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Dimensional Stability of Heavy Walled Incoloy 800 Cladding
Tubes - Data

AUTHOR

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ABSTRACT

The effects of SCB coating, thermal shock and thermal soak on the dimensional stability of four heavy walled Incoloy 800 cladding tubes, ranging in thickness from 20 to 44 mils, was investigated. The results of the study were summarized in TI-759-240-029. This report serves as a repository for the detailed data and profilometer traces used in the preparation of that summary.

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I. INTRODUCTION

Four heavy walled Incoloy 800 cladding tubes, ranging in thickness from 19.9 to 44.0 mils, were processed according to standard procedures. Dimensional measurements were taken before and after each step in the process to determine the effects of SCB coating on changes in T.I.R., length, outside diameter and ovality.

Sections were cut from each tube and submitted to 20 cycles of thermal shock between room temperature and 1400°F, and 200 hours of thermal soak at 1300°F. The lengths, outside diameters and ovalities were determined before and after each 5 cycles of thermal shock and after thermal soak to determine the effects of thermal treatment on dimensional stability.

The results of this study are summarized in TI-759-240-029. This report serves as a repository for the detailed data and profilometer traces used in the preparation of that summary. See Table of Contents.

II. DATA DEVELOPED DURING PROCESSING

TABLE 1

EFFECTS OF SCB COATINGS ON THE LENGTHS
OF VARIOUS THICKNESSES OF INCOLOY 800 CLADDING TUBES

Tube No.	Thickness (mils)	Lengths After			Increase in Length			
					Mils		%	
		Oxidation	1st Coat	2nd Coat	After 1st Coat	After 2nd Coat	After 1st Coat	After 2nd Coat
24	44	19.206	19.208	19.211	2	5	.01	.025
25	30	19.228	19.230	19.232	2	4	.01	.020
26	23	19.268	19.272	19.277	4	9	.02	.045
27	20	19.238	19.243	19.248	5	10	.025	.050

TABLE 2

EFFECTS OF SCB COATINGS ON THE T.I.R.'S
OF VARIOUS THICKNESSES OF INCOLOY 800 CLADDING TUBES

Tube No.	T.I.R.'s in Mils After			Increase in T.I.R. After - Oxidation and	
	Oxidation	1st Coat	2nd Coat	1st Coat	2nd Coat
24	6	3	4	- 3	- 2
25	16	13	17	- 3	+ 1
26	10	10	13	0	+ 3
27	6	18	29	+12	+16

TABLE 3
EFFECTS OF OXIDATION AND SCB COATINGS ON THE
OUTSIDE DIAMETERS OF VARIOUS THICKNESSES OF INCOLOY 800

Tube No.	Loc.	2nd Coat Enamel Thickness (mils)	O.D.'s in Inches				Increases in O.D.'s			
							Mils		%	
			Before Oxidation	After Oxidation	After 1st Coat	After 2nd Coat	After 1st Coat	After 2nd Coat	After 1st Coat	After 2nd Coat
24	23	2.75	.62915	.62920	.62953	.63005	.355	.875	.057	.139
	12	1.95	.62925	.62918	.62965	.62980	.435	.585	.069	.093
	1	.72	.62953	~~.62930~~	.62958	.62975	.05	.22	.008	.035
25	23	2.49	.60038	.60058	.60100	.60140	.52	.92	.087	.153
	12	2.27	~~.60275~~ *	.60265	.60295	.60313	.30	.48	.050	.080
	1	1.12	~~.60050~~	.60080	.60105	.60115	.25	.35	.042	.058
26	23	2.91	.58750	.58793	.58840	.58885	.685	1.135	.117	.193
	12	2.33	.58768	.58740	.58805	.58850	.51	.96	.087	.164
	1	1.02	~~.58775~~	.58763	.58778	.58815	.15	.52	.026	.089
27	23	3.09	.58083	.58068	.58158	.58195	.825	1.195	.142	.206
	12	2.68	.58093	.58093	.58155	.58183	.62	.90	.107	.155
	1	1.10	.58053	~~.58055~~	.58095	.58113	.42	.60	.073	.103

* values not used in calculations.

TABLE 4

EFFECTS OF SCE COATINGS ON THE OVALITIES
OF VARIOUS THICKNESSES OF INCOLOY 800

Tube No.	Loc.	Enamel Thickness (mils)	Ovalities in Mils		
			After Oxidation	After 1st Coat	After 2nd Coat
24	23	2.77	.4	.5	.7
	12	1.96	.4	.6	.6
	1	.68	.2	.2	.3
25	23	2.51	.1	.9	1.0
	12	2.21	.2	.3	1.1
	1	1.04	.7	.6	.5
26	23	2.91	.3	.5	2.2
	12	2.33	.3	.4	1.2
	1	1.02	.8	1.0	1.1
27	23	3.09	1.2	.9	.8
	12	2.68	1.1	.6	2.4
	1	1.10	.6	.5	.5

FIGURE 1
PROFILOMETER TRACES FOR TUBE 24
SHOWING THE EFFECTS OF
PROCESSING ON OUTSIDE DIAMETERS AND OVALITIES
(Metal Thickness 44 mils)

FIGURE 2
PROFILOMETER TRACES FOR TUBE 25
SHOWING THE EFFECTS OF
PROCESSING ON OUTSIDE DIAMETERS AND OVALITIES
(Metal Thickness 30 mils)

FIGURE 3
PROFILOMETER TRACES FOR TUBE 26
SHOWING THE EFFECTS OF
PROCESSING ON OUTSIDE DIAMETERS AND OVALITIES
(Metal Thickness 23 mils)

FIGURE 4
PROFILOMETER TRACES FOR TUBE 27
SHOWING THE EFFECTS OF
PROCESSING ON OUTSIDE DIAMETERS AND OVALITIES
(Metal Thickness 20 mils)

III. DATA DEVELOPED DURING THERMAL TREATMENT

TABLE 5

EFFECTS OF THERMAL CYCLING AND SOAK ON THE
LENGTHS OF SCB COATED INCOLOY 800 CLADDING

Tube No.	Location	Length As Fired	Decreases in Length in % After				
			No. Thermal Cycles				Soak 200 hrs
			5	10	15	20	
24	21-17	3.25011	.0108	.0148	.0163	.0135	.0360
	9-5	3.25150	.0289	.0216	.0302	.0234	.0276
25	21-17	3.25643	.0200	.0086	.0212	.0077	.0369
	9-5	3.24813	.0132	.0135	.0212	.0200	.0390
26	21-17	3.25276	.0059	.0068	.0141	.0040	.0298
	9-5	3.24454	+.0003	+.0018	.0046	.0012	.0215
27	21-17	3.24625	.0080	.0068	.0080	.0129	.0323
	9-5	3.24801	.0282	.0262	.0320	.0302	.0530

TABLE 6

EFFECTS OF THERMAL CYCLING AND SOAK ON THE
DIAMETERS OF SCB COATED INCOLOY 800 CLADDING

Tube No.	Loc.	O.D.'s As Fired		Changes in O.D. in % After					
		Process Data	Th.Cycle Dat	No. Thermal Cycles				Soak 200 hrs	
				5	10	15	20	1st Rdg	2nd Rdg
24	21-17	~~.62996~~	.62990	-.0143	-.0143	0	+.0478	~~.0850~~	-.0127
	9-5	~~.62986~~	.62990	0	-.0159	-.0159	+.0621	~~.1110~~	.0159
25	21-17	.60232	~~.60222~~	.0166	.0316	-.0133	.0316	~~.0582~~	
	9-5	.60326	~~.60323~~	.0316	.0265	.0033	.0431	.0033	.0099
26	21-17	~~.58898~~	.58850	.0017	.0357	-.0017	.0289	.0102	.0221
	9-5	~~.58900~~	.58853	-.0034	.0408	+.0153	.0187	.0051	
27	21-17	.58218	.58194	.0017	.0282	-.0052	.0206	.0103	
	9-5	.58206	.58180	.0017	.0223	.0103	.0309	-.0069	-.0034

* values not used in calculations.

FIGURE 6

PROFILER TRACES FOR TUBE 75 SHOWING THE EFFECTS
OF
THERMAL TREATMENT ON DIAMETERS AND OVALITIES
(Metal Thickness .30 MILS)

FIGURE 7

PROFILER TRACES FOR TYPE 26 SHOWING THE EFFECTS
OF

THERMAL TREATMENT ON DIAMETERS AND QUALITIES
(Metal Thickness .75 mils)

OUTSIDE DIAMETERS IN INCHES

FIGURE 8

PROFILER TRACES FOR TUBE 27 SHOWING THE EFFECTS
OF
THERMAL TREATMENT ON DIAMETERS AND OVALITIES
(Nethl Thickness 20 mils)

Location 21-17

Location 9-5

OUTSIDE DIAMETERS IN INCHES

.585
.580

AVE. O.D. = .58194" OVALITY = 3.8 MILS
MAX

After
2nd Coat

AVE. O.D. = .58180" OVALITY = 1.5 MILS
MAX

.585
.580

AVE. O.D. = .58207" OVALITY = 3.4 MILS
MAX

After
5 Cycles

AVE. O.D. = .58181" OVALITY = 1.4 MILS
MAX

.585
.580

AVE. O.D. = .58223" OVALITY = 3.2 MILS
MAX

After
10 Cycles

AVE. O.D. = .58193" OVALITY = 1.5 MILS
MAX

.585
.580

AVE. O.D. = .58203" OVALITY = 3.2 MILS
MAX

After
15 Cycles

AVE. O.D. = .58186" OVALITY = 1.5 MILS
MAX

.585
.580

AVE. O.D. = .58218" OVALITY = 3.3 MILS
MAX

After
20 Cycles

AVE. O.D. = .58198" OVALITY = 1.7 MILS
MAX

.585
.580

AVE. O.D. = .58212" OVALITY = 3.3 MILS
MAX

After
200 hr 300k
@ 1300°F

AVE. O.D. = .58176" OVALITY = 2.1 MILS
MAX

* VS OBS 178 (REPEAT TRACE)