



Material Safety Data Sheet

According to the EC Directive 93/112

MSDS No. CE001 Carbon Steel Electrodes

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1. Product and company designation

Product Name: CARBON STEEL WELDING ELECTRODES

Product Brands: Nexus E6013, E7018.1, E7018.1VP, E7024.

Product Specification: AWS A 5.1

Product Classification: E6013, E7018.1, E7024.

Recommended use: Shielded Metal Arc Welding of plain carbon steels

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2. Details of composition

These electrodes consist of a mild steel inner core with a flux coating. The mild steel inner core is an uncoated solid steel rod. The flux coatings vary depending on the type of electrode, and contain varying amounts of metal powders, ferro-alloy powders, mineral ores, inorganic oxides, carbonates and fluorides, cellulosic compounds and other siliceous materials mixed together with liquid silicate binders.

Specific details of the contents of the core wire and flux coating for the electrode types covered by this data sheet are given below.

TABLE 1: CORE WIRE COMPOSITION DATA (WT %)

| Mild steel core | Fe | Mn | Cr | Ni | Cu | Si |
|-----------------|-------|------|------|------|------|------|
| Typical | 98-99 | <0.6 | <0.1 | <0.1 | <0.1 | <0.2 |

TABLE 2: COATING COMPOSITION DATA (WT%)

| Flux coating | High Cellulose E6010, 6011 | Rutile E6012, 6013 | Basic Low Hydrogen E7016, 7018 | Rutile Iron Powder E7024 | Basic Iron Powder E7028 | Cas No. |
|--|----------------------------------|--------------------------|--------------------------------------|-----------------------------|----------------------------|----------------------|
| Limestone and/or Calcium Carbonate | - | <10 | 20-30 | <10 | 10-20 | 1317-65-3 |
| Magnesite (total inhalable dust) (respirable dust) | 5-10 | <5 | - | - | - | 546-93-0 |
| Cellulose (total inhalable dust) (respirable dust) | 25-60 | <15 | - | - | - | 9004-34-6 |
| Iron Oxides (as Fe) | <10 | <10 | <10 | <10 | | 1309-37-6 |
| Inorganic Fluorides (as F) | - | <10 | 10-30 | <10 | 5-15 | 16984-48-8 |
| Iron powder | - | <10 | 10-35 | 10-60 | 10-60 | 7439-89-6 |
| Manganese and its Inorganic compounds (as Mn) | 5-15 | 5-15 | <15 | <15 | <10 | 7439-96-5 and others |
| Rutile/Titanium Dioxide (total inhalable dust) (respirable dust) | 10-35 | 15-60 | <10 | 10-30 | <10 | 13463-67-7 |
| Silicon and Silicon Alloys, (as Si) | - | - | <5 | <5 | <5 | 7440-21-3 |
| Silicate Binders | <5 | <5 | <5 | <5 | <5 | 1344-09-8 |
| Mica (total inhalable dust) (respirable dust) | <5 | <20 | <5 | <5 | <5 | 12001-26-2 |
| Quartz/Silica Respirable crystalline | <10 | <15 | 5-60 | <10 | <5 | 14808-60-7 |
| Kaolin (respirable dust) | - | <20 | - | <5 | <5 | 1332-58-7 |
| Other Mineral Silicates | 5-30 | 5-30 | 5-10 | 5-30 | 5-10 | 1332-58-7 |
| Others | | | | | | |

3. Hazards identification

There are no recognised hazards associated directly with unused welding consumables prior to welding. Packaged consumables may be heavy, and should be handled and stored with care. FOLLOW MANUAL HANDLING REGULATIONS.

Some low levels of dust may be produced during handling. DO NOT BREATHE THE DUST.

When using these electrodes as part of the welding process additional potential hazards are likely:

Electric shock from the welding equipment or electrode. This can be fatal.

Hot metal spatter and heat, which can cause burns to the hand and body, and may cause fire if in contact with combustible materials.

UV, IR and light radiation from the arc, which can produce 'arc eye' and possible eye damage to unprotected eyes. WEAR SUITABLE PROTECTIVE EQUIPMENT.



Fumes produced from the welding consumable, material being welded, and the arc radiation:

- Particulate fume such as complex metal oxides, fluorides, and silicates from the weld materials.
- Gaseous fume such as ozone and nitrogen oxides from the action of arc radiation on the atmosphere, and carbon monoxide and dioxide from the dissociation of some flux constituents during welding.
- SHORT TERM INHALATION OF THESE FUMES AND GASES MAY LEAD TO IRRITATION OF THE NOSE, THROAT AND EYES.
- LONG TERM OVEREXPOSURE OR INHALATION OF HIGH LEVELS OF FUMES MAY RESULT IN HARMFUL EFFECTS TO THE RESPIRATORY SYSTEM, CENTRAL NERVOUS SYSTEM AND LUNGS.
- LOCAL EXTRACTION AND /OR VENTILATION SHOULD BE USED TO ENSURE THAT ALL HAZARDOUS INGREDIENTS IN THE FUME ARE KEPT BELOW THEIR INDIVIDUAL OCCUPATIONAL EXPOSURE STANDARDS IN THE WELDER'S AND OTHER WORKERS' BREATHING ZONES.

NOTE: If welding is performed on plated or coated materials such as galvanised steel, excessive fume may be produced which contains additional hazardous components, and may result in metal fume fever and other health effects.

4. First aid measures

No first aid measures should be required for the unused electrode consumables. During welding:

Inhalation

If breathing is difficult, bring the patient in fresh air; breathe in fresh air deeply.

For skin burns

Submerge affected area in cold water until burning sensation ceases and refer for immediate medical attention.

For eye effects

For irritation from radiation and dusts, irrigate eye with sterile water, cover with damp dressing and refer for immediate medical attention if irritation persists.

Ingestion

Ingestion is considered unlikely due to product form. However, if detached flux coating is swallowed do not induce vomiting. Seek medical attention. Advice to doctor: treat symptomatically.

Electric shock

If necessary resuscitate and seek immediate medical attention.

5. Fire prevention measures

No specific measures required for the welding consumable prior to welding.

Welding should not be carried out in the presence of flammable materials, vapours, tanks, cisterns and pipes and other containers which have held flammable substances unless these have been checked and certified safe.

6. Measures in case of unintentional release

No specific actions for welding consumable prior to use.

Welding in proximity to stored or used halogenated solvents may produce toxic and irritant gases. Prohibit welding in areas where these solvents are used.

7. Handling and storage (for safety)

No special precautions are required for these welding consumables.

Welding electrodes are dense materials and can give rise to a handling hazard when multiple packages of the electrodes are lifted or handled incorrectly or with poor lifting posture.

Good practice for handling and storage should be adopted to prevent physical injuries.

8. Exposure prevention / Controls / Personal protection

Exposure Prevention

Welders should not touch live electrical parts, and should insulate themselves from the work and the ground. Manufacturer's guidelines for the use of electrical welding machines should be observed at all times.

Welders and co-workers should be educated about the health hazards associated with welding fume, and trained to keep their heads out of the fume plume.

During welding, fumes and gases will be produced and emitted from the welding process. The content of the fume is dependent on the electrode type and base material being welded. The amount and concentration of fume generated is dependent on factors such as current, voltage, welding practices and number of welders in a given area. By following recommended welding practices, fume production can sometimes be minimised.

For carbon steel electrodes, the main constituents of the fume will be iron, manganese, sodium, potassium and calcium oxides, fluorides and silicates, mainly in the form of complex oxides and other compounds. There will also be smaller amounts of other complex metal oxides and silicates.

Gaseous ozone and nitrous oxides are also formed by arc radiation, and carbon monoxide and carbon dioxide can also be present due to dissociation of some of the flux constituents.

Fume Composition data for the major carbon steel electrodes are given below, and the individual exposure limits for the constituents (when specified) are also given.

Fume exposure should be controlled to below the recognised exposure limit for each of the individual constituents, and to below 5 mgm/m³ for the total particulate fume.

TABLE 3: FUME COMPOSITION DATA (WT%)

| Electrode Type | %Fe | %Mn | %Si | %Mg | %Ti | %Cu | %Na | %K | %Ca | %F |
|---------------------------------------|-------|------|------|-----|-----|-----|------|-------|------|------|
| C-steel, cellulosic E6010, E6011 | 35-55 | 3-8 | 5-10 | 0.1 | 1 | 0.2 | 5-10 | 5-10 | 2-5 | 0-2 |
| C-steel, rutile E6012, E6013 | 15-65 | 4-9 | 2-11 | 0.3 | 3-6 | 0.1 | 0-3 | 5-20 | 0-5 | 0-1 |
| C-steel, basic E7016, E7018 | 10-30 | 3-9 | 1-8 | <1 | 0.7 | 0.1 | 5-15 | 2-20 | 8-20 | 5-25 |
| C Steel, iron powder Rutile E 7024 | 25-55 | 4-15 | 1-15 | 0.1 | 1.1 | 0.1 | 5-10 | 1-5 | 5-10 | 0-2 |
| C Steel, iron powder Basic E 7028 | 10-30 | 5-10 | 4-8 | <1 | 0.1 | 0.1 | 5-10 | 10-20 | 0-5 | 5-25 |

TABLE 4: HAZARDOUS FUME COMPONENTS

| Welding fume component | CAS No. | OEL ¹ | STEL ² |
|------------------------|---------|------------------|-------------------|
| | | 8hr TWA | 15min TWA |
| | | | |

| | | | |
|---|------------|-------|--------|
| Total welding fume (particulate) | - | 5 | |
| Iron oxide fume (as Fe) | 1309-37-1 | 5 | 10 |
| Manganese and its inorganic compounds (as Mn) | 7439-96-5 | 0.5 | |
| Silica, amorphous | | | |
| (total inhalable dust) | - | 6 | |
| (respirable dust) | | 2.4 | |
| Magnesium oxide (as Mg) | | | |
| (total inhalable dust) | 1309-48-4 | 10 | |
| (fume and respirable dust) | | 4 | 10 |
| Titanium dioxide | | | |
| (total inhalable dust) | 13463-67-7 | 10 | |
| (respirable dust) | | 4 | |
| Calcium Oxide | | | |
| | 1305-78-8 | 2 | |
| Calcium Silicate | | | |
| (total inhalable dust) | 1344-95-2 | 10 | |
| (respirable dust) | | 4 | |
| Fluoride, inorganic (as F) | | | |
| | 16984-48-8 | 2.5 | |
| Nitrogen dioxide (NO ₂) * | | | |
| | 10102-44-0 | 3ppm | 5ppm |
| Ozone (O ₃) | | | |
| | 10028-15-6 | | 0.2ppm |
| Nitrogen monoxide (NO) * | | | |
| | 10102-43-9 | 25ppm | 35ppm |

Units are in mgm/m³ except when stated otherwise. For UK only.

* Please refer to <http://www.hse.gov.uk/pubns/chan28.htm> & <http://www.hse.gov.uk/pubns/chan29.htm>

The fume analyses for the carbon steel electrodes covered by this data sheet, and used for welding clean, uncoated plain carbon steels indicate that as long as the 5 mgm/m³ total fume exposure limits are met, fume levels of the other constituents will generally be below their respective exposure limits.

An exception is manganese, as this has a low exposure limit, and additional controls to this limit may be required.

THE FUME LEVELS GIVEN ABOVE WERE GENERATED UNDER LABORATORY CONDITIONS WHEN WELDING CLEAN, PLAIN CARBON STEEL UNDER THE MANUFACTURERS RECOMMENDED WELDING PARAMETERS, AND ARE INDICATIVE OF REASONABLY EXPECTED FUME LEVELS. ACTUAL FUME LEVELS WILL VARY IN PRACTICE, DEPENDING ON THE WELDING PARAMETERS AND OTHER CONDITIONS, AND MAY BE HIGHER OR LOWER THAN THOSE LISTED ABOVE.

ADDITIONAL FUME MAY ARISE WHEN THESE ELECTRODES ARE USED TO WELD CONTAMINATED BASE MATERIALS, COATED OR PLATED STEELS, OTHER METALS AND ALLOYS, OR WHEN INCORRECT WELDING CONDITIONS ARE USED.

THE ONLY ACCURATE WAY TO DETERMINE THE COMPOSITION AND QUANTITY OF FUMES AND GASES TO WHICH WORKERS ARE EXPOSED IS TO TAKE AIR SAMPLES FROM INSIDE THE WELDERS HELMET, IF WORN, OR IN THE WORKER'S BREATHING ZONES.

Individual fume measurements should be made in these cases using recognised sampling and analysis standards. Based on the results of these measurements, additional fume controls may be required to ensure that all the fume constituents are controlled below their exposure limits.

Controls

Good general ventilation, and/or local fume extraction at the arc should be used to control the fumes and gases produced during welding to below their individual recognised exposure limits when measured in the welder's and co-workers' breathing zone. In addition the ventilation and extraction should also be sufficient to ensure that the total particulate fume levels are reduced below 5mgm/m³ when measured in the breathing zone.

In confined spaces where ventilation is not adequate, an air fed breathing system should be used. All precautions for working in confined space should be observed. Refer to:

Safe work in confined spaces Free HSE leaflet INDG258 HSE Books 1999. Also available in priced packs ISBN 0 7176 1442 5.

Safe work in confined spaces: Approved code of practice, regulations and guidance L101 HSE Books 1997 ISBN 0 7176 1405 0

Where fume levels exceed the recognised exposure limits, respiratory protection may be required in the form of a Class P2 (metal fume) respirator.

Personal Protection

Welders and co-workers in the vicinity should wear protective clothing and eye protection appropriate to arc welding as specified by local standards.

Protection of Body and Skin

Suitable clothes for welding should be worn such as non light reflective fireproof overalls, leather apron, welding helmet, leather boots spats and gloves

Protection of Hands

Welders should wear suitable hand protection such a welding gloves or gauntlets of a suitable standard. Co-worker should also wear suitable hand protection against hot metal, sparks and spatter.

Eye Protection

Welders should wear a welding helmet fitted with the appropriate optical welding filter for the operation. Suitable protective welding screens and goggles should be provided, and used by others working in the same area.

9. Physical and chemical properties

Physical state: Solid

Colour: Generally greyish, but other colours can be present

Form: Metal wire with flux coating

Odour: Odourless

PH: Not available

Vapour pressure: Not relevant

Vapour Density: Not relevant

Boiling point / range: Not relevant

Melting Point: ~1500°C

Solubility in water: Insoluble

Density: Not available

Explosive / ignition point: Non flammable. No fire or explosion hazard exists

10. Stability and reactivity

There are no stability or reactivity hazards from electrodes as supplied.

Hazardous decomposition products such as metal oxide fumes and gases (see Section 8) are produced during welding.

11. Toxicity data

Welding fumes if inhaled can potentially produce several differing health effects caused by the metal containing particles and the gases produced during the welding process, both of which are present in the 'fumes'. The exact nature of any likely health effect is dependent on the consumable, material being welded, weld process, all of which affect fume quantity and composition, as well as the use of adequate ventilation, respirators, or breathing equipment as circumstances require.

Inhalation of the fumes/gases produced during welding may lead to irritation to the nose throat and eyes. The range of health effects include respiratory effects with symptoms such as asthma, impaired respiratory and lung function, chronic bronchitis, metal fume fever, pneumoconiosis, possible emphysema and acute pulmonary oedema.

Other potential health effects at elevated levels of exposure include central nervous effects possible lung cancer, bone disease, skin and fertility effects. Which of these health effects is potentially likely is related to the fume composition, and this needs to be consulted with the specific toxicity data below to assess the health risk when using any particular welding process.

Unprotected skin exposed to UV and IR radiation from the welding arc may burn or redden, and UV radiation is potentially a carcinogen. UV radiation can affect the unprotected eye by producing an acute condition known as 'arc eye'.

Specific effects relevant to major particulate and gaseous fume constituents produced when welding with these electrodes

Iron

The chief component of fume generated by welding carbon steels is iron oxide. Iron oxide is generally considered a nuisance material and unlikely to cause any significant health effects. The fume particles however accumulate in the lungs and lead to a benign pneumoconiosis called siderosis.

Manganese

Manganese compounds are also found in carbon steel welding fumes. Manganese is mainly a systemic chronic toxin, although exposure to high particulate concentrations can cause some respiratory irritation.

Overexposure or inhalation of excessive amounts of manganese has been shown to affect pulmonary function, blood and may cause irreversible central nervous system damage (manganism) which resembles Parkinsons disease. Symptoms of manganism include tremors, impaired speech, facial expression changes, slow clumsy movements and eventually impaired walking. The symptoms are typically not apparent for several years.

Fluorides

The main source of fluorides is from the flux coatings on some welding electrodes such as basic types (E7016, 7018, 7028), and this produces mainly fluoride particulate fume. Fluorides are respiratory irritants and if absorbed through inhalation can lead to bone disease known as fluorosis.

Silica

Silica is found in welding fumes produced by fluxes and flux coatings and is produced mainly as amorphous silica. This form of silica has not been associated to any significant degree with lung pneumoconiosis which is associated with crystalline forms of silica.

Rutile sand

Mainly present as Titanium dioxide which is a respiratory irritant but in effect mainly a nuisance material of low toxicity.



Ozone and Nitrogen oxides.

These gases are formed due to interactions of the arc with the surrounding air of the welding arc. Both gases can produce eye, respiratory and lung irritation and also can produce longer term lung effects such as decreased lung capacity, chronic bronchitis, and emphysema. Of particular concern with both gases is that exposure to high levels (eg due to build up in confined spaces) can result in acute lung effects such as delayed pulmonary oedema.

Carbon monoxide and carbon dioxide.

Carbon monoxide (CO) is a chemical asphyxiant and its toxicity is due to its affinity for oxygen carrying blood haemoglobin causing fatigue, weakness, dizziness and eventual unconsciousness and possible death. Carbon dioxide (CO₂) is mainly an asphyxiant but can exert some toxic properties by increasing pulse and heart rate. These gases are mainly formed through decomposition of some electrodes components (cellulose and carbonates).

12. Ecological data

The welding process produces particulate fumes and gases which may cause long term adverse effects in the environment if released directly into the atmosphere. Welding fumes from basic electrodes covered by this data sheet can produce carbon dioxide gas, which is dangerous to the ozone layer.

13. Disposal data

Packaging, stub ends and slag residue should be disposed of as general waste or recycled. No special precautions are required for this product.

14. Transport information

No special requirements are necessary in transporting these products

15. Regulations

- Health and Safety at Work Act 1974.
- The Management of Health and Safety at Work regulations 1992.
- L5 Control of substances hazardous to health. The Control of Substances Hazardous to Health Regulations 2002. Approved codes of practice and guidance. (ISBN 0717625346).
- Guidance Note EH40 – Occupational Exposure Limits (ISBN 0717621944).
- BS EN ISO 10882-1:2001 - health and safety in welding and allied processes - sampling of airborne particles and gases in the operator's breathing zone - part 1: sampling of airborne particles
- HSG 37 – An Introduction to Local Exhaust Ventilation. (ISBN 0717610012).
- L25 Personal protective equipment at work. Guidance on Regulations. Personal Protective Equipment at Work Regulations 1992. (ISBN 0717604152).
- L23 Manual handling. Manual Handling Operations Regulations 1992 (as amended)
- BS EN 169:2002 – Personal eye-protection - filters for welding and related techniques - transmittance requirements and recommended use
- BS EN 379:2003 – Personal eye-protection - automatic welding filters.
- BS EN 12477:2001 Protective Gloves For Welders.
- HSG 118 – Electrical Safety in Arc Welding (ISBN 0717607046).

16. Other information

The customer should provide this Materials Safety Data Sheet to any person involved in the materials use or further distribution. Industrial and Welding Management Ltd requests the users (or distributors) of this product to read this Materials Safety Data Sheet carefully before usage.

The information contained in this Material Safety Data Sheet relates only to the specific materials designated and may not be valid for such material used in combination with any other material or in any process.

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