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# URINATION IN AVIATION: EVALUATION OF URINE COLLECTION EQUIPMENT FOR FEMALE AVIATORS

## Introduction

Between World War II and 1993, United States military women were blocked from flying fighter aircraft. This precluded them from participating in long duration flights in aircraft unequipped with conventional toilet facilities. Personal equipment, to include urine collection equipment, for long duration, especially single seat aircraft, has to date been designed for male specific anatomy. Examples include the flight suit (the zipper ending at the level of the penis), the condom catheter, and the standard urine collection bag ("Piddle Pack"). The law prohibiting women from flying fighter aircraft was repealed in 1991, and female pilots began training for single seat fighter aircraft in 1993. And while female aviators are now eligible by law to fly all aircraft, practical application of this opportunity is hampered by unavailability of appropriate, female anatomy specific equipment.

Anatomic differences between male and female genitourinary anatomy and voiding habits have been recognized by both the medical and aviation communities for some time. As early as 1943, different urine collection equipment requirements for male and female transoceanic aircrew were noted by Jaqueline Cochran<sup>1</sup>. As it is for males, equipment compatible with or designed specifically for female anatomy must be convenient, inconspicuous, comfortable, and effective. There are several commercially available urine collection devices used either in clinical medicine<sup>2,3</sup> or civil aviation<sup>1</sup>. While these have been used extensively in their original settings, they have not been examined in conjunction with the other personal protective equipment used in military aviation, including the high gravity (Gz) environment. What is considered comfortable, unobtrusive, and effective in a private airplane or in a hospital, may be viewed very differently in the setting of military aviation.

Although at present women comprise less than two percent of military aviators, with expanded opportunities they may eventually account for a significant proportion. It is incumbent upon the military community to provide equipment which is compatible with the anatomy of the entire population, and potential population, of military aircrew. The purpose of this study was to identify the optimum urine collection equipment currently available for use by female military aviators, using both subjective and objective criteria. Comfort, convenience, and most importantly acceptance by the pilots of commercially available and prototype devices were assessed.

## Subjects

Seven female military volunteer subjects were asked to participate in the cockpit compatibility portion of this study. The Cockpit Integration Laboratory, Armstrong Laboratory, Brooks AFB, TX was used for the USAF F-15, F-16, and A-10 fighter cockpits. Four centrifuge subjects were asked to evaluate the devices (for comfort only) while experiencing a high Gz centrifuge ride.

Following demonstration of compatibility within the laboratory, all currently deployed female fighter pilots were asked to evaluate these pieces of equipment, in conjunction with a 1.5-2.0 inch zipper extension.

## Materials

The materials consisted of several bladder relief devices: the Freshette<sup>a</sup> by Sanifem, the Lady J adapter<sup>b</sup> ordered from Sporty's Pilot Shop, Hollister's Female Urinary Pouch (9840), Boss Product's Gal's Tote a Potty, Convenience Bag (for vomit and urine collection) from Sporty's Pilot Shop, Foley catheter, and diapers. The collection bag used is the standard issue "Piddle Pack" (bag, pilot relief, male, NSN 8105-00-922-9469)<sup>c</sup>. Also a male condom catheter and a connector tube was used with the Lady J adapter. The flight suits were modified with an extended midline zipper<sup>d</sup> of 1.5-2.0 inches.

## Methods

All devices were discussed with a group of women pilots before testing began. Most of the devices were excluded from further testing for various reasons. Boss Product's Gal's Tote a Potty was excluded due to its large size, 8in x 4.5in x 18in. The device was too large for use in the fighter cockpit and was not inconspicuous. The Hollister Female Urinary Pouch was also eliminated before cockpit testing due to the shaving requirement and its sticky application to the female genital area. The Convenience Bag was excluded due to its shape and its incompatibility with the flight suit. The Foley catheter was not acceptable because pilots were unwilling to be catheterized before every flight and the USAF medical community was concerned about potential bladder infections and the subsequent short term removal

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<sup>a</sup> Freshette: International Sani-fem, PO Box 4117, Downey, CA 90241, (310) 928-3435

<sup>b</sup> Lady J Adapter: Sporty's Pilot Shop, Clermont County Airport, Batavia, OH 45103-9747, 1-800-LIFTOFF (543-8633)

<sup>c</sup> "Piddle Pack": Lighthouse Industries, Long Island City, NY 11101

<sup>d</sup> Zippers: Scovill Fasteners Inc, PO Box 44, Clarkesville, GA 30523, 1-800-756-4734

from flight duties (grounding) due to the medical condition. Diapers, or the disposable absorption containment trunk (DACT) used by U-2 and TR-1 pilots, were also eliminated because they only contain enough liquid for one voiding (900ml)<sup>4</sup>. This would be a significant problem on flights lasting over four hours. Male pilots in Desert Storm routinely collected 3-4 liters of urine on 8-11 hour sorties over Iraq. Additionally, the DACT is not inconspicuous when worn under a conventional flight suit.

Two urine collection devices were found to be acceptable for further testing: the Freshette and the Lady J Adapter. Efficacy of the devices was assessed through cockpit and centrifuge testing. In the cockpit testing, subjects were asked to urinate with one of the two devices in place while sitting in a F-16, F-15 or A-10 mockup of a cockpit. The underwear was simply pulled to the side and the collection device placed under the urethra. The urine was collected in the standard male "Piddle Pack." Any urine spilled during usage was measured. Each subject wore a modified flight suit with an extended zipper and the standard CSU-13B/P anti-G suit. In the highly unlikely event that high G maneuvering would occur with the device in place, the two devices were checked for comfort in the centrifuge on a gradual and rapid Gz onset run up to 9 Gz. In addition, the exposure suit ("Poopy Suit") and the Advanced Technology Anti-G Suit (ATAGS) were analyzed for compatibility with these two urine collection devices.

### Observations

The cockpit testing showed that both the Freshette and the Lady J Adapter were acceptable devices for bladder relief in-flight. Out of the eleven trials, only two had some leakage. Both times the leakage occurred with the Lady J Adapter in the F-16 cockpit; one was 100% leakage and the other was 50% leakage. The Lady J Adapter was used in the F-16 cockpit three other times with only negligible leakage. One problem is that the F-16 seat tilts back 30 degrees - both devices work by gravity flow. The other problem with the Lady J Adapter is that the condom catheter, which attaches the tubing, can kink, restricting the flow of urine. The Freshette was the most effective of the two devices with only minor leakage.

The centrifuge testing was very positive. All four women did a gradual Gz onset run up to 9 Gz plus multiple rapid onset 5-9 Gz runs during the centrifuge ride. Out of the four subjects, only one experienced some discomfort. The discomfort was only minor; it was not enough to interfere with the ride. Since the devices are made of hard plastic they have a tendency to rub against the skin. Two of the women felt the devices were more comfortable at higher Gz and that the devices were not noticeable during the centrifuge ride.

The most important observations were from the actual female fighter pilots. Both devices were given to 64%(7/11) of the

currently active female fighter pilots who were asked whether these devices were acceptable and if they would use them. These pilots were given modified flight suits and one each of the two urine collection devices. They received a briefing on our findings which included our recommendations. The response was encouraging: all of the female pilots approached readily approved of and accepted these urine collection devices. One F-16 pilot used the Freshette on a 1.5 hour cross country flight and found it to work great in the cockpit without leaks. She said this was far superior to "holding it" for four to five hours as she had done while flying over Bosnia a few months earlier.

### Discussion

With Lyon's 1992 review of aeromedical considerations of women in jets came the assurance that bladder relief problems had "been addressed" with the DACT.<sup>5</sup> However, the DACT is suitable only for specialized observation aircraft - not fighters. Now that women are flying long duration missions in single seat aircraft, the need exists to provide the women with a bladder relief system that, like the one for their male counterparts, is convenient, inconspicuous, comfortable, and effective. It became painfully clear that urine collection concerns had not been solved when the pilots actually deployed; preflight dehydration is not an acceptable solution. Seven commercially available urine collection devices were considered, but only two, the Freshette and the Lady J Adapter, were found to be acceptable and effective.

The standard male urine collection bag was used in this study for a very important reason. As with the men's relief system, this is the only disposable component in the women's system. The fact that it is already fielded minimizes supply problems. Also, as happened in Operation Desert Storm when units temporarily ran out of "Piddle Packs," the pilots used a water bottle as a substitute. With these two devices a water bottle can also be used as a backup collection container.

Female ground troops have used these devices for urination in the field setting too. The devices allow an inconspicuous method of urination very similar to the males. It also obviates the need to remove the clothing to the ankles in order to void in cold environments. There is one reported failure of the system in field use. An Army flight surgeon with "extreme urgency" forgot to move her underwear to the side before urination.

Although both urine collection devices are effective for in-flight bladder relief, some problems still exist. Both require practice on the part of the pilots to reduce the amount of leakage during use, they are incompatible with the current exposure suit, and the flight suit must be modified for a longer midline zipper to accommodate the female anatomy. The problems with the exposure suit and the flight suit are currently being dealt with.

All USAF female pilots in single seat aircraft are receiving an explanation of these findings along with each of the two urine collection devices for their own use. Their flight suits are also being modified with the longer midline zipper so that they can use these devices in-flight. The women will be allowed to use these devices pending development of a better bladder relief system.

#### Acknowledgment

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