

# Alleima® 3R69

## Tube and pipe, seamless

### Datasheet

Alleima® 3R69 is an austenitic stainless steel with a low carbon content alloyed with molybdenum, boron and nitrogen and is used in superheaters, reheaters in power boilers and other high temperature applications. The grade is characterized by:

- High creep strength
- Good corrosion and steam oxidation resistance for moderate conditions

### Standards

- ASTM: 316N
- EN Number: 1.4910
- EN Name: X3CrNiMoBN17-13-3
- W.Nr.: 1.4910
- DIN: X 2 CrNiMoN 17 13 3

### Product standards

- EN 10216-5
- DIN 17456, 17458

### Chemical composition (nominal)

#### Chemical composition (nominal) %

| C      | Si  | Mn  | P      | S      | Cr   | Ni   | Mo  | B     |
|--------|-----|-----|--------|--------|------|------|-----|-------|
| ≤0.030 | 0.4 | 1.7 | ≤0.030 | ≤0.015 | 17.5 | 12.5 | 2.2 | 0.002 |

Others  
N=0.12

### Mechanical properties

#### At 20°C (68°F)

| Proof strength  |                 | Tensile strength |  | Elong.   |
|-----------------|-----------------|------------------|--|----------|
| $R_{p0.2}^{1)}$ | $R_{p1.0}^{1)}$ | $R_m$            |  | $A^{2)}$ |

| MPa  | ksi | MPa  | ksi | MPa     | ksi    | %   |
|------|-----|------|-----|---------|--------|-----|
| ≥260 | ≥38 | ≥300 | ≥44 | 550-750 | 80-109 | ≥35 |

1 MPa = N/mm<sup>2</sup>

<sup>1)</sup> R<sub>p0.2</sub> and R<sub>p1.0</sub> correspond to 0.2% offset and 1.0% offset yield strength, respectively.

<sup>2)</sup> Based on  $L_0 = 5.65 \sqrt{S_0}$  where  $L_0$  is the original gauge length and  $S_0$  the original cross-section area.

## Impact strength

Due to its austenitic microstructure, Alleima® 3R69 has very good impact strength both at room temperature and at cryogenic temperatures.

Tests have demonstrated that the steel fulfils the requirements (60 J (44 ft-lb) at -196°C (-320 °F)) according to the European standards EN 13445-2 (UFPV-2) and EN 10216-5.

## At high temperatures

### Metric units

| Temperature | Proof strength    |                   |
|-------------|-------------------|-------------------|
|             | R <sub>p0.2</sub> | R <sub>p1.0</sub> |
| °C          | MPa               | MPa               |
|             | min.              | min.              |
| 50          | 234               | 273               |
| 100         | 205               | 240               |
| 150         | 187               | 220               |
| 200         | 170               | 200               |
| 250         | 159               | 189               |
| 300         | 148               | 178               |
| 350         | 141               | 171               |
| 400         | 134               | 164               |
| 450         | 130               | 160               |
| 500         | 127               | 157               |
| 550         | 124               | 154               |

### Imperial units

| Temperature | Proof strength    |                   |
|-------------|-------------------|-------------------|
|             | R <sub>p0.2</sub> | R <sub>p1.0</sub> |
| °F          | ksi               | ksi               |

|      | <b>min.</b> | <b>min.</b> |
|------|-------------|-------------|
| 100  | 36.1        | 41.2        |
| 200  | 30.3        | 35.4        |
| 300  | 27.2        | 32.0        |
| 400  | 24.5        | 28.9        |
| 500  | 22.7        | 27.1        |
| 600  | 21.0        | 25.5        |
| 700  | 20.0        | 24.4        |
| 800  | 19.1        | 23.5        |
| 900  | 18.6        | 22.9        |
| 1000 | 18.1        | 22.4        |

#### Creep rupture strength

| Temperature |      | 10 000 h       |                | 100 000 h      |                |
|-------------|------|----------------|----------------|----------------|----------------|
| °C          | °F   | MPa            | ksi            | MPa            | ksi            |
|             |      | <b>approx.</b> | <b>approx.</b> | <b>approx.</b> | <b>approx.</b> |
| 550         | 1020 | 290            | 42.1           | 220            | 31.9           |
| 560         | 1040 | 272            | 39.4           | 202            | 29.3           |
| 570         | 1060 | 254            | 36.8           | 186            | 30.0           |
| 580         | 1075 | 237            | 34.4           | 170            | 24.7           |
| 590         | 1095 | 220            | 31.9           | 155            | 22.5           |
| 600         | 1110 | 205            | 29.7           | 141            | 20.4           |
| 610         | 1130 | 190            | 27.6           | 127            | 18.4           |
| 620         | 1150 | 174            | 25.2           | 114            | 16.5           |
| 630         | 1165 | 162            | 23.5           | 102            | 14.8           |
| 640         | 1185 | 148            | 21.5           | 92             | 13.3           |
| 650         | 1200 | 135            | 19.6           | 83             | 12.0           |
| 660         | 1220 | 122            | 17.7           | 75             | 10.9           |
| 670         | 1240 | 112            | 16.2           | 68             | 9.9            |
| 680         | 1255 | 102            | 14.8           | 61             | 8.8            |
| 690         | 1275 | 93             | 13.5           | 56             | 8.1            |
| 700         | 1290 | 84             | 12.2           | 52             | 7.5            |

|     |      |    |      |    |     |
|-----|------|----|------|----|-----|
| 710 | 1310 | 78 | 11.3 | 48 | 7.0 |
| 720 | 1330 | 71 | 10.3 | 45 | 6.5 |
| 730 | 1345 | 65 | 9.4  | 41 | 5.9 |
| 740 | 1365 | 58 | 8.4  | 37 | 5.4 |
| 750 | 1380 | 52 | 7.5  | 34 | 4.9 |
| 760 | 1400 | 48 | 7.0  | 31 | 4.5 |

## Physical properties

**Density:** 8.0 g/cm<sup>3</sup> , 0.29 lb/in<sup>3</sup>

### Thermal conductivity

| Temperature, °C | W/m °C | Temperature, °F | Btu/ft h °F |
|-----------------|--------|-----------------|-------------|
| 20              | 14     | 68              | 8           |
| 100             | 15     | 200             | 8.5         |
| 200             | 17     | 400             | 10          |
| 300             | 18     | 600             | 10.5        |
| 400             | 20     | 800             | 11.5        |
| 500             | 21     | 1000            | 12.5        |
| 600             | 23     | 1100            | 13          |

### Specific heat capacity

| Temperature, °C | J/kg °C | Temperature, °F | Btu/lb °F |
|-----------------|---------|-----------------|-----------|
| 20              | 485     | 68              | 0.11      |
| 100             | 500     | 200             | 0.12      |
| 200             | 515     | 400             | 0.12      |
| 300             | 525     | 600             | 0.13      |
| 400             | 540     | 800             | 0.13      |
| 500             | 555     | 1000            | 0.13      |
| 600             | 575     | 1100            | 0.14      |

### Thermal expansion <sup>1)</sup>

| Temperature, °C | Per °C | Temperature, °F | Per °F |
|-----------------|--------|-----------------|--------|
| 30-100          | 16.5   | 86-200          | 9.5    |

|        |      |         |      |
|--------|------|---------|------|
| 30-200 | 17   | 86-400  | 9.5  |
| 30-300 | 17.5 | 86-600  | 10   |
| 30-400 | 18   | 86-800  | 10   |
| 30-500 | 18   | 86-1000 | 10   |
| 30-600 | 18.5 | 86-1200 | 10.5 |
| 30-700 | 18.5 | 86-1400 | 10.5 |

1) Mean values in temperature ranges ( $\times 10^{-6}$ )

#### Modulus of elasticity <sup>1)</sup>

| Temperature, °C | MPa | Temperature, °F | ksi  |
|-----------------|-----|-----------------|------|
| 20              | 200 | 68              | 29.0 |
| 100             | 194 | 200             | 28.2 |
| 200             | 186 | 400             | 26.9 |
| 300             | 179 | 600             | 25.8 |
| 400             | 172 | 800             | 24.7 |
| 500             | 165 | 1000            | 23.5 |

1) ( $\times 10^3$ )

## Forms of supply

### Seamless tube and pipe - Finishes and dimensions

Seamless tube and pipe in 3R69 is supplied in dimensions up to 260 mm outside diameter in the solution-annealed and white-pickled condition or in the bright-annealed condition.

#### Disclaimer:

Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions. Continuous development may necessitate changes in technical data without notice. This datasheet is only valid for Alleima materials.