X-624-65-491

NASA TM X-55408

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NOVEMBER 1965

GPO PRICE $ _____

CFSTI PRICE(S) $ _____

Hard copy (HC) 1.00

Microfiche (MF) .50

ff 653 July 65

FACILITY FORM 602

N66-17240 (ACCESSION NUMBER) (THRU)

12 (PAGES) 1 (CODE)

(NASA CR OR TMX OR AD NUMBER) 04 (CATEGORY)

NASA — GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

X-624-65-491

MICROBIAL CONTAMINATION OF A SURFACE BY HANDLING

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November 1965

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MICROBIAL CONTAMINATION OF A SURFACE BY HANDLING

INTRODUCTION

This study was undertaken to determine to what extent people contaminate a surface by touching or holding it. Stainless steel strips were chosen for this study because they are used extensively by NASA or NASA contractors for measuring microbial fallout in clean rooms and in spacecraft assembly areas. Portner[1] and Kereluk[2] compared the contamination of stainless steel with other materials such as glass and lucite due to microbial fallout. Portner[3] studied the microbial contamination level of stainless steel strips exposed in a Martin Company clean room over a 52-week period. Powers[4] studied the microbial contamination of surfaces in laminar flow clean rooms, using Rodac plates, as well as the contamination by gloved hands of a vehicle intended for a Mars landing.

Little is known about the extent to which surfaces of spacecraft or spacecraft components are contaminated by personnel during assembly both in and out of clean rooms. There are no standard procedures for monitoring the exterior of spacecraft components for microbial contamination. Accumulation of such data will aid NASA in establishing programs and procedures for the assembly and sterilization of spacecraft and spacecraft components. This report is on the initial phase of a program to determine the extent to which surfaces are contaminated by personnel.

MATERIALS AND METHODS

Sampling Strips. Sterile, type 304 stainless steel strips, 1 in. x 2 in. x .06 in. were used to determine the extent of microbial surface contamination due to handling. The strips were washed in hot tap water containing "sparkleen;" rinsed with tap water and then hot distilled water; rinsed again with isopropyl alcohol followed by ether; then drain-dried. The strips were sterilized in glass petri plates by dry heat, at 170°C for 3 hours.

Sampling Procedure. Personnel handling the strips included men and women. The strips were handled in the Microbiology Laboratory at the Goddard Space Flight Center. The temperature of the laboratory was 28 to 30°C. All personnel washed their hands with palmolive soap and water 10 minutes before handling the stainless steel strips. Each person handled two strips, one in each hand, for 1-, 5-, 10-, and 15-minute periods. They were instructed to hold these strips loosely and to rub all strip surfaces with their fingers. They were also instructed not to touch any object other than the steel strips after their hands were washed.

Another group of stainless steel strips were assayed for microbial contamination after being passed among five people from person to person. The first subject held two strips, one in each hand, for 1 minute, and the strips were cultured immediately. Subject 1 then received two more strips which were held for 1 minute and passed to subject 2, who also held them for 1 minute, then they were cultured. This procedure was repeated using subject 3, then subject 4, and finally subject 5.

Culturing of Strips. Following each time sequence, the stainless steel strips were placed in jars containing 50 ml of 1 percent peptone. The jars were shaken mechanically for 5 minutes on a gyrorotary shaker and then 5 ml aliquots were removed from each jar and plated out in duplicate.

Media. Tryptic soy agar (Difco) was used to determine plate counts. The stainless steel strips were washed in a fluid of 1 percent Bacto peptone (Difco).

Incubation. All plates were incubated at 35°C for 72 hours before colonies were counted.

RESULTS

Table 1 shows the microbial contamination of the stainless steel strips handled with bare hands for various time periods. Counts varied considerably on

Table 1

Contamination of Stainless Steel Strips by Handling

Time Strip Held (Min)	Average Number of Organisms per Strip																		
	Run 1		Run 2		Run 3				Run 4			Run 5					Run 6	
	A	B	A	B	B	C	D	E	B	F	G	B	C	D	E	H	H	
																	Indoors (28–30° C)	Outdoors (5–10° C)
1	25	557	45	420	40	68	130	25	10	33	10	15	30	5	15	1750	865	---
5	15	215	18	120	-	-	-	-	5	62	40	0	40	70	10	8620	3855	---
10	23	310	15	80	35	33	262	8	5	5	13	13	15	13	15	15,575	4930	13
15	18	65	25	15	-	-	-	-	23	18	0	8	5	20	18	17,825	8350	---
S.C.*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Sterile Control

Letters A through H identify personnel who took part in the experiment.

strips handled by different persons. Strips handled by subject B for example, in runs 1 and 2 had counts from 1 to 22 times greater than those of subject A. Although subject B had high counts in runs 1 and 2, his counts in subsequent runs were relatively low.

Runs 3 and 5 included female subjects (D and E) between the ages of 20 and 30. Strips handled by one woman in run 3 had counts lower than the strips handled by the men, while the strips handled by the other woman had counts considerably higher.

Strips were handled for 1 and 10 minutes only in run number 3. Subject H, in run 5, produced extremely high counts which increased with time from 1750 organisms per strip after 1 minute to 17,825 organisms per strip after 15 minutes. All subjects but A and E had moist hands while holding the strips. The hands of subject H were very wet with perspiration which explains the high counts from this person. Contaminants from all personnel were predominantly Staphylococcus epidermitis.

Table 2 shows the contamination on stainless steel strips after they were handled by from one to five people. Contamination increased from 47 to 655

Table 2

Contamination of Stainless Steel Strips
After Passage From One Person to Another

Number of People Handling Strip	Number of Organisms per Strip		Average Organisms per Strip
	Strip 1	Strip 2	
1 (E)	30	65	47
2 (H)	650	660	655
3 (C)	180	210	195
4 (D)	60	30	45
5 (B)	90	40	65
S. C.*	0	0	0

* Sterile Control

1) Letters B through H identify personnel who took part in the experiment.
2) Strips were held for 1 minute by each person.

organisms per strip due to handling by two people, and then decreased to 65 organisms per strip after handling by five people. This was only a slight increase over the contamination caused by the first person handling the strip. Table 2 shows that the second person to handle the strips was subject H causing the high level of contamination by two people. Subsequent handling of the strips appeared to remove contamination from the strips rather than contribute to the population.

DISCUSSION

The data indicates that contamination of surfaces varies among personnel. This variation may be caused by differences in basal metabolism which varies with age, state of nutrition, type of diet, and pathologic condition (abnormal thyroid activity for example). Nervous individuals and individuals who perspire excessively produce high counts because perspiration drives bacteria out of the pores. This was demonstrated by subject H whose hands were wet with perspiration when he handled the steel strips in the laboratory (run 5). When he was kept cool (run 6) by handling the strips outdoors (5 to 10°C) his hands did not perspire and contamination after holding the strips for 10 minutes was as low as the other four subjects (run 5, Table 1). Perspiration may have caused the high counts from subject B in runs 1 and 2.

There was no progressive increase in contamination with time when contamination per strip was low. In many cases contamination was greater after holding the strips for 1 minute than it was after 15 minutes and peak contamination varied with time. The exception to this was subject H in runs 5 and 6 where contamination did increase with time. Possibly an increase in contamination with time cannot be noticed until higher contamination levels are reached. With low levels of contamination there are probably no significant differences with time.

This study did not show a difference in contamination levels between strips handled by men and women. Ages varied from 19 to 45 and did not appear to make a significant difference in contamination level. Because this is an incomplete preliminary study, more data must be collected before definite conclusions can be made. The effect of age, sex, weight, perspiration, and nervousness on the contamination of surfaces caused by handling could be areas for future investigation.

Perhaps the only way to prevent the contamination of a surface (stainless steel strip, spacecraft, or spacecraft component) by personnel is to isolate the personnel from the component.

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