

Odor Control Test Plan of the Urine Containment Bag (UCB) for Orion Utilization

Verify this is the correct version before use

Date July 2010
Revision Baseline

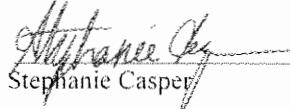


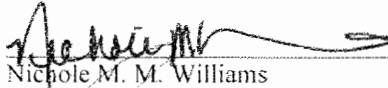
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

Odor Control Test Plan of the Urine Containment Bag (UCB) for Orion Utilization

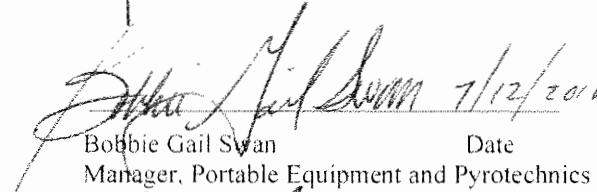
Concurrence Sheet

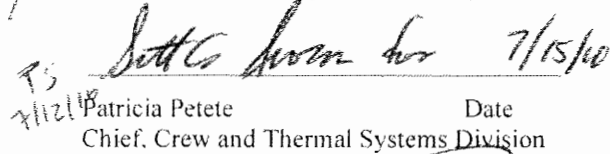
Prepared by:

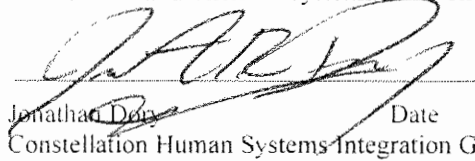
 7/12/10
Stephanie Casper Date

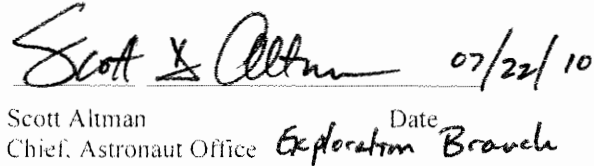
 7/12/10
Nichole M. M. Williams Date

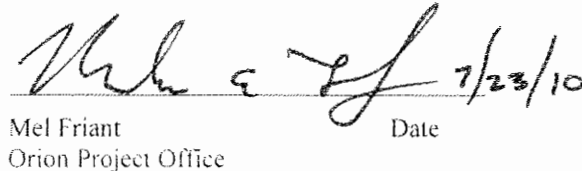
Approval:

 7/12/2010
Bobbie Gail Swan Date
Manager, Portable Equipment and Pyrotechnics Office

PS
7/12/10  7/15/10
Patricia Petete Date
Chief, Crew and Thermal Systems Division

 07/20/10
Jonathan Dora Date
Constellation Human Systems Integration Group (HSIG)

 07/22/10
Scott Altman Date
Chief, Astronaut Office Exploration Branch

 7/23/10
Mel Friant Date
Orion Project Office

 7/29/10
Craig Perez (Optional) Date
S&MA Integration Branch

National Aeronautic and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

APPLICABLE DOCUMENTS

The following documents, of the exact issue and revision shown, form a part of this specification to the extent specified herein.

Document Number	Document Title
CxP 70024	Constellation Program Human-Systems Integration Requirements
Anxiety Disorders Edition 16 (2002)	The relationship between disgust sensitivity and avoidant behavior: Studies of clinical and nonclinical samples

Purpose

The purpose of this test is to evaluate the odor containment of the urine containment bag (UCB), P/N SDD46107234-306 in an environment simulating a space craft capsule. The goal is to determine the time of odor break through and the acceptability of the odor, once break through occurs. The goal is to simulate, as close as possible, the volume ratio (trash to free volume), trash content (vomit, urine, feces, and food trash), humidity, and temperature of the capsule. The goal for minimum break through is 48 hours (Orion Block 0) from the start of the test. The goal for acceptability of odor is 2 weeks (including docked ISS time for Orion Block 0).

Two UCBs will be tested simultaneously in different chambers. The one UCB will be tested empty, serving as a control. Odor break through will be based upon when the filled UCB total organics exceeds that of the control (empty UCB) by a level detectable by a human panel (approximately 2 ppm).

1.0 Roles and Responsibilities

ZD: Provide funding (EC7 and WSTF) and test planning support.

EC7: Funding to Bioastronautics Contract for UCB build and test expertise/support (including travel). Gather and ship test hardware (UCBs, emesis bags, food bags, Maximum Absorption Garments (MAGs), and ISS Waste Bags).

White Sands Test Facility (WSTF): Test expertise, facility, and test support. Prepare test articles, including generating vomit mixture, obtaining fresh volunteer urine, and soliciting adult or children's diapers for feces collection.

2.0 Description of Test Articles

Hardware

HRF Urine Containment Bag (UCB):

- P/N SDD46107234-306
- UCB contains urine containment devices (UCDs).
- UCB Zipper Opening: 11"
- Mass: 1.85 lbs, 840 g
- Deployed Dimensions: 20" x 17" x 6"
- Stowed Dimensions: 11" x 9" x 4"

Current Emesis Bag:

- P/N SED12100656-301
- Emesis Bag is used for crew-sickness in the reduced gravity environment.
- Constructed of GORE-TEX material with cotton diaper gauze along with attached 1 gallon zipper bag.
- Mass: 0.1 lbs, 45 g
- Deployed Dimensions: 24" x 8.875" x 3.250"
- Stowed Dimensions: 4.717" x 4.050" x 1.520"

Retired Emesis Bag:

- P/N 10108-10083-02
- Emesis Bag is used for crew-sickness in the reduced gravity environment.
- Constructed of GORE-TEX material with cotton diaper gauze.
- Deployed Dimensions: 17.375" x 8.875" x 3.250"
- Stowed Dimensions: 3.75" x 2.75" x 1.520"

Maximum Absorption Garment (MAG) with Booster Pad:

- Vendor P/N 4168P
- MAG is worn by the crew as a preventive measure if they need to relieve themselves.
- MAG is the COTS Abri-Form Original X-Plus (L4) Size Large, Original Style.
- Booster Pad is the COTS Abena Abri-Let Maxi Booster Pad (6" x 24") P/N 403501P.
- Mass: Diaper with Pad: 0.71 lbs
- Deployed Dimensions: Large fits waist of 39"- 59"
- Stowed Dimensions: After use, will be stowed within Ziploc P/N 528-50000-5 (12" x 12" x 0.004" thick).

ISS Waste Bag:

- P/N SLG33122024-001
- Trash bag used to contain waste produced on the ISS, food packaging and wet hygiene waste items.
- Constructed of outer cotton fabric with inner liner of ProCare Barrier material (25% polyester and 75% vinyl). The bag cinches at the top with a nylon tether cord with acetyl plastic cord lock.
- Mass: 0.152 lbs, 69 g
- Deployed Dimensions: 10" x 4" x 3.5"
- Stowed Dimensions: 10" x 0.25" x 8"

Food Trash:

- Representative of 4 meals for the crew from Block 0 menu

Item	Part Number	QTY
Meal 1		
Smoked Turkey	SEB39104127-619	1
Peaches	SEG48101861-615	1
Cashews	SEF48100079-606	1
Mixed Vegetables	SEG48101861-674	1
Brown Rice	SEG48101861-680	1
Snickers Marathon Energy Bar	SDD48102039-399	1
Butter Cookies	SEF48100079-605	1
Meal 2		
Tuna Salad Spread	SED48101666-606	1
Crackers	SEF48100079-626	2
Snickers Marathon Energy Bar	SDD48102039-399	1
Fiber One Bar, Oats and Strawberries with Almonds	SDD48102039-375	1
Dried Pears	SEF48100079-616	1
Cranapple Dessert	SEG48101861-664	1
Meal 3		
Beef Steak	SEB39104127-626	1
Black Beans	SEG48101861-662	1
Wheat Flat Bread		1
Pears	SEG48101861-617	1
Yogurt Covered Granola Bar	SEF48100079-629	1
Luna Caramel Nut Brownie Bar	SDD48102039-378	1
Meal 4		
Cheddar Cheese Spread	SEB39104127-607	1
Crackers	SEF48100079-626	1
Tuna	SEG48102005-702	1
Shortbread Cookies	SEF48100079-618	1
Luna, Caramel Nut Brownie Bar	SDD48102039-378	1
Apricot Cobbler	SEG48101861-661	1

Item	Part Number	QTY
Drink Packets		
Drinking Water	SED48101685-622	8

Huggies Wipes Assembly:

- P/N SEG33115639-301, -302
- Soft, resealable COTS package of Huggies baby wipes.
- Wipes used by the crew in the galley and Waste and Hygiene Compartment (WHC) for cleaning purposes.
- Mass: 1.0 lbs, 454 g
- Deployed/Stowed Dimensions: 9.5" x 4.0" x 1.8"

Disinfectant Wipes Assembly:

- P/N SEG33117799-301
- Soft COTS disinfectant wipes made of Polyester/Rayon towelettes saturated with cationic detergents.
- Wipes used by the crew in the galley and Waste and Hygiene Compartment (WHC) for cleaning purposes.
- Mass: 0.45 lbs, 204 g
- Deployed/Stowed Dimensions: 10.0" x 4.2" x 1.0"

Towel, Wet:

- P/N SLG33121830-001
- COTS XXL Shower in a Towel from Klenz, LLC
- Towel used by the crew for personal hygiene purposes.
- Mass: 0.25 lbs, 113 g
- Deployed/Stowed Dimensions: 8.5" x 6.75" x 0.43"

Towel, Dry:

- P/N SLG33121830 -002
- COTS XXL Shower in a Towel from Klenz, LLC
- Towel used by the crew for personal hygiene purposes. For use, the crew must add approximately four ounces of water.
- Mass: 0.08 lbs, 37.5 g
- Deployed/Stowed Dimensions: 8.5" x 6.75" x 0.43"

Ziploc:

- P/N 528-50000-5
- COTS Ziploc bag
- Ziplocs used by crew to contain used MAGs and wipes.
- Deployed/Stowed Dimensions: 12" x 12" x 0.004" thick

Disposable Gloves:

- P/N 10103-80004-01
- COTS package of non-latex gloves.
- Gloves used by the crew for sanity purposes.
- Deployed/Stowed Dimensions: 9.0" x 4.0" x 2.0"

Orion Data

- Quantity of UCBs: 3
- Volume: Total pressurized volume is ~550-600 ft³. For the odor test, the volume is assumed to be ~350-400 ft³ because an amount of the total pressurized volume is within the Avionics Bay, which is not well ventilated.
- Temperature: 75-85°F
 - 0-48 hrs: 85°F +/- 4°F

- Allow 4 hours to change temperature
- 52-308 hrs: 75°F +/- 4°F
- Allow 4 hours to change temperature
- 312-336 hrs; 85°F +/- 4°F
- Maximum dew point: 60° +/- 3 F (for worst-case scenario (85°F), test should be kept at 60°F dew point)

Chamber: Rapid Decompression Chamber (RDC) at White Sands Test Facility (656L = 23.2 ft³)

Trash Content (the filled UCB will contain....):

- Emesis Bags - Qty 6 (0.018 ft³ emesis per bag) (Note: "Emesis Bag" includes the attached zip lock.)
 - Qty 3 Emesis Bags will be placed into 1 ISS Waste Bag
 - Qty 3 Emesis Bags will be placed right in the UCB without being contained within the ISS Waste Bag
- MAGs – Estimated Qty 3 (2 urine, 1 fecal + optional urine)
 - MAGs will be placed into a Ziploc along with the used wipes/gloves. Ziplocs will be placed into the UCB.
- ISS Waste Bag with Food/Misc - Qty 1
 - Contains 4 meals worth of representative Block 0 food trash
 - Qty 2 Dry Hygiene Towels, Qty 2 Wet Hygiene Towels, Qty 4 Disinfectant Wipe Assemblies, and QTY As Required for the Huggies Wipes Assembly (wipes required for urine/fecal collection)

Trash Sample Collection

- Emesis
 - Emesis will be simulated with imitation vomit :
 - "The imitation vomit had an authentic appearance and odor. The recipe for the vomit included common food ingredients (mostly- pureed cottage cheese, tomato soup, apple juice, soy sauce, and bits of vegetables). Vomit odor was simulated with several drops of a 1% solution of isovaleric and butyric acids (in diethyl phthalate, an odorless solvent)" (Woody and Tolin 547). Note: we will use water as the odorless solvent. The final recipe for this solution will be documented in the test report to be released after the test.
 - JSC will provide imitation vomit recipe. WSTF will provide the acids and food ingredients.
 - Vomit is to be mixed and measured within 4 hours of the test start.
- Urine:
 - The NASA volunteers will urinate into a measuring flask. The total volume of urine to be represented is 4L. The 4L should go into at least 2 MAGs. If the MAG reaches saturation, the remaining volume can go into an additional MAG, although the goal is to try to get most (if not all) the urine into 2 MAGs. The used MAG will be placed into the Ziploc along with the used wipes and gloves (the wipes/gloves will not be in the MAG, but placed immediately within the Ziploc). The wipes to be placed within the Ziploc will be those used by the WSTF nurses, those of P/N SEG33115639-302. The disposable gloves to be placed within the Ziploc will also be those used by the nurses of P/N 10103-80004-01. The urine samples will be gathered within 8 hours of the test start. Subjects will record time of first urination into flask to ensure that it is within the 8 hr time limit and accumulate subsequent urine samples into the flask for delivery. WSTF nurses will transfer measured quantities of urine into MAGS. During the accumulation time period, the urine volunteer can use as many wipes/gloves as they choose that will be provided by the WSTF; these wipes/gloves do not need to be saved.
 - The MAGs (Abri-Form Original X-Plus with the Abena Abri-Let Maxi Booster Pad) are to be filled by the WSTF nurses.
- Feces:
 - The MAGS/Huggies Wipes to be used are from inventory. WSTF should weigh the MAGs prior to distribution to volunteers and after the MAG is filled.
 - The NASA volunteer will defecate into the MAG (urination is optional). The volunteer will close the diaper and place it within the Ziploc. The used Huggies Wipes P/N SEG33115639-302 will be

put within the same Ziploc (but not within the MAG). The option of Disposable Gloves P/N 10103-80004-01 will be provided. If the Disposable Gloves P/N 10103-80004-01 are used, they are to be placed in the same Ziploc, but not directly in the MAG. Samples will be gathered within 12 hours of the test start. The mass of the MAG will be taken before and after use.

- If adult fecal collection is unavailable, 2 children's diapers with feces are allowed as a substitution (urine is optional). The child should be on solid food and the mass of the diaper should be measured before and after use. The MAG, Huggies Wipes P/N SEG33115639-302, and the Disposable Gloves P/N 10103-80004-01 will be placed into the Ziploc. Samples will be gathered within 12 hours of the test start.
- Food:
 - Food/drink packets will be provided to WSTF. The contents of the food/drink packets will be emptied into the facility trash and the wrappers/outer wrapping placed in the ISS Waste Bag. If possible/practical, the technician should introduce saliva into the food packages. For example, a product eaten with utensils should have a licked spoon placed into the food package during the emptying process (to simulate "eating" the food).
- Towels/Wipes:
 - Two of the Dry Towel P/N SLG33121830-002 (alternate P/N 5008), two of the Wet Towel P/N SLG33121830-001 (alternate P/Ns 5007 and 5001), and four of the Disinfectant Wipes P/N SEG33117799-301 will be placed in the ISS Waste Bag.

3.0 Materials Required

The total materials required include:

Hardware Name	P/N	Prime Test Qty	Control Test Qty	Spare Qty	Total Qty	Deviations from Flight Hardware	Provider
UCB	SDD46107234-304	1	1	1	3	None	EC7
ISS Waste Bag	SLG33122024-001	2	2	1	5	Prime and control test will contain non-flight bag (different color/texture of material)	EC7
Emesis Bag	SED12100656-301	3	0	0	3	None	EC7(via USA/FCE RFS)
Emesis Bag	10108-10083-02	3	6	1	10	Old Emesis Bags will be the bags that are contained within the ISS Waste Bag and used in the empty baseline UCB. In addition, we will use all old emesis bags in the control test.	EC7 (via USA/FCE RFS)
MAG	Vendor P/N 4168P	3	3	6	12	Being certified	ZD via P-card.

Disposable Gloves (for nurses/fecal volunteers)	10103-80004-01	3	N/A	3	9	None	EC7 (via USA/FCE RFS)
Disposable Gloves (for urine volunteers)	N/A	AR	N/A	AR	AR	N/A	WSTF
Huggies Wipes (for nurses/fecal volunteers)	SEG33117799-301	AR by nurses	N/A	10 pkg	11 pkg	None	EC7/ZD via P-card
Flask for Collecting Urine	N/A	4	N/A	2	6	N/A	WSTF
Sharpie	N/A	0	0	4	4	N/A	WSTF
Baby Diaper (feces if necessary)	N/A	2	Covered by MAG	N/A	2	Baby diaper instead of flight	WSTF
Vomit Materials	N/A	0.108 ft ³	N/A	TBD	TBD	Imitation vomit	WSTF
ISS Waste Bag Contents	N/A	(4 meals, 2 dry towels, 2 wet towels, 4 disinfectant wipes)	Food packaging	N/A	4 meals	None	EC7/Food Lab
Ziploc	528-50000-5	One for every MAG and Old Emesis Bag (6)	One for every MAG and Old Emesis Bag (9)	3	18	None	EC7 (via USA/FCE RFS)

4.0 Test Setup

Volume to Trash Simulation

The goal is to match as close to the Orion to trash ratio as possible.

Vol of 1 UCB = 1.181 ft³

Worst case 3 UCBs in Orion / Worst case Orion volume (350 ft³) = $(3 * 1.181 \text{ ft}^3) / 350 \text{ ft}^3 = 0.0101$

Largest WSTF chamber: 656L = 23.2 ft³

1 UCB/Chamber = $1.181 \text{ ft}^3 / 23.2 \text{ ft}^3 = .05091$

Chamber volume drives the test to be 5X conservative with a pure sample.

Note: WSTF will dilute samples of both filled and empty bags (after extraction from chamber) to mimic as close as possible the Orion trash/volume ratio of 0.01.

Empty Bag Test Setup

The purpose of the empty bag test is to provide a baseline of the hardware materials without the odor causing materials (emesis, urine, feces, and food waste).

- 1) The 2nd Largest WSTF chamber will be used for empty bag simulation, 315L
 - Note: dilution of sample will be used to mimic the volume ratio in test chamber.
- 2) Empty UCB will be placed in a chamber as the control test. The empty UCB will contain a full set of empty emesis bags, ISS Waste Bags, MAGs, and Ziplocs to replicate the filled UCB. Note: the emphasis is to mimic the materials as close as possible; the form of the materials may not be the same (e.g. raw emesis bag scraps vs. flight-like emesis bags).
- 3) Total organic analyzes will occur every 2-4 hours at the same time as the total organic analyzes that are taken from the chamber containing the filled UCB. Odor breakthrough of the test bag will be determined when the total organics is 2 ppm over the empty bag.

Test Bag Test Setup

- 1) Test UCB will be filled with contents and placed into a chamber.
- 2) Total organic analyzes every 2-4 hours to detect odor breakthrough.
- 3) Toxicity and human panel 4 times. The first should be at the time of breakthrough (2 ppm over the empty bag) or at 48 hours, whichever comes first. The remaining 3 split evenly over the remaining portion of the 2 week test.
- 4) Once toxicity screening is performed and approved, test subjects will be exposed to the air from the chamber containing the baseline empty bag followed by the full concentration of air from the chamber containing the filled UCB. The full concentration of air from the chamber containing the baseline empty bag will be introduced to the odor panel member three times consecutively. The panel member will then smell the full concentration of air from the chamber containing the filled UCB three times consecutively. The panel member will enter the test blindly, not knowing the order or concentration of each sample they are given. The panel member will rank each smell (data of the odor test) on an Osgood's Semantic Differential scale. An example of the sheet to be completed by each panel member is given in Appendix C. Each set of three samples will be given with approximately 30 minutes of wait time between exposures to allow time for disadaptation of smell receptors.
- 5) Following the 14 day test, the bag in the chamber will be opened (with a string through a port). A final total organic analysis will be performed to determine the increase due to opening of the bag.

5.0 Conclusion

The test will determine the amount of time the UCB will contain odor in the test setup (which is a conservative representation of the Orion trash environment). The odor acceptability will be determined at 4 points until the test concludes at 2 weeks.

Appendix A: Directions for Adult Urine and Fecal Volunteers

Thank you for volunteering to provide samples for the Trash Bag Odor Test.

Urine Collection: DO NOT COLLECT BEFORE 4 am, August 2st

The following materials should be provided to you:

- 2 Flasks for measuring
- Package/ Ziploc with unscented wipes
- 3 Pairs of gloves
- 2 Ziplocs for double containment
- 1 Ziploc for trash
- 1 Sharpie

Urine Collection Procedures

1. Sample collection should begin no earlier than 8 hours prior to test start.
2. Urine should be deposited into the measuring flask. Use provided gloves if you feel necessary. Place flask inside Ziploc for containment.
3. The first time of urination and approximate amount should be noted on the outside of the Ziploc with the Sharpie.
4. Any gloves/wipes used should be discarded and WILL NOT be included in the Ziploc.
5. Continue to collect additional urine into flask as available. Though maximum amount of urine is desired, please do not force production of larger quantities of urine by drinking excessive water or alcohol as this will dilute urine into water consistency. Visibly yellow urine is desired.
6. Deliver specimens to 803 Prep Room where WSTF will measure the final volume.

Fecal Collection: DO NOT COLLECT BEFORE 12:00 pm, August 1st

The following materials should be provided to you:

- 1 "Hat" for aiding in specimen collection
- 1 Maximum Absorbent Garment (MAG) aka Diaper
- Several Tongue depressors to aid in stool collection if necessary
- Package/ Ziploc with Unscented wipes
- 3 Pairs of gloves
- 2 Ziplocs for double containment
- 1 Ziploc for trash
- 1 Sharpie

Fecal Collection Procedures

1. Sample collection should begin no earlier than 12 hours prior to the test start.
2. Fecal matter should be deposited directly into the MAG that may be placed inside of provided "Hat". Another approach could be to wear the MAG. Urine is optional and does not need to be measured.
3. Use provided gloves for following steps:
 - a. Roll up MAG and seal. Use provided Tongue depressors to adjust stool in MAG if necessary.
 - b. Place MAG inside primary Ziploc bag.
 - c. Use provided wipes for cleaning of area.
 - d. Place MAG, wipes, and gloves inside a Ziploc. Wipes and gloves will NOT be rolled into MAG and will be placed outside of MAG in the Ziploc.
 - e. Dispose of any used tongue depressors in your Ziploc.
4. Place Ziploc filled with MAG/wipes into another outer Ziploc (outer Ziploc will be removed for the test).
5. The time of defecation should be noted on outer Ziploc with a Sharpie.
6. Deliver specimens to 803 Prep Room where WSTF will measure the final mass.

Appendix B: Directions for Baby Fecal Diaper Collection

Thank you for volunteering to provide samples for the Trash Bag Odor Test.

The following materials should be provided to you:

- Package of Unscented wipes
- 3 Pairs of gloves
- 2 Ziplocs
- 1 Sharpie

You are welcome to use your own child's diapers. Please bring an unused diaper to test personnel for a comparison weight.

We are looking for fecal collection from children who are on solid food only, to have the best representation of adult fecal matter.

Fecal Collection

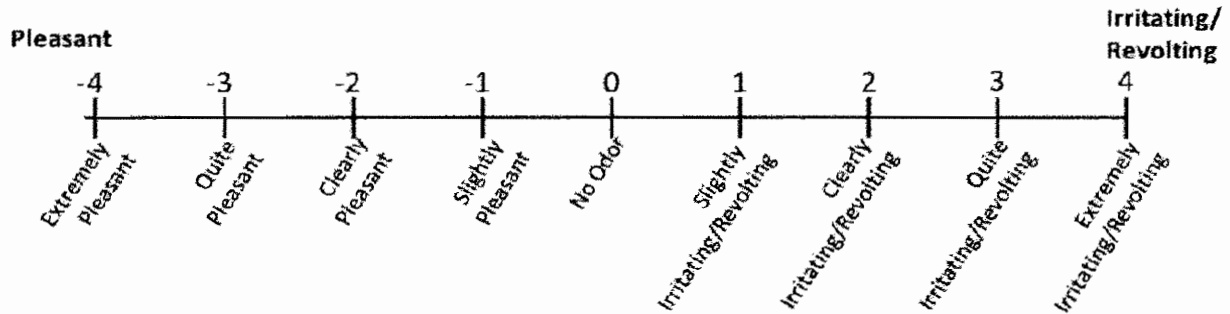
1. Sample collection should begin no earlier than 12 hours prior to the test start.
2. The child should wear their diaper as they typically do. Urine is optional and does not need to be measured. The time of defecation should be noted on the Ziploc with a Sharpie. The diaper (wrapped and closed on itself) and any gloves/wipes used should be placed into a Ziploc. That Ziploc should be placed into another (the outer Ziploc will be removed for the test).
3. WSTF should measure the final mass of the diaper.

Appendix C: Odor Panel Test Results

Odor Panel Test Results

Odor Panel Member: _____

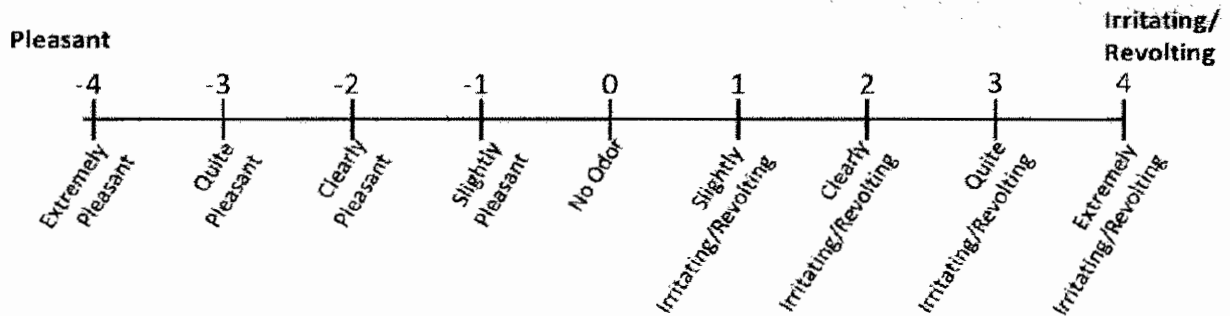
Please Rate First Impression of Odor



Lead Scientist Fill Out Post Test

Baseline 1 Result _____ Description _____ WSTF Number/ Dilution: _____
 Baseline 2 Result _____ Description _____ WSTF Number/ Dilution: _____
 Baseline 3 Result _____ Description _____ WSTF Number/ Dilution: _____

Please Rate First Impression of Odor



Lead Scientist Fill Out Post Test

Sample 1 Result _____ Description _____ WSTF Number/ Dilution: _____
 Sample 2 Result _____ Description _____ WSTF Number/ Dilution: _____
 Sample 3 Result _____ Description _____ WSTF Number/ Dilution: _____

Baseline vs. Sample Comparison Survey**Sample 1 vs. Baseline**

1. Which sample has a more potent smell? _____
2. How much more potent was that sample? (example: 0X, 1X, 2X, 3X more Potent)

3. Can you describe any other differences between the two samples? (Were the types of odors different?)

Sample 2 vs. Baseline

1. Which sample has a more potent smell? _____
2. How much more potent was that sample? (example: 0X, 1X, 2X, 3X more Potent)

3. Can you describe any other differences between the two samples? (Were the types of odors different?)

Sample 3 vs. Baseline

1. Which sample has a more potent smell? _____
2. How much more potent was that sample? (example: 0X, 1X, 2X, 3X more Potent)

3. Can you describe any other differences between the two samples? (Were the types of odors different?)
