

ALLOY DATA SHEET

KHR12C

HEAT RESISTANT ALLOY

REVISION : 03/05

DESCRIPTION

KHR12C is an austenitic Fe-Cr-Ni-Nb alloy developed from the well known HH type II grade. Niobium is added to increase high temperature strength and ductility. A moderate increase in nickel content also contributes to greater strength and improves carburization resistance. The alloy is specifically designed for components that are subjected to frequent thermal cycling and shock. In heavy sections, castings of KHR12C have better weldability than HH II alloy.

COMPOSITION

| | <u>C</u> | <u>Mn</u> | <u>Si</u> | <u>Cr</u> | <u>Ni</u> | <u>P</u> | <u>S</u> | <u>Nb</u> |
|-------|----------|-----------|-----------|-----------|-----------|----------|----------|-----------|
| Min % | 0.30 | - | - | 23 | 13 | - | - | 0.8 |
| Max % | 0.40 | 1.0 | 1.0 | 26 | 15 | 0.03 | 0.03 | 1.5 |

APPLICATIONS

Heat treatment furnace hardware, furnace retorts, trays, muffles and rolls, rabble arms and blades, tube supports and hangers

PRODUCT FORMS

Horizontal and vertical centrifugal castings; static castings.

PHYSICAL PROPERTIES

| | |
|--------------------------------|---------------------|
| Density (lbs/in ³) | 0.284 |
| Melting Solidus | 2462 °F |
| Thermal Expansion | 8.6 @ 68 - 752 °F |
| (x 10 ⁻⁶ in/in °F) | 8.9 @ 68 - 1112 °F |
| | 9.7 @ 68 - 1472 °F |
| | 10.3 @ 68 - 1832 °F |

CARBURIZATION

RESISTANCE

(Pack-100 hours @ 2012 °F)

ALLOY Carbon Increase*

GRADE Wt %

HH 1.70

KHR12C 1.45

HK40 1.41

*Average in 3.0 mm layer.

OXIDATION RATE

(100 hr tests, mm/yr)

Alloy 1832 °F

KHR12C 0.33

HH 0.45

HK40 0.45

MECHANICAL PROPERTIES (Centrifugal Castings @ 70 °F - Typical Values)

| | As Cast | Aged* | Aged** | Aged HH Alloy** | Aged HK40** | |
|------------|---------|-------|--------|-----------------|-------------|------------------------|
| U.T.S. ksi | 82 | 89 | 79 | 82 | 79 | *Aged 100h @ 1472 °F |
| Y.S. ksi | 37 | 43 | 37 | 41 | 60 | **Aged 1000h @ 1472 °F |
| El. % | 32 | 24 | 15 | 8 | 5 | |

HIGH TEMPERATURE MECHANICAL PROPERTIES (Typcial Values)

| | | R.T. | 752 | 1112 | 1472 | 1832 | 2012 °F |
|----------------------|-----|------|------|------|------|------|---------|
| U.T.S. | ksi | 82 | 74 | 65 | 36 | 13 | 8.7 |
| Y.S. | ksi | 37 | 25 | 22 | 20 | 8.4 | 6.1 |
| Elongation | % | 32 | 33 | 29 | 24 | 39 | 42 |
| R.A. | % | | 28 | 28 | 29 | 47 | 53 |
| E x 10 ⁻³ | ksi | | 21.3 | | | | |

SERVICE TEMPERATURE

The alloy is suitable for long term service at cyclic temperatures up to 1850 °F.

WELDABILITY

The alloy may be welded by the SMAW, GTAW and GMAW processes. Welding procededures are available from Kubota Metal Corporation.

CREEP-RUPTURE PROPERTIES

Long term creep-rupture properties were extrapolated from Larson-Miller Parameter versus stress plots.

| | | <u>RUPTURE-STRESS-KSI</u> | | | | | |
|--------------|------|----------------------------------|-------------|-------------|-------------|-------------|---------------|
| <u>HOURS</u> | | <u>1400</u> | <u>1500</u> | <u>1600</u> | <u>1700</u> | <u>1800</u> | <u>1900°F</u> |
| 1,000 | AVG. | 14.50 | 10.95 | 8.12 | 5.73 | 3.92 | 2.51 |
| | MIN. | 11.75 | 8.99 | 6.66 | 4.68 | 3.19 | 2.06 |
| 10,000 | AVG. | 10.88 | 7.86 | 5.42 | 3.55 | 2.26 | 1.35 |
| | MIN. | 8.85 | 6.43 | 4.42 | 2.93 | 1.86 | 1.10 |
| 100,000 | AVG. | 7.98 | 5.37 | 3.61 | 2.10 | 1.26 | |
| | MIN. | 6.53 | 4.38 | 2.84 | 1.74 | 1.03 | |

Note: Creep-rupture stresses are subject to periodic revisions as the results from long term tests become available.

RELATED SPECIFICATIONS

None

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