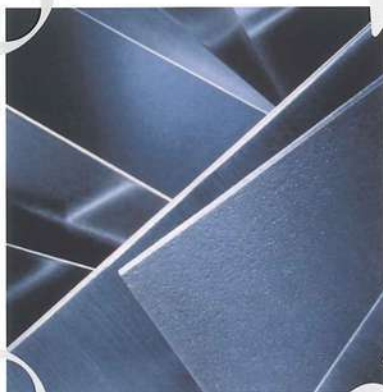




**SUPERLEGHE DI NICKEL**



Nickel e leghe di nickel resistenti alla corrosione

Leghe di nickel per alte temperature

Cupronickel per impieghi in acqua di mare

Materiali per saldatura

Tubi bimetallici

Tubi in leghe di rame per scambiatori di calore

Tubi alettati per rullatura

Bronzi speciali per industria motoristica



Impianti per  
taglio barre



*Corrosion-resistant nickel and nickel alloys*

*Heat-resistant nickel alloys*

*Copper-nickel for seawater*

*Welding materials*

*Bimetal tubes*

*Heat exchanger tubes in copper alloys*

*Ruled finned tubes*

*Special bronzes for motor industry*

# Leghe Thyssen-Krupp VDM

## Alloys from Thyssen-Krupp VDM

Le leghe ad alta temperatura di produzione Thyssen-Krupp VDM sono prodotti che soddisfano le esigenze della progettazione industriale nel campo dell'alta temperatura e della resistenza alla corrosione.

*High-temperature alloys from Thyssen-Krupp VDM are materials which fulfill industrial engineering needs at high temperatures and resistance to corrosion.*

| Denominazione<br>Thyssen-Krupp VDM |  | Materiale<br>N° | Denominazione<br>DIN | Denominazione<br>UNS | Denominazione<br>BS |
|------------------------------------|--|-----------------|----------------------|----------------------|---------------------|
|------------------------------------|--|-----------------|----------------------|----------------------|---------------------|

### LEGHE RESISTENTI ALLA CORROSIONE

|                    |                 |        |                       |         |        |
|--------------------|-----------------|--------|-----------------------|---------|--------|
| VDM Nickel 99.2    | alloy 200       | 2.4066 | Ni 99.2               | N 02200 | NA 11  |
| VDM LC-Nickel 99.2 | alloy 201       | 2.4068 | LC-Ni 99              | N 02201 | NA 12  |
| Nicrocor           | alloy 400       | 2.4360 | NiCu30Fe              | N 04400 | NA 13  |
| Nicrocor Al        | alloy K-500     | 2.4375 | NiCu30Al              | N 05500 | NA 18  |
| Nimofor 6928       | alloy B-2       | 2.4617 | NiMo28                | N 10665 | -      |
| Nimofor 6629       | alloy B-4       | 2.4600 | NiMo29Cr              | N 10629 | -      |
| Nicrofer 6616 hMo  | alloy C-4       | 2.4610 | NiMo16Cr16Ti          | N 06455 | -      |
| Nicrofer 6020 hMo  | alloy 625       | 2.4856 | NiCr22Mo9Nb           | N 06625 | NA 21  |
| Nicrofer 5923 hMo  | alloy 59        | 2.4605 | NiCr23Mo16Al          | N 06059 | -      |
| Nicrofer 5716 hMoW | alloy C-276     | 2.4819 | NiMo16Cr15W           | N 10276 | -      |
| Nicrofer 5621 hMoW | alloy C-22      | 2.4602 | NiCr21Mo14W           | N 06022 | -      |
| Nicrofer 5219 Nb   | alloy 718       | 2.4668 | NiCr19NbMo            | N 07718 | -      |
| Nicrofer 7216 LC   | alloy 600 L     | 2.4817 | LC-NiCr15Fe           | N 06600 | NA 14  |
| Nicrofer 4221      | alloy 825       | 2.4858 | NiCr21Mo              | N 08825 | NA 16  |
| Nicrofer 3620 Nb   | alloy 20        | 2.4660 | NiCr20CuMo            | N 08020 | -      |
| Nicrofer 3127 hMo  | alloy 31        | 1.4562 | X 1 NiCrMoCu 32 28 7  | N 08031 | -      |
| Nicrofer 3127 LC   | alloy 28        | 1.4563 | X 1 NiCrMoCuN 31 27 4 | N 08028 | -      |
| Cronifer 1925 hMo  | alloy 926       | 1.4529 | X 1 NiCrMoCuN 25 20 6 | N 08926 | -      |
| Cunifer 50         | alloy CuNi70/30 | 2.0882 | CuNi30Mn1Fe           | C 71500 | CN 107 |
| Cunifer 10         | alloy CuNi90/10 | 2.0872 | CuNi10Fe1Mn           | C 70600 | CN 102 |

### LEGHE RESISTENTI AL CALORE

|                  |                  |        |                    |             |           |
|------------------|------------------|--------|--------------------|-------------|-----------|
| Nicrofer 7250    | alloy 75         | 2.4951 | NiCr20Ti           | N 06075     | HR 203    |
| Nicrofer 7216    | alloy 600        | 2.4816 | NiCr15Fe           | N 06600     | NA 14     |
| Nicrofer 6025    | alloy 601        | 2.4851 | NiCr23Fe           | N 06601     | -         |
| Nicrofer 5718 So | alloy DS         | 1.4862 | X 8 NiCrSi 38 18   | -           | NA 17     |
| Nicrofer 5718    | (alloy 330)      | 1.4864 | X 12 NiCrSi 36 16  | (N 08330)   | -         |
| Nicrofer 7520Ti  | alloy 80 A       | 2.4952 | NiCr20TiAl         | N 07080     | NA 20     |
| Nicrofer 6025 HT | alloy 602 CA     | 2.4633 | NiCr25FeAlY        | N 06025     | -         |
| Nicrofer 5520 Co | alloy 617        | 2.4663 | NiCr23Co12Mo       | N 06617     | -         |
| Nicrofer 5219 Nb | alloy 718        | 2.4668 | NiCr19NbMo         | N 07718     | -         |
| Nicrofer 3220 HT | alloy 800 HT     | 1.4959 | X 8 NiCrAlTi 52 21 | N 08811     | -         |
| Nicrofer 3220 H  | alloy 800 H      | 1.4958 | X 5 NiCrAlTi 31 20 | N 08810     | NA 15(II) |
| Cronix 80        | alloy NiCr 80/20 | 2.4869 | NiCr80 20          | N 06003     | -         |
| Cronix 70        | alloy NiCr 70/30 | 2.4658 | NiCr70 30          | N 06008     | -         |
| Permifer 56      | alloy 56         | 1.3912 | Ni56               | K 93600/601 | -         |

# Leghe per corrosione

Nicrofer 5219 Nb - alloy 718

Cronifer 1925 hMo - alloy 926

Nicrofer 5520 Co - alloy 617

Lamiere/nastri Tubi Barre

Lamiere/nastri Tubi Barre

Lamiere/nastri Tubi Barre

## SPECIFICHE E DENOMINAZIONI

|     |                  |            |     |                               |             |              |     |     |
|-----|------------------|------------|-----|-------------------------------|-------------|--------------|-----|-----|
| D   | Denominazione    | NiCr19NbMo |     | NiCrMoCuN 25 20 6             |             | NiCr23Co12Mo |     |     |
|     | Materiale N.     | 2.4668     |     | 1.4529                        |             | 2.4663       |     |     |
|     | VdTUV            | -          |     | 502                           | 502         | 485          | 485 | 485 |
| USA | UNS              | N 07718    |     | N 08926 (sostituisce N 08925) |             | N 06617      |     |     |
|     | ASTM(B) ASME(SB) | 670        | 637 | 625                           | 673/674/677 | 649          |     |     |
| GB  | Denominazione BS | -          |     |                               |             |              |     |     |
|     | BS               | -          |     |                               |             |              |     |     |
| F   | AFNOR            | NC 19 FeNb |     |                               |             |              |     |     |

## COMPOSIZIONE CHIMICA (%)

|           |                                |  |                |  |             |
|-----------|--------------------------------|--|----------------|--|-------------|
| Nickel    | 50 - 55                        |  | 24.5 - 25.5    |  | Differenza  |
| Cromo     | 17 - 21                        |  | 20 - 21        |  | 20 - 25     |
| Ferro     | Differenza                     |  |                |  | max. 2      |
| Molibdeno | 2.8 - 3.3                      |  | 6 - 6.8        |  | 8 - 10      |
| Carbonio  | 0.02 - 0.08                    |  | max. 0.020     |  | 0.05 - 0.1  |
| Titanio   | 0.7 - 1.15                     |  |                |  | 0.2 - 0.6   |
| Alluminio | 0.3 - 0.7                      |  |                |  | 0.6 - 1.5   |
| Altri     | Nb: 4.8 - 5.5 B: 0.002 - 0.006 |  | N: 0.18 - 0.20 |  | Co: 10 - 13 |

## PROPRIETÀ MECCANICHE (N/mm<sup>2</sup>, %)

| Temperatura (°C) | Rp 0.2    | Rp 1.0 | Rm        | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|-----------|--------|-----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 1040 | -      | Min. 1240 | Min. 12 | Min. 300 | Min. 340 | Min. 650 | Min. 40 | Min. 350 | Min. 380 | Min. 750 | Min. 35 |
| 100              | 1060      | -      | -         | -       | Min. 230 | Min. 270 | Min. 610 | -       | Min. 270 | Min. 300 | Min. 650 | -       |
| 200              | 1040      | -      | -         | -       | Min. 190 | Min. 225 | Min. 560 | -       | Min. 230 | Min. 260 | Min. 620 | -       |
| 280              | -         | -      | -         | -       | -        | -        | -        | -       | -        | -        | -        | -       |
| 300              | 1020      | -      | -         | -       | Min. 170 | Min. 205 | Min. 525 | -       | Min. 220 | Min. 250 | Min. 600 | -       |
| 400              | 1000      | -      | -         | -       | Min. 160 | Min. 190 | Min. 510 | -       | Min. 210 | Min. 240 | Min. 570 | -       |
| 500              | 980       | -      | -         | -       | Min. 120 | Min. 150 | -        | -       | Min. 200 | Min. 225 | Min. 540 | -       |
| 550              | -         | -      | -         | -       | Min. 105 | Min. 135 | -        | -       | -        | -        | -        | -       |
| 600              | 950       | -      | -         | -       | -        | -        | -        | -       | Min. 190 | Min. 210 | Min. 510 | -       |
| 700              | 870       | -      | -         | -       | -        | -        | -        | -       | Min. 185 | Min. 205 | Min. 400 | -       |
| 750              | -         | -      | -         | -       | -        | -        | -        | -       | Min. 180 | Min. 200 | Min. 340 | -       |
| 800              | 640       | -      | -         | -       | -        | -        | -        | -       | -        | -        | -        | -       |

## PROPRIETÀ DI RESISTENZA ALLO SCORRIMENTO VISCOSO (N/mm<sup>2</sup>)

| Temperatura (°C) | Rp 1.0/10 <sup>3</sup> Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> Rm/10 <sup>3</sup> |
|------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| 600              | 580                                       | 620                                       | 430                                       | 505                                       |
| 700              | 200                                       | 248                                       | 88                                        | 132                                       |
| 800              | 19                                        | 36                                        | 6.1                                       | 12                                        |
| 900              | -                                         | -                                         | -                                         | -                                         |
| 1000             | -                                         | -                                         | -                                         | -                                         |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |                    |      |      |      |
|-----------------------|--------------------|------|------|------|
| Densità               | g/cm <sup>3</sup>  | 8.2  | 8.1  | 8.4  |
| Calore specifico      | J/Kg K             | 432  | 415  | 420  |
| Conducibilità termica | W/m K              | 11.1 | 12.0 | 13.4 |
| Resistività elettrica | μΩ                 | 123  | 96   | 122  |
| Dilatazione termica   | 10 <sup>3</sup> /K | 13.8 | 16.1 | 13.1 |
| 20-300°C              |                    |      |      |      |
| Modulo di elasticità  | kN/mm <sup>2</sup> | 205  | 193  | 212  |

## CARATTERISTICHE DI LAVORAZIONE

|              |                        |       |       |
|--------------|------------------------|-------|-------|
| Lavorabilità | Ricotto: buona         | Buona | Buona |
| Saldabilità  | Ricotto: soddisfacente | Buona | Buona |

## PRODOTTI PER LA SALDATURA

|                     |                          |                                         |                          |
|---------------------|--------------------------|-----------------------------------------|--------------------------|
| Fili di apporto     | Nicrofer S 5219 - FM 718 | Nicrofer S 6020 - FM 625/S 5923 - FM 59 | Nicrofer S 5520 - FM 617 |
| Elettrodi rivestiti | -                        | 2.4621 2.4609                           | 2.4628                   |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

Legna nickel-cromo-ferro indurenti per invecchiamento, con aggiunta di niobio e molibdeno. Particolarmente resistente a scorrimento viscoso a temperature fino a 700°C. Buona saldabilità e resistenza a corrosione. Eccellente tenacia a temperature criogeniche.

1) Solubilizzato, indurito per precipitazione.

Acciaio inossidabile austenitico, legato, simile al Cronifer 1925 hC - alloy 901 L, ma con contenuto più elevato di molibdeno e azoto. Eccezionale resistenza alla corrosione, alla corrosione interstiziale e alla tenso-corrosione in ambienti con alogeni. Elevata stabilità. Eccellente resistenza ad una ampia gamma di prodotti chimici.

Legna in soluzione solida di nickel-cromo-cobalto-molibdeno, con notevole resistenza allo scorrimento viscoso, eccezionale resistenza alla carburazione, ottima resistenza alla ossidazione ed eccellente stabilità metallurgica.

# Leghe per corrosione

| VDM LC-Nickel 99.2 - alloy 201 |      |       | Nicrocorros - alloy 400 |      |       | Nicrocorros Al - alloy K.500 |      |       |
|--------------------------------|------|-------|-------------------------|------|-------|------------------------------|------|-------|
| Lamiere/nastri                 | Tubi | Barre | Lamiere/nastri          | Tubi | Barre | Lamiere/nastri               | Tubi | Barre |

## SPECIFICHE E DENOMINAZIONI

|     |                  |           |         |           |         |           |      |      |
|-----|------------------|-----------|---------|-----------|---------|-----------|------|------|
| D   | Denominazione    | LC-Ni 99  |         | NiCu30Fe  |         | NiCu30Al  |      |      |
|     | Materiale N.     | 2.4068    |         | 2.4360    |         | 2.4375    |      |      |
|     | VaTUV            | 345       | 345     | 263       | 263     | -         | -    | -    |
| USA | UNS              | N 02201   |         | N 04400   |         | N 05500   |      |      |
|     | ASTM(B) ASME(SB) | 162       | 161/163 | 127       | 163/165 | 161       | -    | -    |
| GB  | Denominazione BS | NA12      |         | NA13      |         | NA18      |      |      |
|     | BS               | 3072/3073 | 3074    | 3072/3073 | 3074    | 3072/3073 | 3074 | 3076 |
| F   | AFNOR            | -         |         | NU 30     |         | NU 30 AT  |      |      |

## COMPOSIZIONE CHIMICA (%)

|           |           |  |  |           |  |             |  |  |
|-----------|-----------|--|--|-----------|--|-------------|--|--|
| Nickel    | Min. 99   |  |  | Min. 63   |  | Min. 63     |  |  |
| Manganese | Max. 0.3  |  |  | Max. 1.25 |  | Max. 1.5    |  |  |
| Alluminio | -         |  |  | Max. 0.5  |  | 2.3 - 3.15  |  |  |
| Ferro     | Max. 0.4  |  |  | 1 - 2.5   |  | 0.5 - 2     |  |  |
| Magnesio  | Max. 0.05 |  |  | -         |  | -           |  |  |
| Rame      | Max. 0.25 |  |  | 28 - 34   |  | 27 - 33     |  |  |
| Titanio   | -         |  |  | Max. 0.3  |  | 0.35 - 0.85 |  |  |
| Carbonio  | Max. 0.02 |  |  | Max. 0.15 |  | Max. 0.25   |  |  |

## PROPRIETÀ MECCANICHE (N/mm<sup>2</sup>, %)

| Temperatura (°C) | Rp 0.2  | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0 | Rm       | A5      |
|------------------|---------|----------|----------|---------|----------|----------|----------|---------|----------|--------|----------|---------|
| 20               | Min. 80 | Min. 105 | Min. 340 | Min. 40 | Min. 175 | Min. 205 | Min. 450 | Min. 30 | Min. 690 | -      | Min. 965 | Min. 20 |
| 100              | Min. 70 | Min. 95  | 290      | 40      | Min. 150 | 220      | 420      | 30      | 740      | -      | 1050     | 24      |
| 200              | Min. 65 | Min. 90  | 275      | 40      | Min. 135 | 210      | 390      | 30      | 700      | -      | 1025     | 23      |
| 300              | Min. 60 | Min. 85  | 260      | 45      | Min. 130 | 190      | 380      | 30      | 660      | -      | 975      | 23      |
| 400              | Min. 55 | Min. 80  | 240      | 55      | Min. 130 | 180      | 370      | 30      | 640      | -      | 880      | 10      |
| 500              | Min. 50 | Min. 75  | 210      | 60      | Min. 130 | -        | 360      | 30      | -        | -      | -        | -       |
| 600              | Min. 40 | Min. 65  | 150      | 75      | Min. 400 | -        | Min. 580 | Min. 18 | Min. 620 | -      | Min. 895 | Min. 20 |

## PROPRIETÀ DI RESISTENZA ALLO SCORRIMENTO VISCOSO (N/mm<sup>2</sup>)

| Temperatura (°C) | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° |
|------------------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|
| 300              | 110        | 260    | 95         | 238    | -          | -      | -          | -      | -          | -      | -          | -      |
| 400              | 75         | 159    | 60         | 145    | 150        | 280    | 130        | 240    | 770        | -      | -          | -      |
| 500              | 35         | 85     | 25         | 55     | 75         | 125    | 62         | 75     | 260        | -      | -          | -      |
| 600              | 10         | 45     | 6          | 25     | 17         | 45     | 8          | 20     | 60         | -      | -          | -      |
| 650              | 7          | 33     | 3          | 19     | 7          | 23     | 3          | 3      | -          | -      | -          | -      |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |                     |      |  |      |  |      |  |  |
|-----------------------|---------------------|------|--|------|--|------|--|--|
| Densità               | g/cm <sup>3</sup>   | 8.9  |  | 8.8  |  | 8.5  |  |  |
| Calore specifico      | J/Kg K              | 456  |  | 430  |  | 420  |  |  |
| Conducibilità termica | W/m K               | 79   |  | 26   |  | 17.4 |  |  |
| Resistività elettrica | μΩ                  | 8.5  |  | 51.3 |  | 61   |  |  |
| Dilatazione termica   | 10 <sup>-6</sup> /K | 14.3 |  | 15.8 |  | 14.9 |  |  |
| 20-300°C              |                     |      |  |      |  |      |  |  |
| Modulo di elasticità  | kN/mm <sup>2</sup>  | 207  |  | 182  |  | 179  |  |  |

## CARATTERISTICHE DI LAVORAZIONE

|              |            |  |            |  |                              |  |
|--------------|------------|--|------------|--|------------------------------|--|
| Lavorabilità | Eccellente |  | Eccellente |  | Buona                        |  |
| Saldabilità  | Buona      |  | Buona      |  | Ricotto: buona               |  |
|              |            |  |            |  | Invecchiato: non applicabile |  |

## PRODOTTI PER LA SALDATURA

|                     |                           |                            |                            |
|---------------------|---------------------------|----------------------------|----------------------------|
| Fili di apporto     | VDM Nickel S 9604 - FM 61 | Nicrocorros S 6530 - FM 60 | Nicrocorros S 6530 - FM 60 |
| Elettrodi rivestiti | 2.4156                    | 2.4366                     | 2.4366                     |
|                     | EL-NiTi 3 AWS ENi-1       | EL-NiCu30Mn AWS ENiCu-7    | EL-NiCu30Mn AWS ENiCu-7    |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

Nickel commercialmente puro, con basso contenuto di carbonio. Il basso contenuto di carbonio evita precipitazione di grafite a temperature al di sopra dei 315°C. Le leggi tedesche relative ai recipienti a pressione permettono che questo materiale venga utilizzato a temperature fino a 600°C e fino a 450°C per evaporatori di soda caustica.

Leghe nickel-rame. Elevata resistenza e tenacità entro un'ampia gamma di temperature. Eccellente resistenza all'acqua di mare corrente. Buona resistenza ad acido fluoridrico, acidi diluiti, non ossidanti, alcali e soluzioni di sali, acidi organici e gas secchi, come Cl<sub>2</sub> e HCl. Insensibile alla tenso-corrosione da cloruri.

Leghe nickel-titanio. Indurente per invecchiamento, con aggiunta di alluminio e titanio. Questo materiale unisce all'eccellente resistenza alla corrosione del Nicrocorros - alloy 400, elevate proprietà meccaniche. La sua elevata resistenza a trazione è mantenuta fino a temperature di 650°C. Nicrocorros Al - alloy K-500 mostra bassa permeabilità e non è magnetico. 3) Finito a caldo, ricotto, invecchiato secondo QQN 286 a 20°C.

1) a 425°C  
2) a 20°C, ricotto per distensione

# Leghe per corrosione

| Nicrofer 5716 hMoW - alloy C-276 |      |       | Nicrofer 4221 - alloy 825 |      |       | Cunifer 10 - alloy CuNi 90/10 |      |       |
|----------------------------------|------|-------|---------------------------|------|-------|-------------------------------|------|-------|
| Lamiere/nastri                   | Tubi | Barre | Lamiere/nastri            | Tubi | Barre | Lamiere/nastri                | Tubi | Barre |

## SPECIFICHE E DENOMINAZIONI

| D   | Denominazione    | NiMo16Cr15W |             | NiCr21Mo   |       | CuNi10Fe1Mn     |           |                 |
|-----|------------------|-------------|-------------|------------|-------|-----------------|-----------|-----------------|
|     | Materiale N.     | 2.4819      |             | 2.4858     |       | 2.0872          |           |                 |
|     | VdTV             | 400         | -           | 452/1      | 452/2 | 452/3           | -         | -               |
| USA | UNS              | N 10276     |             | N 08825    |       | C 70600         |           |                 |
|     | ASTM(B) ASME(SB) | 575         | 619/622/626 | 574        | 424   | 163/423/704/705 | 425       | 466/467/111     |
| GB  | Denominazione BS | -           | -           | NA16       |       |                 |           |                 |
|     | BS               | -           | -           | 3072/3073  | 3074  | 3076            | 2870/2875 | 2871            |
| F   | AFNOR            | NC 17 D     |             | NC 21 FeDu |       |                 |           | 2874            |
|     |                  |             |             |            |       |                 |           | CuNi 10 Fe 1 Mn |

## COMPOSIZIONE CHIMICA (%)

|           |                         |  |  |             |  |                |              |
|-----------|-------------------------|--|--|-------------|--|----------------|--------------|
| Nickel    | Differenza              |  |  | 38 - 46     |  | 9 - 11         |              |
| Cromo     | 15 - 16.5               |  |  | 19.5 - 23.5 |  | -              |              |
| Molibdeno | 15 - 17                 |  |  | 2.5 - 3.5   |  | -              |              |
| Ferro     | 4 - 7                   |  |  | differenza  |  | 1 - 1.8        |              |
| Silicio   | Max. 0.08               |  |  | -           |  | -              |              |
| Altri     | W: 3 - 4.5 Co: Max. 2.5 |  |  | Cu: 1.5 - 3 |  | Mn: 0.2 - 1    | Zn: Max. 0.5 |
|           | V: 0.1 - 0.3            |  |  |             |  | Cu: differenza |              |
| Titanio   | -                       |  |  | 0.6 - 1.2   |  | -              |              |
| Carbonio  | Max. 0.01               |  |  | Max. 0.025  |  | -              |              |

## PROPRIETÀ MECCANICHE (N/mm<sup>2</sup>, %)

| Temperatura (°C) | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|----------|----------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 310 | Min. 330 | Min. 750 | Min. 30 | Min. 240 | Min. 265 | Min. 550 | Min. 30 | Min. 100 | Min. 125 | Min. 300 | Min. 30 |
| 100              | Min. 280 | Min. 305 | 685      | 50      | Min. 205 | Min. 235 | 530      | 40      | -        | Min. 118 | -        | -       |
| 200              | Min. 240 | Min. 275 | 680      | 60      | Min. 180 | Min. 205 | 515      | 40      | -        | Min. 109 | -        | -       |
| 300              | Min. 220 | Min. 245 | 650      | 65      | Min. 170 | Min. 195 | 500      | 45      | -        | Min. 99  | -        | -       |
| 400              | Min. 195 | Min. 230 | 630      | 60      | Min. 160 | Min. 185 | 490      | 45      | -        | -        | -        | -       |
| 450              | -        | -        | -        | -       | Min. 155 | Min. 181 | 485      | 45      | -        | -        | -        | -       |
| 500              | -        | -        | -        | -       | -        | -        | -        | -       | -        | -        | -        | -       |
| 600              | -        | -        | -        | -       | -        | -        | -        | -       | -        | -        | -        | -       |

## PROPRIETÀ DI RESISTENZA ALLO SCORRIMENTO VISCOSO (N/mm<sup>2</sup>)

| Temperatura (°C) | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° |
|------------------|------------|--------|------------|--------|
| 200              | 98         | -      | 94         | -      |
| 250              | 88         | -      | 88         | -      |
| 300              | 74         | -      | 74         | -      |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |                     |      |      |     |
|-----------------------|---------------------|------|------|-----|
| Densità               | g/cm <sup>3</sup>   | 8.9  | 8.1  | 8.9 |
| Calore specifico      | J/Kg K              | 407  | 440  | 380 |
| Conducibilità termica | W/m K               | 10.6 | 10.8 | 45  |
| Resistività elettrica | μΩ                  | 125  | 112  | 19  |
| Dilatazione termica   | 10 <sup>-6</sup> /K | 12.8 | 15.2 | 17  |
| 20-300°C              |                     |      |      |     |
| Modulo di elasticità  | kN/mm <sup>2</sup>  | 208  | 195  | 130 |

## CARATTERISTICHE DI LAVORAZIONE

|              |       |       |       |
|--------------|-------|-------|-------|
| Lavorabilità | Buona | Buona | Buona |
| Saldabilità  | Buona | Buona | Buona |

## PRODOTTI PER LA SALDATURA

| Fili di apporto     | Nicrofer 5716 - FM C-276     | Nicrofer 56020 - FM 625 | S 4225 - FM 65 | Cunifer 57030 - FM 67 | Cunifer 59010 |
|---------------------|------------------------------|-------------------------|----------------|-----------------------|---------------|
| Elettrodi rivestiti | 2.4887                       | 2.4621                  | 2.4652         | 2.0838                |               |
|                     | EL.NiMo15Cr15W AWS ENiCrMo-4 | EL.NiCr20Mo9Nb          | EL.NiCr26Mo    | EL.CuNi30Mn           | AWS ECAuNi    |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

Leghe nickel-cromo-molibdeno con aggiunta di tungsteno e contenuti estremamente bassi di carbonio e silicio. Eccellente resistenza alla corrosione interstiziale, alla vaiolatura e alla tenso-corrosione. Notevole resistenza ad un'ampia gamma di prodotti chimici, specialmente in condizioni riducenti. Eccellente resistenza agli acidi minerali e organici contaminanti a caldo e in acqua di mare.

Leghe nickel-ferro-cromo, completamente austenitica, stabilizzata al titanio, con aggiunte di molibdeno e rame. Eccellente resistenza alla tenso-corrosione, buona resistenza alla vaiolatura e alla corrosione interstiziale. Buona resistenza agli acidi ossidanti e riducenti, come acido solforico, fosforico e nitrico, e a soluzioni organiche alcaline, alcali e acqua di mare.

Leghe rame-nickel con circa 10% di nickel e aggiunte di ferro e manganese. Buona resistenza in acqua di mare e alle acque salmastre e industriali. Buona resistenza all'acqua di mare corrente pulita (velocità della corrente da 1 a 3 m/s).



# Leghe per corrosione

| Nicrofer 6020 hMo – alloy 625 |      |       | Nicrofer 5923 hMo – alloy 59 |      |       | Nicrofer 5621 hMoW – alloy C-22 |      |       |
|-------------------------------|------|-------|------------------------------|------|-------|---------------------------------|------|-------|
| Lamiere/nastri                | Tubi | Barre | Lamiere/nastri               | Tubi | Barre | Lamiere/nastri                  | Tubi | Barre |

## SPECIFICHE E DENOMINAZIONI

|     |                  |             |             |              |             |             |             |     |
|-----|------------------|-------------|-------------|--------------|-------------|-------------|-------------|-----|
| D   | Denominazione    | NiCr22Mo9Nb |             | NiCr23Mo16Al |             | NiCr21Mo14W |             |     |
|     | Materiale N.     | 2.4856      |             | 2.4605       |             | 2.4602      |             |     |
|     | VdTUV            | 499         | 499         | 505          | -           | 479         | 479         | 479 |
| USA | UNS              | N 06625     |             | N 06059      |             | N 06022     |             |     |
|     | ASTM(B) ASME(SB) | 445         | 444/704/705 | 446          | 619/622/626 | 574         | 619/622/626 | 574 |
| GB  | Denominazione BS | NA21        |             | -            | -           | -           | -           | -   |
|     | BS               | 3072        | 3076        | -            | -           | -           | -           | -   |
| F   | AFNOR            | NU 22 DNB   |             | -            | -           | -           | -           | -   |

## COMPOSIZIONE CHIMICA (%)

|           |            |  |              |  |               |
|-----------|------------|--|--------------|--|---------------|
| Nickel    | Differenza |  | Differenza   |  | Differenza    |
| Cromo     | 21 - 23    |  | 22 - 24      |  | 20 - 22,5     |
| Ferro     | Max. 3     |  | Max. 1,5     |  | 2 - 6         |
| Silicio   | -          |  | Max. 0,1     |  | Max. 0,08     |
| Altri     | -          |  | Al 0,1 - 0,4 |  | Min. Max. 0,5 |
| Molibdeno | 8 - 10     |  | 15 - 16,5    |  | 12,5 - 14,5   |
| Cobalto   | -          |  | Max. 0,3     |  | Max. 2,5      |
| Niobio    | 3,2 - 10   |  | -            |  | -             |
| Tungsteno | -          |  | -            |  | 2,5 - 3,5     |
| Vanadio   | -          |  | -            |  | Max. 0,35     |
| Carbonio  | Max. 0,025 |  | Max. 0,010   |  | Max. 0,010    |

## PROPRIETÀ MECCANICHE (N/mm², %)

| Temperatura (°C) | Rp 0,2   | Rp 1,0   | Rm       | A5      | Rp 0,2   | Rp 1,0   | Rm       | A5      | Rp 0,2   | Rp 1,0   | Rm       | A5      |
|------------------|----------|----------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 415 | Min. 445 | Min. 830 | Min. 35 | Min. 340 | Min. 380 | Min. 690 | Min. 40 | Min. 310 | Min. 335 | Min. 690 | Min. 45 |
| 100              | Min. 350 | -        | 740      | -       | Min. 290 | Min. 330 | 650      | 50      | Min. 270 | Min. 290 | -        | -       |
| 200              | Min. 320 | -        | 700      | -       | Min. 250 | Min. 290 | 615      | 50      | Min. 225 | Min. 245 | -        | -       |
| 300              | Min. 300 | -        | 685      | -       | Min. 220 | Min. 260 | 580      | 50      | Min. 195 | Min. 215 | -        | -       |
| 400              | Min. 280 | -        | 670      | -       | Min. 190 | Min. 230 | 545      | 50      | Min. 175 | Min. 195 | -        | -       |
| 450              | Min. 270 | -        | 660      | -       | Min. 175 | Min. 215 | 525      | 50      | -        | -        | -        | -       |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |        |      |      |      |
|-----------------------|--------|------|------|------|
| Densità               | g/cm³  | 8,5  | 8,6  | 8,7  |
| Calore specifico      | J/Kg K | 415  | 414  | 406  |
| Conducibilità termica | W/m K  | 9,8  | 10,4 | 9,4  |
| Resistività elettrica | μΩ     | 128  | 126  | 114  |
| Dilatazione termica   | 10⁻⁶/K | 13,4 | 12,5 | 12,5 |
| 20-300°C              |        |      |      |      |
| Modulo di elasticità  | kN/mm² | 209  | 210  | 206  |

## CARATTERISTICHE DI LAVORAZIONE

|              |       |       |       |
|--------------|-------|-------|-------|
| Lavorabilità | Buona | Buona | Buona |
| Saldabilità  | Buona | Buona | Buona |

## PRODOTTI PER LA SALDATURA

|                     |                         |                         |                         |                |
|---------------------|-------------------------|-------------------------|-------------------------|----------------|
| Fili di apporto     | Nimofel S 6020 - FM 625 | Nicrofer S 5923 - FM 59 | Nicrofer S 5621 - FM 22 | S 5923 - FM 59 |
| Elettrodi rivestiti | 2.4621                  | 2.4609                  | 2.4635                  | 2.4609         |
|                     | EL-NiCr20Mo9Nb          | EL-NiCr22Mo16           | 8G-NiCr21Mo14W          | EL-NiCr22Mo16  |
|                     | AWS ENiCrMo-3           |                         | AWSA 5.14               |                |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

Legna nickel-cromo-molibdeno a basso contenuto di carbonio, con aggiunta di niobio. Eccellente resistenza alla corrosione, alla corrosione interstiziale e alla tenso-corrosione. Molto resistente ad un'ampia gamma di acidi organici e minerali. Buona resistenza alla corrosione alle alte temperature in alcuni ambienti ossidanti solforici/cloridrici.

Legna nickel-cromo-molibdeno con contenuti di carbonio e silicio estremamente bassi e senza tungsteno. Notevole resistenza ad un'ampia gamma di ambienti corrosivi in condizioni ossidanti e riducenti. Eccellente resistenza agli acidi nitrico, fosforico, solforico e cloridrico, anche quando sono contaminati. Elevata stabilità metallurgica.

Legna nickel-molibdeno con contenuti di carbonio e silicio estremamente bassi. Notevole resistenza agli ioni di cloro, è uno dei pochi materiali che resistono alla corrosione dei gas umidi di cloro, ipocloriti e soluzioni di diossido di cloro. Eccellente resistenza alle soluzioni concentrate di sali ossidanti. La lega è anche indicata in caso di utilizzo di acidi minerali contaminati, solventi ed acidi organici.

# Leghe per corrosione

| Nicrofer 3620 Nb – alloy 20 |  |      |       | Nicrofer 3127 hMo – alloy 31 |  |      |       | Nicrofer 3127 LC – alloy 28 |  |      |       |
|-----------------------------|--|------|-------|------------------------------|--|------|-------|-----------------------------|--|------|-------|
| Lamiere/nastri              |  | Tubi | Barre | Lamiere/nastri               |  | Tubi | Barre | Lamiere/nastri              |  | Tubi | Barre |

## SPECIFICHE E DENOMINAZIONI

|     |                  |            |  |  |  |                      |  |  |  |                       |  |  |  |
|-----|------------------|------------|--|--|--|----------------------|--|--|--|-----------------------|--|--|--|
| D   | Denominazione    | NiCr20CuMo |  |  |  | X 1 NiCrMoCu 32 28 7 |  |  |  | X 1 NiCrMoCuN 31 27 4 |  |  |  |
|     | Materiale N.     | 2-4660     |  |  |  | 1.4562               |  |  |  | 1.4563                |  |  |  |
|     | VdTUV            | -          |  |  |  | 509                  |  |  |  | -                     |  |  |  |
| USA | UNS              | N 08020    |  |  |  | N 08031              |  |  |  | N 08028               |  |  |  |
|     | ASTM(B) ASME(SB) | 463        |  |  |  | 619/622/626          |  |  |  | 709                   |  |  |  |
| GB  | Denominazione BS | -          |  |  |  | -                    |  |  |  | 668                   |  |  |  |
|     | BS               | -          |  |  |  | -                    |  |  |  | -                     |  |  |  |
| F   | AFNOR            | -          |  |  |  | -                    |  |  |  | Z 1 NCDU 31.27        |  |  |  |

## COMPOSIZIONE CHIMICA (%)

|           |                         |             |             |
|-----------|-------------------------|-------------|-------------|
| Nickel    | 36.5 - 38               | 30 - 32     | 30 - 32     |
| Cromo     | 19 - 21                 | 26 - 28     | 26 - 28     |
| Ferro     | Differenza              | Differenza  | Differenza  |
| Azoto     | -                       | 0.15 - 0.25 | 0.04 - 0.07 |
| Altri     | Cu: 3 - 4 Nb: 0.1 - 0.3 | Cu: 1 - 1.4 | Cu: 1 - 1.4 |
| Molibdeno | 2 - 3                   | 6 - 7       | 3 - 4       |
| Carbonio  | Max. 0.02               | Max. 0.015  | Max. 0.015  |

## PROPRIETÀ MECCANICHE (N/mm², %)

| Temperatura (°C) | Rp 0.2   | Rp 1.0 | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|----------|--------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 240 | -      | Min. 550 | Min. 30 | Min. 280 | Min. 310 | Min. 650 | Min. 40 | Min. 215 | Min. 245 | Min. 500 | Min. 35 |
| 100              | Min. 210 | -      | 520      | 40      | Min. 210 | Min. 240 | 630      | 50      | Min. 190 | Min. 220 | 500      | 40      |
| 200              | Min. 180 | -      | 500      | 40      | Min. 180 | Min. 210 | 580      | 50      | Min. 165 | Min. 195 | 490      | 40      |
| 300              | Min. 140 | -      | 480      | 40      | Min. 165 | Min. 195 | 530      | 50      | Min. 150 | Min. 180 | 480      | 40      |
| 400              | -        | -      | -        | -       | Min. 150 | Min. 180 | 500      | 50      | Min. 135 | Min. 165 | 465      | 40      |
| 500              | -        | -      | -        | -       | Min. 135 | Min. 165 | 470      | 50      | Min. 120 | Min. 150 | -        | -       |
| 550              | -        | -      | -        | -       | Min. 125 | Min. 155 | -        | -       | Min. 115 | Min. 145 | -        | -       |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |        |      |      |      |
|-----------------------|--------|------|------|------|
| Densità               | g/cm³  | 8.1  | 8.1  | 8.0  |
| Calore specifico      | J/Kg K | 456  | 452  | 452  |
| Conducibilità termica | W/m K  | 11.5 | 11.7 | 11.7 |
| Resistività elettrica | μΩ     | 107  | 103  | 104  |
| Dilatazione termica   | 10⁻⁶/K | 16   | 15.1 | 15.8 |
| 20-500°C              |        |      |      |      |
| Modulo di elasticità  | kN/mm² | 202  | 198  | 191  |

## CARATTERISTICHE DI LAVORAZIONE

|              |               |       |       |
|--------------|---------------|-------|-------|
| Lavorabilità | Buona         | Buona | Buona |
| Saldabilità  | Soddisfacente | Buona | Buona |

## PRODOTTI PER LA SALDATURA

|                     |                          |                |                         |                 |                         |                 |
|---------------------|--------------------------|----------------|-------------------------|-----------------|-------------------------|-----------------|
| Fili di apporto     | Nicrofer S 6020 - FM 625 | S 5923 - FM 59 | Nicrofer S 3127- FM 31* | S 5923 - FM 59* | Nicrofer S 3127 - FM 31 | S 6020 - FM 625 |
| Elettrodi rivestiti | 2.4621                   | 2.4609         | 1.4562                  | 2.4609          | 1.4562                  | 2.4621          |
|                     | EL-NiCr20Mo9Nb           | EL-NiCr22Mo16  | X1NiCrMoCu 32 28 7      | EL-NiCr22Mo16   | X1NiCrMoCu 32 28 7      | EL-NiCr20Mo9Nb  |
|                     | AWS ENiCrMo-3            |                |                         |                 |                         | AWS ENiCrMo-3   |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

Legna nickel-ferro-cromo, stabilizzata al niobio, con aggiunta di molibdeno e rame.  
Eccellente resistenza alla tenso-corrosione.  
Buona resistenza all'acido solforico diluito, anche ad elevate temperature.

Legna ferro-nickel-cromo, austenitica, ad alto molibdeno, con aggiunta di rame e azoto.  
Eccellente resistenza alla viatura, alla corrosione interstiziale e alla tenso-corrosione.  
Notevole resistenza agli ambienti ossidanti.  
Particolarmente resistente a soluzioni di acido solforico, anche quando sono contaminate e all'acido fosforico.

Legna ferro-nickel-cromo, austenitica, con aggiunta di molibdeno e rame.  
Elevata resistenza alla viatura, alla corrosione interstiziale e alla tenso-corrosione.  
Resistenza molto buona agli ambienti ossidanti.

1) In funzione delle condizioni operative



# Leghe per corrosione e per alta temperatura

| Nimofor 6928 – alloy B-2 |      |       | Nicrofer 3220 HT – alloy 800 HT |      |       | Nicrofer 6023 – alloy 601 |      |       |
|--------------------------|------|-------|---------------------------------|------|-------|---------------------------|------|-------|
| Lamiere/nastri           | Tubi | Barre | Lamiere/nastri                  | Tubi | Barre | Lamiere/nastri            | Tubi | Barre |

## SPECIFICHE E DENOMINAZIONI

|     |                  |         |             |     |                    |         |     |           |
|-----|------------------|---------|-------------|-----|--------------------|---------|-----|-----------|
| D   | Denominazione    | NiMo28  |             |     | X 8 NiCrAlTi 32 21 |         |     | NiCr23Fe  |
|     | Materiale N.     | 2.4617  |             |     | 1.4959             |         |     | 2.4851    |
|     | VdTUV            | 436     |             | 436 | 310                | -       | -   | -         |
| USA | UNS              | N 10665 |             |     | N 08811            |         |     | N 06601   |
|     | ASTM(B) ASME(SB) | 333     | 619/622/626 | 335 | 409                | 163/407 | 408 | 168       |
| GB  | Denominazione BS | -       | -           | -   | -                  | -       | -   | -         |
|     | BS               | -       | -           | -   | -                  | -       | -   | -         |
| F   | AFNOR            | NiMo 28 |             |     | -                  |         |     | NC 23 FeA |

## COMPOSIZIONE CHIMICA (%)

|          |             |  |  |               |  |  |               |
|----------|-------------|--|--|---------------|--|--|---------------|
| Nickel   | Differenza  |  |  | 30 - 32       |  |  | 58 - 63       |
| Cromo    | 0.4 - 1     |  |  | 19 - 22       |  |  | 22 - 24       |
| Ferro    | 1.5 - 2     |  |  | Differenza    |  |  | Differenza    |
| Silicio  | Max. 0.08   |  |  | 0.2 - 0.6     |  |  | Max. 0.5      |
| Altri    | Mo: 26 - 30 |  |  | Al: 0.3 - 0.6 |  |  | Al: 1.1 - 1.6 |
|          | Co: Max. 1  |  |  |               |  |  |               |
| Titanio  | -           |  |  | 0.3 - 0.6     |  |  | 0.1 - 0.4     |
| Carbonio | Max. 0.01   |  |  | 0.06 - 0.1    |  |  | 0.03 - 0.08   |

## PROPRIETÀ MECCANICHE (N/mm<sup>2</sup>, %)

| Temperatura (°C) | Rp 0.2  | Rp 1.0  | Rm      | A5      | Rp 0.2  | Rp 1.0  | Rm      | A5      | Rp 0.2  | Rp 1.0  | Rm      | A5      |
|------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 20               | Min.350 | Min.380 | Min.760 | Min. 40 | Min.170 | Min.200 | Min.500 | Min. 35 | Min.300 | Min.350 | Min.650 | Min. 30 |
| 100              | Min.315 | Min.355 | -       | -       | Min.140 | Min.160 | -       | -       | 440     | -       | 750     | 40      |
| 200              | Min.285 | Min.325 | -       | -       | Min.115 | Min.135 | -       | -       | 430     | -       | 740     | 70      |
| 300              | Min.270 | Min.310 | -       | -       | Min.95  | Min.115 | -       | -       | 400     | -       | 730     | 35      |
| 400              | Min.255 | Min.295 | -       | -       | Min.85  | Min.105 | -       | -       | 370     | -       | 700     | 35      |
| 500              | Min.230 | -       | -       | -       | Min.80  | Min.100 | -       | -       | 350     | -       | 670     | 40      |
| 600              | -       | -       | -       | -       | Min.75  | Min.95  | -       | -       | 320     | -       | 580     | 40      |

## PROPRIETÀ DI RESISTENZA ALLO SCORRIMENTO VISCOSO (N/mm<sup>2</sup>)

| Temperatura (°C) | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° | Rp 1.0/10° | Rm/10° |
|------------------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|
| 700              | -          | -      | -          | -      | 59         | 73     | 40         | 57     | -          | -      | -          | -      |
| 800              | -          | -      | -          | -      | 30         | 41     | 19         | 26     | -          | -      | -          | -      |
| 900              | -          | -      | -          | -      | 13         | 18     | 6.7        | 11.2   | -          | -      | -          | -      |
| 950              | -          | -      | -          | -      | 8.2        | 12     | 3.9        | 7.2    | -          | -      | -          | -      |
| 1000             | -          | -      | -          | -      | 4.4        | 7.9    | 1.9        | 4      | -          | -      | -          | -      |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |                     |      |  |      |  |  |      |
|-----------------------|---------------------|------|--|------|--|--|------|
| Densità               | g/cm <sup>3</sup>   | 9.2  |  | 8.0  |  |  | 8.1  |
| Calore specifico      | J/Kg K              | 377  |  | 472  |  |  | 450  |
| Conduttività termica  | W/m K               | 11.4 |  | 11.5 |  |  | 11.3 |
| Resistività elettrica | μΩ                  | 137  |  | 101  |  |  | 119  |
| Dilatazione termica   | 10 <sup>-6</sup> /K | 11.1 |  | 16.2 |  |  | 14.6 |
| 20-300°C              |                     |      |  |      |  |  |      |
| Modulo di elasticità  | kN/mm <sup>2</sup>  | 217  |  | 194  |  |  | 207  |

## CARATTERISTICHE DI LAVORAZIONE

|              |       |  |               |  |               |
|--------------|-------|--|---------------|--|---------------|
| Lavorabilità | Buona |  | Buona         |  | Buona         |
| Saldabilità  | Buona |  | Soddisfacente |  | Soddisfacente |

## PRODOTTI PER LA SALDATURA

|                     |                         |                         |                 |                          |                |
|---------------------|-------------------------|-------------------------|-----------------|--------------------------|----------------|
| Fili di apporto     | Nimofor S 6928 - FM B-2 | Nicrofer S 7020 - FM 82 | S 6020 - FM 625 | Nicrofer S 6023 - FM 601 | S 7020 - FM 82 |
| Elettrodi rivestiti | 2.4616                  | 2.4618                  | 2.4621          | 2.4618                   | 2.4618         |
|                     | EL-NiMo29               | EL-NiCr19Nb             | EL-NiCr20Mo9Nb  |                          | EL-NiCr19Nb    |
|                     | AWS ENiMo-7             | AWS ENiCrMo-3           | AWS ENiCrMo-3   |                          |                |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

Leghe nickel-molibdeno con un contenuto molto basso di carbonio e silicio che assicura un buon comportamento alla corrosione anche nella condizione saldata. La lavorabilità della lega è stata recentemente migliorata grazie alla riduzione del contenuto di ferro a 1.5/2% e ad una lieve aggiunta di cromo.

Variante del Nicrofer 3220 HT - alloy 800 HT, con contenuto "controllato" di carbonio e solubilizzato ad alta temperatura per resistenza molto elevata allo scorrimento viscoso. Eccellente resistenza ad atmosfere carburanti, ossidanti e riducenti.

Leghe nickel-cromo-ferro con aggiunte di alluminio e titanio. Resistenza particolarmente elevata all'ossidazione fino a 1150°C circa. Buona resistenza alla carburazione.

1) Fino a 8 mm di spessore e per l'ultima passata.

# Leghe per alta temperatura

| Nicrofer 3220 H - alloy 800 H |      |       | Nicrofer 7216 - alloy 600 |      |       | Nicrofer 3718 - alloy 330 |      |       |
|-------------------------------|------|-------|---------------------------|------|-------|---------------------------|------|-------|
| Lamiere/nastri                | Tubi | Barre | Lamiere/nastri            | Tubi | Barre | Lamiere/nastri            | Tubi | Barre |

## SPECIFICHE E DENOMINAZIONI

|     |                  |                    |  |  |           |  |  |                  |  |  |
|-----|------------------|--------------------|--|--|-----------|--|--|------------------|--|--|
| D   | Denominazione    | X 5 NiCrAlTi 31 20 |  |  | NiCr15Fe  |  |  | X 12 NiCrSi36 16 |  |  |
|     | Materiale N.     | 1.4958 (1.4876)    |  |  | 2.4816    |  |  | 1.4864           |  |  |
|     | VdTV             | 412/434            |  |  | 305       |  |  | -                |  |  |
| USA | UNS              | N 08810            |  |  | N 06600   |  |  | N 08330          |  |  |
|     | ASTM(B) ASME(SB) | 409                |  |  | 168       |  |  | -                |  |  |
| GB  | Denominazione BS | NA 15 (H)          |  |  | NA14      |  |  | -                |  |  |
|     | BS               | 3072/3073          |  |  | 3072/3073 |  |  | -                |  |  |
| F   | AFNOR            | -                  |  |  | NC 15 Fe  |  |  | Z 12 NCS 35.16   |  |  |

## COMPOSIZIONE CHIMICA (%)

|           |                 |  |  |              |  |  |  |            |
|-----------|-----------------|--|--|--------------|--|--|--|------------|
| Nickel    | 30 - 32         |  |  | Min. 72      |  |  |  | 34 - 37    |
| Cromo     | 19 - 22         |  |  | 14 - 17      |  |  |  | 15 - 17    |
| Ferro     | Differenza      |  |  | 6 - 10       |  |  |  | Differenza |
| Manganese | -               |  |  | -            |  |  |  | Max. 2     |
| Silicio   | 0.2 - 0.6       |  |  | Max. 0.5     |  |  |  | 1 - 2      |
| Altri     | Al+Ti: Max. 0.7 |  |  | Cr: Max. 0.5 |  |  |  | -          |
|           |                 |  |  | Al: Max. 0.3 |  |  |  | -          |
| Carbonio  | 0.05 - 0.08     |  |  | 0.05 - 0.08  |  |  |  | Max. 0.15  |

## PROPRIETÀ MECCANICHE (N/mm<sup>2</sup>, %)

| Temperatura (°C) | Rp 0.2   | Rp 1.0   | Rm       | A5 | Rp 0.2   | Rp 1.0 | Rm       | A5     | Rp 0.2   | Rp 1.0 | Rm       | A5      |
|------------------|----------|----------|----------|----|----------|--------|----------|--------|----------|--------|----------|---------|
| 20               | Min. 170 | Min. 200 | Min. 450 | -  | Min. 240 | 265    | Min. 550 | Min. 3 | Min. 230 | -      | Min. 550 | Min. 30 |
| 100              | Min. 140 | Min. 160 | 425      | -  | Min. 180 | -      | 520      | 35     | 330      | -      | 640      | 35      |
| 200              | Min. 115 | Min. 135 | 400      | -  | Min. 165 | -      | 500      | 35     | 300      | -      | 620      | 35      |
| 300              | Min. 95  | Min. 115 | 390      | -  | Min. 155 | -      | 485      | 35     | 290      | -      | 610      | 35      |
| 400              | Min. 85  | Min. 105 | 380      | -  | Min. 150 | -      | 480      | 35     | 280      | -      | 600      | 35      |
| 500              | Min. 80  | Min. 100 | 360      | -  | Min. 140 | -      | 470      | -      | 265      | -      | 560      | 35      |
| 600              | Min. 75  | Min. 95  | 300      | -  | -        | -      | -        | -      | 250      | -      | 490      | 40      |

## PROPRIETÀ DI RESISTENZA ALLO SCORRIMENTO VISCOSO (N/mm<sup>2</sup>)

| Temperatura (°C) | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> |
|------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|
| 600              | -                      | 152                | -                      | 114                | 80                     | 125                | 40                     | 75                 |
| 700              | -                      | 75                 | -                      | 53                 | 35                     | 45                 | 14                     | 25                 |
| 800              | -                      | 57                 | -                      | 24                 | 15                     | 20                 | 4                      | 7                  |
| 900              | -                      | 17                 | -                      | 10.5               | 5                      | 8                  | 1.5                    | 3                  |
| 950              | -                      | 11.5               | -                      | 7                  | -                      | -                  | -                      | -                  |
| 1000             | -                      | -                  | -                      | -                  | -                      | 4                  | -                      | 1.5                |

## PROPRIETÀ FISICHE A TEMPERATURA AMBIENTE O COME INDICATO

|                       |                    |      |      |      |
|-----------------------|--------------------|------|------|------|
| Densità               | g/cm <sup>3</sup>  | 8.0  | 8.4  | 8.0  |
| Calore specifico      | J/Kg K             | 472  | 455  | 472  |
| Conducibilità termica | W/m K              | 11.5 | 14.8 | 11.4 |
| Resistività elettrica | μΩ                 | 101  | 103  | 104  |
| Dilatazione termica   | 10 <sup>3</sup> /K | 16.2 | 14.4 | 16.2 |
| 20-300°C              |                    |      |      |      |
| Modulo di elasticità  | kN/mm <sup>2</sup> | 194  | 214  | 194  |

## CARATTERISTICHE DI LAVORAZIONE

|              |               |       |       |
|--------------|---------------|-------|-------|
| Lavorabilità | Buona         | Buona | Buona |
| Saldabilità  | Soddisfacente | Buona | Buona |

## PRODOTTI PER LA SALDATURA

|                     |                       |                 |                         |                         |
|---------------------|-----------------------|-----------------|-------------------------|-------------------------|
| Filli di apporto    | Nicrofer S 7020-FM 82 | S 6020 - FM 625 | Nicrofer S 7020 - FM 82 | Nicrofer S 7020 - FM 82 |
| Elettrodi rivestiti | 2.46-18               | 2.46-21         | 2.46-18                 | 2.46-18                 |
|                     | EL-NiCr19Nb           | EL-NiCr20Mo9Nb  | EL-NiCr19Nb             | EL-NiCr19Nb             |
|                     |                       |                 | AWS ENiCrFe-3           | AWS ENiCrFe-3           |

## DESCRIZIONE DEL MATERIALE, CARATTERISTICHE PRINCIPALI

|                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                              |                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Particolarmente impegnata alle alte temperature sia in atmosfera ossidante che riducente ed in estreme condizioni di corrosione. La lega è impiegata inoltre per l'equipaggiamento di forni, caldaie nell'industria chimica, petrolchimica e nucleare. | Leghe nickel-cromo-ferro. Notevole resistenza ad atmosfere nitruvanti e carburanti. Ottima resistenza agli alogeni fino a 600°C. Per temperature oltre i 600°C è preferibile utilizzare la variante per elevate temperature. | Leghe ferro-nickel-cromo con aggiunte di silicio e manganese. Buona resistenza alla carburazione e ad atmosfere alternativamente ossidanti e riducenti. |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

1) Secondo VdTV-BIAT 412, Edizione 01.84, materiale n. 1.4876

# Corrosion-resistant alloys

Nicrofer 5219 Nb – alloy 718

Cronifer 1925 hMo – alloy 926

Nicrofer 5520 Co – alloy 617

Sheet/strip

Tube/pipe

Rod/bar

Sheet/strip

Tube/pipe

Rod/bar

## DESIGNATIONS AND SPECIFICATIONS

| D   | Designation      | NiCr19NbMo |  |     | NiCrMoCuN 25 20 6          |  |             | NiCr23Co12Mo |  |     |
|-----|------------------|------------|--|-----|----------------------------|--|-------------|--------------|--|-----|
|     | Material N.      | 2.4668     |  |     | 1.4529                     |  |             | 2.4663       |  |     |
|     | VdTUV            | -          |  |     | 502                        |  | 502         | 485          |  | 485 |
| USA | UNS              | N 07718    |  |     | N 08926 (previous N 08925) |  |             | N 06617      |  |     |
|     | ASTM(B) ASME(SH) | 670        |  | 637 | 625                        |  | 673/674/677 |              |  |     |
| GB  | Designation BS   | -          |  | -   | -                          |  | -           | -            |  | -   |
|     | BS               | -          |  | -   | -                          |  | -           | -            |  | -   |
| F   | AFNOR            | NC 19 FeNb |  | -   | -                          |  | -           | -            |  | -   |

## CHEMICAL COMPOSITION (%)

|            |  |               |  |                  |                |  |  |             |  |  |
|------------|--|---------------|--|------------------|----------------|--|--|-------------|--|--|
| Nickel     |  | 50 - 55       |  |                  | 24.5 - 25.5    |  |  | Balance     |  |  |
| Chromium   |  | 17 - 21       |  |                  | 20 - 21        |  |  | 20 - 23     |  |  |
| Iron       |  | Balance       |  |                  |                |  |  | max. 2      |  |  |
| Molybdenum |  | 2.8 - 3.3     |  |                  | 6 - 6.8        |  |  | 8 - 10      |  |  |
| Carbon     |  | 0.02 - 0.08   |  |                  | max. 0.020     |  |  | 0.05 - 0.1  |  |  |
| Titanium   |  | 0.7 - 1.15    |  |                  |                |  |  | 0.2 - 0.6   |  |  |
| Aluminum   |  | 0.5 - 0.7     |  |                  |                |  |  | 0.6 - 1.5   |  |  |
| Others     |  | Nb: 4.8 - 5.5 |  | B: 0.002 - 0.006 | N: 0.18 - 0.20 |  |  | Co: 10 - 15 |  |  |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2 <sup>a</sup> | Rp 1.0 | Rm <sup>b</sup> | A5 <sup>c</sup> | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|---------------------|--------|-----------------|-----------------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 1040           | -      | Min. 1240       | Min. 12         | Min. 300 | Min. 340 | Min. 650 | Min. 40 | Min. 350 | Min. 380 | Min. 750 | Min. 35 |
| 100              | 1060                | -      | -               | -               | Min. 230 | Min. 270 | Min. 610 | -       | Min. 270 | Min. 300 | Min. 650 | -       |
| 200              | 1040                | -      | -               | -               | Min. 190 | Min. 225 | Min. 560 | -       | Min. 230 | Min. 260 | Min. 620 | -       |
| 280              | -                   | -      | -               | -               | -        | -        | -        | -       | -        | -        | -        | -       |
| 300              | 1020                | -      | -               | -               | Min. 170 | Min. 205 | Min. 525 | -       | Min. 220 | Min. 250 | Min. 600 | -       |
| 400              | 1000                | -      | -               | -               | Min. 160 | Min. 190 | Min. 510 | -       | Min. 210 | Min. 240 | Min. 570 | -       |
| 500              | 980                 | -      | -               | -               | Min. 120 | Min. 150 | -        | -       | Min. 200 | Min. 225 | Min. 540 | -       |
| 550              | -                   | -      | -               | -               | Min. 105 | Min. 135 | -        | -       | -        | -        | -        | -       |
| 600              | 950                 | -      | -               | -               | -        | -        | -        | -       | Min. 190 | Min. 210 | Min. 510 | -       |
| 700              | 870                 | -      | -               | -               | -        | -        | -        | -       | Min. 185 | Min. 205 | Min. 400 | -       |
| 750              | -                   | -      | -               | -               | -        | -        | -        | -       | Min. 180 | Min. 200 | Min. 340 | -       |
| 800              | 640                 | -      | -               | -               | -        | -        | -        | -       | -        | -        | -        | -       |

## CREEP PROPERTIES (N/mm<sup>2</sup>)

| Temperature (°C) | Rp 1.0/10 <sup>4</sup> | Rm/10 <sup>4</sup> | Rp 1.0/10 <sup>4</sup> | Rm/10 <sup>4</sup> | Rp 1.0/10 <sup>4</sup> | Rm/10 <sup>4</sup> | Rp 1.0/10 <sup>4</sup> | Rm/10 <sup>4</sup> |
|------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|
| 580              | 620                    | 430                | 505                    |                    | 220                    | 260                | 140                    | 190                |
| 700              | 200                    | 248                | 88                     | 132                | 99                     | 123                | 66                     | 95                 |
| 800              | 19                     | 36                 | 6.1                    | 12                 | 45                     | 65                 | 28                     | 43                 |
| 900              |                        |                    |                        |                    | 19                     | 30                 | 10                     | 16                 |
| 1000             |                        |                    |                        |                    | 5.5                    | 10                 | 1.0                    | 4.5                |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                    |      |  |      |  |      |
|------------------------|--------------------|------|--|------|--|------|
| Density                | g/cm <sup>3</sup>  | 8.2  |  | 8.1  |  | 8.4  |
| Specific heat          | J/Kg K             | 432  |  | 415  |  | 420  |
| Thermal conductivity   | W/m K              | 11.1 |  | 12.0 |  | 13.4 |
| Electrical resistivity | μf                 | 123  |  | 96   |  | 122  |
| Thermal expansion      | 10 <sup>3</sup> /K | 13.8 |  | 16.1 |  | 13.1 |
| 20-300°C               |                    |      |  |      |  |      |
| Modulus of elasticity  | kN/mm <sup>2</sup> | 205  |  | 193  |  | 212  |

## FABRICATION CHARACTERISTICS

|             |                        |  |      |  |      |
|-------------|------------------------|--|------|--|------|
| Formability | Good                   |  | Good |  | Good |
| Weldability | annealed: satisfactory |  | Good |  | Good |

## WELDING PRODUCTS

|                   |                          |                                         |                          |
|-------------------|--------------------------|-----------------------------------------|--------------------------|
| Filler wire       | Nicrofer S 5219 - FM 718 | Nicrofer S 6020 - FM 625/S 5923 - FM 59 | Nicrofer S 5520 - FM 617 |
| Covered electrode | -                        | 2.4621 2.4609                           | 2.4628                   |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Niobium and molybdenum – containing nickel-iron-chromium alloy, age-hardenable through aluminum and titanium additions. Excellent corrosion resistance at high and low temperatures, good resistance to pitting and stress-corrosion cracking. Good mechanical properties, high fatigue strength and creep rupture strength up to 700°C (1300°F) and resistance to oxidation up to 1000°C (1840°F). 1) Solution annealed, age hardened.

Austenitic iron-nickel-chromium alloy similar to Cronifer 1925 LC – alloy 904 L, but with increased molybdenum and nitrogen contents. Exceptional resistance to pitting, crevice corrosion and to stress-corrosion cracking in halide media. High strength. Excellent resistance to a wide range of chemicals.

Solid solution nickel-chromium-cobalt-molybdenum alloy, with extremely high creep strength and exceptional resistance to carburization, very good resistance to oxidation and excellent metallurgical stability.

# Corrosion-resistant alloys

| VDM LC-Nickel 99.2 - alloy 201 |           |         |  | Nicrocor - alloy 400 |           |         | Nicrocor Al - alloy K-500 |           |         |
|--------------------------------|-----------|---------|--|----------------------|-----------|---------|---------------------------|-----------|---------|
| Sheet/strip                    | Tube/pipe | Rod/bar |  | Sheet/strip          | Tube/pipe | Rod/bar | Sheet/strip               | Tube/pipe | Rod/bar |

## DESIGNATIONS AND SPECIFICATIONS

| D   | Designation      | LC-Ni 99  |         |      | NiCu30Fe  |         |      | NiCu30Al  |      |
|-----|------------------|-----------|---------|------|-----------|---------|------|-----------|------|
|     | Material N.      | 2.4068    |         |      | 2.4360    |         |      | 2.4375    |      |
|     | Vdt/V            | 345       | 345     | 345  | 263       | 263     | 263  | -         | -    |
| USA | UNS              | N 02201   |         |      | N 04400   |         |      | N 05500   |      |
|     | ASTM(B) ASME(SB) | 162       | 161/163 | 160  | 127       | 163/165 | 164  | -         | -    |
| GB  | Designation BS   | NA12      |         |      | NA13      |         |      | NA18      |      |
|     | BS               | 3072/3073 | 3074    | 3076 | 3072/3073 | 3074    | 3076 | 3072/3073 | 3074 |
| F   | AFNOR            | -         |         |      | NU 30     |         |      | NU 30 AT  | 3076 |

## CHEMICAL COMPOSITION (%)

|           |  |           |  |  |           |  |  |             |  |
|-----------|--|-----------|--|--|-----------|--|--|-------------|--|
| Nickel    |  | Min. 99   |  |  | Min. 63   |  |  | Min. 63     |  |
| Manganese |  | Max. 0.3  |  |  | Max. 1.25 |  |  | Max. 1.5    |  |
| Aluminum  |  | -         |  |  | Max. 0.5  |  |  | 2.3 - 3.15  |  |
| Iron      |  | Max. 0.4  |  |  | 1 - 2.5   |  |  | 0.5 - 2     |  |
| Magnesium |  | Max. 0.05 |  |  | -         |  |  | -           |  |
| Copper    |  | Max. 0.25 |  |  | 28 - 34   |  |  | 27 - 33     |  |
| Titanium  |  | -         |  |  | Max. 0.3  |  |  | 0.35 - 0.85 |  |
| Carbon    |  | Max. 0.02 |  |  | Max. 0.15 |  |  | Max. 0.25   |  |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2  | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0 | Rm       | A5      |
|------------------|---------|----------|----------|---------|----------|----------|----------|---------|----------|--------|----------|---------|
| 20               | Min. 80 | Min. 105 | Min. 340 | Min. 40 | Min. 175 | Min. 205 | Min. 420 | Min. 30 | Min. 690 | -      | Min. 965 | Min. 20 |
| 100              | Min. 70 | Min. 95  | 290      | 40      | Min. 150 | 220      | 420      | 30      | 740      | -      | 1050     | 24      |
| 200              | Min. 65 | Min. 90  | 275      | 40      | Min. 135 | 210      | 390      | 30      | 700      | -      | 1025     | 23      |
| 300              | Min. 60 | Min. 85  | 260      | 45      | Min. 130 | 190      | 380      | 30      | 660      | -      | 975      | 23      |
| 400              | Min. 55 | Min. 80  | 240      | 55      | Min. 130 | 180      | 370      | 30      | 640      | -      | 880      | 10      |
| 500              | Min. 50 | Min. 75  | 210      | 60      | Min. 130 | -        | 360      | 30      | -        | -      | -        | -       |
| 600              | Min. 40 | Min. 65  | 150      | 75      | Min. 400 | -        | Min. 580 | Min. 18 | Min. 620 | -      | Min. 895 | Min. 20 |

## CREEP PROPERTIES (N/mm<sup>2</sup>)

| Temperature (°C) | Rp 1.0/10' | Rm/10' | Rp 1.0/10' | Rm/10' | Rp 1.0/10' | Rm/10' | Rp 1.0/10' | Rm/10' | Rp 1.0/10' | Rm/104 | Rp 1.0/105 | Rm/105 |
|------------------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|
| 300              | 110        | 260    | 95         | 238    | -          | -      | -          | -      | -          | -      | -          | -      |
| 400              | 75         | 159    | 60         | 145    | 150        | 280    | 130        | 240    | 770        | -      | -          | -      |
| 500              | 35         | 85     | 23         | 55     | 75         | 125    | 62         | 75     | 260        | -      | -          | -      |
| 600              | 10         | 45     | 6          | 25     | 17         | 45     | 8          | 20     | 60         | -      | -          | -      |
| 650              | 7          | 33     | 3          | 19     | 7          | 23     | 3          | 3      | -          | -      | -          | -      |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                     |      |  |  |      |  |  |      |
|------------------------|---------------------|------|--|--|------|--|--|------|
| Density                | g/cm <sup>3</sup>   | 8.9  |  |  | 8.8  |  |  | 8.5  |
| Specific heat          | J/Kg K              | 456  |  |  | 430  |  |  | 420  |
| Thermal conductivity   | W/m K               | 79   |  |  | 26   |  |  | 17.4 |
| Electrical resistivity | μΩ                  | 8.5  |  |  | 51.3 |  |  | 61   |
| Thermal expansion      | 10 <sup>-6</sup> /K | 14.3 |  |  | 15.8 |  |  | 14.9 |
| 20-300°C               |                     |      |  |  |      |  |  |      |
| Modulus of elasticity  | kN/mm <sup>2</sup>  | 207  |  |  | 182  |  |  | 179  |

## FABRICATION CHARACTERISTICS

|             |           |  |  |           |  |  |                              |
|-------------|-----------|--|--|-----------|--|--|------------------------------|
| Formability | Excellent |  |  | Excellent |  |  | Good                         |
| Weldability | Good      |  |  | Good      |  |  | annealed: good               |
|             |           |  |  |           |  |  | age-hardened: not applicable |

## WELDING PRODUCTS

|                   |                           |           |                         |             |                         |
|-------------------|---------------------------|-----------|-------------------------|-------------|-------------------------|
| Filler wire       | VDM Nickel S 9604 - FM 61 |           | Nicrocor S 6530 - FM 60 |             | Nicrocor S 6530 - FM 60 |
| Covered electrode | 2.4156                    |           | 2.4366                  |             | 2.4366                  |
|                   | EL-NiTi 3                 | AW5 ENi-1 | EL-NiCu30Mn             | AW5 ENiCu-7 | EL-NiCu30Mn             |
|                   |                           |           |                         |             | AW5 ENiCu-7             |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Commercially pure wrought nickel with reduced carbon content (0.02% max). The reduced carbon content avoids graphite precipitation at temperatures above 315°C (600°F). German pressure vessel regulations permit this material to be used at temperatures up to 600°C (1110°F), and up to 450°C (840°F) for caustic soda evaporators.

Nickel-copper alloy. High strength and toughness over a wide temperature range. Excellent resistance to flowing seawater. Good resistance to hydrofluoric acid, non-oxidizing dilute acids, alkalis and salt solutions, organic acids dry gases such as chlorine and to hydrogen chloride. Not susceptible to chloride-induced stress corrosion cracking. Pressure vessel regulations permit this material to be used at temperatures up to approx. 425°C (800°F).

Nickel-copper alloy, age-hardenable through aluminum and titanium additions. This material combines the excellent corrosion resistance of Nicrocor - alloy 400 with much higher mechanical properties. Its high tensile strength is maintained at temperatures up to 650°C (1200°F). Nicrocor Al - alloy K-500 features low permeability and is non-magnetic.

# Corrosion-resistant alloys

| Nicrofer 5716 hMoW – alloy C-276 |           |         |  | Nicrofer 4221 – alloy 825 |           |         |  | Canifer 10 – alloy CuNi 90/10 |           |         |  |
|----------------------------------|-----------|---------|--|---------------------------|-----------|---------|--|-------------------------------|-----------|---------|--|
| Sheet/strip                      | Tube/pipe | Rod/bar |  | Sheet/strip               | Tube/pipe | Rod/bar |  | Sheet/strip                   | Tube/pipe | Rod/bar |  |

## DESIGNATIONS AND SPECIFICATIONS

| D   | Designation      | NiMo16Cr15W |             |     | NiCr21Mo   |                 |       |       | CuNi10Fe1Mn     |             |      |
|-----|------------------|-------------|-------------|-----|------------|-----------------|-------|-------|-----------------|-------------|------|
|     | Material N.      | 2.4819      |             |     | 2.4858     |                 |       |       | 2.0872          |             |      |
|     | VdTUV            | 400         |             | 400 | 432/1      |                 | 432/2 | 432/3 | -               | -           | -    |
| USA | UNS              | N 10276     |             |     | N 08825    |                 |       |       | C 70600         |             |      |
|     | ASTM(B) ASME(SB) | 575         | 619/622/626 | 574 | 424        | 165/423/704/705 | 425   |       | 122, 171        | 466/467/111 | 151  |
| GB  | Designation BS   | -           | -           | -   | NA16       |                 |       |       | CN1027          |             |      |
|     | BS               | -           | -           | -   | 3072/3073  |                 | 3074  | 3076  | 2870/2875       | 2871        | 2874 |
| F   | AFNOR            | NC 17 D     |             |     | NC 21 FeDU |                 |       |       | CuNi 10 Fe 1 Mn |             |      |

## CHEMICAL COMPOSITION (%)

|            |                         |  |  |  |             |  |  |  |                          |  |  |
|------------|-------------------------|--|--|--|-------------|--|--|--|--------------------------|--|--|
| Nickel     | Balance                 |  |  |  | 38 - 46     |  |  |  | 9 - 11                   |  |  |
| Chromium   | 15 - 16.5               |  |  |  | 19.5 - 23.5 |  |  |  | -                        |  |  |
| Molybdenum | 15 - 17                 |  |  |  | 2.5 - 3.5   |  |  |  | -                        |  |  |
| Iron       | 4 - 7                   |  |  |  | balance     |  |  |  | 1 - 1.8                  |  |  |
| Silicon    | Max. 0.08               |  |  |  | -           |  |  |  | -                        |  |  |
| Others     | W: 3 - 4.5 Co: Max. 2.5 |  |  |  | Cu: 1.5 - 3 |  |  |  | Mn: 0.2 - 1 Zn: Max. 0.5 |  |  |
|            | V: 0.1 - 0.3            |  |  |  |             |  |  |  | Cu: balance              |  |  |
| Titanium   | -                       |  |  |  | 0.6 - 1.2   |  |  |  | -                        |  |  |
| Carbon     | Max. 0.01               |  |  |  | Max. 0.025  |  |  |  | -                        |  |  |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|----------|----------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 310 | Min. 330 | Min. 750 | Min. 30 | Min. 240 | Min. 265 | Min. 550 | Min. 30 | Min. 100 | Min. 125 | Min. 300 | Min. 30 |
| 100              | Min. 280 | Min. 305 | 685      | 50      | Min. 205 | Min. 235 | 530      | 40      | -        | Min. 118 | -        | -       |
| 200              | Min. 240 | Min. 275 | 680      | 60      | Min. 180 | Min. 205 | 515      | 40      | -        | Min. 109 | -        | -       |
| 300              | Min. 220 | Min. 245 | 650      | 65      | Min. 170 | Min. 195 | 500      | 45      | -        | Min. 99  | -        | -       |
| 400              | Min. 195 | Min. 230 | 630      | 60      | Min. 160 | Min. 185 | 490      | 45      | -        | -        | -        | -       |
| 450              | -        | -        | -        | -       | Min. 155 | Min. 181 | 485      | 45      | -        | -        | -        | -       |
| 500              | -        | -        | -        | -       | -        | -        | -        | -       | -        | -        | -        | -       |
| 600              | -        | -        | -        | -       | -        | -        | -        | -       | -        | -        | -        | -       |

## CREEP PROPERTIES (N/mm<sup>2</sup>)

| Temperature (°C) | Rp 1.0/10 <sup>6</sup> | Rm/10 <sup>6</sup> | Rp 1.0/10 <sup>6</sup> | Rm/10 <sup>6</sup> |
|------------------|------------------------|--------------------|------------------------|--------------------|
| 200              | 98                     | -                  | 94                     | -                  |
| 250              | 88                     | -                  | 88                     | -                  |
| 300              | 74                     | -                  | 74                     | -                  |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                     |      |      |     |
|------------------------|---------------------|------|------|-----|
| Density                | g/cm <sup>3</sup>   | 8.9  | 8.1  | 8.9 |
| Specific heat          | J/Kg K              | 407  | 440  | 380 |
| Thermal conductivity   | W/m K               | 10.6 | 10.8 | 45  |
| Electrical resistivity | μΩ                  | 125  | 112  | 19  |
| Thermal expansion      | 10 <sup>-6</sup> /K | 12.8 | 15.2 | 17  |
| 20-300°C               |                     |      |      |     |
| Modulus of elasticity  | kN/mm <sup>2</sup>  | 208  | 195  | 130 |

## FABRICATION CHARACTERISTICS

|             |      |      |      |
|-------------|------|------|------|
| Formability | Good | Good | Good |
| Weldability | Good | Good | Good |

## WELDING PRODUCTS

|                   |                              |                          |                |                        |                |
|-------------------|------------------------------|--------------------------|----------------|------------------------|----------------|
| Filler wire       | Nicrofer S 5716 - FM C-276   | Nicrofer S 6020 - FM 625 | S 4225 - FM 65 | Canifer S 7030 - FM 67 | Canifer S 9010 |
| Covered electrode | 2.4887                       | 2.4621                   | 2.4652         | 2.0838                 |                |
|                   | EL-NiMo15Cr15W AWS ENiCrMo-4 | EL-NiCr20Mo9Nb           | EL-NiCr26Mo    | EL-CuNi30Mn            | AWS ECuNi      |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Nickel-chromium-molybdenum alloy with a tungsten addition and extremely low carbon and silicon contents. Excellent resistance to crevice corrosion, pitting and stress corrosion cracking. Outstanding resistance to a wide range of chemical media, particularly under reducing conditions. Excellent resistance to hot contaminated mineral and organic acids and to seawater.

Titanium stabilized fully austenitic nickel-iron-chromium alloy with molybdenum and copper additions. Excellent resistance to stress-corrosion cracking, good resistance to pitting and crevice corrosion. Good resistance to oxidizing and reducing acids such as sulfuric, phosphoric and nitric acid and to organic alkaline solutions, alkalis and seawater. Approved for pressure vessel operating temperatures up to 425°C (800°F).

Copper-nickel alloy with approx. 10% nickel and iron and manganese additions. Good resistance to seawater and to brackish and industrial waters. Good resistance to flowing clean seawater (flow velocities from 1 to 3.5 m/s). Good resistance to stress corrosion cracking.

# Corrosion-resistant alloys

| Nicrofer 6020 hMo – alloy 625 |  |           |         | Nicrofer 5923 hMo – alloy 59 |  |           |         | Nicrofer 5621 hMoW – alloy C-22 |  |           |         |
|-------------------------------|--|-----------|---------|------------------------------|--|-----------|---------|---------------------------------|--|-----------|---------|
| Sheet/strip                   |  | Tube/pipe | Rod/bar | Sheet/strip                  |  | Tube/pipe | Rod/bar | Sheet/strip                     |  | Tube/pipe | Rod/bar |

## DESIGNATIONS AND SPECIFICATIONS

|     |                    |             |             |      |              |             |     |             |             |     |     |
|-----|--------------------|-------------|-------------|------|--------------|-------------|-----|-------------|-------------|-----|-----|
| D   | Designation        | NiCr22Mo9Nb |             |      | NiCr23Mo16Al |             |     | NiCr21Mo14W |             |     |     |
|     | Material N.        | 2.4856      |             |      | 2.4605       |             |     | 2.4602      |             |     |     |
|     | VdTUV              | 499         | 499         | 499  | 505          | -           | -   | 479         |             | 479 | 479 |
| USA | UNS                | N 06625     |             |      | N 06059      |             |     | N 06022     |             |     |     |
|     | ASTM (D) ASME (SB) | 443         | 444/704/705 | 446  | 575          | 619/622/626 | 574 | 575         | 619/622/626 | 574 |     |
| GB  | Designation BS     | NA21        |             |      | -            | -           | -   | -           | -           | -   | -   |
|     | BS                 | 3072        |             | 3076 | -            | -           | -   | -           | -           | -   | -   |
| F   | AFNOR              | NU 22 DNB   |             |      | -            | -           | -   | -           | -           | -   | -   |

## CHEMICAL COMPOSITION (%)

|            |            |  |  |               |  |  |               |  |  |  |
|------------|------------|--|--|---------------|--|--|---------------|--|--|--|
| Nickel     | Balance    |  |  | Balance       |  |  | Balance       |  |  |  |
| Chromium   | 21 - 23    |  |  | 22 - 24       |  |  | 20 - 22.5     |  |  |  |
| Iron       | Max. 3     |  |  | Max. 1.5      |  |  | 2 - 6         |  |  |  |
| Silicon    | -          |  |  | Max. 0.1      |  |  | Max. 0.08     |  |  |  |
| Others     | -          |  |  | Al: 0.1 - 0.4 |  |  | Min: Max. 0.5 |  |  |  |
| Molybdenum | 8 - 10     |  |  | 15 - 16.5     |  |  | 12.5 - 14.5   |  |  |  |
| Cobalt     | -          |  |  | Max. 0.3      |  |  | Max. 2.5      |  |  |  |
| Niobium    | 3.2 - 10   |  |  | -             |  |  | -             |  |  |  |
| Tungsten   | -          |  |  | -             |  |  | 2.5 - 3.5     |  |  |  |
| Vanadium   | -          |  |  | -             |  |  | Max. 0.35     |  |  |  |
| Carbon     | Max. 0.025 |  |  | Max. 0.010    |  |  | Max. 0.010    |  |  |  |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|----------|----------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 415 | Min. 445 | Min. 830 | Min. 35 | Min. 340 | Min. 380 | Min. 690 | Min. 40 | Min. 310 | Min. 335 | Min. 690 | Min. 45 |
| 100              | Min. 350 | -        | 740      | -       | Min. 290 | Min. 330 | 650      | 50      | Min. 270 | Min. 290 | -        | -       |
| 200              | Min. 320 | -        | 700      | -       | Min. 250 | Min. 290 | 615      | 50      | Min. 225 | Min. 245 | -        | -       |
| 300              | Min. 300 | -        | 685      | -       | Min. 220 | Min. 260 | 580      | 50      | Min. 195 | Min. 215 | -        | -       |
| 400              | Min. 280 | -        | 670      | -       | Min. 190 | Min. 230 | 545      | 50      | Min. 175 | Min. 195 | -        | -       |
| 450              | Min. 270 | -        | 660      | -       | Min. 175 | Min. 215 | 525      | 50      | -        | -        | -        | -       |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                     |      |      |      |
|------------------------|---------------------|------|------|------|
| Density                | g/cm <sup>3</sup>   | 8.5  | 8.6  | 8.7  |
| Specific heat          | J/Kg K              | 415  | 414  | 406  |
| Thermal conductivity   | W/m K               | 9.8  | 10.4 | 9.4  |
| Electrical resistivity | μΩ                  | 128  | 126  | 114  |
| Thermal expansion      | 10 <sup>-6</sup> /K | 13.4 | 12.5 | 12.5 |
| 20-300°C               |                     |      |      |      |
| Modulus of elasticity  | kN/mm <sup>2</sup>  | 209  | 210  | 206  |

## FABRICATION CHARACTERISTICS

|             |      |      |      |
|-------------|------|------|------|
| Formability | Good | Good | Good |
| Weldability | Good | Good | Good |

## WELDING PRODUCTS

|                   |                          |                         |                         |                |
|-------------------|--------------------------|-------------------------|-------------------------|----------------|
| Filler wire       | Nicrofer S 6020 - FM 625 | Nicrofer S 5923 - FM 59 | Nicrofer S 5621 - FM 22 | S 5923 - FM 59 |
| Covered electrode | 2.4621                   | 2.4609                  | 2.4635                  | 2.4609         |
|                   | EL-NiCr20Mo9Nb           | EL-NiCr22Mo16           | SG-NiCr21Mo14W          | EL-NiCr22Mo16  |
|                   | AWS ENiCrMo-3            |                         | AWSA 5.14               |                |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Low-carbon nickel-chromium-molybdenum alloy with a niobium addition. Excellent resistance to pitting, crevice corrosion and stress-corrosion cracking. Excellent resistance to corrosion fatigue and erosion-corrosion. Highly resistant in a wide range of organic and mineral acids. Good resistance to high temperature corrosion in some oxidizing sulfur/chloride media. Good mechanical properties at temperatures up to 450°C (840°F).

Nickel-chromium-molybdenum alloy with extremely low carbon and silicon contents and tungsten-free. Outstanding resistance to a large number of corrosive media under both oxidizing and reducing conditions. Excellent resistance to mineral acids such as nitric, phosphoric, sulfuric and hydrochloric acids, even when contaminated. Very high metallurgical stability.

Nickel-chromium-molybdenum alloy with a tungsten addition and extremely low carbon and silicon contents. Outstanding resistance to crevice corrosion, pitting and stress-corrosion cracking. Excellent resistance to a wide range of chemical media under both oxidizing and reducing conditions. Good metallurgical stability.



# Corrosion-resistant alloys

| Nicrofer 3620 Nb – alloy 20 |           |         |  | Nicrofer 3127 hMo – alloy 31 |           |         |  | Nicrofer 3127 LC – alloy 28 |           |         |  |
|-----------------------------|-----------|---------|--|------------------------------|-----------|---------|--|-----------------------------|-----------|---------|--|
| Sheet/strip                 | Tube/pipe | Rod/bar |  | Sheet/strip                  | Tube/pipe | Rod/bar |  | Sheet/strip                 | Tube/pipe | Rod/bar |  |

## DESIGNATIONS AND SPECIFICATIONS

| D   | Designation      | NiCr20CuMo |                 | X 1 NiCrMoCu 32 28 7 |             | X 1 NiCrMoCu 31 27 4 |
|-----|------------------|------------|-----------------|----------------------|-------------|----------------------|
|     | Material N.      | 2.4660     |                 | 1.4562               |             | 1.4563               |
|     | VdTUV            | -          | -               | 509                  | -           | -                    |
| USA | UNS              | N 08020    |                 | N 08051              |             | N 08028              |
|     | ASTM(B) ASME(SB) | 463        | 464/468/474/729 | 472/473              | 619/622/626 | 649                  |
| GB  | Designation BS   | -          | -               | -                    | -           | -                    |
|     | BS               | -          | -               | -                    | -           | -                    |
| F   | AFNOR            | -          | -               | -                    | -           | Z 1 NCDU 31.27       |

## CHEMICAL COMPOSITION (%)

|            |                         |  |             |  |             |
|------------|-------------------------|--|-------------|--|-------------|
| Nickel     | 36.5 - 38               |  | 30 - 32     |  | 30 - 32     |
| Chromium   | 19 - 21                 |  | 26 - 28     |  | 26 - 28     |
| Iron       | Balance                 |  | Balance     |  | Balance     |
| Azote      | -                       |  | 0.15 - 0.25 |  | 0.04 - 0.07 |
| Others     | Cu: 3 - 4 Nb: 0.1 - 0.3 |  | Cu: 1 - 1.4 |  | Cu: 1 - 1.4 |
| Molybdenum | 2 - 3                   |  | 6 - 7       |  | 3 - 4       |
| Carbon     | Max. 0.02               |  | Max. 0.015  |  | Max. 0.015  |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2   | Rp 1.0 | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|----------|--------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 240 | -      | Min. 550 | Min. 50 | Min. 280 | Min. 310 | Min. 650 | Min. 40 | Min. 215 | Min. 245 | Min. 500 | Min. 35 |
| 100              | Min. 210 | -      | 520      | 40      | Min. 210 | Min. 240 | 630      | 50      | Min. 190 | Min. 220 | 500      | 40      |
| 200              | Min. 180 | -      | 500      | 40      | Min. 180 | Min. 210 | 580      | 50      | Min. 165 | Min. 195 | 490      | 40      |
| 300              | Min. 140 | -      | 480      | 40      | Min. 165 | Min. 195 | 530      | 50      | Min. 150 | Min. 180 | 480      | 40      |
| 400              | -        | -      | -        | -       | Min. 150 | Min. 180 | 500      | 50      | Min. 135 | Min. 165 | 465      | 40      |
| 500              | -        | -      | -        | -       | Min. 135 | Min. 165 | 470      | 50      | Min. 120 | Min. 150 | -        | -       |
| 550              | -        | -      | -        | -       | Min. 125 | Min. 155 | -        | -       | Min. 115 | Min. 145 | -        | -       |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                     |      |  |      |  |      |
|------------------------|---------------------|------|--|------|--|------|
| Density                | g/cm <sup>3</sup>   | 8.1  |  | 8.1  |  | 8.0  |
| Specific heat          | J/Kg K              | 456  |  | 452  |  | 452  |
| Thermal conductivity   | W/m K               | 11.5 |  | 11.7 |  | 11.7 |
| Electrical resistivity | μΩ                  | 107  |  | 103  |  | 104  |
| Thermal expansion      | 10 <sup>-6</sup> /K | 16   |  | 15.1 |  | 15.8 |
| 20-300°C               |                     |      |  |      |  |      |
| Modulus of elasticity  | kN/mm <sup>2</sup>  | 202  |  | 198  |  | 191  |

## FABRICATION CHARACTERISTICS

|             |              |  |      |  |      |
|-------------|--------------|--|------|--|------|
| Formability | Good         |  | Good |  | Good |
| Weldability | Satisfactory |  | Good |  | Good |

## WELDING PRODUCTS

|                   |                          |                |                         |                |                         |                 |
|-------------------|--------------------------|----------------|-------------------------|----------------|-------------------------|-----------------|
| Filler wire       | Nicrofer S 6020 - FM 625 | S 5925 - FM 59 | Nicrofer S 3127 - FM 31 | S 5925 - FM 59 | Nicrofer S 3127 - FM 31 | S 6020 - FM 625 |
| Covered electrode | 2.4621                   | 2.4609         | 1.4562                  | 2.4609         | 1.4562                  | 2.4621          |
|                   | EL-NiCr20Mo9Nb           | EL-NiCr22Mo16  | X1NiCrMoCu 32 28 7      | EL-NiCr22Mo16  | X1NiCrMoCu 32 28 7      | EL-NiCr20Mo9Nb  |
|                   | AWS ENiCrMo-3            |                |                         |                |                         | AWS ENiCrMo-3   |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Niobium stabilised nickel-iron-chromium alloy with molybdenum and copper additions. Excellent resistance to stress-corrosion cracking. Good resistance to dilute sulfuric acid, even at high temperatures.

Austenitic low-carbon, high-molybdenum iron-nickel-chromium alloy with copper and nitrogen additions. Excellent resistance to pitting, crevice corrosion and stress-corrosion cracking. Outstanding resistance to oxidizing media. Particularly resistant to sulfuric acid solutions, even when contaminated, and to phosphoric acid.

Austenitic low-carbon iron-nickel-chromium alloy with molybdenum and copper additions. High resistance to pitting, crevice corrosion and to stress-corrosion cracking. Very good resistance to oxidizing media.

# Heat-resistant and corrosion-resistant alloys

| Nimofor 6928 – alloy B-2 |           |         | Nicrofer 3220 HT – alloy 800 HT |           |         | Nicrofer 6023 – alloy 601 |           |         |
|--------------------------|-----------|---------|---------------------------------|-----------|---------|---------------------------|-----------|---------|
| Sheet/strip              | Tube/pipe | Rod/bar | Sheet/strip                     | Tube/pipe | Rod/bar | Sheet/strip               | Tube/pipe | Rod/bar |

## DESIGNATIONS AND SPECIFICATIONS

|     |                  |         |             |     |                    |         |     |           |
|-----|------------------|---------|-------------|-----|--------------------|---------|-----|-----------|
| D   | Designation      | NiMo28  |             |     | X 8 NiCrAlTi 32 21 |         |     | NiCr23Fe  |
|     | Material N.      | 2.4617  |             |     | 1.4999             |         |     | 2.4851    |
|     | VdTUV            | 436     |             | 436 | 310                |         | -   | -         |
| USA | UNS              | N 10665 |             |     | N 08811            |         |     | N 06601   |
|     | ASTM(B) ASME(SB) | 333     | 619/622/626 | 335 | 409                | 163/407 | 408 | 168       |
| GB  | Designation BS   | -       | -           | -   | -                  | -       | -   | -         |
|     | BS               | -       | -           | -   | -                  | -       | -   | -         |
| F   | AFNOR            | NiMo 28 |             |     | -                  |         |     | NC 23 FeA |

## CHEMICAL COMPOSITION (%)

|          |                           |  |  |               |  |  |               |
|----------|---------------------------|--|--|---------------|--|--|---------------|
| Nickel   | Balance                   |  |  | 30 - 32       |  |  | 58 - 63       |
| Chromium | 0.4 - 1                   |  |  | 19 - 22       |  |  | 22 - 24       |
| Iron     | 1.5 - 2                   |  |  | Balance       |  |  | Balance       |
| Silicon  | Max. 0.08                 |  |  | 0.2 - 0.6     |  |  | Max. 0.5      |
| Others   | Mo: 26 - 30<br>Co: Max. 1 |  |  | Al: 0.3 - 0.6 |  |  | Al: 1.1 - 1.6 |
| Titanium | -                         |  |  | 0.3 - 0.6     |  |  | 0.1 - 0.4     |
| Carbon   | Max. 0.01                 |  |  | 0.06 - 0.1    |  |  | 0.05 - 0.08   |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      | Rp 0.2   | Rp 1.0   | Rm       | A5      |
|------------------|----------|----------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|
| 20               | Min. 350 | Min. 380 | Min. 760 | Min. 40 | Min. 170 | Min. 200 | Min. 500 | Min. 35 | Min. 300 | Min. 330 | Min. 650 | Min. 30 |
| 100              | Min. 315 | Min. 355 | -        | -       | Min. 140 | Min. 160 | -        | -       | 440      | -        | 750      | 40      |
| 200              | Min. 285 | Min. 325 | -        | -       | Min. 115 | Min. 135 | -        | -       | 430      | -        | 740      | 70      |
| 300              | Min. 270 | Min. 310 | -        | -       | Min. 95  | Min. 115 | -        | -       | 400      | -        | 730      | 35      |
| 400              | Min. 255 | Min. 295 | -        | -       | Min. 85  | Min. 105 | -        | -       | 370      | -        | 700      | 35      |
| 500              | Min. 230 | -        | -        | -       | Min. 80  | Min. 100 | -        | -       | 350      | -        | 670      | 40      |
| 600              | -        | -        | -        | -       | Min. 75  | Min. 95  | -        | -       | 320      | -        | 580      | 40      |

## CREEP PROPERTIES (N/mm<sup>2</sup>)

| Temperature (°C) | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> |
|------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|
| 700              | -                      | -                  | -                      | -                  | 59                     | 73                 | 40                     | 57                 | -                      | -                  |
| 800              | -                      | -                  | -                      | -                  | 30                     | 41                 | 19                     | 26                 | -                      | -                  |
| 900              | -                      | -                  | -                      | -                  | 13                     | 18                 | 6.7                    | 11.2               | -                      | -                  |
| 950              | -                      | -                  | -                      | -                  | 8.2                    | 12                 | 3.9                    | 7.2                | -                      | -                  |
| 1000             | -                      | -                  | -                      | -                  | 4.4                    | 7.9                | 1.9                    | 4                  | -                      | -                  |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                     |      |  |      |  |      |
|------------------------|---------------------|------|--|------|--|------|
| Density                | g/cm <sup>3</sup>   | 9.2  |  | 8.0  |  | 8.1  |
| Specific heat          | J/Kg K              | 577  |  | 472  |  | 450  |
| Thermal conductivity   | W/m K               | 11.4 |  | 11.5 |  | 11.3 |
| Electrical resistivity | μΩ                  | 137  |  | 101  |  | 119  |
| Thermal expansion      | 10 <sup>-6</sup> /K | 11.1 |  | 16.2 |  | 14.6 |
| 20-300°C               |                     |      |  |      |  |      |
| Modulus of elasticity  | kN/mm <sup>2</sup>  | 217  |  | 194  |  | 207  |

## FABRICATION CHARACTERISTICS

|             |      |  |              |  |              |
|-------------|------|--|--------------|--|--------------|
| Formability | Good |  | Good         |  | Good         |
| Weldability | Good |  | Satisfactory |  | Satisfactory |

## WELDING PRODUCTS

|                   |                         |             |                         |                 |                                        |                |
|-------------------|-------------------------|-------------|-------------------------|-----------------|----------------------------------------|----------------|
| Filler wire       | Nimofor S 6928 - FM B-2 |             | Nicrofer S 7020 - FM 82 | S 6020 - FM 625 | Nicrofer S 6023 - FM 601 <sup>1)</sup> | S 7020 - FM 82 |
| Covered electrode | 2.4616                  |             | 2.4618                  | 2.4621          |                                        | 2.4618         |
|                   | ELNiMo29                | AWS ENiMo-7 | ELNiCr19Nb              | ELNiCr20Mo9Nb   |                                        | ELNiCr19Nb     |
|                   |                         |             | AWS ENiCrMo-3           | AWS ENiCrMo-3   |                                        |                |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Nickel-molybdenum alloy with very low carbon and silicon contents to ensure good corrosion behaviour even in the welded condition. Excellent resistance to stress-corrosion cracking, pitting and kauline attack. Particularly resistant to reducing media, such as hydrochloric acid, even at high temperature.

Grade of Nicrofer 3220 HT - alloy 800 with higher total aluminum and titanium contents, for maximum creep strength in the temperature range 700-1000°C (1290-1830°F). Not for long time service below 700°C (1290°F).

Nickel-chromium-iron alloy with aluminum and titanium additions. Particularly high resistance to oxidation up to about 1150°C (2100°F). Good carburization resistance.

1) Up to 10 mm thickness and cover layer

# Heat-resistant alloys

| Nicrofer 3220 H – alloy 800 H |           |         | Nicrofer 7216 – alloy 600 |           |         | Nicrofer 5718 – alloy 330 |           |         |
|-------------------------------|-----------|---------|---------------------------|-----------|---------|---------------------------|-----------|---------|
| Sheet/strip                   | Tube/pipe | Rod/bar | Sheet/strip               | Tube/pipe | Rod/bar | Sheet/strip               | Tube/pipe | Rod/bar |

## DESIGNATIONS AND SPECIFICATIONS

|     |                  |                              |                 |      |           |                 |      |   |
|-----|------------------|------------------------------|-----------------|------|-----------|-----------------|------|---|
| D   | Designation      | X 5 NiCrAlTi 31 20           | NiCr15Fe        |      |           | X 12 NiCrSi6 16 |      |   |
|     | Material N.      | 1.4958 (1.4876 <sup>1)</sup> | 2.4816          |      |           | 1.4864          |      |   |
|     | VdTV             | 412/434                      | 412/434         | 305  | 305       | -               | -    | - |
| USA | UNS              | N 08810                      | N 06600         |      |           | N 08330         |      |   |
|     | ASTM(B) ASME(SB) | 409                          | 163/407/514/515 | 408  | 168       | 163/167/516/517 | 166  | - |
| GB  | Designation BS   | NA 15 (H)                    | NA14            |      |           | -               |      |   |
|     | BS               | 3072/3073                    | 3074            | 3076 | 3072/3073 | 3074            | 3076 | - |
| F   | AFNOR            | -                            | NC 15 Fe        |      |           | Z 12 NCS 35.16  |      |   |

## CHEMICAL COMPOSITION (%)

|           |                 |              |                    |
|-----------|-----------------|--------------|--------------------|
| Nickel    | 30 - 32         | Min. 72      | 34 - 37            |
| Chromium  | 19 - 22         | 14 - 17      | 15 - 17            |
| Iron      | Balance         | 6 - 10       | Balance            |
| Manganese | -               | -            | Max. 2             |
| Silicon   | 0.2 - 0.6       | Max. 0.5     | 1 - 2              |
| Others    | Al+Ti: Max. 0.7 | Cu: Max. 0.5 | Ti: Max. 0.2 - 0.6 |
|           | -               | Al: Max. 0.3 | -                  |
| Carbon    | 0.06 - 0.08     | 0.05 - 0.08  | Max. 0.15          |

## MECHANICAL PROPERTIES (N/mm<sup>2</sup>, %)

| Temperature (°C) | Rp 0.2   | Rp 1.0   | Rm       | A5 | Rp 0.2   | Rp 1.0 | Rm       | A5     | Rp 0.2   | Rp 1.0 | Rm       | A5      |
|------------------|----------|----------|----------|----|----------|--------|----------|--------|----------|--------|----------|---------|
| 20               | Min. 170 | Min. 200 | Min. 450 | -  | Min. 240 | 265    | Min. 550 | Min. 3 | Min. 250 | -      | Min. 550 | Min. 30 |
| 100              | Min. 140 | Min. 160 | 425      | -  | Min. 180 | -      | 520      | 35     | 330      | -      | 640      | 35      |
| 200              | Min. 115 | Min. 135 | 400      | -  | Min. 165 | -      | 500      | 35     | 300      | -      | 620      | 35      |
| 300              | Min. 95  | Min. 115 | 390      | -  | Min. 155 | -      | 485      | 35     | 290      | -      | 610      | 35      |
| 400              | Min. 85  | Min. 105 | 380      | -  | Min. 150 | -      | 480      | 35     | 280      | -      | 600      | 35      |
| 500              | Min. 80  | Min. 100 | 360      | -  | Min. 140 | -      | 470      | -      | 265      | -      | 560      | 35      |
| 600              | Min. 75  | Min. 95  | 300      | -  | -        | -      | -        | -      | 250      | -      | 490      | 40      |

## CREEP PROPERTIES (N/mm<sup>2</sup>)

| Temperature (°C) | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> | Rp 1.0/10 <sup>3</sup> | Rm/10 <sup>3</sup> |
|------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|------------------------|--------------------|
| 600              | -                      | 152                | -                      | 114                | 80                     | 125                | 40                     | 75                 |
| 700              | -                      | 75                 | -                      | 53                 | 35                     | 45                 | 14                     | 25                 |
| 800              | -                      | 37                 | -                      | 24                 | 15                     | 20                 | 4                      | 7                  |
| 900              | -                      | 17                 | -                      | 10.5               | 5                      | 8                  | 1.5                    | 3                  |
| 950              | -                      | 11.5               | -                      | 7                  | -                      | -                  | -                      | -                  |
| 1000             | -                      | -                  | -                      | -                  | -                      | 4                  | -                      | 1.5                |

## PHYSICAL PROPERTIES AT ROOM TEMPERATURE OR AS INDICATED

|                        |                     |      |      |      |
|------------------------|---------------------|------|------|------|
| Density                | g/cm <sup>3</sup>   | 8.0  | 8.4  | 8.0  |
| Specific heat          | J/Kg K              | 472  | 455  | 472  |
| Thermal conductivity   | W/m K               | 11.5 | 14.8 | 11.4 |
| Electrical resistivity | μΩ                  | 101  | 103  | 104  |
| Thermal expansion      | 10 <sup>-6</sup> /K | 16.2 | 14.4 | 16.2 |
| 20-300°C               |                     |      |      |      |
| Modulus of elasticity  | kN/mm <sup>2</sup>  | 194  | 214  | 194  |

## FABRICATION CHARACTERISTICS

|             |              |      |      |
|-------------|--------------|------|------|
| Formability | Good         | Good | Good |
| Weldability | Satisfactory | Good | Good |

## WELDING PRODUCTS

|                   |                       |                 |                         |                         |
|-------------------|-----------------------|-----------------|-------------------------|-------------------------|
| Filler wire       | Nicrofer 5 7020-FM 82 | S 6020 - FM 625 | Nicrofer 5 7020 - FM 82 | Nicrofer 5 7020 - FM 82 |
| Covered electrode | 2.4648                | 2.4621          | 2.4648                  | 2.4648                  |
|                   | EL-NiCr19Nb           | EL-NiCr20Mo9Nb  | EL-NiCr19Nb             | EL-NiCr19Nb             |
|                   |                       |                 | AWS ENiCrFe-3           | AWS ENiCrFe-3           |

## MATERIAL DESCRIPTION, MAIN CHARACTERISTICS

Grade of Nicrofer 3220 - alloy 800 with controlled carbon content and high temperatures solution annealing for very high creep rupture strength. Excellent resistance to carburizing, oxidizing and nitriding atmospheres.

Nickel-chromium-iron alloy.  
For service temperature to about 700°C (1280°F). Extremely good resistance to nitriding atmospheres. Very good resistance to halogen atmospheres, up to about 600°C (1100°F). Very good carburization resistance.

Iron-nickel chromium alloy with silicon and manganese additions.  
Good carburization resistance, even in alternating reducing-oxidizing atmospheres.

<sup>1)</sup> According VdTV data sheet 412, edition 01.84, former material no. 1.4876



Abbiamo inoltre disponibili presso il nostro magazzino anche le leghe seguenti sotto forma di barre e lamiere:

*Also the following alloys are available from stock as bars, plates and sheets:*

|     |                             |                  |
|-----|-----------------------------|------------------|
| F51 | UNS S31803 DUPLEX 2205      | WERKSTOFF 1.4462 |
| F55 | UNS S32760 SUPERDUPLEX 2507 | WERKSTOFF 1.4501 |
| F44 | UNS S31254 254 SMO          | WERKSTOFF 1.4547 |
| F53 | UNS S32750 SUPERDUPLEX 2507 | WERKSTOFF 1.4410 |

## **Caratteristiche principali**

### *Main characteristics*

Acciaio inossidabile austenitico-ferritico superduplex, presenta un'elevata resistenza a tutti i vari tipi di corrosione (generalizzata, sotto tensione, sotto schermo, vaiolatura). Grazie alle elevate caratteristiche meccaniche è altrettanto resistente in ambienti nei quali esistono le condizioni di corrosione per fatica e di corrosione-erosione. La saldabilità è buona e, salvo casi eccezionali, non è necessario il trattamento termico post saldatura.

Possiede una discreta lavorabilità per deformazione plastica a freddo. Si raccomanda di utilizzare sempre il materiale con la superficie decapata o lavorata di macchina utensile e di non utilizzare l'acciaio a temperature oltre 280°C per lunghi periodi, o oltre 300°C per periodi brevi.

*The superduplex stainless steel shows a good resistance to the most common corrosion process as well as: general, pitting, stress and crevice corrosion. Thanks to its very high mechanical property it is well resistant also in environments in which fatigue and/or erosion-corrosion condition occurs. The weldability is good. Post weld heat treatment normally is not necessary.*

*We recommend the use of the material with the pickled or machined surface and not to exceed the working temperature of 280°C. A temperature of 300°C is tolerated for short time.*



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