Final Report on Analysis of Boeing Specimens Flown on the Effects of Space Environment on Materials Experiment

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The Boeing Company provided the Materials Sample Holder(MSH) that held the NASA LaRC, College of William & Mary, and Boeing materials specimens and contamination witness plates flown by NASA LaRC. Test materials flown by Boeing on the ESEM MSH are KAPTON, Aluminized-KAPTON laminate, AORAMID(TOR, COR), Ag/FEP, 10 mil, ITO coated FOSR (2 samples, differing ITO thickness), Cyanate Ester/graphite composite, Viton (V835), Braycoat 601 (perfluoroether) on V835, Braycoat 803(perfluoroether) on V835, Silicone (S383), Braycoat 601 on S383, Braycoat 803 on S383, Fluorosilicone, White Paint (BMS 10-79), Compound parabolic Solar Concentrator with perforated Ag/FEP film, and atomic Oxygen concentrators (x4, x9, x16) with selected target materials Kapton, COR, and Ag/FEP. Certain of these materials were chosen because they are of interest to the International Space Station program, and because specimens of the same materials were also being flown on the Passive Optical Sample Assembly (POSA) II experiment on MIR.

Manufacturers list for the Boeing ESEM (Effects of the Space Environment on Materials) Materials Sample Holder(MSH) specimens.

Fluorosilicone

MIL-R-25988, Type II, Class I, Grade 60
(The Batch used for POSA and for ESEM is manufactured by Kirkhill Rubber)
There are several manufacturers qualified to the specification listed.

Silverized teflon	Sheldahl Corporation

Braycote 601 and Braycote 803	Castrol, Inc.

Silicone S383-70 and Viton V-835	Parker Hannifin

ISSA Airlock paint

Suppliers

Deft (topcoat)
DeSoto (Primer)

Formulated at Boeing

Aoramid	Triton, Inc

Aluminum surface treatments on the sample holder pieces were applied at Boeing. Two thicknesses of ITO on silverized Teflon were supplied by Sheldahl.

The Cyanate Ester resin/graphite fiber composite specimen was cut from a piece fabricated at Boeing.

Three sets of atomic oxygen focusers (x4, x9, and x16 accelerations) were fabricated at Boeing. Kapton, Ag/FEP, and aoramid materials were chosen as the substrates to receive the accelerated doses of atomic oxygen.

A solar UV focusser, ~3-10 suns with Ag/Fep wrapped around an aluminum cylinder at the focus was flown. It is a compound parabolic focusser with MgF_2 coated walls. This piece has not been examined post-flight.

Mass Loss Data

Weight changes for selected specimens are reported in Table I.

Table I. Pre- and Post-Flight Mass of Selected ESEM Specimens

Specimen name	Flight sample weight (g)	
	Pre-flight	Post-flight
Aluminized-Kapton laminate	0.24754	0.24665
Si 383 + B601	3.82648	3.81807
Si 383 + B803	3.77386	3.76470
Si 383	3.83090	3.83329
V835 + B803	6.39821	6.38736
V835 + B601	6.29209	6.29037
V835	6.28280	6.29286
Ag/FEP	1.13515	1.13505
Fluorosilicone	4.36046	4.35710
White top-coat paint	5.83978	5.83614
Kapton	0.10300	0.09945

Atomic Oxygen Environment

The atomic oxygen exposure level on ESEM was determined by mass change on a Kapton specimen weighed before and after the flight. A recession rate of $3.0 \times 10^{-24} cm^3$/atom was used for Kapton exposed to atomic oxygen.

Atomic Oxygen Fluence Estimate
The fluence of atomic oxygen has been estimated two ways. One method used is the measured mass loss of Kapton specimen and the reaction efficiency of Kapton with atomic oxygen as determined on previous flights. This estimate is provided below.

Assume Reaction efficiency (R_e) of $3.0 \times 10^{-24} cm^3$/atom

$$\text{Fluence} = \text{change in mass} / (\text{Kapton density} \times \text{Exposed Area} \times R_e)$$

$$\text{Fluence} = (0.10300 - 0.09945)\ g / ((1.42\ g/cm^3) \times 9.647\ cm^2 \times 3.0\ 10^{-24}\ cm^3/\text{atom})$$

$$\text{Fluence} = 8.6 \times 10^{19}\ \text{atoms}/cm^2$$

The second method used is to calculate the fluence of atomic oxygen from a detailed computer model. The ram fluence and 90^o-from-ram fluence of atomic oxygen for one hour exposure at 290 km and at 255 km were determined using the computer model. For contributions from orientations between 10 and 80 degrees, the ram fluence was multiplied by the cosine of the angle from ram, and the result multiplied by the number of hours in the particular orientation. The 90^o-from-ram orientation was calculated from the model (the fluence at 90^o-from-ram is due to the thermal velocity spread of atoms in the atmosphere). The orientations greater than 90^o were ignored. Contributions from these orientations are likely less than 1% of the total fluence. The fluence values for each orientation between ram and 90^o-from-ram at both 290 km and 255 km were summed to provide the predicted fluence for the mission of 1.0×10^{20} atoms/cm^2. Results are shown below in Table II. The mission fluence estimated from the model agrees relatively well with the fluence estimated from the mass loss of Kapton.

Table II. Summary of Calculations using Predictions from Boeing Atomic Oxygen Fluence Model

Angle from Ram	Cos of Angle	Hrs at Angle	Fluence @290 km	Hrs at angle	Fluence at 255 km	Mission fluence
0	1	52.48	3.76282E+19	24.52	4.09484E+19	
10	0.98480768	1.07	7.55535E+17	0.28	4.60496E+17	
20	0.93969234	1.43	9.63476E+17	0.32	5.02172E+17	
30	0.86602479	7.4	4.59495E+18	0.35	5.06191E+17	
40	0.76604339	3.02	1.65874E+18	0.42	5.37303E+17	
50	0.64278605	3.53	1.6269E+18	0.47	5.04523E+17	
60	0.49999788	5.1	1.82834E+18	1.18	9.85296E+17	
70	0.34201746	6.15	1.50814E+18	1.52	8.68177E+17	
80	0.17364496	8.02	9.98518E+17	1.03	2.98687E+17	
90		100.1	2.39E+18	6.72	3.70E+17	
Fluence Totals			5.39528E+19		4.59812E+19	9.9934E+19

The presence of silicone based contamination may introduce artifacts into the estimate based on Kapton mass loss. Silicone may deposit on the Kapton surface and add to the weight. Silicone on the surface will react with atomic oxygen to produce SiO_x. This process will also add to the weight and decrease the apparent efficiency of atomic oxygen reaction with Kapton. Estimates of the recession rate of certain materials are listed in Table III.

Table III. Atomic Oxygen Reaction Rate for Selected Materials

Material	Mass Changes (g)	Exposed Area (cm^2)	R_e ($10^{-24} cm^3$/atom)
Ag/FEP	-0.00010	17.96	0.045
Fluorosilicone	-0.00337	15.71	1.7
Al-Kapton laminate	-0.00088	15.71	
S383 silicone	+0.00239	9.65	
V835 fluorocarbon	+0.00486	9.65	
White paint	-0.00364	9.65	3.1

The Ag/FEP recession rate estimate is similar to previous STS measurement results. The fluorosilicone rate probably reflects considerable outgassing in addition to any atomic oxygen attack. The weight changes measured for the S383 and V835 specimens are likely dominated by contamination effects. The white paint recession rate reflects a binder removal typical rate for a polyurethane-based paint. The aluminized MLI was flown with the aluminum side facing out. It is likely the mass loss on the MLI specimen is due to outgassing.

Optical Properties - Post-Flight Normal Emittance and Solar Absorptance

The emittance reported for the aluminized Kapton laminate is artificially low. The instrument does not respond well at very low emittance values. The uncertainty in emittance measurements is 0.01-0.02. Thermo-optical properties measured post-flight are reported in Table IV.

Table IV. Post-Flight Optical Properties for Certain Material Specimens

Material	Emittance	Absorptance
Al-Kapton laminate	0.02	0.12
Fluorosilicone	0.91	0.65
Cyanate Ester	0.69	0.95
Ag/FEP	0.86	0.05
Polyarylene ether	0.77	0.50
Silicone S383-70	0.91	0.75
Kapton		0.88 0.91[1]
ITO coated Ag/FEP	0.80	0.05
White paint(TT-P-2756)	0.91	0.21

[1]Not corrected for transmission

Photos of MSH Hardware before and after the flight

The following set of photographs provides a comparison of the appearance of the MSH before and after the flight. The first photo in Figure 1 shows the as-built MSH without any specimens loaded. The photo in Figure 2 shows the Boeing specimens loaded in position for flight. Figure 3 is a post-flight overview picture of the entire MSH. Figure 4 shows a close-up of the Viton 835,Silicone S383, Kapton, and white paint specimens post-flight.

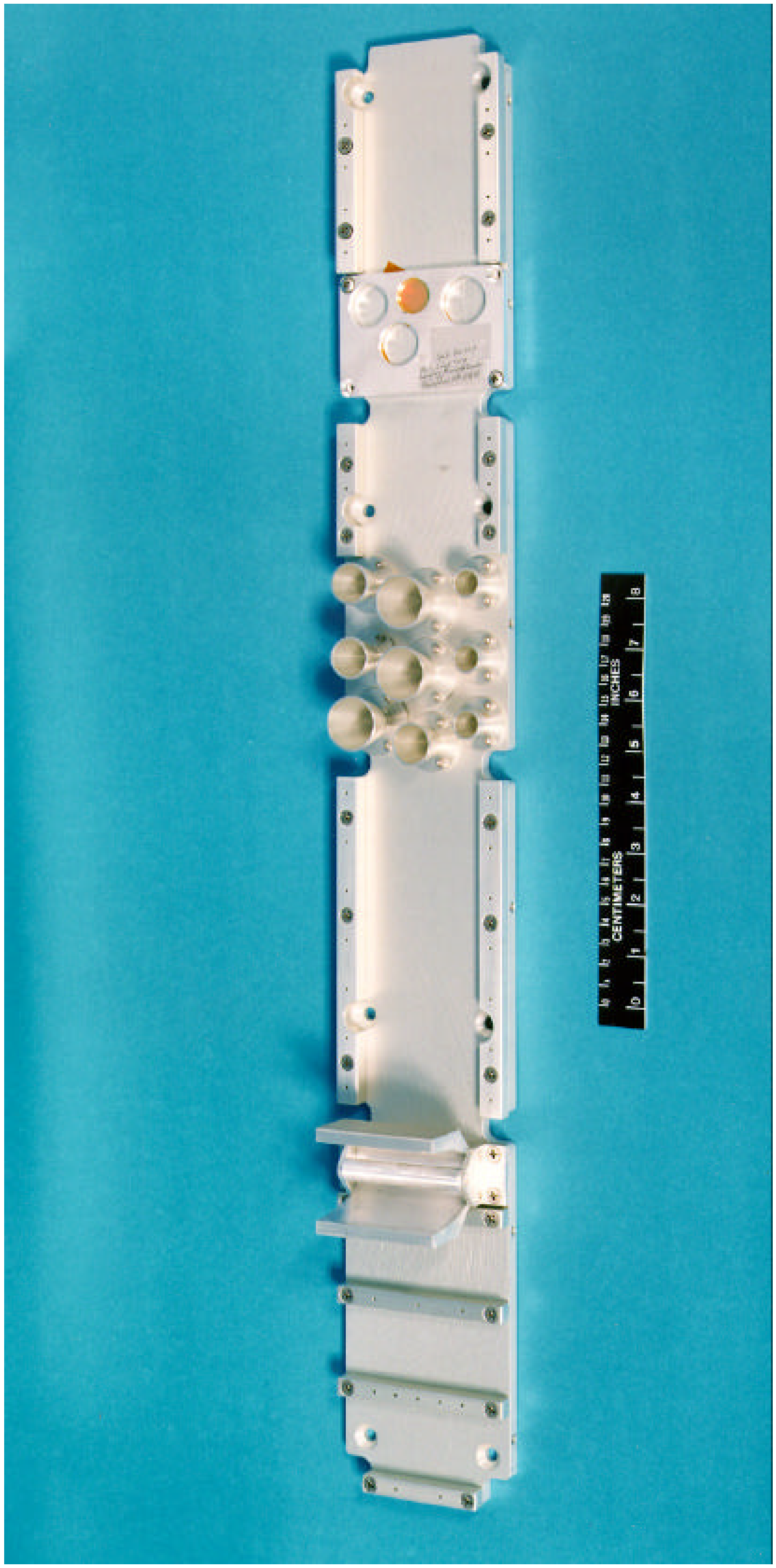

Figure 1. A Pre-Flight Photograph of the MSH Tray.

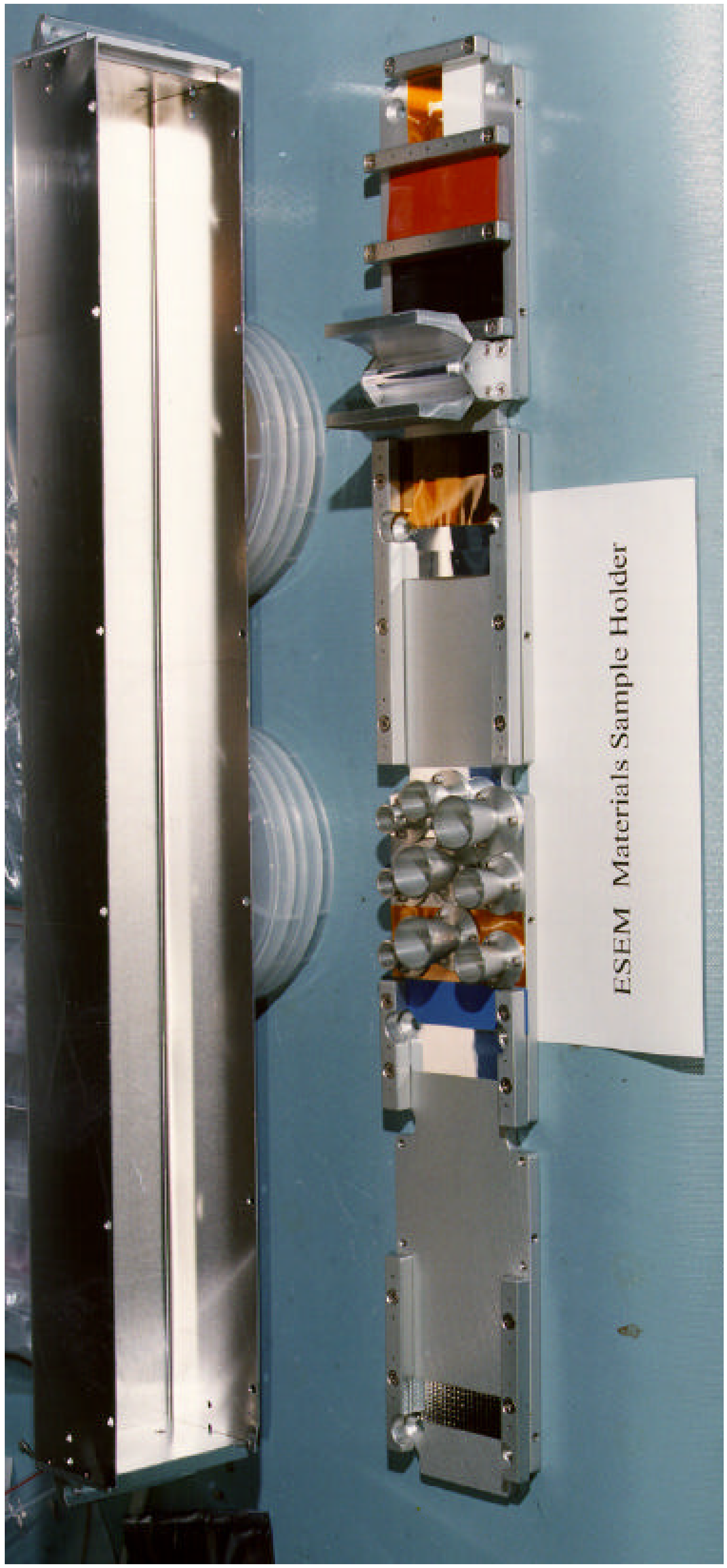

Figure 2. A Pre-Flight Photograph of the MSH Tray with Boeing Specimens in place.

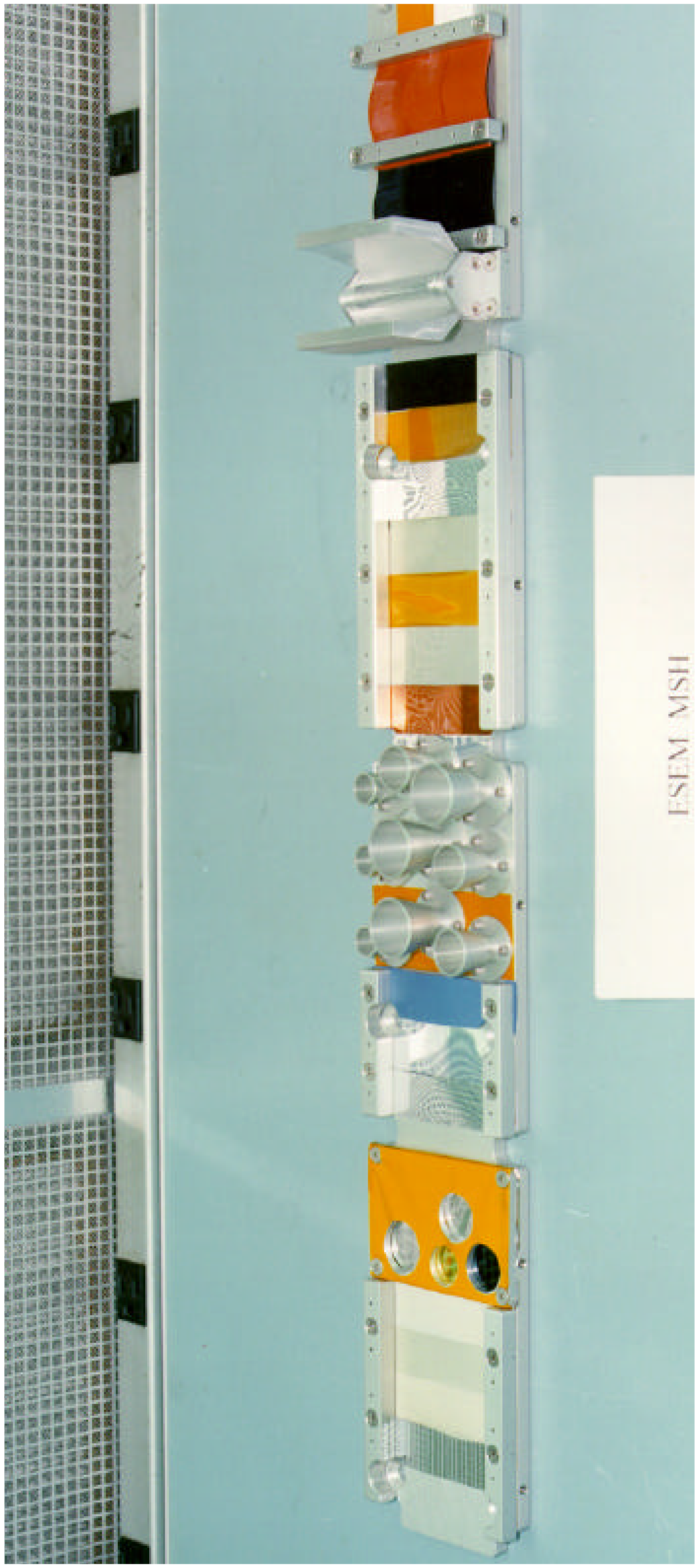

Figure 3. Photograph of MSH Tray Post-Flight.

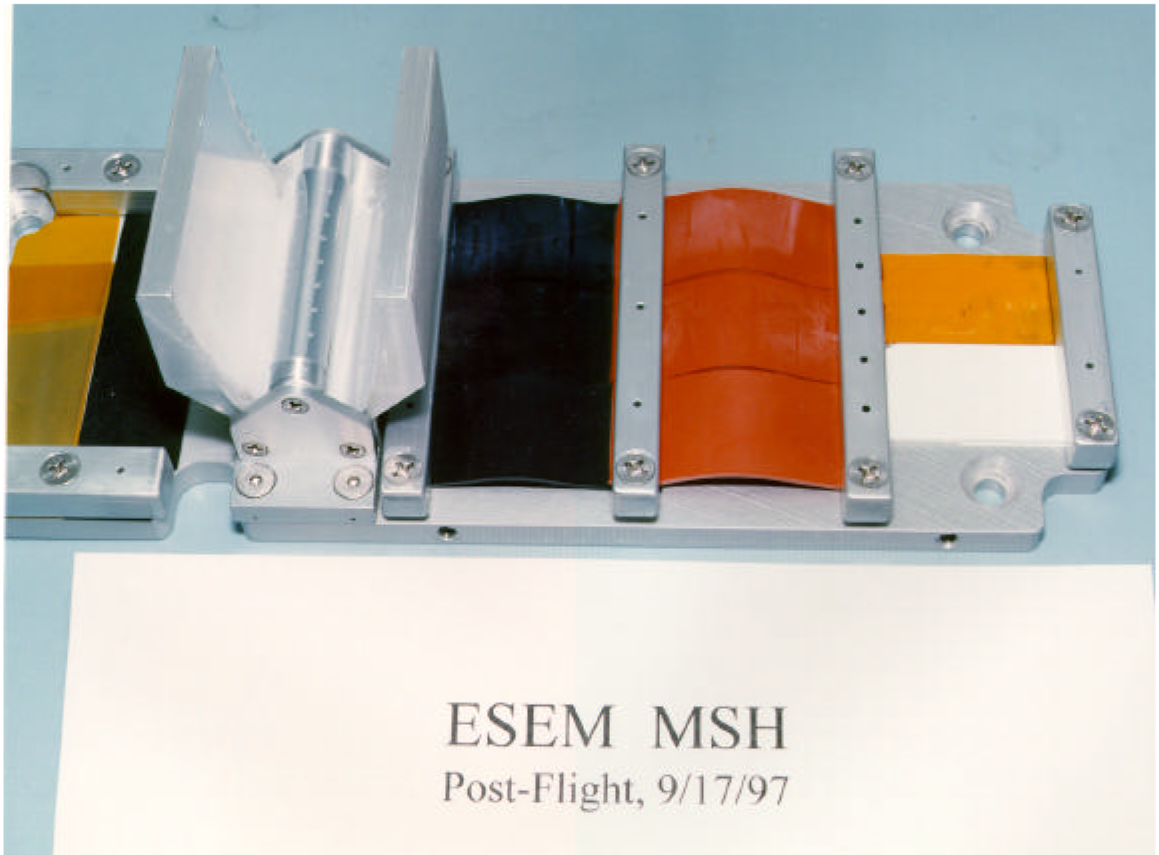

Figure 4. A Post-Flight Close-up Photograph of one end of the MSH.

The samples are held in place using stainless steel alignment pins to prevent lateral movement. Most samples are clamped down with aluminum bars at each end of the sample. Each atomic oxygen concentrator is fastened to the baseplate with 3 bolts. The sample materials are held in place by these bolts and the base of each atomic oxygen concentrator. The solar UV focuser and the contamination witness plate are each fastened to the baseplate using 4 stainless steel 8-32 size bolts.

The aluminum baseplate, solar UV focuser, atomic oxygen concentrators, and the aluminum bars used to clamp the samples were each Boric-Sulfuric acid anodized following the same procedure evaluated for use with International Space Station hardware.

Surface Resistivity of an Indium-Tin-Oxide (ITO) coated silver teflon specimen

An initial examination of the sample using ESCA, followed bu Auger depth profiling showed that the ITO layer was less than ~100A thick. Because the ITO layer was so thin, to make the resistivity measurements, a Loresta MCP-T400 was used with a four point probe and probe tips space ~0.05 inches apart. The approximate locations of the twelve individual measurements are shown in Figure 5. Locations 1 and 10 (and probably location 9) were under the aluminum structure holding the specimens and thus were not directly exposed to the atomic oxygen and solar environments. Surface resistivity measurements on the exposed area of the specimen ranged from 40,000 to 300,000 ohms/square, with the lowest readings from the very center of the exposed area. The results of the individual surface resistivity measurements are listed below in Table V.

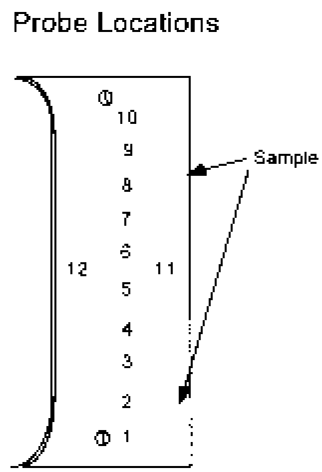

Figure 5. Location of Surface Resistivity Measurements on ITO-coated Ag/FEP Specimen.

Table V. Post-Flight Sheet Resistance Measurements on ITO Coated Ag/FEP Specimen

Measurement Site	Sheet Resistance (Ω/sq)
1	1000000
2	60000
3	150000
4	56000
5	62000
6	40000
7	300000
8	200000
9	700000
10	700000
11	50000
12	80000

Recession Measurements for samples in focusing concentrators

A LASER profilometer with a resolution 0.00003" was used to measure the recession of specimens flown under the focusing concentrators. This means recessions of ~0.76 μm can be detected using this technique.. Mass change measurements of a Kapton specimen exposed to ambient conditions leads to an estimate of ~0.2 μm recession. Similarly, the COR specimen exposed to ambient conditions leads to an estimate of ~0.3 μm recession for this material. Table VI is a summary of data for the average thickness changes of the Kapton and COR material specimens placed under the focusing concentrators during the ESEM experiment flight.

Table VI. Estimated Recession on Materials Exposed to Amplified Atomic Oxygen Flux

Material	Acceleration factor		
	X4	**X9**	**X16**
Kapton	9 μm	18 μm	15 μm
COR	16 μm	15 μm	19 μm

The quantitative values do not mean much. There was probably pressure build-up in each focusing concentrators, providing an opportunity for multiple reactions. It is clear that reaction rates were increased over ambient rates, but the trends are not correlated with acceleration factor.

Elemental analysis of selected specimens

Certain specimens were examined using ESCA to determine the distribution of elements on the sample surface after the flight. Two specimens were also examined using Auger depth profiling techniques. Figures 6 and 7 show the ESCA and Figures 8 and 9 show the Auger data obtained post flight. The ESCA data shows the expected increased oxygen content of the exposed portions of the samples. The ESCA results also show the background silicon contamination on samples with no silicon content in the substrate materials. The silicone and fluorosilicone specimens also show increased silicon on the surface, as other atoms are preferentially removed by the atomic oxygen. The Auger data from the aluminized Kapton MLI piece shows the silicon-based contaminant layer to be extremely thin, ~< 50A. The ITO thickness is shown to be about 100A.

Solar Conditions During Flight

Solar activity was relatively low throughout the period of August 8-18, 1997. Tables VII through IX listed below include the daily solar, particle and geomagnetic data for the 30 days previous to August 22, 1997. The solar data indicates a few small x-ray or sub-flare events most days during the first part of the period and relatively small variations in radio flux (10.7 cm) throughout the period, with a peak flux of 82 on August 13, 1997. Particle data indicates some fluctuations at the low energy (0.6-2.0 MeV) with a peak >1.0 MeV flux of 6.1 x 10^5 protons/cm^2-day-ster on August 17, 1997. The geomagnetic field was unsettled during August 13 and 14. Otherwise, quiet geomagnetic conditions prevailed during the time period of the ESEM flight.

ESCA survey-scan composition table summary

Atomic %:	Fluorosilicone Rubber unexposed	Fluorosilicone Rubber exposed	Silicone Rubber S383 unexposed	Silicone Rubber S383 exposed	Cyanate Ester Composite unexposed	Cyanate Ester Composite exposed
Carbon	32.1%	18.3%	41.4%	29.3%	60.8%	49.5%
Oxygen	20.9%	30.7%	22.4%	38.3%	21.5%	21.3%
Nitrogen	-	-	-	-	2.0%	3.6%
Aluminum	-	-	-	-	-	1.1%
Silicon	10.7%	11.6%	17.2%	28.4%	2.7%	1.8%
Fluorine	33.7%	39.4%	19.0%	4.1%	8.0%	22.5%
Sodium	-	-	-	-	0.4%	-
Sulfur	-	-	-	-	0.8%	-
Chlorine	-	-	-	-	0.3%	-
Magnesium	2.6%	-	-	-	3.4%	-
Copper	-	-	-	-	-	0.2%

Figure 6. ESCA Results from ESEM Flight Specimens

ESCA survey-scan composition table summary

Atomic %:	MLI aluminized reinforced kapton (Al out)	Ag/FEP	Poly Arylene ether (COR) 'rougher' area	Poly Arylene ether (COR) smooth area	Kapton film 'rougher' area	Kapton film smooth area	Ag/FEP ITO coated
Carbon	17.3%	12.8%	66.8%	42.2%	37.3%	50.8%	42.9%
Oxygen	47.9%	52.4%	21.4%	19.6%	12.8%	18.9%	30.6%
Nitrogen	1.3%	-	6.5%	2.8%	1.8%	2.0%	1.5%
Aluminum	18.0%	-	-	-	-	-	-
Silicon	13.4%	29.6%	1.0%	1.6%	-	14.4%	-
Phosphorus	-	-	4.3%	1.0%	-	-	-
Fluorine	1.9%	5.3%	-	32.9%	48.1%	14.0%	12.0%
Chlorine	-	-	-	-	-	-	1.0%
Indium	-	-	-	-	-	-	11.1%
Tin	0.3%	-	-	-	-	-	1.0%

Figure 7. ESCA Results from More ESEM Flight Specimens

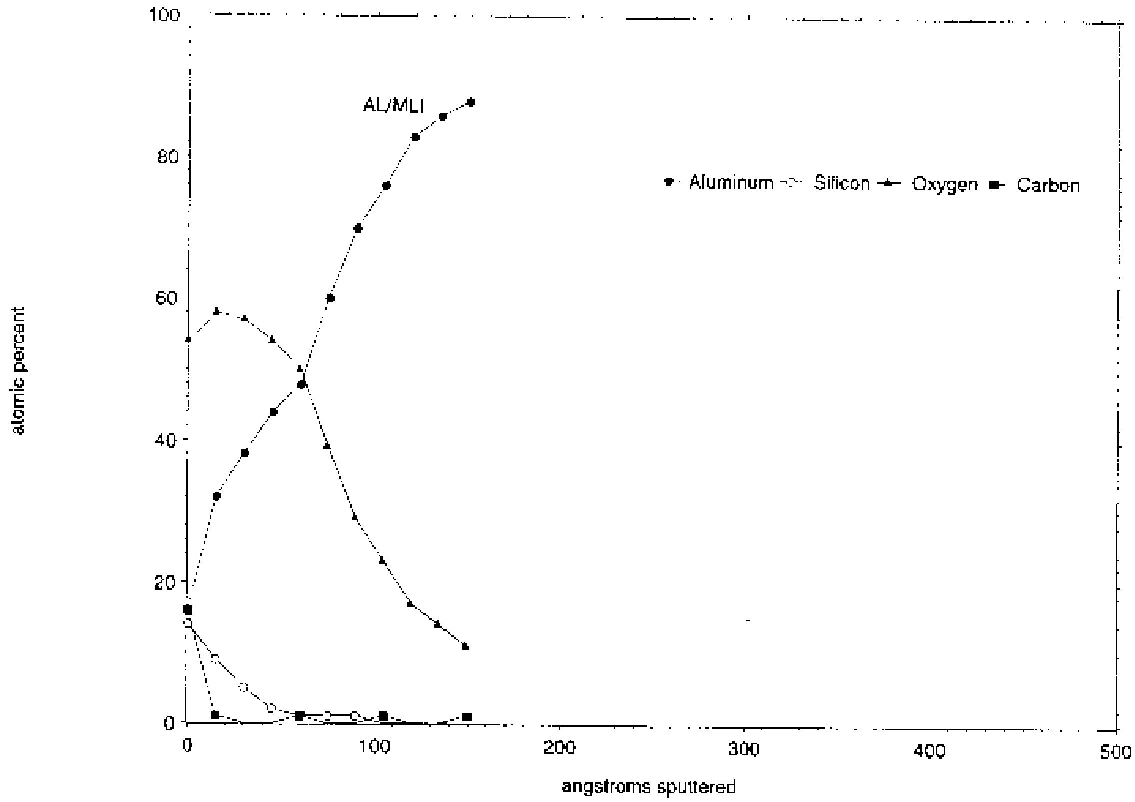

Figure 8. ESCA Depth Profile of Aluminized MLI

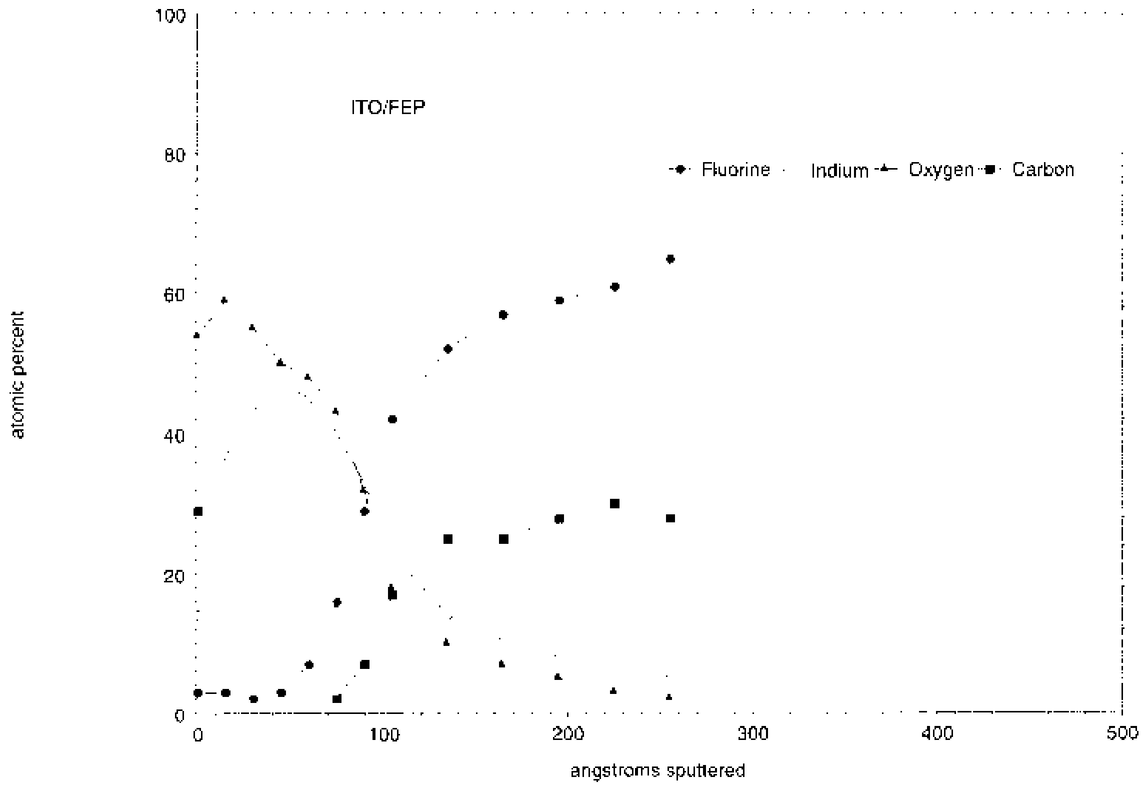

Figure 9. ESCA Depth Profile of ITO Coated FEP

Table VII. Solar Data Provided by NOAA

Product: **Daily Solar Data** DSD.txt
Issued: 0225 UT 22 Aug 1997
Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
Please send comments and suggestions to sec@sec.noaa.gov
Last 30 Days Daily Solar Data
#

Date	**Radio Flux 10.7 cm**	SESC Sunspot Number	Sunspot Area 10E-06 Hemis.	New Regions	Stanford Solar Mean Field	GOES9 X-Ray Bkgr Flux	**Flares X-Ray**			**Optical**			
							C	M	X	S	1	2	3
1997 07 23	76	31	60	0	-999	A2.6	0	0	0	0	0	0	0
1997 07 24	79	44	90	1	2	A5.0	0	0	0	3	0	0	0
1997 07 25	80	65	200	1	1	B1.2	3	0	0	6	0	0	0
1997 07 26	77	58	180	0	11	B1.3	0	0	0	1	0	0	0
1997 07 27	75	53	180	0	0	A5.0	0	0	0	3	0	0	0
1997 07 28	74	26	10	0	-8	A4.2	0	0	0	0	0	0	0
1997 07 29	73	24	0	0	-13	A5.6	0	0	0	3	0	0	0
1997 07 30	71	12	0	0	-15	A2.7	0	0	0	0	0	0	0
1997 07 31	70	0	0	0	-10	A1.1	0	0	0	0	0	0	0
1997 08 01	71	0	0	0	-4	A0.0	0	0	0	0	0	0	0
1997 08 02	71	11	10	1	-10	A1.9	0	0	0	0	0	0	0
1997 08 03	72	27	30	1	2	A1.3	0	0	0	3	0	0	0
1997 08 04	73	12	20	0	1	A0.0	0	0	0	0	0	0	0
1997 08 05	75	39	30	2	8	A0.0	0	0	0	0	0	0	0
1997 08 06	77	45	120	0	2	A3.6	0	0	0	1	0	0	0
1997 08 07	78	55	140	0	7	A3.0	0	0	0	8	0	0	0
1997 08 08	**78**	**65**	**230**	**1**	**15**	**A5.2**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
1997 08 09	**78**	**61**	**90**	**1**	**8**	**A8.8**	**5**	**0**	**0**	**3**	**0**	**0**	**0**
1997 08 10	**78**	**31**	**40**	**0**	**18**	**B2.3**	**4**	**0**	**0**	**0**	**0**	**0**	**0**
1997 08 11	**80**	**53**	**220**	**2**	**8**	**B2.5**	**1**	**0**	**0**	**1**	**0**	**0**	**0**
1997 08 12	**81**	**57**	**140**	**0**	**10**	**A9.5**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
1997 08 13	**82**	**61**	**180**	**0**	**6**	**A6.6**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
1997 08 14	**80**	**49**	**140**	**0**	**5**	**A7.2**	**1**	**0**	**0**	**1**	**0**	**0**	**0**
1997 08 15	**78**	**60**	**120**	**1**	**-2**	**A4.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1997 08 16	**78**	**33**	**100**	**0**	**-5**	**A5.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1997 08 17	**76**	**23**	**60**	**0**	**-1**	**A6.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1997 08 18	**76**	**11**	**60**	**0**	**-10**	**A2.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1997 08 19	74	11	60	0	-999	A2.1	0	0	0	0	0	0	0
1997 08 20	75	11	50	0	-999	A1.6	0	0	0	0	0	0	0
1997 08 21	75	11	60	0	-999	A2.4	0	0	0	0	0	0	0

Table VIII. Particle Data Provided by NOAA

Product: **Daily Particle Data** DPD.txt
Issued: 0223 UT 22 Aug 1997
Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
Please send comments and suggestions to sec@sec.noaa.gov
Last 30 Days Daily Particle Data
#

Date	**GOES-9 Proton Fluence** --- Protons/cm2-day-sr ---			**GOES-9 Electron Fluence** ---Electrons/cm2-day-sr ––		Neutron Monitor
	>1 MeV	>10 MeV	>100 MeV	**>0.6 MeV**	**>2 MeV**	% of bkgd
1997 07 23	5.0e+05	1.9e+04	4.3e+03	1.7e+10	2.5e+07	0.53
1997 07 24	5.5e+05	1.8e+04	4.3e+03	6.4e+09	3.0e+06	0.40
1997 07 25	2.3e+05	1.9e+04	4.7e+03	3.4e+09	5.4e+05	0.44
1997 07 26	3.5e+05	2.4e+04	4.4e+03	3.4e+09	7.2e+05	0.44
1997 07 27	2.9e+05	1.9e+04	4.6e+03	3.8e+09	1.0e+06	0.47
1997 07 28	2.7e+05	1.9e+04	4.8e+03	3.5e+09	9.3e+05	0.40
1997 07 29	3.3e+05	1.9e+04	4.6e+03	3.3e+09	8.7e+05	0.58
1997 07 30	3.7e+05	1.8e+04	4.3e+03	1.9e+09	5.1e+05	0.38
1997 07 31	3.7e+05	1.8e+04	4.1e+03	1.1e+10	5.1e+05	-0.40
1997 08 01	2.8e+05	1.8e+04	4.3e+03	2.8e+10	6.1e+06	-0.70
1997 08 02	1.5e+05	1.7e+04	4.1e+03	2.4e+10	5.4e+06	-0.10
1997 08 03	9.3e+05	1.7e+04	3.9e+03	1.2e+10	2.7e+06	0.03
1997 08 04	5.3e+05	1.8e+04	4.2e+03	1.2e+10	3.1e+06	0.05
1997 08 05	3.0e+05	1.8e+04	4.2e+03	1.1e+10	2.6e+06	0.45
1997 08 06	3.0e+05	1.8e+04	4.3e+03	1.3e+10	2.3e+06	0.06
1997 08 07	4.7e+05	1.8e+04	4.3e+03	9.7e+09	2.3e+06	0.06
1997 08 08	**4.2e+05**	**1.8e+04**	**4.2e+03**	**9.1e+09**	**1.7e+06**	**-999.99**
1997 08 09	**4.2e+05**	**1.8e+04**	**4.2e+03**	**6.8e+09**	**9.3e+05**	**-999.99**
1997 08 10	**2.9e+05**	**1.8e+04**	**4.1e+03**	**9.9e+09**	**2.0e+06**	**-999.99**
1997 08 11	**2.7e+05**	**1.7e+04**	**4.0e+03**	**1.6e+10**	**6.4e+06**	**-999.99**
1997 08 12	**3.1e+05**	**1.7e+04**	**3.9e+03**	**2.2e+10**	**1.1e+07**	**-999.99**
1997 08 13	**4.8e+05**	**1.8e+04**	**3.8e+03**	**1.4e+10**	**6.5e+06**	**-999.99**
1997 08 14	**5.3e+05**	**1.7e+04**	**4.1e+03**	**3.0e+10**	**1.1e+07**	**-999.99**
1997 08 15	**1.1e+06**	**1.8e+04**	**4.1e+03**	**5.8e+10**	**1.1e+08**	**-999.99**
1997 08 16	**4.0e+05**	**1.8e+04**	**4.1e+03**	**3.3e+10**	**5.7e+07**	**-999.99**
1997 08 17	**6.1e+05**	**1.8e+04**	**4.3e+03**	**2.1e+10**	**3.9e+07**	**-999.99**
1997 08 18	**3.2e+05**	**1.8e+04**	**4.0e+03**	**1.5e+10**	**2.7e+07**	**-999.99**
1997 08 19	2.6e+05	1.9e+04	4.5e+03	1.8e+10	2.2e+07	-999.99
1997 08 20	3.8e+05	1.9e+04	4.5e+03	1.3e+10	2.0e+07	-999.99
1997 08 21	4.5e+05	1.9e+04	4.6e+03	1.4e+10	1.8e+07	-999.99

Table IX. Geomagnetic Data Provided by NOAA

Product: Daily Geomagnetic Data DGD.txt
Issued: 0328 UT 22 Aug 1997
Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
Please send comment and suggestions to sec@sec.noaa.gov
Last 30 Days Daily Geomagnetic Data
#

	Middle Latitude Fredericksburg									High Latitude College									Estimated Planetary								
Date	A	K-indices								A	K-Indices								A	K-Indices							
1997 07 24	15	2	2	2	3	4	3	3	4	9	1	1	2	1	5	1	1	1	10	2	1	3	3	3	2	3	3
1997 07 25	8	2	2	1	2	2	3	2	2	1	2	1	0	0	1	0	0	0	5	2	2	1	0	1	2	2	2
1997 07 26	8	2	1	1	1	2	2	3	3	0	0	0	0	0	0	0	1	1	4	1	1	2	0	1	2	2	2
1997 07 27	7	2	2	2	1	2	2	2	2	1	0	0	0	2	0	1	0	1	6	2	1	2	2	2	2	1	2
1997 07 28	8	2	1	2	2	3	2	2	2	1	0	1	2	0	0	0	0	0	5	2	0	3	1	2	1	1	1
1997 07 29	7	2	2	1	2	2	2	2	2	0	0	1	0	0	0	0	0	0	3	1	1	1	1	1	2	1	1
1997 07 30	8	3	2	1	2	1	1	2	3	2	1	2	0	2	0	0	0	1	7	3	3	1	1	1	1	2	3
1997 07 31	18	4	4	3	4	3	3	2	2	15	4	3	5	2	3	1	0	1	19	5	4	4	4	2	2	2	2
1997 08 01	11	2	3	2	2	3	3	2	3	7	2	0	3	3	3	0	0	1	8	2	3	2	2	2	2	2	3
1997 08 02	6	2	1	1	1	2	2	2	2	1	1	0	0	0	0	0	0	1	5	1	0	1	1	2	2	3	2
1997 08 03	14	1	1	2	3	4	4	3	3	22	0	1	3	5	3	6	3	2	15	2	1	2	3	4	5	3	3
1997 08 04	10	4	2	2	3	1	1	3	1	4	2	2	3	2	0	0	0	0	8	3	2	2	3	1	2	3	2
1997 08 05	6	1	2	2	1	1	2	2	2	0	0	1	0	0	0	0	0	0	3	1	1	1	1	0	1	1	1
1997 08 06	5	2	2	0	0	2	2	2	1	-1	0	0	0	0	-1	0	0	0	4	1	2	0	0	2	3	2	1
1997 08 07	7	1	1	1	1	3	2	2	3	1	1	0	0	0	2	0	0	0	6	1	1	1	2	2	2	2	3
1997 08 08	**7**	**2**	**2**	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**1**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**5**	**1**	**2**	**1**	**2**	**2**	**2**	**2**	**2**
1997 08 09	**10**	**0**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**-1**	**0**	**0**	**2**	**0**	**-1**	**1**	**1**	**0**	**7**	**1**	**0**	**2**	**1**	**3**	**3**	**2**	**2**
1997 08 10	**8**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**1**	**1**	**2**	**3**	**0**	**0**	**1**	**0**	**7**	**2**	**1**	**4**	**2**	**1**	**1**	**2**	**2**
1997 08 11	**10**	**2**	**4**	**2**	**2**	**2**	**2**	**2**	**2**	**5**	**2**	**1**	**0**	**4**	**1**	**0**	**0**	**0**	**9**	**2**	**4**	**2**	**2**	**3**	**2**	**2**	**2**
1997 08 12	**7**	**1**	**1**	**1**	**2**	**2**	**1**	**3**	**3**	**-1**	**-1**	**0**	**1**	**3**	**0**	**0**	**0**	**1**	**5**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**3**
1997 08 13	**17**	**3**	**3**	**4**	**4**	**3**	**2**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**0**	**12**	**3**	**2**	**4**	**3**	**1**	**2**	**2**	**3**
1997 08 14	**18**	**3**	**5**	**4**	**2**	**2**	**2**	**3**	**3**	**9**	**2**	**4**	**4**	**1**	**0**	**2**	**1**	**0**	**17**	**3**	**5**	**5**	**2**	**1**	**2**	**2**	**3**
1997 08 15	**8**	**1**	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**4**	**2**	**1**	**2**	**0**	**1**	**1**	**1**	**1**	**8**	**1**	**2**	**3**	**3**	**2**	**2**	**2**	**1**
1997 08 16	**8**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**6**	**1**	**1**	**4**	**3**	**0**	**0**	**0**	**0**	**9**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**1**
1997 08 17	**10**	**2**	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**4**	**2**	**0**	**1**	**1**	**2**	**2**	**1**	**2**	**9**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
1997 08 18	**8**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**6**	**1**	**0**	**1**	**1**	**4**	**2**	**1**	**1**	**6**	**1**	**1**	**2**	**2**	**2**	**3**	**2**	**2**
1997 08 19	5	2	2	1	1	2	1	1	1	0	1	0	0	0	0	0	0	0	5	2	2	0	1	2	2	2	1
1997 08 20	5	1	2	2	1	1	1	2	2	3	0	2	1	2	1	0	1	2	5	1	2	2	1	2	1	2	2
1997 08 21	-1	2	4	1	2	-1	-1	-1	-1	-1	2	3	0	5	-1	0	-1	1	9	3	4	0	2	2	2	2	3
1997 08 22	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1