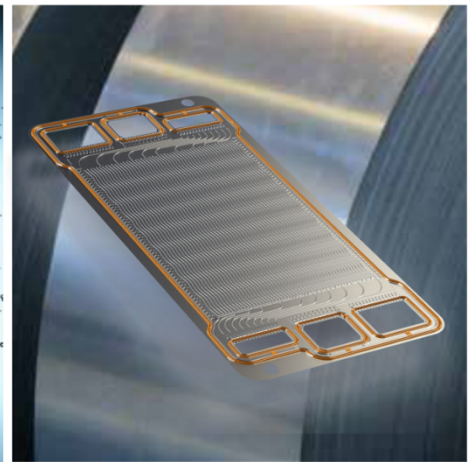
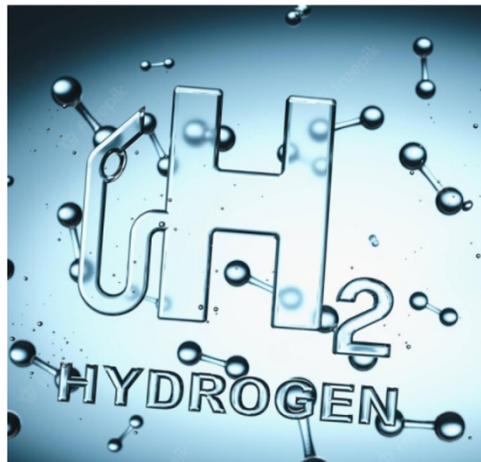


Stainless Steel for Fuel Cell Application



General Information

PEM-FC – Application Grades

MKM X2CrNiMo17-12-2 (1.4404)

is the standard austenitic stainless steel grade used for bipolar plates in PEM - Fuel Cells

MKM X2CrTiNb18 (1.4509)

is the cost efficient ferritic alternative stainless steel grade for bipolar plates in PEM - Fuel Cells

Both PEM-FC grades are processed in a way, to improve isotropic formability of the flowfield, as well as its dimensional stability and durability.

Surface parameters are optimized for optimal adhesion and durability. Safeguarding the functionality, even when the coating degraded or gets damaged.

SOFC – Application Grade

MKM CrMoW22 (1.4755-1 mod.)

is an oxidation resistant, ferritic chromium steel, optimized for high temperature applications.

The material is alloyed in a way which improves high temperature oxidation resistance and strength in combination with high creep resistance and electrical conductivity.

These characteristics are a result of a unique composition of alloying elements, such as Chromium, Molybdenum, Tungsten and rare earth elements like Lanthanum.

Main applications for this grade are components in high temperature, oxidizing and mechanically stressed environments, as they are present for interconnector plates in solid oxide fuel cells (SOFC).

Technical Information

MKM X2CrNiMo17-12-2 (1.4404)

Chemical Composition (in wt-% according to DIN EN 10088-3)

| | C | Si | Mn | P | S | Cr | Mo | Ni | N |
|------|----------|-----------|-----------|----------|----------|-----------|-----------|-----------|----------|
| min. | - | - | - | - | - | 16.5 | 2.0 | 10.0 | - |
| max. | 0.03 | 1.0 | 2.0 | 0.045 | 0.03 | 18.5 | 2.5 | 13.0 | 0.1 |

Typical Physical Properties

| | |
|--|------|
| Density in kg/dm ³ | 8.0 |
| Spec. electrical resistivity at 20°C in (Ω mm ²)/m | 0.75 |
| Magnetizability | low |
| Thermal conductivity at 20°C in W/(m K) | 15 |
| Specific heat capacity at 20°C in J/(kg K) | 500 |
| Young's modulus in GPa at | |
| » 20°C | 200 |
| » 100°C | 194 |
| » 200°C | 186 |
| » 300°C | 179 |
| » 400°C | 172 |
| » 500°C | 165 |
| Thermal expansion coefficient in 10 ⁻⁶ K ⁻¹ | |
| » 20°C - 100°C | 16.0 |
| » 20°C - 200°C | 16.5 |
| » 20°C - 300°C | 17.0 |
| » 20°C - 400°C | 17.5 |
| » 20°C - 500°C | 18.0 |

Customer specific, application related requirements to be defined and agreed on in separate specification.

MKM X2CrTiNb18 (1.4509)

Chemical Composition (in wt-% according to DIN EN 10088-3)

| | C | Si | Mn | P | S | Cr | Ti | Nb |
|------|----------|-----------|-----------|----------|----------|-----------|-----------|---------------|
| min. | - | - | - | - | - | 17.5 | 0.1 | (3 x C) + 0.3 |
| max. | 0.03 | 1.0 | 1.0 | 0.04 | 0.015 | 18.5 | 0.6 | 1.0 |

Typical Physical Properties

| | |
|--|------|
| Density in kg/dm ³ | 7.7 |
| Spec. electrical resistivity at 20°C in (Ω mm ²)/m | 0.6 |
| Magnetizability | yes |
| Thermal conductivity at 20°C in W/(m K) | 25 |
| Specific heat capacity at 20°C in J/(kg K) | 460 |
| Young's modulus in GPa at | |
| » 20°C | 220 |
| » 100°C | 215 |
| » 200°C | 210 |
| » 300°C | 205 |
| » 400°C | 195 |
| » 500°C | 180 |
| Thermal expansion coefficient in 10 ⁻⁶ K ⁻¹ | |
| » 20°C - 100°C | 10.0 |
| » 20°C - 200°C | 10.0 |
| » 20°C - 300°C | 10.5 |
| » 20°C - 400°C | 10.5 |
| » 20°C - 500°C | 11.0 |

Customer specific, application related requirements to be defined and agreed on in separate specification.

MKM CrMoW22 (1.4755-1 mod.)

Chemical Composition (in wt-% according to DIN EN 10088-3)

| | C | Si | Mn | P | S | Al | Cr | Ni | Cu | Ti | Nb | W | Mo | La |
|------|------|------|-----|-------|-------|------|------|------|------|------|-----|-----|-----|------|
| min. | - | 0.10 | 0.3 | - | - | 0.10 | 21.0 | - | - | 0.02 | - | - | - | - |
| max. | 0.03 | 0.50 | 0.8 | 0.015 | 0.005 | 0.30 | 23.0 | 0.50 | 0.50 | 0.10 | 1.0 | 1.0 | 1.0 | 0.08 |

Typical Physical Properties

| | |
|--|------|
| Density in kg/dm ³ | 7.8 |
| Spec. electrical resistivity at 20°C in (Ω mm ²)/m | 0.58 |
| Magnetizability | yes |
| Thermal conductivity at 20°C in W/(m K) | 22 |
| Specific heat capacity at 20°C in J/(kg K) | 470 |
| Young's modulus in GPa at | |
| » 20°C | 210 |
| » 100°C | 208 |
| » 200°C | 205 |
| » 300°C | 200 |
| » 400°C | 195 |
| » 500°C | 183 |
| Thermal expansion coefficient in 10 ⁻⁶ K ⁻¹ | |
| » 20°C - 100°C | 10.1 |
| » 20°C - 200°C | 10.0 |
| » 20°C - 300°C | 10.3 |
| » 20°C - 400°C | 10.5 |
| » 20°C - 500°C | 10.6 |

For more detailed, high temperature related properties, refer to separate MKM CrMoW22 data sheet, available on request.

Customer specific, application related requirements to be defined and agreed on in separate specification.