



STORAGE & HANDLING

COVERED ELECTRODE | SUB FLUX | FLUX CORED WIRE

Storage & handling

1. Covered Electrode

Handling and keeping standards of electrodes.

Sufficiently dried welding consumables do need the storage in order to prevent from re-moisture absorption during taking in and out the goods by employees.

Moreover, it's recommended to place the [drying case](#) (maintaining 100~120°C) around workplace to enable workers conveniently take in and out the goods.

The moisture absorption speed of welding consumables largely rises and falls by the weather conditions. It is ideal to decide each day's working standard by measuring daily temperature and humidity after setting a time limit when the employee use welding consumables taking in and out from the [drying case](#). But when considering the actual working conditions, it's quite impossible to do so.

Therefore, choosing the worst condition when setting up the standards is compulsorily needed to find a solution.

Now, when setting up the standards after considering all things about working efficiency with limiting the moisture absorption rate below 0.6% for low hydrogen electrode.

These are the recommendable standards;

First of all, limiting a time limit within 6 hours between taking out the welding consumables from drying case and its final usage.

1. **Dry in dry furnace for right after removing it's package**
2. **Keep in holding oven promptly after**
3. **Use preheated portable dryer when taking out on the scene of**
4. **Estimate the quantity of welding consumable needed for the work. (collect all the remainings and use after its re-drying)**

2. The managing of redried welding consumables (The problems caused by moisture absorption)

These are the influences of moisture absorption on weldability and physical properties.

1. Welding consumables are getting wet as absorbing moisture in the atmosphere. Those wet welding consumables are not functional as much as original s and they bring about poor weldability and crack resistance. From time to time they cause a serious problem.
2. As electrodes are wet, arc stays unstable and spatte rs are increasing. Plus it is difficult to remove slag, bead appearance is getting rough, blow holes and under cut generate. If welding with wet flux, blow holes, pork marks and pit generate. More over it brings about defects such as difficulties to remove slag and roughness of bead appearance. These defects are preventable by appropriate treatments of welding consumables and re dryness.
3. Problems in welding performance previously mentioned are not only ones. When electrodes are wet, hydrogen gas coming out of H₂O decomposition increase its ratio in the deposited metal, in conclusion it mainly causes cracks.

Storage & handling

- The rate of moisture absorption differentiates according to not only temperature and humidity in the atmosphere but also packing method.
- As long as moisture absorption ratio does not influence a serious problem in welding performance, the maximum allowed moisture absorption ratio is called limited moisture absorption ratio. It is decided considering the risk of crack generation in terms of non low hydrogen types.

3. The moisture and dryness of electrodes

- The content of moisture must be controlled approximately in 1.0% while packing process of electrodes for mild
- In case of low hydrogen type, the content of moisture is 0.0~0.5% while packing process after the process of high temperature dryness.
- Limit capacity of moisture absorption.

Classification	AWS	Limit capacity of moisture absorption	Product name
Ilmenite type	E 6019 (KS E4301)	3%	S-4301.I
High titania type	E 6013	3%	S-6013.LF
Iron powder iron oxide type	E 6027	2%	S-6027.LF
Low hydrogen type	E 7016	0.6%	S-7012.H

- If the content of moisture is more than limit capacity, there will be some risks like deterioration of efficiency or of crack resistance.
- Capacity of moisture absorption of electrodes for mild steels and low hydrogen type
 - Electrode for mild steels absorbs approximately 3% of moisture if it is left for 8 hours in the air (30°C , relative humidity 80%).
 - Perfectly dried Low hydrogen type electrode absorbs 0.6% of moisture if it is left for 5hours in the air (30°C , relative humidity 80%).
- Dry condition.
 - It needs proper temperature and time during re-dryness of electrodes. Typically 60 minutes are proper, minimum 30 minutes.
 - If it exceeds the critical temperature (depends on classification of electrodes), it causes a change in quality, crack in coating flux and deterioration of efficiency
 - Low hydrogen type is dried in 300°C during 1 hour. Electrode for mild steels also can be used without problem if it is warmed in a properly heated tube.

Storage & handling

4. Re-dryness of covered electrode for arc welding and proper temperature in use.

The hydrogen quantity in deposited metal after dryness of covered electrode and it's re-dryness:
(The example of hydrogen quantity in deposited metal after dryness of covered electrode)

Covered electrode for arc welding	The hydrogen quantity of deposited metal	
	Low hydrogen type	Extremely low hydrogen type
For mild steels and HT50	4.0	2.0
For HT60	2.5	1.0
For HT70 and 80	1.0	0.5

The proper temperature in use and re-dryness: AWS A5.1 91 Appendix Table A2

AWS Classification	Re-dryness	Preservation
E6010, E6011	-	-
E6012, E6013, E6019 E6022, E6020, E6027 E7014, E7024, E7027	120 ~ 150°C 1 Hour	12 ~ 24°C (more than surrounding)
E7015, E7016, E7018 E7028, E7048, E7018M	260 ~ 427°C 1~2 Hours	30 ~ 140°C (more than surrounding temperature)



Storage & handling

Redry condition of covered electrodes welding and SUB FLUX.

Steel type	Covering material type	Product name	Limited moisture absorption ratio	Dry conditons	Dry time (min)
Covered Electrodes for Carbon Steels	Ilmenite type	S-4301.I, S 4301.LF	2.5	70 ~ 100°C	30 ~ 60
	Lime titania type	S-4303.V, S 4303.T	2.0	70 ~ 100°C	30 ~ 60
	High cellulose type	S-6010D, S 6011.D	5.0	70 ~ 100°C	30 ~ 60
	High titania type	S-6013.LF, S-6013.V S-7014.F, S-7024.F	3.0	70 ~ 100°C	30 ~ 60
	Iron power oxide titania type	S-7016.O, S-7016 .M	2.0	70 ~ 100°C	30 ~ 60
	Low hydrogen type	S-7048.V	0.5	300 ~ 350°C	30 ~ 60
	Iron powder oxide type	S-6027.LF	2.0	70 ~ 100°C	30 ~ 60
Covered Electrodes for High Tensile Steels	Low hydrogen type	S-7016.H, S 7016.LF, S-7016.L S-7016.N, S 7016.G, S-7016.LS	0.5	300 ~ 350°C	30 ~ 60
		S-8016.G, S-9016.G S-10016.G, S-11016.G	0.5	350 ~ 400°C	60
	Iron powder low hydrogen type	S-7018.G, S-8018.W S-7028.F, S-8018.G, S-9018.M(G)	0.5	350 ~ 400°C	60
Covered Electrodes for Low Temperature Service and Low Alloy Steels	Low hydrogen type	S-7016.N, S-8018.W S-7016.LF, S-7016.L, S-7016.N S-7016.G, S-7016.LS	0.5	350 ~ 400°C	60
	High cellulose type	S-7010A1, S-7018.A1, S-8018B2	5.0	70 ~ 100°C	30 ~ 60
	Iron powder low hydrogen type	S-8018.C1, S-9018.B3 S-11018.M, S-8018.C3	0.5	350 ~ 400°C	60
Covered Electrodes for Hardfacing Applications	Special type	SRL	0.5	350 ~ 400°C	60
	Titania type	S-240.R, S-350A.R	2.0	150 ~ 200°C	30 ~ 60
	Low hydrogen type	S-260A.B, S-350B.B, S-400A.B, S-450B.B, S-500B.B, S-600B.B S-700B.B	0.5	350 ~ 400°C	60
		S-13MNB	1.0	150 ~ 200°C	30 ~ 60
Covered Electrodes for Stainless Steels	Lime titania type	S-308.16N , S-309.16N, S-309Mo.16, S-309L.16, S 309cb.16, S-316.16N, S 316L.16N, S-347.16, S-308L.16N	1.0	300 ~ 350°C	30 ~ 60
Covered Electrodes for Cast Nickel alloy Steels	Graphite type	S-NCI, S-IGT, S-FCF	1.5	70 ~ 100°C	30 ~ 60
Submerged Flux	Bonded type Flux	S-707, S-727, S-777, S-717ULT S-737, S-787TB, S-717, S-705EF S-777MX	0.1	300 ~ 350°C	60

Storage & handling

5. SUB FLUX

Keeping & handling method of SUB FLUX

SUB FLUX do not cause any problem like toughness, crack when a crystal in the particle maintains below 0.1% at the 1.000°C. So It need to be paid close attention.

Regarding the SUB FLUX, it will be dried naturally when it is welded. Therefore there will be no problem to use it continuously after confining the dryness.

- a After unpacking the FLUX, it need to be dry again and spread it evenly below 30mm in the drying furnace.
- b It need to be dry again because the rest of SUB FLUX is easy to absorb moisture when finished.
- c The FLUX that is dry again contain ma ny integration so it need to be mixed new FLUX with the ratio of one to three. That's way you can prevent the problem from welding.
- d In case of welding the FLUX outside, it will need to be preheating the basic material to remove moisture which is caused by leaving a welding material for a long time.

In case of SUB welding, It is kind of heat input welding so it is necessary to avoid preheating, considered a drop of intensity, occurrence of high temperature crack and transformation of welding material.

But, especially when welded outside it will be desirable to preheat between 40 and 70°C to remove the moisture that is caused by leaving a welding material for a long time. In this case it is often to occur moisture cohesion phenomenon by preheating method & temperature.

- Make sure that keep the preheating temperature so as not to occur moisture cohesion phenomenon around the groove part.
- The preheating place should be avoided from the groove part. Also you have to push the preheating torch on the outside to the thickness of 5 times in the both side. That's way you can prevent from the moisture cohesion phenomenon.

Dry and crystal clearness of SUB FLUX

1. When you pack the SUB FLUX, the content of crystal clearness should be controlled under 0.10%.
2. The measurement of crystal clearness should be right after re-drying.

Dry condition of FLUX

- a. When you re dry FLUX, you should keep the temperature & time. An appropriate re-drying temperature will be about 300°C and an appropriate time is 60 min.
- b. FLUX should be kept around 100 ~ 120°C to avoid the re-moisture absorption from the air.
- c. Re-dry of SUB FLUX should be carried in the 300°C for one hour. When you use it, it is desirable to maintain the same condition just like low hydrogen Arc Weld (about 100°C)



Storage & handling

6. FCW

How to keep FCW

when it comes to fcw, the diffusible hydrogen of deposited metal is not influenced under the condition of relative humidity 60 %, normal temperature (10 ~ 30°C) up to 6 month without unsealing, because moisture absorption property is very slight.

However for the purpose of preventing wire surface from contaminating , a spool is supposed to be covered. Plus in the case of carelessness, surface gets rusty. If it is opened and used again after long storage, it should be watchful of moisture absorption and rust.

How to prevent fcw from moisture absorption

generally, FCW is dealt with bluing treatment or the other surface treatments for improvement of antirust effect. In the case of long storage, fcw is packed with vaporable antirust paper and vinyl. Wires packed by spools are not able to be re dried, but if opened, wires should be stored in the condition of 12 ~ 24°C higher than surroundings. If wires are exposed in the rainy season, welding defects can be reduced due to the removal of wires surface moisture absorption after 60 ~ 80°C 2 hour re-drying as long as plastic spool is not transformed.

■ A test example of FCW moisture absorption aptitude

1. Purpose

the consideration of moisture absorption aptitude when FCW is used
(maintenance of remaining sealed, maintenance after the removal of packing)

2. Clauses

reaction of wire in the condition of constant temperature and moisture
(temperature: 40°C, relative humidity : 80%, time : 72 hours) weldability (h-fillet weldability) diffusible hydrogen ratio in the deposited metal (gas chromatography method)

3. Outcomes (reactivity in the condition of constant temperature and moisture)

Outcomes / Condition	Maintenance of remaining sealed	Maintenance after the removal of packing
* Constant temperature and Moisture reaction test - inside temp. : 40°C - relative moisture : 80%	* No change both wire surface and inside reaction	* Rusty points partially on wire surface * Wire surface and inside getting rough
- Maintenance time : 24, 36, 72 hr * H-fillet weldability (300a / 31v / 40s) * Diffusible hydrogen ratio (Gas chromatography Method)	* Almost the same With prior condition Of constant temperature and moisture maintenance	* Due to the roughness of wire surface, Feedability is getting worse * W/h partially generates after 24 hours Especially , it generates inside strongly)
	* Avg. ≤ 10cc/100g	* Avg. ≤ 10cc/100g

Storage & handling

7. Handling, packaging and storage of flux cored wire

in order to achieve an excellent welding quality, the methods below must be followed.

1. Storage & handling

in order to prevent any moisture absorption, the wire must be stored under the conditions as below,
temperature : $30 \pm 10^{\circ}\text{c}$, humidity : 50~70%, wrapped with plastic bag

- New products must be stored at dry and well ventilated place. New products must be placed over the wooden pallet and at least 10 cm from the sidewall
- Products must be separated by size, item, and outer diameter.
- It requires a full caution while handling

2. Redry

generally, surface and inside filling flux of flux cored wires are easily exposed to moisture while storage. It could cause blowholes in the weld metal. To prevent from any defect, we advise you to execute redry. Recommended temperature and time of redry are depending on packing method as below,

- Basket spool / masonite spool : 150°c , 5 hours
- Plastic spool : 50°c , 48 hours
- The plastic bag must be removed before

3. Remarks

- Welders must receive rapidly the exact amount of flux cored wires to prevent from any moisture absorption.
- When welders finish the welding, wires must be protected from the moisture absorption
- If welders stop welding more than 4 hours, one of following methods must be proceeded:

* Place wires into the drying oven (temperature : $30 \pm 10^{\circ}\text{c}$, humidity : max. 60%)

* Welder can use again without removing the fcw from feeder when it is used within 4 hour.

* Welders must resume welding within one hour on rainy day.





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