

BRAZING AND SOLDERING

IO2 – EDUCATIONAL MATERIALS



Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure with or without the use of filler material.

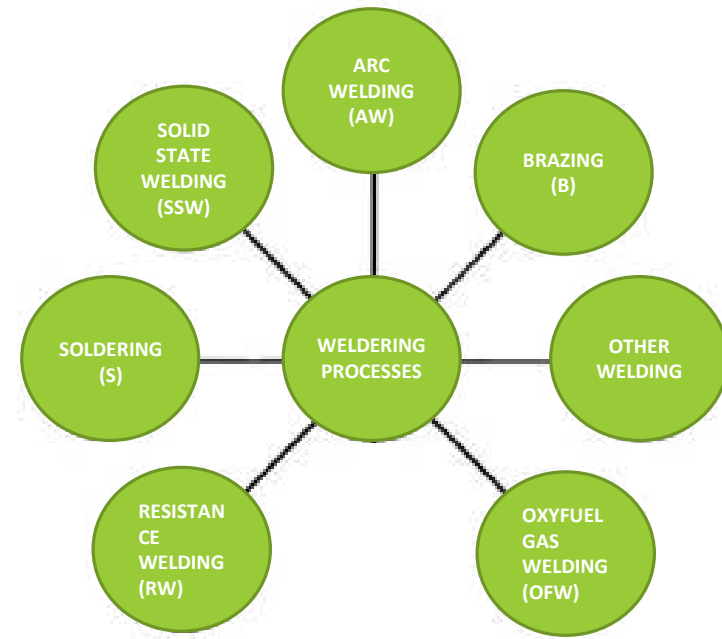
The American Welding Society

AWS distinguishes the welding processes according to:

- Mode of energy transfer
- Influence of capillary attraction in effecting distribution of filler metal in the joint

Groups of welding processes:

- Arc welding
- Brazing
- Oxyfuel Gas Welding
- Resistance Welding
- Solid State Welding
- Soldering
- Other



Brazing

- Brazing and soldering are principally classified according to process temperature.
- Brazing doesn't melt the base metals.
- The brazing process joins the base metals by creating a metallurgical bond between the filler metal and the surfaces of the two metals being joined
- Applications:
 - Heating Ventilation
 - Air conditioning
 - Gas transport
 - Fastening of pipe fitting, tanks, carbide tips on tools, radiators, heat exchangers, electrical parts, axles



Figure 1 – Brazing. Source:
<https://www.nttinc.com/blog/brazing-copper-tips-and-tricks-for-the-novice/>

Brazing vs Soldering

- **Brazing** - The American Welding Society (AWS), defines brazing as a group of joining processes that produce coalescence of materials by heating them to the brazing temperature and by using a filler metal (solder) having a liquidus above 840°F (450°C), and below the solidus of the base metals.
- **Soldering** - Soldering has the same definition as brazing except for the fact that the filler metal used has a liquidus below 840°F (450°C) and below the solidus of the base metals.

Soldering Process

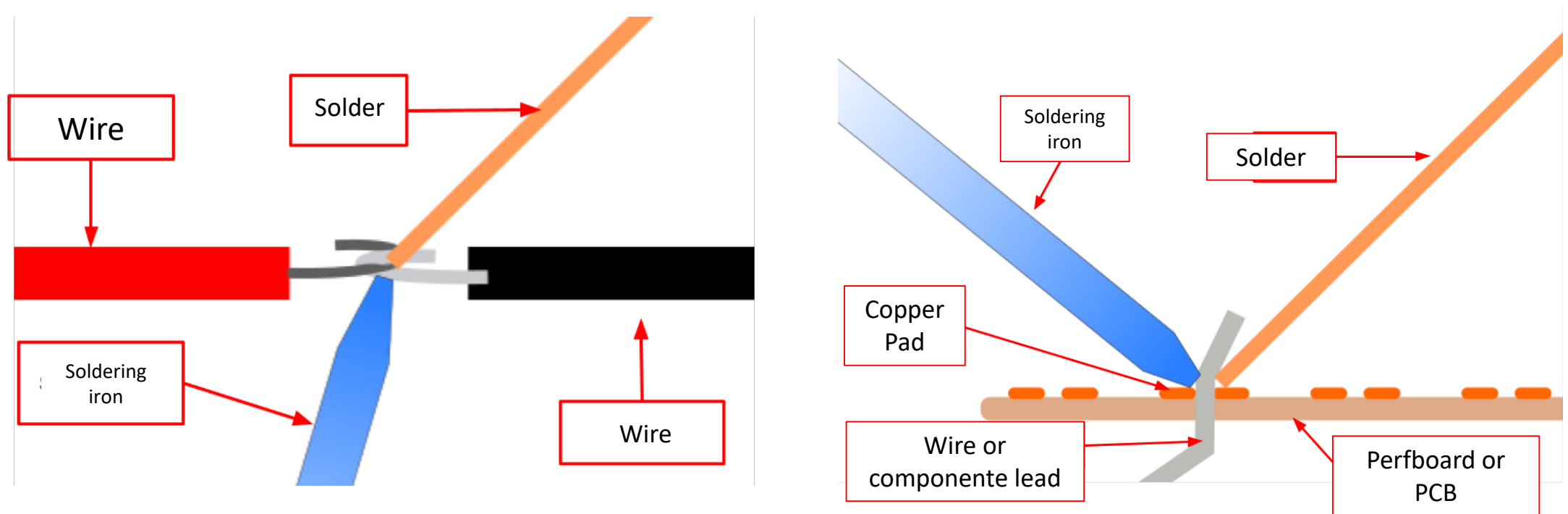


Figure 2 –Soldering process. Source: <http://volunteer.makerepo.com/soldering.html>

Brazing : fluxes and filler materials

Commonly Used Brazing Filler Materials for Copper and Copper Alloys*

AWS Classification	UNS No.	Composition, wt. %								Brazing Temperature Range	
		Ag	Cu	Zn	Cd	Sn	Fe	Ni	P	°F	°C
BAg-1	P07450	44-46	14-16	14-18	23-25	—	—	—	—	1,145-1,400	618-760
BAg-1a	P07500	49-51	14.5-16.5	14.5-18.5	17-19	—	—	—	—	1,175-1,400	635-760
BAg-2	P07350	34-36	25-27	19-23	17-19	—	—	—	—	1,285-1,550	702-843
BAg-3	P07501	49-51	14.5-16.5	13.5-17.5	15-17	—	—	2.5-3.5	—	1,270-1,500	688-816
BAg-5	P07453	44-46	29-31	23-27	—	—	—	—	—	1,370-1,550	743-843
BAg-6	P07503	49-51	33-35	14-18	—	—	—	—	—	1,425-1,600	774-871
BAg-7	P07563	55-57	21-23	15-19	—	4.5-5.5	—	—	—	1,205-1,400	652-760
BAg-8	P07720	71-73	Bal.	—	—	—	—	—	—	1,435-1,650	780-899
BAg-18	P07600	59-61	Bal.	—	—	9.5-10.5	—	—	—	1,325-1,550	718-843
BCu-1	C14180	—	99.9 min	—	—	—	—	—	0.75	2,000-2,100	1,093-1,149
RBCuZn-A	C47000	—	57-61	Bal.	—	0.25-1.0	—	—	—	1,670-1,750	910-955
RBCuZn-C	C68100	—	56-60	Bal.	—	0.8-1.1	0.25-1.2	—	—	1,670-1,750	910-955
RBCuZn-D	C77300	—	46-50	Bal.	—	—	9-11	—	0.25	1,720-1,800	938-982
BCuP-2	C55181	—	Bal.	—	—	—	—	—	7.0-7.5	1,350-1,550	732-843
BCuP-3	C55281	4.8-5.2	Bal.	—	—	—	—	—	5.8-6.2	1,325-1,500	718-816
BCuP-4	C55283	5.8-6.2	Bal.	—	—	—	—	—	7.0-7.5	1,275-1,450	681-788
BCuP-5	C55284	14.5-15.5	Bal.	—	—	—	—	—	4.8-5.2	1,300-1,500	704-816

*Refer to ANS/ANS A5.8, Specification for Filler Metals for Brazing and Braze Welding.

Table 1 – Commonly used Brazing filler materials for copper and copper alloys.



Figure 3- Brazing Flux. Source: <http://topslurrypumps.com/slurry-pumps/index.htm?affid=engineerroom>

Risks

- Burns;
- Working with gas cylinders;
- Fumes from fluxes and solder;
- Skin contact with fluxes;
- Wrong waste disposal;

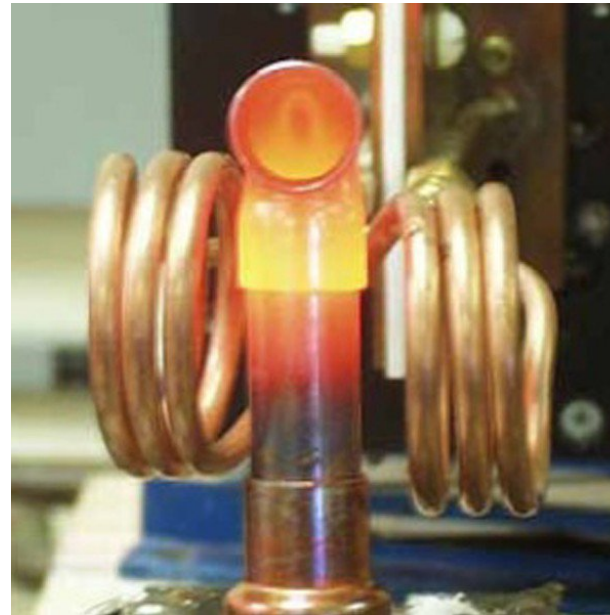


Figure 4 – Burn risk. Source: https://cdn2.hubspot.net/hubfs/508263/Ambrell_PDFs/411-0134-10.pdf?t=1503341887420

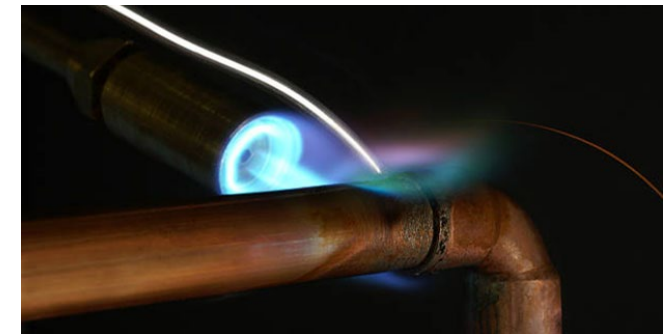


Figure 5 – Burn risk. Source: <http://ukcountry.info/sweating-copper-tubing/sweating-copper-tubing-identification-diy-soldering-copper-tubing-sweat-soldering-copper-tubing/>

Recognizing the risks

- Burns:
 - Open flame → flame brazing
 - Electricity → Induction brazing
- Handling gas cylinders



Figure 6 – Handling gas cylinder. Source: www.hanessupply.com/

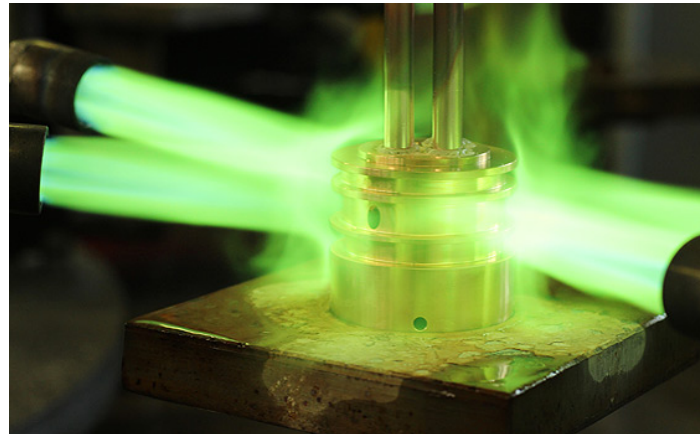


Figure 7 – Flame Brazing. Source: <https://www.lwz.de/index.php/en/technical-services/brazing-technology/flame-brazing>



Figure 8 – Compressed gas sign. Source: <https://www.manutan.ch/fr/fab/panneau-clp-gaz-comprim%C3%A9-adh%C3%A9sif-mig2606116-1008> -

Recognizing the risks

Fumes:

- Generated by the fluxes
- Some fluxes contain:
 - Boric acid
 - Cadmium
 - Boraxvery poisonous
- Look on container for:
 - Boric acid H_3BO_3
 - Cadmium Cd
 - Borax $\text{Na}_2\text{B}_4\text{O}_7$



Figure 9 - Hazard symbol. Source:
https://en.wikipedia.org/wiki/Hazard_symbol

Recognizing the risks

Skin contact with fluxes:

- Can cause irritation of the skin;
- Contact with open wounds is very dangerous;

Avoid contact with eyes

➔ fumes or pure product;

Digesting flux:

- Very toxic ➔ wash hands thoroughly after use.



Figure 10 - Warning symbol. Source:
http://ec.europa.eu/taxation_customs/dds2/SAMANCTA/IT/Safety/SymbolsOfHazard_IT.htm

Prevention and PPE's

Fumes:

- Use fluxes without these harmful components → First step to consider → Ask supervisor!
- Adequate ventilation
 - → Protects yourself and others
- Respiratory devices, masks;



Figure 11 -Welding fumes ventilation symbol.

Source:

www.mysafetysign.com/welding-signs



Figure 12 – Fumes.
Source:
<http://hasshe.com/black-background-photography-smoke-5b7ab8492756dd6f6c7fe4dd/>

Brazing and Soldering

The emission of fumes is related to the process and the material used



Figure 13 – Fumes. Source:
<http://www.diversitech.ca/en/applications/soldering>

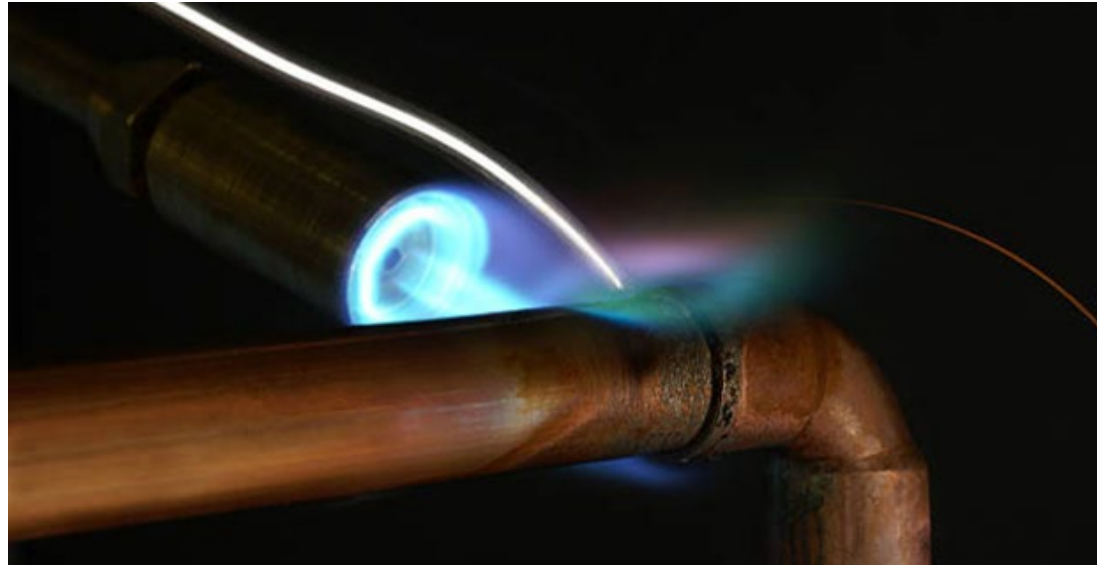


Figure 14- Fumes. Source: www.diversitech.ca/en/safety/unbreathables/lead-free-solder-



Safety Data Sheet
acc. to OSHA GHS (29 CFR 1910.1200)

Printing date: 02/08/2017

Revision: 02/08/2017

1 Identification

- Product identifier
- Trade name: Stay Silv® White Paste Brazing Flux
- Other means of identification:
 - SDS Number: 0134
- Recommended use and restriction on use
 - Recommended use: Metal Brazing
 - Restrictions on use: No relevant information available.
- Manufacturer/Importer/Supplier/Distributor information
 - Manufacturer/Supplier:
 - Harris Products Group
 - 4501 Quality Place
 - Mason, Ohio 45040 US
 - 513-754-2000
- Safety Data Sheet Questions: salesinfo@jwharris.com
- Arc Welding Safety Information: www.lincolnelectric.com/safety
- 24-Hour Emergency Response Telephone Numbers:
 - USA/Canada/Mexico: +1 (888) 809-1762
 - Americas/Europe: +1 (216) 383-8962
 - Asia Pacific: +1 (216) 383-8968
 - Middle East/Africa: +1 (216) 383-8969
- 3E Company Access Code: 333988

2 Hazard(s) identification

Classified according to the criteria of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), OSHA Hazard Communication Standard (29 CFR 1910.1200) and the Canadian Controlled Products Regulations.

Classification of the substance or mixture



GHS08 Health hazard

Repr. 2 H361 Suspected of damaging fertility or the unborn child. Route of exposure: Oral.



GHS07

Acute Tox. 4 H302 Harmful if swallowed.
Acute Tox. 4 H312 Harmful in contact with skin.
Acute Tox. 4 H332 Harmful if inhaled.

(Cont'd. on page 2)

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Trade name: Stay Silv® White Paste Brazing Flux

(Cont'd. of page 1)

- Label elements
- GHS label elements
 - The product is classified and labeled according to the Globally Harmonized System (GHS).
- Hazard pictograms:



GHS07 GHS08

- Signal word: Warning
- Hazard-determining components of labeling:
 - potassium difluorodihydroxyborate(1-)
 - potassium fluoride
- Hazard statements:
 - H302 Harmful if swallowed.
 - H312 Harmful in contact with skin.
 - H332 Harmful if inhaled.
 - H361 Suspected of damaging fertility or the unborn child. Route of exposure: Oral.
- Precautionary statements:
 - P201 Obtain special instructions before use.
 - P202 Do not handle until all safety precautions have been read and understood.
 - P261 Avoid breathing dust.
 - P264 Wash thoroughly after handling.
 - P280 Wear protective gloves/protective clothing/eye protection.
 - P270 Do not eat, drink or smoke when using this product.
 - P271 Use only outdoors or in a well-ventilated area.
 - P302+P352 IF ON SKIN: Wash with plenty of soap and water.
 - P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
 - P301+P312 IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
 - P330 Rinse mouth.
 - P308+P313 IF exposed or concerned: Get medical advice/attention.
 - P362+P364 Take off contaminated clothing and wash it before reuse.
 - P405 Store locked up.
 - P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
- Additional information:
- Other hazards which do not result in GHS classification:
 - Heat rays (infrared radiation) from flame or hot metal can injure eyes. Overexposure to brazing fumes and gases can be hazardous. Read and understand the manufacturer's instructions, Safety Data Sheet and the precautionary labels before using this product.

3 Composition/information on ingredients

Chemical characterization: Mixtures

Components:

85392-66-1	potassium difluorodihydroxyborate(1-)	>50%
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Figure 15 – Safety Data Sheet. Source: <https://www.scribd.com/document/307544587/Stay-Silv-Black-Brazing-Flux>

Prevention

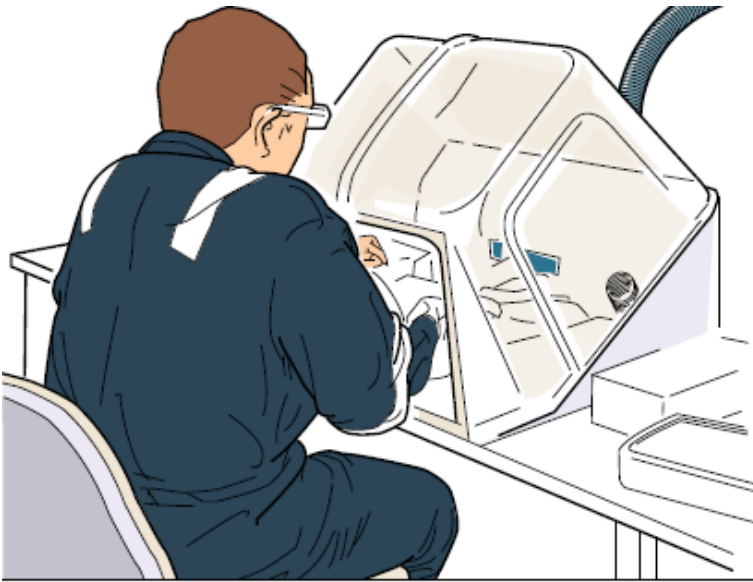


Figure 16 - Solder fumes cabinet. Source: IIS



Figure 17 -Fume extractors. Source:
<http://fumeextractor.in/soldering-fume-extractor.html>

Prevention and PPE's

Skin contact:

- Wear latex gloves;
- Cover your body;
- Wash hands after use ➔ digestion;



Figure 18 – Washing Hands Sign.
Source:
<http://www.keysigns.co.uk/signs-c2/safety-signs-c3/mandatory-signs-c58/wash-your-hands-signs-c78>



Figure 19 – Protective gloves sign.
Source: <https://www.sapros.ch/it-Segnali-di-obbligo.htm?pn=100&cn=2221&pgid=23956&prodgrptype=detail>

Prevention and PPE's

Contact with eyes:

- Wear safety goggles to prevent contact;
- If contact with eyes occurs → rinse thoroughly with water (eye shower);
- In the event of persistent complaints, consult a doctor;



Figure 20 – Eye shower. Source: <http://www.cgk-online.be/fr/douche-de-securite-oculaires-144.htm>



Figure 21- Protective Glasses Sign.
Source: <https://www.mepi.be/shop/en-polypropylene-rigide-690/pictogramme-en-polypropylene-rigide-de-400-mm-signalant-l-039-obligation-de-porter-des-lunettes-de-protection-2604.html>

Waste disposal

Environmental:

- Rinse properly after use;
- Catch contaminated water with drip tray;
- Dispose of the water according to local regulations;



Figure 22 – Environmental Danger Sign. Source:
https://www.skssigns.co.uk/New-Danger-to-Environment-sign-p/ds_000034.htm



Figure 23 -Galvanised Drip Tray.
Source:
<https://www.seton.co.uk/galvanised-drip-trays-1.html>

Waste disposal

- Do not dispose fluxes in the sewers;
- Do not discharge products into ground water/surface water;
- Must not be disposed of in regular household thrash;
- Check the Safety Data Sheet at point 13;



Figure 24 –Recycling symbol.Source:
<https://imagepng.org/simbolo-de-reciclagem/simbolo-de-reciclagem/>



Co-funded by the
Erasmus+ Programme
of the European Union

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- **Product identifier**
- **Trade name:** Stay Silv® Black Paste Brazing Flux
- **Other means of identification:**
- **SDS Number:** 0135

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
Contact waste processors for recycling information.
The user of this material has the responsibility to dispose of unused material, residues and containers in compliance with all relevant local, state and federal laws and regulations regarding treatment, storage and disposal for hazardous and nonhazardous wastes.
- **Uncleaned packagings**
- **Recommendation:** Disposal must be made according to official regulations.

Figure 25 – Safety data sheet. Source: <https://www.scribd.com/document/307544587/Stay-Silv-Black-Brazing-Flux>

Handling and storage

- Store products in a locked and well ventilated closet;
- Inside the closet, drip trays should be present;
- Only qualified personnel is allowed to access and use these products;



Figure 26 -Authorized Personnel Sign. Source: <https://www.conney.com/style/authorized-personnel-signs>

European, National Regulations and Recommendations

- ANSI Z49.1:2012- Safety in Welding, Cutting, and Allied Processes
- ISO 857-2:2005 Welding and allied processes -- Vocabulary -- Part 2: Soldering and brazing processes and related terms
- ISO 9455-11:2017 Soft soldering fluxes -- Test methods -- Part 11: Solubility of flux residues

- BRH:2007 BRAZING HANDBOOK, 5th EDITION
- SHB:1999 SOLDERING HANDBOOK, SOFTBOUND, 3RD ED