Tests have been performed to evaluate the separation forces induced by air flow in the WCS commode. The tests have been based on a nominal WCS air flow of 30 CFM. Although present test data indicate that the effective air flow is less than 30 CFM the preliminary results and recommendations to decrease the space between the ring and the seat and to minimize the gap in the slide valve are still applicable.

TEST SET UP

The test set up consisted of a transport tube with a simulated bolus suspended from a fine resolution scale. See Figure 1.

TEST SAMPLES

Three different size of bolus were simulated: 1" DIA, 1¼" DIA and 1½" DIA. For each size there were two different lengths (4" and 6"). Also for each size there was a smooth surface sample and a rough surface sample.

SUMMARY OF RESULTS

The test results have been plotted and are attached to this report.

Plots 1 and 2 reflect the present design. As expected, separation forces increase as a function of the bolus size (i.e. surface area) and air flow.

At A nominal flow of 30 CFM the pull on test sample caused by air flow varies from 13 to 31 gms. since the test samples rapresent masses of approximately 77 gms. and 173 gms., the forces result in a pull equivalent to approximately 17% of one "G".

Plots 3, 4, 5 and 6 show that if the distance between the seat surface and the air slots in the present ring is reduced then the pull forces are increased two fold at the nominal WCS 30 CFM flow. These results support the recommendation made Mr. W. Giles, form G. E. Corporate Research Center.

Plots 7, 8 and 9 show that changing the angle of the air slots from 30° to horizontal, i.e., perpendicular to the test piece, is not as effective particularly if the air flow is increased above the 30 CFM level. Plot 10 is the composite of a rerun of test 7, 8, and 9. The result show reasonable repeatibility.

Plots 11 and 12 show that if the size of the opening is increased the forces on the test samples are significantly lower. This is true for either horizontal air slots (Plot #11) or the 30° slots (Plot #12).

Plot #16 shows the results of tests performed to evaluate the effect of the gap in the slide valve. The gap permits some of the air flow to bypass the air slots in the ring below the seat. The results show that, at the nominal 30 CFM flow, the loss in force is not significant if the gap is kept in the 010" range. The loss becomes significant at larger gap and/or higher flow.

Some tests were performed to evaluate the effectiveness of air jets as separation devices. Because of difficulties in instrumentation the force measurements were made under steady state rather than pulsing. The tests indicate that the use of jets in conjunction with air flowing through the ring results in a net loss effective pull on the test sample. Apparently this is due to the fact that the jet configuration used was less effective than the slotted ring. As a consequence, for a given air flow the, quanity of air flowing through the rings and the resulting forces were by the amount of air from the jets.

Plot #22 shows the combined pull from the combination of jets and air flowing from the slotted ring. The loss in effectiveness is obvious when comparing the results with Plot #1 which is based on the same air flow conditions without the jets. Plot #17 shows the forces induced by the same jet and a smaller jet without air flowing through the slotted ring (Blower Off).

PRELIMINARY CONCLUSIONS

Substantial improvements can be made by reducing the air gap in the slide valve and by moving the slotted ring closer to the seat interface.

The nominal gap in the slide valve is .038". This gap may increase as "O" ring flattens toward the end of the mission. This gap can be reduced to a nominal .010 or less with minimumal hardware impact.

The relocation of the slotted ring is more difficult due to the changes required in the seat design. This change should also be implemented as preferable to any other more drastic system change to improve air flow.