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Infrared Database for Process Support Materials

K.E. Bennett, R.E. Boothe, and H.D. Burns
Marshall Space Flight Center, Marshall Space Flight Center, Alabama

June 2003

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Marshall Space Flight Center, Marshall Space Flight Center, Alabama

National Aeronautics and
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Marshall Space Flight Center • MSFC, Alabama 35812

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LIST OF ACRONYMS

HATR	horizontal attenuated total reflectance
IR	infrared
MP&M	Materials, Processes, and Manufacturing (Department)
MSFC	Marshall Space Flight Center
SOC–400	Surface Optics Corporation Model 400 Spectrometer
TCA	methyl chloroform
TM	Technical Memorandum

TECHNICAL MEMORANDUM

INFRARED DATABASE FOR PROCESS SUPPORT MATERIALS

1. INTRODUCTION

Process support materials' compatibility with cleaning processes is critical to ensure final hardware cleanliness and that performance requirements are met. Previous discovery of potential contaminants in process materials shows the need for incoming materials testing and establishment of a process materials database. The Contamination Control Team of the Materials, Processes, and Manufacturing (MP&M) Department at Marshall Space Flight Center (MSFC) has initiated the development of such an infrared (IR) database, called the MSFC Process Materials IR database, of the common process support materials used at MSFC. These process support materials include solvents, wiper cloths, gloves, bagging materials, etc. Testing includes evaluation of the potential of gloves, wiper cloths, and other items to transfer contamination to handled articles in the absence of solvent exposure, and the potential for solvent exposure to induce material degradation. This Technical Memorandum (TM) summarizes the initial testing completed through December 2002. It is anticipated that additional testing will be conducted with updates provided in future TMs.

2. DESCRIPTION

Materials were analyzed using two different IR techniques: (1) Dry transference and (2) liquid extraction testing. The first of these techniques utilized the Nicolet Magna 750 IR spectrometer outfitted with a horizontal attenuated total reflectance (HATR) crystal accessory. The region from 650 to 4,000 wave numbers was analyzed, and 50 scans were performed per IR spectrum. A dry transference test was conducted by applying each sample with hand pressure to the HATR crystal to first obtain a spectrum of the parent material. The material was then removed from the HATR crystal and analyzed to determine the presence of any residues. If volatile, liquid samples were examined both prior to and following evaporation. A list of materials tested by the dry transference technique can be found in appendix A; the liquid samples analyzed are listed in appendix B. Dry transference test results are shown in appendix C.

The second technique was to perform an extraction test with each sample in five different solvents. The materials used for extraction testing were those most common in MP&M laboratories and the substore in building 4707. A list of these materials can be found in appendix D. The extraction residues were scanned using a Surface Optics Corporation 400 spectrometer (SOC–400) outfitted with a V-sphere analysis accessory. The analysis region for this instrument was 650 to 4,000 wave numbers, and 32 scans were performed per IR spectrum. Each sample material was tested a total of 10 times (2 exposure periods with each of the 5 solvents). For the first portion of the test, a sample would be agitated in the solvent for 10 s in a glass jar. The solvent would then be added to the V-sphere cup, allowed to evaporate, and then scanned. For the second exposure period, a sample would be placed in a glass jar with the solvent for a total of 1 hr. The solvent would then be added to the V-sphere cup, allowed to evaporate, and then scanned. Extraction test results are shown in appendix E.

Once the scans were complete for both the dry transference and the extraction tests, the residue from each scan was interpreted. Several very significant findings were made using both techniques.

3. RESULTS

Dry transference testing was important for all materials since gloves are used for handling, wiper cloths can be used for dry cleaning, and plastic forms are used for bagging contact hardware. Glove selection is critical since direct contact with sensitive hardware occurs during handling. Two gloves tested using the transference test were found to contain a silicone coating. A few different lots of each of these gloves were tested to determine the accuracy of the findings. The gloves found to include the silicone residue were the MAPA Professional Technic® glove and the Microflex® Ultra One® latex glove. In each case it is believed that the silicone is a coating on the glove and not a degradation product or glove particulate. Spectra of the MAPA Professional Technic glove residue and a common silicone are shown in figure 1.

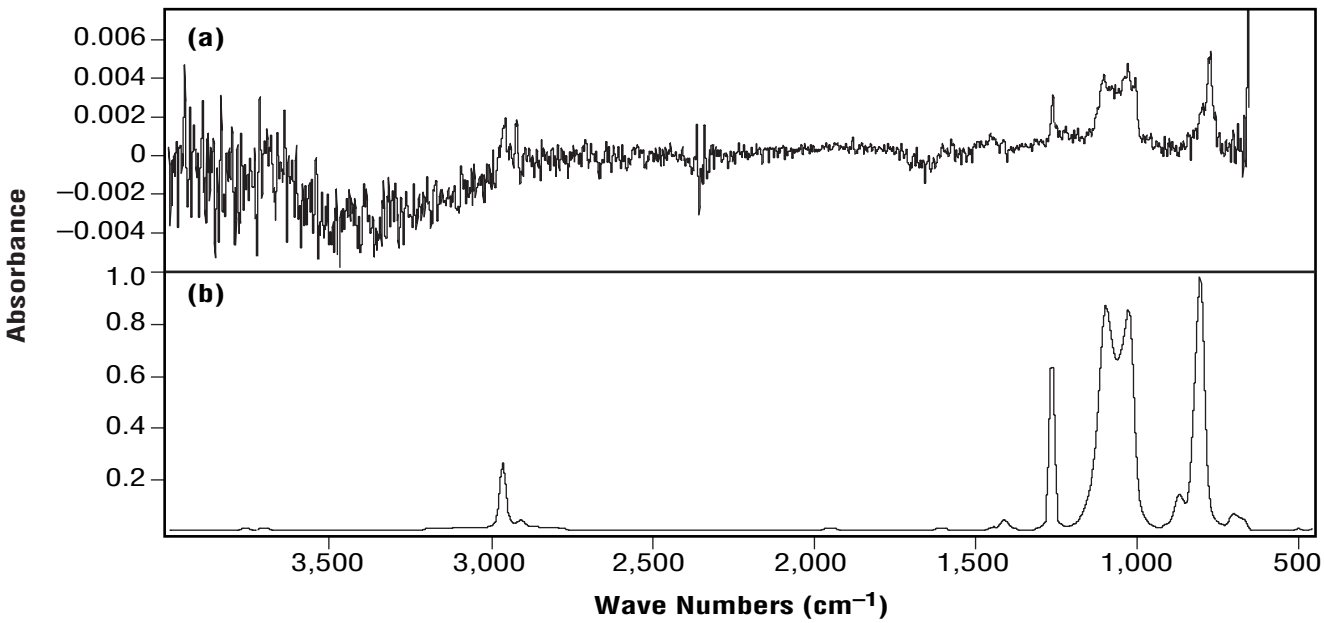

Figure 1. Results of transference test shown by spectra of (a) residue from dry MAPA Professional Technic glove and (b) silicone fluid F–751.

Residue collected from dry transference testing of Ansell Edmont gloves was shown to be consistent with a hydrocarbon wax such as paraffin (fig. 2). This residue is believed to be a coating on the glove and not a degradation product or glove particulate.

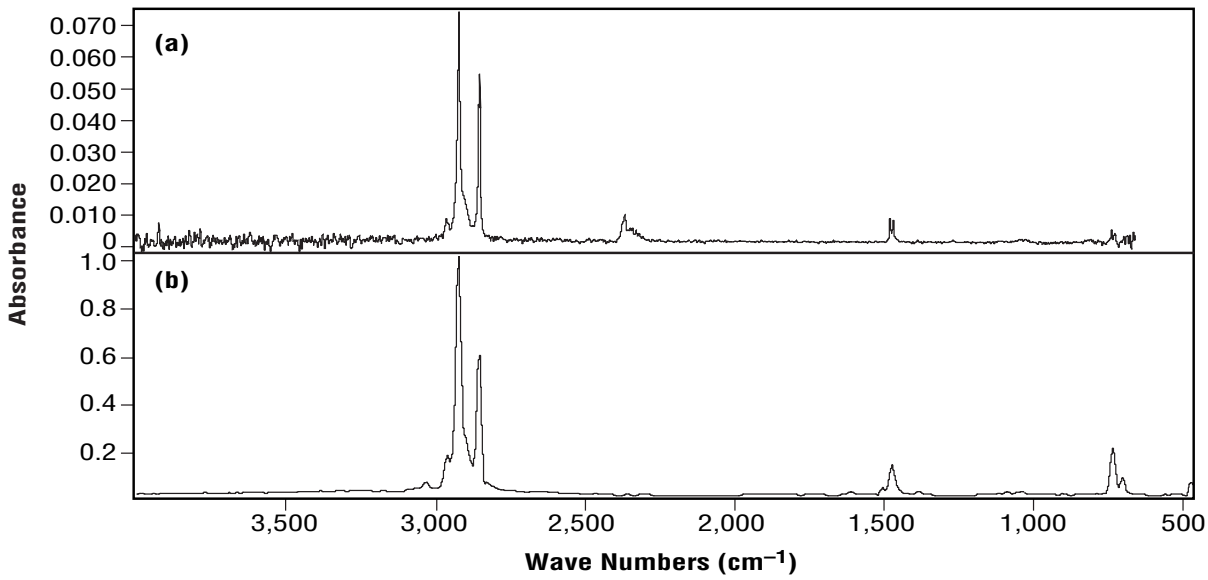

Figure 2. Results of transference test shown by spectra of (a) residue from dry Ansell Edmont glove and (b) paraffin wax.

Extraction testing was conducted on wiper cloths, gloves, and other materials that might come in contact with solvents or solutions during cleaning processes or by inadvertent contact. The extraction testing found several significant findings as well. Tests completed on CRP orange nylon bagging material with the solvents alcohol, methyl chloroform (TCA), and acetone produced a polyamide. Dry transference testing performed on the bagging material resulted in no residue observed. This comparison indicates that the residue is a degradation product of the material. Spectra of the extraction residue and a common polyamide are shown in figure 3.

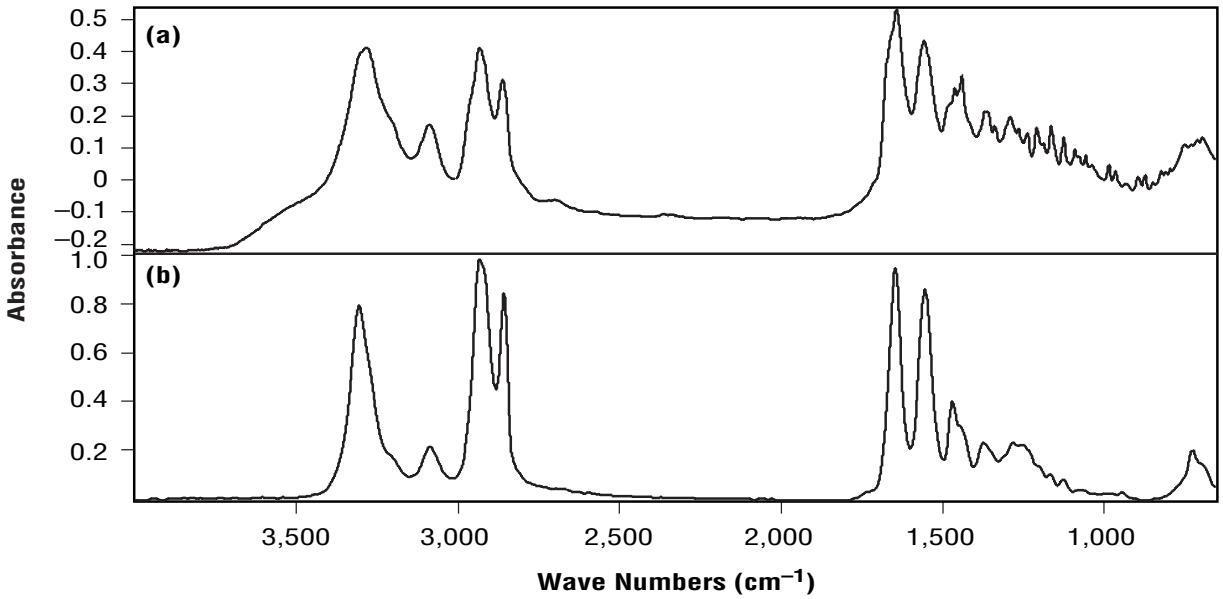

Figure 3. Results of extraction test shown by spectra of (a) residue from denatured alcohol extraction of CRP orange nylon bagging material and (b) polyamide–11.

Another finding from the extraction testing is that exposure of Rymple cloth to TCA and alcohol residue produces a hydrocarbon wax residue. When performing dry transference testing on the HATR crystal, the residue from the Rymple cloth was a fiber residue, indicating that the extraction residue is a degradation product. Spectra of the Rymple cloth residue and a common hydrocarbon wax are shown in figure 4.

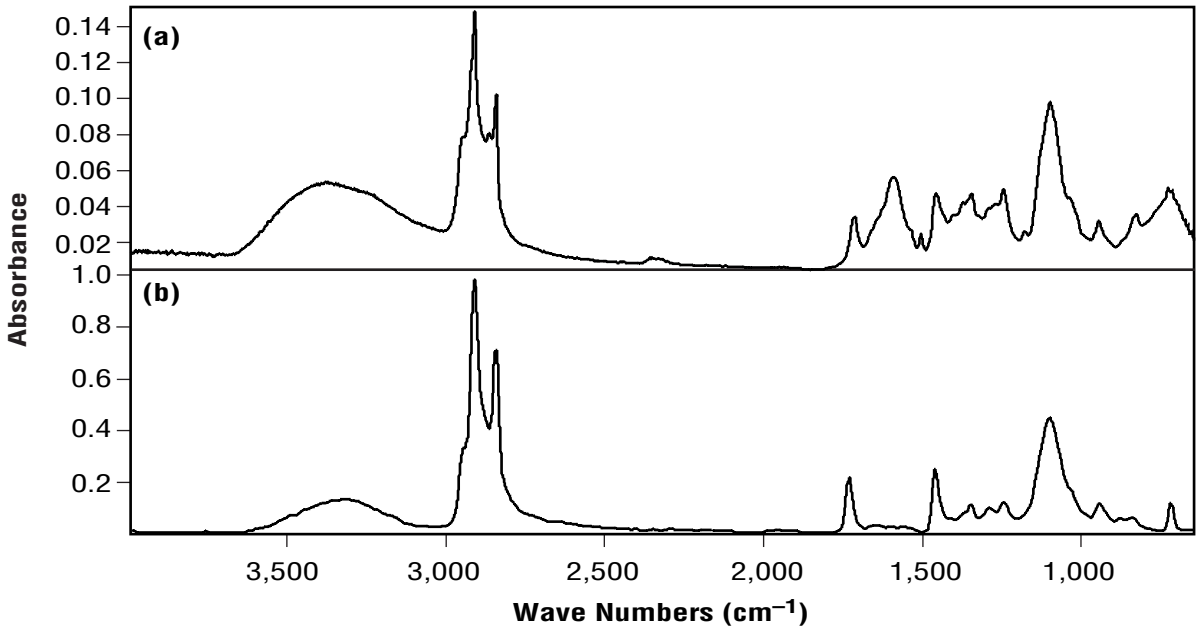

Figure 4. Results of extraction test shown by spectra of (a) residue from TCA extraction of Rymple cloth and (b) wax dispersion.

4. CONCLUSIONS

The test results summarized in this TM illustrate that many process support materials in use in MSFC laboratories have the potential to transfer contamination to items with which they come into contact. This is particularly true if the material is used in conjunction with a solvent. Continued cataloguing of processing materials will increase the likelihood that unknown contaminants found on bonding, optical, and other surfaces can be accurately identified. The database can also serve as a reference to help determine how or whether processing materials should be used for specific applications.

APPENDIX A—HORIZONTAL ATTENUATED TOTAL REFLECTANCE CRYSTAL ANALYZED PRODUCTS

The following are products analyzed using the HATR crysal accessory:

Gloves:

Ansell Chem-White™ glove
Ansell Edmont Chem-White™ Sol-Vex® nitrile glove 37–105
Ansell Edmont Sol-Vex® glove 9323A 37–155 8
Ansell Nitrilite® gloves lot 0103501008
Berkshire BCR® glove liner
Cotton glove insert
MAPA Pioneer Stanzoil® neoprene glove
MAPA Professional Technic® glove NS–35
Microflex® Ultra One® glove
ORS treated industrial glove RN67368

Wipers:

Anticon 100® wiper cloth by Milliken Research Corporation
Anticon 100® with Plus-4 premoistened wiper cloth by Milliken Research Corporation
Chix® TM aerospace wiper
Contec® wiper
Horizon tech wipe 530/5353
Merocel® wiper cloth 900284
Multigraphics® Multilith® pads 200–847
PF degreaser solvent wiper
Rippey wiper cloth
Ross optical lens tissue
Rymple cloth
Vera Clean premoistened actone wipes lot 071902

Brushes:

Maxwell Corp. of America 2-in foam brush
Sponge brush 828265
Tynex brush part No. 01–004210–001

Cleaners:

Blue Gold industrial cleaner by Modern Chemical Inc.
ChemCo 030 white titanium dioxide LS06838
Cole-Parmer lab cleaning solution series 8790
DIF hand cleaner type 1C12 grade B

Miscellaneous:

- 2100 blue side
- 2100 brown side
- Brown paper
- Capran® 980
- Cotton-tipped applicator
- CRC Power Lube®
- CRP orange nylon bag
- DoAll rust preventive
- DOW Corning® RTV sealant
- Kapton® H
- Polyethylene bag
- Silikroil® by Kano Laboratories
- TechSpray Envi-ro-tech™ circuit chiller 1672
- TriFlow mold release by Krylon
- WD– 40®

APPENDIX B—NICOLET 750 ANALYZED SOLVENTS/LIQUIDS

The following are solvents and liquids analyzed using the Nicolet 750 spectrometer configured as described in section 2:

Blue Gold industrial cleaner by Modern Chemical Inc.
Cole-Parmer lab cleaning solution series 8790
Dichloromethane alpha
E-Z lacquer thinner
Fisher Scientific methyl ethyl ketone UN1193
HFE–7100 Novec, 3M lot 24132
Humco Isopropyl Rubbing Alcohol 70% USP
Klean-Strip S-L-X denatured alcohol
Lacquer thinner
Mallinckrodt acetone SpectrAR 2438
Methyl ethyl ketone
PF degreaser
RE-ENTRY® Plus-4 by Petroferm Inc.
Silquest A–187
Toluene
Xylene dyce

APPENDIX C—DRY TRANSFERENCE TEST RESULTS

Table 1 shows process materials used and whether residue was detected as a result of dry transference testing.

Table 1. Process materials and residue detected.

Process Material	Residue Detected
2100 blue side	
2100 brown side	
Ansell Chem-White glove	
Ansell Edmont Chem-White Sol-Vex nitrile glove 37–106	X
Ansell Edmont gloves	X
Ansell Edmont Sol-Vex glove 9323A 37–155 8	
Ansell Nitrilite gloves	X
Anticon 100 wiper cloth by Milliken Research Corp.	
Anticon 100 wiper with Plus 4 by Milliken Research Corp.	
Berkshire BCR glove liner	X
Brown paper	
Capran 980	
Chix TM aerospace wiper	
Contec wipe	X
Cotton glove insert	
Cotton-tipped applicator	
CRC Power Lube	X
CRP orange nylon bag	
DoAll rust preventive	X
Horizon tech wipe 5350/5353	
Kapton H	
MAPA Pioneer Stanzoil neoprene glove NS–35	X
MAPA Professional Technic glove NS–35	X
Maxwell Corp. of America 2-in foam brush	
Merocel wiper cloth 900284	
Microflex Ultra One glove	X
Multigraphics Multilith pads	X
ORS treated industrial glove RN67368	
PF degreaser solvent wiper	
Polyethylene bag	X
Rippey wiper cloth	X
Ross optical lens tissue	
Silikroil by Kano Laboratories	X
Sponge brush 828265	X
TriFlow mold release by Krylon	X
Tynex brush part No. 01–004210–001	
Vera Clean acetone wipes	
WD–40	X

X = Dry transference residue

APPENDIX D—SURFACE OPTICS CORPORATION MODEL 400 SPECTROMETER ANALYZED PRODUCTS

The following are products analyzed in liquid extraction testing using the SOC–400 spectrometer configured as described in section 2:

Solvents used:

- Acetone
- Denatured alcohol
- Ethanol
- Isopropyl alcohol
- TCA

Products analyzed:

- 2100 (brown and blue sides)
- Ansell nitrile glove lot 0103501008
- Ansell Sol-vex
- Ansell Sol-vex 9323A 37–1558 0493
- Anticon 100 wiper by Milliken Research Corporation
- Capran 980
- Clean class PFLT203 lot 4587
- Contec wiper
- CRP orange nylon bag
- Horizon tech wipes 5350/5353
- Kapton H
- MAPA Pioneer Stanzoil neoprene glove NS–35
- Merocel wiper cloth 900284
- Microflex latex glove
- Microflex Ultra One glove UL–315–XL
- Multigraphics Multilith pads 200–847
- Polyethylene bag
- Rippey wiper cloth
- Ross optical lens tissue
- Rymple cloth

APPENDIX E—SOLVENT EXTRACTION TEST RESULTS

Results from solvent extraction tests are shown in table 2.

Table 2. Results from solvent extraction tests.

Process Material	Solvent									
	Acetone		Denatured Alcohol		Ethanol		Isopropyl Alcohol		TCA	
	10 s	1 hr	10 s	1 hr	10 s	1 hr	10 s	1 hr	10 s	1 hr
2100 Bagging material	X	X							X	X
Ansell nitrile glove	X	X	X	X	X	X	X	X	X	X
Ansell Sol-vex glove	X	X	X	X	X	X	X	X	X	X
Anticon 100 wiper cloth	X	X	X	X	X	X	X	X	X	X
Capran 980	X	X		X		X		X		X
Clean class glove	X	X		X	X	X	X	X	X	X
Contec wiper cloth	X	X		X	X	X	X	X	X	X
CRP nylon bagging material	X	X	X	X	X	X	X	X	X	X
Horizon tech wipe			X	X	X	X	X	X		
Kapton H										
MAPA Pioneer Stanzoil neoprene glove	X	X	X	X	X	X	X	X	X	X
Merocel wiper cloth		X		X		X		X		X
Microflex latex gloves	X	X		X		X		X	X	X
Microflex Ultra One latex glove	X	X	X	X	X	X		X	X	X
Multigraphics Multilith pads										
Polyethylene bag	X	X	X	X	X	X	X	X	X	X
Rippey wiper cloth	X	X	X	X	X	X	X	X	X	X
Ross optical lens tissue									X	X
Rymple cloth	X	X	X	X	X	X	X	X	X	X

X = Extraction residue observed

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13. ABSTRACT *(Maximum 200 words)*
In order to help identify contamination found on bonding surfaces, optical surfaces, or other items, the Materials Contamination Team of the Materials, Processes, and Manufacturing Department at Marshall Space Flight Center (MSFC) has initiated the development of an infrared database containing MSFC process materials and residues. Process materials analyzed to date using infrared spectroscopy for transferable and extractable contamination have included gloves, wiper cloths, solvents, bagging materials, etc. Significant findings included silicone contamination on several gloves and observations of extractables from the majority of materials tested.

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