

# ALLOY DATA SHEET HE

## HEAT RESISTANT ALLOY

REVISION: 04/91

### DESCRIPTION

HE alloy is a two phase Fe-Cr-Ni alloy in which 28% chromium provides good oxidation resistance at temperatures up to 2000 °F. Nickel is higher than in the HC and HD grades resulting in moderate strength without seriously reducing resistance to sulphurous gases. Long term service of HE alloy at 1300 to 1500 °F may result in the transformation of the ferrite in the austenite/ferrite matrix to sigma phase, causing embrittlement of the alloy at room temperature.

### COMPOSITION

	<u>C</u>	<u>Mn</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>P</u>	<u>S</u>
Min %	0.3	0.3	0.35	26	8	-	-	-
Max %	0.4	1.0	2.0	30	11	0.5	0.04	0.04

### APPLICATIONS

Grate bars, dampers, recuperators, molten salt pots , furnace skids and rails, rabble blades, tuyeres, slag tapping blocks, burner nozzles

### PRODUCT FORMS

Horizontal and vertical centrifugal castings; static castings.

### PHYSICAL PROPERTIES

Density (lbs/in <sup>3</sup> )	0.277
Melting Point(°F)	2650
Thermal Conductivity (Btu/h/ft <sup>2</sup> /ft/°F)	8.5 @ 212°F
	12.4 @ 1000°F
	13.5 @ 1200°F
	14.6 @ 1400°F
	15.9 @ 1600°F
	16.9 @ 1800°F
	18.2 @ 2000°F
Thermal Expansion (10 <sup>-6</sup> in/in °F)	9.6 @ 70-1000°F
	9.9 @ 70-1200°F
	10.2 @ 70-1400°F
	10.5 @ 70-1600°F
	10.8 @ 70-1800°F
	11.1 @ 70-2000°F
Magnetic Permeability	1.3-2.5

### CARBURIZATION

#### RESISTANCE

(Gas-1064 hours @ 1760°F)	
ALLOY	WEIGHT GAIN
GRADE	mg/mm <sup>2</sup>
H C	0.69
H D	0.60
<b>H E</b>	<b>0.54</b>
H F	0.81

### MECHANICAL PROPERTIES (Typical Values)

		70	1400	1600	1800	2000 °F	ASTM Spec A297
U.T.S.	K.S.I.	95					85 Min.
Y.S.	K.S.I.	45					40 Min.
Elong.	%	20					9 Min.

**SERVICE TEMPERATURE**

The alloy is suitable for service at temperatures up to approximately 2000°F.

COMPARATIVE OXIDATION RATES (mm / year)  
(500 hour cyclic tests)

GRADE	1832	1922	2012	2102	°F
H D	<0.1	0.25	1.3	5.2	
<b>H E</b>	<b>&lt;0.1</b>	<b>0.26</b>	<b>1.05</b>	<b>4.3</b>	
H F	0.86	1.8	3.6	6.7	

**WELDABILITY**

HE alloy may be welded by the SMAW, GMAW and GTAW processes.

**CREEP-RUPTURE PROPERTIES**

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

		<b><u>RUPTURE-STRESS-KSI</u></b>					
<u>HOURS</u>		<u>1400</u>	<u>1500</u>	<u>1600</u>	<u>1700</u>	<u>1800</u>	°F
100	AVG.	11	7.6	5.3	3.6	2.5	
1,000	AVG.	7.7	4.9	3.1	2.0	1.3	
10,000	AVG.	4.8	2.9	1.8	1.1	0.66	
100,000	AVG.						

		<b><u>CREEP-STRESS-KSI</u></b>							
<u>%/HOUR</u>		<u>1400</u>	<u>1500</u>	<u>1600</u>	<u>1700</u>	<u>1800</u>	<u>1900</u>	<u>2000</u>	°F
0.0001	AVG.	4.0	3.1	2.4	1.8	1.4	0.75	0.4	

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

**RELATED SPECIFICATIONS**

ASTM: A 297 (HE); A608 (HE 35)

Nearest wrought grade: AISI 312. The composition of the wrought grade differs from that of the cast alloy and has different properties. The cast alloy designation should always be used to identify castings.

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