

ALLOY DATA SHEET KHR35CL

HEAT RESISTANT ALLOY

REVISION: 06/99

DESCRIPTION

KHR 35CL is a low carbon modification of KHR 35C. This alloy is particularly suited for service in conditions where resistance to thermal fatigue and thermal shock is required. While somewhat comparable to the low carbon KHR 32C alloy, the higher chromium and nickel levels provide greater resistance to oxidation and carburization.

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 %	0.18	-	0.5	24	36.5	-	-	-
Max %	0.23	1.5	1.2	26	38.5	<.03	<.03	1.5

APPLICATIONS

Ethylene pyrolysis coils and fittings, heat treatment furnace rolls, trays and fixtures.

PRODUCT FORMS

Horizontal and vertical centrifugal castings, static castings, formed fittings and sweeps.

PHYSICAL PROPERTIES

Density (lbs/in ³)	0.291
Melting Solidus	2310 °F
Thermal Conductivity (Btu ft / ft ² hr °F)	18.1 @ 1922 °F
Thermal Expansion (x 10 ⁻⁶ in / in °F)	8.7 @ 68-400 °F
	9.2 @ 68-750 °F
	9.6 @ 68-1100 °F
	9.7 @ 68-1500 °F
	10.0 @ 68-1800 °F
	10.1 @ 68-2000 °F

CARBURIZATION

RESISTANCE

(Pack-cyclic tests @ 1560-2100 °F, weight percent gain in 5 mm.)

Alloy <u>Grade</u>	Wt Gain <u>%</u>
KHR35C HiSi	22.6
KHR35CW	20.4
KHR35CL	23.8
KHR45A LC	7.5

MECHANICAL PROPERTIES

Typical High Temperature Tensile Properties - Centrifugal Castings

	<u>570</u>	<u>932</u>	<u>1112</u>	<u>1292</u>	<u>1472</u>	<u>1652</u>	<u>1832</u>	<u>2012</u>	°F	Minimum Values @ 70 °F
U.T.S. (ksi)	68.3	68.3	62.5	55.4	38.4	24.2	14.9	10.0		63.8
Y.S. (ksi)	24.2	22.8	22.8	21.3	21.3	11.3	8.7	5.7		26.8
El. (%)										25 (c.c.), 20 (static)

Typical 100 Hour Aged Room Temperature Tensile Properties - Centrifugal Castings

Aging Temperature	<u>932</u>	<u>1112</u>	<u>1292</u>	<u>1472</u>	<u>1652</u>	<u>1832</u>	°F
U.T.S. (ksi)	81.4	85.8	81.6	82.0	74.4	79.9	
Y.S. (ksi)	37.2	38.7	40.8	41.3	38.0	37.6	
El. (%)	26.9	23.7	12.8	13.2	11.5	15.7	
RA. (%)	20.9	18.3	12.1	9.6	9.6	13.5	

MODULUS OF ELASTICITY

	<u>68</u>	<u>1112</u>	<u>1292</u>	<u>1472</u>	<u>1652</u>	<u>1832</u>	°F
	26.3	20.8	19.6	18.5	17.4	15.5	(x 10 ³ ksi)

SERVICE TEMPERATURE

The alloy is suitable for long term service at temperatures up 1975 °F, but because of the detrimental effect of niobium on oxidation resistance, it should be used with caution above this temperature.

WELDABILITY

Procedures for welding KHR35CL are available from Kubota Metal Corporation

CREEP-RUPTURE PROPERTIES

Long term creep-rupture data was taken from Larson-Miller Parameter versus stress plots published by Kubota.

RUPTURE-STRESS-KSI

HOURS		1400	1500	1600	1700	1800	1900	2000	2100	2200 °F
100	AVG.		10.15	8.63	6.97	5.29	3.73	2.43	1.93	1.53
	MIN.		8.48	7.21	5.82	4.41	3.11	2.02	1.60	1.27
1,000	AVG.	10.36	8.81	7.08	5.32	3.69	2.35	1.46	0.78	0.41
	MIN.	8.65	7.35	5.91	4.44	3.08	1.96	1.20	0.65	0.34
10,000	AVG.	9.12	7.34	5.50	3.79	2.37	1.44	0.74	0.38	
	MIN.	7.62	6.12	4.59	3.15	1.97	1.19	0.62	0.32	
100,000	AVG.	7.75	5.83	4.01	2.50	1.48	0.75	0.37		
	MIN.	6.47	4.87	3.34	2.08	1.22	0.63	0.31		

CREEP-STRESS-KSI

<u>%/HOUR</u>		<u>1562</u>	<u>1652</u>	<u>1742</u>	<u>1832</u>	°F
0.0001	AVG.	5.08	3.70	2.26	1.19	

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

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