

**For Hardfacing**

**A guide for selecting welding consumables**

Weld metal microstructure and main alloying elements determine the performances of welding consumables for hardfacing as summarized in Table 1. In addition, PF-200S/US-63B is good for reclamation of mill rolls.

Table 1 Welding consumables and their characteristics

| Weld metal microstructure and alloying formula | Hv                     | Features  | Type of wear <sup>(1)</sup> |     |     |     |     |     |     | SMAW  | FCAW                                     | GMAW             | SAW   |
|--|------------------------|---|-----------------------------|-----|-----|-----|-----|-----|-----|---|--|------------------|---|
|  |                        |   | MTM                         | ABR | HTW | CAV | COR | HRT | IMP |   |  |                  |   |
| Pearlite                                       | 200-400                | •Good crack resistance<br>•Good machinability                               | ○                           | △   | ×   | -   | -   | ×   | ○   | HF-240<br>HF-260<br>HF-330<br>HF-350                      | DWH-250<br>DWH-350                       | MG-250<br>MG-350 | G-50 / USH-250N<br>G-50 / USH-350N  |
| Martensite                                     | 350-800                | •Good wear resistance   | ○                           | ○   | △   | -   | ×   | △   | △   | HF-450<br>HF-500<br>HF-600<br>HF-650<br>HF-700<br>HF-800K | DWH-450<br>DWH-600<br>DWH-700<br>DWH-800 | -                | G-50 / USH-400N<br>G-50 / USH-450N<br>G-50 / USH-500N<br>MF-30 / USH-550N<br>MF-30 / USH-600N |
| 13%Cr stainless steel type                     | 350-500                | •Good resistance to oxidation, heat and corrosion<br>•Good wear resistance  | ○                           | △   | ○   | ○   | ○   | ○   | △   | HF-13   | -  | -                | -   |
| Semi-Austenite                                 | 500-700                | •High toughness and good wear resistance                                    | ○                           | ○   | △   | △   | △   | △   | △   | HF-12   | -  | -                | -   |
| High Mn Austenite                              | 13%Mn<br>150-500       | •High toughness and good impact wear resistance<br>•High work hardenability | ×                           | ○   | ×   | △   | ×   | ×   | ⊙   | HF-11   | DWH-11                                   | -                | -   |
|  | 16%Mn-16%Cr<br>200-400 | •High hardness at high temperatures<br>•High toughness                      | ○                           | △   | ○   | ○   | ○   | ○   | ○   | HF-16   | DWH-16                                   | -                | -   |
| High Cr-Fe                                     | 600-800                | •Excellent erosion resistance<br>•Good resistance to corrosion and heat     | △                           | ⊙   | ⊙   | ×   | ○   | ○   | ×   | HF-30   | DWH-30<br>DWH-30MV                       | -                | -   |
| Tungsten carbide type                          | 800-1200               | •Excellent resistance to heavy abrasion                                     | ×                           | ⊙   | ×   | ×   | ×   | ×   | ×   | HF-950  | -  | -                | -   |

Note (1) MTM: Metal-to-metal wear, ABR: Abrasion, HTW: High temp. wear, CAV: Cavitation, COR; Corrosion wear, HRT: Heat resistance, IMP: Impact wear  
 ⊙: Excellent resistance, ○: Good resistance, △: Slightly inferior, ×: Inferior, -: Not used for general application

## For Hardfacing

### Tips for better welding results

#### Common to individual welding processes

Important points in hardfacing are to obtain sufficient hardness and to minimize cracking. In order to achieve them, proper selection of welding consumables and proper welding procedures mentioned below are necessary.

1) Preparation of base metal:

Rust, oil and soil attached on the base metal may cause blowholes. Cracks in the base metal may cause cracking of the weld metal; therefore, they must be removed completely beforehand.

2) Preheat and interpass temperature:

In order to minimize cracking, control of preheat and interpass temperature is a key technique. Table 1 shows a rule of thumb for proper preheat and interpass temperatures in relation to the carbon equivalent of the base metal. In practice, size of work, type of welding consumable and method of hardfacing should be taken into consideration to determine the most appropriate temperatures.

Table 1 A rule of thumb for preheat and interpass temperature in relation to base metal carbon equivalents

| Type of steel                          | Carbon equivalent <sup>(1)</sup> | Preheat and interpass temperature (°C)                              |
|--|----------------------------------|---|
| Carbon steel and Low alloy steel       | Less than 0.3                    | 100 max.  |
|  | 0.3-0.4                          | 100 min.  |
|  | 0.4-0.5                          | 150 min.  |
|  | 0.5-0.6                          | 200 min.  |
|  | 0.6-0.7                          | 250 min.  |
|  | 0.7-0.8                          | 300 min.  |
|  | Over 0.8                         | 350 min.  |
| High-Mn steel (13%Mn steel)            |                                  | Use no preheat and cool each weld pass with water                   |
| Austenitic stainless steel             |                                  | Use no preheat and control the interpass temperature 150°C or lower |
| High alloy steel (e.g., High-Cr steel) |                                  | 400 min.  |

Note (1) Carbon equivalent =  $C + Mn/6 + Si/24 + Cr/5 + Mo/4 + Ni/15$

3) Immediate postweld heating:

Heating the weldment at 300-350°C for 10-30 minutes just after welding was finished is effective to prevent cold cracking. Control the temperature carefully, or the hardness of the weld will be decreased by excessive heating.

4) Postweld heat treatment:

Postweld heat treatment (PWHT) at 550-750°C is effective to prevent cold cracking and distortion in service, and to improve properties of the welds. It is important to set the PWHT conditions taking into account that the hardness of the weld is normally decreased by PWHT.

5) Underlaying:

Underlaying is effective to prevent cracking in welds where low-alloy steel having high hardenability is hardfaced or where high-hardness weld metal is deposited on carbon steel. For underlaying, mild steel type welding consumables or austenitic stainless steel type welding consumables should be used.

6) Penetration:

In hardfacing, the properties of the weld metal will considerably be affected by welding penetration into the base metal, because the chemical composition of the welding consumable is generally very different from those of the base metal. In order to use sufficiently the desired properties of the welding consumable, welding penetration must be controlled by using an appropriate welding procedure, for instance, multi-layer welding.

7) Welding distortion:

Intermittent and symmetrical welding sequences are effective to minimize welding distortion. Restraint of the work is also effective to minimize welding distortion.

#### SMAW

- 1) Control the arc length as short as possible.
- 2) Use the backstep method for arc starting to prevent blowholes.
- 3) Control the weaving width less than 3-4 times the diameter of a covered electrode.
- 4) Re-dry covered electrodes before use.

#### FCAW, GMAW

- 1) Control shielding gas flow rates within 20-25 l/mm for general applications. Note that poor shielding due to low flow rates and wind can cause blowholes and pits in the weld metal.
- 2) Refer to proper currents for individual wire sizes as shown in Table 2.

Table 2 Proper welding currents

| Type of wire | Diameter (mm) | Polarity | Welding current (A) |
|--------------|---------------|----------|---------------------|
| DWH series   | 1.2           | DC-EP    | 120-360             |
|              | 1.6           | DC-EP    | 200-420             |
| MG series    | 1.2           | DC-EP    | 120-320             |
|              | 1.6           | DC-EP    | 200-420             |

## Covered Electrodes for Hardfacing

| Brand name | Nominal hardness | Type of covering | Pol.        | Features  | WP           | Chemical composition of overlay weld metal (%) |      |      |      |      |    | Hardness of weld metal |     | Pre. H & IPT |
|------------|------------------|------------------|-------------|---|--------------|--|------|------|------|------|----|------------------------|-----|--------------|
|            |                  |                  |             |   |              | C  | Si   | Mn   | Cr   | PWHT | Hv |                        |     |              |
| HF-240     | Hv 240           | Titania          | AC<br>DC-EP | •Hardfacing of gears and wheels<br>•RC: 70~100°Cx0.5~1h                           | F<br>V<br>OH | Ex   | 0.09 | 0.58 | 0.58 | 0.81 | Ex | AW                     | 240 | ≥ 150°C      |
|            |                  |                  |             |   |              |  |      |      |      |      |    | 900°C,OQ               | 350 |              |
| HF-260     | Hv 260           | Low hydrogen     | AC<br>DC-EP | •Hardfacing of shafts, crane wheels and couplings<br>•RC: 300~350°Cx0.5~1h        | F            | Ex   | 0.17 | 0.69 | 1.81 | -    | Ex | AW                     | 271 | ≥ 150°C      |
|            |                  |                  |             |   |              |  |      |      |      |      |    | 900°C,OQ               | 395 |              |
| HF-330     | Hv 330           | Titania          | AC<br>DC-EP | •Hardfacing of keys and clutch lugs<br>•RC: 70~100°Cx0.5~1h                       | F            | Ex   | 0.10 | 0.69 | 0.86 | 2.29 | Ex | AW                     | 340 | ≥ 150°C      |
|            |                  |                  |             |   |              |  |      |      |      |      |    | -                      | -   |              |
| HF-350     | Hv 350           | Low hydrogen     | AC<br>DC-EP | •Hardfacing of upper rollers and sprockets of bulldozers<br>•RC: 300~350°Cx0.5~1h | F<br>V<br>OH | Ex   | 0.25 | 0.49 | 1.38 | 1.16 | Ex | AW                     | 366 | ≥ 150°C      |
|            |                  |                  |             |   |              |  |      |      |      |      |    | 850°C,OQ               | 510 |              |

Note: Welding tests are as per Kobe Steel's Standard. Ex: Example (polarity: AC)

| Diameter and Length (mm) |     |     |     |     |     |
|--------------------------|-----|-----|-----|-----|-----|
| Dia.                     | 2.6 | 3.2 | 4.0 | 5.0 | 6.0 |
| HF-240                   | -   | 350 | 400 | 400 | 450 |
| HF-260                   | 300 | 350 | 400 | 400 | 450 |
| HF-330                   | -   | 350 | 400 | 400 | 450 |
| HF-350                   | 300 | 350 | 400 | 400 | 450 |

## Covered Electrodes for Hardfacing

| Brand name | Nominal hardness | Type of covering | Pol.     | Features  | WP | Chemical composition of overlay weld metal (%) |      |      |      |      |      |      |             | Hardness of weld metal |              |     |        |
|------------|------------------|------------------|----------|---|----|--|------|------|------|------|------|------|-------------|------------------------|--------------|-----|--------|
|            |                  |                  |          |   |    | C  | Si   | Mn   | Cr   | Mo   | V    | W    | PWHT (°Cxh) | Hv                     | Pre. H & IPT |     |        |
| HF-450     | Hv 450           | Low hydrogen     | AC DC-EP | •Hardfacing of idlers, rollers and truck links of bulldozers<br>•RC: 300~350°Cx0.5~1h | F  | Ex   | 0.20 | 1.30 | 0.31 | 2.54 | 0.60 | 0.23 | -           | Ex                     | AW           | 456 | ≥150°C |
|            |                  |                  |          |   |    |  |      |      |      |      |      |      |             |                        | 550x6        | 443 |        |
| HF-500     | Hv 500           | Low hydrogen     | AC DC-EP | •Hardfacing of idlers and truck links of bulldozers<br>•RC: 300~350°Cx0.5~1h          | F  | Ex   | 0.45 | 1.37 | 0.91 | -    | 0.98 | 0.28 | -           | Ex                     | AW           | 517 | ≥150°C |
| HF-600     | Hv 600           | Low hydrogen     | AC DC-EP | •Hardfacing of lower rollers and bucket edges<br>•RC: 300~350°Cx0.5~1h                | F  | Ex   | 0.48 | 0.77 | 2.58 | 2.50 | -    | -    | -           | Ex                     | AW           | 595 | ≥200°C |
| HF-650     | Hv 650           | Low hydrogen     | AC DC-EP | •Hardfacing of tamping dies and mixer blades<br>•RC: 300~350°Cx0.5~1h                 | F  | Ex   | 0.67 | 0.90 | 0.87 | 4.91 | 1.17 | 0.55 | 1.42        | Ex                     | AW           | 634 | ≥200°C |
|            |                  |                  |          |   |    |  |      |      |      |      |      |      |             |                        | 600x1, AC    | 580 |        |

Note: Welding tests are as per Kobe Steel's Standard. Ex: Example (polarity: AC)

| Diameter and Length (mm) |     |     |     |     |     |
|--------------------------|-----|-----|-----|-----|-----|
| Dia.                     | 2.6 | 3.2 | 4.0 | 5.0 | 6.0 |
| HF-450                   | -   | -   | 400 | 400 | 450 |
| HF-500                   | -   | 350 | 400 | 400 | 450 |
| HF-600                   | 300 | 350 | 400 | 400 | 450 |
| HF-650                   | 300 | 350 | 400 | 400 | 450 |

## Covered Electrodes for Hardfacing

| Brand name | Nominal hardness | Type of covering | Pol.        | Features   | WP |    | Chemical composition of overlay weld metal (%) |      |      |      |      |      |      | Hardness of weld metal |           |               |        |
|------------|------------------|------------------|-------------|--|----|----|--|------|------|------|------|------|------|------------------------|-----------|---------------|--------|
|            |                  |                  |             |  |    |    | C  | Si   | Mn   | Cr   | Mo   | W    | B    | PWHT (°C×h)            | Hv        | Pre. H, & IPT |        |
| HF-700     | Hv 700           | Low hydrogen     | AC<br>DC-EP | ▪Hardfacing of cutter knives and casings<br>▪RC: 300~350°Cx0.5~1h      | F  | Ex | 0.62   | 0.80 | 0.78 | 5.12 | 2.21 | -    | -    | Ex                     | AW        | 654           | ≥200°C |
|            |                  |                  |             |  |    |    |  |      |      |      |      |      |      |                        | 600x1, AC | 485           |        |
| HF-800K    | Hv 800           | Low hydrogen     | AC<br>DC-EP | ▪Hardfacing of cutter knives and casings<br>▪RC: 300~350°Cx0.5~1h      | F  | Ex | 0.80   | 1.65 | 1.24 | 3.82 | -    | 2.42 | 0.29 | Ex                     | AW        | 736           | ≥200°C |
|            |                  |                  |             |  |    |    |  |      |      |      |      |      |      |                        | 600x1, AC | 535           |        |
| HF-950     | Hv 950           | Graphite         | AC<br>DC-EP | ▪Hardfacing of shovel teeth and cutter knives<br>▪RC: 150~200°Cx0.5~1h | F  | Ex | 3.5  | 0.1  | 2.6  | -    | -    | 26   | -    | Ex                     | AW        | 930           | ≥300°C |

Note: Welding tests are as per Kobe Steel's Standard. Ex: Example (polarity: AC)

| Diameter and Length (mm) |     |     |     |     |
|--------------------------|-----|-----|-----|-----|
| Dia.                     | 3.2 | 4.0 | 5.0 | 6.0 |
| HF-700                   | -   | 400 | 400 | 450 |
| HF-800K                  | 350 | 400 | 400 | 450 |
| HF-950                   | -   | 400 | 400 |     |

## Covered Electrodes for Hardfacing

| Brand name | Nominal hardness | Type of covering | Pol.     | Features   | WP | Chemical composition of overlay weld metal (%) |      |      |       |       |      |      |             | Hardness of weld metal |       |     |
|------------|------------------|------------------|----------|--|----|--|------|------|-------|-------|------|------|-------------|------------------------|-------|-----|
|            |                  |                  |          |  |    | C  | Si   | Mn   | Cr    | Mo    | V    | Ni   | PWHT (°Cxh) | Hv                     |       |     |
| HF-11      | Hv 250           | Low hydrogen     | AC DC-EP | •Hardfacing of crusher hammers and crusher jaws<br>•RC: 150~200°Cx0.5~1h     | F  | Ex   | 0.82 | 0.39 | 13.88 | -     | -    | -    | -           | Ex                     | AW    | 266 |
| HF-12      | Hv 500           | Low hydrogen     | AC DC-EP | •Hardfacing of ripper teeth, impellers and breakers<br>•RC: 300~350°Cx0.5~1h | F  | Ex   | 0.72 | 0.89 | 1.17  | 7.30  | 1.12 | -    | -           | Ex                     | AW    | 532 |
|            |                  |                  |          |  |    |  |      |      |       |       |      |      |             |                        | 500×2 | 630 |
| HF-13      | Hv 450           | Low hydrogen     | AC DC-EP | •Hardfacing of valve seats and agitator propellers<br>•RC: 300~350°Cx0.5~1h  | F  | Ex   | 0.13 | 0.50 | 0.74  | 12.97 | 0.97 | -    | 0.99        | Ex                     | AW    | 420 |
|            |                  |                  |          |  |    |  |      |      |       |       |      |      |             |                        | 750×1 | 260 |
| HF-16      | Hv 300           | Low hydrogen     | AC DC-EP | •Hardfacing of hot shears and hot dies<br>•RC: 150~200°Cx0.5~1h              | F  | Ex   | 0.71 | 0.48 | 14.59 | 15.33 | 1.85 | 0.42 | 2.20        | Ex                     | AW    | 306 |
| HF-30      | Hv 700           | Low hydrogen     | AC DC-EP | •Hardfacing of crusher rotors and liners<br>•RC: 300~350°Cx0.5~1h            | F  | Ex   | 5.00 | 0.42 | 1.23  | 30.5  | -    | -    | -           | Ex                     | AW    | 770 |

Note: Welding tests are as per Kobe Steel's Standard. Ex: Example (polarity: AC)

| Diameter and Length (mm) |     |     |     |     |     |
|--------------------------|-----|-----|-----|-----|-----|
| Dia.                     | 2.6 | 3.2 | 4.0 | 5.0 | 6.0 |
| HF-11                    | -   | 350 | 400 | 400 | 450 |
| HF-12                    | 300 | 350 | 400 | 400 | 450 |
| HF-13                    | -   | 350 | 400 | 400 | -   |
| HF-16                    | -   | 300 | 350 | 350 | -   |
| HF-30                    | -   | -   | 400 | 450 | -   |

## Flux Cored Wires for Hardfacing

| Brand name | Nominal hardness | Type of cored flux | SG              | Pol.  | Features  | WP      | Chemical composition of overlay weld metal (%) |      |      |      |      |        |                    |    | Hardness of weld metal |     |        |
|------------|------------------|--------------------|-----------------|-------|---|---------|--|------|------|------|------|--------|--------------------|----|------------------------|-----|--------|
|            |                  |                    |                 |       |   |         | C  | Si   | Mn   | Cr   | Mo   | Others | PWHT (°C×h)        | Hv | Pre. H, & IPT          |     |        |
| DWH-250    | Hv 250           | Rutile             | CO <sub>2</sub> | DC-EP | •Suitable for metal-to-metal wear parts and underlaying for hardfacing and repair | F<br>HF | Ex   | 0.09 | 0.49 | 1.30 | 1.02 | 0.40   | -                  | Ex | AW                     | 269 | ≥150°C |
|            |                  |                    |                 |       |   |         |  |      |      |      |      |        |                    |    | 600x2                  | 270 |        |
| DWH-350    | Hv 350           | Rutile             | CO <sub>2</sub> | DC-EP | •Suitable for metal-to-metal wear and light abrasion parts                        | F<br>HF | Ex   | 0.13 | 0.64 | 1.70 | 0.48 | 0.53   | -                  | Ex | AW                     | 370 | ≥150°C |
|            |                  |                    |                 |       |   |         |  |      |      |      |      |        |                    |    | 600x2                  | 297 |        |
| DWH-450    | Hv 450           | Rutile             | CO <sub>2</sub> | DC-EP | •Suitable for metal-to-metal wear and abrasion parts                              | F<br>HF | Ex   | 0.15 | 0.57 | 1.40 | 3.70 | 0.47   | V: 0.25            | Ex | AW                     | 431 | ≥150°C |
|            |                  |                    |                 |       |   |         |  |      |      |      |      |        |                    |    | 600x2                  | 384 |        |
| DWH-600    | Hv 600           | Rutile             | CO <sub>2</sub> | DC-EP | •Suitable for abrasion parts  | F<br>HF | Ex   | 0.45 | 0.48 | 0.97 | 4.31 | 0.51   | -                  | Ex | AW                     | 574 | ≥200°C |
|            |                  |                    |                 |       |   |         |  |      |      |      |      |        |                    |    | 600x2                  | 398 |        |
| DWH-700    | Hv 700           | Rutile             | CO <sub>2</sub> | DC-EP | •Suitable for abrasion parts  | F<br>HF | Ex   | 0.57 | 0.73 | 1.05 | 5.40 | 1.01   | V: 0.54<br>W: 1.21 | Ex | AW                     | 673 | ≥250°C |
|            |                  |                    |                 |       |   |         |  |      |      |      |      |        |                    |    | 600x2                  | 605 |        |
| DWH-800    | Hv 800           | Metal              | CO <sub>2</sub> | DC-EP | •Suitable for heavy abrasion parts  | F<br>HF | Ex   | 1.10 | 0.68 | 1.83 | 4.22 | -      | W: 2.26<br>B:0.54  | Ex | AW                     | 772 | ≥250°C |
|            |                  |                    |                 |       |   |         |  |      |      |      |      |        |                    |    | 600x2                  | 612 |        |

Note: Welding tests are as per Kobe Steel's Standard. Ex: Example

| Diameter (mm) |          |
|---------------|----------|
| DWH-250       | 1.2, 1.6 |
| DWH-350       | 1.2, 1.6 |
| DWH-450       | 1.2, 1.6 |
| DWH-600       | 1.2, 1.6 |
| DWH-700       | 1.2, 1.6 |
| DWH-800       | 1.2, 1.6 |

## Flux Cored Wires for Hardfacing

| Brand name | Nominal hardness | Type of cored flux | SG                 | Pol.  | Features  | WP      | Chemical composition of overlay weld metal (%) |      |      |       |       |        |                   | Hardness of weld metal |               |     |        |
|------------|------------------|--------------------|--------------------|-------|---|---------|--|------|------|-------|-------|--------|-------------------|------------------------|---------------|-----|--------|
|            |                  |                    |                    |       |   |         | C  | Si   | Mn   | Cr    | Mo    | Others | PWHT              | Hv                     | Pre. H, & IPT |     |        |
| DWH-11     | Hv 250           | Metal              | Ar-CO <sub>2</sub> | DC-EP | •Suitable for abrasion accompanied by heavy impact parts and repair welding of 13%-Mn cast steel  | F<br>HF | Ex   | 0.84 | 0.68 | 14.17 | -     | -      | -                 | Ex                     | AW            | 233 | -      |
| DWH-16     | Hv 300           | Metal              | Ar-CO <sub>2</sub> | DC-EP | •Suitable for high temperature wear, impact wear and cavitation parts such as hot shear bytes, hot saws, and hydraulic power water turbines | F<br>HF | Ex   | 0.60 | 0.51 | 16.76 | 16.21 | 1.49   | V: 0.49           | Ex                     | AW            | 278 | ≥150°C |
| DWH-30     | Hv 700           | Metal              | CO <sub>2</sub>    | DC-EP | •Suitable for heavy abrasive parts such as crushers and hoppers   | F<br>HF | Ex   | 2.92 | 1.16 | 0.16  | 24.06 | -      | B:0.3             | Ex                     | AW            | 755 | ≥250°C |
| DWH-30MV   | Hv 800           | Metal              | CO <sub>2</sub>    | DC-EP | •Suitable for heavy abrasive and high temperature wear parts such as liners, screws, and crushers   | F<br>HF | Ex   | 5.03 | 2.39 | 0.19  | 21.60 | 0.94   | B:0.28<br>V: 2.61 | Ex                     | AW            | 821 | ≥200°C |

Note: Welding tests are as per Kobe Steel's Standard. Ex: Example

| Diameter (mm) |          |
|---------------|----------|
| DWH-11        | 1.6      |
| DWH-16        | 1.2      |
| DWH-30        | 1.2, 1.6 |
| DWH-30MV      | 1.2, 1.6 |

## Flux and Wire Combinations for Hardfacing

| Brand name      | Nominal hardness | Type of flux | Pol. | Features   |         | Chemical composition of overlay weld metal (%) |      |      |      |      |      | Hardness of weld metal |              |            |
|-----------------|------------------|--------------|------|--|---------|--|------|------|------|------|------|------------------------|--------------|------------|
|                 |                  |              |      |  |         | C  | Si   | Mn   | Cr   | Mo   | V    | PWHT (°Cxh)            | Hv           |            |
| G-50 / USH-250N | Hv 250           | Fused        | AC   | •Suitable for hardfacing of wheels and rollers and for underlaying of idlers and rollers<br>•RC: 150~350°Cx1h                                      | Weld-Ex | 0.06   | 0.60 | 1.82 | -    | 0.62 | -    | Ex                     | AW           | 267        |
| G-50 / USH-350N | Hv 350           | Fused        | AC   | •Suitable for hardfacing of idlers and links of tractors and shovels, rollers for steel mills, and tires ,and hutches<br>•RC: 150~350°Cx1h         | Weld-Ex | 0.10   | 0.63 | 1.95 | 1.10 | 0.52 | -    | Ex                     | AW           | 361        |
| G-50 / USH-400N | Hv 400           | Fused        | AC   | •Suitable for hardfacing of idlers and links of tractors and shovels, rollers for steel mills, and tires<br>•RC: 150~350°Cx1h                      | Weld-Ex | 0.13   | 0.65 | 2.02 | 2.21 | 0.36 | 0.17 | Ex                     | AW           | 409        |
| G-50 / USH-450N | Hv 450           | Fused        | AC   | •Suitable for hardfacing of rollers and idlers of tractors and shovels, rollers for steel mills, and bells for blast furnaces<br>•RC: 150~350°Cx1h | Weld-Ex | 0.19   | 0.72 | 2.22 | 2.69 | 0.60 | 0.31 | Ex                     | AW<br>600x 5 | 453<br>431 |

Note: Welding tests are as per Kobe Steel's Standard, Wire-Ex: Example of wire, Weld-Ex: Example of weld metal, Ex: Example of weld metal (polarity: AC)

| Diameter of wire (mm) |          | Mesh size of flux |      |
|-----------------------|----------|-------------------|------|
| USH-250N              | 3.2      | G-50              | 8x48 |
| USH-350N              | 3.2      |                   |      |
| USH-400N              | 3.2, 4.0 |                   |      |
| USH-450N              | 3.2, 4.0 |                   |      |

## Flux and Wire Combinations for Hardfacing

| Brand name         | Nominal hardness | Type of flux | Pol. | Features   |         | Chemical composition of overlay weld metal (%) |      |      |      |      |      |      | Hardness of weld metal |       |     |
|--------------------|------------------|--------------|------|--|---------|--|------|------|------|------|------|------|------------------------|-------|-----|
|                    |                  |              |      |  |         | C  | Si   | Mn   | Cr   | Mo   | W    | V    | PWHT (°Cxh)            | Hv    |     |
| G-50/<br>USH-500N  | Hv 500           | Fused        | AC   | •Suitable for hardfacing of rollers and idlers of tractors and shovels, rollers for steel mills, and bells for blast furnaces<br>•RC: 150~350°Cx1h | Weld-Ex | 0.22   | 0.85 | 2.26 | 2.85 | 1.10 | 1.45 | 0.32 | Ex                     | AW    | 509 |
|                    |                  |              |      |  |         |  |      |      |      |      |      |      |                        | 600x2 | 506 |
| MF-30/<br>USH-550N | Hv 550           | Fused        | AC   | •Suitable for hardfacing of rollers for steel mills, and bells for blast furnaces<br>•RC: 150~350°Cx1h   | Weld-Ex | 0.34   | 0.58 | 2.12 | 6.72 | 3.75 | -    | -    | Ex                     | AW    | 540 |
|                    |                  |              |      |  |         |  |      |      |      |      |      |      |                        | 600x2 | 503 |
| MF-30/<br>USH-600N | Hv 600           | Fused        | AC   | •Suitable for hardfacing of rollers for steel mills, and crusher cones<br>•RC: 150~350°Cx1h  | Weld-Ex | 0.38   | 0.63 | 2.19 | 6.96 | 3.72 | -    | -    | Ex                     | AW    | 596 |
|                    |                  |              |      |  |         |  |      |      |      |      |      |      |                        | 600x2 | 570 |

Note: Welding tests are as per Kobe Steel's Standard. Wire-Ex: Example of wire, Weld-Ex: Example of weld metal, Ex: Example of weld metal (polarity: AC)

| Diameter of wire (mm) |     | Mesh size of flux |       |
|-----------------------|-----|-------------------|-------|
| USH-500N              | 3.2 | G-50              | 8x48  |
| USH-550N              | 3.2 | MF-30             | 12x65 |
| USH-600N              | 3.2 |                   |       |