

# ALLOY DATA SHEET KHR 45A

HEAT RESISTANT ALLOY

REVISION: 06/99

## DESCRIPTION

KHR45A is a niobium bearing high nickel-chromium alloy developed for ethylene pyrolysis service at temperatures up to 2066 °F. Carburization resistance is significantly higher than the HP modified alloys while creep strength is greater than that of KHR35CW and KHR35C Hi Si. KHR45A is Kubota's premiere material for ethylene pyrolysis furnaces. It has also been found to be highly resistant to metal dusting and can be used to combat vanadium ash attack.

COMPOSITION	<u>C</u>	<u>Mn</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Nb</u>	<u>P</u>	<u>S</u>	<u>Other</u>
Min %	0.4			30	40	0.5	-	-	
Max %	0.6	2.0	2.0	35	46	1.8	0.03	0.03	Ti, Al

## APPLICATIONS

Ethylene pyrolysis tubes and fittings, direct reduction furnace assemblies.

## PHYSICAL PROPERTIES

Density (lbs/in <sup>3</sup> )	0.297
Melting Solidus	2348 °F
Thermal Conductivity (Btu ft/ ft <sup>2</sup> hr °F)	17.6 @ 1832 °F
	18.6 @ 2012 °F
	19.3 @ 2102 °F
Thermal Expansion (μ in/in °F)	8.61 @ 68-1472 °F
	8.89 @ 68-1652 °F
	9.11 @ 68-1832 °F
	9.39 @ 68-2012 °F

## CARBURIZATION RESISTANCE

(Cyclic tests @ 1560-2100 °F)	
Alloy	Carbon Wt % Gain
KHR35C Hi Si	22.6
KHR35CW	20.4
<b>KHR45A</b>	<b>7.5</b>
(Standard Pack, 2012 °F, 300 hours) *	
HK40	18.3
KHR35CW	9.6
<b>KHR45A</b>	<b>5.4</b>

\* Carbon Wt % Gain in 4 mm layer

## MECHANICAL PROPERTIES

(Typical Values)

		Centrifugal Castings						Min. Values
		70	1400	1600	1800	2000 °F	68 °F	
U.T.S.	ksi	75	51	30	18	10	64	
Y.S.	ksi	41	24	17	10.5	6.5	34	
EI.	%	11	23	32	39	40	5 (c.c.), 3 (statics)	

## ELASTIC MODULUS

	<u>70</u>	<u>932</u>	<u>1112</u>	<u>1292</u>	<u>1472</u>	<u>1652</u>	<u>1832</u>	<u>2012 °F</u>
(x 1000 ksi)	24.9	21.1	20.8	18.3	16.6	15.6	14.9	13.5

## CREEP RUPTURE PROPERTIES

		RUPTURE STRESS (ksi)							
HOURS		<u>1400</u>	<u>1500</u>	<u>1600</u>	<u>1700</u>	<u>1800</u>	<u>1900</u>	<u>2000</u>	<u>2100 °F</u>
100	AVG	-	-	9.14	7.66	5.83	4.24	2.93	1.90
	MIN	-	-	8.15	6.74	5.21	3.79	2.58	1.70
1000	AVG	-	9.34	7.80	5.86	4.21	2.84	1.81	1.12
	MIN	-	8.27	6.82	5.22	3.76	2.47	1.58	0.98
10000	AVG	9.57	7.98	6.09	4.31	2.86	1.78	1.08	0.65
	MIN	8.56	7.02	5.44	3.83	2.48	1.57	0.95	0.56
100000	AVG	8.25	6.41	4.51	2.97	1.84	1.10	0.64	0.36
	MIN	7.40	5.69	4.02	2.65	1.63	0.96	0.55	0.32

		LIMITING CREEP STRESS (ksi)							
%/HOUR		<u>1400</u>	<u>1500</u>	<u>1600</u>	<u>1700</u>	<u>1800</u>	<u>1900</u>	<u>2000</u>	<u>2100 °F</u>
0.0001 AVG.		-	-	5.37	4.21	3.05	1.89	1.11	-