ARMY RESEARCH LABORATORY

Laboratory Evaluation of Commercial Coatings for Use by Soldiers in the Field to Lower Operating Temperatures of Collapsible Fuel Tanks

by James Sloan, Paul Touchet, Alan Teets, Dave Flanagan, and Charles Pergantis

ARL-TR-3728 **February 2006**

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Army Research Laboratory
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REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

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1. REPORT DATE *(DD-MM-YYYY)* February 2006	**2. REPORT TYPE** Final	**3. DATES COVERED (From - To)** 1 October 2003–1 June 2005
4. TITLE AND SUBTITLE Laboratory Evaluation of Commercial Coatings for Use by Soldiers in the Field to Lower Operating Temperatures of Collapsible Fuel Tanks		**5a. CONTRACT NUMBER** **5b. GRANT NUMBER** **5c. PROGRAM ELEMENT NUMBER**
6. AUTHOR(S) James Sloan, Paul Touchet,* Alan Teets, Dave Flanagan, and Charles Pergantis		**5d. PROJECT NUMBER** AH80 **5e. TASK NUMBER** **5f. WORK UNIT NUMBER**
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Laboratory ATTN: AMSRD-ARL-WM-MA Aberdeen Proving Ground, MD 21005-5069		**8. PERFORMING ORGANIZATION REPORT NUMBER** ARL-TR-3728
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		**10. SPONSOR/MONITOR'S ACRONYM(S)** **11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

*Paul Touchet Consultants

14. ABSTRACT

Collapsible fuel storage containers currently being used by the U.S. military in South West Asia for Operation Iraqi Freedom are encountering surface temperatures approaching 200 °F. Consequently, these polyurethane-coated fabric fuel tanks are experiencing catastrophic failures at an alarming rate. The purpose of this work was to survey the market and obtain common off-the-shelf solar reflecting paints and determine the potential of these materials for use as a temperature-reducing coating that could be applied by a Soldier in the field to prolong the service life of coated fabric collapsible fuel tanks.
From this study, two candidate coating materials, UG1 Thermoshield, manufactured by Uni-Glaze, and Evercoat 1025, produced by Everest Coatings, were selected and recommended by the U.S. Army Research Laboratory for future application to collapsible fuel tanks in the field for the purpose of prolonging the service life of these items by reducing their surface temperatures. The data presented herein show that these coatings can reduce the surface temperature by as much as 25 °F to 30 °F if used in the South West Asia environment.

15. SUBJECT TERMS

coating, collapsible fuel tanks, temperature

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** Dr. James Sloan
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** (*Include area code*)
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL	28	410-306-0685

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

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1. Introduction

The purpose of this work was (1) to survey the market and obtain solar reflecting paints (SRPs) and coatings for conducting laboratory tests and (2) to determine the potential of these materials for use as temperature reducing coatings that could be applied by a soldier in the field to prolong the life of collapsible fuel tanks. The U.S. Army Tank and Automotive Research, Development, and Engineering Center's (TARDEC's) plan is to use these coatings on collapsible tanks that will be in service for more than six months of continuous use at the same location, including a majority of the larger tank systems, such as the 50,000-gal capacity and up. Once a coating is applied, it is not designed to survive transit or storage conditions. If a coated tank is transported to a new location, an additional coat would need to be applied. The type of coatings being investigated in this study would not be recommended for tanks that are expected to be repeatedly relocated, such as the more maneuverable 20,000-gal or smaller tanks within the U.S. Army inventory. The plan is to coat the tanks in the field just prior to loading the tank with fuel. Thus, the coating must be able to flex and stretch with the tank as the fill height rises and falls during use. TARDEC has also indicated that the color of the coating should be a secondary matter and not as significant as the coating's ability to reduce the temperature of the tank's coated fabric material and seam joints, thus prolonging the life of the tank system in the field.

2. Market Survey

A market survey was first conducted in which eleven candidate SRPs and coatings from three different suppliers were chosen. The results of this survey are provided in table 1. Columns 2 and 3 identify the material and supplier, respectively; the coating/film type and color are listed in columns 4 and 5, respectively. In addition, cost per gallon is given in column 6 and their coverage, for a 4-mil thickness, is shown in column 7.

3. Experimental

3.1 Sample Preparation

All fabric test samples were obtained from a 14- × 14-in polyurethane-coated fabric sheet material, which the U.S. Army Research Laboratory (ARL) had in storage from a previous collapsible fuel tank study. Samples were cut, scrubbed with a cleaning solution (simple green) using a hard bristle scrub brush, rinsed with clean tap water, and dried, prior to being painted. Two coats of paint were then applied using a standard paint roller with a 1/4-in nap and allowed a minimum of 2 hr of drying time between applications. The samples were then coded as indicated in column 1, table 1.

Table 1. Tabulation of market survey results.

1	2	3	4	5	6	7
Sample Code	**Sample ID**	**Supplier**	**Coating or Film Type**	**Color**	**Cost per Gallon**	**Coverage for 4-mil Dry Film**
A	Coated fabric	—	None	Sand	—	—
C	LO/MIT-1 radiant barrier coating (2 coats)	Solec 129 Walters Ave. Ewing, NJ 08638-1829 Phone: 609-883-7700 Web: Solec.org GSA Contract TFTC-88-CK-NIS-01 80 brushes, paint, sealers, and adhesives	Coating/silicone xylene solvent	Silver	$38.40	400 ft^2
C-1	LO/MIT-2 radiant barrier coating	Solec	Coating/silicone waterborne	Silver	?	400 ft^2
D	Thermoshield beige/frost (2 coats)	Uni-Glaze 651 M Oak Grove Ave. Menio Park, CA 94025	Thermoplastic acrylic waterborne	Beige	$25	225 ft^2
E	Thermoshield beige/frost (2 coats) covered with clear satin glaze (1 coat)	Uni-Glaze	Thermoplastic acrylic waterborne, clear coat	Beige, clear	$25, $20	225 ft^2, 300 ft^2
F	Thermoshield arctic white (2 coats)	Uni-Glaze	Thermoplastic acrylic waterborne	White	$25	225 ft^2
G	Evercoat 925 (2 coats)	Everest Coatings P.O. Box 392 Spring, TX 77383-0394 Phone: 281-350-9800	Acrylic	Tan	$20	225 ft^2
H	Evercoat 1025 (2 coats)	Everest Coatings	Aliphatic urethane	Tan	$65	225 ft^2
I	UG 1 Thermoshield (2 coats)	Uni-Glaze	Thermoplastic acrylic waterborne	White	$25	225 ft^2
J	UG 801 Thermoshield (2 coats)	Uni-Glaze	Thermoplastic acrylic waterborne	Sahara	$25	225 ft^2
K	UG 802 Thermoshield (2 coats)	Uni-Glaze	Thermoplastic acrylic waterborne	Limestone sand	$25	225 ft^2
L	UG 803 Thermoshield (2 coats)	Uni-Glaze	Thermoplastic acrylic waterborne	Sandstorm	$25	225 ft^2
M	LO/MIT-1 (2 coats) covered with clear satin (1 coat)	Solec, Uni-Glaze	Coating/silicone, clear coat	Silver, clear	$38.40, $20	400 ft^2, 300 ft^2

3.2 Evaluations and Results

In order to evaluate the candidate coatings and recommend an acceptable coating for this application, the following test procedure and acceptance criteria were used for evaluation. Test data results for the various evaluations are tabulated and presented in the following subsections.

3.2.1 Abrasion Test

ASTM D 4090 was used.[1] The least abrasive and resilient wheel, a Calibrase Wheel No. CS-10, and a 250-g weight were used for testing. The number of cycles needed to abrade through the paint and reveal the polyurethane tank material was considered the test end-point, or the test was terminated after 1000 cycles, if the wheel had not abraded through to the base urethane material. Test results are provided in table 2.

Table 2. Abrasion resistance test results on unaged samples.

Sample Code	**A**	**C**	**C-1**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Color	Sand	Silver	Silver w/clear	Beige	Beige	White	Tan	Tan	White	Sahara	Lime-stone sand	Sand-storm	Silver
Cycle Count to Failure	—	200	20	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000

3.2.2 Flexibility

A sample of painted fabric material 2 × 6 in was wrapped around a 1-1/2-in mandrel, and the coating was inspected for any cracking along its surface and/or delaminations between the coating and urethane substrate. Any cracks or delaminating features was considered a failure for this test. Flexibility tests were run on unaged samples, after aging for 24 hr at 200 ºF and after exposure to accelerated weathering (table 3).

Table 3. Results of flexibility tests on unaged samples.

Sample Code	**A**	**C**	**C-1**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Color	Sand	Silver	Silver w/clear	Beige	Beige	White	Tan	Tan	White	Sahara	Lime-stone sand	Sand-storm	Silver
Flexibility Rating	—	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

3.2.3 Resistance to Fuel

Painted samples cut into 1 × 4 in strips were immersed in reference fuel D (60% iso-octane and 40% toluene) and JP-8 fuel for 4 and 16 hr at room temperature. Excessive swelling, dissolving, or delaminating of paint from the base urethane surface were considered failures. Table 4 shows the rating of each sample subjected to fuel immersion.

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[1]ASTM D 4090. Standard Test Method for Abrasion Resistance of Organic Coatings by Taber Abraser. *Annu. Book ASTM Stand.* **1995**, Vol 06.01.

Table 4. Results of unaged samples to fuel immersion testing.

Sample Code	A	C	C-1	D	E	F	G	H	I	J	K	L	M
Color	Sand	Silver	Silver w/clear	Beige	Beige	White	Tan	Tan	White	Sahara	Lime-stone sand	Sand-storm	Silver
Resistance Rating	—	Failed	Failed	Fair	Fair	Good	Good	Excellent	Good	Good	Good	Good	Failed

3.2.4 Temperature Reduction Performance of SRPs

Four solar lamps (125 W each) were mounted to a table containing an insulated foam board which held the painted coated fabric material with an air cavity below the sample as depicted in the figure 1 illustration.   The height of the samples, in relationship to the heat lamps, was adjusted to provide a surface temperature of ~185 °F on the unpainted (control) sample. Two methods were performed to measure the temperature of the coated fabric while irradiated. The first method (method I) consisted of positioning the sample over the cavity with the painted surface facing the heat lamps and attaching a thermocouple to the opposite (or underside) of the sample (air cavity side). The lamps were then energized and the temperature recorded every minute until the temperature stabilized to a steady state condition (nominally 18 min for all samples). A similar second method (method II) was used where the sample was again placed on the insulated cavity as before, except that the thermocouple was attached to the painted top surface and temperature measurements recorded as before. Temperature data of painted samples were compared to unpainted samples for determining the temperature reduction characteristics provided by the various paints and coatings. These data are presented in tables 5 and 6 and are shown graphically in figures 2–5. In addition, figure 4 ranks the worst to best performers.

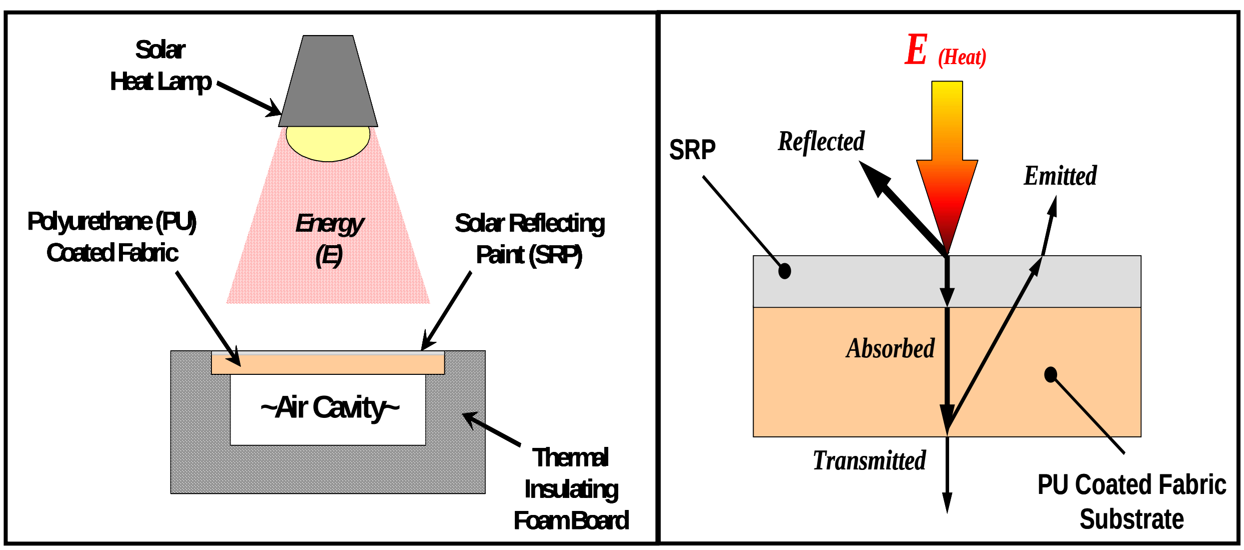

Figure 1. Test set-up for measuring temperature response of painted and unpainted material samples (left) and an illustration of the theoretical energy flow diagram for an SRP polyurethane (PU)-coated fabric material (right).

Table 5. Temperature results comparing underside response of samples during test method I.

Sample Code	**A**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Test Time (min)	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**	**Temp (°F)**
0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
1	116.5	88.4	101.8	100.7	98.4	100.0	100.4	96.2	103.5	101.2	101.8	91.5
2	141.3	99.8	121.8	120.6	116.7	119.4	119.4	113.6	124.8	121.2	121.8	108.0
3	156.8	108.5	134.6	133.2	128.5	131.5	132.3	125.5	139.1	134.5	135.0	119.0
4	166.6	115.1	143.5	141.8	136.5	140.0	140.1	133.8	147.8	143.0	143.8	127.5
5	172.6	120.0	149.3	147.7	141.6	145.7	146.0	139.8	152.7	148.7	149.7	133.5
6	176.3	123.6	153.1	151.8	145.4	149.9	150.2	144.1	156.3	152.7	153.7	137.6
7	179.0	126.4	155.3	154.9	148.1	152.6	152.7	146.6	158.9	155.8	156.1	140.4
8	181.0	128.5	157.3	157.0	150.0	154.1	154.7	148.8	161.1	157.4	158.1	142.5
9	182.4	130.6	159.1	158.7	151.7	155.5	156.2	150.3	162.2	158.5	159.6	143.8
10	183.2	131.9	159.9	159.6	152.6	156.3	157.1	151.3	163.1	159.7	160.3	144.9
Stabilizing temperature	185.0	135.0	162.5	163.0	154.5	158.5	159.5	152.5	165.8	163.0	163.8	146.0
Temperature change	—	–50.0	–22.5	–22.0	–30.5	–26.5	–25.5	–32.5	–19.2	–22.0	–21.2	–39.0

Table 6. Test method II results compared with test method I data for samples A and C.

Sample Code	**Sample A**		**Sample C**	
	Top	**Bottom**	**Top**	**Bottom**
Test Time (min)	**Temperature (°F)**	**Temperature (°F)**	**Temperature (°F)**	**Temperature (°F)**
0	75.0	75.0	75.0	75.0
1	119	116.5	99.8	88.4
2	145	141.3	113.2	99.8
3	160	156.8	122	108.5
4	170	166.6	128.2	115.1
5	173	172.6	131	120
6	176.5	176.3	135.8	123.6
7	179.3	179	138	126.4
8	179.8	181	140	128.5
9	181.2	182.4	141.8	130.6
10	181.3	183.2	143.1	131.9
Stabilizing temperature °F	184.5	185	144	135

3.2.5 Accelerated Laboratory Weathering

Samples were subjected to an accelerated laboratory weathering test conforming to ASTM G 155 employing a xenon-arc light source and using an Atlas cycle cam no. 180, for a continuous duration of 14 days.[2] After exposure, temperature measurements were repeated, as in section 3.1.5, to determine if the simulated weather exposure would have any adversely affects on the coating's ability to reduce the sample's surface temperature. In addition, the flexibility tests, as stated in section 3.1.3 were also repeated. The test results are depicted in table 7 and temperature reduction results comparing unaged to aged samples are shown in figure 6.

[2]ASTM G 155. Standard Practice of Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials. *Annu. Book ASTM Stand.* **2000**.

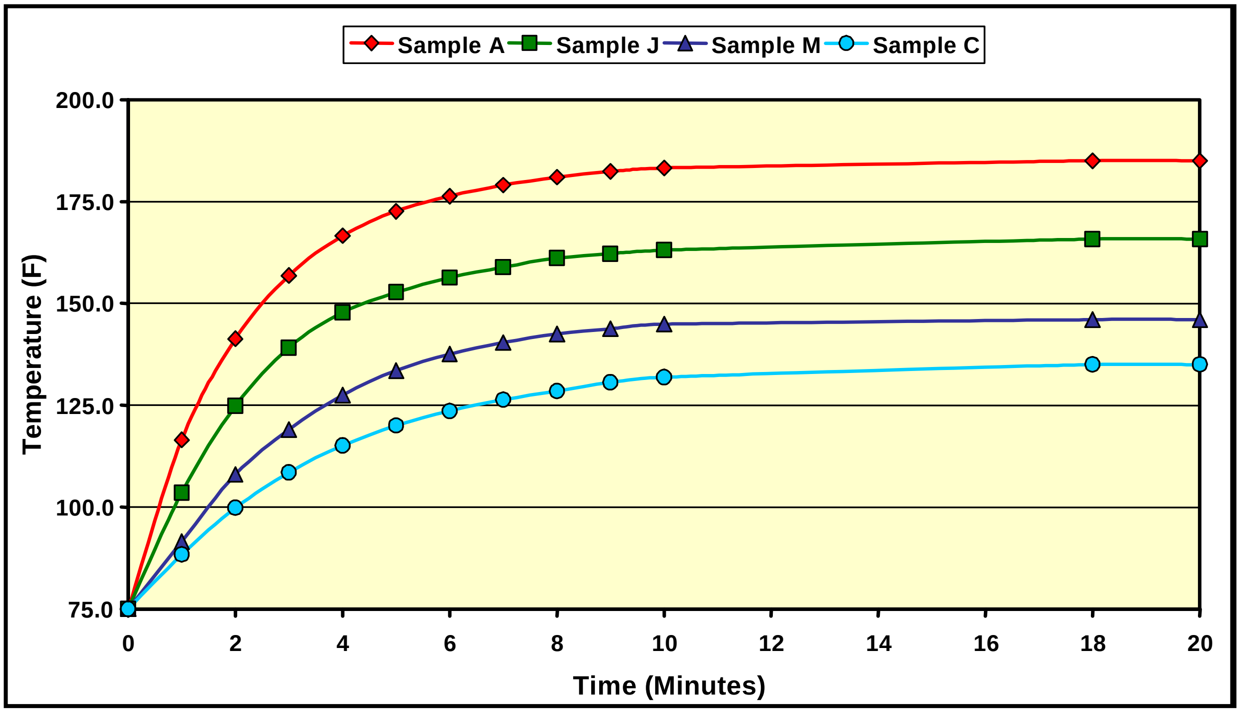

Figure 2. Thermal response comparing unpainted sample A (control) to SRP polyurethane-coated fabric samples J, M, and C, subjected to constant intense simulated solar heat loading (data from table 5).

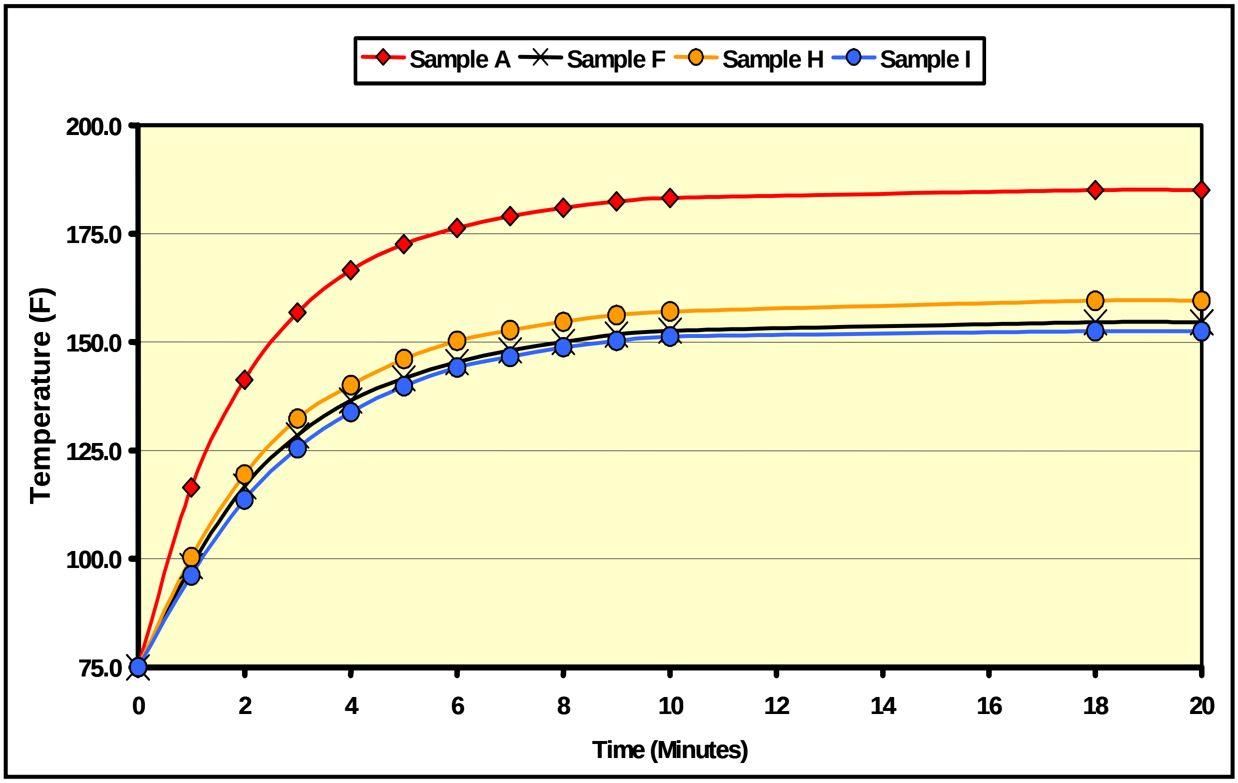

Figure 3. Thermal response comparing unpainted sample a (control) to SRP polyurethane-coated fabric samples F, H and I, subjected to constant intense simulated solar heat loading (data from table 5).

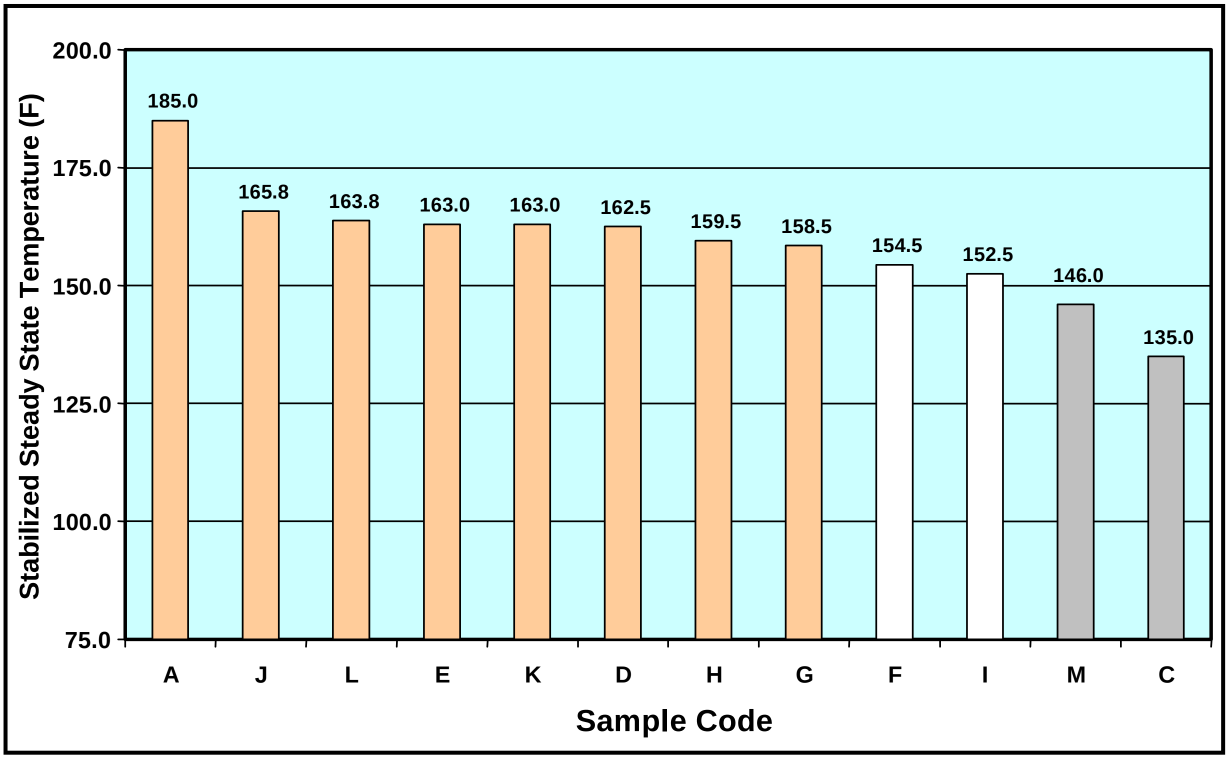

Figure 4. Stabilized steady state temperature ranking under constant intense simulated heat loading; worst to best performance shown from left to right (data from table 5).

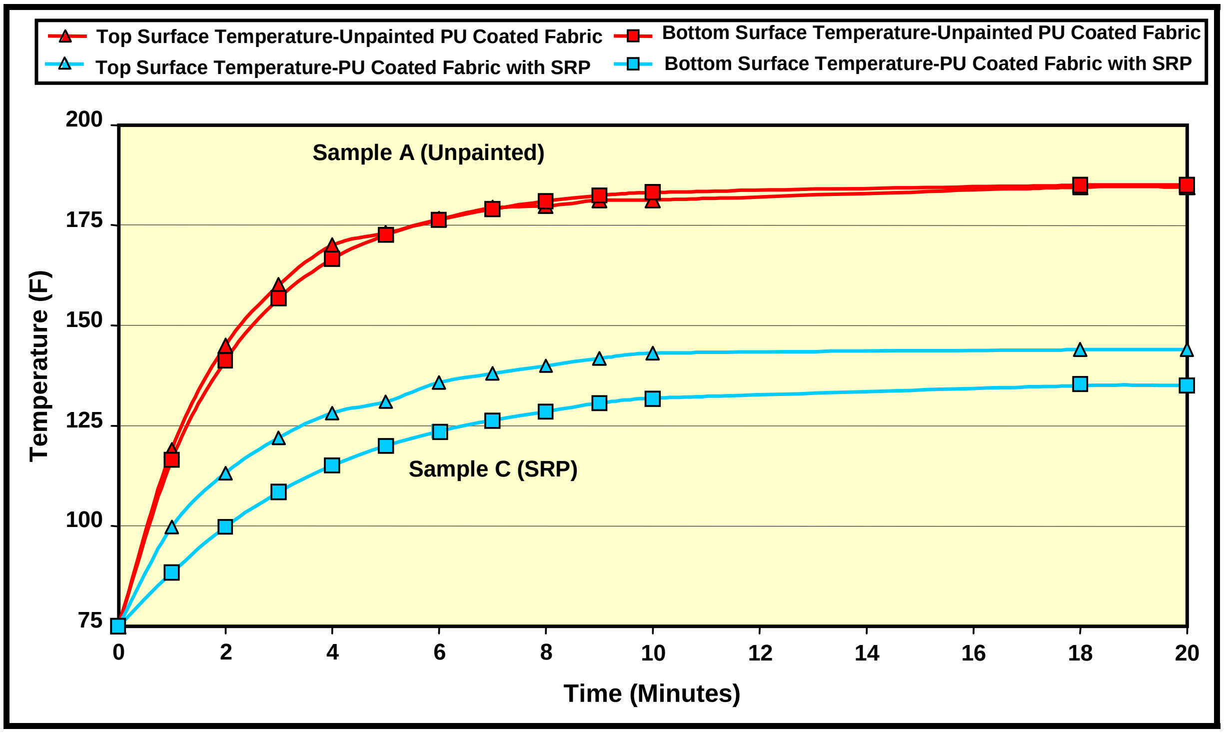

Figure 5. Thermal response comparing top and underside of uncoated sample A to SRP polyurethane-coated sample C, subjected to constant intense simulated solar heat loading (data from table 6).

Table 7. Test results on samples after accelerated laboratory weathering exposure.

After Weathering Results					
Sample Code	**Color**	**Temperature Reduction (°F) (Unaged)**	**Temperature Reduction (°F) (Weathering)**	**Color Change**	**Flexibility (Weathered)**
A	Sand	Control	—	—	—
C	Silver	50	52.5	No change	Pass
C-1	Silver/clear	—	Not tested	Not tested	Pass
D	Beige	22.5	Not tested	Not tested	Pass
E	Beige	23	Not tested	Not tested	Pass
F	White	30.5	31	Yellowing	Pass
G	Tan	26.5	30	No change	Pass
H	Tan	25.5	30	No change	Pass
I	White	32.5	37	Yellowing	Pass
J	Sahara	19.5	24	Faded	Pass
K	Limestone sand	22	Not tested	Not tested	Pass
L	Sandstorm	21.5	25.5	Faded	Pass
M	Silver	39	40.5	No change	Pass

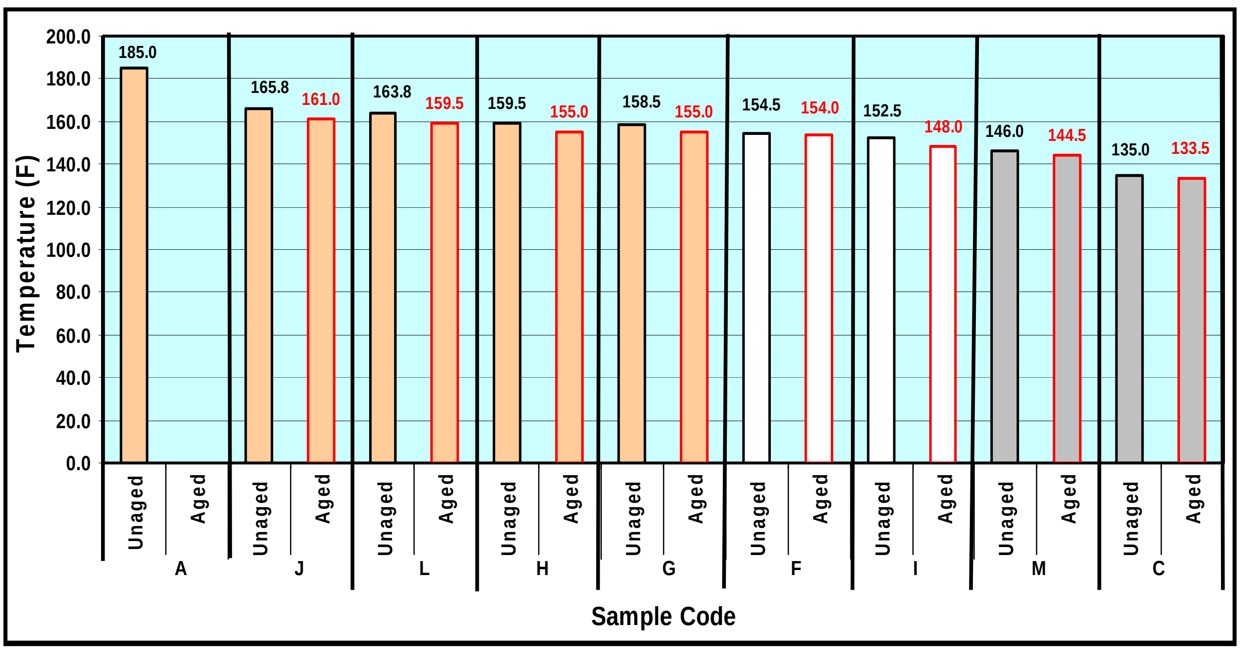

Figure 6. Stabilized steady state temperature ranking under constant intense simulated heat loading comparing unaged and aged samples; worst to best performance shown from right to left (method I repeated).

3.2.6 Reflectance

Reflectance measurements were accomplished on the coated samples using a Varian Cary 5000, UV-Vis-NIR spectrophotometer. Scans showing the spectral performance of the coatings from the ultraviolet (UV) region, starting at 300 nm, though the visible wavelengths and into the near-infrared (NIR), up to the 2500 nm, were conducted. Test results are shown in figure 7.

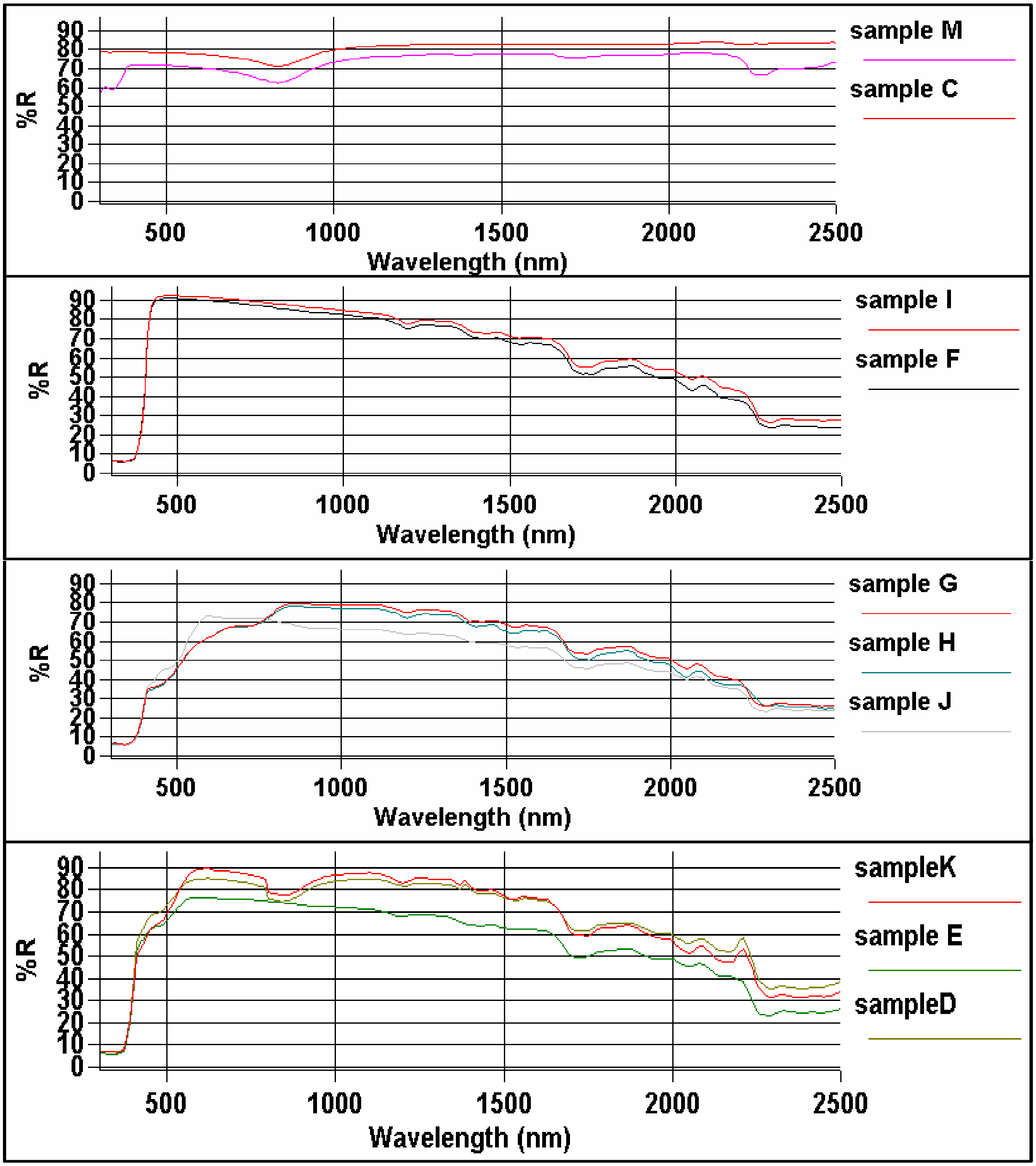

Figure 7. Reflectance properties of samples from the UV to NIR wavelengths.

4. Discussion of Results

4.1 Abrasion Resistance

Abrasion resistance results showed that the C-sample series (samples C-1 and C coated with LO/MIT silver-colored waterborne silicone-based coating) performed the poorest, accomplishing only a mere 20 and 200 cycles, respectively, upon exposure of the urethane base material. In fact, prior to testing sample C-1 could be rubbed and smeared off with one's fingers; thus, this material was found unacceptable and was eliminated from further consideration. It is felt by ARL that coating sample materials C-1 and C would be too susceptible to abrasion effects caused by blowing sand, which is typical in South West Asia or other course terrain environments. The remaining coated material samples all provided over 1000 cycles without the exposure of the base urethane material, including sample M (LO/MIT-1 with an applied satin clear coat finish) passing the minimum 1000 cycle requirement.

4.2 Flexibility

All coating materials passed flexibility testing initially, after heat aging, and after accelerated laboratory weathering. None of the materials showed any signs of film cracking or delamination.

4.3 Resistance to Fuel

The simulated gasoline fuel (fuel D), which has an aromatic content of 40%, was much harsher on these coatings than the JP-8 fuel, which has an aromatic content of 25% or less. Only samples G, H, and L provided resistance to fuel D after 4 hr of immersion. All of the LO/MIT coated samples (samples C-1, C, and M) were severely attacked by the JP-8 fuel and were deemed unacceptable for use in a fuel laden environment. Samples D and E exhibited slight delamination of the coating from the base urethane material; thus, use of these two materials in a fuel environment should be regarded as questionable. The remaining coating materials showed sufficient fuel resistance and are deemed acceptable to be used in environments in contact with JP-8 fuel, with sample H providing the best fuel resistance, followed closely by sample G.

4.4 Temperature Reduction Performance of SRPs

During method I of the section 3.2.4 temperature tests, samples coated with the LO/MIT paints, which were silver in color, provided the best temperature reduction, up to 50 ºF lower than the control sample A (at steady state heating condition), followed by the M-painted sample (the same silver coating but with an additional transparent clear topcoat). These samples were followed by the two white coated samples I and F, which provided a temperature reduction of ~30 ºF lower when compared to the control. The seven tan colored coatings provided temperature reductions ranging from 26.5 ºF for sample G to 19.2 ºF for sample J. These data are depicted in table 6 and are graphically represented in figures 2 and 3. The bar chart (figure 4) clearly shows the performance of the various coatings while subjected to constant continuous heat loading (steady state condition) and their capability to reduce temperature, as compared to the sample A control material.

Temperature measurements were also made comparing both the top painted surface (outside surface) and the underside surface (fuel tank's inner surface) to the worst and best performing samples A and C, respectively (refer to table 6 and figure 5). The silver LO/MIT coated C-sample provided approximately a 10 ºF differential between its top and bottom two surfaces, showing its superior ability to reflect and reduce heat transmission from the base coated fabric material. The A sample showed little temperature difference between its two surfaces. In fact, after 8 min of heating the underside became slightly warmer than the topside. This was due to heating of the air cavity causing a slight "green house" effect. Method II tests were not performed on the other samples due to time limitations.

4.5 Accelerated Laboratory Weathering

After two weeks of accelerated weather exposure, method I temperature measurements were repeated on some of the coated fabric material (refer to table 7 and figure 6). The temperature reduction after accelerated aging remained essentially the same, as compared to the unaged samples, although there is a consistent slight reduction of a few degrees Fahrenheit for the aged samples. The white painted materials showed some yellowing and most of the tan colored samples faded after accelerated weathering. Two materials, samples G and M, actually stuck to the metal sample holder after exposure and while being removed from the fixture caused some of the coating to delaminate from its base urethane material. Since samples C and M were disqualified for not having acceptable abrasion and/or fuel resistances, the next best material performers for temperature reduction after being exposed were the two white colored materials, samples I and F, followed by the tan colored materials, samples H, G, L, and J. For the tan colored samples, their temperature reductions ranged from 37–24 ºF, respectively. To further determine prolonged outdoor weather exposure effects, much longer duration laboratory tests are required.

4.6 Reflectance

Reflectance measurements using a Varian 5000 spectrophotometer are shown in figure 7. The LO/MIT silver-colored coatings, samples C and M (LO/MIT with a clear coat), maintained similar reflectance curves throughout the visible to NIR wavelengths; however, sample M encompassed approximately a constant 10% higher reflectance, primarily due to the application of the clear coat; sample C exhibited a dip in the UV region (300–400 nm), as well as in the shortwave IR (2200–2500 nm). Even though sample M provided higher reflectance values, the temperature reduction provided by sample C was still 11 ºF better compared to sample M. Obviously, the clear coat affected the transmissibility and/or absorption of heat flow into the base coated fabric material.

The white-colored materials, samples F and I, were very parallel in reflectance values throughout the scanned range and thus should visibly appear similar. The reflectance of these two coatings dropped at a somewhat consistent slope from about 90% in the visual (500 nm) to 25% in the NIR (2200 nm) and then leveled off. Samples G, H, and J exhibited similar reflectance curves increasing from 10% reflectance at 300 nm to a maximum of 78% reflectance at ~800 nm, remaining level until to 1200 nm and then dropping to 25% reflectance at 2200 nm and again leveled off, similar to samples F and I.

The tan-colored materials, samples K, E, and D, also exhibited similar reflectance curves. The reflectance curves for these materials rose sharply from 10% reflectance at 300 nm to over 80% reflectance at 550 nm and held relatively constant until 1500 nm, than dropped to ~30% at 2200 nm and became relatively level.

All samples exhibited very poor UV reflectance (300–400 nm), except for samples M and C. M and C exhibit a UV reflectance of 80% and 60%, respectively. All other samples produced UV reflectances below 10%.

4.7 Ranking and Recommendations

Table 8 shows the overall ranking, determined by ARL, for the coating/paint samples investigated from 1 (best performer) to 7 (worst performer). As mentioned earlier, samples C, C-1, and M (LO/MIT coated) were disqualified because of their poor resistance to JP-8 fuel and low abrasion resistance. The white coating, sample I (Thermoshield UG-1 supplied by Uni-Glaze), although it discolored slightly during the accelerated laboratory weathering test, provided the best overall properties of the candidate coatings/paints tested and provided a respectable temperature reduction value of 32 ºF when compared to the uncoated control sample A. However, if the U.S. Army is concerned with having a white-coated, rather large item present in the field, the next best coating selected was sample H (Evercoat 1025, a tan-colored urethane supplied by Everest Coatings), which also provided the best resistance to fuel immersion and exhibited a temperature reduction of ~25 ºF lower than the control. In ARL's opinion, and presuming color as a factor, this material would be the most compatible coating for use with collapsible fuel tanks, even at a much higher price of $65 per gallon, as compared to about $25 per gallon for the sample I material.

Table 8. Overall performance ranking of candidate samples with the top two candidates highlighted.

Ranking													
Sample Code	**A**	**C**	**C-1**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Color	Sand	Silver	Silver w/clear	Beige	Beige	White	Tan	Tan	White	Sahara	Lime-stone sand	Sand-storm	Silver
Overall Ranking	Control	Failed	Failed	7	7	3	4	2	1	6	5	5	Failed

4.8 Applicability to Fielded Systems

Both coating/paint samples H and I can easily be applied in the field by using a standard paint roller with 1/4-in nap and applied as one would regular paint or by using a paint spraying system with a typical 625 nozzle tip that has a 0.8-GPM capability. If a roller is used, two coats would probably be needed to cover completely and provide a dry film thickness of 3.5–4 mil. When spraying, apply enough paint to also provide the same dry film thickness of 3.5–4 mil.

Lastly, both coatings of samples H and I were applied to strips of unpainted coated fabric material that had previously been exposed to JP-8 fuel for a 4-day duration (for a previous test). Prior to painting, the two samples were cleaned, painted, and dried as to procedures stated in section 3.1. Both coatings adhered to the cleaned surfaces as well as the original samples. Thus, application to already existing and established collapsible fuel tank systems in the field is possible.

5. Conclusions

In conclusion, two coating materials samples H and I, from the 13 sample paint systems investigated, have been recommended by ARL as preferred paints for application to collapsible fuel tanks in the field for the purpose of prolonging the service life of these items by reducing the surface temperature. These coatings should reduce the temperatures of the body fabric, as well as tank seams, by as much as 25–30 °F, therefore reducing the chances of seam slippage due to higher temperatures and with the added benefit of reducing the amount of fuel diffusion. Reducing the material temperature can also reduce the rate of chemical attack on the base urethane coating, such as by hydrolysis. Either sample H or I can be purchased using the information provided in table 1.

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Appendix. Raw Data

This appendix appears in its original form, without editorial change.

Sample Code	Sample ID	Supplier	Coating or Film Type	Color	Temperature Reduction (oF)	After Weathering Temp. Change/Color Change	Original Flexibility	Flex After Weathering & 200 Deg. F	Resist To JP 8 Fuel	Abrasion Resist.	Cost Per Gallon	Coverage For 4 mil Dry Film	Overall Ranking
A	Coated Fabric		None	Sand	Standard	---	---	---	---	---	---	---	---
C	LO/MIT-1 Radiant Barrier Coating (2Coats)	Solec 129 Walters Ave Ewing, NJ 08638-1829 Phone: 609-883-7700 Web: Solec.org GSA Contract TFTC-88-CK-NIS-01 80 Brushes, Paint, Sealers & adhesives	Coating/Silicone Xylene Solvent	Silver	50.0	--52.5/No Change	Passed	Passed	Failed	200 Cycles	$38.40	400 Ft^2	Failed
C-1	LO/MIT-2 Radiant Barrier Coating	Solec 129 Walters Ave Ewing, NJ 08638-1829 Phone: 609-883-7700	Coating/Silicone Waterborne	Silver	---	Not Tested	Passed	Passed	Failed	20 Cycles	?	400 Ft^2	Failed
D	Thermoshield Beige/Frost (2 Coats)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne	Beige	22.5	Not Tested	Passed	Passed	Fair	>1000 Cycles	$25	225 Ft^2	7
E	Thermoshield Beige/Frost (2 Coats) Covered with Clear Satin Glaze (1 Coat)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025 Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne Clear Coat	Beige Clear	23.0	Not Tested Not Tested	Passed	Passed	Fair	>1000 Cycles	$25 $20	225 Ft^2 300 Ft^2	7
F	Thermoshield Arctic White (2 Coats)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne	White	30.5	-31/Yellowing	Passed	Passed	Good	>1000 Cycles	$25	225 Ft^2	3

G	Evercoat 925 (2 Coats)	Everest Coatings PO Box 392 Spring, Texas 77383-0394 Phone: 281-350-9800	Acrylic	Tan	26.5	-30/NC but Stuck to Met	Passed	Passed	Good	>1000 Cycles	$20	225 Ft^2	4
H	Evercoat 1025 (2 Coats)	Everest Coatings PO Box 392 Spring, Texas 77383-0394 Phone: 281-350-9800	Aliphatic Urethane	Tan	25.5	-30 /No Change	Passed	Passed	Excellent	>1000 Cycles	$65	225 Ft^2	2
I	UG 1 Thermoshield (2 Coats)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne	White	32.5	-37/Yellowing	Passed	Passed	Good	>1000 Cycles	$25	225 Ft^2	1
J	UG 801 Thermoshield (2 Coats)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne	Sahara	19.2	-24/Faded	Passed	Passed	Good	>1000 Cycles	$25	225 Ft^2	6
K	UG 802 Thermoshield (2 Coats)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne	Limestone Sand	22.0	Not Tested	Passed	Passed	Good	>1000 Cycles	$25	225 Ft^2	5
L	UG 803 Thermoshield (2 Coats)	Uni-Glaze 651 M Oak Grove Ave Menlo Park, CA 94025	Thermoplastic Acrylic Waterborne	Sandstorm	21.2	-25.5/Faded	Passed	Passed	Good	>1000 Cycles	$25	225 Ft^2	5
M	LO/MIT-1 (2 Coats) covered with Clear Satin (1 Coat)	Solec Uni-Glaze	Coating/Silicone Clear Coat	Silver Clear	39.0	-40.5/NC but Stuck to Metal	Passed	Passed	Failed	>1000 Cycles	$38.40 $20	400 Ft^2 300 Ft^2	Failed

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