

Brazing Materials & Applications

Material Safety Data Sheet 1100/105

Appendix D - Brazing Fluxes

Issue No 3/March 2000

Brazing Fluxes

1. Identification of Substance This Product Safety Data Sheet gives specific information on brazing fluxes.

| Product Name | Form | Working Range | pH* | Composition Group |
|-----------------------------------|---------------|---------------|--------------|-------------------|
| Easy-flo Flux Powder | White Powder | 550 - 800°C | 8 | 1 * |
| Easy-flo - Stainless Steel Grade | White Powder | 550 - 775°C | 8 | 1 |
| Easy-flo - Stainless Steel Grade | White Paste | 550 - 775°C | 8 | 1 |
| Tenacity No.2 | White Powder | 550 - 800°C | 8 | 1 |
| Tenacity No.6 | Brown Powder | 550 - 800°C | 8 | 1 |
| Tenacity No.14 | White Powder | 550 - 750°C | 8 | 1 |
| Easy-flo Flux Paste | White Paste | 575 - 825°C | 8 | 1 |
| Easy-flo Dipping Grade | White Paste | 560 - 750°C | 9 | 1 |
| Silver-flo Flux Paste | White Paste | 550 - 775°C | 9 | 1 |
| Mattiflux 100 Paste | White Paste | 560 - 800°C | 9.5 | 1 |
| Mattiflux 3A Paste | Brown Paste | 600 - 875°C | 8 | 1 |
| Tenacity No.4A | White Powder | 600 - 850°C | 8 | 2 |
| Tenacity No.5 | White Powder | 600 - 900°C | 8 | 2 |
| Tenacity No.5A | Brown Powder | 600 - 900°C | 8 | 2 |
| Tenacity No. 125 Powder | White Powder | 750 - 1200°C | 7 | 3 |
| Tenacity No. 125 Paste | White Paste | 750 - 1200°C | 7 | 3 |
| Easy-flo - Aluminium Bronze Grade | White Paste | 550 - 800°C | 5 | 4 |
| Tenacity 12 | White Powder | 800 - 1300°C | Not measured | 5 |
| Flux Coating on Rods | White Compact | 550 - 850°C | 8 | 6 |

* pH of aqueous suspension

2. Composition

- Group 1** Mixture of potassium bifluoride (CAS No. 7789-29-9), potassium tetraborate (CAS No. 1332-77-0) potassium fluoroborate (CAS No. 14075-53-7) with boric acid (CAS No. 10043-35-3) and boric anhydride (CAS No. 1303-86-2). Elemental boron (CAS No. 7440-42-8) in Tenacity 6 and Mattiflux 3A.
- Group 2** Mixture of potassium bifluoride (CAS No. 7789-29-9), potassium tetraborate (CAS No. 1332-77-0) and potassium fluorosilicate (CAS No. 16871-90-2) with boric acid (CAS No. 10043-35-3) and boric anhydride (CAS No. 1303-86-2). Elemental boron (CAS No. 7440-42-8) in Tenacity 5A only.
- Group 3** Mixture of potassium tetraborate (CAS No. 1332-77-0) and potassium fluorosilicate (CAS No. 16871-90-2) with borax (CAS No. 1303-96-4) and boric acid (CAS No. 10043-35-3).
- Group 4** Mixture of potassium tetraborate (CAS No. 1332-77-0) and potassium fluoroborate (CAS No. 14075-53-7) with zinc chloride (CAS No. 7646-85-7), sodium chloride (CAS No. 7647-14-5) and lithium chloride (CAS No. 7447-41-8).
- Group 5** Mixture of borax (CAS No. 1303-96-4), boric acid (CAS No. 10043-35-3) and potassium tetraborate (CAS No. 1332-77-0).



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Group 6 Mixture of potassium tetraborate (CAS No. 1332-77-0), potassium fluoroborate (CAS No. 14075-53-7), potassium bifluoride (CAS No. 7789-29-9) and potassium fluorosilicate (CAS No. 16871-80-2) bonded with an organic polymer.

3. Hazard Identification

The main hazard with this product occurs in its use. On heating the flux will fume slightly, and with overheating the fume will increase. The fumes produced include hydrogen fluoride and boron trifluoride which can cause irritation of the nasal passages, eyes and throat.

The flux is harmful by ingestion and is irritating to the eyes. Contact with skin may cause moderate irritation.

4. First Aid Measures

Severe long term exposure to fume may result in fluorosis. In acute cases there is a danger of pulmonary oedema although this occurrence could also result from inhalation of brazing metal fume or torch gases. Inhalation of fumes will be irritating to the nose and throat and will cause smarting of the eyes.

Tests carried out on fluxes indicate they are moderately irritating to the skin and if the skin is broken immediate irritation will occur on contact. The use of barrier creams may prevent skin irritation.

Inhalation Remove from exposure and allow to rest in fresh air. In acute cases apply artificial respiration and if necessary, summon medical aid.

Ingestion Rinse mouth with water and give patient water or milk mixed with calcium carbonate (chalk) to drink. Do not induce vomiting. Summon medical aid.

Eyes Irrigate with water or isotonic saline for up to 20 minutes. Seek medical attention if there is any hint of eye damage.

Skin Remove any contaminated clothing and wash skin with soap and water. Seek medical attention if sores develop. Launder clothing before re-use.

5. Fire Fighting Measures

Non flammable. Use full protection with breathing apparatus if involved in a fire as harmful fumes may be evolved. Use any extinguishing medium suitable for surrounding fire.

6. Accidental Release Measures

Powder Carefully sweep up and collect in suitable container for re-use or disposal.

Paste Either collect in suitable container for re-use or disposal. For large spills, cover with sand or other inert absorbent and collect in suitable container for disposal. Wash area with water.

Avoid contact with skin or eyes and do not inhale dust.

7. Handling and Storage

Handling Use only under conditions of good local ventilation or efficient extraction systems and do not inhale fumes evolved during use. Avoid contact with skin and eyes. Do not eat, drink, smoke or apply cosmetics whilst using this material. Keep away from food, drink and animal feeding stuffs and out of reach of children. Observe good industrial hygiene practices.

Storage Store in a cool, dry place. Keep container closed when not in use. Do not freeze paste.

8. Exposure Controls and Personal Protection

UK Occupational Exposure Standards are:

| Fume | Long Term 8-hour TWA* Value | Short Term 15 minutes Value |
|--------------------------|--------------------------------|--------------------------------|
| Hydrogen Fluoride (as F) | - | 2.5mg/m ³ |
| Fluoride (as Fluorine) | 2.5mg/m ³ | - |
| Boron Trifluoride | - | 3mg/m ³ |

* Time Weighted Average

Avoid exposure to fume with good ventilation or local extraction. If a risk of inhalation exists, personal respiratory protection should be worn. Safety glasses should be worn as well as impervious gloves to prevent skin contact. Wash hands after using this material. The use of protective clothing is recommended.



Brazing Fluxes

9. Physical and Chemical Properties

| | |
|-----------------------|---|
| Appearance | White or brown powder or paste. See page 1 |
| Odour | No detectable odour. |
| pH | See page 1. |
| Boiling/melting point | Becomes fluid on heating; working range - See page 1. |
| Flash point | Not applicable. |
| Flammability | Not flammable |
| oxidising properties | Not oxidising. |
| Solubility | Water-low solubility, no specific data. |

10. Stability and Reactivity

Containers of powder left open once the seals are broken may absorb moisture and become lumpy. Pastes are water based and, whilst stable, will lose water by evaporation if left open. Avoid contact with acids and strong oxidising agents.

No other adverse reactions are known.

11. Toxicological Data

Toxicological data for these preparations: LD50(oral - rat) > 200mg/kg.

Classified as moderately irritating, according to Draize skin test.

12. Ecological Information

Likely to be harmful to all species of animal life. As far as is known no other threat is posed to the environment.

13. Disposal Consideration

Disposal according to local and national regulations. Registered waste contractors should be aware of the composition and data in Section 2 of this document.

14. Transport Information

Not classified for land, sea or air transport. No UN No's have been issued for fluxes.

15. Regulatory Information

| | |
|-------------------------|--|
| Material Classification | Harmful |
| Risk Phrases | 20/22 Harmful by inhalation and if swallowed. |
| | 36/38 Irritating to eyes and skin. |
| Safety Phrases | 2 Keep out of reach of children. |
| | 13 Keep away from food, drink and animal feed stuffs. |
| | 20/21 When using do not eat, drink or smoke. |
| | 22/23 Do not breathe dust or fumes. |
| | 26 In case of eye contact, rinse immediately with water and seek medical advice. |
| | 45 In case of feeling unwell seek medical attention. |

16. Other Information

For further information, see Johnson Matthey Data Sheet 1100:105

"Health and Safety in Brazing."

Guidance Note EH54

"Assessment of Exposure to fume from welding and allied processes" HSE 1990.

Guidance Note EH55

"The control of exposure to fume from welding, brazing and similar processes" HSE 1990.

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Health and Safety in Brazing

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Brazing is firmly established throughout the world as a reliable, simple and safe method of joining metal components. However as brazing operations entail the raising of components to elevated temperatures and the use of alloys and fluxes that contain volatile constituents, a regard must be paid to safety precautions at the brazing work bench.

Many of the recommendations in this document are common sense, others are not so obvious. It is important that management, safety officers and individual brazing operators make themselves fully conversant with all of these safety precautions and so minimise the chance of accidents occurring.

General Precautions

The most versatile brazing alloys are those based on the silver-copper-cadmium-zinc or silver-copper-zinc systems. They are all distinguished by their low melting points and good flow properties. They should never be overheated. Overheating is bad brazing practice and is likely to result in poor joints and increased evolution of fume. Metal and metal oxide fumes are irritating and can be harmful to health. Cadmium oxide fumes are particularly poisonous.

Operator well-being and safety will result from following the precautions given in this document and basic rules of safe brazing practice.

Potential health and safety problems in brazing may arise in the following areas:-

- 1 Metal and metal oxide fumes from the brazing alloys
- 2 Fumes from heating the flux
- 3 Fumes from brazing torches
- 4 Equipment used to effect the brazed joint

Recommended safety precautions and working practices on each of these are given below.

Section 1: Metal and Metal Oxide Fumes

1.1 General

All brazing operations raise the temperature of the filler metal above its melting point hence it is unavoidable that metal fume (as the oxide of the elements present) will be evolved.

The Health and Safety Executive in their Guidance Note EH40 list Occupational Exposure Standards (OESs) for metals commonly used in brazing alloys and these are given in specific product safety data sheets.

1.2 Specific Hazards Cadmium Oxide

Cadmium Oxide fume will always be evolved to some extent during brazing with alloys from the silver-copper-cadmium-zinc range. The Control of Substances Hazardous to Health (COSHH) Regulations list the exposure limits for Cadmium Oxide as a MAXIMUM EXPOSURE LEVEL (MEL) which must never be exceeded. The level present in the workplace must always be as low as practicable. The use of local extraction is virtually obligatory when brazing with cadmium containing alloys.

Short exposures to high levels of cadmium oxide fume can lead to pulmonary oedema and may be fatal. Prolonged or repeated over exposure to cadmium oxide fume is reported as causing renal damage. There is a symptomless latent period and any person thought to have been over exposed to cadmium oxide fume should be kept under observation for 48 hours.

Cadmium Oxide fume is reported as carcinogenic and may cause cancer by inhalation.

The likelihood of any problems occurring under normal brazing conditions is very limited and are normally the result of extremely poor brazing practice. These conditions would include severe overheating of the molten alloy using an intense heat source such as oxy-acetylene, brazing in an enclosed or ill ventilated area where fume build up is possible; or brazing without flux cover.



If cadmium containing alloys are felt likely to cause a health hazard then consideration should be given to the use of a cadmium free alloy from the Johnson Matthey Silver-flo range. These alloys may still contain cadmium as an impurity, but at a very low controlled limit of 0.025% maximum. This level allows brazing to be carried out under normal conditions of ventilation without the need for local exhaust ventilation as far as cadmium oxide fume is concerned. There could, of course, be other factors which would make local exhaust ventilation necessary.

If brazing is to be carried out where ventilation is poor, such as an enclosed pipe joint, or any similar situation, then brazing of any kind, or welding, must be carried out with the operator using breathing equipment, in conformance to factory regulations for working in confined spaces.

Copper Oxide & Zinc Oxide

Copper and zinc oxide fumes under normal conditions are unlikely to be a problem but, if excessive, are irritating and can cause metal fume fever. Symptoms of metal fume fever are similar to those of influenza and often appear after a latent period of up to 10 hours; they will normally disappear after 24 hours with rest. Zinc oxide can also be irritating to the nose, mouth and throat.

Diphosphorus Pentoxide

On overheating of phosphorus containing alloys corrosive diphosphorus pentoxide fumes may be evolved which are irritating to mucous membranes, the respiratory system, eyes and skin. Contact between the fume and perspiration may produce a mildly acidic reaction causing irritation of the eyes, skin and mucous membrane.

1.3 Atmospheric Sampling

Workshop personnel who may be exposed to excessive fumes during brazing operations should undergo tests of their working zone using personal air sampling equipment to ensure that MELS and OESs are not exceeded. Alternatively portable detection devices may be used to monitor the atmosphere during brazing operations. There are an increasing number of companies specialising in environmental monitoring who can undertake the necessary testing. Where local exhaust ventilation is installed regular checks on air flows and capture velocities should be made as required under HSE regulations.

Section 2: Fluxes

2.1 Skin Contact

The Johnson Matthey Range of brazing fluxes is based on fluorides, fluoroborates, borates, fluorosilicates and chlorides of potassium with additions of boric acid and borax.

On prolonged contact, these fluxes are moderately irritating to skin. Extra care should be taken if the skin is broken as immediate irritation will occur. If the irritation becomes a problem, operators should use barrier creams. Any cuts or abrasions, however slight, should be covered with an adhesive dressing. The use of flux paste eliminates the contact which could occur when mixing a flux powder with water before use. The use of impervious gloves e.g. rubber or latex is recommended to prevent skin contact.

Tests have shown the fluxes are irritant to the eyes. If flux does come into contact with the eyes they should be irrigated immediately with water or isotonic saline for up to 20 minutes. Medical attention should be sought if there is any suspicion of eye damage.

2.2 Oral Ingestion

Fluxes are harmful if ingested. They should be kept out of the reach of children and away from food, drink and animal feeding stuffs. It is advisable not to smoke when using these materials. Before meals, hands must be washed and fingernails cleaned. In the event of flux being swallowed, a doctor should be called and, meanwhile, the patient should drink plenty of water or milk with calcium carbonate (chalk) mixed in. Do not induce vomiting.

If powder fluxes are used, they should be mixed in a special flux tray. Flux should never be put in a container such as a cup, a mug or a bottle which might be used for drinking or other purposes. Empty flux containers must not be used for the storage of foodstuffs e.g. sugar, coffee, powdered milk etc.

2.3 Flux Fumes

On heating, flux will fume slightly. With overheating, the fume will increase. Fumes generated include Hydrogen Fluoride, Fluorine and Boron Trifluoride. Without adequate ventilation, or as the result of bad brazing practice, fume can cause irritation of nasal passages and eyes.

The workpiece should not be overheated and operators should avoid standing directly over the work. Any annoyance from fumes can be minimised by using workshops with high roofs, good local ventilation and efficient extraction systems.

2.4 Inhalation

In acute cases, remove to fresh air, apply artificial respiration and oxygen and summon medical aid. Continue observation for 48 hours. (Note: Poisoning by inhalation may also result from brazing metal fume or torch gases).



Section 3: Fumes from Brazing Torches

Torch fumes will be burnt gases, primarily oxides of carbon and nitrogen which are unlikely to cause problems in well ventilated conditions.

Section 4: Brazing Equipment

Although brazing is a reliable, simple and safe method of joining metal components, there are a number of basic precautions to follow when brazing.

- Brazing stations should be made from non flammable materials and suitable refractory brick.
- Hot brazed components must only be handled with pliers or tongs unless gloves are worn.

4.1 Hand & Fixed Torch Brazing

A torch should always be pointed away from the operator or other people when being lit. Fixed torches should be lit from the side or from below. Do not reach over one unlit torch to light another. It is usual for all the torches in a system to light simultaneously, and very severe burns to the forearm can result.

4.2 Induction Brazing

Never touch the work coil while the machine is working. Although work coils are often water cooled, when machines have been recently switched off the coils retain enough heat to cause a minor burn if they are touched.

Hands should never be inserted into a work coil if a ring, a watch, a metal bracelet or any other metal object is worn. The object will heat up rapidly and cause an extremely severe burn.

4.3 Furnace Brazing

Controlled atmosphere furnaces usually have a curtain of burning gases at the inlet and outlet doors. Since these flames are often colourless and virtually invisible, a piece of iron or steel gauze should be hung in the flame path, this will glow brightly when a flame is present.

Care should be taken when components are removed from a furnace or from a conveyor belt or container, since they may still be hot.

4.4 Resistance Heating

The hot electrodes should never be touched.

The electrical apparatus and the equipment which regulates the flow of a controlled atmosphere gas (if one is used) should be set and adjusted only by competent personnel.

4.5 Salt Bath Brazing

The parts must be completely dry before they are immersed in the bath. Any water on them is converted immediately into steam, causing a minor explosion in the bath and throwing out droplets of molten salt. The salt sticks to virtually anything it touches and can cause very severe skin burns.

The components should be lowered very slowly into the bath to avoid splashing the molten salt. Salt residues should be scrubbed off the hands before meals and at the end of the day. The controls that govern the heat input to the salt bath should be set and adjusted only by competent personnel.

4.6 General

Mechanised brazing operations should always be set and adjusted by competent personnel. If machines fail to operate or operate incorrectly local supervision should always be notified immediately.

Section 5: Safety Precautions

Operator well-being and safety will result from observing the following basic precautions:

- Wear suitable protective clothing. Gloves are recommended to prevent skin contact with flux powders and pastes.
- Always wear safety glasses or goggles. Suitable tinted glasses should be worn if glare from brazing torches is a problem.
- Local extraction should always be used when brazing with cadmium containing alloys. Good ventilation is essential in all brazing operations.



- Avoid standing with the face directly over the workplace. All brazing atmospheres should be monitored to ensure OESs and MELs are not being exceeded.
- Welding techniques must not be used when brazing. For example, the direct heating of a pool of molten brazing alloy must be avoided.
- Brazing in confined spaces should only be carried out using suitable breathing apparatus.
- Health and Safety Information on specific alloys and fluxes showing current OESs and MELs is available on request.

Material Safety Data Sheet

The following General Material Safety Data Sheets are appendices to this data sheet.

- Appendix A Cadmium Free Brazing Alloys
- Appendix B Cadmium Containing Brazing Alloys
- Appendix C Phosphorus Containing Brazing Alloys
- Appendix D Brazing Fluxes

Individual Material Safety Data Sheets appertaining to products not covered by the appendices above are available on request.

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