JUN 8 9 1960

MASTER

OAK RIDGE NATIONAL LABORATORY

Operated by
UNION CARBIDE NUCLEAR COMPANY
Division of Union Carbide Corporation

Post Office Box X
Oak Ridge, Tennessee

External Transmittal
Authorized

ORNL
CENTRAL FILES NUMBER

60-6-54

DATE: June 8, 1960
SUBJECT: Relative Effectiveness of Decontamination of
Various Stainless Steel Surface Finishes
TO: Listed Distribution
FROM: E. E. Pierce

COPY NO. 45

Abstract

Comparison data was needed concerning stainless steel plate and sheet for use as linings in shielded cells. An investigation was made to obtain information concerning surface finish specifications, prices and decontamination properties of 1/4-inch thick plate with a No. 1 finish, 3/16-inch thick sheet with a No. 1 finish and 11 gauge sheet with a 2B finish. The ASTM specifications relating to stainless steel sheet and plate describes the procedures used to obtain the various finishes but does not give specific tolerances for the surface finishes. The finishes may vary considerably depending upon production conditions.

NOTICE

This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report. The information is not to be abstracted, reprinted or otherwise given public dissemination without the approval of the ORNL patent branch, Legal and Information Control Department.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

- A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
- B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

The over-all decontamination factor averages for each of the three thicknesses of specimens tested indicates that the 2B finish on the 11 gauge sheet is better than the No. 1 finish on the 1/4-inch plate by a factor of four. The No. 1 finish on the 3/16-inch sheet is better than the No. 1 finish of the 1/4-inch plate by a factor of three. It is also noted that a decrease in the decontamination factor occurs when the contact time between the contaminant and the stainless steel surfaces is increased.

Introduction

Linings for shielded cells are usually selected on the basis of cost, availability and ease of decontamination. Due to an apparent lack of information on the decontamination properties of various surface finishes on stainless steel sheet and plate, experiments were performed to supply data for selecting suitable surface finishes. Several specimens were tested under varying conditions and the data is recorded in the accompanying tables.

Description

The ASTM specifications relating to stainless steel sheet and plate describes the procedures used to obtain the various finishes but does not state specific tolerances for the surface finishes.

The following description of finishes for 1/4-inch thick stainless steel plate was supplied by the ORNL Material Control Department.

Number 1 Finish

There is not a standard for this finish. It varies from plate to plate depending upon the condition of the rolls. It only means that the stock has been hot rolled to size, annealed and pickled.

Number 2B Finish

There is no standard for this finish. It means that the stock described above has been cold rolled as a finishing operation to reduce the thickness and to improve the surface. There are no mills in the U.S. equipped to provide a 2B finish on 1/4-inch plate by cold rolling. Several mills in Europe are equipped to do this.

French Finish

This is the nearest equivalent to a 2B finish on 1/4-inch plate that is available in the U.S. The Eastern Stainless Steel Corporation of Baltimore, Maryland is a supplier of this finish. The stock is hot rolled to size, providing a No. 1 finish, and then passed through cold rolls to improve the surface but not to further reduce the thickness. This finish is not as good as a 2B finish. A premium of 2¢/lb is charged for the French Finish.

Number 4 Finish This is a better finish than a No. 1. It requires grinding and polishing after rolling. A premium of 12-1/2¢/lb is charged for this finish.

The following prices were paid for, type 347 stainless steel sheet and plate, on a recent purchase order.

<u>Finish No.</u>	<u>Thickness</u>	<u>Price</u>
2B	1/8	85.6¢/lb
1	1/4	77.1¢/lb

The information listed below contains typical surface finish specifications of material available from Allegheny Ludlum Steel Corporation.

Stainless Steel Sheet (Including 3/16-inch Thick Material)

<u>Finish No.</u>	<u>Finish in Micro-Inches</u>	<u>Treatment</u>
1	9 - 14	Hot rolled, annealed, pickled.
2B (Bright)	2 - 6	Cold rolled to size and finish.
2D (Dull)	2 - 6	Cold rolled to size and finish. The dull finish is obtained by pickling.
3	30 - 35	Final finish by grinding.
4	12 - 16	Final finish by grinding.
6	13 - 14	Final finish by grinding.
7	2-1/2 - 3	Final finish by grinding.

Stainless Steel Plate (1/4-inch Thick)

<u>Finish No.</u>	<u>Finish in Micro-Inches</u>	<u>Treatment</u>
1	~ 250 average	Hot rolled, annealed and pickled.
4	12 - 16	Final finish by grinding.

The following surface finish specifications were received from the Eastern Stainless Steel Corporation of Baltimore, Maryland. The surface finishes listed in microinches are average figures and may vary depending upon the condition of the rolls and the width of the sheet.

Stainless Steel Sheet (Type 347, 1/8-inch Thick)

<u>Finish No.</u>	<u>Finish in Micro-Inches</u>	<u>Treatment</u>
1	50 - 70	Hot rolled, annealed and pickled.
2B	35 - 40	Cold rolled to size and finish.
2D	30 - 40	Cold rolled to size and finish. The dull finish is obtained by pickling.
4	15 - 20	Final finish by grinding.
7	8 - 10	Final finish by grinding.

Stainless Steel Plate (Type 347, 3/16 and 1/4-inch Thick)

<u>Finish No.</u>	<u>Finish in Micro-Inches</u>	<u>Treatment</u>
1	100 - 125	Hot rolled, annealed and pickled.
4	15 - 20	Final finish by grinding.

Decontamination Experiment Type 347 Stainless Steel
With No. 1 and No. 2B Finishes

Four-inch square specimens of 1/8-inch stainless steel sheet with a 2B finish, 3/16-inch stainless steel with a No. 1 finish and 1/4-inch thick stainless steel plate with a No. 1 finish were cleaned in a solution of NaOH, rinsed thoroughly with water and dried at 120 - 130°F.

A solution of mixed fission products was used as the contaminant. The solution contained approximately 3 mc/ml of mixed fission products and was 5.84 N in nitric acid. Volumes of 0.20 ml and 0.10 ml of the solution were pipetted on the centers of the stainless steel squares and evaporated to dryness over periods of time ranging from one to 23 hours.

Radiation measurements were made on the plates in a set-up utilizing a cutie-pie and positioning arrangements for both horizontal and vertical alignment. The center line of the chamber was 3-9/16-inches from the stainless steel surface. A similar arrangement using a Victoreen Survey Meter

was used as a check on the readings after decontamination. The center line of the Victoreen instrument chamber was 2-7/16-inches from the stainless steel surface. All readings were double checked for orientation of specimen and condition of instrument.

Each specimen was rinsed with water for two minutes. The stream of water was not directed at the contaminated area but permitted to flow across it. Each specimen was dried and radiation measurements were made.

Each specimen was given a nitric acid scrub in 3 N HNO_3 . They were placed in a flat dish, one at a time with the HNO_3 covering them to a depth of approximately 1/8-inch and given 100 passes with a pure bristle (Medic) brush held in 18-inch tongs. Clean solution was used on each specimen. They were dried and radiation measurements were made with the cutie-pie and Victoreen Survey Meters. All radiation readings were corrected for background. See Tables 1, 2 and 3.

Two specimens of each thickness were boiled in concentrated HNO_3 for one hour to reduce the residual contamination. A 0.1 ml volume of the mixed fission products solution was placed in the center of each specimen and evaporated to dryness in air over a period of approximately two hours. These tests were made to check the effect on the decontamination properties of the surfaces by repeated contamination. Also included in this group is one specimen from Eastern Stainless Steel Corporation having a French Finish.

The results of these tests are listed in Table 4.

Results and Conclusions

The average over-all decontamination factors for each of the three thicknesses of test specimens listed in Tables 1, 2 and 3 indicate that the 2B finish on the 1/8-inch thickness is better than the No. 1 finish on 1/4-inch plate by a factor of four. The No. 1 finish on the 3/16-inch thick sheet is better than the No. 1 finish on 1/4-inch plate by a factor of three.

Decontamination factors decrease when the contact time between the fission product solution and the stainless steel surfaces is increased.

TABLE 1

1/4" Thick Stainless Steel Plate - Type 347 - No. 1 Finish

Specimen number	Drying Time (Hours)	Radiation Reading After Evaporation (cutie-pie) mr/hr	Radiation Reading After H ₂ O Rinse (cutie-pie) mr/hr	Radiation Reading After HNO ₃ Scrub (cutie-pie) (Victoreen) mr/hr		Decontamination Factor	Average
1/4" 1	1	3600	150	8.6	8.8	401	
2	1	3550	96	5.1	6.1	583	
3	1	3650	74	7.6	7.6	480	
4	1	3700	59	6.6	6.4	578	508
8	1	1600	145	8.2	7.9	207	
9	1	1650	135	6.2	5.6	295	
10	1	1550	140	9.2	8.8	176	226
12	2	1900	190	8.7	8.0	238	
13*	2	1850	170	13.7	11.8	157	194
5	16	1700	565	7.0	8.0	211	
6	16	1700	570	6.5	8.0	211	
7	16	1750	500	7.0	8.5	206	
16	16	1800	344	9.0	8.6	210	210
14	23	1750	860	14.0	14.6	120	
15	23	1750	750	9.0	10.0	175	147

*Scratch in center of specimen

Average decontamination factor - 257

TABLE 2

3/16" Thick Stainless Steel Sheet - Type 347 - No. 1 Finish

Specimen number	Drying Time (Hours)	Radiation Reading After Evaporation (cutie-pie) mr/hr	Radiation Reading After H ₂ O Rinse (cutie-pie) mr/hr	Radiation Reading After HNO ₃ Scrub (cutie-pie) (Victoreen) mr/hr		Decontamination Factor	Average
3/16" 1	1	3600	40	2.6	2.6	1385	
3	1	3750	42	4.1	3.1	1210	
4	1	3800	45	3.6	2.9	1310	1301
8*	1	1750	42	1.2	.7	2500	
9	1	1750	59	3.7	3.2	547	
10	1	1750	54	1.7	1.5	1168	
11	1	1700	72	3.2	2.7	630	1211
12*	2	1850	260	15.7	16.4	113	
13	2	1900	145	5.7	4.3	442	277
5	16	1650	480	1.0	2.5	660	
6	16	1625	90	1.0	1.25	1300	
7	16	1550	490	1.5	2.6	600	
16	16	1800	150	4.9	3.8	475	
17*	16	1750	110	5.4	5.0	350	677
14	23	1800	550	6.2	6.6	271	
15	23	1500	980	12.7	14.0	107	189

*Scratch in center of specimen

Average decontamination factor - 731

TABLE 3

1/8" Thick Stainless Steel Sheet - Type 347 - No. 2B Finish

Specimen number	Drying Time (Hours)	Radiation Reading After Evaporation (cutie-pie) mr/hr	Radiation Reading After H ₂ O Rinse (cutie-pie) mr/hr	Radiation Reading After HNO ₃ Scrub (cutie-pie) mr/hr	Radiation Reading (Victoreen) mr/hr	Decontamination Factor	Average
* 1/8" 1	1	2700	122	5.9	6.1	371	
2	1	3300	61	2.6	2.3	1435	
3	1	3500	76	8.6	5.6	625	
4	1	3600	79	8.1	5.1	706	922
8	1	1800	19.5	0.7	0.70	2538	
9	1	1800	22.0	0.7	0.62	2900	
10	1	1800	24.5	0.7	0.74	2420	
11	1	1800	21.5	0.7	0.66	2715	2643
12	2	1750	62	4.2	4.6	380	
13	2	1750	72	2.7	1.9	920	650
5	16	1750	89.5	1.0	1.5	1170	
6	16	1700	80.5	2.5	3.6	470	
7	16	1700	72	1	2.1	810	
16	16	1600	32	1	0.82	953	
17	16	1600	50	0.5	0.80	2000	1081
14	23	1650	565	12.7	12.8	129	
15	23	1650	575	5.2	6.3	261	195

*Instrument zero was off. This reading was not
used to determine average decontamination factor.

Average decontamination factor - 1088

TABLE 4

Radiation Readings After Recontaminating Test Specimens

Specimen number	Drying Time (Hours)	Radiation Reading After Boiling HNO ₃ Treatment (mr/hr)	Radiation Reading After Evaporation cutie-pie (mr/hr)	Radiation Reading After H ₂ O Rinse cutie-pie (mr/hr)	Radiation Reading After HNO ₃ Scrub (cutie-pie) ³ (Victoreen)	Decontamination Factor	Average
1/4" 2	1	0.20	1650	105	2.3	2.8	635
3	1	0.25	1700	110	2.3	3.8	478
							555
3/16" 3	1	0.40	1650	84.5	2.3	2.3	869
4	1	0.30	1700	55	2.8	3.3	567
							718
1/8" 2	1	0.20	1600	57	0.8	1.15	1600
3	1	0.55	1600	92	2.3	3.2	604
							1102
French Finish	1		1650	105	3.3	4.1	403
							403

Distribution

1. T. A. Arehart	15. G. W. Parker
2. E. E. Beauchamp	16-25. E. E. Pierce
3. W. A. Brooksbank	26. R. A. Robinson
4. R. L. Clark	27. A. F. Rupp
5. S. S. Croft	28. R. W. Schaich
6. F. L. Culler	29. M. J. Skinner
7. A. B. Fuller	30. Jack Vanderryn (AEC)
8. J. H. Gillette	31. C. D. Watson
9. H. M. Glen	32. T. R. Workinger (AEC)
10. K. W. Haff	33-44. Laboratory Records
11. D. T. Jones	45-59. TISE
12. E. Lamb	60-61. Central Research Library
13. T. E. Northup	62. Document Reference Section
14. A. R. Olsen	