - RECOMMENDED EXPOSURE LIMIT
- **TLV** - THRESHOLD LIMIT VALUE
- **LEL** - LOWER EXPLOSIVE LIMIT

THANK YOU !!!