

A welder wearing a full protective suit, including a helmet with a large visor and gloves, is shown in profile, working on a metal surface. Bright sparks are flying from the point of contact between the welding torch and the metal. The background is a blue-tinted industrial setting with horizontal lines.

## Storage & handling recommendations for consumables

COVERED ELECTRODES, SOLID MIG/MAG WIRES, CORED WIRES,  
TIG RODS AND SAW/ESW WIRES, STRIPS AND FLUXES

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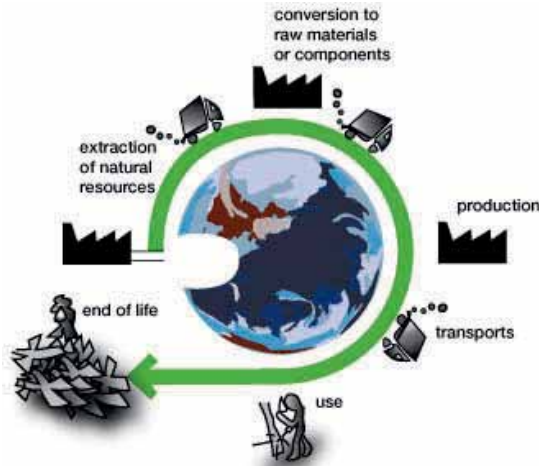
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## DISCLAIMER

Whilst all reasonable efforts have been made to ensure the accuracy of the information contained in this handbook at the time of going to press, ESAB gives no warranty with regard to its accuracy or completeness. It is the responsibility of the reader to check the accuracy of the information contained in this handbook, read product labels and equipment instructions and comply with current regulations. If the reader is in any doubt with regard to the proper use of any technology they should contact the manufacturer or obtain alternative expert advice. ESAB accepts no responsibility or liability for any injury, loss or damage incurred as a result of any use or reliance upon the information contained in this handbook.



# Environmental care - sound welds



ESAB is one of the few international companies with a global ISO 14001 certification. Every ESAB product is produced to the same environmental standard with every step taken to minimise environmental impact, from the cradle to the grave.

The broad range of consumables sold by ESAB are manufactured under a strict ISO 9001 quality assurance programme. Moreover, with ISO 14001 worldwide certification, the company's high quality consumables are preferred by industries for their ability to minimise welding defects. Special packaging, such as Marathon Pac™ and VacPac™ has also been developed to make handling even more rational for the customer.

## Maximum storage time

If the recommended storage conditions described in the individual consumables sections in this handbook are adhered to, the maximum storage time for all the consumables covered in this handbook is 3 years. After this time the product should be thoroughly checked before use.

## Disposal

The majority of the packaging used by ESAB are designed for environmental friendly recycling. Any product, residue (slag), disposable container, liner or other packaging should be disposed of in an environmentally acceptable manner, in full compliance with federal and local regulations. Please address your local disposal company for prescribed disposal. Information on product and residues are given in the Safety Data Sheets available through [www.esab.com](http://www.esab.com).

### **Quality of welds.**

Porosity is formed by entrapment of discrete pockets of gas in the solidifying weld pool. The gas may originate from poor gas shielding, surface contaminants such as moisture, rust or grease, or insufficient deoxidants in the parent metal, electrode or filler wire. A particularly severe form of porosity is 'wormholes', caused by gross surface contamination or welding with damp electrodes.

Characteristically, wormholes are elongated pores which produce a herring bone appearance on the radiograph. Wormholes are

indicative of a large amount of gas being formed, which is then trapped in the solidifying weld metal. Hydrogen is also a contribution to cracks in welds or the HAZ. Hydrogen in combination with residual tensile stresses and crack sensitive steels can cause cold cracking several hours or days after welding. High strength steels and constructions with high levels of residual tension are more sensitive to hydrogen cracking. For these applications ESAB recommend using methods and consumables that give low hydrogen levels together with adequate procedures



**Marathon Pac is folded flat after use for minimal disposal space.**

for pre-heating, work temperature and post weld heat treatment. It is important to note that there can be other significant sources of hydrogen e.g. moisture from the atmosphere or from the material where processing or service history has left the steel with a significant level of hydrogen.

Hydrogen may also be derived from the surface of the material or the consumable, or from oil and paint etc.

The below chart shows the relative humidity at which detrimental water

condense will form for a number of given differential temperatures. \*  
 Example - If the relative humidity in the weld area is 70%, the base metal and electrode must be no colder than 5°C below the air temperature to prevent moisture condensation.

This can happen when plates or electrodes come from a colder workshop, warehouse or from the outside.

Dew point conditions versus relative humidity

(Tair - Tmetal)* °C	Relative Humidity %	(Tair - Tmetal) °C	Relative Humidity %
0	100	12	44
1	93	13	41
2	87	14	38
3	81	15	36
4	75	16	34
5*	70*	18	30
6	66	20	26
7	61	22	23
8	57	24	21
9	53	26	18
10	50	28	16
11	48	30	14

\* Difference in temperature between work piece or consumable and the air temperature

# Covered MMA electrodes

ESAB electrodes can be supplied in different packaging types depending on the type and grade.

- Shrink film paper box, this is not completely airtight, so moisture from the surrounding atmosphere can enter the box and be picked up by the coating.
- Plastic capsules have a lid and tape, moisture will permeate through at very low rates and be picked up by electrode coatings.

Therefore, if there is any doubt about whether an electrode is dry enough, it should be re-dried according to instructions shown on the label before use.

- VacPac vacuum packaging provides a complete protection against moisture provided the package is intact (vacuum maintained). If this is the case, no re-drying is needed before use.

## Storage conditions

All covered electrodes are sensitive to moisture pick-up. High moisture contents in the coating can cause porosity or hydrogen cracking. However, the pick up rate will be very slow when stored under correct climatic conditions:

- 5 - 15°C: max 60% RH
- 15 - 25°C: max 50% RH
- >25°C: max 40% RH

At low temperatures, the humidity level can be maintained at low levels by ensuring a storage temperature of at least 10°C above the outside temperature. Cold packs should be allowed to reach ambient temperature before being opened. At high temperatures, low humidity levels can be maintained by air dehumidification.

If electrodes are stored under the described storage conditions, they can be kept for maximum of three years.

## **Redrying**

- Low hydrogen covered basic electrodes should be re-dried before use whenever there are application requirements relating to weld metal hydrogen content and/or radiographic soundness (not needed for VacPac).
- Acid rutile stainless electrodes and all types of basic electrodes may produce pores in the weld metal if they have not been stored in sufficiently dry conditions. Re-drying the electrodes will restore their usability.
- Mild steel rutile and acid electrodes normally need no re-drying.
- Cellulose electrodes must not be re-dried.
- Electrodes, which are seriously damaged by moisture, cannot be restored to their original condition by baking and should be scrapped.

## **Redrying conditions**

- Redrying and holding temperatures and holding times are specified on the package label.
- The redrying temperature is the temperature in the bulk of the electrodes. The redrying time is measured from the point at which the redrying temperature has been reached.
- Do not stack more than four layers of electrodes in the redrying oven.
- It is recommended not to redry covered electrodes more than three times.
- A summary of recommended redrying conditions for ESAB electrodes is given in table on the next page.

Recommended redrying temperatures, holding time two hours for OK electrodes.

80°C	150°C	200°C	250°C	300°C	350°C	350°C
OK 92.78	OK 50.10**	OK 39.50	OK 33.60	OK 62.53	OK 38.48	OK 67.43
		OK 61.25	OK 33.80	OK 68.82	OK 38.65	OK 67.50
		OK 61.35	OK 33.81	OK 83.50	OK 38.95	OK 67.51
		OK 61.35 Cryo	OK 67.13	OK 83.53	OK 48.00	OK 67.52
		OK 61.50	OK 67.20	OK 84.78	OK 48.04	OK 67.53
		OK 61.85	OK 68.37	OK 84.80	OK 48.05	OK 67.60
		OK 63.35	OK 68.53	OK 92.82	OK 48.08	OK 67.62
		OK 63.85	OK 68.55	OK 94.25	OK 48.15	OK 67.70
		OK 67.15	OK 69.33		OK 48.18	OK 67.71
		OK 67.45	OK 69.63		OK 48.30	OK 68.17
		OK 67.55	OK 84.76		OK 48.50	OK 68.25
		OK 67.75	OK 84.84		OK 48.60	OK 68.81
		OK 310Mo-L	OK 92.05		OK 48.65	OK 73.08
		OK 68.15	OK 92.15		OK 48.68	OK 73.15
		OK 69.25	OK 92.55*		OK 53.00	OK 73.35
		OK 83.27	OK 94.35		OK 53.18	OK 73.46
		OK 83.28			OK 53.35	OK 73.68
		OK 83.65			OK 53.68	OK 74.46
		OK 84.42			OK 53.70	OK 74.70
		OK 84.52			OK 55.00	OK 74.78
		OK 84.58			OK 61.20	OK 75.75
		OK 85.58			OK 61.30	OK 75.78
		OK 85.65			OK 61.80	OK 76.16
		OK 86.08			OK 61.81	OK 76.18
		OK 92.18			OK 61.86	OK 76.26
		OK 92.26			OK 62.73	OK 76.28
		OK 92.45			OK 62.75	OK 76.35*
		OK 92.58			OK 63.20	OK 76.96
		OK 92.59			OK 63.30	OK 76.98
		OK 92.60			OK 63.34	OK 78.16
		OK 92.86			OK 63.41	OK 83.29
					OK 63.80	OK 86.28
					OK 64.30	OK 86.30
					OK 64.63	OK 92.35

\*1h drying time \*\*3h drying time



## **Equipment for storage and redrying of electrodes**

The PK 1 is a light and handy dry-storage container for electrodes. It is easy to carry around. The storage temperature is around 100°C.



**PK 1 dry-storage container**

The PK 5 is a combined drying and dry-storage system for most types of electrode. The drying time at full effect is one to seven hours depending on the type of electrode. The temperature is thermostatically controlled and ranges from 50-300°C. The electrodes should be stored in the PK 5 without packaging.



**PK 5 drying equipment**

The SK 40 is a dry-storage cabinet with four removable shelves for storing electrodes. The electrodes should be stored without packing. The cabinet is equipped with a thermometer, thermostat and control lamp.



**SK 40 dry-storage cabinet**



**PK 410 drying cabinet**

The PK 410 is a robust cabinet for the drying and dry storage of electrodes. The drying temperature can be regulated between 0°C and 450°C. The dry-storage temperature is around 150°C. The PK 410 is equipped with a control lamp, electronic thermometer and electronic thermostat. The PK 410 also has a seven-day timer. The timer makes it possible to automatically change from drying to dry storage for selected times and temperature ranges.

### **Discoloration in the coating**

If the colour of the electrodes changes during storage, they should be scrapped or an ESAB representative should be contacted.

### **Damaged coating**

Physically damaged electrodes where sections of the coating are missing will not perform correctly and should be scrapped.

# Covered MMA electrodes in VacPac

## **No re-baking, no holding ovens, no quivers.**

MMA electrodes from VacPac can be used straight from the package without the need to re-bake them and store them temporarily in holding ovens and quivers. Upon opening, fresh and dry electrodes are guaranteed when the vacuum is maintained.

Electrodes of low moisture absorption type (LMA, classified as

H4 or H5), re-absorb moisture slowly from the air. The safe exposure time for this type of electrode is 12 hours\* after opening the VacPac with the foil left in place.

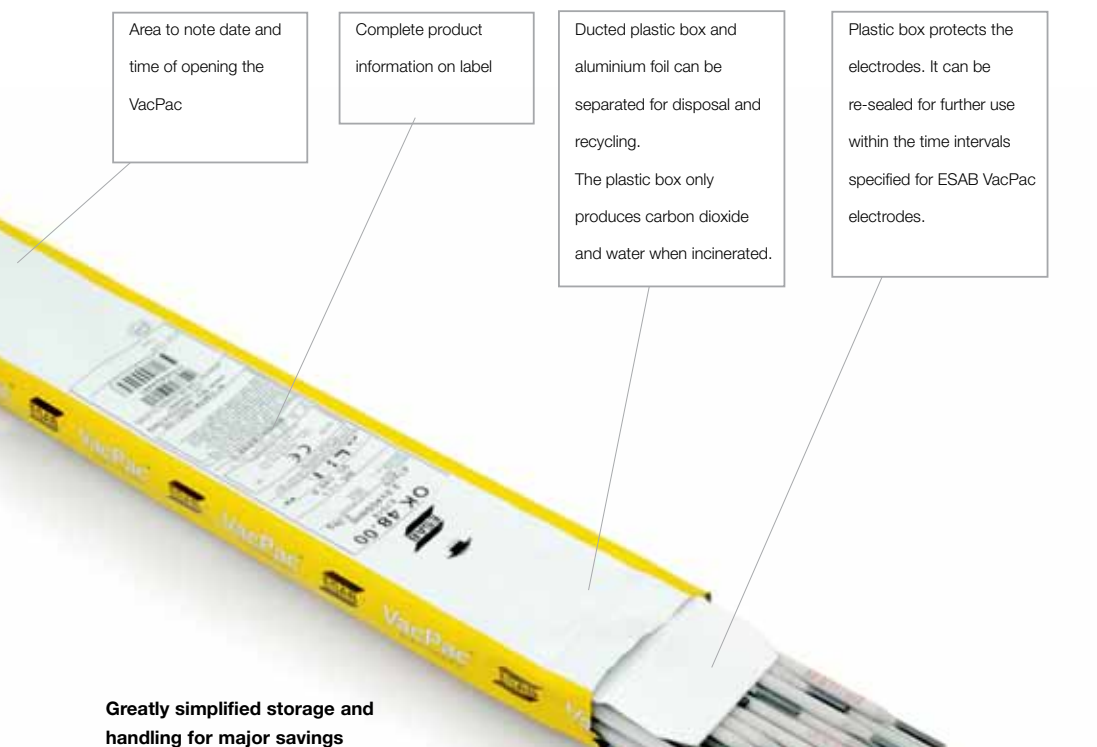
\* Valid at standard AWS test conditions of 26.7 °C and 80% RH.

## **How to handle VacPac**

To protect the vacuum foil, avoid using a knife or any other sharp object when opening the outer package. Keep the electrodes inside the package and do not take out more than one electrode at a time. Low moisture absorption type electrodes (LMA) that have been exposed to the atmosphere in an opened VacPac for more than 12 hours (26.7°C and 80% RH) should be discarded or re-dried.



**VacPac is available in various packaging sizes to suit fabricators' individual consumption of MMA electrodes.**



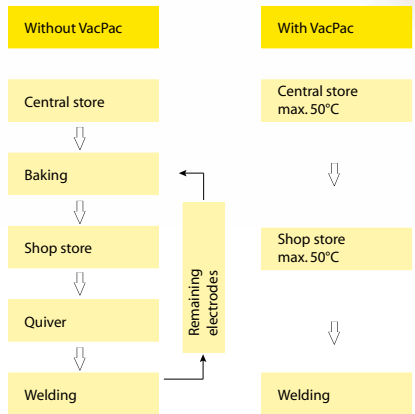
Area to note date and time of opening the VacPac

Complete product information on label

Ducted plastic box and aluminium foil can be separated for disposal and recycling.  
The plastic box only produces carbon dioxide and water when incinerated.

Plastic box protects the electrodes. It can be re-sealed for further use within the time intervals specified for ESAB VacPac electrodes.

**Greatly simplified storage and handling for major savings**



# MIG/MAG/SAW wires, TIG rods and strips



**Solid MIG/MAG wires, TIG rods and SAW wires** should be stored in dry conditions in original sealed undamaged packaging as supplied. Contact with water or moisture should be avoided. This could take the form of rain or the condensation of moisture on a cold wire. To avoid condensation, keep the wire in the original packaging and, if necessary, leave the wire to warm up to at

least the ambient temperature before opening the package. Other hydrogen-containing substances, like oil, grease and corrosion or substances that could absorb moisture must also be avoided on the surface of the wires. Spooled wire is supplied packed in plastic bags and partly used spools should be replaced into a plastic bag for storage to prevent surface

contamination. Wire should be stored at ambient conditions of temperature and humidity, and dusty areas should be avoided when wire is not enclosed in some type of dust-protecting packaging or equipment.

Wire for TIG (GTAW) welding should be protected from dust and airborne contamination after removal from the packaging. The package for TIG wires consist of a rigid fibre tube with a plastic lid that can be closed again after breaking the sealing. The tube is PE coated and provides a very good moisture protection. The package is also very stable and user friendly.

Marathon Pac bulk drums for MIG/MAG welding is designed for fast, efficient handling and ease of eventual recycling. VCI paper inside every drum and protective foil around each pallet is protecting the wire against moisture during transport and storage.

Once empty, simply remove the

lifting straps from the octagonal drum and fold it completely flat for easy and space saving storage until collection. Also note that Marathon Pac protects your welding wire from contamination.

Recommended conditions of storage for all solid wires are minimum temperature of 15°C and humidity of maximum 60% RH.

### **Aluminium wires**

Atmospheric conditions affect weld quality. Moisture (H<sub>2</sub>O) is a prime source of hydrogen. At arc temperatures, water breaks down releasing hydrogen atoms that cause porosity in weldments.

Aluminium, which is allowed to repeatedly come into contact with water, will eventually form a hydrated oxide (AlOH) coating.

Moisture from condensation present on either the electrode or the base metal can cause two problems during welding:

- Porosity caused by hydrogen generated from the breakdown of water or from the breakdown of hydrated oxide (AlOH) present on the metal surfaces.
- Entrapment of the actual oxide (AlOH) present on the metal surfaces, in the weldment.

In an aluminium welding shop, the uniformity of air and metal temperatures is important especially when the relative humidity is high. Electrode and base metal should be allowed to stabilise to the weld area temperature. The electrode should not be opened in the weld area for 24 hours after entry from a cooler storage area. The base metal

should be cleaned and brushed with a clean stainless steel brush prior to welding. ESAB recommends mild alkaline solutions and commercial degreasers that do not evolve toxic fumes during welding. Welders should wipe joint edges with a clean cloth dipped in a volatile petroleum based solvent. All surfaces must be thoroughly dried after cleaning.

### **Strips**

Welding operators must keep strips as clean and protected as possible. This includes careful and proper storage and handling all stock to prevent dust and organic compounds including body oils contaminating the strip surface.



# Cored Wires

Cored wires should be stored in their unopened and undamaged original packaging. Failure to do this may seriously reduce the durability of the consumables.

Storage times should be kept to a minimum and stock rotation should be used.

Non and low alloyed cored wires

are not susceptible to rapid moisture absorption since the core ingredients are protected from the atmosphere but the sheath. Strict QA procedures ensure all of ESAB's cored wires contain low levels of moisture in the as manufactured condition.

To maintain the low moisture levels cored wires should be stored under correct conditions. Poor storage conditions can be detrimental to their performance and shelf life. Inadequate storage conditions can lead to surface rusting or contamination of the wire to the extent that feedability and diffusible hydrogen levels are adversely affected.

Stainless steel cored wires are more sensitive to moisture pick up. Therefore the spools are vacuum packed in Aluminium foil pouches. The storage recommendations are the same as for unalloyed and low-alloyed cored wires.





For stainless steel cored wires extra attention is required in order to ensure that they are returned to the correct storage conditions the end of the working period.

Wires should not be left on welding machines or out of the store for prolonged periods, especially overnight, since condensation of moisture from the air may lead to rapid surface deterioration. Always replace wires in their original packaging and return them to controlled storage areas.

If a wire has been left on the equipment for a long period of time, it is good practice to run off at least one layer of wire to remove the worst of any surface oxidation or contamination that may have occurred.

All cored wires should avoid direct contact with water or moisture. This could take the form of rain or the condensation of moisture on a

cold wire. To avoid condensation the relative humidity and temperature shall be monitored and the temperature should not fall below the dew point (listed in table on page 5).

Other hydrogen-containing substances like oil, grease and corrosion or substances that could absorb moisture must also be avoided on the wire surface.

### **Deteriorated product**

Cored wires that are rusty, have suffered from serious water and moisture contamination, or have been exposed to the atmosphere over long periods of time cannot be restored in their original condition and should be discarded.

ESAB ceramic weld metal supports have no adverse influence on weld metal composition and mechanical properties. They are dry and insensitive to moisture absorption, leaving consumables' low-hydrogen performance unaffected.

# SAW and strip cladding fluxes



In order that customers can use fluxes without prior redrying, ESAB has equipped the BigBags with an aluminium liner, reliably protecting the flux from moisture, even in tough climates such as around the equator. The complete BigBag, including the aluminium liner, is fully recyclable (EN 13431).

The new moisture protected BigBags have a very well defined discharge spout which can be closed during the flux flow.



ESAB fluxes, agglomerated and fused, have a guaranteed as-manufactured moisture content from production. This moisture content is controlled by internal ESAB specifications. Before transport, each pallet is shrink wrapped in plastic foil. This precautionary action is done in order to maintain the as-manufactured moisture content for as long as possible. Flux should never be exposed to wet conditions, such as rain or snow.

## Storage

- Unopened flux bags must be stored in maintained storage conditions as follows:  
T: 20 +/- 10°C Relative humidity: as low as possible - not exceeding 60%.
- Fluxes delivered in aluminium lined BigBags can be stored under more severe climatic conditions, because the packaging protects the flux reliably from moisture pick-up, as

long as it is unopened and undamaged.

- The content of unprotected flux hoppers must, after an 8 hours shift, be placed in a drying cabinet or heated flux hopper at a temperature of 150 +/- 25°C.
- Remaining flux from opened bags must be placed at a temperature of 150 +/- 25°C.

## Re-cycling

- Moisture and oil must be removed from the compressed air used in the re-cycling system.
- Addition of new flux must be done with the proportion of at least one part new flux to three parts re-cycled flux.
- Foreign material, such as millscale and slag, must be removed by a suitable system, such as sieving

## Re-drying

- When handled and stored as above, the ESAB fluxes can normally be used straight away.

- In severe applications, stipulated by the applicable material specification, re-drying of the flux is recommended.
- Furthermore, if the flux has somehow picked up moisture, re-drying can return the flux to its original moisture content.
- Re-drying shall be performed as follows: Agglomerated fluxes: 300 +/- 25°C for about 2-4 hours. Fused fluxes: 200 +/- 50°C for about 2-4 hours.
- Redrying must be done either in equipment that turns the flux so that the moisture can evaporate easily or in an oven on shallow plates with a flux height not exceeding 5 cm.
- Re-dried flux, not immediately used, must be kept at 150 +/- 25°C before use.



#### **JK 50 Powder Dryer**

- Redries flux at max. 500°C for about 3 hours
- Then automatically drops temperature to pre-set value (max. 200°C) and stores flux
- Capacity: 50 l
- Supply voltage: 400V, 3 phase; output: 3.7 kW



#### **JS 200 Flux storage silo**

- Keeps flux dry and clean
- Adjustable temperature between 100 and 300°C
- Capacity: 200 l
- Supply voltage: 220V, 1 phase; output: 2 kW

# World leader in welding and cutting technology and systems.



ESAB operates at the forefront of welding and cutting technology. Over one hundred years of continuous improvement in products and processes enables us to meet the challenges of technological advance in every sector in which ESAB operates.

## Quality and environment standards

Quality, the environment and safety are three key areas of focus. ESAB is one of few international companies to have achieved the ISO 14001 and OHSAS 18001 standards in Environmental, Health & Safety Management

Systems across all our global manufacturing facilities.

At ESAB, quality is an ongoing process that is at the heart of all our production processes and facilities worldwide. Multinational manufacturing, local representation and an international network of independent distributors brings the benefits of ESAB quality and unrivalled expertise in materials and processes within reach of all our customers, wherever they are located.

ESAB Sales and Support Offices worldwide



Global solutions for local customers - everywhere.

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