This MSDS consists of submerged fluxes and wires, and the list is as follow. The symbol ( ) indicates MSDS No.

<table>
<thead>
<tr>
<th>Submerged Flux</th>
<th>OK Flux 10.90 (ESC 1-14-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submerged Wire</td>
<td>NCM-S625 (Wire) (ESC 1-17-3)</td>
</tr>
<tr>
<td></td>
<td>OK Autrod 19.81 (Strip) (ESC 1-17-3)</td>
</tr>
</tbody>
</table>
1. PRODUCT AND COMPANY IDENTIFICATION

A. Product Name
Welding Material (Baked Type Flux for Submerged Arc Welding)
OK Flux 10.90

B. Recommended use of the chemical and restrictions on use
1) Recommended use
Baked type flux for submerged arc welding (refer to product guide book)

2) Restrictions on use
Refer to 7. Handling and Storage

C. Supplier’s details
1) Name
ESAB SeAH Corporation

2) Address
51 Seongju-dong, Seongsan-gu, Changwon, Kyungnam, Korea

3) Phone number
055-269-8111

D. Emergency phone number
055-269-8111, 055-269-8225

2. HAZARD IDENTIFICATION

A. Classification of product
Skin sensitizer: category 1
Carcinogenicity: category 2
Specific target organ toxicity (repeated exposure): category 2

B. GHS Label elements, including precautionary statements

1) Pictograms (Hazard symbols)

![Pictogram]

2) Signal word
Warning

3) Hazard statements
H317 May cause an allergic skin reaction.
H351 Suspected of causing cancer.
H373 May cause damage to organs through prolonged or repeated exposure.

4) Precautionary statements

A) Prevention
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P272 Contaminated work clothing should not be allowed out of the workplace.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

B) Response
P302+P352 If on skin, wash with plenty of water.
P308+P313 If exposed or concerned, get medical advice/attention.
P314 Get medical advice/attention if you feel unwell.
P333+P313 If skin irritation or rash occurs, get medical advice/attention.
P363 Wash contaminated clothing before reuse.
C) Storage
P405 Store locked up.

D) Disposal
P501 Dispose of contents/container in accordance with related laws.

C. Other hazards which do not result in classification
No available data

D. Hazards During welding
When these products are used in a welding process, the most important hazards are heat, radiation, electric shock and welding fumes.
Heat: Spatter and melting metal can cause burn injuries and start fires.
Radiation: Arc rays can severely damage eyes or skin.
Electricity: Electric shock can kill.
Fumes: Overexposure to welding fume may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes. Chronic overexposure to welding fumes may affect pulmonary function.

1) Prevention: Welding fumes and gases may be dangerous to your health. Use adequate ventilation to keep fumes from the breathing zone. Arc rays may injure eyes and burn skin. Wear adequate hand, head, eye and body protection.

2) Response: Not applicable

3) Storage: Stored locked up and keep dry

4) Disposal: Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>CAS No.</th>
<th>OK Flux 10.90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Oxide (Al₂O₃)</td>
<td>1344-28-1</td>
<td>30~40</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>7440-47-3</td>
<td>1~2</td>
</tr>
<tr>
<td>Calcium Fluoride (CaF₂)</td>
<td>7789-75-5</td>
<td>40~50</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>7439-96-5</td>
<td>10~15</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>7440-02-0</td>
<td>1~2</td>
</tr>
<tr>
<td>Sodium Silicate</td>
<td>1344-09-8</td>
<td>5~10</td>
</tr>
</tbody>
</table>

AWS Classification

4. FIRST AID MEASURES

A. Eye contact
If irritation persists, obtain medical assistance.
To remove dusts or fumes flush with water for at least twenty minutes.
For radiation burns due to arc flash, see physician.

B. Skin contact
If skin irritation or erythema occurs, see physician.
Clean the contaminated clothing for reuse.
For skin burns from arc radiation, promptly flush with plenty of cold water.
Remove contaminated clothing and shoes, and isolate contaminated area.
To remove dust or particles wash with mild soap and water for at least twenty minutes.

C. Inhalation
If exposure, obtain medical assistance immediately.
Move to safety area.  
If breathing has stopped, perform Cardio Pulmonary Resuscitation (CPR) and obtain medical assistance immediately.  
If breathing is difficult, provide fresh air and call physician.  
Keep warm and stabilize body.

D. Ingestion  
Call a physician or poison control center immediately.  
Do not induce vomiting unless directed to do so by a physician.

E. Others  
If exposure, obtain special medical assistance immediately.  
Recognize materials and do protective action.  
In an electric shock, Disconnect and turn off the power.  
Use a nonconductive material to pull victim away from contact with live parts or wires.  
If not breathing, begin artificial respiration, preferably mouth-to-mouth.  
If no detectable pulse, begin Cardio Pulmonary Resuscitation (CPR).  
Immediately call a physician.

5. FIRE-FIGHTING MEASURES

A. Suitable extinguishing media  
No specific recommendations for welding consumables.  
Welding arcs and sparks can ignite combustible and flammable materials.  
Use the extinguishing media recommended for the burning materials and fire situation (CO2, water).  
Cover fire site with dried sand or soil.

B. Specific hazards arising from the chemical  
A harmful gas will be produced at high temperature.  
When heated, container may explode.  
Friction, heat, and spark can ignite materials.  
Materials can be re-ignited after extinguishing.

C. Special protective actions for fire-fighters  
Wear proper protective equipment.  
Keep a certain distance and extinguish the fire.  
If not dangerous, remove container.  
If impossible extinguish, protect surround and extinguish itself.

6. ACCIDENTAL RELEASE MEASURES

A. Personal precautions, protective equipment and emergency procedures  
Avoid inhalation of dust, fume, gas, mist, and spray.  
Clean up the spilling and follow the section 8. C. individual protection measures.  
Don’t touch and don’t wake around the spilling.  
Remove all ignition sources.  
If not dangerous, stop leaking.  
Pay attention to the avoiding substances and condition.

B. Environmental precautions
The spilling can cause pollution.
Block the inflow to waterway, drain, basement, and enclosed area.

C. Method and materials for containment and cleaning up
Absorb the spilling with the Inert materials (dried sand or soil) and put it to chemical waste container.
Wash the contaminated area with water and soap.

7. HANDLING AND STORAGE

A. Precautions for safe handling
Don’t treat before reading and understanding all safe precautions.
Avoid inhalation of dust, fume, gas, mist, and spray.
Wash handling part after finishing handling.
Don’t eat, drink, and smoke when treating.
Follow MSDS/label precautions when treating empty container.
Use with caution when handling and storing.
Remove the cap with caution.
If no a ventilation system, don’t enter the storage area.
Prevent dust generation.
Don’t touch products when welding.
Wear the nonconductive gloves.
Don’t use damaged or wet gloves.
Wear insulating shoes at workplace.
Don’t touch terminal of products, welding cable, and welding machine socket,
Don’t wear wet clothing at conductive place.
Keep the instruction manual and precautions before welding.
Use proper welding cable and repair or exchange the damaged cables.
Remove hazardous materials (combustibles or flammable liquid) to prevent spatter from firing, or cover them with nonflammable materials.
Don’t weld container or pipe with combustible or flammable materials, or enclosed container or pipe.
Don’t put a hot welding material around combustible or flammable materials.
Remove hidden combustible or flammable materials when welding around ceiling, floor, and wall.
Keep extinguisher around workplace.

B. Conditions for safe storage
Keep away food and drink.
Store in a well-ventilated and low humidity place.

8. EXPOSURE CONTROLS/PERSOANAL PROTECTION

A. Control parameters

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>CAS No.</th>
<th>Internal</th>
<th></th>
<th>External</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TWA(1)</td>
<td>STEL(2)</td>
<td>TLV(3)</td>
<td>PEL(4)</td>
</tr>
<tr>
<td>Aluminum Oxide (Al₂O₃)</td>
<td>1344-28-1</td>
<td>10</td>
<td>-</td>
<td>1** (as Al)</td>
<td>15*, 5**</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>7440-47-3</td>
<td>0.5</td>
<td>-</td>
<td>0.5</td>
<td>1</td>
</tr>
</tbody>
</table>
Calcium Fluoride (CaF$_2$) | 7789-75-5 | - | - | 2.5 | 2.5 |
Manganese (Mn) | 7439-96-5 | 1 | 3 | 0.2 | 5 |
Nickel (Ni) | 7440-02-0 | 1 | - | 1.5*** | 1 |
Sodium Silicate | 1344-09-8 | - | - | - | - |

(1) TWA : Time Weighted Average
(2) STEL : Short Time Exposure Limit
(3) TLV : Threshold Limit Values according to American Conference of Governmental Hygienists, 2012
(4) PEL : Permissible Exposure Limits according to the Occupational Safety & Health Administration (USA)
* Total dust, ** Respirable fraction, *** Inhalable fraction.
^ Value from OSHA expressed in PPM and value shown is conversion to mg/m$^3$
## AIHA WEEL (particulates only)
### Respirable dust

2) Biological limit values Not available

B. Appropriate engineering controls

To install local ventilation system in the vicinity of welding fume sources is more effective than to deal with fume spreaded at workplace

Natural ventilation : If the concentration is low, the space is 284m$^3$ or more per two workers, and a ceiling height of space is more 5 meter, the natural ventilation is applied. It is also applied to the non-enclosed space with dilution.

Local ventilation : Install the appropriate local ventilation system depending on the nature of processing and welding materials. If the local ventilation is installed newly, the combined type, local air supply and local exhaust, is recommended. Local ventilation system installed closer to the worker as possible is desirable. It must have the ventability lower than the exposure limit. It is the most effective system to remove fume, but if the exhaust is too larger, welding defects will be occurred because of disturbance of the shielding gas. Workers should turn on it while working and conduct maintenance.

Portable local ventilation : It is applied when working in a confined space such as ship-body assembly or in the tank. Local air supply and local exhaust takes place at the same time. If necessary, run all the time. If welding fume exhausts to other workplace, portable dust collection equipment should be installed.

Full ventilation : Workplace is ventilized with fans and blowers. It is effective when workplace is a relatively small volume. To remove fume, parallel push-pull ventilation should be considered. It should be designed and installed accordind to the workplace.

C. Individual protection measures

Use proective equipment cerified by the Korea Occupational Safety and Health agency while welding.

1) Respiratory protecton

To prevent fume or hazardous gases, wear a mask while welding as below.
Dust mask : Wear it in a bad ventilation condition while welding.
Remove dust or dry frequently after using.
Gas mask : Wear a gas mask when ventilation is not sufficient such as inside the tank or in a narrow place.
Select a gas mask that can be used to combined with protective goggles
Use the proper canister according to hazardous substance.
Air-supplied respirator : Use air-line mask with compressed air.

2) Eye protection

Use a facial mask with filter screen from the ultraviolet of arc or spatter. There are face shield helmet or hand shielded helmet.
Use shielding grade as welding type.

<table>
<thead>
<tr>
<th>Welding type</th>
<th>Shielding grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielded metal arc welding</td>
<td>10-12</td>
</tr>
<tr>
<td>Gas metal arc welding</td>
<td>11-12</td>
</tr>
<tr>
<td>Gas tungsten arc welding</td>
<td>12</td>
</tr>
<tr>
<td>Flux cored arc welding</td>
<td>11-12</td>
</tr>
</tbody>
</table>

3) Hand protection
Wear the nonconductive gloves.
Don’t use damaged or wet gloves.

4) Body protection
Wear leather apron and welding gloves to prevent burns and take insulating shoes at workplace.

9. PHYSICAL AND CHEMICAL PROPERTIES

A. Appearance
1) Physical state Solid
2) Colour Silver or gray

B. Odour Not available
C. Odour threshold Not available
D. pH Not available
E. Melting point/freezing point Not available
F. Initial boiling point and boiling range Not available
G. Flash point Not available
H. Evaporation rate Not available
I. Flammability (Solid, Gas) Not available
J. Upper/lower flammability or explosive limits Not available
K. Vapour pressure Not available
L. Vapour density Not available
M. Relative density Not available
N. Solubility Not available
O. Partition coefficient: n-octanol/water Not available
P. Auto-ignition temperature Not available
Q. Decomposition temperature Not available
R. Viscosity Not available
S. Molecular weight Not available

10. STABILITY AND REACTIVITY

A. Reactivity, chemical stability, and possibility of hazardous reactions
Although may be burnt, ignition is difficult.
During fire, irritant gases and fume will be produced.

B. Conditions to avoid
Ignition sources (heat, spark, blaze)
C. Incompatible materials
Combustible or flammable materials, chemical substances like acids and strong bases

D. Hazardous decomposition products
May produce irritant gases and fume

11. TOXICOLOGICAL INFORMATION

A. Information on the likely routes of exposure
Not available

B. Health hazard information

1) Acute toxicity
   A) Oral
   B) Dermal
   C) Inhalation
   Not available

2) Skin corrosion/irritation
   Not available

3) Serious eye damage/irritation
   Not available

4) Respiratory sensitization
   Not available

5) Skin sensitization
   May cause an allergic skin reaction.

6) Carcinogenicity
   Suspected of causing cancer
   A) Occupation safety and health acts
   B) The ministry of employment and labor
   2 (Nickel)
   C) IARC
   Group 2 (Nickel)
   D) OSHA
   Not available
   E) ACGIH
   A5 (Nickel)
   F) NTP
   R (Nickel)
   G) EU CLP
   Carc. 2 (Nickel)

7) Germ cell mutagenicity
   Not available

8) Reproductive toxicity
   Not available

9) STOT-single exposure
   Not available

10) STOT-repeated exposure
    May cause damage to organs through prolonged or repeated exposure.

11) Aspiration hazard
    Not available

12. ECOLOGICAL INFORMATION

A. Toxicity
   1) Fish
   Not available
   2) Crustacea
   Not available
   3) Birds
   Not available

B. Persistence and degradability
   1) Persistence
   Not available
   2) Degradability
   Not available

C. Bioaccumulative potential
   1) Bioconcentration factor
   Not available
This Safety Data Sheet complies with the guidance on Occupation Safety and Health Act and enforcement regulations.

2) Biodegradation
D. Mobility in soil
E. Other advers effects

Not available

Not available

Not available

13. DISPOSAL CONSIDERATIONS

A. Disposal method

Disposal contents and container as wastes control act.

B. Precautions

Disposal contents and container as wastes control act.

14. TRANSPORT INFORMATION

A. UN number

Not available

B. UN proper shipping name

Not available

C. Transport hazard class

Not available

D. Packing group

Not available

E. Environmental hazards

Not available

F. Special precautions for user

1) Fire emergency action

Not available

2) Leak emergency action

Not available

15. REGULATORY INFORMATION

A. Internal regulation

No available internal regulation against products.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Al₂O₃</th>
<th>Cr</th>
<th>CaF₂</th>
<th>Mn</th>
<th>Ni</th>
<th>Na-silicate</th>
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<tbody>
<tr>
<td>Control material</td>
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<tr>
<td>Special health monitoring material</td>
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<td>Permission material</td>
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<td>Toxic Chemicals Control Act</td>
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<td>Safety Control of Dangerous Substances Act</td>
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<tr>
<td>Wastes Control Act</td>
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<td>X</td>
<td>X</td>
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<td>X</td>
</tr>
</tbody>
</table>

Work environment monitoring material: unless noted, measure every 6 months.
Special health monitoring material: unless noted, measure every 12 months.
O: included
X: not included.

B. Other internal or external regulations

No available other internal or external regulation against products.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Al₂O₃</th>
<th>Cr</th>
<th>CaF₂</th>
<th>Mn</th>
<th>Ni</th>
<th>Na-silicate</th>
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</thead>
<tbody>
<tr>
<td>Internal regulation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Persistent Organic Pollutant Act</td>
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</tbody>
</table>
This Safety Data Sheet complies with the guidance on Occupation Safety and Health Act and enforcement regulations.

### External regulation

<table>
<thead>
<tr>
<th></th>
<th>OSHA</th>
<th>CERCLA</th>
<th>EPCRA 302</th>
<th>EPCRA 304</th>
<th>EPCRA 313</th>
<th>Rotterdam convention material</th>
<th>Stockholm convention material</th>
<th>Montreal protocol material</th>
<th>EU classification (result)</th>
<th>EU classification (R-phrase)</th>
<th>EU classification (S-phrase)</th>
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<tr>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<td>X</td>
<td>X</td>
<td>Carc. Cat. 3; R40 R43 T; R48/23, R52, R53</td>
<td>R40 R43 R48/23 R52/53</td>
<td>S2 S36/37/39 S45 S61</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

X : not included.

### 16. OTHER INFORMATION

#### A. References
- EU REGULATION (EC) No 1272/2008
- EU DIRECTIVE 2009/2/EC
- The Ministry of Employment and Labor notification No. 2012-31
- Threshold Limit Values according to American Conference of Governmental Hygienists, 2012
- Permissible Exposure Limits according to the Occupational Safety & Health Administration (USA)
- Chemical Information System (http://ncis.nier.go.kr/ncis)
- Korea Occupational Safety & Health Agency (http://www.kosha.or.kr)
- National Emergency Management Agency (http://www.nema.go.kr)

#### B. First issued date
- 2013. 06. 11

#### C. Revision
1) Revision No.
- 1
2) Date revised
- 2013.12.02
1. PRODUCT AND COMPANY IDENTIFICATION

A. Product Name
Welding Material (Wire for Submerged Arc Welding)
NCM-S625 (Wire), OK Band 11.92 (Strip), OK Autrod 19.81 (Strip), SMP-S308(L), SMP-S309(L), SMP-S316(L)

B. Recommended use of the chemical and restrictions on use
1) Recommended use
Wire for submerged arc welding (refer to product guide book)
2) Restrictions on use
Refer to 7. Handling and Storage

C. Supplier’s details
1) Name
ESAB SeAH Corporation
2) Address
51 Seongju-dong, Seongsan-gu, Changwon, Kyungnam, Korea
3) Phone number
055-269-8111

D. Emergency phone number
055-269-8111, 055-269-8225

2. HAZARD IDENTIFICATION

A. Classification of product
Skin sensitizer: category 1
Carcinogenicity: category 2
Specific target organ toxicity (repeated exposure): category 1

B. GHS Label elements, including precautionary statements

1) Pictograms (Hazard symbols)

2) Signal word
Warning

3) Hazard statements
H317 May cause an allergic skin reaction.
H351 Suspected of causing cancer.
H372 Cause damage to organs through prolonged or repeated exposure.

4) Precautionary statements
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P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P264 Wash the contaminated part thoroughly after handling..
P270 Don’t eat, drink or smoke when using this product
P272 Contaminated work clothing should not be allowed out of the workplace.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

B) Response
P302+P352 If on skin, wash with plenty of water.
P308+P313 If exposed or concerned, get medical advice/attention.
P314 Get medical advice/attention if you feel unwell.
P333+P313 If skin irritation or rash occurs, get medical advice/attention.
P363 Wash contaminated clothing before reuse.

C) Storage
P405 Store locked up.

D) Disposal
P501 Dispose of contents/container in accordance with related laws.

C. Other hazards which do not result in classification  No available data

D. Hazards During welding
When these products are used in a welding process, the most important hazards are heat, radiation, electric shock and welding fumes.

Heat : Spatter and melting metal can cause burn injuries and start fires.
Radiation : Arc rays can severely damage eyes or skin.
Electricity : Electric shock can kill.
Fumes : Overexposure to welding fume may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes. Chronic overexposure to welding fumes may affect pulmonary function.

1) Prevention : Welding fumes and gases may be dangerous to your health. Use adequate ventilation to keep fumes from the breathing zone. Arc rays may injure eyes and burn skin. Wear adequate hand, head, eye and body protection.

2) Response : Not applicable

3) Storage : Stored locked up and keep dry

4) Disposal : Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

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<thead>
<tr>
<th>Ingredient</th>
<th>CAS No.</th>
<th>NCM-S625 (Wire)</th>
<th>OK Band 11.92 (Strip)</th>
<th>OK Autrod 19.81 (Strip)</th>
<th>SMP-S308(L)</th>
<th>SMP-S309(L)</th>
<th>SMP-S316(L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (Al)</td>
<td>7429-90-5</td>
<td>-</td>
<td>-</td>
<td>&lt;1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>7440-47-3</td>
<td>20~30</td>
<td>20~30</td>
<td>20~25</td>
<td>19.5~22.0</td>
<td>23~25</td>
<td>18~20</td>
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<tr>
<td>Cobalt (Co)</td>
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<td>-</td>
<td>&lt;0.3</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Copper (Cu)</td>
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<tr>
<td>Iron (Fe)</td>
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<td>1~2</td>
<td>1~2</td>
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</table>

4. FIRST AID MEASURES

A. Eye contact
If irritation persists, obtain medical assistance.
To remove dusts or fumes flush with water for at least twenty minutes.
For radiation burns due to arc flash, see physician.
B. Skin contact
   If skin irritation or erythema occurs, see physician.
   Clean the contaminated clothing for reuse.
   For skin burns from arc radiation, promptly flush with plenty of cold water.
   Remove contaminated clothing and shoes, and isolate contaminated area.
   To remove dust or particles wash with mild soap and water for at least twenty minutes.

C. Inhalation
   If exposure, obtain medical assistance immediately.
   Move to safety area.
   If breathing has stopped, perform Cardio Pulmonary Resuscitation (CPR) and obtain medical assistance immediately.
   If breathing is difficult, provide fresh air and call physician.
   Keep warm and stabilize body.

D. Ingestion
   Call a physician or poison control center immediately.
   Do not induce vomiting unless directed to do so by a physician.

E. Others
   If exposure, obtain special medical assistance immediately.
   Recognize materials and do protective action.
   In an electric shock, Disconnect and turn off the power.
   Use a nonconductive material to pull victim away from contact with live parts or wires.
   If not breathing, begin artificial respiration, preferably mouth-to-mouth.
   If no detectable pulse, begin Cardio Pulmonary Resuscitation (CPR).
   Immediately call a physician.

5. FIRE-FIGHTING MEASURES

A. Suitable extinguishing media
   No specific recommendations for welding consumables.
   Welding arcs and sparks can ignite combustible and flammable materials.
   Use the extinguishing media recommended for the burning materials and fire situation (CO2, water).
   Cover fire site with dried sand or soil.

B. Specific hazards arising from the chemical
   A harmful gas will be produced at high temperature.
   When heated, container may explode.
   Friction, heat, and spark can ignite materials.
   Materials can be re-ignited after extinguishing.

C. Special protective actions for fire-fighters
   Wear proper protective equipment.
   Keep a certain distance and extinguish the fire.
   If not dangerous, remove container.
   If impossible extinguish, protect surround and extinguish itself.

6. ACCIDENTAL RELEASE MEASURES
A. Personal precautions, protective equipment and emergency procedures
   Avoid inhalation of dust, fume, gas, mist, and spray.
   Clean up the spilling and follow the section 8. C. individual protection measures.
   Don’t touch and don’t wake around the spilling.
   Remove all ignition sources.
   If not dangerous, stop leaking.
   Pay attention to the avoiding substances and condition.

B. Environmental precautions
   The spilling can cause pollution.
   Block the inflow to waterway, drain, basement, and enclosed area.

C. Method and materials for containment and cleaning up
   Absorb the spilling with the Inert materials (dried sand or soil) and put it to chemical waste container.
   Wash the contaminated area with water and soap.

7. HANDLING AND STORAGE

A. Precautions for safe handling
   Don’t treat before reading and understanding all safe precautions.
   Avoid inhalation of dust, fume, gas, mist, and spray.
   Wash handling part after finishing handling.
   Don’t eat, drink, and smoke when treating.
   Follow MSDS/label precautions when treating empty container.
   Use with caution when handling and storing.
   Remove the cap with caution.
   If no a ventilation system, don’t enter the storage area.
   Prevent dust generation.
   Don’t touch products when welding.
   Wear the nonconductive gloves.
   Don’t use damaged or wet gloves.
   Wear insulating shoes at workplace.
   Don’t touch terminal of products, welding cable, and welding machine socket,
   Don’t wear wet clothing at conductive place.
   Keep the instruction manual and precautions before welding.
   Use proper welding cable and repair or exchange the damaged cables.
   Remove hazardous materials (combustibles or flammable liquid) to prevent spatter from firing, or cover them with nonflammable materials.
   Don’t weld container or pipe with combustible or flammable materials, or enclosed container or pipe.
   Don’t put a hot welding material around combustible or flammable materials.
   Remove hidden combustible or flammable materials when welding around ceiling, floor, and wall.
   Keep extinguisher around workplace.

B. Conditions for safe storage
   Keep away food and drink.
   Store in a well-ventilated and low humidity place.
8. EXPOSURE CONTROLS/PERSONAL PROTECTION

A. Control parameters

1) Internal and external regulations

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>CAS No.</th>
<th>Internal TWA(1) (mg/m^3)</th>
<th>Internal STEL(2) (mg/m^3)</th>
<th>External TLV(3) (mg/m^3)</th>
<th>External PEL(4) (mg/m^3)</th>
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</table>

(1) TWA : Time Weighted Average
(2) STEL : Short Time Exposure Limit
(3) TLV : Threshold Limit Values according to American Conference of Governmental Hygienists, 2012
(4) PEL : Permissible Exposure Limits according to the Occupational Safety & Health Administration (USA)
* Total dust, ** Respirable fraction, *** Inhalable fraction.
^ Value from OSHA expressed in PPM and value shown is conversion to mg/m^3
## AIHA WEEL (particulates only)
### Respirable dust

2) Biological limit values

Not available

B. Appropriate engineering controls

To install local ventilation system in the vicinity of welding fume sources is more effective than to deal with fume spreaded at workplace

Natural ventilation : If the concentration is low, the space is 284m^3 or more per two workers, and a ceiling height of space is more 5 meter, the natural ventilation is applied. It is also applied to the non-enclosed space with dilution.

Local ventilation : Install the appropriate local ventilation system depending on the nature of processing and welding materials. If the local ventilation is installed newly, the combined type, local air supply and local exhaust, is recommended. Local ventilation system installed closer to the worker as possible is desirable. It must have the ventability lower than the exposure limit. It is the most effective system to remove fume, but if the exhaust is too larger, welding defects will be occurred because of disturbance of the shielding gas. Workers should turn it on while working and conduct maintenance.

Portable local ventilation : It is applied when working in a confined space such as ship-body assembly or in the tank. Local air supply and local exhaust takes place at the same time. If necessary, run all the time.
If welding fume exhausts to other workplace, portable dust collection equipment should be installed.

**Full ventilation**: Workplace is ventilated with fans and blowers. It is effective when workplace is a relatively small volume. To remove fume, parallel push-pull ventilation should be considered. It should be designed and installed according to the workplace.

C. **Individual protection measures**

Use protective equipment certified by the Korea Occupational Safety and Health agency while welding.

1) **Respiratory protection**

- To prevent fume or hazardous gases, wear a mask while welding as below.
- Dust mask: Wear it in a bad ventilation condition while welding.
  - Remove dust or dry frequently after using.
- Gas mask: Wear a gas mask when ventilation is not sufficient such as inside the tank or in a narrow place.
  - Select a gas mask that can be used to combined with protective goggles
  - Use the proper canister according to hazardous substance.

Air-supplied respirator: Use air-line mask with compressed air.

2) **Eye protection**

- Use a facial mask with filter screen from the ultraviolet of arc or spatter. There are face shield helmet or hand shielded helmet.
- Use shielding grade as welding type.

<table>
<thead>
<tr>
<th>Welding type</th>
<th>Shielding grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielded metal arc welding</td>
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<td>Gas metal arc welding</td>
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<td>Gas tungsten arc welding</td>
<td>12</td>
</tr>
<tr>
<td>Flux cored arc welding</td>
<td>11-12</td>
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</tbody>
</table>

3) **Hand protection**

- Wear the nonconductive gloves.
- Don’t use damaged or wet gloves.

4) **Body protection**

- Wear leather apron and welding gloves to prevent burns and take insulating shoes at workplace.

9. **PHYSICAL AND CHEMICAL PROPERTIES**

A. Appearance

1) **Physical state**

   - Solid

2) **Colour**

   - Silver or gray

B. **Odour**

   Not available

C. **Odour threshold**

   Not available

D. **pH**

   Not available

E. **Melting point/freezing point**

   Not available

F. **Initial boiling point and boiling range**

   Not available

G. **Flash point**

   Not available

H. **Evaporation rate**

   Not available

I. **Flammability (Solid, Gas)**

   Not available

J. **Upper/lower flammability or explosive limits**

   Not available
K. Vapour pressure  Not available
L. Vapour density  Not available
M. Relative density  Not available
N. Solubility  Not available
O. Partition coefficient: n-octanol/water  Not available
P. Auto-ignition temperature  Not available
Q Decomposition temperature  Not available
R. Viscosity  Not available
S. Molecular weight  Not available

10. STABILITY AND REACTIVITY
A. Reactivity, chemical stability, and possibility of hazardous reactions
   Although may be burnt, ignition is difficult.
   During fire, irritant gases and fume will be produced.
B. Conditions to avoid
   Ignition sources (heat, spark, blaze)
C. Incompatible materials
   Combustible or flammable materials, chemical substances like acids and strong bases
D. Hazardous decomposition products
   May produce irritant gases and fume

11. TOXICOLOGICAL INFORMATION
A. Information on the likely routes of exposure  Not available
B. Health hazard information
   1) Acute toxicity
      A) Oral  Not available
      B) Dermal  Not available
      C) Inhalation  Not available
   2) Skin corrosion/irritation  Not available
   3) Serious eye damage/irritation  Not available
   4) Respiratory sensitization  Not available
   5) Skin sensitization  May cause an allergic skin reaction.
   6) Carcinogenicity
      A) Occupation safety and health acts  Not available
      B) The ministry of employment and labor  2 (Nickel)
      C) IARC  Group 2 (Nickel)
      D) OSHA  Not available
      E) ACGIH  A5 (Nickel)
      F) NTP  R (Nickel)
      G) EU CLP  Carc. 2 (Nickel)
   7) Germ cell mutagenicity  Not available
This Safety Data Sheet complies with the guidance on Occupation Safety and Health Act and enforcement regulations.

8) Reproductive toxicity
   Not available

9) STOT-single exposure
   Not available

10) STOT-repeated exposure
   Cause damage to organs through prolonged or repeated exposure.

11) Aspiration hazard
   Not available

12. ECOLOGICAL INFORMATION

A. Toxicity
   1) Fish
      Not available
   2) Crustacea
      Not available
   3) Birds
      Not available

B. Persistence and degradability
   1) Persistence
      Not available
   2) Degradability
      Not available

C. Bioaccumulative potential
   1) Bioconcentration factor
      Not available
   2) Biodegradation
      Not available

D. Mobility in soil
   Not available

E. Other adverse effects
   Not available

13. DISPOSAL CONSIDERATIONS

A. Disposal method
   Disposal contents and container as wastes control act.

B. Precautions
   Disposal contents and container as wastes control act.

14. TRANSPORT INFORMATION

A. UN number
   Not available

B. UN proper shipping name
   Not available

C. Transport hazard class
   Not available

D. Packing group
   Not available

E. Environmental hazards
   Not available

F. Special precautions for user
   1) Fire emergency action
      Not available
   2) Leak emergency action
      Not available

15. REGULATORY INFORMATION

A. Internal regulation
   No available internal regulation against products.

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<th>Occupation Safety and Health Act</th>
<th>Toxic Chemicals Control Act</th>
<th>Safety Control of Dangerous Substances Act</th>
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<td>Control material</td>
<td>Work environment monitoring</td>
<td>Special health monitoring</td>
<td>Exposure standard material</td>
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This Safety Data Sheet complies with the guidance on Occupation Safety and Health Act and enforcement regulations.

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X : not included.

B. Other internal or external regulations

No available other internal or external regulation against products.

Work environment monitoring material: unless noted, measure every 6 months.
Special health monitoring material: unless noted, measure every 12 months.
O: included
X: not included.
This Safety Data Sheet complies with the guidance on Occupation Safety and Health Act and enforcement regulations.

### CERCLA

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### EPCRA 302

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### EPCRA 304

|          | X | X | X | X | X | X | X | X |

### EPCRA 313

|          | X | X | included | X | X |

### Rotterdam convention material

|          | X | X | X | X | X | X |

### Stockholm convention material

|          | X | X | X | X | X | X |

### Montreal protocol material

|          | X | X | X | X | X | X | X |

### EU classification (result)

|          | X | X | Carc. Cat. 3; R40 R43 T; R48/23, R52, R53 | X | X |

### EU classification (R-phrase)

|          | X | X | R40 R43 R48/23 R52/53 | X | X |

### EU classification (S-phrase)

|          | X | X | S2 S36/37/39 S45 S61 | X | X |

X : not included.

### 16. OTHER INFORMATION

#### A. References

- EU REGULATION (EC) No 1272/2008
- EU DIRECTIVE 2009/2/EC
- The Ministry of Employment and Labor notification No. 2012-31
- Threshold Limit Values according to American Conference of Governmental Hygienists, 2012
- Permissible Exposure Limits according to the Occupational Safety & Health Administration (USA)
- Chemical Information System (http://ncis.nier.go.kr/ncis)
- Korea Occupational Safety & Health Agency (http://www.kosha.or.kr)
- National Emergency Management Agency (http://www.nema.go.kr)

#### B. First issued date

2013. 06. 11

#### C. Revision

1. Revision No. 1
2. Date revised 2013.12.02